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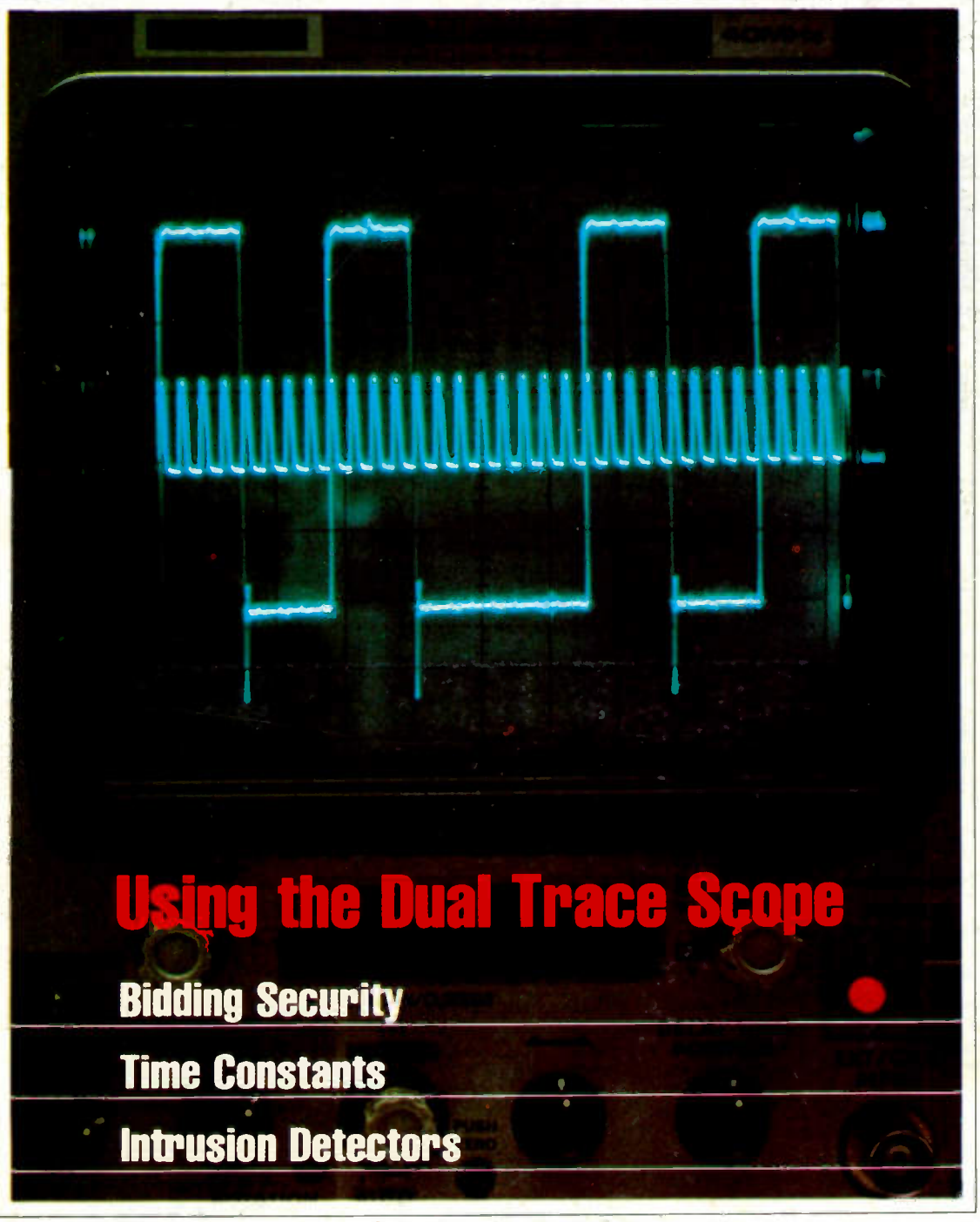


Using the Dual Trace Scope

Bidding Security

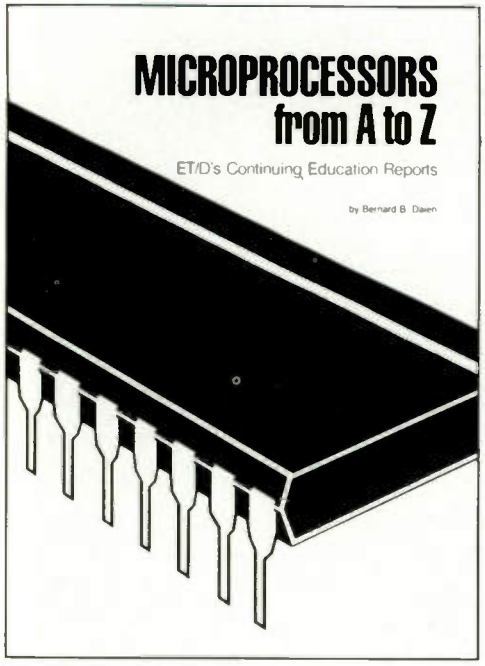
Time Constants

Intrusion Detectors

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION

MICROPROCESSORS from A to Z

by Bernard B. Daien



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INDUSTRY REPORT

NAB Requests Single AM-Stereo Technical Standard

The National Association of Broadcasters, in a recent filing with the FCC, stated that a survey of broadcasters and receiver manufacturers overwhelmingly favored a single standard and that without such a standard manufacturers would not produce the necessary receivers.

NATESA 31st Annual Convention

The 31st Annual Convention of the National Association of Television Electronics Services of America will be held August 19-23 at Indian Lakes Resort, Bloomingdale IL. A business panel and technical sessions are scheduled as are a golf tournament and a ladies program. For more information write NATESA, 5930 S. Polaski Road, Chicago, IL 60629.

Worldwide Introduction of VHD Videodisc System Including U.S.

The timetable for worldwide introduction of the VHD Video Disc System was announced recently by Gary Dartnall, President of VHD Programs, Inc. and VHD Disc Mfg. Company, joint ventures of General Electric Company, Victor Company of Japan, Ltd. (JVC), Matsushita Electric Industrial Company, and Thorn-EMI of the United Kingdom. The VHD (video high density) disc system will be introduced in Japan in October, 1981 by JVC and Matsushita with an opening library of approximately 100 titles including movies, music, sports and educational programs. Developed by JVC, support for the VHD system in Japan has been announced by Akai, Sansui, Sanyo, Sharp, General, NEC, Toshiba, Trio, Mitsubishi Electric and Yamaha.

The U.S. introduction of the VHD system will follow in January 1982. The system will be marketed under the General Electric, JVC, Panasonic and Quasar brand names. Negotiations for first run movies, shows and other entertainment and educational materials are in progress with the major studios and independent producers. In the United Kingdom, JVC, Matsushita and Thorn-EMI plan introduction of the system in June, 1982.

In addition, Sharp Electronics Corporation has adopted the VHD format videodisc for marketing in the U.S. in the first quarter of 1982. According to Robert Whitehouse, general manager of TV/VTR, Sharp Electronics will concentrate on the marketing of players only, which will be designed and produced by Sharp Corporation at its plant in Tochigi, Japan. Full product specifications and marketing plans, including pricing, will be announced sometime later this year.

RCA Mobile Division Sold

RCA Mobile Communications System has been acquired by TACTEC Systems, Inc. The activities acquired include all mobile and portable radio product lines, brand names, maintenance service agreements, and replacement parts. Customer services, purchasing, accounting and other staff functions will remain at the TACTEC Systems Inc. headquarters, a 300,000 square foot facility in Meadow Lands, Pennsylvania. TACTEC Systems Inc. will continue to engineer, manufacture and market Product and systems from Meadow Lands. Some 350 manufacturer representatives and direct salesmen will sell domestically. Worldwide marketing activities will continue through distributors as well as direct channels. Although TACTEC Systems, Inc. will continue to manufacture the RCA line of TAC brand radios for business and commercial users, special emphasis will be placed on applied research and new product development.

General Electric Promotes VCR Training In The South

General Electric has launched a VCR training program that covers the 12 Southeastern and Western states. The two day sessions are designed to give the service dealer "hands on" experience not only in servicing the GE VCR machines, but to understand VCR service in general. Sencore, manufacture of electronic test instruments is assisting in the GE program. Because of Sencore's belief that training is important to the service dealer, Sencore has provided six complete set-ups of their SC60 oscilloscope, DVM56 digital volt meter, PR57 variable isolation transformer and leakage tester, CG25 color bar generator and VA48 video analyzer for the technicians to use in the GE training sessions.

According to Mr. James Painter, Atlanta Regional Training Manager, the sessions are going great, and the technicians appreciate the training that they are receiving. Mr. Painter also stated that he appreciated Sencore's willingness to work with manufactures such as GE, to promote this valuable VCR training to the service dealers.

RCA Sees $175 Million Industry Sales For Projection TV in 1981

RCA has predicted its entry into the projection screen TV market will push industry sales to some $175 million in 1981. President Arnold T. Valencia of the RCA Sales Corp. told a news conference that RCA's planned major marketing effort this year will help shift projection television "from being a curiosity in public places to an important new video product for the home." RCA introduced in February a one-piece projection TV with a 50-inch screen for the home. The RCA projection TV set will have infrared remote control. It features a stereo amplifier with 10 watts of power per channel feeding the unit's four speakers. The model includes video and audio inputs so that both a VCR and a video disc player—which RCA began selling in March—can be connected simultaneously to the projection set. RCA also announced that five specific growth areas will stimulate the video consumer products industry to record sales levels in 1981. "Remote control television, personal-size color receivers and projection TV models, along with the developing video disc and video cassette recorder markets, should lend additional strength to a home video business that was exceptionally strong in 1980," said Jack K. Sauter, vice president and general manager of the RCA Consumer Electronics Division. He said at the opening of the industry's consumer electronics show that video consumer products in 1981 are expected to reach record dollar sales levels "despite the prospect of an uncertain economy."

At the same time, Mr. Sauter said, the emergence of the developing video disc

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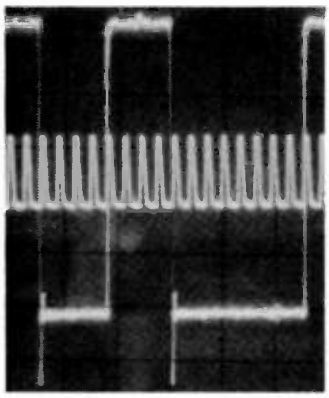
FEATURES

DEPARTMENTS



On the cover: The dual trace oscilloscope is your most valuable troubleshooting tool except for a good multimeter or DMM. This month's cover shows time relationships in a counter time base, something only effectively viewed on a good dual trace oscilloscope.

HBJ A HARCOURT BRACE JOVANOVICH PUBLICATION ABP ABC EIA

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will help to revitalize "one of the industry's most valuable assets, the independent television dealer." He said this particular segment of retailing "has not successfully participated in the VCR business, mostly by choice."

In reviewing the anticipated five growth areas of the video industry, Mr. Sauter forecast:

Remote control receivers should account for some 35 percent of all color TV unit sales in 1981, a continuing exceptional growth in recent years. Currently, remote control sets account for one of every four color television sales.

Projection television receivers will amount to approximately $175 million in new business for the video industry in 1981 as more brand names, including RCA, enter the business. "While industry sales are difficult to measure at this formative stage of the business, total projection TV sales should exceed 65,000 units as a conservative estimate," Mr. Sauter said.

Personal-size color sets will become increasingly important in 1981 as dealers recognize the multi-set sales opportunities represented by nine-inch (diagonal) and smaller receivers. Mr. Sauter said the more compact size of these models will make them more attractive to the consumer for use in the bedroom, kitchen and office.

Video cassette recorders will continue their upward growth pattern exceeding the million unit sales level for the first time in 1981. Portable VCR units in particular will take an increasingly larger share of the business, "stimulating color camera sales in the process," Mr. Sauter said.

Video disc players will achieve national distribution during the year, setting the stage for subsequent explosive growth of an affordable new product that will be the most important addition to the predicted "video age of the 1980's." RCA expects to sell some 200,000 VideoDisc players bearing its brand in 1981, he said.

Mr. Sauter said the principal product of the industry's video business, color television, should again reach the 10-million unit sales level in 1981. Color TV, stimulated by improved performance and features, will continue to be an excellent value in today's economic environment. Industry sales of black-and-white receivers are expected to reach 6 million units this year. "While the vigorous growth elements are in place for a video explosion in this decade, I doubt that this will happen unless we have full support of the retail universe, particularly the independent television dealer. At the same time, retailers need a product like the video disc to make their customers aware that they are truly in the video business," Mr. Sauter added. "While manufacturers can develop new products, much depends on the television dealer making a commitment to be a leader in the video market of the 1980's." He said, "A casual participant simply will not share in the growth that lies ahead."

Mr. Sauter urged independent TV dealers to consider dedicating meaningful areas of floor space, investing in sales training and to be more active in promoting the new video products. "If they do not establish themselves as respected video dealers, then the obvious alternative is to sell the commodity items of the business and settle for the thin profits that go with commodity selling."

Fourth Telephone Satellite Launched

The fourth and last Comstar communications satellite will round out an era of high-performance long-distance telephone service when it was launched at the end of February. The four Comstar satellites, owned and operated by COMSTAT General Corporation, are leased to American Telephone & Telegraph Company and are used jointly by AT&T and GTE Satellite Corporation. They provide telephone circuits, WATS and private line services to their customers.

Hughes Aircraft Company's Space and Communications Group, El Segundo, Calif., built the satellites. The first was launched in May, 1976, and the second the following July. The third was launched in June, 1978. The fourth was held on the ground as a spare. Despite their relative age in the fast-developing satellite communications industry, the Comstars are still regarded as having high-performance capability. Each has capacity to carry up to 18,000 simultaneous two-way telephone calls. They serve the United States, including Hawaii and Alaska, as well as Puerto Rico. The satellites also carry television services to Hawaii and Puerto Rico from the continental United States.

The satellites are linked to earth stations operated by AT&T and GTE Satellite Corp. Four of the earth stations are owned and operated by AT&T's Long Lines department and are located near San Francisco, Chicago, Atlanta and New York. Three are owned and operated by GTE Satellite and are located near Los Angeles, Tampa and Honolulu. One in Puerto Rico is owned and operated by an International Telephone and Telegraph Company subsidiary and another, located near Anchorage, is owned and operated by Alascom. Comstat General maintains control of the satellites from a control station near Washington, D.C.

Although the Comstar is the last of its series, AT&T has ordered from Hughes three advanced communications satellites, designated Telstar 3, to succeed the Comstars. The new AT&T satellites are based on the HS 376, Hughes' newest communications satellite spacecraft. The AT&T order includes tracking, control and other ground equipment to be used in conjunction with present AT&T facilities. The first Telstar is scheduled for launch in 1983. Like their predecessor Comstars, the Telstar 3 will bring long distance telephone and other communications services to their customers. The Telstar 3 satellites each will have capacity for up to 21,600 telephone calls and are designed for a 10-year lifespan in orbit.

Third Party Computer Maintenance Increasing

Servicing and maintaining computers may be less glamorous than other activities in the fast moving computer industry, but offers many opportunities according to a new report by Frost & Sullivan Inc., New York City.

The third party computer maintenance market in the U.S., said to be nearly $400 million in 1980, is increasing about 15 percent a year and should reach $620 million in 1985 (constant 1980 dollars), says the 244-page report, entitled "Third Party Computer Maintenance Markets," the projections of which are roughly as follows:

MARKET SECTOR	1980	1985
Mainframes	40	52
Minis	60	92
Peripherals	135	210
Terminals	155	265

(Constant 1980 $Millions)

The industry has fragmented around the above categories. Some companies maintain only IBM equipment, for example; others service only minis or only data terminals. Others only refurbish and reconfigure used computers. Many are regional in scope.

The statistics indicate : By the end of this year, some 1.2 million business and scientific computers, worth about $75 billion will be in place. All must be maintained. About 90 percent of the users choose maintenance provided directly by the computer manufacturer.

The remaining 10 percent of end users—comprising the third party maintenance market—are served by the independent maintenance firms in one of two ways:

a. Directly by third party maintenance firms which reportedly account for 68 percent market share.

b. Firms operating in the name of the manufacturer, which represent the remaining 32 percent market share.

Moreover, service to end users provided directly by third party maintenance firms, already twice the market size of the manufacturer oriented sector, will increase more rapidly, according to Frost and Sullivan. This sector is also "more profitable and easier for an independent service firm to manage," the report adds. ETID

SERVICE SEMINAR

ADMIRAL

Chassis H10. Horizontal sync weak, horizontal roll. Zero volts at pin 9 of 6JW8, low voltage at pin 3. To correct: Replace R129, 100K ohm resistor (Sams 949). Gary Summerland, CET, Youngstown, OH.

MAGNAVOX

Chassis T950. Insufficient vertical sweep. Vertical linear control reacts as if it were a vertical hold control. To correct: Replace R-514, 82K ohm 1 watt resistor (resistor increased in value to around 500 K ohm). Jerry Harris, CET, Stillwater, OK.

Chassis T981,982,985,986,987,991,995, installing correct retrace capacitor—When installing a new retrace capacitor in the horizontal output section of a color TV chassis, it is very important to use an exact Magnavox replacement part. This practice should be followed on all current and older chassis as well. The value of this capacitor is critical because it forms part of a resonant circuit along with the deflection yoke and the horizontal output transformer. An incorrect value of capacity here can detune the horizontal output stage enough to cause the CRT voltage to rise to an excessive value. This capacitor also has a safety function. Two separate leads are attached to each plate which provide a dc path for collector current through one plate and emitter current through the other plate. In the event the capacitor should open, the dc paths to the horizontal output transistor open and high voltage shuts down. The following is the part number of the retrace capacitors that should be used for the current chassis. Note especially the differences in group numbers.

Chassis	*Use Capacitor*
T981	250663-11
T982	250663-13
T985	250663-14
T986	250663-13
T987	250663-13
T991	250663-5
T995	Use horizontal retrace/screen module, Part No. 703647-6

RCA

Handling integrated circuits—Thoughtful handling procedures and some inexpensive equipment can go a long way towards reducing static electricity damage to integrated circuits. Basic principles are the frequent discharging of static electricity from the human body and other objects and avoiding the use of static producing accessories. The following procedures are effective in reducing the possibility of integrated circuit damage due to static electricity:

1. Just before touching any component or module, touch the metal chassis (observe line isolation precautions) to ensure your body is not statically charged.

2. When removing circuit boards or modules from the chassis, place them on a conductive surface such as aluminum foil. Do not place them directly on the floor, carpet, workbench or TV cabinet.

3. Touch the metal chassis (observe line isolation precautions) just before picking up a module or component for insertion.

4. When removing or replacing integrated circuits, grounded tip solder irons are absolutely essential.

5. Some "solder suckers" generate up to 20,000 volts of charge when triggered and should not be used. Even when the IC being removed is known to be bad, a solder sucker can generate enough static to damage other components on the board. Anti static suckers are available and are essential for IC work.

6. Replacement integrated circuits are packaged in conductive foam or with aluminum foil. Do not remove the IC from its protective package until it is ready to be used. Just before removing the IC, touch the conductive foam to the chassis or circuit board into which it will be inserted. This can be done by touching the board with one hand and the conductive package with the other.

7. Try to minimize motion when handling unpackaged integrated circuits. When seated, the simple action of lifting your feet from the floor can generate static electricity. Clothes really generate static electricity when brushed against other objects.

8. Do not use freon propelled sprays on the circuit boards or chassis. Freon sprays can generate more than 5,000 volts of static electricity. Even when an IC is in a protective package or soldered into a circuit board, a freon propelled spray can generate static electricity which could damage internal components not directly connected to the IC pins. A short bristle brush (1/2 inch or 1.25 centimeters) with a metal handle is a safer method of clearing debris.

9. Defective components should be returned in a conducting package, not in plastic boxes or plastic envelopes. Aluminum foil is an effective packing material.

In situations where the above guidelines are in conflict with safe operating procedures, the safety rules come first. Components and TVs can be replaced, people cannot.

SYLVANIA

Chassis E21, no sync, oscilloscope displays loss of sync signal. To correct: Replace defective coil L-408 (located off of sync IC). Scott Leibrand, CET, Des Moines, Iowa.

TRUETONE

Chassis 2DC2063. No raster, sound okay. No high voltage, capacitor connected to 6KD6 tube defective. To correct: Replace defective circuit breaker (note: resistor inside of circuit breaker which connects to cathode of 6KD6 open) also check for possible open horizontal centering control. Replace if defective. Pete Mikita, Strutters, OH.

ZENITH

Chassis 20XIC38, picture dark, picture appears negative. To correct: Replace defective coil L-7. Located off of pin no. 7 of 6KT8 cathode follower. Manual DeLaRosa, CET, Monro Bay, CA. ETD

FROM THE EDITOR'S DESK

This month I am going to tell you how to run your business, which I'm sure will be welcome. I want to discuss several points you may have heard before but which I feel need constant repetition. These ideas are by no means original with me but have recently come up in discussions with various people in or related to the service industry.

First for those of you who are service only: seriously consider selling a respectable line of television and perhaps compact audio. You have a foot in the door with many of your customers: I am sure you have been asked to recommend a replacement for that economically unrepairable color television or stereo receiver/eight track player. Why not sell it? I have found at least some distributors willing to sell to a dealer on a small lot basis and willing not to try to load him with excessive stock. You may have to look, but one or the other brand, is probably available to you at the rate of only a few pieces per month mostly on an order when needed basis. Check into it.

Then there is the matter of professionalism. I find that IBM charges in this area $54/hr, one hour minimum, plus 23 cents per mile, plus parts for service calls for an electric typewriter. How does IBM get away with it? A major factor is professional appearance. The IBM technician wears a business suit and tie and carries his tools in an attache style tool case. He looks professional. How about trying a comparable approach—including the $54/hour charge. Wear slacks (washable) a blazer and a tie. Buy a new attache style tool case. Fully equipped for service calls it will cost several hundred dollars if you include a color bar/pattern generator, a DMM and perhaps a miniscope, *but it is impressive.* Use a dropcloth and otherwise conduct yourself confidently and competently.

Unfortunately the technician's image is nearly the opposite of this. I talked to a major distributor recently who said of his customers, "those TV technicians are a bunch of slobs" and he doesn't sell clothing or razor blades. You are all as good, probably better and more trained technicians, than the office machine technicians. IBM is very successful; how do you argue with that?

Further: ET/D did a readership survey recently. While most of our readers, being among the most progressive in the industry, appear to have well equipped and stocked service facilities, some apparently do not. If you are among the underequipped and your excuse is that you cannot afford to update, you are probably in the wrong business. If you don't have enough business to make modern efficient service and troubleshooting methods and equipment pay, you are simply hurting yourself by spending too much time making too little money. If you are a good technician, get a job that can pay you a living wage!

Another suggestion: check into your local association and the national associations. Some shops belong to all of the national associations as well as their local organization. At the value of today's dollar this is not expensive, and there is a vast amount of both business and technical experience and knowhow there for you to absorb. The average shop owner/technician is so independent it hurts—both himself and his fellows. You are not giving this up by associating with NETESA, NESDA, ETA-I, etc., but possibly stand to gain tremendously. Don't you wish you had the power of AMA or the Bar Association?

Sincerely,

Walter W. Schmitz

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LETTERS

CET

I just received the January issue of ET/D. I was somewhat surprised but also gratified to see that some people, specifically you and your staff and Mr. Egner, CET, recognize the importance of upgrading the Electronics Technician to a level where his expertise and professionalism should be. The Certification Exam is one stepping stone in that direction. Another stepping stone would be to get together with other Technicians and pool the information and experience of each for the good of all.

Congratulations, on the article, to all concerned and keep Certification of Tech's vital.

Michael J. Chapman, CET
The Professional Electronics Technicians Association of Pa.
435 Oak St.
Scranton, PA 18508

WHERE WAS JANUARY?

I have been a subscriber to ET/D since 1976 and have been reading letters of subscribers saying they can't wait to receive your latest TEKFAX manuals. I am happy to report that I belong to the list, except the last issue I received was TEKFAX #112 back in '76.

It is now January 29th and I am still awaiting your January issue. This lateness has been going on since 1979.

I would appreciate any measure of action from you to get me up to date with TEKFAX manuals and help me receive the magazine on my door step in time.

Ronnie J. Camilleri
30-80 43 St.
Astoria, NY 11103

Editor: Production problems, new typesetting equipment problems delayed the January issue of ET/D. I have been assured most of these problems have been remedied. Several back issues of TEKFAX are still available, 112, 114, 115.

HELP NEEDED:

We need a flyback Part No. 15-097079 for Western Auto, Truetone Model Number MIC4212A27 color table TV. VZ12032A stamped on original trans. Please send cost of transformer and UPS shipping charge.

Bill Schaf
Action TV Service
88 Locust Park
Albany, NY 12205

Dial Glass for Magnavox Stereo, Part #1512490006. Will be more than glad to pay whatever charges are necessary.

Pat's TV Service, Inc.
1034A Park Blvd.
Massapequa Park, NY 11762

I need a schematic for an RCA stereo radio/phono/tape deck which is out of print. The Sams Photofact® No. is MHF36. If one of your readers has it, I would like to buy a copy.

Thank you.

John W. Walker
8411 Oakford Drive
Springfield, VA 22152

TECHNICAL INFORMATION:

Many of the letters to the editor are for technical information relating to specific equipment. I would like to suggest to your readers, the possibility of using their local central or regional libraries as a possible resource center. Many of the central or regional libraries have Photofacts in their reference section that copies can be made from. A quick phone call can sometimes save time and money.

I personally have approximately 150 service manuals on surplus test equipment. Inquiry should be sent to R. Wongwai, 91-1182 Kauiki St., Ewa Beach, Hawaii 96706 and include a S.A.S.E.

Roland J.J. Wongwai, AV Tech III
Ewa Beach Community-School Library
91-950 North Rd.
Ewa Beach, Hawaii 96706

Editor: For parts information write the EIA for its *Consumer Electronics Service Technician, Replacement Parts Handbook*, it's free. Write: Consumer Electronics Group/Electronics Industries Association, 2001 Eye St. N.W., Washington, DC 20006

OTHER SERVICE AREAS:

The precise presentation of the Service Seminar is well received. The format provides a means of easily removal and placing on a card file for future reference, or even assembling into a loose leaf book. The publishing business must be interesting. Trying at all times to properly balance the advertising to reader interest in order to continue the project. From the standpoint of servicing TV's at a $35.00 per hr rate is becoming impossible. On the other hand electronic calculators such as the IBM, Singer, Friden II60 etc. would be more in line. But presently no such information is being covered by your publication. Dec. '80 has a short description

of the TRS-80. But only as a sales angle. How come no mention is made of the service angle that the technicians may be interested in?

Time marches on, if we are not careful, we are likely to be trampled by its passage unless we keep in step. Radio used to be the only market. Then came TV. Now it is computers. Is ET/D so specialized that there is no room for the newest electronic application?

Are one or two ads such as on page 25 sufficient renumeration? Or would it be more perpetuating to the ET/D existence to enter the field on its own?

Being non union all my life, I do not see any advantage of being too specialized. Sooner than appreciated, it becomes like hardening of the arteries. Then heart attack.

Why become so automated that you react only as a zombie? I always did enjoy the challenge of a new job. Never the apprehension of losing an old one. Let's see what effect this much gab has on the near future.

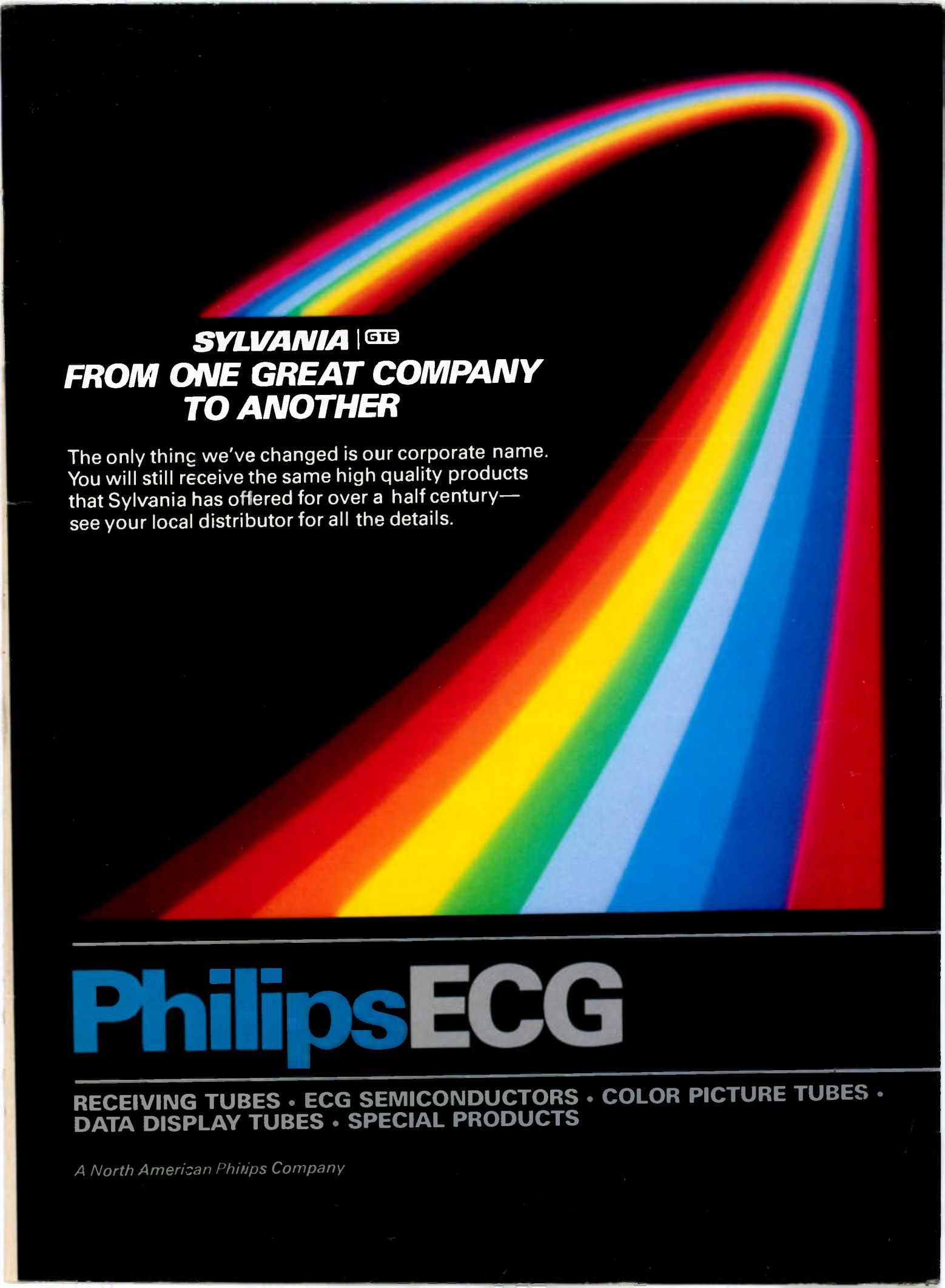
H. Johnson, Electronic Enterprises
84 860 D Farrington Hwy.
Waianae, HI 96792

Editor: The magazine business is interesting and trying and sometimes like most anything, also boring. However—$35.00 per hour may be quite reasonable for TV service; a television receiver is as complex as much office equipment. Competition and huge volume keep the initial cost down but should not depress the cost of repair unless you the service technician, wants to in effect, make the manufacturer look good. If it should cost $50.00 to repair a $68.00 B&W TV receiver tell the customer; don't hurt yourself!

ET/D is examining new areas of service, witness the present coverage of security electronics which will be more specific as time passes. We hope to have closed circuit TV articles, (it is often quite different from broadcast TV). We are looking into computer service; third party computer service is about 10-15% of the computer service business and will grow in volume, if not percentage.

BOUQUETS TO WILLIAM JOSEPH:

Keep up the great work. I really enjoy E.T.D. and especially the management articles by William Joseph. It's a pleasure to read a writer who is an obvious expert in our business and who can write in such a way that anyone can understand his points. I'm just a technician now, reading the boss's copy, but I'm planning to go into business for myself soon. Raul Perez ET/D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FROM ONE GREAT COMPANY
TO ANOTHER
The only thing we've changed is our corporate name.
You will still receive the same high quality products
that Sylvania has offered for over a half century—
see your local distributor for all the details.
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RECEIVING TUBES • ECG SEMICONDUCTORS • COLOR PICTURE TUBES •
DATA DISPLAY TUBES • SPECIAL PRODUCTS
A North American Philips Company

Announcing the Philips ECG "Reach for the Rainbow" Sweepstakes.

You could grab a week in Hawaii.

Philips ECG's new "Reach for the Rainbow" Sweepstakes makes it easier to be a winner than ever before, because there are three ways to enter, and there will be guaranteed winners from every state.*

To enter, just send an entry form (available from your local distributor) to Philips ECG Sweepstakes Award Headquarters, P.O. Box 4900, Fenton, MO 63026, attached to any of the following:

- 5 Sylvania receiving tube address tabs—one entry
- 5 Sylvania semiconductor address tabs or bags—one entry
- 1 Sylvania color picture tube serial label—ten entries

There's no limit to the number of times you can enter. And there's no limit to the number of times you can win.

FIRST PLACE—(1 winner) 6 days and 5 nights in Hawaii for 2.

SECOND PLACE—(4 winners) Puch moped or choose from 1700 other awards.

THIRD PLACE—(5 winners) Toro self-propelled rotary mower or choose from 1500 other awards.

FOURTH PLACE—(50 winners) McCulloch power chain saw or choose from 660 other awards.

FIFTH PLACE—(100 winners) Black & Decker Workmate or one of 36 other awards.

SIXTH PLACE—(300 winners) Royal desktop calculator or one of 36 other awards.

SEVENTH PLACE—(700 winners) Weathercaster vest or one of 36 other awards.

EIGHTH PLACE—(1,000 winners) $5 rebate from Philips ECG, Inc.

2,160 awards in all!

All entries must be postmarked by midnight, August 31, 1981.

Ask your local distributor for all the details.

Then, when you reach for the components you trust, you just might grab a week in the sun.

*The Philips ECG "Reach for the Rainbow" Sweepstakes is available only to dealers and service technicians. Employees of Philips ECG, Inc., its authorized distributors, or their advertising agencies are not eligible to participate. No purchase required. Reasonable facsimile accepted. Void where prohibited by law.

PhilipsECG

A North American Philips Company

NEWSLINE

DOW JONES SELECTS ANTIOPE TELETEXT FOR CABLE SYSTEM

Dow Jones & Co. has selected the French teletext system, Antiope, for its first installation of a teletext-type home information service on a cable TV system. That announcement was made by Antiope Videotex Systems, Inc. which is supplying the unique Antiope transmission system, DIDON, the Antiope language, and a complete editing and encoding console. The teletext service will be installed as an added feature for some cable subscribers in Danbury, Conn., where the Danbury News Times, which is in the Ottaway Newspaper Group - a subsidiary of Dow Jones - already provides a 24-hour cable news service on a channel leased from Teleprompter. Dow Jones plans to offer 100 pages of information on the Danbury system, including financial news and consumer information, weather and traffic reports, sports results, a dining guide, local news, and special features like a community bulletin board.

RCA DROPS AUTOSOUND

Citing "long & continuing deterioration" of the new car market, RCA said Distributor & Special Products Div. is phasing out of autosound business, dropping car radios, tape players, CBs & accessories. DSPD has been selling car stereo since 1970. Company said 75% of its autosound sales have been through new car dealers. For last 2 years, RCA's annual report has noted that autosound has been earnings drain. Decision ends hardware involvement of all 3 companies that launched today's autosound business with introduction of 8-track tape player in 1965. System inventor, Lear Jet, left business in early 1970s; Motorola, first hardware licensee, sold all but OEM segment of autosound business last year. While RCA's Consumer Electronics Div. dropped all audio products in 1974, company continues in tape arena through RCA Records.

SONY ANNOUNCES FIRST QUARTER RESULTS

Sony Corporation announced consolidated results for the first quarter which ended January 31, 1981. Sony's consolidated net sales for the first quarter reached an all-time high as compared with all previous first quarters. Consolidated net income also recorded an increase compared with the high level of the same period of the last fiscal year. However, consolidated operating income for the same period declined. During this first quarter, the yen value showed a sharp rise in comparison to its value during the first quarter last year, resulting in a substantial negative influence on the book value of consolidated net sales, which also caused a corresponding rise in the cost ratio. However, these negative influences were offset by the substantial growth of sales in terms of unit volume in Sony's major product lines, including such unique products as the Walkman stereo cassette player, the Betamax, and other video equipment. Another offsetting factor was the result of substantial translation gains arising from the conversion of the financial statement of the company's overseas subsidiaries into yen and also currency exchange gains due to forward contracts.

SECURITY VIEWPOINT

Licensing laws for alarm installation companies are on the upswing! A growing number of states are requiring alarm installing companies to pass a variety of tests to show competence in regard to the installation of home and commercial security systems.

And if you have either recently entered, or intend to enter this business, you should check your state's laws concerning licensing, as they vary from state to state.

Basically, the licensing law was adopted to quell the growing number of "fly-by-night" operators who were in business on a Monday, and out of business by Thursday.

Not only were consumers cheated out of monies and services, but these unscrupulous members of the alarm community created an avalanche of bad will concerning the industry in general.

Generally, the licensing laws require the following:

- That the applicant demonstrate a good working knowledge of alarm systems and alarm installations.
- That the applicant is of good moral character (this has caused some problems in the industry; applicants can understand that due to the nature of the job, their backgrounds must be checked but feel that in some instances this has been an invasion of their privacy).
- That the owner of the alarm company will be responsible for the licensing of *each* installer in his employ.

What has happened is that in some states, if the owner of the alarm company can come up with the initial fee for himself and his workers he is almost assured of receiving his license to operate.

In other states, things are not quite so easy, and as a result the industry is currently attempting to come up with some uniform requirements for all involved in installation.

The state of North Carolina (whose licensing procedures are regulated by the Private Protective Services Board) recently passed legislation that now distinguishes between hard-wire companies and wireless.

In North Carolina, if your business offers both services, you need two separate licenses!

A recent past president of the North Carolina Alarm Systems Association told *ET/D* that the Association felt that the licensing was a good thing, mainly in the protection of the consumer.

Currently, in that state, if someone is caught operating without a license, a fine of up to $5,000, *and* a jail sentence could be imposed on the offender.

While in favor of the licensing principle, the NCASA is not very pleased with the distinction currently regulating hard-wire and wireless. But as long as this particular law is on the books they have to live with it.

I strongly suggest that you make sure you are aware of the laws that may regulate your business. For like them or not, you have to live with them.

Ray Allegrezza

BULLETIN BOARD

The new B&K-Precision Industrial Test Instrument Catalog, BK-181, **featuring more than fifty instruments,** is now available free from *Dynascan Corporation.* The 44-page catalog features a broad range of high-quality test instruments for engineering, production line, MRO and other industrial applications. Each catalog product description includes a detailed specification section and helpful applications information. New products include a 100MHz quadruple trace scope; a portable, dual-trace mini scope; an autoranging microcomputer controlled DMM; autoranging capacitance meters; a bench top DMM; and new 300MHz scopes. Additional instruments featured include frequency counters, analog multimeters, function and RF signal generators, digital and pulser probes, semiconductor testers, power supplies, instrument probes and cables, carrying cases and other accessories. The entire line of instruments described in the B&K-Precision industrial catalog is locally stocked at leading distributors throughout North America. Selected products are stocked at distributors worldwide. Most products are available for the off-the-shelf delivery.
Circle No. 118 on Reader Inquiry Card

TRW RF Semiconductors has published a **large-format, 12-page short-form catalog,** number 503A, that lists basic specifications for 156 components. Ten categories of products are shown, along with photographs and engineering drawings of each package type. There is an alphanumeric index and a cross-reference table. Copies are available from any TRW RF Semiconductors sales office or authorized distributor.
Circle No. 119 on Reader Inquiry Card

A. W. Sperry Instruments Inc. has issued a new comprehensive full line, **short form catalog** and price sheet. The short form catalog (MES-200) contains detailed specifications for the A. W. Sperry line of Digital and Analog Snap-Around Ammeters, Digital and Analog Multi-Testers, Insulation Testers, Voltage Indicators, and accessories. The accompanying price sheet (RPL-18C) lists the suggested trade prices along with instructions on how to purchase A. W. Sperry Instruments. The catalog and price sheet can be obtained through your local stocking distributor or by contacting A. W. Sperry Instruments Inc.
Circle No. 120 on Reader Inquiry Card

Digital Electronics Troubleshooting by Joseph C. Carr, a self-study guide primarily aimed at technicians already in the field of electronics who want to learn something about digital circuits has just been published by *Tab Books Inc.* The guide begins with an overview of digital electronics and ends with a discussion of common repair problems and how to service various types of digital equipment. In between chapters cover such topics as digital IC families, logic gates, flip-flops, registers, data conversion, and test equipment for digital equipment.
Circle No. 121 on Reader Inquiry Card

A new **power semiconductor cross reference guide** has been published by the semiconductor division of the *Westinghouse Electric Corporation* to provide users with a source for determining replacement devices of the same current and voltage ratings. The guide cov-

ers all rectifiers, transistors, SCR's and assemblies available from Westinghouse as well as 10,000 part numbers from JEDEC, Westinghouse and other suppliers. All are cross-referenced to Westinghouse part numbers. As with cross reference guides, the user must determine substitution acceptability by reviewing the electrical and mechanical characteristics of a given device. Copies of the "Westinghouse Power Semiconductor Cross Reference Guide" may be obtained by contacting the Semiconductor Division, Westinghouse Electric Corporation, Youngwood, Pa., 15697.
Circle No. 122 on Reader Inquiry Card

The second edition of **Electronic Communications** by Dennis Roddy and John Coolen has just been published by *Reston*. The text covers in considerable detail communications fundamentals, circuits, modulation, transmission and radiation, and systems, including data transmission and line communications. The level of treatment presupposes a detailed (but not complex) knowledge of electronics, math, and basic electric circuits, such as would be presented in an electronics technology program at the junior college level. Up to date information regarding integrated circuits and special transistor packages specifically intended for communications circuits have also been added to the second edition.
Circle No. 123 on Reader Inquiry Card

Electronic Techniques: Shop Practices and Construction, has just been published by *Prentice-Hall*. The second edition was prepared to reduce the gap which exists between industry and an eductional environment in the layout and fabrication of electronic packaging with its almost exclusive reliance on printed circuits. New material added to the second edition reflects current industrial practices in the fabrication of printed circuits. Additional subjects include dry-film laminating, tin-lead electroplating techniques and double-sided printed circuit layout and fabrication. The second edition provides a realistic approach for developing skills in the planning, layout and construction of electronic equipment.
Circle No. 124 on Reader Inquiry Card

A new four-page **DMM selector guide** is now available from *Keithley Instruments, Inc*. The guide is designed to help users choose the right instrument for the job, and covers ten cost-effective service DMMs priced from $115 to $595. Two of Keithley's most recently introduced instruments, the Models 135 and 176, are included. The eight other service DMMs covered in the Selector Guide offer a wide variety of capabilities. A user may choose from features such as TRMS or ac averaging, extended current range, analog output, IEEE-488 interfaceability (three models), two or four wire input and microprocessor signal conditioning. The guide also includes a full line of accessories to extend the capabilities of all Keithley DMMs.
Circle No. 125 on Reader Inquiry Card

Switchcraft, Inc. has published a new 36-page catalog on **audio and general purpose connectors and ac receptacles.** The catalog (No. C502f) includes product descriptions, full engineering specifications, detailed drawings, and mating charts showing connecting compatibility with similar products. The catalog includes such Switchcraft products as Mini "Q-G" miniature connectors and accessories; "Q-G" audio connectors including a variety of panel and wall plate receptacles, adapters, inserts and accessories; "Slim-Line" audio connectors and accessories; various other microphone connec-

tors, CB connectors, and phono plugs and jacks; as well as ac receptacles for electrical/electronic applications. For a copy of the Connector Catalog C502f, write to Switchcraft, Inc., 5555 N. Elston Ave., Chicago, IL 60630.
Circle No. 126 on Reader Inquiry Card

Continental Resources, Inc. has just published its new 1981 **Electronic Instrument Rental Catalog** which contains descriptions of over 1500 electronic test instruments available for monthly rental. The 64-page catalog offers full specifications and monthly rates for the latest model test and measurement equipment from leading manufacturers. Included are oscilloscopes, recorders, logic analyzers, microprocessor test systems, power meters, X-Y plotters, function generators, frequency synthesizers and telecommunications test sets. Descriptions and monthly rates for such popular computer peripherals as line printers, CRT's and modems are also offered. All Continental equipment is available for immediate delivery from eight nationwide inventory centers. Each instrument is fully tested, calibrated and guaranteed to meet manufacturer's specifications, while adhering to all NBS certification regulations. Free copies of the new 1981 Continental Electronic Instrument Rental Catalog are available directly from Continental Resources Inc., 175 Middlesex Turnpike, Bedford, MA 01730.
Circle No. 127 on Reader Inquiry Card

A new and expanded 1981 **Snap-Action Switches catalog** has just been published by *Cherry Electrical Products Corp.* It includes detailed information on the complete Cherry line of snap-action switches and contains both a glossary of snap-action switch terms and a snap-action switch selector guide which gives access to the entire line. Two entirely new switches are contained in the catalog. They are the Series E90 solid base subminiature switches which are available in a choice of 0.1, 5 and 11 amps, and the Series F80 line-interrupt switches specifically designed to meet the requirements of UL, CSA and other international approval organizations. In addition to engineering drawings and specifications, the catalog contains operating characteristics and technical data on subminiature, miniature, general purpose, panel mount pushbutton, low torque, and open and gold cross-point contact switches. For a copy of this new catalog No. CE-666, contact Cherry Electrical Products Corp., P. O. Box 718, Waukegan, IL 60085.
Circle No. 128 on Reader Inquiry Card

A guidebook on magnetic recording, theory, practice, applications, and maintenance has been published by *TAB Books, Inc.* **The Complete Handbook of Magnetic Recording** is written for the technically inclined person who wants to acquire a greater in-depth knowledge of magnetic recording and storage. The book falls into three main areas covering fundamentals of magnetism, heads, tapes and disks (theory, materials, fabrications and performance) and equipment and application (equipment configurations and performances). The book is well written and should provide user, designer, or engineer with extensive technical information on the subject.
Circle No. 129 on Reader Inquiry Card

RCA's 1981 SK Top of the Line **Solid State Replacement Guide** listing over 1300 solid state replacement devices that replace more than 170,000 domestic and foreign types is now available from RCA SK Device Distributors. RCA's SK Guide shows the SK stock number along with the stock number of the numbering system used by ECG, REN and TM, which makes it easy to locate the correct solid state replacement device in this one publication. RCA's 1981 Guide offers information on the complete line of RCA's replacement transistors, rectifiers, thyristors, integrated circuits and high voltage triplers including many MRO replacements. Also included are an Index and Comprehensive Data section with listings grouped according to type of device. The 408-page Guide (SPG-202Z) may be ordered from local RCA Distributors.
Circle No. 130 on Reader Inquiry Card

Vaco Products Company introduces its new expanded major product catalog No. SD-281. This all-inclusive catalog contains all the information needed to specify, order and sell a unique product mix of **hand tools, solderless connectors, special fastening devices, and special application tools**. Complete descriptions and illustrations are found on Vaco's extensive product line including screwdrivers, nut drivers, hex keys, pliers, wrenches, crimping and wiring tools, testers, measuring tapes, and solderless connectors. Plus, Vaco has added a new dimension to their catalog. It has been designed as an information center to help the professional and do-it-yourselfer make the right choice. It provides simplified technical information and important how-to-use

information with the purpose of helping the user of quality tools select the proper tool to fill his particular needs. Vaco's new expanded SD-271 Master Catalog is available free upon request by writing Vaco Products Company, 1510 Skokie Blvd., Northbrook, IL 60062.

Circle No. 131 on Reader Inquiry Card

ITT Pomona Electronics has published a new 108-page catalog of **test accessories for use in electronic equipment.** The 1981 Pomona Electronics catalog includes over 450 black and white photographs and 30 drawings of such test accessories as banana plugs, jacks and patch cords; phone tip jacks, plugs and connecting cords; test clips, probes and holders, binding posts, black boxes and sockets. Also included in the catalog is an order form for use in special request quotations, electrical data, cable and wire description charts, an illustration of how to assemble BNC and triaxial cable, and metric and temperature conversion charts.

Circle No. 132 on Reader Inquiry Card

Multicore Solders has issued a 1981 edition of its "Selector Guide." This is a short form, quick reference guide to the complete **Multicore line of solders, fluxes and chemicals.** The 4-page brochure describes the basic features of each category of products and lists in tables all products within the category. The tables include such information as: characteristics, formulations, uses, variations, alloys where applicable, MIL and gov't approvals, and ordering data. Free copies of this brochure are available from Multicore Solders, Cantiague Rock Rd., Westbury, NY 11590.

Circle No. 133 on Reader Inquiry Card

Electronic Devices, Inc. has prepared a completely new condensed catalog of its lines of **bridge rectifiers, high and low voltage diodes, high voltage assemblies, and CRT rectifiers.** The 30 types of bridge rectifiers covered are single phase, center tapped, three phase, doubler, in standard and fast recovery types, in ratings up to 1,000 Volts and 50 Amps. The 61 diodes and assemblies shown range from 2.5 mA up to 6 Amps and to 50,000 Volts. They are available with recovery times as fast as 100 nanoseconds. Condensed specifications, photographs, and dimension drawings are provided. ET/D

Circle No. 134 on Reader Inquiry Card

WHAT'S BETTER THAN SPEED READING?

SPEED LEARNING

(SPEED PLUS COMPREHENSION)

Speed Learning is replacing speed reading. It's easy to learn... lasts a lifetime... applies to everything you read... and is the only accredited course with the option of college or continuing education credits.

Do you have too much to read and too little time to read it? Do you mentally pronounce each word as you read? Do you frequently have to go back and re-read words or whole paragraphs you just finished reading? Do you have trouble concentrating? Do you quickly forget most of what you read?

If you answer "yes" to any of these questions — then here at last is the practical help you've been waiting for. Whether you read for business or pleasure, school or college, you will build exceptional skills from this major breakthrough in effective reading, created by Dr. Russell Stauffer at the University of Delaware.

Not just "speed reading" — but speed reading-thinking-understanding-remembering-and-learning

The new *Speed Learning Program* shows you step-by-proven-step how to increase your reading skill and speed, so you understand more, remember more and use more of everything you read. The typical remark made by the 75,000 slow readers who completed the *Speed Learning Program* was: "Why didn't someone teach me this a long time ago?" They were no longer held back by the lack of skills and poor reading habits. They could read almost as fast as they could think.

What makes Speed Learning so successful?

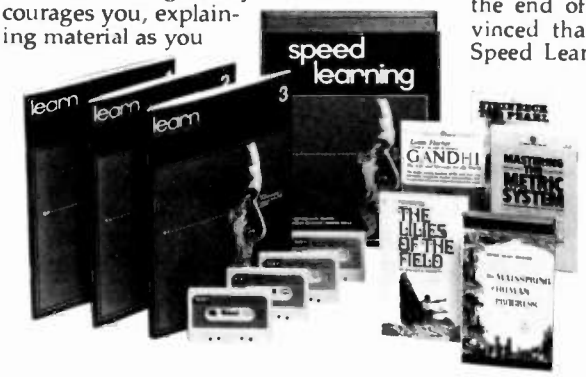
The new *Speed Learning Program* does not offer you a rehash of the usual eye-exercises, timing devices, costly gadgets you've probably heard about in connection with speed reading courses or even tried and found ineffective.

In just a few spare minutes a day of easy reading and exciting listening, you discover an entirely new way to read and think — a radical departure from anything you have ever seen or heard about. Research shows that reading is 95% *thinking* and only 5% eye movement. Yet most of today's speed reading programs spend their time teaching you rapid eye movement (5% of the problem) and ignore the most important part (95%) *thinking*. In brief, *Speed Learning* gives you what speed reading *can't*.

Imagine the new freedom you'll have when you learn how to dash through all types of reading material *at least* twice as fast as you do now, and with greater comprehension. Think of being able to get on top of the avalanche of newspapers, magazines and correspondence you have to read . . . finishing a stimulating book and retaining facts and details more clearly and with greater accuracy than ever before.

Listen-and-learn at your own pace

This is a practical, easy-to-learn program that will work for you — no matter how slow a reader you think you are now. The *Speed Learning Program* is scientifically planned to get you started quickly . . . to help you in spare minutes a day. It brings you a "teacher-on-cassettes" who guides you, instructs, encourages you, explaining material as you read. Interesting items taken from *Time* Magazine, *Business Week*, *Wall Street Journal*, *Family Circle*, *N.Y. Times* and many others, make the program stimulating, easy and fun . . . and so much more effective.



Executives, students, professional people, men and women in all walks of life from 15 to 70 have benefited from this program. Speed Learning is a fully accredited course . . . costing only 1/5 the price of less effective speed reading classroom courses. Now you can examine the same, easy, practical and proven methods at home . . . in spare time . . . without risking a penny.

Examine Speed Learning FREE for 15 days

You will be thrilled at how quickly this program will begin to develop new thinking and reading skills. After listening to just one cassette and reading the preface you will quickly see how you can achieve increases in both the speed at which you read and in the amount you understand and remember.

You must be delighted with what you see or you pay nothing. Examine this remarkable program for 15 days. If, at the end of that time you are not convinced that you would like to master Speed Learning, simply return the program and owe nothing. See the coupon for low price and convenient credit terms.

Note: Many companies and government agencies have tuition assistance plans for employees providing full or partial payment for college credit programs.

In most cases, the entire cost of your Speed Learning Program is Tax Deductible.

COLLEGE CREDITS

You may obtain *2 full semester hour credits* for course completion, wherever you reside. Credits offered through Whittier College (California). Details included in your program.

CONTINUING EDUCATION UNITS

National Management Association, the world's largest association of professional managers, awards 3.0 CEU's for course completion. CEU's can be applied toward the certificate in Management Studies.

PROFESSIONAL SOCIETIES

Speed Learning is offered internationally to members of professional associations such as: American Chemical Society, Foundation for Accounting Education, Institute of Electrical and Electronics Engineers and dozens more. Consult your Education Director for information.

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Many companies and government agencies offer Speed Learning as a wholly-paid or tuition reimbursement program. Consult your Training or Personnel Director for details.

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ETID -581

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- ☐ Please send the Speed Learning Medical Edition @ $109.95 plus $4 postage and handling.
- ☐ Please send the Junior Speed Learning program (ages 11 to 16) @ $89.95 plus $4 postage and handling.

Check method of payment below: NJ residents add 5% sales tax.

- ☐ Check or money order enclosed (payable to learn incorporated)
- ☐ Charge my credit card under the regular payment terms
  - ☐ Visa ☐ Master Card Interbank No. _____ ☐ American Express
  - Card No. _____ Exp. Date _____

I understand that if after 15 days I am not delighted in every way, that I may return the materials in their original condition for a full refund. No questions asked.

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Address _____

City _____ State _____ Zip _____

Signature _____

If you don't already own a cassette player, you may order this Deluxe Cassette Recorder for only $49.95. (Includes handling and delivery.)

Check here to order ☐

Outside USA add $10 per item—Airmail extra

Dual-Trace Scope Techniques

The most versatile instrument?

The wideband, dual-trace, triggered oscilloscope is perhaps the most versatile test instrument available for troubleshooting, if you know how to use it, *and you must!* Here are some principles of its application

By Robert L. Goodman

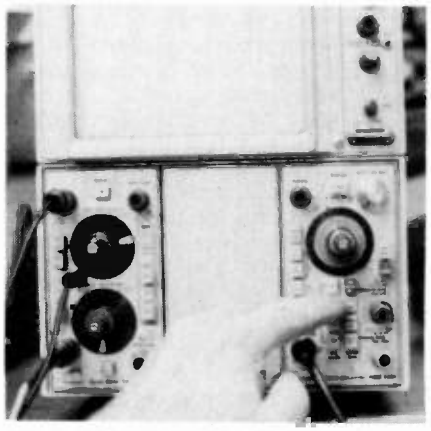


Fig. 1. Tektronix scope with delayed sweep and intensified mode.

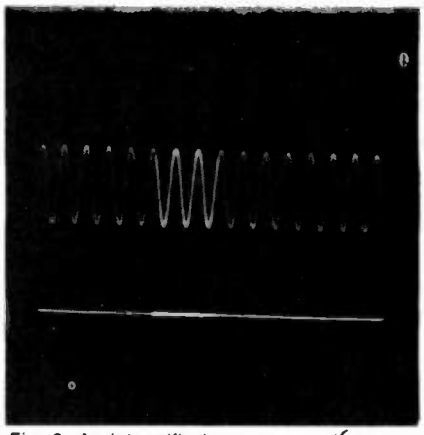


Fig. 2. An intensified scope waveform.

If you were just starting in the electronics service profession, what major test instrument would you purchase first? An oscilloscope, most technicians would answer, and you would be quite right. However, in this fast paced electronics age of the 80's you had best make that a dual-trace, wideband width, triggered-sweep oscilloscope.

So, with this in mind, we will now check out various circuits that most electronics technicians encounter every day to illustrate the versatility of this new breed of triggered-sweep scopes that are now available on the today's market.

Refer to the Appendix for examples of the features that are most wanted in oscilloscopes by professional electronics service technicians. This should help you decide which scope is best suited for your particular requirements.

Delayed sweep or Delayed Trace

Do I want or need "delayed sweep" or "delayed trace" on my scope? That is a question many technicians ask.

Thus, there appears to be some confusion about the difference between delayed sweep and delayed trace operation. Many technicians want their scope to have delayed sweep so they can see the leading edge of the pulse that actually "Triggers ON" the scope's sweep or time base generator.

However, to see this leading edge, the scope needs a delayed trace and not a delayed sweep. A delay line in the vertical circuits of the scope compensates for the delays in the triggering and sweep circuits so that the vertical signal reaches the CRT at the exact instant the trace begins its sweep across the scope screen. Thus, most technicians are actually looking for a scope that has a delayed trace function.

In order to have delayed sweep the scope would require two time base generators. These are referred to as time base generators "A" and "B". This feature may be referred to as a delaying time base generator and can become complicated to set-up and operate properly. Delayed sweep lets you expand any portion of the displayed waveform for more detail. Of course, the times 10 expansion (×10) feature in many triggered sweep scopes provides a similar expansion capability with a good bit less complexity. The delayed trace scope allows you to see the details of the triggering pulse's leading edge in digital signal application, with the least operating complexity possible.

Some of the more costly scopes with delayed sweep also have an intensified trace mode. The author's "old faithful" 5403 Tektronix scope is shown in Fig. 1 being switched into the "B" sweep intensified by "A" mode for a detailed look at some complex signals. An intensified waveform is shown in Fig. 2 to illustrate this mode concept. This mode can be used for a better look at a digital pulse train that has been expanded, for example, and in which you may suspect some very faint spikes to be present. The intensified mode will thus make them visible. Delayed sweep with intensification does have some applications on the service bench, but is more often used by the design engineer in the lab.

Amplifier phase shift

Phase shifts in audio amplifiers can be measured with a scope. In all amplifiers, a phase shift is associated with a change in amplitude response. For example, at the −3 dB points, a phase shift of 45 degrees occurs.

Phase measurements can be performed by operating the scope

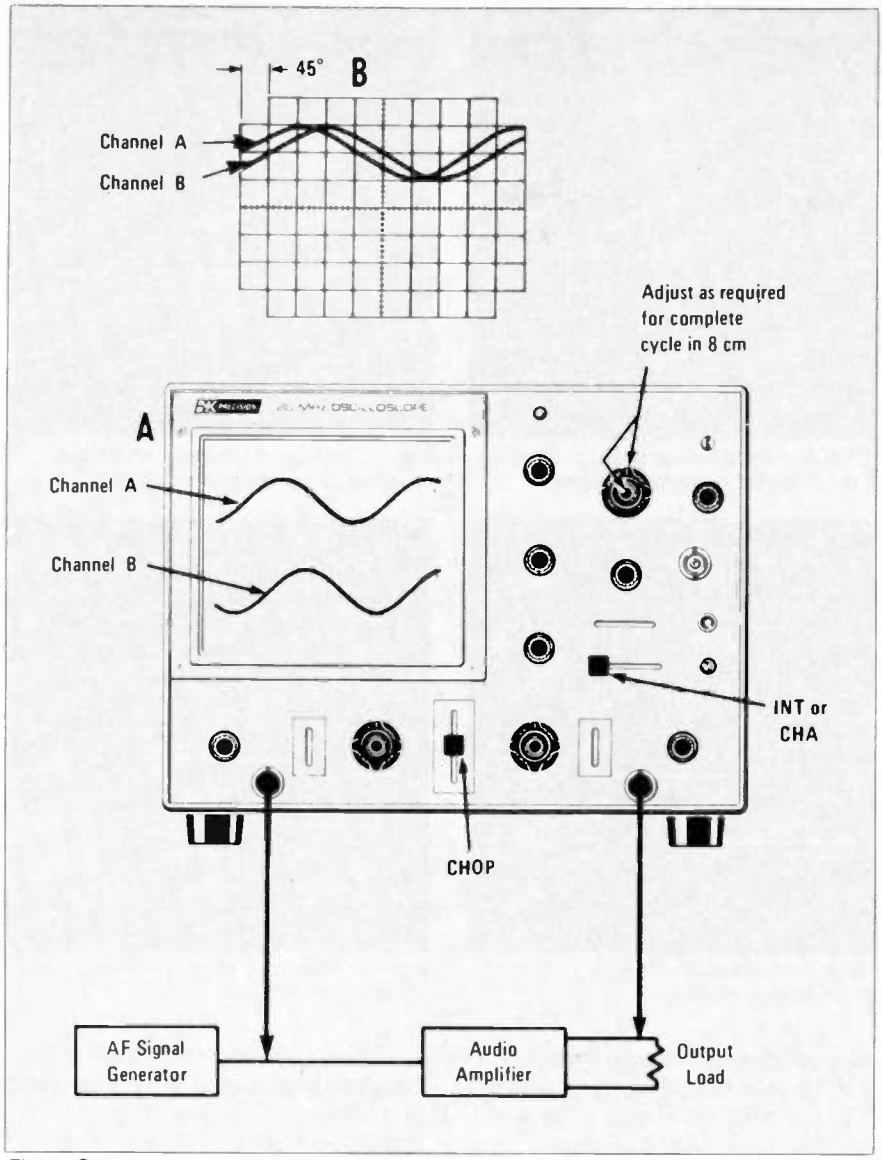


Fig. 3. Set-up for measuring audio amplifier phase shift on an oscilloscope.

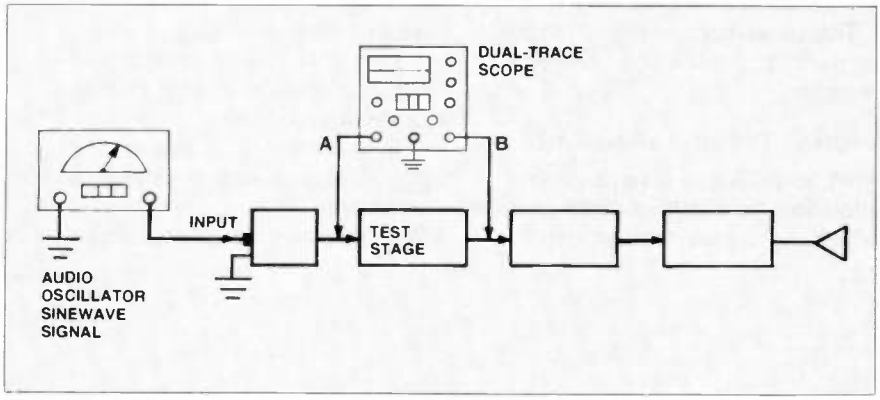


Fig. 4. Test set-up for pin-pointing audio amplifier distortion.

either in the dual-trace or the X-Y mode. The dual-trace mode is used to measure amplifier phase shift directly. Refer to Fig. 3 for this test set-up. In this set-up the measurements are being made at 500 Hz. The input signal to the audio amplifier is used as a reference and is fed to the A input jack.

The sweep time VARIABLE control is adjusted to provide a complete cycle of the input waveform display on 8 divisions horizontally. A waveform height of 2 divisions is used. The 8 division display represents 360° at the displayed frequency and each division represents 45° of the waveform. The signal developed across the output of the audio amplifier is fed to the CHANNEL B INPUT jack. The vertical attenuator controls of CHANNEL B are adjusted as required to also produce a peak-to-peak waveform of 2 divisions.

The CHANNEL B Position control is then adjusted so that the Channel B waveform is displayed on the same horizontal axis as the Channel A waveform in Fig. 3-B. The distance between corresponding points on the horizontal axis for the two waveforms then repreesents the phase shift between the two waveforms. In this case, the zero crossover points of the two waveforms are compared and indicates a phase shift of 45°.

The second method of phase measurement requires some calculations based on the Lissajous patterns obtained by using an oscilloscope in the X-Y mode. Distortion due to non-linear amplification can also be displayed by this technique. For these tests a sinewave signal from a function generator is fed into the audio amplifier's input stage.

Isolating Distortion

(Using the scope's "A+B" and "A−B" channel modes)

Let's now see how we can use the oscilloscope to isolate a possibly distorting stage in an audio amplifier. For these tests we will use the "A+B" and "A−B" display modes. The dual-trace scope is connected to the input and output of one suspected stage and then set to cancel the output signal with the input signal. The resulting CRT display will be the distortion introduced by the suspect stage. The audio test signal source used should be a sine-wave, but does not need to have low distortion levels because any distortion in the test signal will also be present at the output of the stage being tested, resulting in cancellation of the test signal source distortion. It is possible to isolate distortion as small as 0.1% using this method because the gain of the scope channels may be increased beyond the level that would cause full-scale deflection, if channel A and B were displayed normally, while the residual distortion signal will remain relatively small on the CRT display.

Pinpointing Distortion

1 — Connect an audio oscillator by feeding its test signal into the amplifier input stage.

2 — Connect the scope's channel A probe to the input of the stage to be tested, and the channel B probe to the stage output. Refer to the set-up block diagram (Fig. 4).

3 — Set the Volts/Division switch for

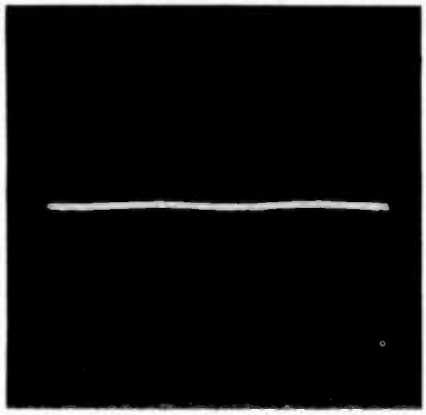


Fig. 5 Smooth trace indicates no distortion.

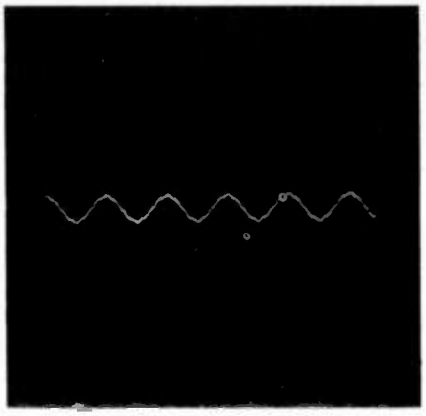


Fig. 6 This trace indicates some distortion in the amplifier stage being tested.

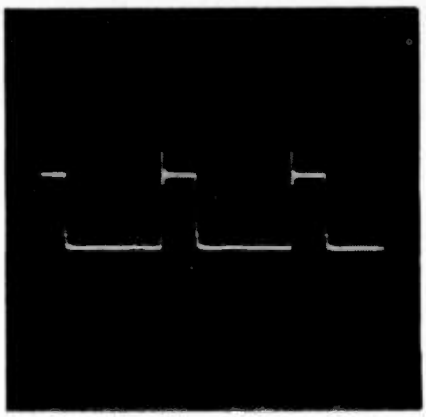


Fig. 7 Small spike notch (or notch) on leading edge of the pulse is a glitch.

both channels to produce a full-scale signal. Make sure the scope is being triggered properly.

4 — Confirm that the phase of the Channel B signal is *OPPOSITE* that of the Channel A signal. If they are in the same phase, pull the Channel A vertical position control to invert Channel A.

5 — To obtain an "A+B" display mode, depress both the Channel A and Channel B pushbuttons at the same time.

6 — Adjust the Vernier control of either A or B channel until the trace is as small as possible vertically. This step balances the amplitude of the two traces for full cancellation of the input signal. The resulting signal, that cannot be eliminated with this step, is the distortion, added by the amplifier being tested.

7 — If the result of step 6 is a straight line, as shown in the Fig. 5 scope waveform, there is less than a 2% distortion in the measured signal. The distortion resolution may be increased by ten times (20 dB) by increasing the sensitivity of both channel VOLTS/DIVISION switches by ten times. If, for example, channel A is set to 1 volt per division, and channel B is set for 2 volts per division, change them to 0.1 and 0.2 volts per division respectively.

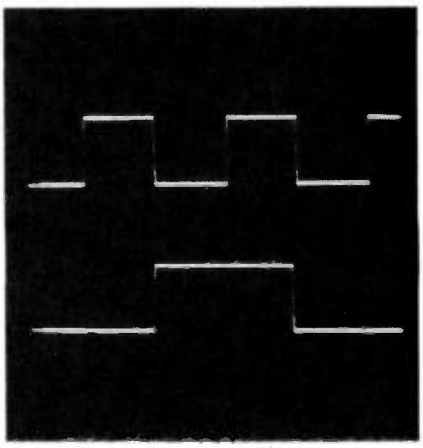


Fig. 8 Proper waveforms for a divide-by-two stage.

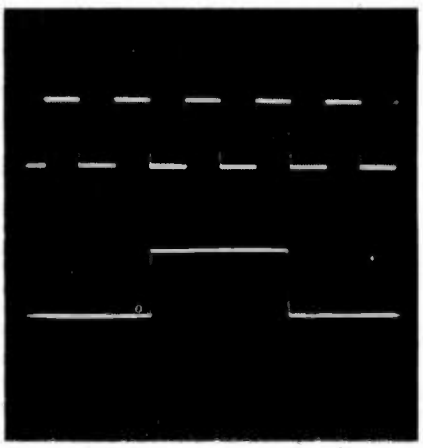


Fig. 9 A glitch may cause a divide-by-two stage to divide-by-four.

To pin-point the trouble in an audio amplifier, check with the scope stage-by-stage, until the stage causing the distortion is located.

The scope trace in (Fig. 6) indicates an audio amplifier stage with some distortion.

Digital Troubleshooting

A wideband scope is required to effectively troubleshoot digital circuits now found in most modern day electronic devices. Many of these high-frequency digital circuits are used as counting and divider stages in phase-locked-loop systems.

When testing these digital circuits, your scope must show you the true square-wave waveform.

Let's now look at some of the reasons why this is so in checking digital waveforms.

1 — You need to be able to accurately measure the signal pulse amplitude.

2 — You must be able to accurately

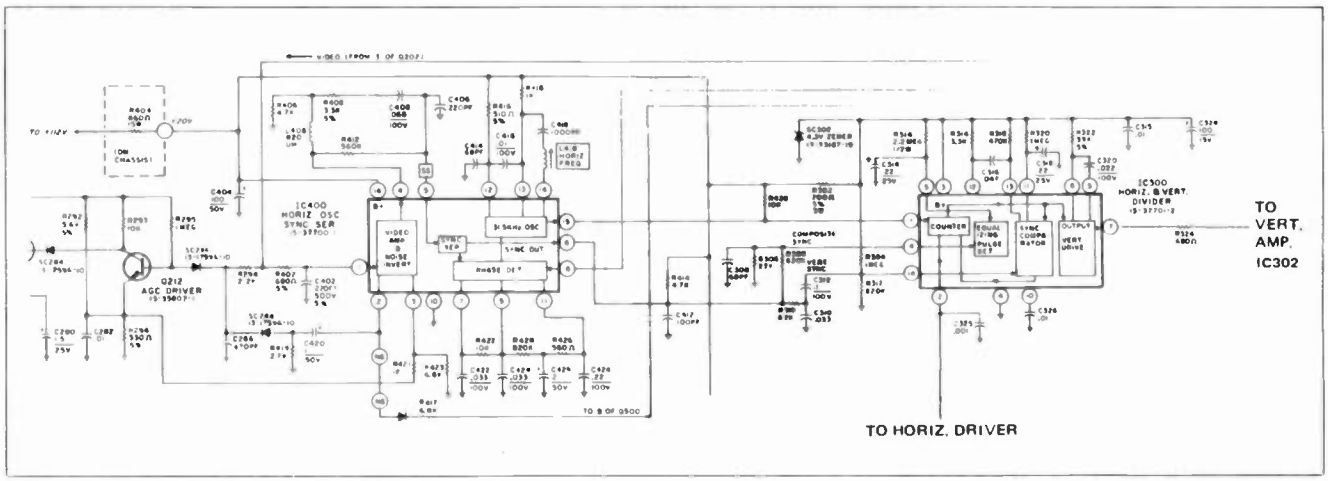


Fig. 10 Circuit for the Sylvania count-down system.

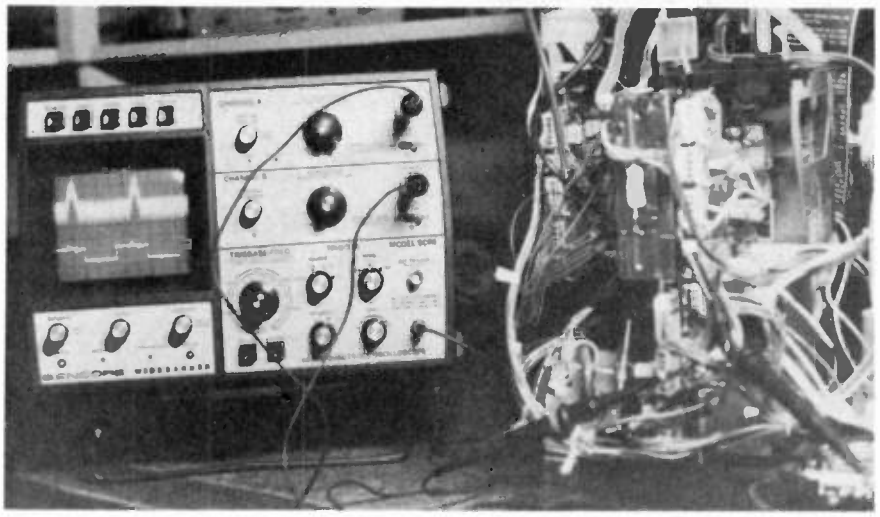


Fig. 11 Dual-trace scope set-up for locating intermittent trouble in a Zenith System Three receiver.

see the timing relationships of two input signals to make certain the output signal is correct.
3 — You must be able to locate interfering "glitches" that could cause improper circuit operation by adding to the desired input signals.

The "Glitch"

Let's now see what a glitch is and how it can affect circuit count-down and divide operation.

Referring to Fig. 7 you will see a scope trace of a signal fed to the input of a digital counting stage. Notice the small spike on the leading edge of the signal. This is a glitch. Glitches are caused by many circuit problems, such as an IC with an intermittent condition, unwanted coupling of signals through the ac power lines, or delays introduced to a signal as it passes through a transistor inside an IC. The glitch does not cause trouble unless its amplitude is high enough to trigger a subsequent digital stage. The scope waveform in Fig. 8 shows the proper operation of the input and output of a divide-by-two stage with out a glitch. The output is a square-wave with a frequency one-half the input.

Now note what occurs when a glitch signal is fed to this divider stage. The digital counter considers the glitch as a separate input signal. The circuit divides the glitch by two, resulting in a narrow spike output instead of the normal square-wave output. At times a glitch may force a divide-by-two stage to become a divide-by-four stage as the digital wave-form in Fig. 9 indicates.

If you were troubleshooting these divider circuits with a 10 or 20 MHz bandwidth scope you could not see these glitches. Thus, this is just one reason you will need a 50 MHz or more, bandwidth triggered sweep scope in order to successfully service logic systems now in use and on into the future.

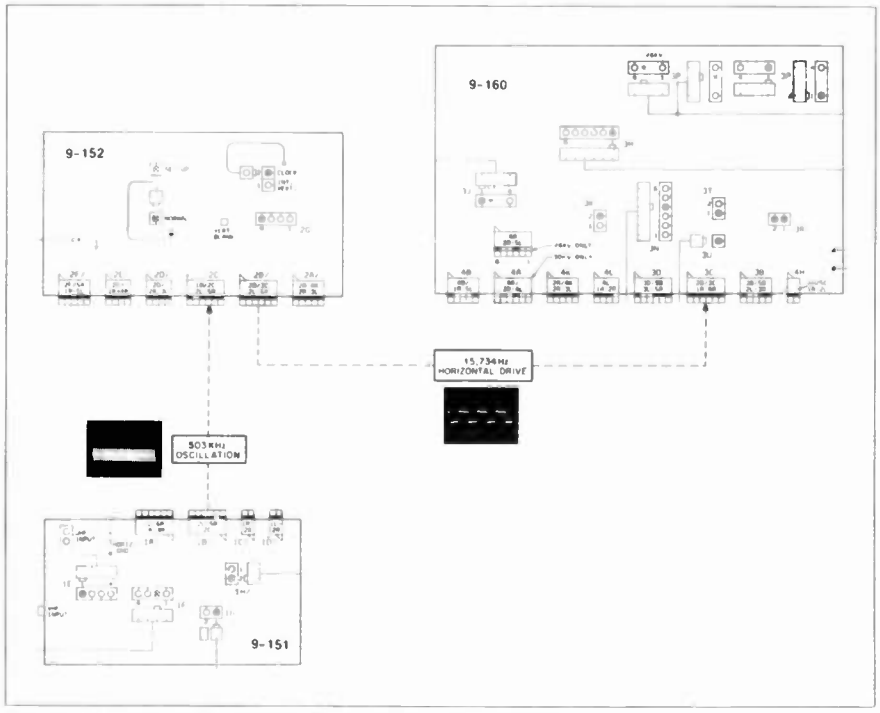


Fig. 12 Diagram of the System Three intermodular signals.

TV Horizontal/Vertical Count-Down Circuits

The dual-trace triggered sweep scope is a natural for troubleshooting the modern count-down system chips now found in Sylvania, Zenith and other brands of color TV receivers. Let's now check out an actual count-down circuit.

You will find in the Sylvania system, instead of a horizontal oscillator, a 31.5 KHz clock or oscillator signal. Refer to Fig. 10 for diagram of the Sylvania countdown circuit. The 31.5 KHz clock frequency is twice the normal horizontal frequency of 15,750 Hz. The horizontal sync signal locks the clock to its proper phase. The clock output leaves pin 15 of IC400 and enters pin 1 of the horizontal and vertical divider IC300. The sync signal also leaves IC400 via pin 6 and enters IC300 through pins 4 and 14. If you have picture locking problems, use the scope to check for correct sync signals at these two pins.

In the IC300, the Horizontal and Vertical Driver, the 31.5 KHz signal is divided by 525 (the number of scanning lines) by a flip-flop circuit that produces the 60 Hz vertical drive signal. This signal leaves pin 7 of IC300 and goes to the vertical driver/amplifier IC circuit.

The 31.5 KHz signal is divided by two by another flip flop circuit that produces the 15,750 Hz horizontal drive signal that leaves pin 2 of IC300 and goes to the Horizontal Driver circuit. When troubleshooting this stage use the scope to check the 31.5 KHz input at pin 1 of IC300 and then the vertical and horizontal output signals of this chip after being processed. Thus, should a glitch appear at the input of IC300, the chip may not divide properly and vertical/horizontal picture lock would be affected. A sufficiently wideband (60 MHz) scope would tell you if there is a glitch or spike present, and pin point the problem area.

Because of the precision

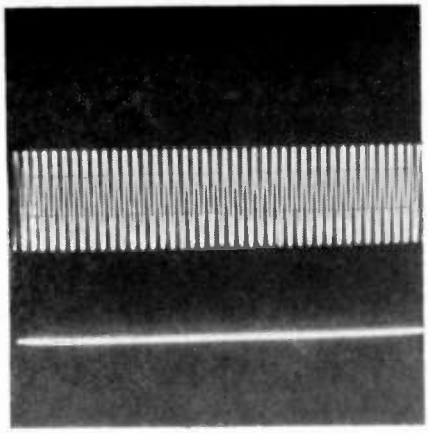


Fig. 13. Correct 503kHz master scan oscillator signal.

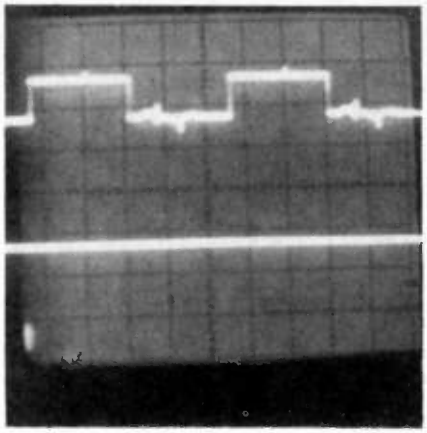


Fig. 14. Correct horizontal drive signal.

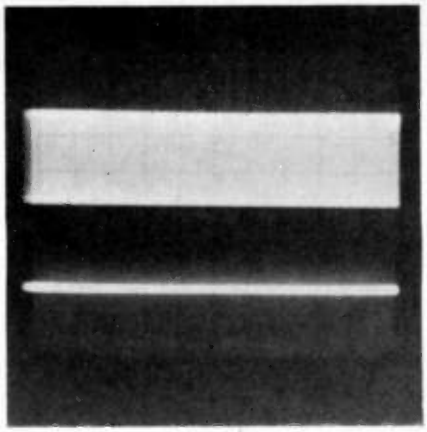


Fig. 15. The horizontal drive signal is missing on the bottom dual-trace scope photo. Master scan oscillator signal is good.

count-down circuits used in the above described IC's, the sets using these circuit systems have excellent horizontal and vertical sync that is not disturbed by noise spikes or interference signals. The tip off, to you, for TV receivers that use these count down/divider systems is that there are no customer vertical or horizontal hold controls to be found. There will be a horizontal or master scan oscillator (clock) adjustment control inside the set, however.

Also note that you will not find a vertical oscillator circuit in these count-down systems. As an example, the vertical signal from IC300 at pin 7 is actually a vertical drive signal and not sync pulses.

Next up, a look at the Zenith System Three count-down system operation and check-out.

Zenith, System Three, Scope Quick Checks

The servicing of the Zenith System Three sets can be a time consuming task if you do not approach the problems systematically. The reason for the systematic service approach becomes more apparent as we look at and then understand the relationships of the various modules in the receiver.

A dual-trace scope will make this faulty module isolation task much easier, especially should you encounter an intermittent problem. Note the scope bench set-up in Fig. 11 for locating an intermittent problem.

The relationship is such that certain signals from one module to another module must be present for the receiving module to be operative. In fact, a missing or improper master scan or horizontal drive signal waveform can damage components in other receiving modules. As we make these checks refer to the intermodular signals in the Fig. 12 block diagram.

You may find a defective M1 or M2 module could cause a failure of the M10 module. Therefore, before replacing a "defective" M10 module, the M1 and M2 modules should be checked out or substituted. On the M1 (9-151) module, test the 503 KHz oscillation, and for the M2 (9-152) module observe the horizontal drive (15,734 Hz) waveform on the scope.

With a symptom of no raster, no high voltage, with normal hiss in the sound, the following checks should be performed:

1 — Disconnect the yoke plug (3D) on the M10 module.

2 — Turn the receiver on and check with the scope for presence of the 503 KHz oscillation at test point pin 32H or pin 4 of connector 1B on the M1 module. This signal is a 1.5 volt P-P waveform riding on a 2.5 volt dc level, as viewed on a scope. See waveform in fig. 13. This peak-to-peak signal should read approximately 1.2 volts on the ac RMS meter scale.

5 — If the preceding signals are incorrect or missing, replace the M2 module.

6 — If the M1 and M2 modules are providing normal signals to the M10 module, then replace the M10 module, or confine your troubleshooting to the M10 module and yoke circuitry.

Some of these sets may lose the picture and high voltage intermittently. This may last only a few seconds and occur only every 30 minutes or so. A fault in any of the three modules could cause this intermittent symptom. To quickly isolate the problem module, connect one channel of the scope to monitor the 503 KHz signal and the other channel to monitor the 15,734 Hz drive signal. When the trouble

Fig. 16. B&K model 1520 dual-trace scope photo.

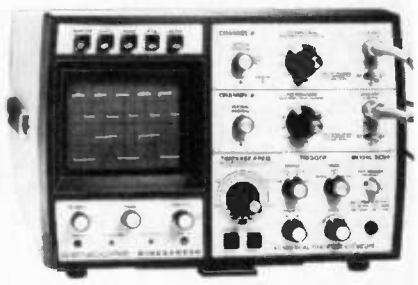


Fig. 17. Sencore SC60 WIDEBANDER scope photo.

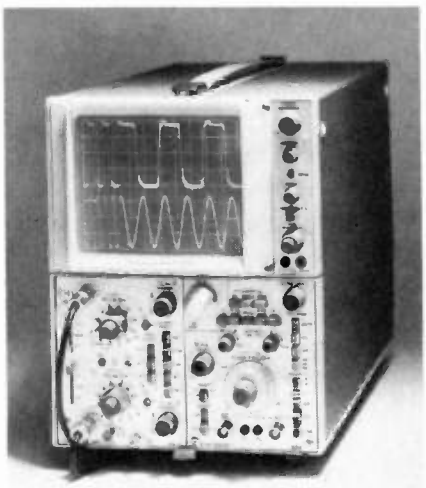


Fig. 18. Photo of the Telequipment model D83 dual-trace oscilloscope.

occurs see which scope trace is missing. The dual-trace scope photo in Fig. 15 indicates the drive signal is missing and the master scan signal is good. This would point to a faulty 9-152 module. Should both signals be normal then suspect a defect in the 9-160 (M-10) module.

Appendix

Following are some characteristics of typical service scopes of somewhat varying capabilities. Many other manufacturers offer instruments with similar features, among them are in no particular order are: B&K-Precision, Sencor, and Telequipment and Simpson, Gould, Philips, Hitachi, Hameg, Kikusui, Ballantine, Soltec, Hickok, Leader, Non-Linear, Viz, Vu-Data, Hewlett-Packard and Tektronix. The scopes that follow are typical of those offered to the service industry. You read the specifications and make your choice.

B&K-Precision 1520

This B&K scope (see photo in Fig. 16) is a high-performance, lab type instrument. It features dual-trace, bandwidth of dc to 20 MHz and vertical amp sensitivity of 5 mv/cm. The matched, dual vertical inputs let you view, simultaneously, two waveforms. Chopped or alternate sweep operation is manually selected. Add and subtract capability is also provided so that the sum or difference of two waveforms can be displayed as a single trace.

For video applications such as video tape recorders, CATV and MATV networks, plus TV sets, a built-in sync separator lets you view and lock-in composite video waveforms. Vector-scope operation is provided for analyzing color circuits.

Features like ×10 magnification, electrical trace rotation (adjustable from the front panel), a slotted bezel for mounting a scope camera, and a good looking case will also be found.

Sencore SC60

The SC60 scope's triggering circuits are designed for high stability and ease of operation. (Fig. 17)

There are three reasons for the SC60's stable lock-in features. First, the triggering circuits use differential amplifiers for less noise pick-up. Second, the triggering circuits themselves are digital, using the fastest available today, Emitter-Coupled-Logic (ECL). And the third reason is that the triggering circuits always operate at a 100 MHz rate, even when you are triggering on an audio signal. This high switching insures such stable triggering that there is virtually no measurable triggering error.

The SC60 will add the two input signals together (A+B) when both the A and B channel display push buttons are depressed at the same time. Algebraic subtractions (B−A) results if the Channel A signal is inverted by pulling on the VERTICAL POSITION control and both the A and B channel buttons are depressed.

The "A+B" display mode may be used to simplify the comparison of the timing for two signals or phase relationships or making audio amplifier distortion checks.

The SC60 has a TIMEBASE-FREQ switch that is calibrated in both time per division and frequency for 10 full divisions of deflection.

The SC60 scope also has an Vector Analysis Mode for chroma circuit troubleshooting and alignment.

Another time saver is the video preset modes which allows you to select two full fields at the vertical or horizontal rate at the push of a button.

The VITS and VIR signals lock-in very well on this scope due to the special built-in TV sync separator circuits. The checks I have made did not require an external trigger signal to lock-in the VITS signals.

The sync separator has both an amplitude detector and a vertical integrator filter which really locks-in the vertical sync information. The SC60 has a video sync separator for horizontal sync and a second separator for the vertical sync lock-in mode.

Telequipment D83

Shown in Fig. 18 is the model D83 Telequipment scope which can be purchased from Tektronix regional sales offices. This is a dual-trace, triggered sweep scope with a bandwidth of 25 MHz. It has delayed trace and two time base generators with delayed sweep features. This scope has been out several years and is an excellent instrument at a reasonable cost.

These are just some selected features of a few triggered-sweep scopes now on the market, features that are most wanted by professional electronics service technicians. This information may help you decide what kind of scope is best suited for your requirements. ET/D

Semiconductor Substitutions, Part II

FETs, SCRs, etc.

Proper substitution of FETs and SCRs is just as complex a subject as substitution of bipolar transistors. Here we discuss the characteristics of SCRs and the many kinds of FETs.

by Bernard B. Daien

In the first part of this article we discussed bipolar transistors, including Darlingtons. It was noted that the frequency response of bipolar transistors can vary considerably, and this factor is important when making substitutions.

SCRs

Now we are considering silicon controlled recitifiers briefly, and again, speed is a factor, but the term is changed to, "turn on," and "turn off" time, since the SCR is a latching device.

The SCRs used in some TV sets for horizontal deflection generators, are good examples of this. These SCRs are capable of very fast turn on and turn off times, when compared to the SCRs used for 60 Hertz power line use. Conventional SCRs simply are not fast enough for horizontal sweep use. (The fast SCRs cost considerably more, and are in less abundant supply.) To compound the problem, some TV manufacturers have elected to include a fast damping diode in parallel with the SCR, in the same package. (RCA's "ITR" is one such example). This makes testing a little more confusing. And, of course, the failure of one component requires the replacement of both. The result is that most shops have found it best to replace only with original parts . . . a policy which I recommend.

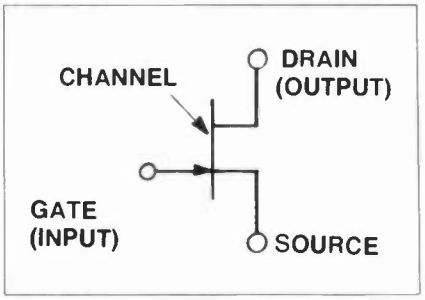


Fig. 1. An N channel Junction FET

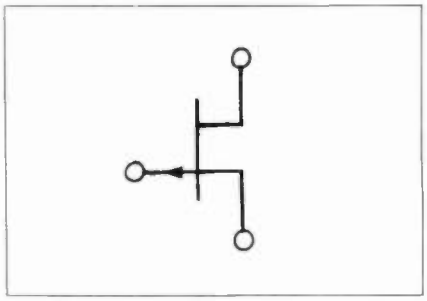


Fig. 2. A P channel Junction FET

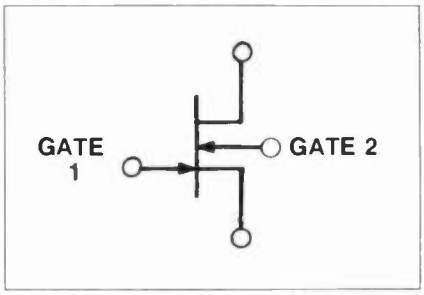


Fig. 3. A dual gate N channel JFET

SCRs also come in varying sensitivity, so far as the gate pulse amplitude and duration are concerned. Some devices trigger "on" with microsecond pulse widths, microamperes of gate current, and voltage of a volt or so . . . while others require longer pulses, milliamperes of current, and several volts of amplitude. Again, sensitive SCRs cost more.

Most technicians understand the need for adequate reverse voltage rating, average and peak current ratings, etc. But there is one little characteristic that can give you real headaches . . . the "rate of applied voltage." If an SCR has a very fast rising waveshape applied to the anode, it may turn itself on WITHOUT A TRIGGER PULSE. This characteristic differs with manufacturers, and the particular SCR, and is specified. Often the semiconductor substitution manuals do not even mention this important factor!

To sum up, the SCR is as difficult to substitute as most other semiconductors, perhaps even a bit more difficult. Because many consumer electronics service technicians do not have much exposure to SCRs they tend to be cautious about them, which is quite fortunate, in the light of the above mentioned factors.

FETs

FETs come in a wide variety . . . and they are NOT interchangeable, due to different biasing requirements, etc. The first problem we have is just sorting them out . . . there are two different families, junction FETs (JFETs), and metal-oxide-silicon FETs (MOSFETs). The JFETs and MOSFETs each come in two main varieties, N channel, and P channel (roughly corresponding to the way that bipolar transistors come in NPN or PNP varieties). JFETs and MOSFETs also come in either "single gate" or "dual gate" configurations.

Due to the basic difference in method of operation, JFETs come in only "depletion mode" types, while MOSFETs can be "depletion mode," "enhancement mode," or "enhancement/depletion mode" types. This set of definitions will be made clear to the reader in the following

text, but for now, the point being made is that there is one heck of a lot of FET types . . . and they are NOT interchangeable!

It may also come as a surprise that the only way you can identify these different types is by subtle differences in the symbols on the schematic . . . but unfortunately many of the draftsmen who draw electronic schematics are not aware of these differences, so the schematic is often inadequate, or just plain in error when the FETs are depicted. As a result, many textbooks on the subject of semiconductors are also wrong, in the illustrations and schematics provided. At the present time the industry does not seem concerned about improving the situation, so once again, the service technician must shoulder the burden of doing "detective work" in replacing parts.

I would suggest a rule of thumb that has worked well in the past. "If the FET has a standard 'N' type part number, such as '3NXXX,' look it up in a semiconductor manual to verify what it is. If the description matches the set function you can then buy it from any distributor under the part number. If it has a non-standard part number (house number), don't waste your time . . . just buy the original part from the set manufacturer."

Sorting them out

Let's try to sort out the different FETs, in two ways . . . by function, and by schematic symbols. The functions have to be learned, but there are some "tricks" to help identify the schematic symbols. In order to understand how the different FETs function we must first review the theory of operation of JFETs and MOSFETs, very briefly, in a practical way. . . . (Some literature refers to MOSFETs as "insulated gate FETs," or simply IGFETs. They are the same thing.)

All FETs, whether JFETs or MOSFETs, operate on the principle of a VOLTAGE INPUT causing the output current of the device to vary, as is the case with vacuum tubes. Stated another way, the input influence is controlled by an electrostatic field, as the electrostatic field around a vacuum tube grid modules the current flowing towards the plate. As in a vacuum tube, the *input impedance is very high,* since there is no current flow.

The primary difference between the JFET and MOSFET is in how the electrostatic field is created. In the MOSFET the input, called "the gate" is formed by a true capacitor, made by depositing a layer of glass (silicon oxide) on the silicon device, which forms the dielectric of a capacitor. On top of the glass is deposited a metallic layer, forming the second plate of a capacitor. Voltage applied to this plate, causes an electrostatic field to penetrate the dielectric, and influence the flow of current in the silicon. In the JFET the capacitor is not made of metal/oxide/silicon layers, but is made by depositing or forming another silicon layer on the surface of the silicon device, but with doping to form

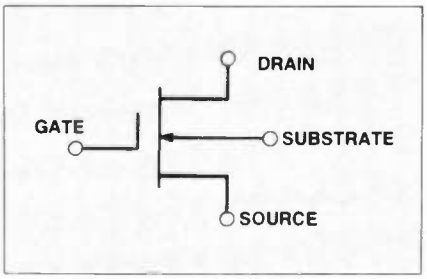


Fig. 4. An N channel MOSFET (depletion mode)

the opposite polarity silicon . . . thus we have N silicon on P silicon (or P silicon on N silicon, as the case may be). This forms a PN junction, which is a semiconductor diode. If we reverse bias this diode, no current will flow, and, in fact, it is a small capacitor! (Remember, a reverse diode is a "varicap.") This capacitor works just like the metal/oxide/silicon capacitor of the MOSFET, with one very important limitation . . . it MUST ALWAYS BE REVERSE BIASED. If it ever becomes forward biased, current will flow, and the input will change from a capacitor to a conductor.

This means that the input of a JFET can only be reverse biased in some varying degree . . . i.e., the current through it can be reduced from the "no input bias" condition, but can never be increased. This is the case with vacuum tubes too . . . and both JFETs and vacuum tubes are said to be "depletion mode" devices, since the output current can be reduced (depleted), but not increased (enhanced) by the application of bias. In normal use, both the JFET and the vacuum tube are reverse biased by the input bias, in order to get the output current at some operating point, around which the signal input can swing the output current up and down.

Since the MOSFET need not be reverse biased, it is possible to apply either an input bias which increases the output current (forward bias), or a bias which decreases the output current (reverse bias). The MOSFET can thus be biased in either the enhancement mode, or the depletion mode, or in a mode somewhere in between, called the "enhancement/depletion mode." Of course the design of the MOSFET is made to optimize its operation in the intended mode of operation. To sum up then, MOSFETs do not have a limitation on forward bias, as do JFETs. Freed of this limitation, they can be used in either enhancement or depletion modes of operation . . . and therefore the manufacturer of the device can optimise the design for the desired mode of operation.

With these basic facts in mind, let's look at some FET symbols as used (correction, "should be used") in schematic diagrams. Figure 1 shows an N Channel JFET. The polarity of the device, N channel, is indicated by the gate (input) arrow pointing TOWARDS the channel. If you think about it, this is exactly the same symbology used with bipolar transistors, in which the emitter arrow of an NPN transistor points AWAY from the base (P base material). In a PNP transistor the emitter arrow points toward the base (N material). The simple little trick then is to recall that the arrow always points toward N, and away from P material in either bipolar or FET transistors. In the case of bipolars the arrow points towards or away from the base, in the case of FETs it points toward or away from the "channel" (which connects the source and the drain). The drain corresponds to the plate in a vacuum tube, or the collector in a transistor. . . . it is the output terminal in normal usage. Figure 1 also shows that the input is a PN junction formed by the gate and the channel, using conventional diode symbols . . . perfectly clear semiconductor conventional symbology.

Figure 2 illustrated the symbol for a P channel JFET, note the difference between it and the N channel JFET in Figure 1. Figure 3 shows a "dual gate" N channel JFET. This second gate can be used for secondary control purposes, such as AGC. Sometimes dual gate FETs are called "tetrode FETs" but they do not really correspond to tetrode vacuum tubes, and the comparison can be misleading, therefore we will not use it

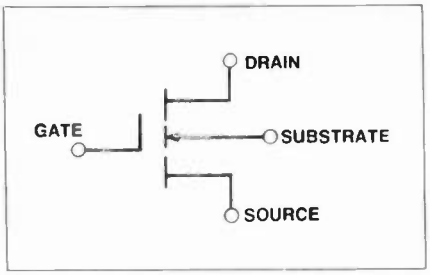


Fig. 5. An N channel MOSFET (enhancement type)

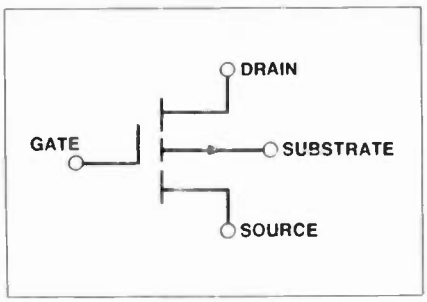


Fig. 6. What is this?

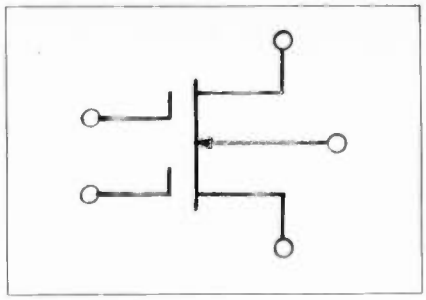


Fig. 7. ...and this?

in this article.

Figure 4 shows an N channel MOSFET. Note that the gate capacitor is clearly denoted. In addition, the substrate, which is connected to the channel is shown, and is the means for indicating whether the device is an N channel, or a P channel, by the direction of the arrow. (The substrate is used in all modern MOSFETs, as a result of modern fabrication technology methods,) Actually, this device is a depletion mode device. Figure 5 shows the same N channel MOSFET as an enhancement device. Can you spot the difference between Figures 4 and 5?

In Figure 5, the channel between source and drain is broken, while in Figure 4 the channel is unbroken. Look at it as if we are talking about a conductor (which the channel is). If the channel is unbroken it is a good conductor normally. In that case all we can do with the gate is reduce the current, or deplete it . . . so we have a depletion MOSFET. If the channel is pictorially depicted as being interrupted, it symbolizes a poor conductor (open circuit), so that the channel is normally at very low current. In that case, the gate could only be used to increase the current flow (enhance it), and we would have an enhancement MOSFET. Remember, the symbol for the MOSFET depicts the channel as it is normally, without the influence of an external bias applied to the gate. Obviously external biasing cannot decrease the current through an already open circuit. Similarly it cannot increase the current through an already fully conducting circuit. So, with a moment of thought, you can decipher the clues in the FET symbol.

Let's try our new found knowledge. Figure 6 depicts a MOSFET. Before reading further, tell yourself what it is. . . .

Now let's see what the symbol says. . . . The gate is a capacitor so it is a MOSFET. There is only one gate, therefore, it is not a dual gate device. The substrate arrow points away from the channel . . . indicating a P channel. The channel is interrupted, telling you that it must be an enhancement device because the current can only be made to increase in the channel. Simple, isn't it. . . . ?

Similarly Figure 7 is a dual gate, N channel MOSFET, depletion mode. Did you read it correctly?

Now we are adding a little more to the schematic symbol. Since the gate input capacitor can be punctured by static charges, etc., many MOSFETs have added zener diode protection to the input gate. But since destructive input overvoltage can occur in either negative or positive polarity, we need two zeners on the input, reverse polarized with respect to each other. And to insure that each zener conducts in the proper direction, we add a reverse blocking diode in series with each zener to insure that it works as a zener, and not as a forward diode. Thus we wind up with four extra diodes in the input, fabricated right along with the MOSFET. Now some schematics omit showing these diodes, in which case it would be very easy to pick up a substitute without zener input protection. So again, you have to be very careful to choose the right substitute . . . and looking up the device number should enable you to determine whether it has input protection or not. Figure 8 shows such an N channel, gate protected, depletion mode, MOSFET. (We are getting a little complicated now!) At this point you can relax, because we have come to the end of the identification part of this FET discussion.

You should now be able to identify what kind of FET you are dealing with, IF the schematic is well drawn. At any rate, you can now read the clues available to you, in making FET substitutions, which is what this article is all about! Figure 9 is a JFET, as indicated by the junction type gates . . . it is a dual gate device, P channel depletion mode. But wait a moment, there are two FETs shown in Figure 9, drawn slightly differently. The figure is correct . . . it's just that sometimes JFETs are drawn a little differently, depending upon the company making the drawings. I know this can be confusing, but there is no real standardization in the FET field at the present time.

Why so many FETs

Think back to vacuum tubes . . . there are diodes, triodes, tetrodes, pentodes, pentagrid converters, beam tetrodes, duo diodes, duo triodes, triode pentodes, etc., so we become a little spoiled by the lowly bipolar transistor. FETs come in a variety of types as did vacuum tubes . . . but not quite so wide a variety as tubes. They have a high input impedance, like the vacuum tubes, which gives us a useful design tool for dealing with high impedance circuits. FETs perform well in AGC'd stages, where transistors do not like to work. So you are going to be seeing more of them now that the technology for making them has been mastered. (They require more stringent manufacturing methods.) FETs also make very good low voltage constant current sources, which gives us a powerful tool for high voltage gains in semiconductor amplifiers. This point is worth a small discussion. . . .

As you already know, even a single transistor amplifier stage can achieve high gain if the load resistor is made very large. The trouble is that a large resistor reduces the collector current to a very low value . . . unless the power supply voltage is increased to a high voltage. This is obviously not practical. One way out of this dilemma is to use a constant current device as a load resistor. A constant current device looks like an almost infinitely large resistor to attempt to change the current flowing through it (it has a very high "dynamic resistance").

If we use a FET as a constant current load, it appears to be a very large resistor, and it is possible to

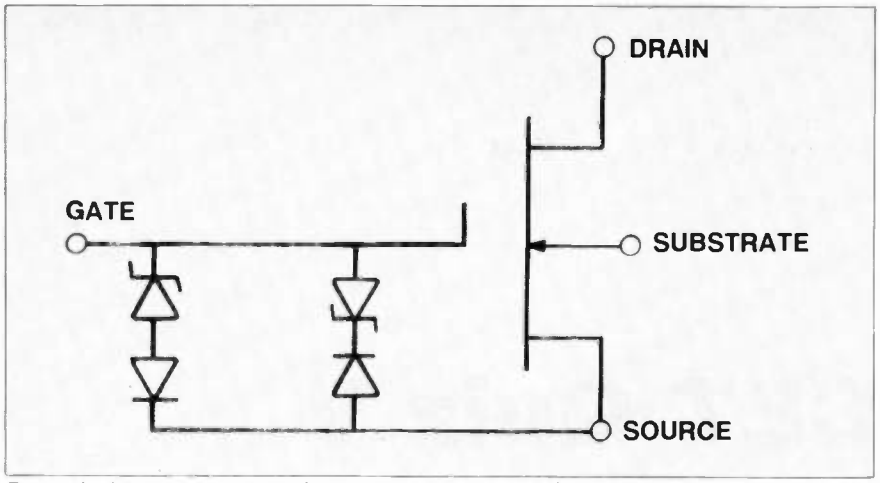


Fig. 8. An N channel protected gate, depletion mode MOSFET. (The diodes usually are not shown.)

achieve gains of a thousand or more, out of a single transistor stage, at some reasonable value of collector current, and with a low voltage power supply. FETs are often packaged and sold as "constant current diodes," with the gate tied to the source, forming a two-terminal device. Of course they are not really diodes, but can be connected in the same way a diode is. Inside of many integrated circuits are such constant current sources, often also called "pinch resistors" because they pinch the current down to some low value. Another name for such constant current sources when used as a load resistor is "active load" (as opposed to resistors which are "passive" loads).

Now it is important for you to understand that these "active loads," "pinch resistors," "constant current diodes," or whatever other name you call them by . . . have their current largely determined by the FET characteristics fabricated into them . . . and you cannot substitute another FET unless it has substantially identical characteristics. That should tell you the story about substituting FETs in these applications! Please don't become discouraged, because things could be worse . . . and, as the old cliche goes . . . "Tomorrow they probably will be." It appears that we are in an era where the consumer electronics technician is the forgotten man. The only answer to this problem of "impossible to identify," and "impossible to substitute" devices, is an organized effort to get the set manufacturers to use standard registered parts, available from several of the major manufacturers, and have them clearly identified on parts lists, etc. Until that happens, despite all your efforts, the cost of "detective work" will have to be passed on to the consumer, or absorbed by the shop as a charitable donation to the set maker. The use of non-standard, or "selected" parts is a practice that needlessly complicates the life of the repairman, and should be regarded as very poor manufacturing philosophy which ignores repairability and obstructs the efforts of service technicians.

Before you decide that a FET is bad, check the voltage applied to the device, between the source and the drain. FETs are extremely voltage dependent . . . and strangely enough, an increase in the applied voltage can cause a marked decrease in the current, as the device goes toward the "pinch off" point. This happens because of an internal voltage divider action in the channel, depending upon the geometry of the device . . . i.e., where the gate is located along the channel.

An incorrect power supply voltage, changes in the value of associated resistors, etc., which normally would result in relatively minor changes in the current through an ordinary bipolar transistor, can and do cause drastic changes in the current through a FET . . . sometimes even causing the current to completely cut off. Conversely, substituting another FET with a different "pinch voltage" can cause endless problems. This is like changing from a remote cutoff pentode to a sharp cutoff pentode in a tube type set, only the action is even more pronounced. Put another way, the operating point of the device depends partly upon the biasing, partly upon the design of the device, and partly upon the applied voltage.

As you can see, FETs are a different ball game . . . in use, in design, in symbology, and in troubleshooting. So be careful when you make a substitution . . . Due to the multiplicity of types, and the variations, I recommend that you use an original part whenever possible . . . make substitutions only when there is no other way out. (Except for the registered devices, as previously discussed.)

Even with registered devices, some set makers select devices, especially in tuners for FM and TV sets. As usual, in such usage original parts are recommended. FETs are now used in a wide range of frequencies from audio to UHF, and the same precautions apply in their substitution as with the bipolar transistors, so far as application is concerned. Where the frequency is high, and the application is critical, use common sense, and stick with original parts so as to avoid the need for drastic realignment.

This article had as many warnings about what not to do, as suggestions as to what to do . . . but unfortunately that's the way things are in semiconductor substitution. A poor substitute can tie your bench up for hours, because it "works," but not quite right. Once you go through that experience, you will avoid the risky substitutions . . . which is what this article is all about . . . avoiding the risky ones. ET/D

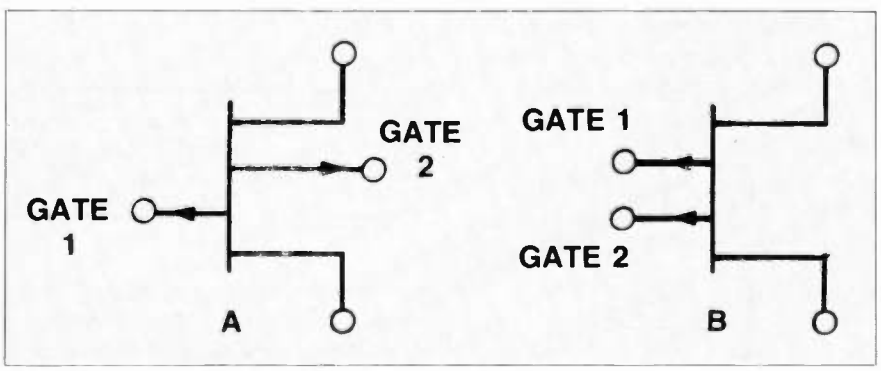


Fig. 9. A dual gate depletion mode, P channel, JFET.

CET Quiz V

Kirchhoff's Laws, vectors, etc.

Here are some more teasers for those of you looking to the CET tests. Good luck.

By Frank R. Egner, CET

Here's another electronics quiz to challenge your knowledge and recall of electronic fundamentals. For example, to answer questions about figure 3, you'll have to recall the basic Ohm's and Kirchhoff's laws to resolve the circuit. Solving dc power supply voltage dividers is necessary to answer figure 4 questions. Do you remember how to calibrate an oscilloscope to measure other than peak-to-peak voltages? And how is your recall on vector or phasor diagrams to indicate circuit relationships?

This quiz, like the others, can be an indicator of how rusty you may have become on some of the fundamentals over a period of time. Give it your best effort without looking at the answers. If you take a few minutes to look up the questions you miss, it'll serve as an excellent review and fundamentals refresher. To make a passing score of 75%, you should miss no more than six questions.

1. An oscilloscope is to be calibrated to measure RMS voltages directly on the volts/division ranges. A tube tester will provide the reference voltage by using the 6.3v ac filament voltage. The volts/division variable control should be adjusted for:
   a. 2 divisions on the 10v/div range.
   b. 2 divisions on the 5v/div range.
   c. 4.4 divisions on the 1v/div range.
   d. 6.3 divisions on the 1v/div range.
2. A 9 volt battery will be used to calibrate an oscilloscope to measure ac RMS voltages directly on the volts/division ranges. The volts/division variable control should be adjusted for:
   a. 5 divisions on the 5v/div range.
   b. 3.2 divisions on the 1v/div range
   c. 6.3 divisions on the 2v/div range
   d. 4.5 divisions on the 1v/div range
3. The parallel RL circuit in figure 1 is represented by which vector (phasor) diagram below?

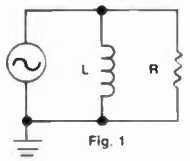


Fig. 1

4. The conditions in the series RC circuit of figure 2 are represented by which vector (phasor) diagram below?

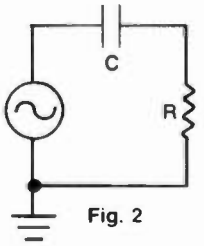


Fig. 2

5. In the series RC circuit in figure 2, the phase angle is the angle measured between:
   a. ER and EC.
   b. EC and Eapp.
   c. IC and EC.
   d. IT and Eapp.

6. Three capacitors (100pf, 200pf, and 300 pf) are connected in series across a 10MHz, 10v source. The voltage drop across the 200pf capacitor will be:
   a. 3.3v
   b. 5.7v
   c. 2.8v
   d. 1.4v

7. Three inductors (2.5mh, 6mh, and 10mh) are connected in series across a 100kHz, 10v source. The voltage drop across the 6mh coil is about:
   a. 3.2v
   b. 5.4v
   c. 1.3v
   d. 6.0v

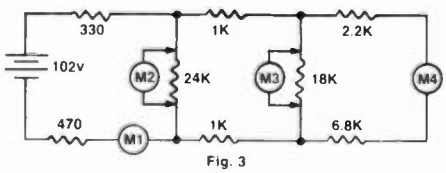


Fig. 3

8. If an ohmmeter replaced the battery in figure 3, the ohmmeter would indicate a circuit resistance of:

a. 6.8K ohms.
b. 9.8K ohms.
c. 11.8K ohms.
d. 24.8K ohms.

9. In figure 3, ammeter M1 will indicate a current flow of:
   a. 8.6 ma.
   b. 15 ma.
   c. 4 ma.
   d. 10.4 ma.

10. In figure 3, voltmeter M2 connected across the 24K resistor indicates a voltage drop of:
    a. 91.7v.
    b. 98.8v.
    c. 96.2v.
    d. 90.0v.

11. In figure 3, meter M3 indicates the voltage drop across the 18K resistor as:
    a. 56v.
    b. 83.8v.
    c. 67.5v.
    d. 60.0v.

12. In figure 3, the current flowing through ammeter M4 will be:
    a. 7.5ma.
    b. 6 ma.
    c. 9.2 ma.
    d. 12 ma.

13. A 6 foot length of a certain transmission line has an impedance (Z_o) of 75 ohms. A 30 foot section of this same transmission line will have an impedance of:
    a. 375 ohms.
    b. 75 ohms.
    c. Depends on the load connected.
    d. (Z_o) must be redetermined by measurement.

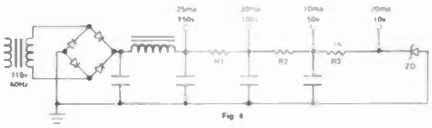
14. An inductor (coil) has identifying dots of brown, black, and orange. This indicates an inductance of:
    a. 1 henry.
    b. 0.1 henry.
    c. 10 millihenry.
    d. 0.1 millihenry.

15. Three inductors (2.5mh, 6mh, and 10mh) are connected in parallel. The inductance of the combination is:
    a. 1.5 mh.
    b. 18.5 mh.
    c. 6.26 mh.
    d. 8.1 mh.

16. A mica capacitor has a six dot color code of black, yellow, violet, black, silver, red. The capacitance is:
    a. 470pf, 12%
    b. 470pf, 10%
    c. 47pf, 12%
    d. 47pf, 10%.

17. A high Q series resonant circuit is connected between the load and a 10 volt source. Then:
    a. Current through the circuit will be minimum.
    b. The voltage dropped across the capacitor will be much larger than 10 volts.
    c. An ac voltmeter connected across L and C together indicates 0 volts.
    d. More than one but not all of these is true.

18. In figure 4, the resistance of R2 in the voltage divider must be:
    a. 1.67K.
    b. 1K.
    c. 5K.
    d. 0.5K.



19. In figure 4, voltage divider resistor R1 should have a resistance of:
    a. 833 ohms.
    b. 714 ohms.
    c. 625 ohms.
    d. 1000 ohms.

20. In figure 4, the current flowing through the zener diode ZD is:
    a. 20 ma.
    b. 5 ma.
    c. 10 ma.
    d. Cannot be calculated.

21. In figure 4, the ac line voltage increased by 5%. Then:
    a. All output voltages increase by 5%.
    b. The internal resistance of ZD decreases.
    c. All load currents increase by 5%.
    d. More than one but not all the above are true.

22. In figure 4, if the load current of the 50v terminal increases by 5 ma:
    a. All output voltages will decrease.
    b. Only the 100v output will decrease.
    c. The 10v output will remain constant.
    d. All output voltages, except 150v, will decrease.

23. In figure 4, the power dissipated by R3 under normal operation is:
    a. 1.6 watts.
    b. 0.4 watts.
    c. 2.5 watts.
    d. Can't be determined because of ZD.

24. In figure 4, an overload has burned out resistor R2. A 2 watt replacement is installed.
    a. This is a proper replacement.
    b. This resistor will soon burn out, too.
    c. A 1 watt resistor could have been used.
    d. A 25 watt resistor should be used to prevent callbacks.

25. In figure 4, zener diode ZD is rated at one watt.
    a. If the 20v load opens, ZD will burn out.
    b. 1 watt provides insufficient safety margin.
    c. The 1 watt rating is more than adequate.
    d. More than one but not all the above are true.

You'll find the solution on page 57

Bidding Alarm Systems

Ensuring a Profit

You are in business to make a profit. The security business like MATV, sound, etc., often requires bidding. Since man/hours of time are involved you must have a basis on which to make your estimates. Here is a system developed by an installation company with extensive experience.

By John Sanger

The alarm industry is growing at a steady rate and for good reason: the basic economic law of supply and demand. More people are becoming security conscious and are having alarm systems installed.

There is an excellent potential for making a good profit in the alarm industry. New companies are entering the market constantly. And the market, for all practical purposes, is untapped. It is estimated that only three percent of the residential structures in this country are equipped with alarm systems — leaving ninety-seven percent as potential customers.

Ironically, many alarm dealers will close their doors this year — bankrupt, or nearly so. Why? The reasons are numerous, but they all reduce to a common denominator: the inability to make a profit that will sustain operations. Personally, I suspect that the problem started when the sales rep handed the proposal (bid) to the prospective customer.

There are two significant threats to the bidding process that yield the

Table 1

Table 1 shows the equipment, man-hours, and related cost data for a typical residential alarm system. The man-hours listed are for an *average* installer.

QTY	ITEM	EQUIPMENT COST	M/H
1	Control Unit	$100.00	1.50
1	Digital Remote Station	20.00	1.50
1	Transformer	5.00	—
1	Gel Cell	19.00	—
1	Siren Driver	10.00	—
1 1h	Space Protection Device — Surface Mounted	125.00	
6	Recessed Magnetic Contact Switches	21.00	5.25
1	External Speaker	30.00	0.85
1	Internal Speaker	12.50	0.65
1	Smoke Detector	24.00	1.00
5	Heat Detectors (Thermostats)	12.50	3.00
	Wire	35.00	—
	Miscellaneous Hardware	12.00	—
	TOTAL	$426.50	15.00

Total Equipment Cost	$426.50
Labor Cost for Bidding*	225.00
Subtotal	$651.50
Profit Margin (30%)	195.45
System Price to customer	$846.95
Less Actual (Direct) Expenses	
Equipment	–$246.50
Installer's Wages**	– 75.00
Helper's Wages**	– 56.25
GROSS PROFIT	$289.20

* Labor cost for bidding is calculated at $15.00 per hour. When the 30% profit margin is added, the true labor charge amounts to $19.50 per hour.

** The installer, earning $10.00 per hour, would earn $75.00 for 7½ hours work. The helper, earning $7.50 per hour, would earn $56.25.

same net result: *zero* profit (or, worse, a loss). First, if a bid is too high in a competitive bid situation, we will not be awarded the contract and will have lost a customer and future referrals. Second, if we grossly underbid the job, we will be fortunate to merely cover our expenses.

Even with the best of bidding practices, there will be a few installations that will turn out unprofitable. Occasionally, there will be a job that was just more than we bargained for — it is unavoidable. Fortunately, by following some basic guidelines and developing good bidding practices, the unprofitable jobs will be kept to a minimum.

Table 2

INSTALLATION MAN-HOURS

EQUIPMENT	M/H RANGE	COMMENTS
Control Box	1.00-2.00	Includes bench test prior to installation and connection of power supply.
Remote Station (Key)	1.00-1.50	Includes wire run to control.
Remote Station (Digital)	1.25-1.75	Includes wire run to control.
Automatic Dialer (Tape or Digital)	0.50-1.00	Requires telco installed RJ31X jack.
Space Protection Device — Surface Mounted (Ultrasonic, Microwave, Passive IR, Photoelectric)	1.00-1.50	Includes mounting and wire runs for power and loop connection.
Space Protection Device — Flush Mounted (Ultrasonic, Microwave, Passive IR, Photoelectric)	1.50-2.00	Same as above.
Contact/Switch — Surface Mounted (Magnetic, Vibration, Pull Trap, Take-Off)	0.50-0.75	Includes wire run to control or connection to loop.
Contact(Switch — Recess Mounted (Magnetic, Plunger)	0.75-1.00	Same as above.
Magnetic Contact Switch — Overhead Door	1.00-1.50	Same as above.
Foil Tape (per door or window)	0.50-0.75	Application of tape, varnish coating, and foil take-off blocks. Includes wire run to control or connection to loop.
Glass Breakage Detector	0.25-0.50	Includes wire run to control or connection to loop.
Emergency (Panic) Button (N. O. Momentary — Door Bell Type)	0.50-0.75	Includes wire run to control or connection to loop.
Speaker — Exterior	0.75-1.00	Includes wire run to control.
Speaker — Interior	0.50-0.75	Same as above.
Strobe Light — Exterior	0.75-1.00	Same as above.
Bell and Box — Exterior	1.50-2.00	Same as above.
Heat Detector (Thermostat)	0.50-0.75	Includes wire run to control or connection to loop.
Smoke Detector	0.75-1.00	Includes wire runs for power and signal to control.

Assuming that the sales rep has done his job adequately and provided the system designer with accurate data, the next step will be to prepare a proposal for the prospect. (See the March, 1981, issue of *ET/D* for information on designing the system.)

In order to prepare the proposal we need to know the types and quantities of equipment that will be used and how much labor will be required to install the equipment. Developing an equipment list is a relatively simple procedure — estimating man-hour requirements is not. As a guide, the installation man-hour chart (Table 2) is provided.

Keep in mind that the chart is a guide; it is not a magic formula. Several variables must be considered: the experience of the installer, the exact type of equipment being installed, and the type of structure where the system will be installed.

For the sake of simplicity in explaining the preparation of a bid, let us assume that we are bidding a *residential* structure for a *hardwired* system. (Commercial systems are similar, and in many instances, easier to install.) Moreover, let us assume that the system will be *sold* instead of *leased.*

Table 2 shows the type of equipment to be installed, the range of man-hours required to install a single piece of equipment, and some comments concerning the installation. The range of man-hours allows for a variance in the experience of the installer. The low end of the range would be used for a veteran installer (three years experience or more) and the high end of the range for a novice installer (less than one year of experience).

The total system price of $846.95 is realistic — and competitive — allowing for a gross profit of $289.20 (34% of the retail price) if the system is installed in fifteen man-hours. As the learning curve takes effect and the installation time decreases, profit increases.

The basic formula for calculating the system price to the customer can be modified by changing the labor cost for bidding rate (calculated at $15.00 per hour in Table 1).and/or the profit margin (30% in Table 1). For example, raising the profit margin from 30% to 40% would result in a retail price of $912.10 (still fairly competitive) and would increase the gross profit by $65.15 to $354.35 — which is not a

continued on page 57

Modern Intrusion Detection Methods

Complication Eliminated

When the term "intrusion detector" is mentioned, what comes immediately to mind is the conducting tape on all windows and magnetic switches on doors and windows—but—there are other, simpler, more modern methods of detecting intrusion, and they are the subject of this article.

by James A. Ross*
and Steven Browne*

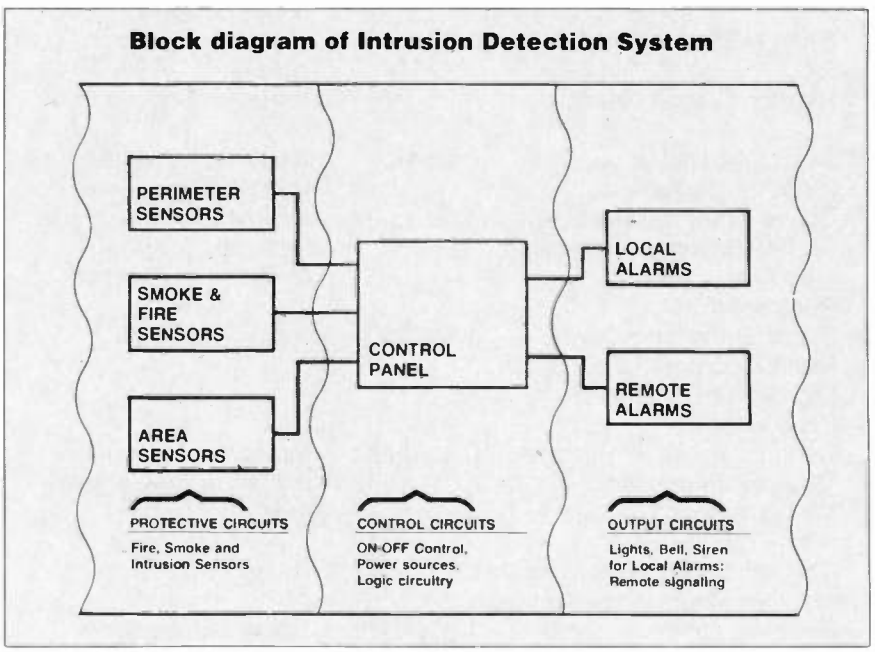


Fig. 1 Block Diagram of Intrusion Detection System

Before we describe these modern sensor systems let's first cover where they fit, and why they are important. Figure 1 is a block diagram of a complete intrusion detection system. The protective circuits could be grouped into several zones to accommodate a business which has different work hours for different areas, however, a simple system would have only one zone as shown. The perimeter sensors are one continuous conducting loop covering all windows and doors. This loop is normally closed (NC), and, therefore, is self-supervising. That is, if someone cut the wire going back to the control panel, it would open the loop and thereby cause an alarm. The fire and smoke sensors are almost always normally open (NO), and should always be provided with supervision.

The third block in protective circuits is labeled area sensors, the subject of this article. They are . especially important because they are easier to install than perimeter systems, and they provide protection far greater than that provided by perimeter systems. (Also, in some cases, they are superior because the false alarm rate is lower.) The particular area sensors to be covered are:

- Glass break detector
- Ultrasonic motion detector
- Microwave motion detector
- Passive infrared motion detector

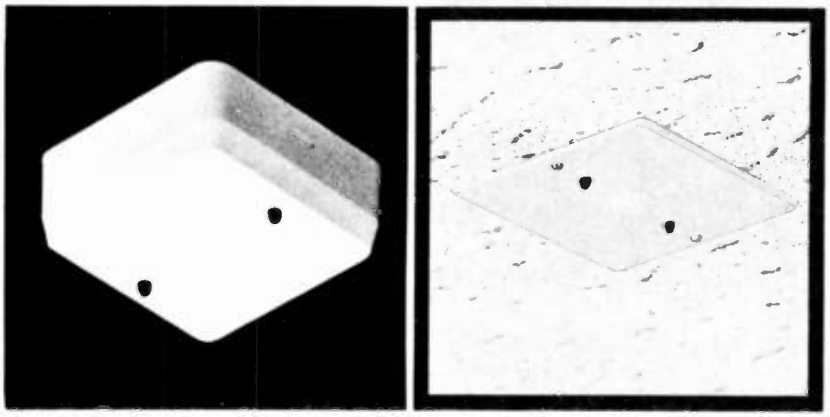
These area sensors provide better protection than the perimeter sensors because they observe the *inside* of the protected premises. The perimeter sensors provide no interior protection at all; so, if someone manages to enter without causing an alarm, he can move about freely without fear of detection. If you are wondering how someone could enter without being detected, consider these facts:

1) A wall or ceiling can be breached very simply. Government tests show that a standard cinder block wall can be penetrated in less than thirty seconds on average by a man using only hand tools. For a poured concrete wall the average penetration time with hand tools is just over three minutes.

2) Many magnetic door switches have been improperly installed with conductors and screw terminals exposed. If there are only two conductors, the bad guy knows that all he has to do is short out the switch with a paper clip during the day when the establishment is open and he can open that door and walk in without causing an alarm during the night when the system is "on."

Except for the possible psychological deterrent effect of visible

**James A. Ross is President of Capital Security Systems, Washington D.C. and Steven Browne is president of Solid State Electronics, Rockville, Md.*



Surface Detector
Length: 3-3/4 inches (9.5 cm)
Width: 3-3/4 inches (9.5 cm)
Depth: 1-9/16 inches (3.1 cm)
Weight: 5 oz. (140 grams)

Flush Detector
Length: 5 inches (12.7 cm)
Width: 5 inches (12.7 cm)
Depth: 1/8 inches (.318 cm)
Weight: 6.5 oz. (182 grams)

Fig. 2 Audio Force Discriminator Detector Unisec Model AFD-2500

tape, etc., the effectiveness of the intrusion detection system is not lessened by using only area sensors if they are properly chosen and properly installed.

Glass break detector

This sensor goes under different names. One manufacturer calls it a discriminator; another calls it an audio force discriminating detector; and others call it a glass break detector. Regardless of what it is called, its function is to evaluate the characteristics of the sound impinging upon it, and to generate an alarm signal when it senses sounds which are characteristic of splintering wood, metal-on-metal prying, breaking glass, or the scraping of a glass cutter. These sounds have two characteristics common to "harsh" sounds: fast rise time and high amplitude within a certain range of frequencies.

Figure 2 shows the ADF-2500-S and the ADF-2500-F of Unisec of San Leandro, California. According to Unisec, the ADF-2500 is capable of operating in environments where the background noise is as high as 75dB. This particular model has two LEDs which light when the system is alarmed. One of these LEDs latches "on" so that you can tell the system is alarmed even if you had not been present during the intrusion. The other LED turns "off" after each activation, so that you can use it for adjusting sensitivity during installation without having to reset the system after each activation. As you can see in Figure 2, the detectors are quite small, and can be flush mounted or surface mounted. Each detector will protect 1200 square feet and will detect glass breakage at a distance of fifteen feet.

An additional feature of this particular detector is that it offers an optional "listen-in." Using this feature you could listen to the sounds at the protected premises to verify that there had been an intrusion.

The drawbacks of the glass break detector are few, and if its weaknesses are properly appreciated, it will be an extremely valuable part of the overall system. The most important characteristic to remember is that it detects only noisy forced entry. If your intruder has a key, or uses a lock pick, this sensor will not detect his entry. The other characteristic to keep in mind is the type of sound that activates the alarm—abrupt, medium high frequency, and loud. Therefore, the location of each sensor should be carefully selected. Door bells, chimes, telephone ringers, clanging steel doors, pots, pans, and dishes must be avoided. Also noise sources like old-fashioned steam radiators, and belt driven devices like air compressors and fans in central heating and air conditioning systems should be avoided because of the hiss from the radiators and whine from the belts running in their pulleys.

Ultrasonic motion detector

One of the first motion detectors developed was the type which transmits sound energy at a frequency too high to be heard by man, and detects motion by the doppler shift in the frequency of the returned energy due to the motion of some reflecting surface. These ultrasonic motion detectors can be quite simple and therefore quite reasonable in price, but a lot of people who have purchased and installed them are upset because of false alarms. In fairness, it must be pointed out that, although the simple ultrasonic units do have some weaknesses, the biggest single cause of false alarms is improper installation. If, for instance, the sensitivity is set too high, the unit will alarm due to air currents or moving drapes, and you know very well that it's human nature for the layman to turn the sensitivity to maximum. Properly trained and experienced installers, on the other hand, know that they must properly position and aim the transducers, and perform a walk test to be sure that the sensitivity is backed off to the point where the system will just alarm at its maximum extended range—doorway, end of hallway, or whatever. If this step is properly performed, false alarms will be minimized.

Ultrasonic motion detectors have been manufactured with operating frequencies from about 20kHz to about 40kHz. At present most use either 26 kHz or 40 kHz, with the usual trade-offs of advantages and disadvantages. The 40 kHz models are less disturbed by air currents, but their range varies with changes in temperature and humidity. The 26 kHz models have almost constant range with changes in environmental conditions, but are more sensitive to moving air.

Figure 3 is a picture of a self-contained ultrasonic motion detector with and without its cover. The unit shown is the model 2010 from Raytek of Mountain View, California. According to Raytek this is the only stand-alone ultrasonic motion detector which uses balanced signal processing to reduce false alarms. Operating at a frequency of 25.6 kHz, the Raytek model 2010 uses "vector rotation signal processing" in order to reduce false alarms. This method takes into account the fact that phenomena which cause false alarms tend to be oscillatory in nature; that is, they alternately cause positive and negative shifts in frequency. Imagine, if you will, a drapery being moved by air leaking through a window behind it. First it moves toward the motion detector causing an upward shift in frequency; then it drops back toward the window and away from the detector causing a downward shift in

frequency, etc. The balanced signal processing system senses this oscillation and determines that there is no net motion, either toward or away from the detector; and, therefore, does not alarm.

Another feature of this model is crystal control at 25.6 kHz. Because all detectors are on the same frequency and that frequency is held constant by crystal control, these motion detectors can be installed close together without causing false alarms. If two were operated close together without ultra-stable oscillators, as soon as one drifted slightly off frequency, both would alarm.

Ultrasonic motion detectors have been widely criticized because of false alarms, however, modern detectors properly installed do not have an unacceptable false alarm rate. They do have a reasonable price, and price is something that every seller and every buyer is interested in.

Microwave motion detectors

Microwave motion detectors are very similar to ultrasonic detectors. Instead of sound energy, they transmit radio frequency energy in the microwave frequency range; but, like the ultrasonic, they are looking for a doppler shift in the frequency of the returned energy caused by the motion of a reflecting object in their field. Because the energy is RF and not sound, moving currents of air, bells, and other sounds cause no problems. However, the microwave units suffer from a source of false alarms which does not affect the ultrasonics. Simply put, the sound energy will be contained by the walls of the room, but many walls are nearly transparent for RF energy at microwave frequencies. What this means is that the installer must carefully adjust sensitivity with a walk test, and must be sure that the unit is not aimed at a wall which might have activity on the other side during protected hours. If not properly installed, the unit will sense motion in another room or outside and will alarm when it should not.

Passive infrared motion detectors

Passive infrared motion detectors, as the name says, are passive; they do not radiate anything. As intrusion detectors what they are looking for is heat and motion.

Before going into the details of operation, let's first consider the effect

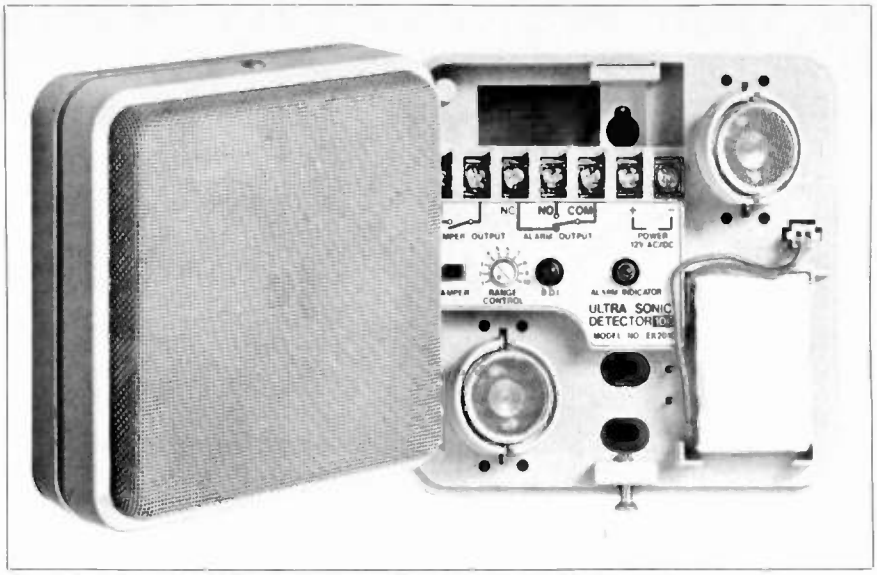


Fig. 3 Self-Contained Ultrasonic Motion Detector Raytek Model 2010

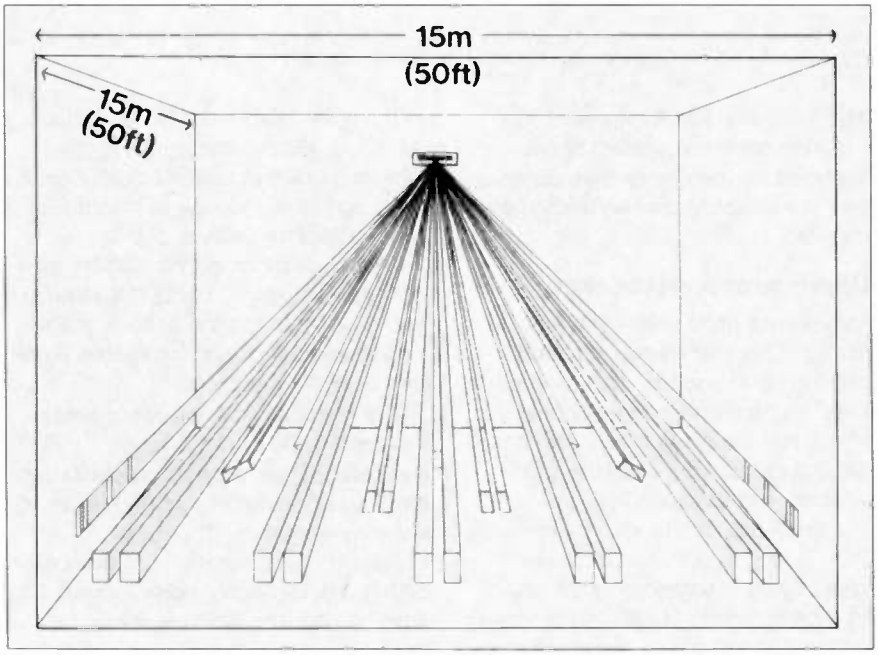


Fig. 4 Beam Pattern of Dual Element Infrared Motion Detector Racal Model IR737

of one colossal source of infrared energy—the sun. If we tried to use a standard passive infrared motion detector outdoors, the energy from the sun would swamp the detector. The infrared energy output from a human would be insignificant compared to the sun, and, therefore, we can't use these devices outside. How then are we able to use them inside with sunlight streaming in through the window? The answer is that although the glass in the windows admits most of the sun's energy, it is essentially opaque to infrared energy of long wavelength. All we have to do is to design our detector to operate in that long wavelength part of the spectrum and the sun will not interfere.

The latest infrared motion detectors are almost totally free of false alarms because they use a dual element or dual beam technique. The dual element detector is connected electronically so that the output of one detector is positive and the output of the other detector is negative. Optically these two detectors are focused in beams that are side by side. Suppose this dual beam is aimed at a wall that is being heated by sunlight on the outside of it. As the temperature of the wall goes up, the signals from the two elements go up—one in the positive direction, and the other in the negative direction. Because they are equal and opposite, they cancel and the output of the detector is zero, resulting in no alarm. If a person were to move across these two beams, on the other hand, he would be seen first partially by one, then totally by the same beam, then partially by the other, and so on with

the result that a positive or a negative signal would always be continuously generated and rarely would they be equal, so there would be an output signal and an alarm.

A practical system would use an array of mirrors to generate many dual beams to cover an area such as depicted in Figure 4. Of course, it is possible that there might be a radiator or some other heat source in the view of one of the two beams of a dual beam. In this case false alarm protection comes about through the ability of the system to differentiate between the slowly changing radiation from a radiator, and the rapid change which occurs when a person walks into a beam.

The pattern shown in Figure 4 is that of the Racal model IR737. As you can see, it covers an area of about fifty feet by fifty feet. The latest model from Raytek is their model 4000 which offers a choice of two coverages—forty feet by forty feet to cover a room, or a beam one hundred and twenty feet long and three feet wide at the end to cover a hallway. Raytek's model 4000 also offers an environmental test switch which lowers the alarm threshold by 50% so that potential false alarm sources can be checked and the system adjusted to have at least a two to one safety factor.

Summary

To achieve a high level of protection against intrusion it is not necessary to install conducting foil on all windows, nor even to use magnetic switches on doors and windows. Glass break detectors are capable of detecting forced entry, and motion detectors (ultrasonic, microwave, or infrared) provide area coverage of the inside of the protected premises. Your choice of area protection system will depend on the size, shape, and other characteristics of the area to be protected; and your evaluation of whether price or false alarm rate is more important. If some false alarms can be tolerated and the cost must be held down, you'll probably use ultrasonic. If you absolutely must achieve the lowest false alarm rate, you'll probably use passive infrared.

This article has described only four types of sensor systems for use in intrusion detection. There are many, many more types available; but these are the most common—the ones which security companies use most often. ETID

Understanding and Using Time Constants

RC and RL

Every resistor capacitor, and resistor/inductor, combination has a time constant. They are so common you don't even look for them though they can confuse troubleshooting. Here we'll take some of the mystery out of them.

By Bernard B. Dalen

The words, "time constant" summon up vague recollections of resistor-capacitor networks, and time delays, for most technicians.

Actually, time constants are used so extensively throughout most electronic circuits that they have become as invisible as "the forest that cannot be seen because of the trees."

Time constants occur with resistor-inductor networks, as well as resistor-capacitor networks . . . a fact that is infrequently discussed in textbooks. And, since RL and RC networks form either differentiators or integrators, time constants are involved in their design too.

You don't remember what an integrator is . . .? Well, reading this article is a quick and easy way to become familiar with time constants, integrators, differentiators, and their uses.

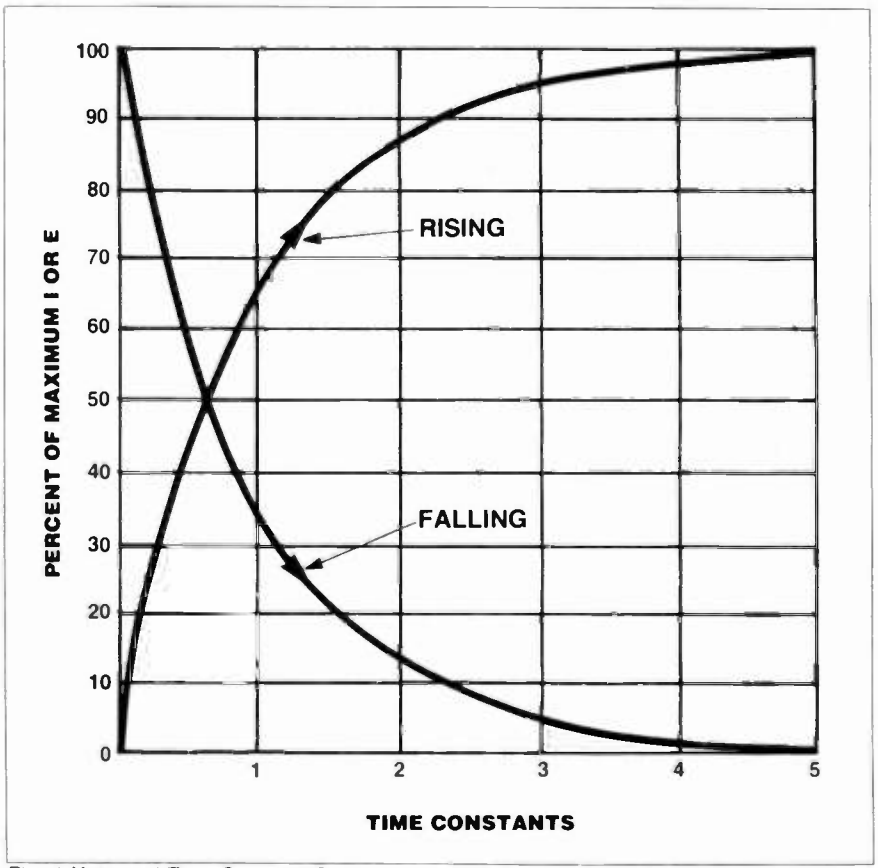


Fig. 1 Universal Time Constant Graph

RL Circuits

When sudden voltage is applied to an inductor, the resulting current rises slowly, due to the counter electromotive force generated as the expanding magnetic field cuts the turns of the coil.

In a perfect inductor, without resistance or other losses, the current would continue to rise forever, at an extremely slow rate, . . . first because there would be no resistance to limit it, and also because the counter electromotive force in a perfect coil would be almost equal to the applied voltage.

Conversely, in an inductor with appreciable resistance, and other losses, the current would be quickly limited, and stop rising almost immediately. It is therefore self evident that the inductance and resistance have opposite effect . . . the inductance causing a slow, gradual rise time, while the resistance shortens the rise time of the current.

Expressed as a formula, we can write this as follows:

$$\text{The Time Constant, in seconds} = \frac{\text{Inductance in Henrys}}{\text{Resistance in Ohms}}$$

Inductance, in Henrys for the current to reach 63% of maximum or, restated in symbols,

Basic RC Network

E across R = E_{in} - E charge on capacitor

I CHARGING = $\frac{\text{E ACROSS R}}{\text{R}}$

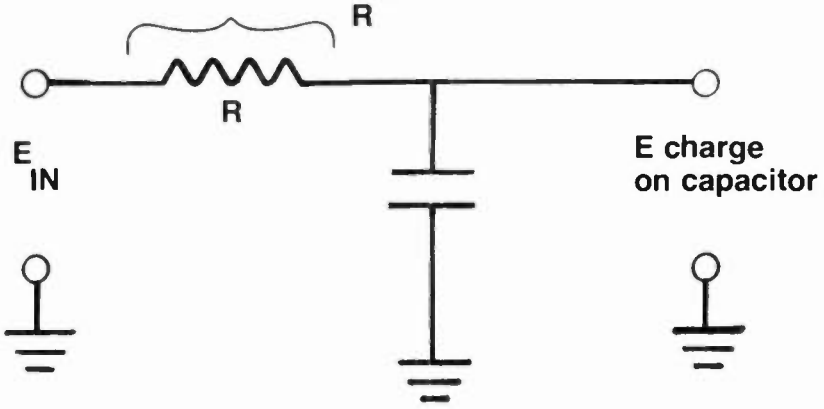


Fig. 2 Basic RC Network

Time Constant Chart

To Discharge To:	$\frac{T}{RC}$	To Charge To:
1% of Max E or I	4.5	99% of Max E or I
2	3.9	98
5	3.0	95
10	2.3	90
20	1.6	80
25	1.4	75
33.3	1.1	66.6
50	0.7	50
63	0.45	37
75	0.3	25
80	0.2	20
90	0.1	10
95	0.05	5

EXAMPLE FOR USE OF CHART:
"How long will it take for a 10 mfd capacitor and 1000 ohm resistor network to charge to 75% of the maximum voltage?"

ANSWER, FROM CHART $1.4 = \frac{T}{RC}$

Transposing, then 1.4 RC = T Since R = 1000, and $C = 10 \times 10^{-6}$
Then, 1.4 (1000) (10×10^{-6}) = T = .014 Seconds

Fig. 3 Time Constant Chart

$T_c = \frac{L}{R}$

This simple formula tells us several interesting things . . . The length of time for current to reach 63% of its maximum (steady state) value, is directly proportional to the amount of inductance, and inversely proportional to the amount of resistance. It also says that the time constant is THE RATIO OF THE INDUCTANCE TO THE RESISTANCE, R. This means that if we use a coil of one Henry with a resistance of one Ohm, it will take one second for the current to reach 63% of its steady state value . . . or if we use ten Henrys and ten Ohms, or a hundred Henrys and a hundred Ohms, the time constant will still be one second! As a matter of fact, with an RL time constant there are an infinite number of L's and R's that give the same time constant.

Remember, we are dealing only with the time required to reach 63% of the maximum current, (one time constant). At this point you are probably thinking, . . . "But what about the time to reach 90%, or even 99% of the maximum current . . . or some other times?"

Well, the answer to that question is quite simple. During the second time constant, the current will rise 63% of the remaining current . . . and so on. To sum up, in the first time constant the current will rise to 63% of its steady state value, with 37% left to increase. During the second time constant the current will increase 63% of the remaining 37%, (which is another 23%) for a total increase, in two time constants of 86%. During the third time constant the current will rise 63% of the remaining 14%, etc., etc. If you do all the calculations you will discover that the current rises to 99% of its final value in five time constants. Simple, isn't it?

In order to save you the trouble of doing these repetitive calculations, a universal time constant graph is shown in Figure 1. Since the current falls in the same manner as it rises, the graph shows both rising and falling curves. In using this graph, use a little common sense. Remember that the signal source for the input to the RL network often has resistance, and this must be included. Similarly, don't expect to open an RL circuit with a switch, which is an infinite resistance (open circuit), and get a time constant . . . all you will have is a spark coil. You must know what your RL is during charging, and what it is during the discharge . . . and the two may be quite different is some circuits.

RC Circuits

Most technicians appreciate the fact that inductors and capacitors behave "oppositely". This is also true in the matter of time constants. This happens because, in the case of an inductor, we apply a voltage which

causes a current to flow, while in the case of the capacitor, we apply a charging current which causes a voltage to appear across the capacitor. With the capacitor, if there is a series resistor in the circuit, the charging current flowing through the resistor will be proportional to the voltage across the resistor, and that voltage will be the difference between the supply voltage and the voltage accumulated on the capacitor. (See Figure 2).

Obviously the current flow will decrease as time passes and the capacitor charges up towards the supply voltage . . . but the larger the capacitor, the longer it will take for this to happen. Also the larger the resistor, the longer the time constant. Thus we can state, "The changing time is proportional to the resistance, and is also proportional to the capacitance." Written as a formula, Time Constant in Seconds = Resistance in Ohms X Capacitance in Farads, or, simply, $T_c = RC$

Note that unlike the formula for RL time constants, there is no ratio between C and R. With RC time constants, if R is increased, C must be decreased to maintain the same time constant, and vice versa. Further, unlike the RL circuit, the time constant of an RC circuit *increases* as R increases.

As each time constant elapses, the voltage rises 63% of the remainder, just as with LR circuits, therefore the universal time constant graph in Figure 1 can be used in the same way, remembering of course that in the RL circuit we were talking about the current increase (or decrease), while in RC circuit we are discussing the voltage charge on the capacitor.

Figure 3 is a chart derived from the universal time current graph, showing several time constants and their respective percentages of charge (or discharge). Again, this chart is equally useful for RL or RC circuits.

Integrators And Differentiators . . .

Integrators and differentiators are RL, or RC circuits, which do not change the shape of a pure sine wave. They can only change the amplitude or phase of sine waves. But . . they can change the shape of non sinusoidal waves . . . especially pulses, and are therefore used for wave shaping and signal processing . . . such as generating sweep ramp waveforms, or deriving sync pulses from other waveforms (sync separating).

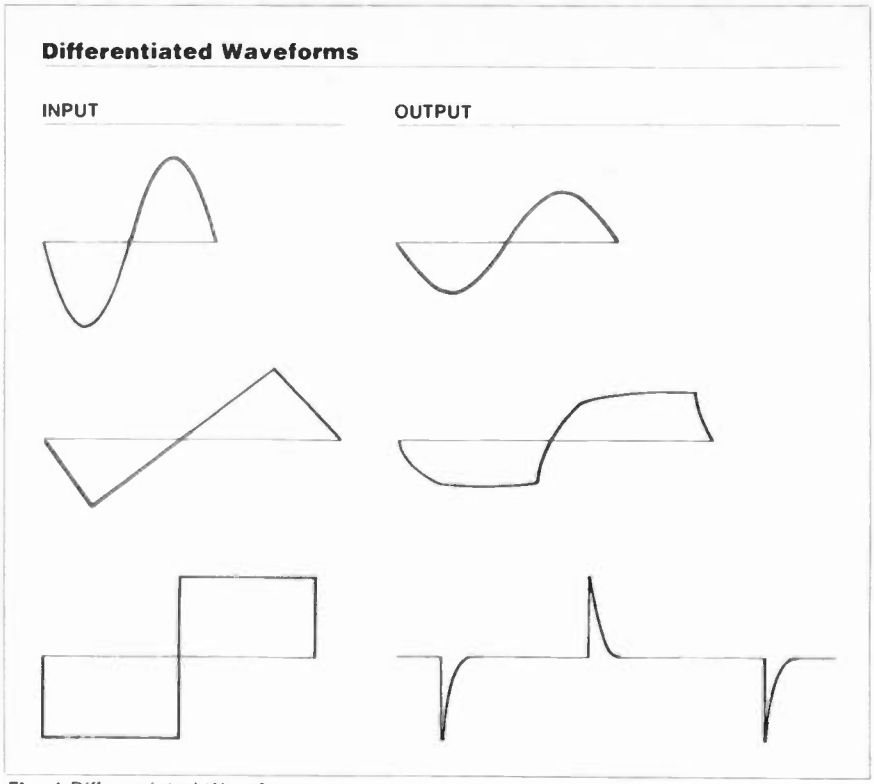


Fig. 4 Differentiated Waveforms

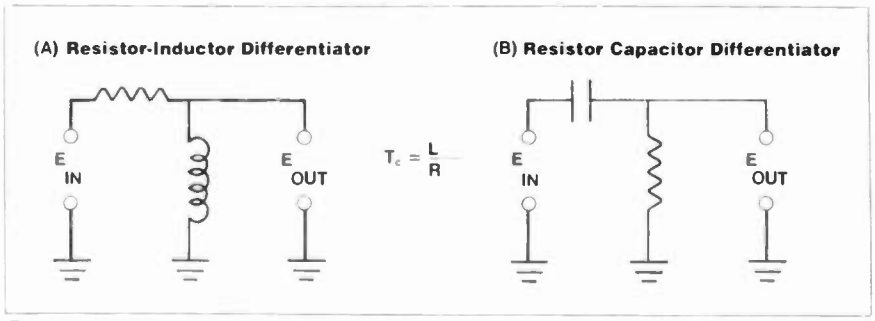


Fig. 5(A) Resistor-inductor differentiator (B) Resistor-capacitor differentiator

Which brings us to the subject of the relationship of time constants and "integrators" and "differentiators". It must be self evident that the values of R and C must affect the operation of the differentiator, which is a basic RC circuit, (shown in Figure 5B). The formula for the output of such a differentiator is

$$E_{out} = R \times C \times \left\{ \begin{matrix} \text{change in voltage} \\ \text{change in time} \end{matrix} \right\}$$

or, stated in words, the ouput of the differentiator is the time constant, RC, multiplied by THE RATE OF CHANGE OF THE INPUT VOLTAGE. (The rate of change is the amount of change, divided by the time in which the change occurred).

Of course if the rate of change goes to zero (no change), the output goes to zero. You know this circuit as the elementary "sync separator" used to generate the horizontal sync pulses from the composite video signal in TV receivers.

There is an optimum value of R and C for each rate of change at the input (an optimum time constant). When R and C are chosen so that the output increases at the rate of 6 db per octave, (doubles each time the frequency is doubled), you have a differentiator. You also have a high pass filter! Of course we are speaking about frequencies that are being employed at the time . . . if pulses are being handled, then the frequency is the reciprocal of the period of the pulse, or, $F = \frac{1}{p}$

Since the differentiator responds to the rate of change of the input, we should mention that the rate of change is usually referred to as, "volts per second", or in the case of faster pulses, "volts per microsecond".

As you have probably realized by now, the only difference between the RC coupling network in a resistance

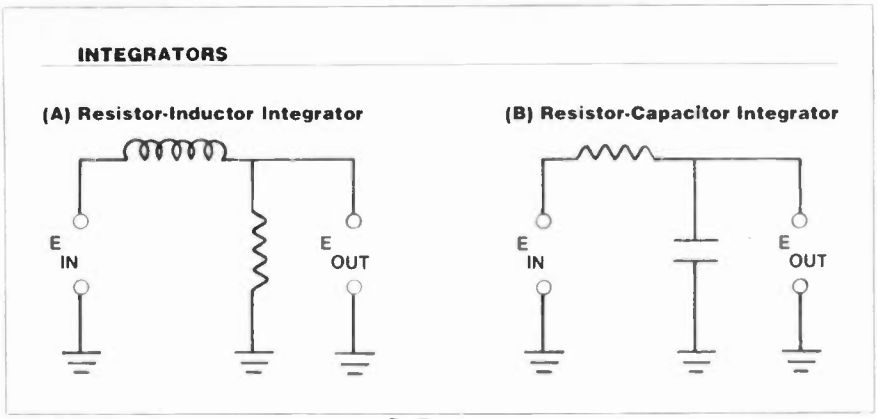


Fig. 6(A) Resistor-inductor integrator (B) Resistor-capacitor integrator

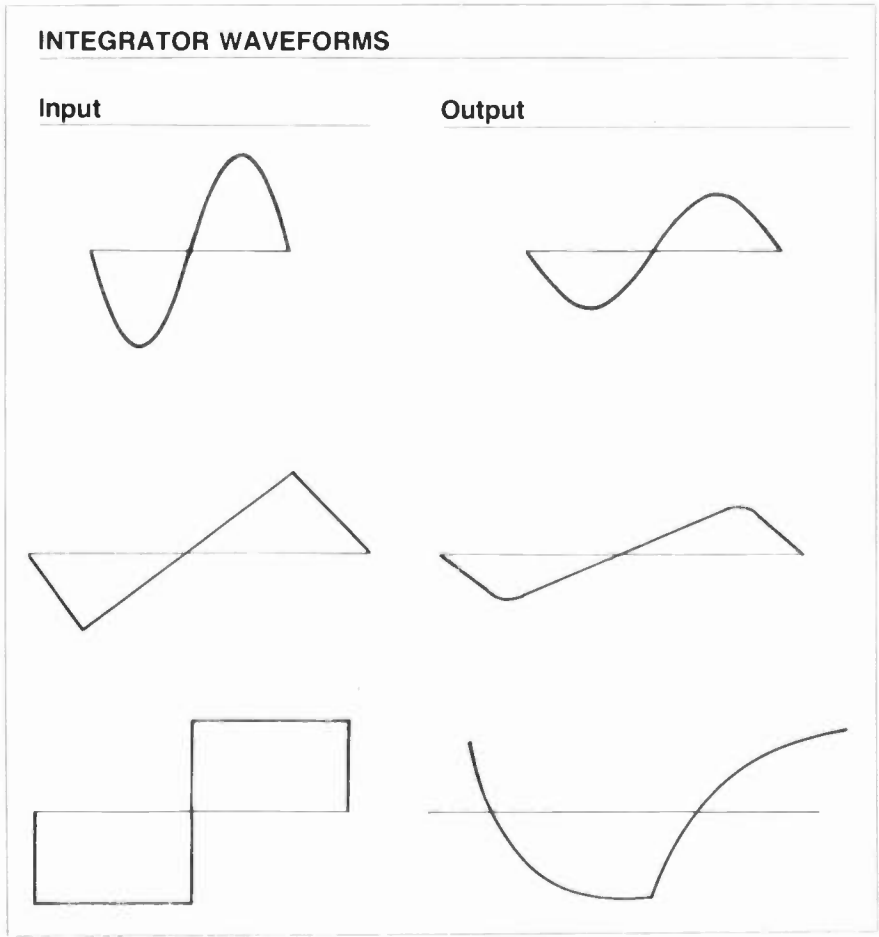


Fig. 7 Integrator waveforms

coupled audio amplifier, and the RC network in a differentiator, is the time constant chosen. An RC network that functions as a coupler at one frequency, is a discriminator at the lower frequencies. To insure a flat frequency response in an RC coupled audio amplifier, the time constant should be greater than the period of a half wave at the lowest frequency to be amplified. To function as a differentiator, the time constant should be one fifth, or less, the period of a half wave.

The input versus the output waveforms of a differentiator are shown for sine waves, square waves, and triangular waves, in Figure 4. These waveshapes are shown to give the reader "a feeling" for the scope waveforms in differentiator circuits.

It should be pointed out that an RL circuit can also be used as a differentiator, as shown in the schematic of Figure 5A. Since an inductor behaves oppositely from a capacitor, the positions of the resistor and inductor are interchanged with respect to the resistor and capacitor in an RC differentiator . . . and, as discussed earlier the time constant of the RL differentiator is, L and, as in the RC circuit, should be much less than the period of a half wave at the operating frequency.

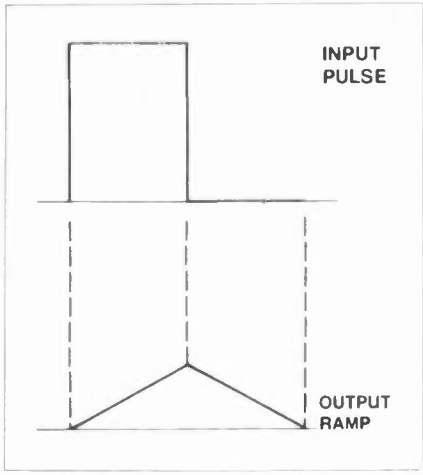


Fig. 8 Integrator output when time constant is much longer than input pulse.

Now, on to integrators, RL and RC integrators are shown in Figure 6. Figure 7 shows the input versus output waveforms for sine, square, and triangular waveshapes.

In order to function as an integrator, the time constants of the circuits in Figure 6 should be longer than the period of a half wave. The integrator will then *provide a linear ramp of output from a step function* (increase or decrease) at the input, as shown in Figure 8. A positive going step at the input causes a rising ramp, while a negative going step causes a falling ramp. As you may have surmised, integrators are the basis for linear sweep waveform generators.

The reason that a long time constant is required can be found by examining the universal time constant graph. Note that the first 30% of the curve is quite linear, while the remainder of the curve becomes progressively more non-linear (curved). If the output of the integrator is to be a linear ramp, the time constant must be long compared to the period of the input pulse, so that we will always be operating in the portion of the time constant curve that is confined to the linear 30% (or less).

The integrator is really a form of low pass filter, with a time constant such that the output decreases at the rate of 6 db per octave as the frequency is increased. This is just opposite to the action of the differentiator discussed earlier.

More Time Constants

A.M. broadcast receivers use time constants . . . in the A.G.C. line there is a low pass filter, with a time constant much longer than the lowest demodulated audio frequency. The

continued on page 57

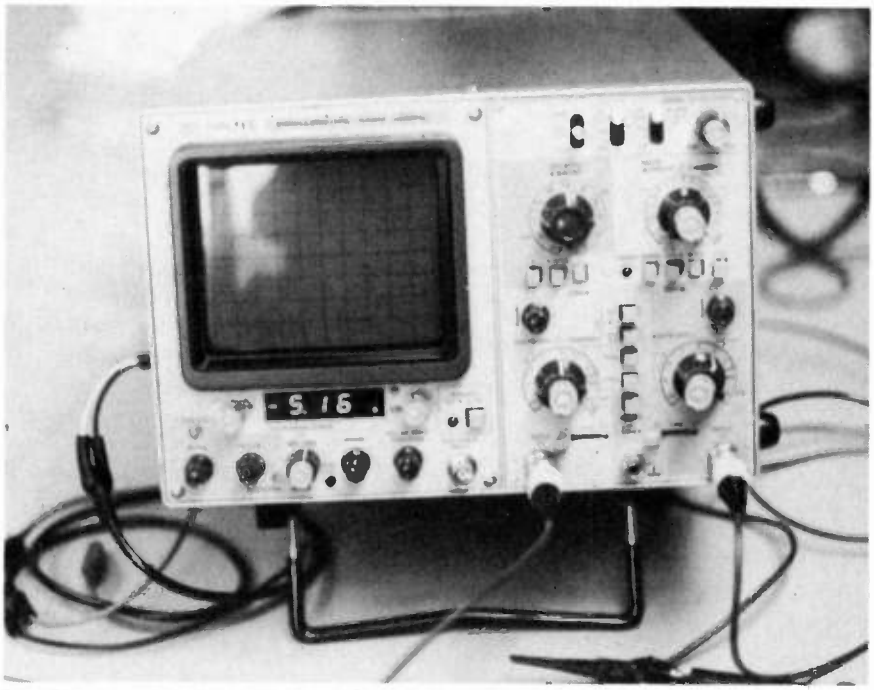
TEST INSTRUMENT REPORT

Soltec's 540M 40MHz Oscilloscope

With DMM

by Peter Credit

Soltec's new 40MHz oscilloscope, the 540M, has some special features that make it a very versatile piece of test equipment. Some of these features include a 6 inch square domed mesh CRT with an internal graticule (we found the traces of the 540M to be clean and sharp), triple-trace display capability (by using the external CH3 input terminal which serves not only as an external trigger signal connector, but also as an input connector for triple trace display), a built in delayed sweep function, and a built in 4 digit multimeter with independent input terminals plus the added capability of providing a digital display of the voltage value of any waveshape that is displayed on the CRT using the CH3 trace as a cursor.



The Soltec model 450M 40MHz oscilloscope. For more information circle No. 150 on the reader service card.

The DMM specifications are as follows: on dcv, there are five ranges, 200mv, 2, 20, 200 and 1000v. Accuracy is said to be ±0.2% (full scale) ±1 count on the 200mv, 2, 20, and 200v ranges, and ±0.3%±1 count on the 1000v range. The ac specifications indicate an accuracy of ±0.5% (full scale) ±1 count on the 200mv (rms) 2, 20, and 200v ranges, and ±1% ±1 count on the 700v (rms) range.

The resistance ranges are 2K, 20K, 200K, 2M and 20MΩ with accuracies of ±0.3% (full scale) ±1 count on the 2K, 20K, 200K and 2MΩ ranges and 0.5% (full scale) ±1 count on the 20MΩ range. The measurement of a displayed waveshape is made by moving the CH3 trace to the base of the signal to be measured. The PUSH ZERO (auto zero) switch is then pushed to set the digital display to zero, and then the CH3 trace is moved to the portion of the waveform to be measured. The measurement is displayed in 4 digits using LED's. The accuracy of the CH3 cursor measurement is said to be ±0.2% of the CRT graticule area ±1 count. The auto zero function has a set up time of 0.1 ms or less, and a hold time of 5 seconds.

The vertical deflection factor of the 540M is 20mv/div to 10v/div (with no magnifier) and 2 mv/div to 1v/div (with magnifier set at X10). The deflection factor accuracy is within 3% of indicated deflection with the variable knob set at CAL position. The uncalibrated (variable) range provides continuously variable deflection factors between the calibrated steps. It extends the maximum uncalibrated deflection factor to at least 25v/div.

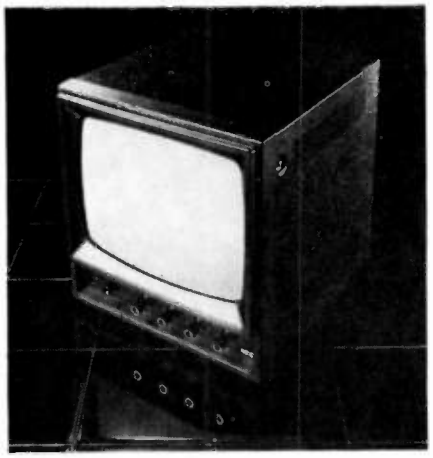
The frequency response of the 540M when tested proved to be as good (if not a little better) than manufacturers' specifications. Manufacturers' specifications indicate the X1 bandwidth to be dc to 40 MHz (risetime of 8.7 nsec) and the X10 bandwidth to be dc to 25MHz (risetime of 14 nsec). The input impedance of the 540M is 1 MΩ paralleled by approximately 30 pf (direct) and with a probe it is 10 MΩ paralleled by approximately 20 pf. The maximum input voltage is 500V (dc + ac peak).

The triggering modes of the 540M are norm and auto fix with three sources of triggering (internal, line, and external). Internal triggering selects the source of the internal trigger signal from the vertical deflection system, the line trigger signal is obtained from sample of the line voltage applied to the oscilloscope, and an external trigger signal is obtained from an external signal source.

Sweep speeds of the 540M are 0.5s/div to 0.2 μs/div in 20 calibrated steps in a 1-2-5 sequence (A sweep) and 0.5ms/div to 0.2 μs/div in 11 calibrated steps in a 1-2-5 sequence B sweep). The variable sweep rates are 1.25s/div for A sweep, and 1.25ms/div for B sweep. The delayed sweep starting point is from 0.5 to 10 divisions (A sweep). The 540M is enjoyable to operate and is well constructed. The size of the 540M is 244 mm (width) X197 mm (height) X450 mm (depth), and weighs approximately 17 lbs.

Standard accessories include a 10 to 1 probe, a BNC adapter, a grounding adapter, two Allen wrenches, measuring leads and an instruction manual. In addition to the 540M, Soltec offers a wide variety of other oscilloscopes and DMM's. ETD

SECURITY PRODUCTS



B&W Video Monitor

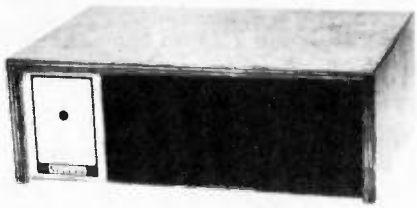
Circle No. 135 on Reader Inquiry Card

New from *NEC America Inc.*, is a 9 in. B&W Video Monitor, the FVM-95. Specifications include resolution of more than 600 lines, an input level of 0.5 to 2.0 v p-p, input impedance of 75 ohms or high impedance, frequency response of 6MHz (±3db) and power consumption of 28 watts. Front panel controls include: power, horizontal hold, vertical hold, brightness, and contrast. Rear panel controls include: vertical linearity, vertical height, impedance selector, video in and out, and ac supply. The dimensions of the FVM-95 are 220 (width) × 230 (height) × 235 (depth) mm.

Microwave Intrusion Detector

Circle No. 136 on Reader Inquiry Card

New from *Solfan* is a microwave intrusion detector, the Model 2054. This sensor projects a precise radiation pattern into a protected area. An intruder walking within the protected area causes a Doppler frequency shift which is electronically converted to an alarm signal. The detector has a range control which allows adjustment of the size of the protection area. The Model 2054's relay output is compatible with local alarm and standard central station control and transmission equipment. Features of the 2054 include: process and signaling electronics, one antenna, and a four hour rechargeable standby battery. Since the microwave intrusion detector is a high frequency device, it is reportedly unaffected by environmental changes. Thus, the range and sensitivity remain constant through temperature and humidity fluctuations. Likewise,

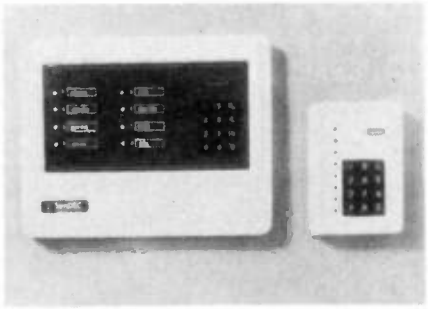


noise and air turbulence have no effect on the behavior of the sensor. Circuit design reportedly affords maximum immunity against radio frequency interference from all common transmission sources.

Security System

Circle No. 137 on Reader Inquiry Card

Sendec Corporation has announced a new microprocessor controlled security system, the *System® 8*. The *System® 8's* features include fire and smoke detection, intrusion detection, accessory control and monitoring and emergency alarm. The system provides for location of violated zones with lighted readouts while a different set of auditory and visual alarms allow the owner to determine the nature and exact location of the violation. Outputs available from the *System 8®* include audible outputs, fire-warble, intrusion pulsating, entry warning steady tone, and supervision pulsating



tone. Zone status, zone alarm, ac power on, and low battery are indicated visually. The *System 8®* is powered by a 14 vac Class II transformer with a built in charging circuit which maintains a 12 volt gel-type battery.

Security Lockers

Circle No. 138 on Reader Inquiry Card

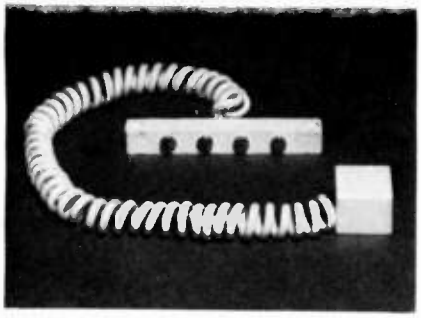
A complete new line of patented security lockers, which lock and unlock electronically without keys is now available from *Bernard Franklin Company*. Featuring push-button opening control, the electronic lockers provide one-hand opening operation for the employee at the locker door location, as well as master-controlled on opening or closings by management supervision from a console located up to 1000 ft. away. No handles or keys are used. The lockers, equipped with an electronically activated positive locking device and with a three digit combo lock, can be opened for inspection from a remote location, as well as from the front of the door by the user. Rows of doors or complete areas of lockers can be opened instantly from one center point, or kept closed during certain hours. Door combination locks can be changed on site within 30

seconds, replacing lost keys or costly changing of key locks on doors. Optional features include: programming to control the opening or closing of locker doors at specific times of the day; tamper-proof alarm system; corridor control or central console control modules. Varying sizes and arrangements of lockers are available with these patented electronic features. Single-tier lockers with openings 12 inches or 15 inches wide, with 60 inch or 72 inch door heights, as well as double-tier configurations, are available. Installation of the system requires only basic electrical connections. All electronic control devices are pre-installed, and involve only standard electrical connections. Special colors are available.

Glass-Break Detector

Circle No. 139 on Reader Inquiry Card

Glass-Gard II, the piezio-electronic glass-break detector from *International Electronics, Inc.* is now available with a latching LED. Glass-Gard II reportedly has a low incidence of false alarm because its solid-state piezio-electronic sensor reacts only to the frequency of breaking glass. The LED makes Glass-Gard II easier to service by pinpointing



the source of any malfunction that might occur in the system. Glass-Gard II is available in three models and comes with a money back guarantee plus a full three year warranty.

Camera Security System

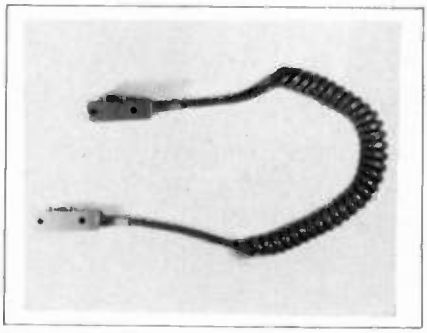
Circle No. 140 on Reader Inquiry Card

A new camera security system is now being offered by the CFI Camera Div. of *Schirmer-National Co.* The system features the magazine loaded Model 500 CFI film camera which has a shutter speed of 1/60 and a 16.5 minute magazine running time. The camera is driven by a low current (200 ma) 12 vdc motor. The photo rate of the camera is two frames per second. The camera uses Kodak 16 mm film magazine which is available in 400 ASA with film indicator. Magazine contains 2000 pictures, with color film available. The Model 560-CP control panel indicates camera running, power on, film remaining and end of film. The control operates on 115-230 volts 50/60 Hz and supplies voltage and power for up to three cameras per control. The control receives signals via wire or digital space command, and comes completely wired with plug-in connector or line cord. Wireless hand/disk transmitter and cash drawer money transmitter are also available.

Door Cord

Circle No. 141 on Reader Inquiry Card

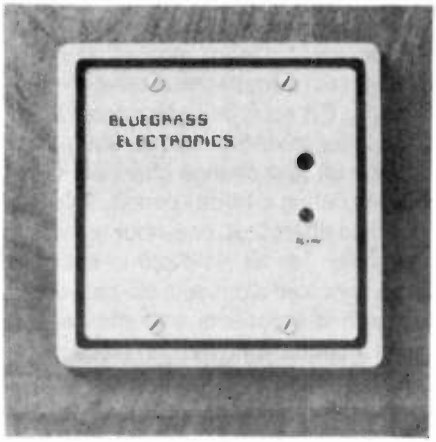
The slim line blocks on the new EPC *Emergency Products Corp.*, stretch door cord make them suitable for modern window and door frames. The Model CC-2 is a 2 conductor 12 in. cord that stretches to approximately 36 in. Model CC-4 is a similar design but with four conductors. Also available is Model CC-2L, a 2 conductor, four foot cord that stretches out to almost 20 feet. The Model CC-2L may be used to bring foil or screen circuits off overhead doors. All models feature crack resistant cords. Wires are soldered to the terminal connections, not crimped as in similar designs.



Sound Alarm Switch

Circle No. 142 on Reader Inquiry Card

Blue Grass Electronics Incorporated has just announced its new Sound Discriminatory Audio Alarm Switch, the Model AS-4000. The switch mounts in a standard size (4 in. x 4 in.) two gang outlet box for flush mounting and can be mounted in Blue Grass Electronic's

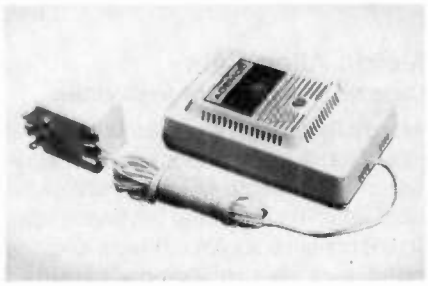


extension box #AS-100 for surface mounting installations. A dual coverage will vary, according to room configuration and conditions, but normal installation will reportedly cover 1000 to 2000 sq ft. Power consumption of the AS-1000 is 2 ma at 6 vdc or vac.

Gas Detector

Circle No. 143 on Reader Inquiry Card

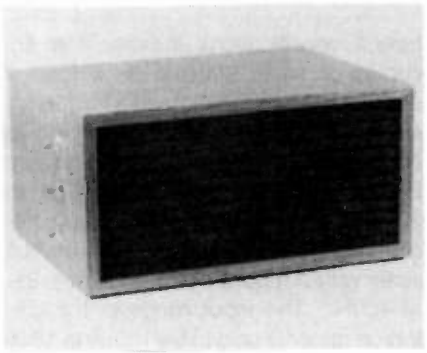
Ademco's No. 585 Gas Detector reportedly senses leaking propane or natural gas before it can build to lethal concentrations. The No. 585 gas detector is solid state and transformer operated. A nine foot cord and plug-in transformer are included. The gas detector uses a loud piercing sound for its warning system.



Sound Burglar System

Circle No. 144 on Reader Inquiry Card

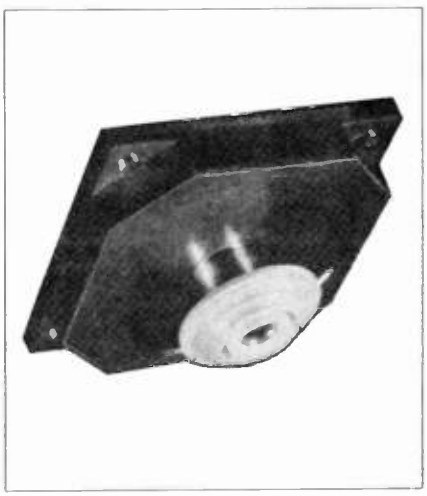
MRL, Inc. has added a new feature to its Sound-Alert sound discriminator burglar deterrent system. Model #1100 has second act noise activation. When first break-in sound occurs, lights only are turned on. Unit begins to listen again after 3 to 4 seconds and for whatever time the cycle time is set; if second break-in sound occurs during this time, unit turns on noise and, if desired, activates a dialer to call neighbors, another number, police, etc. A second act pilot light comes on and stays on until turned off, if second act action occurs. If there is no second act, unit re-arms for regular protection. Sound-Alert is sensitive to hostile noises but reportedly does not alarm to ordinary noises outside or inside. Model #1100 comes in speaker type cabinet and requires no installation. Has sensitivity adjustment and alarm duration control. Has provision for standby power and 900 watts of power for additional accessories. Sound-Alert comes with an unconditional one year service guarantee. Has switches on side for activation of unit, horn, and switched receptacles.



Passive Infrared Spot Control Device

Circle No. 145 on Reader Inquiry Card

Dexter Research Center has announced its passive infrared spot control device, the Thermacon. The Thermacon is designed for single or multiple head use and features solid state circuitry that operates from low voltage power (9 to 30 vdc or 9 to 28 vac). The housing is shielded to protect the unit from RF interference and reportedly is not affected by natural or artificial light. The Thermacon provides relay activation by sensing the presence of natural body heat to a range of 12 feet and with a preset time delay of from 50 milliseconds to 8 minutes. Four selectable sensitivity patterns are available. The wide angle provides a detection zone conical in shape with 90 degrees of coverage. The corridor pattern covers a 90 degree by 50 degree prism shaped zone. The narrow beam pattern covers a 50 degree zone and the pencil beam provides a 30 degree cone of coverage.



Digital Alarm Control

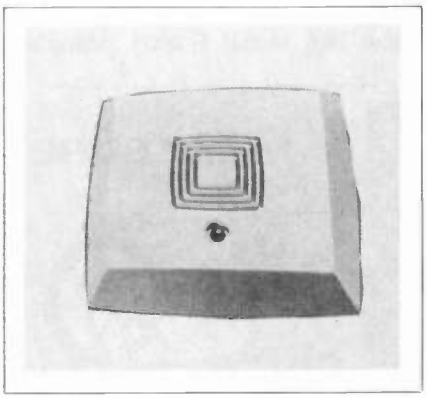
Circle No. 146 on Reader Inquiry Card

The Model P-61 Linear Alert from the *Linear Corporation* is a digitally coded alarm control unit that operates in conjunction with radio transmitters connected to a wide variety of intrusion and space protection sensors. The Linear Alert employs a digital coding technique which reportedly provides for highly reliable operation and makes the system virtually immune to false alarms. There are 250 separate codes available, and these codes can be selected and set by the users. The unit is housed in a wood and plastic case which measures approximately 12-⅛ inches (308 mm) wide, 7¼ inches (184 mm) high, and 7-¾ inches (197 mm) deep. Space is provided inside the unit to house a rechargeable battery used for standby power. The internal siren is said to have an output in excess of 100 db. The Linear Alert has two output features: (1) An output is available to drive an 8 ohm, 10 watt speaker or horn. (2) The second output provides a signal to trip an external telephone dialer. Although the Linear Alert is normally powered by an external ac transformer, the system design provides for 12 volt standby battery operation in the event of power failure. For this purpose, an appropriate rechargeable 12 volt battery rated for at least 1.2 ampere hours can be used.

Smoke Detector

Circle No. 147 on Reader Inquiry Card

B&K Electronics introduces its new smoke detector, the Model 79DCRI. Features include a built-in relay that allows it to turn auxiliary functions on or off, connect to a control panel, or connect to RF transmitters. Built-in flashing



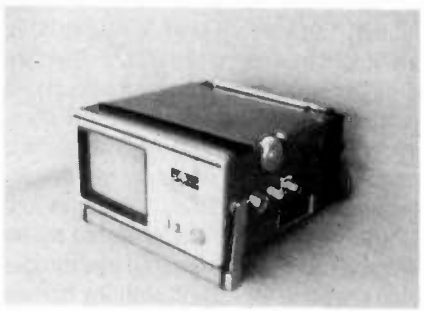
LED indicates that the battery is connected—steady LED indicates which detector is in alarm. The unit is powered by a 9 v battery and has a battery monitoring circuit that sounds when the battery voltage is too low. ETD

NEW PRODUCTS

Battery Operated Service Monitor

Circle No. 151 on Reader Inquiry Card

The VM 520 from *Visual Methods, Inc.*, is a battery powered, black and white service monitor having a 4.5 inch viewing screen and is 100% solid state. It is for the CCTV and CATV technician on a ladder or a pole, in an elevator or anywhere where power is not easily available. The VM 520 has two 75 ohm video signal input connectors; one BNC and one UHF type and also has a 75 ohm F type connector for VHF signal



input. The VM 520 can receive broadcast UHF and VHF. The VM 520 is powered by a rechargable NiCd battery or by an external source of either 12 vdc or 117 vac. An optional carrying case is available to protect the monitor against dropping and rough handling. The case features a neck/shoulder strap, padding, and high impact plastic exterior.

Automatic Distortion Meter

Circle No. 152 on Reader Inquiry Card

NF Circuit Design Block Co., has announced its new automatic distortion meter, the Model E-2001. Manufac-

turer's specifications indicate the accuracy of the E-2001 to be 0.1% full scale (distortion meter) with a frequency coverage of 20Hz to 20kHz which is continuously variable in 3 ranges. The E-2001 is also usable as a 10Hz to 200kHz ac voltmeter with a measurement range of 100μv to 100v rms full scale with a reported accuracy of ± 3% at 400Hz. The input range of the distortion meter is said to be 100μv to 100v rms at 100% calibration. The input impedance of the E-2001 is 100K ohms shunted by 70pf unbalanced, and has x and y output terminals for x and y axis hookup with an oscilliscope.

Programmable VHS Video Cassette Recorder

Circle No. 153 on Reader Inquiry Card

Panasonic Video Systems has expanded its line of Omnivision video cassette recorders with the introduction of its NV-8320 programmable 2-4-6 hour

VHS video cassette player/recorder. This video unit employs 4-video heads for several "special motion" features and a direct drive capstan servo for high stability. It is equipped with a programmable tuner/timer that can be set to turn on and off and change channels up to 8 times during a 14-day period. The new unit also offers 2, 4, or 6-hour recording capability. Model NV-8320 is encased in an annealed aluminum die-cast chassis with components and mechanical parts mounted onto the one-piece chassis to insure overall durability of the system. Other features incorporated into the Panasonic unit include × 9 high speed search with picture at all recorded modes; still/slow/× 2 speed play operated by remote control in the 6 hour and 2 hour mode as well as noiseless slow motion at 1/20 - 1/4 normal speed. Additional features include Automatic Assembly Recording (AAR), crystal oriented HPF heads, a 4 digit tape counter with memory on/off; built-in RF modulator for CH3/CH4 selection and auto rewind at the end of the tape. Model NV-8320 also has a front panel connection for video, audio, microphone or camera remote and a three mode input select switch (line/tuner/TV). Rear panel connections include BNC video, RCA audio, 8P E1AJ connector, and an on-switched ac outlet. The unit also is equipped with an LED dew indicator and 3 pronged ac power cord.

Metric Allen Sets

Circle No. 154 on Reader Inquiry Card

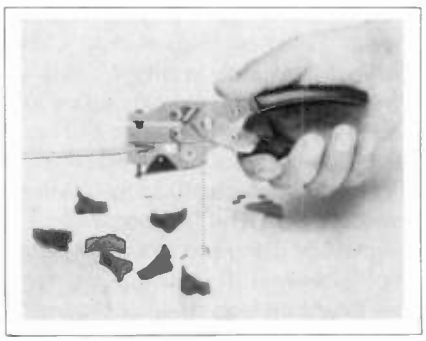
Moody Tools, Inc., manufacturer of miniature hand tools, announces the addition of three metric Allen sets to its Acu-Min® line. The Economy Set (stock #58-0158) contains six Allen drivers and one solid locking, chuck-type, knurled Swivltop™ handle. The Standard Set (stock #58-0159) includes six Allen drivers and six handles. The Deluxe Set

(stock #58-0160) contains six drivers, six handles and six spare drivers. All sets include hardened steel Allen drivers sizes 0.7mm, 0.9mm, 1.27mm, 1.5mm, 2.0mm and 2.5mm.

PCB Ejector Assembly Hand Tool

Circle No. 155 on Reader Inquiry Card

Bivar, Inc. has just released its PCB ejector assembly hand tool the CTP-1. Designed to make ejector installation easier and faster while providing uniform results, the new tool has a spring loaded centering device for installing ejectors in the desired position onto 1/16 in. and 3/32 in. PCBs. A funnel loading spring pin locator allows the parallel

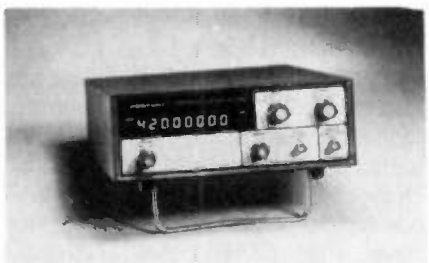


acting tool to press the mounting pin through both sides of the ejector, at the same time attaching the ejector onto the PCB. An adjustable stop controls and limits the stroke. Test results indicate a reported savings of 85% in installation time when using the tool.

Digital Frequency Counter

Circle No. 156 on Reader Inquiry Card

Heath Company has recently announced the introduction of a new 512 MHz portable frequency counter in both kit and assembled versions. The IM-2420 features four gate times and 8-digit resolution for precise readings, according to a Heath spokesperson. It is said to do more than just measure the frequencies of input signals. A period function can give cycle time in seconds, while the frequency ratio function provides the ratio between two input frequencies. For more accurate measurements, says Heath, a standby power switch can keep the crystal oven warm

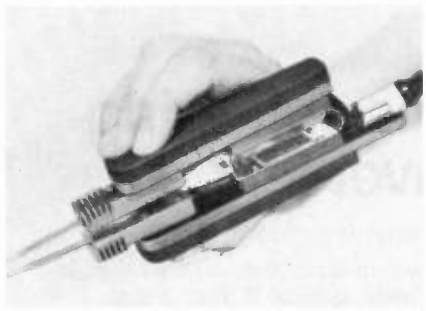


for maximum frequency accuracy. The oven is proportionally-controlled to keep the internal time base within 0.1 part per million over a wide temperature range. The crystal-controlled time base is said to provide excellent long-term stability, with drift controlled to less than 1 ppm per year. The IM-2420 also has provisions for using external time base signals. Four gate times and a large, 0.43-inch-high, 8-digit LED display provide the resolution necessary to measure UHF signals. The IM-2420's 4-15 mV typical sensitivity reportedly allows counting of low level signals. Frequency measurements can be made by direct connection, or by using the optional SMA-2400-1 Swiveling Telescopic Antenna. The IM-2420 can be wired for either 120 or 240 vac operation.

Resistance Soldering Tool

Circle No. 157 on Reader Inquiry Card

American Beauty's new heavy-duty Resistance Soldering Tool No. 105127 that reportedly handles connections up to 1/2" (12.7 mm) in diameter is now available from *American Electrical Heater Co.* Applications include soldering of heavy gauge wire to terminals, lugs, posts, etc. The tool's heavy electrodes span the joint, pass a low voltage, high amperage current through it. Resist-

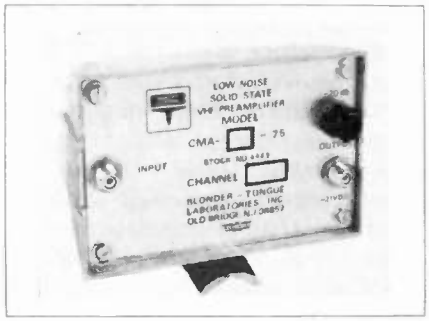


ance to the current brings work to soldering temperature quickly, confining the heat to the exact work area. The tweezer-type tool has .125" (3.175 mm) diameter copper-clad, stainless steel electrodes, and operates on 15 to 250 watts of power. There are several power units to choose from. American Beauty resistance soldering equipment ranges from micro-miniature for electronics work to heavy equipment for work with bus bars and copper tubing.

VHF TV Preamplifiers

Circle No. 158 on Reader Inquiry Card

MATV installers now have a series of VHF TV preamplifiers available from *Blonder-Tongue Laboratories, Inc.* These new CMA series preamplifiers are available for low band, high band



or broad band use to optimize gain in a specific band and afford high input capability reportedly as high as 25dBmV per channel. An installer can select the preamplifier specifically designed for his particular need. The CMA's (B-T stock no. 4448) gain is said to be 26dB, which is rated exceptionally high for an MATV preamplifier. Each CMA model has an all metal case for added component protection. A wide operating temperature range and mast-mount design make the units suitable for tower installations. To reduce signal degradation, coaxial cable downlead can be used without the need for a separate balun since CMA's have 75 ohm input and output connectors. The units feature a -20dB back-matched output test jack to permit monitoring a CMA after installation without interrupting service. All mounting hardware and cable connectors are supplied with each CMA.

Power Protectors

Circle No. 159 on Reader Inquiry Card

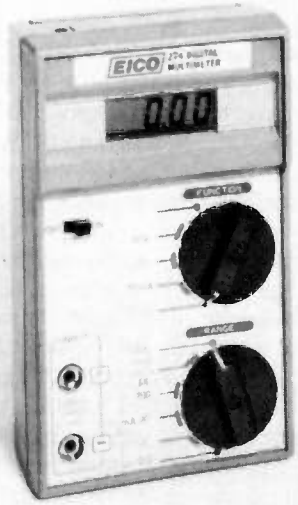
The Mini-Ups, a portable, plug-in uninterruptible power source (UPS) system, designed to protect small electronic equipment from all potential ac power line problems including blackouts, has been announced by *Sola Electric*. Available in 400 va and 750 va models for use with POS terminals, electronic lab monitors and test devices, microcomputers, and other digital electronics, the

Mini-Ups contains a sealed maintenance-free, lead-acid type battery. In a blackout situation, the 400 and 750 va units are said to provide up to 20 minutes of regulated power at full load from battery backup. The Mini-Ups operate from a single-phase 115 vac input and

provide an output voltage reportedly regulated to ±3% of nominal through input fluctuations as great as +10 -20%. Input frequency fluctuations of up to ±10% of nominal (60Hz) are said to be tightly regulated at the output to ±0.5Hz (one-half cycle). The Mini-Ups also reportedly attenuates electrical noise and holds output harmonics to less than 2% single and 3% total harmonic distortion (THD) into a resistive load.

Portable Digital Multimeter

Circle No. 160 on Reader Inquiry Card

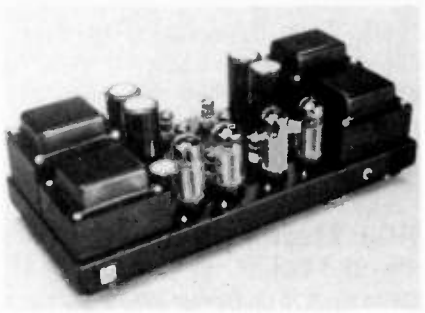


A new hand held 3-1/2 digit LCD DMM has just been introduced by *Eico Electronic Instrument Co., Inc.* The Eico 274 measures ac and dc volts, dc current and resistance in 21 ranges. It features single-chip LSI logic, automatic decimal point and overload protection, plus reportedly getting up to 200 hours operation from a single 9 v transistor battery. The automatic "Lo Bat" indicator warns you of the last 20% of battery life. The large, LCD readouts allow easy viewing. Accuracy is said to be better than 0.8%, input impedance 10 megohms. The Eico 274 comes complete with 9 v battery, test probes, spare fuse and carrying case.

Tube Amplifier

Circle No. 161 on Reader Inquiry Card

A thermionic power amplifier is now available from *Strathclyde Transcription Developments Ltd.* (Scotland), that dispenses with output protection circuitry and can handle loads from 5 to 20 ohms impedance. The D2000 Tube Amplifier is said to provide continuous output power of 60 + 60w, 8 ohms, 0.5% maximum distortion; maximum output power 75 + 75w, 8 ohms, 1% clipping; and maximum dynamic power of 200 + 200w, 8 ohms, 1kHz. The amplifier



reportedly will clip cleanly without latching or delayed distortion effects because it has no output protection circuitry; its rapid transient recovery ensures a near instantaneous return to clear amplification. Employing a linear output configuration, it is load matched to a nominal 8 ohms impedance to provide the rated continuous power; and can handle 5 to 20 ohms impedance. The differential amplifier operates in symmetrical push-pull form, input to output; all stages have wide overload margins apart from the output stage proper. The low feedback, wide-open, loop bandwidth results in negligible intermodulation and loop slew distortion. The unit separates the channels by using two monaural power amplifiers—with their own power supplies to ensure high channel separation (reportedly greater than 70db) and freedom from dynamic crosstalk. The chassis and power connector are the only common elements. Supply transformers are incorporated for low mechanical noise; a silicon bridge rectifier and stacked electrolytic reservoir capacitors provide a low impedance/high tension supply rail. Output tubes are the newest beam tetrode.

DMM

Circle No. 162 on Reader Inquiry Card

United States Corp. has introduced a new pushbutton DMM. The Model 2380 DMM measures dcv, dc current, acv (TRMS), ac current (TRMS), and resistance—plus- dB, dcv + acv (TRMS), and dc current + ac current (TRMS). With 25,000-count A/D conversion, the 2380 reportedly displays 25% more measurement range than conventional 4-1/2 digit meters. Direct readout in dB permits gain and loss measurements, simply and directly, without complicated calculations. Most decibel instruments provide a single input reference for zero dB, Model 2380 references both 600 and 900 ohms with other references also available. Four 60% overlapping ranges, ensure accurate dB measurements from −40 to +60 dB. Input lead changes are not needed to switch from one function to another. For safety, test leads, front panel inputs and panel

markings conform to UL1244 specifications. The Model 2380 DMM, housed in an impact resistant case for ruggedness, is designed and built for the hard-working applications of research and development, test and industrial service. Large, bright, LED's provide displays that are easy to read, solid-state input protections avoid damage from overloads and LSI circuitry assures long term reliability. This new multimeter is lightweight (4 lbs.) and measures 3 in. × 10 1/4 in. ETD

TIME CONSTANTS

continued from page 49

output of this low pass RC filter ramps up and down, as the rectified carrier voltage step functions up and down when the station is changed. It's an integrator. The RC coupling in the audio amplifier of the same receiver has a time constant longer than the lowest desired audio frequency.

More complex equipment uses "signal conditioning" (signal processing . . . which means that the signal is amplified, or attenuated . . . differentiated or integrated . . . AGC'd or clipped or limited . . . expanded or compressed, etc., etc., in order to put the signal into the proper form and amplitude for the following circuits. As you can readily understand, the use of RC and RL circuits plays a very important role in signal processing . . . and, since RC and RL circuits are made of passive (non-amplifying) components, they attenuate the signal. These losses can accumulate to an undesireable degree. It is therefore common to use amplifiers to offset the losses. Op amps are generally used in conjunction with RC and RL time constant circuitry in order to make practical designs.

Following articles covering op amps will illustrate representative op amp RL and RC circuits for a variety of practical applications. ETD

ALARM SYSTEMS

continued from page 41

bad profit for an installation crew of two working one day.

One key to successful — that is, profitable — bidding is to maintain accurate records regarding the number of man-hours spent. If the installation crew consistently exceeds or falls below the estimated man-hours for the job, then the man-hour chart should be adjusted for that crew. It is unlikely that any two crews will work with the same efficiency.

It is not recommended that the man-hour chart be modified after one or two installations. Allow sufficient time — and a dozen or more installations — before adjusting the chart. The installers can play an important part in the bidding process by reporting which items of equipment are causing delays in installation time. If a piece of equipment consistently causes problems, it might be worthwhile to review the installation method, consider using different equipment, and/or modify the man-hour chart. Whatever the course of action, accurate records are needed. ETD

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2.b	7.a	12.a	17.d	22.c
3.c	8.a	13.b	18.b	23.a
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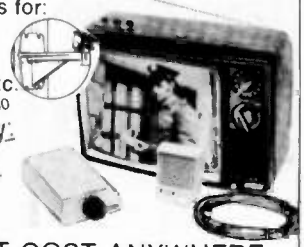

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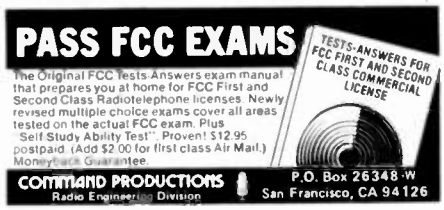

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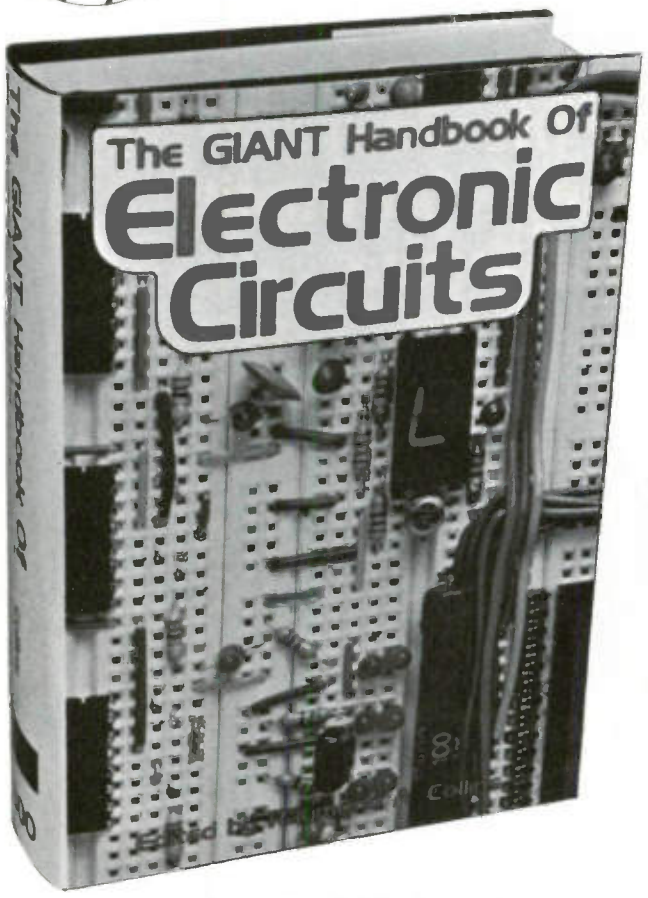

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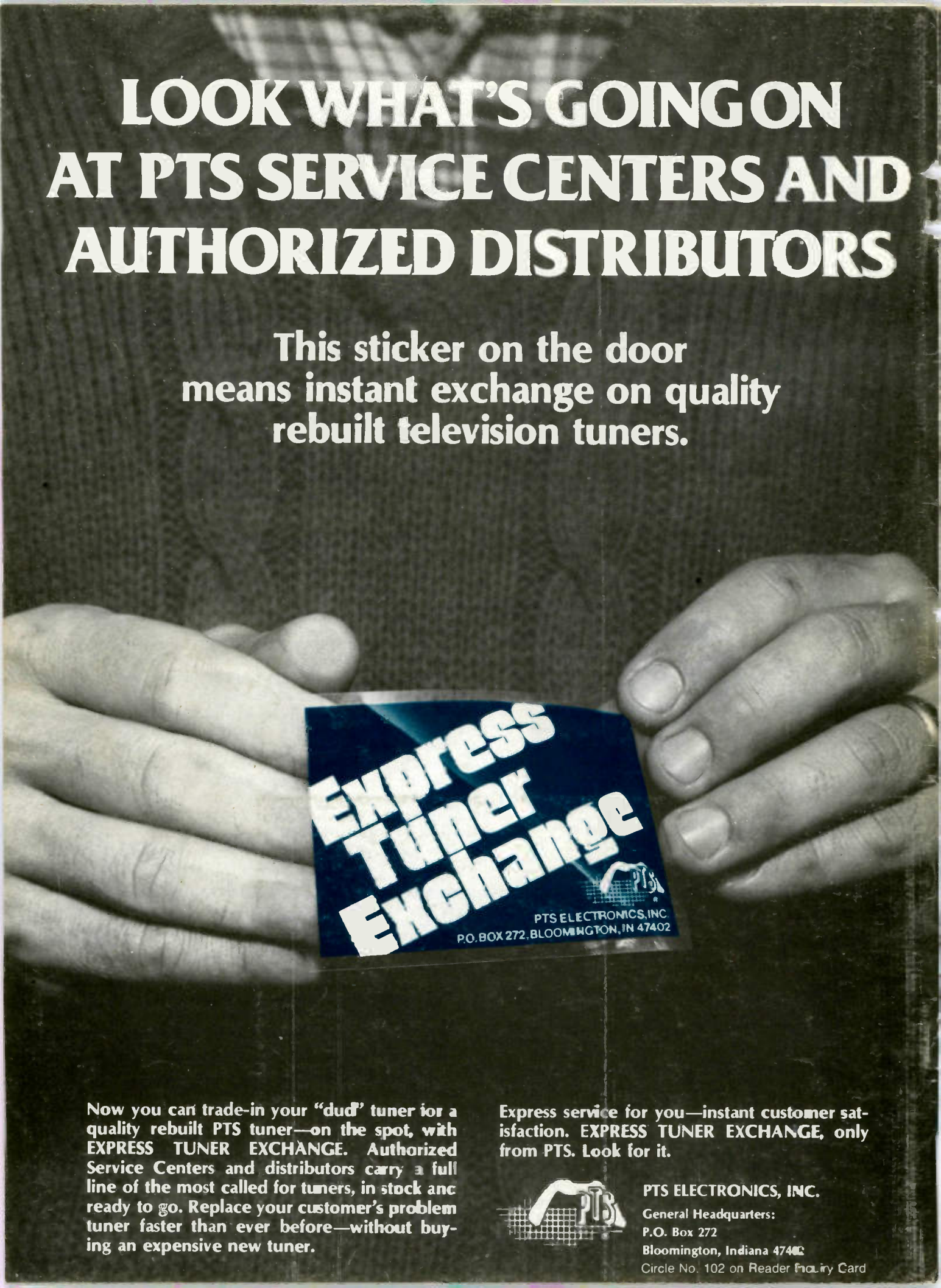

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