THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC™

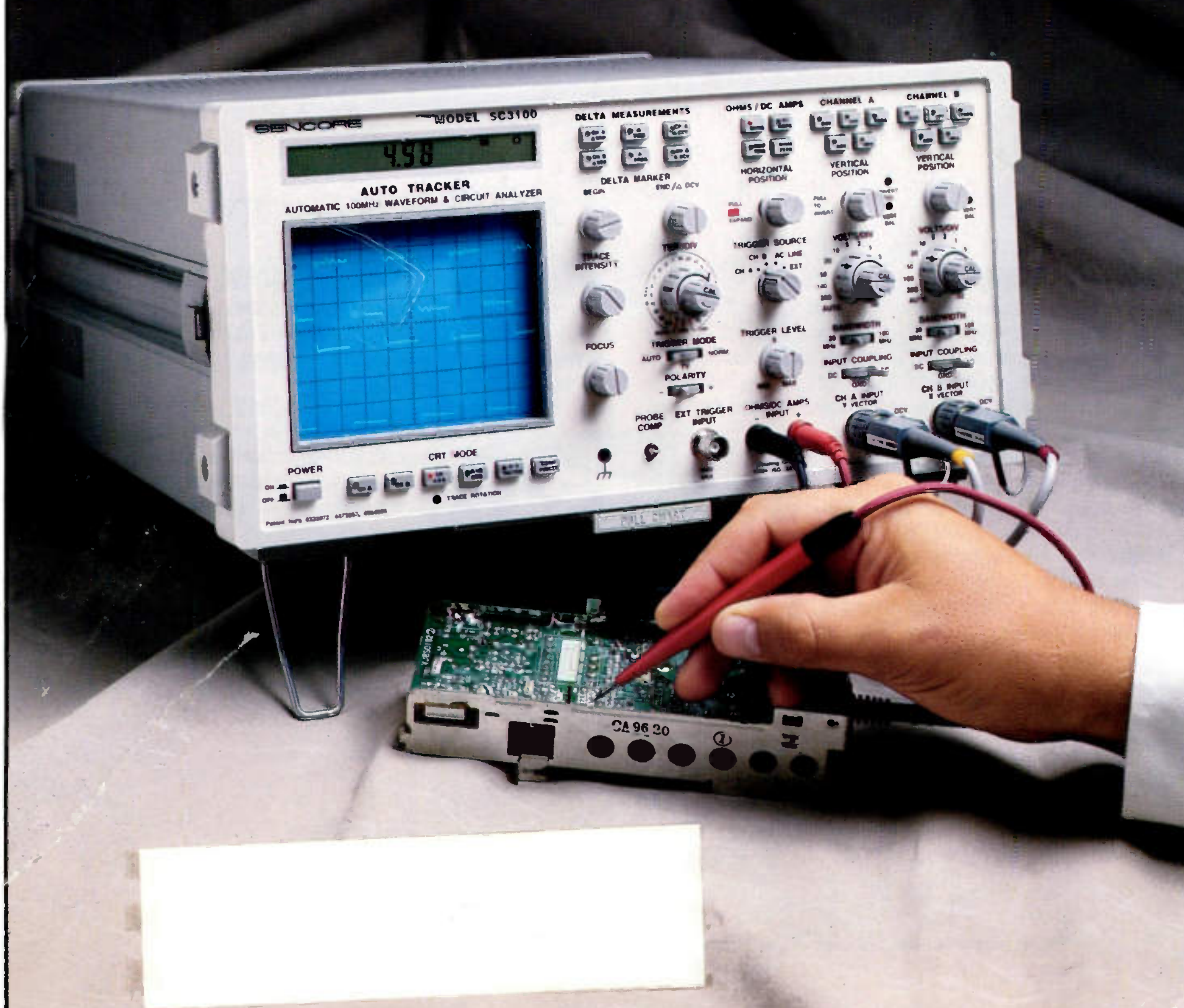
Servicing & Technology

DECEMBER 1992/$3.00

Hand-held digital troubleshooting, Part II

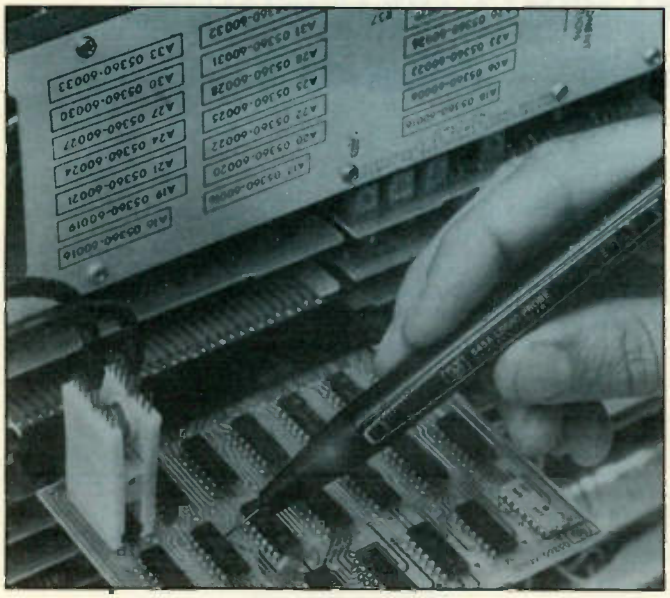
A glossary of integrated circuit terms

Replacement parts/servicing information sourcebook

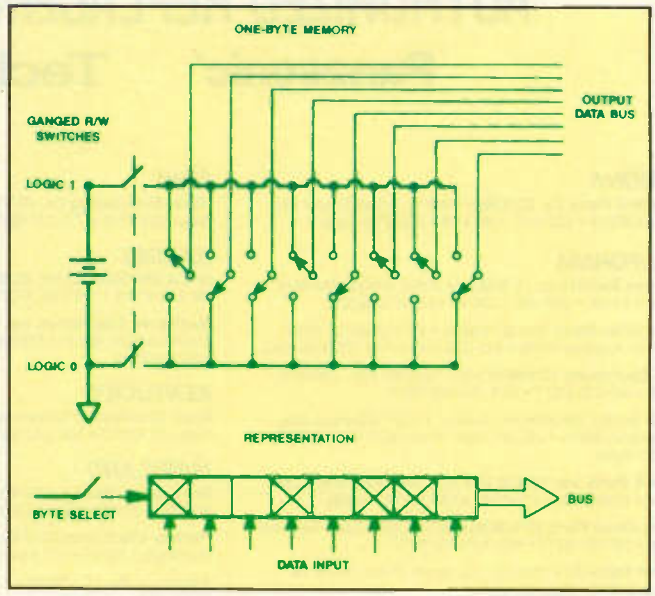


Contents

Volume 12, No. 12 December 1992



page 19



page 42

FEATURES

DEPARTMENTS

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
ELECTRONIC
Servicing & Technology

ON THE COVER

Servicing today's complex, sophisticated consumer electronics products demands a combination of a well trained technician, detailed information about the design, construction and operation of the product, sophisticated test equipment and the correct replacement components. *(Photo courtesy Sencore.)*

Servicing doesn't get any easier

Servicing of consumer electronics products seems to be continually becoming more difficult, more difficult to cost justify, and just plain frustrating with each passing year.

There are many reasons for this:

- Products and components are becoming more complex.
- The number of different brands and models is increasing, so there's an increasing variety of circuitry in each type of product.
- There are more and more types of consumer electronics product. Where there was once radio and TV, there is now radio, TV, VCR, microwave ovens, CD players, personal computers, video games and more.
- Consumer electronics products have continually become more complex.
- The price of consumer electronics products, and therefore the amount that a consumer is willing to pay to have a product serviced has decreased markedly, in contrast to the general increase in prices of consumer goods.
- More and more companies offer private branded consumer electronics products for which service literature is difficult to obtain, or nonexistent.

The problem with private brands

All of the factors mentioned above, as well as, no doubt, some not mentioned here are making the business of providing service on consumer electronics products more difficult. One of the worst of these problems, however, seems to be that of private brands. Many of these seem to be orphans for which it is difficult, if not impossible to locate servicing information, component parts specifications, or replacement parts.

There are at least two kinds of private branders that seem to cause many of the private brand consumer electronics product servicing problems, and possibly more. For example there are the companies that buy the name of a venerable old consumer product company and contract with offshore manufacturers to manufacture products under that brand name for sale in this country. The other is the large discount chain store that contracts with offshore manufacturers to manufacture products under a brand sold only by that store.

When a customer who has bought one of those products brings it in to an independent service company to have it serviced, the service center takes it in on faith, and begins to look for servicing literature and a source of replacement components.

In some of these cases, the company actually has provided for service literature and a stock of replacement components in this country, and the service center can obtain the literature and components and get on with servicing the product. Unfortunately, in some cases, either no support literature and parts exist, or it takes a sleuth with the patience and tenacity of a Sherlock Holmes to track it down.

The 80/20 rule applies here

One of the interesting things about this problem is that it seems that 20%, or less, of the products causes 80%, or more of the problem. This was revealed indirectly in literature that was produced several years ago by one of the U.S. manufacturers. It was a list, by manufacturer, of market share of consumer electronics products sold in this country.

Not suprisingly, RCA and GE were at the top with a huge percentage of the market. This was followed by manufacturers with names like NAP and Zenith, then other companies like Matsushita, Sony, and all of the other well known and reputable manufacturers. This list represented 80%, or more of the volume of products sold in this country.

With few exceptions, when a servicer needs literature or replacement components for any of these brands, he is able to obtain them.

At the very bottom of the list, was the entry "Others", which included all of the unknown brands and private brands. This represented considerably less than 20% of the market. But from the letters and telephone calls we receive at **ES&T**, almost all of the problems of finding service literature and replacement components by all of the service centers across the country, have to do with that small percentage of the total market.

Here's some help

Because of this problem, each year in December we present a Replacement parts/servicing information sourcebook. According to many of our readers, it's helpful in finding servicing information and replacement components for that segment of the consumer electronics product servicing market that is such a problem. For example, by checking the FCC ID number on a product and using the cross reference found in the sourcebook in this issue, a service center may be able to determine the actual manufacturer of a private branded product.

Unfortunately, this may or may not lead to a resolution of the problem, because in some cases the manufacturer is not forthcoming with information. Their position is that they manufactured that product for that private label, to the other company's specifications, and they do not have the service literature or replacement components for it.

In many cases, though, the information on the actual manufacturer of a product does help.

Because so many readers found this sourcebook helpful, we have expanded it considerably for this issue. We have increased the size of our FCC ID number/manufacturer cross reference considerably, and in this issue we present it in two ways: alphabetically by FCC ID number prefix and alphabetically by manufacturer name.

We have also included an enlarged and updated list of manufacturers.

Nils Conrad Persson

Cable testing seminars

Tektronix Inc. has announced it is conducting a series of Cable TV Testing seminars. Open to the public, the seminars are scheduled for cities across the U.S.: December 9 in Chicago, IL, December 11 in Dallas TX, January 13 Atlanta,GA, January 15 Orlando, FL, February 3 San Fransisco, CA, February 5 Los Angeles, CA.

The full-day seminars cover baseband and RF measurements by offering both a discussion of theory and application-oriented training. The goal is to give each student a comprehensive understanding of three key subjects: system distortions and their effect on system performance, system proofs and FCC requirements, and the use of measurement equipment.

Each seminar is conducted by seasoned instructors from Tektronix Television Division training education services.

Every seminar participant will receive a workbook containing valuable reference information about distortions and signal measurement. In addition, each is eligible to win a complete video reference library valued at $250.00. One library will be awarded at each seminar location. The workbook, related literature, and a luncheon are included in a $125 registration fee.

For information about enrolling in the Tektronix Cable TV Measurement seminars, readers can contact Kathy Richards at Tektronix at (503) 627-1555.

Grant to set national skills standard for electronic technicians awarded to EIF

Through Department of Education's Business and Education Standards Program initiative, the Electronics Industries Foundation (EIF), in collaboration with its parent organization the Electronic Industries Association (EIA), has been awarded a $545,000 grant. The grant will fund the development of a national skills standard for the electronics technician profession.

The EIF and EIA are working in partnership with over 30 EIA member companies as well as a number of business, labor and education associations who will examine the full extent of occupational needs and determine the full range of academic, theoretical, occupational, and employability skills needed to enter, succeed, and advance in an electronics technician job.

In announcing the award, EIF President Molly M. Mannon said, "America has identified the need for reform in education as one of its major goals. The America 2000 education strategy stresses the importance of business and labor in the development of voluntary industry-based skill standards. By undertaking an effort to help redesign and reform education, our industry will go far not only in ensuring that its need for qualified workers is met, but in helping the nation achieve the national education goals set forth by President Bush and the nation's governors in 1990."

The award has a 50 percent matching requirement that will be fulfilled through in-kind contribution from partnerships developed with business, labor, and education organizations. Many EIA member companies have agreed to participate in this effort by assigning representatives with expertise in electronics and operations to help direct the project and to develop the standards. Other EIA members will serve by virtue of their participation on the Product Services Committee. Among the organizations joining EIA and EIF in this effort will be:

- National Association of State Directors of Vocational Technical Education (NASDVTEC)
- National Electronic Service Dealers of America (NESDA)
- National Association of Retail Dealers of America (NARDA)
- Vocational Industrial Clubs of America (VICA) and many more.

Color TV's , 20 inches and larger,- lead May video sales

Sales to dealers of color televisions 20 inches and larger led May 1992 video sales, according to statistics released today by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

Sales for screen sizes 20 inches and over accounted for nearly 61% of color TV sales during May. Total color TV sales rose 4% through the first five months of this year. The annualized rate of color TV sales in May was in excess of 20.3 million units for the third consecutive month.

VCR deck sales were also strong in May, rising 14% from the same period last year during a month that has historically been the slowest sales month of the year. VCR unit sales totaled over 740,000 units in May, for an annualized sales rate of 13.3 million units.

Sales of laserdisc players continued to post large double-digit gains in May, rising 25% over the same period last year. TV/VCR combination units continued to turn around slow yearly sales with a 44% gain in May over the same period last year, rising 22% in the year-to-date.

Projection television and camcorder sales in May 1992 were virtually unchanged from May 1991; projection TVs posted a 0.8% gain over last May's strong sales performance, and camcorders fell 0.1 percent from May 1991.

The May Conference Board survey found that 26% of those responding thought conditions would improve in the future, while only 10% expected conditions to worsen. The board also noted that, although consumers are becoming more bullish on the economy, they continue to be cautious on committing to future big ticket purchases.

The Department of Labor recently reported that summer hirings are ahead of last year's pace, and are occuring earlier than last summer. In addition, preliminary data on May retail sales gives evidence that business confidence may continue to expand. Salomon Brothers reported that retail sales at 10 of the nation's largest retailers increased 4.2% in May, despite unseasonable weather that hurt sales of outdoor products such as lawn care equipment and outdoor furniture.

ASTA offers new consumer/dealer education pamphlet

"Satellite dish antenna ownership: Rights, Responsibilities, and Regulations," is a new educational pamphlet designed to inform consumers of their legal right to own and use a satellite dish in the face of extreme or unreasonable zoning regulations and restrictive covenants.

Written as a basic primer for new or prospective dish owners whose rights are threatened, it discusses the FCC zoning preemption, restrictive covenants, and how to prepare a strong dish defense.

It also is a low-cost way for dealers and consumer advocates to quickly reassure citizens of their rights, said Court Newton, Jr., executive director of the American Satellite Television Alliance (ASTA), publisher of the pamphlet.

"Many consumers mistakenly believe zoning boards or neighbors can keep them from having a dish," Newton said. "Some homeowners associations (HOAs) brazenly try to keep owners from enjoying the full use of their own property.

"People are intimidated by ill-informed city or HOA officials who say 'rules are rules' and you can't have a dish. But courts take a more equitable view. This pamphlet tells consumers that law and principle are on their side and encourages them to assert their rights."

A sample copy is available by sending $1.75 - the raw cost of filling a single request - to ASTA, 16 Broadway, Valhalla, NY 10595. Quantities are available to dealers and consumer activists at greatly reduced prices and can be ordered by calling 914-997-8192. Space is provided for a dealer address.

ASTA is a non-profit consumer service organization formed to combat zoning and covenant restrictions that impede a citizen's right to use satellite TV systems to receive news, information and entertainment. ■

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

Electronic Servicing & Technology is edited for servicing professionals who service consumer electronics equipment. This includes service technicians, field service personnel and avid servicing enthusiasts who repair and maintain audio, video, computer and other consumer electronics equipment.

EDITORIAL
Nils Conrad Persson, *Editor*
Jeffrey Uschok, *Assistant Editor*

CONSULTING EDITORS
Homer L.Davidson, *TV Servicing Consultant*
William J. Lynott, *Business Consultant*
Victor Meldjik, *Components Consultant*
John E. Shepler, *Audio Consultant*
Sam Wilson, *Electronics Theory Consultant*

PRODUCTION
Elizabeth Ryan, *Art Director*
Barbara Terzo, *Assistant Art Director*
Susan Reale, *Artist*
Edmond Pesonen, *Electronic Composition Mgr.*
Dorothy Kehrwieder, *Production Manager*
Emily Kreutz, *Production*
Pat Le Blanc, *Phototypographer*

BUSINESS
Richard A. Ross, *Publisher*
Jonathan C. Kummer, *Associate Publisher*
Dorothy Kehrwieder, *General Manager*
Frank V. Fuzia, *Controller*
Catherine Ross, *Circulation Director*
Melissa Kehrwieder, *Data Processing Manager*
Carol Licata, *Data Processing*
Denise Pyne, *Customer Service*

SALES OFFICE
Electronic Servicing & Technology
76 N. Broadway, Hicksville, NY 11801
516-681-2922; FAX 516-681-2926

Jonathan Kummer, *Advertising Manager*
Emily Kreutz, *Sales Assistant*

NESDA — Member, Electronic Servicing Dealers Association

AFSM INTERNATIONAL — ASSOCIATION FOR SERVICES MANAGEMENT INTERNATIONAL

EDITORIAL CORRESPONDENCE
P.O. Box 12487
Overland Park, KS 66212
913-492-4857

Electronic Servicing & Technology (ISSN 0278-9922) is published 13 times a year by CQ Communications, Inc. 76 N. Broadway, Hicksville, NY 11801. Telephone (516) 681-2922. Second class postage paid at Hicksville, NY and additional offices. Subscription prices (payable in US dollars only): Domestic—one year $24, two years $40. Foreign countries—one years $30, two years $52. Allow six weeks for delivery of first issue and for change of address. printed in the United States of America.

Postmaster: Please send change of address notice to Electronic Servicing & Technology, 76 N. Broadway, Hicksville, NY 11801.

CQ Communications, Inc. is publisher of CQ The Radio Amateur's Journal, Popular Communications, ComputerCraft, CQ Radio Amateur (Spanish CQ), CQ Amateur Radio Equipment Buyer's Guide, CQ Amateur Radio Antenna Buyer's Guide. Popular Communications Communications Guides, and Electronic Servicing & Technology.

Literature

Catalog covers electronic specialties market

A new product ordering guide for electronic specialty markets (ESM) is now available from 3M. The ordering guide is a resource for engineers, assemblers and technicians who require a wide variety of electronic parts in small quantities. The 184-page catalog provides detailed descriptions, specification drawings, and photos of more than 5,000 3M products.

The catalog includes information on the following types of products: packaged products, breadboards and test clips, bumpers, cable handling products, chemicals, aerosols and compounds, connectors, IC sockets, IDC cables, joining products, static control products, tapes, terminals, vacuums and cleaning supplies. The catalog also includes extensive cross reference charts and a detailed index to assist in quickly locating products. Complete ordering information is provided including dimensions, part numbers and accessories.

Circle (20) on Reply Card

Brochure details adhesives and sealant line

Chemtronics Inc. has issued a 6-page, five-color brochure that features the company's new line of ultra-pure adhesives, sealants and speciality compounds for electronics applications. These products meet numerous military and other qualitative standards.

The brochure provides detailed information on one and two component RTV silicone systems, silicone greases and compounds, Ultra-Cure UV curable adhesives, epoxy adhesives, MicroBond III cynanoacrylate adhesive and Industrial Grade Spray Adhesive.

The products are engineered for bonding, sealing encapsulating and coating applications, and are packaged in handy ready to use containers that provide greater flexibility and consistently superior integrity for dependable performance.

Circle (71) on Reply Card

Tektronix offers test and measurement seminars

Tektronix, Inc. is hosting free seminars across the United States this fall to teach the latest oscilloscope and logic analyzer test and measurement techniques. The one-day training session will include both a formal presentation and hands-on lab work. The company's senior engineering staff will guide attendees to an understanding of the fundamentals of today's oscilloscope and logic analyzer technologies, including hands-on lab experience structured around common applications.

The seminars are directed at engineering group managers, test engineers, analog and digital designers, electronics service technicians, evaluation engineers and researchers. Each oscilloscope seminar will run analyzer break-out sessions for interested attendees.

Oscilloscopes ranging from low-cost portables to sophisticated laboratory instruments with sampling rates to 2GS/sec will be discussed and demonstrated. Attendees will learn probing techniques to improve accuracy and productivity, tips on SMT probing, isolating metastable conditions and triggering on noisy signals, and gain an understanding of what manufacturers specifications mean and how they combine to determine overall instrument performance.

Circle (21) on Reply Card

Test instrument catalog

Bel Merit's new fall catalog line features detailed specifications and descriptions of portable and benchtop test and measurement instruments designed for the engineer, student, technician or hobbyist who test, repair or assemble electronic or electrical equipment.

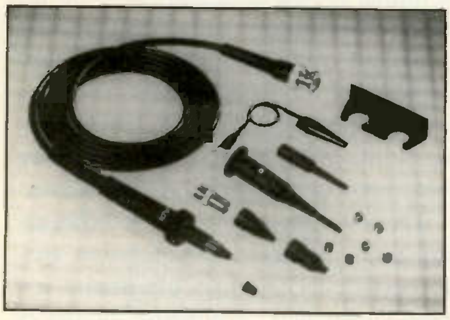
Some new product highlights include full multi-function digital multimeters with holster, digital clamp-on current meters, bench instruments, non-contact voltage detectors, electrical voltage testers, continuity checkers, ac circuits analyzers, oscilloscope probes and more.

Circle (22) on Reply Card

Master catalog

A new 284-page Master Catalog from Jensen Tools introduces OSHA-required insulated tool sets (VDE certified), magnetic screwdrivers, and other hard-to-find tools for electrical and electronic installation and repair. Also included are wiring accessories, hand-held multimeter and other bench and field instruments, tool belts, kits, and more. ■

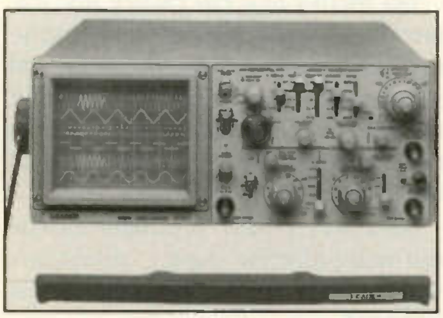
Circle (23) on Reply Card



Oscilloscope probe

Compatible with all oscilloscopes, *API's* new 610-SW-1 oscilloscope probe combines all the quality and durability of standard probes with the added versatility of interchangeable/replaceable tips. This affords the option of using the standard 0.0055" tip for durability or the new 0.030" miniature tip to reach more difficult test areas. Probes have switchable three position X1-REF-X10 attenuations and high accuracy (± 3% at X10). Improved electronics and faster risetimes have increased the usable bandwidth to 150MHz. Comes complete with full accessories.

Circle (25) on Reply Card



A new 60-MHz oscilloscope

Leader Instruments Corporation announces the availabiliy of a new three-channel, 60-MHz dual time base oscilloscope. This model 8060 is capable of six trace operation. Sensitivity ranges from 1mV/div to 5V/div in twelve steps with bandlimiting to 20MHz at the 1 and 2mV/div settings. Sweep speeds as high as 5 ns/div are offered and built-in CH-1, CH-2 delay lines allow observation of fast trigger edges. Calibrated delayed sweep expands the main time base for close observation of timing events, and the use of alternate sweep displays both the main (A) and delayed (B) sweep simultaneously (six traces in the 3-channel mode). Trigger source selection includes a VERT setting where the trigger is automatically selected from the channel choosen for observation.

Circle (26) on Reply Card

New product packaging

Electronix Corp has designed EASY VCR CLEAN and VCR REPAIR. Though geared for the layman, the instructional videos have been sold to both new and existing repair facilities throughout the United States, Canada, and South America. The tapes have been informative for the service dealers just starting VCR repair and has been a very good reference/training tool for the established repair facility.

Circle (27) on Reply Card

Complete microwave oven test instrument

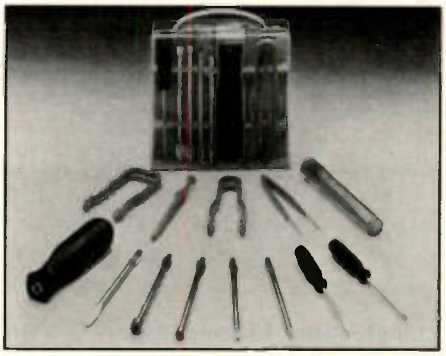
Electronic Design Specialists announces the EDS-76 Microanalyzer, made just for microwave oven techniques. This microwave oven test instrument utilizes a quick GO/NO GO test circuit to test high-voltage diodes and capacitors in circuit under high voltage loads, and uses simple indicators for open, shorted or normal components. The capacitor checker will even indicate if a capacitor is good but low in value, and there are tests for checking power transformers, magnetrons and door safety switches Also built into the unit is a digital voltmeter capable of measuring up to 500V or 500C, ac or dc in two ranges with auto decimal point and auto polarity. If you've ever tried to measure the high negative voltage inside a microwave and fried your multimeter or almost electrocuted yourself trying to use a HV TV test probe, you know how important this is, says the manufacturer. Additionally, a semiconductor tester is built in for testing triacs, SCRs, transistors, diodes and even MOSFET transistors. All test leads are included along with a reprint of the article "Repairing Microwave Ovens with the Microanalyzer." This product is also available in kit form.

Circle (28) on Reply Card

Test probe

The JP-29591 probe from *J.S. Popper, Inc.* is designed to reach the conductor within a connector, sensor, plug, etc. Its half-round shape conforms to the space it is entering, thus minimizing the possibility of damage to the connector body. Its shape also gives it maximum strength. After insertion, hands-off use is possible. It is available in two sizes as either a solo tool, or on a test lead with a banana plug on the opposite end. The probe is of copper alloy and plated for corrosion resistance.

Circle (29) on Reply Card



Computer tool kit

Computer Coverup, Inc. has introduced a 14-piece tool kit that contains all the essential tools needed to service personal computers and peripherals. Designed to save computer users time and money on repairs, all the metal tools are demagnetized and all chip tools are antistatic. All the screwdrivers are chrome-plated, chip resistant and made from hardened steel and have rubber coated handles for secure grip. Its convenient plastic case allows for easy storage.

Circle (30) on Reply Card

Hand-held TDR cable fault locator

The Biddle 511 TDR (time Domain Reflectometer) from *AVO International* is designed to locate and identify cable faults as close as six inches or as far awary as 950 feet with accuracy. A light-weight, hand-held TDR featuring a full trace display (LCD), the unit locates and identifies impedance changes or faults. The full cable trace display allows the operator to see the whole picture: initial pulse, all reflections, distance to the reflections in feet, the nature of the impedance change, propagation factor and battery condition. Useful for power utilities, industrials, CATV, telecommunications, LANS and transportation, the tester combines compact portability for restrictive space with short-range accuracy. The TDR is available with a fused blocking filter option for uninterrupted testing of on-line cables up to 440Vac, 230Vdc. The unit has simple five-key operation that requires minimal operator training and comes complete with an easy-to-follow reference guide.

Circle (31) on Reply Card

Port expander for monitor burn-in

Network Technologies Inc. introduces the VOPEX-8V-H video port expander, compatible with VGA, SVGA, or XGA. It allows 8 monitors to be driven by a single VGA graphics adapter. This device can be used by depot repair centers, as well as monitor manufacturers allowing 8 monitors to be burned-in from one video source. The unit connects directly to the computer's VGA video port via a 6 foot interface cable. Monitors can be plugged directly into any of the 8 output ports.

Circle (32) on Reply Card

Isolated power source

The Vector Group, Inc. introduces the Vector-VID WP-29B. Iso-V-AV provides isolated output voltage adjustable from 0V to 150V, and maximum current of 3.0A. Output voltage or current can be checked on the large built-in analog meter which offers full scale accuracy of ±2%. Two isolated outputs a polarized three prong ac socket, and two high quality banana jacks are provided. The input transformer and the adjustable various output voltages are protected by separate fuses. Isolation meets ANSI specification C-101-1.

Circle (33) on Reply Card

Fiber optics coating removal kit

A new solvent kit is now being offered by *Dynaloy* for use in the removal of coatings and polymer calddings that are used to protect optical fibers. The kit consists of 1 pint each of six different solvents that have successfully stripped the coatings and/or claddings from various types of optical fibers. Laboratory studies have determined that these solvents will remove the coatings from optical fibers made by Ensign Bickford Optics Co., 3M fiber Optics, and Corning Glass Works, among others. Typical applications include splicing and connectorizing.

Circle (34) on Reply Card

Replacement parts/servicing information sourcebook

By the ES&T Staff

The twin problems of locating servicing information and obtaining replacement parts are among the toughest problems faced by consumer electronic servicing technicians. These problems are frequently compounded by the fact that many products are private labeled, and without some kind of key it's impossible to determine who manufactured them.

In the December 1989 issue, we published a replacement parts and servicing information sourcebook that provided several keys to determining who made a given brand of product, and where to go to obtain replacement parts. That article was so well received that we ran it again in the December 1990 issue for the sake of those who missed it the first time around, with some additions and changes.

We've received so many calls and comments from readers who benefited from the article, as well as many calls from other readers who are looking for the information that was published in those articles, and who obviously never saw it, that we've decided to publish this information, along with updates and new features, annually.

A number of improvements have been incorporated into this feature for 1992:

• The list of FCC ID number prefixes has been checked and corrected, updated and significantly expanded, and is presented here in two ways: alphanumerically by code designation and alphabetically by manufacturer name.

• The manufacturer name, address and telephone number list has been carefully checked, corrected, updated and expanded.

Also included is a list of manufacturers and the products that they manufacture. For example, many people do not seem to be aware that Magnavox, Philco and Sylvania are all products manufactured by North American Philips, or NAP. We have included that type of information here.

Breaking the codes

One way to identify the manufacturer of a product is to find the UL manufacturer's code number or an FCC ID number on the product, and compare it to the numbers in a listing of manufacturers. We have presented such a listing in this article. This does not work in all cases, but it does in a lot of cases, so it's always worth a try.

A VCR cross reference, might allow you to use a VCR servicing manual that you already have from a well-known manufacturer to troubleshoot a VCR from a manufacturer you've never heard of, and you might even have some of the needed replacement components in stock and might be able to identify them.

Finding replacement parts

Here's a list of references that are useful in tracking down the manufacturer, or parts distributors. We think that every electronics servicing facility should have them:

Consumer Electronics Replacement Parts Source Book
Consumer Electronics Group,
Electronic Industries Association
PO Box 19100
Washington, DC 20036
Include $1.00 for postage and handling.

Electronic Industry Telephone Directory (Or some equivalent)
Harris Publishing Company
2057-2 Aurora Rd.
Twinsburg, OH 44087-1999
This will cost around $50.00 (Or you might be able to get a copy free from your distributor).

Consumer Electronics Show (CES) Directory
Consumer Electronics Group
Electronic Industries Association
2001 Pennsylvania Ave. N.W.
Washington, DC 20006-1813

The CES directory includes over 1,000 manufacturers, brand names, products and key personnel. The best way to get a copy of this directory is to attend the Consumer Electronics Show in Las Vegas, January 7 through 10 1993, or Chicago, June 3 through 6

Please send me a copy of the Consumer Electronics Show Directory, as mentioned in **ES&T**. Enclosed is a check for $15.00, payable to the Consumer Electronics Show. (For **ES&T** readers only. Regular value is $100.00.)

Name ____________________ Occupation/Title ______________

Address ____

City ______________ State ______ Zip ______________

Mail to: CES, Attn: Pam Davis
2001 Pennsylvania Ave, N.W.
Washington, DC 20006-1813

The FCC public-access information system

Every VCR, personal computer, microwave oven and cordless phone sold in the United States must bear an FCC identification number because they are considered to be potential generators of radio-frequency interference. This number identifies which company manufactured the unit. If you have one of these products in your shop for service and can't identify the manufacturer, you can contact the FCC through its public-access system and find out.

There are two ways to get this information: via voice telephone or via computer and modem by contacting the public-access bulletin board. The FCC prefers to have people use direct computer-to-computer contact.

To contact the FCC bulletin board, you must have a computer and a modem capable of 300 baud or 1200 baud. The number to call, in Maryland (just outside of Washington, D.C.), is 301-725-1072. This is a toll call. Dialing this number at any time should get you in direct contact with the bulletin board.

Once you have made contact, the computer screen will tell you how much time you have and provide you with a menu of items to choose from. When **ES&T** dialed up the bulletin board in October, once we accessed the bulletin board the following screen information appeared:

"P A L"

1 - Access Equipment Authorization Database
2 - Definitions - Terms/Codes used in Application Records
3 - Applying for an Equipment Authorization (1/92)
4 - Other Commission Activities and Procedures (8/92)
5 - Laboratory Operational Information
6 - Public Notices (8/92)
7 - Bulletins / Measurement Procedures (5/92)
8 - Rulemakings (8/92)
9 - Help
a - Information Hotline (7/92)
b - ADVISORY COMMITTEE ON ADVANCED TELEVISION SERVICE
c - Processing Speed of Service (10/92)
d - Test Sites on File per Sec 2.948 (10/92)
0 - Exit PAL
Enter your selection:

Pressing the number 1 on the keyboard brought up the following information on the screen:

Equipment Authorization Database

Form 731: Until Form 731 is revised the March 1988 and July 1989 editions may continue to be used. The OMB expiration dates shown on the forms do not affect public use. Availability of the revised Form 731 will be announced here and by public notice. est: 7/92

1 - Equipment Authorization Application Status
2 - Applicant/grantee Names and Addresses by Code
0 - Exit this Menu
Enter your selection: Enter Grantee Code (CR to end): ...

At this point, it was only necessary to enter the three character alpha or alphanumeric code, and the name, address and telephone number of the manufacturer identified by that code appeared. For example, entering the three letter ID aaa and pressing the ENTER key brought up this information on the screen:

AAA Code A Phone Corporation
PO Box 5656 Portland, OR
97228 USA

The system gives you six minutes at a time, and you can enter as many codes and gather as much information as you can in that time period. If your software allows you to download information, you can download all of this information to your computer's disk for future reference.

The other method of obtaining this information is to call 301- 725-1585, Monday through Thursday between 2:00 and 4:30 p.m. and ask to be connected to the status desk. The individual who answers will relay your question to the bulletin board via a computer terminal and will then relay the information it provides to you.

Obviously, if you have a computer and a modem, it makes far more sense to contact the computer directly. You'll cut out the middle man and, of course, you can contact the computer any time

---

1993. It comes with the price of attendance. If you can't get to the show, limited numbers of copies of the directory will be available from the above address.

Limited quantities of the CES Show directory will be available at a reduced price to **ES&T** readers who send in the coupon in this issue. Quantities are limited, but the EIA/CEG will fill as many orders as possible.

A VCR model number and parts reference

Another invaluable reference is published by the International Society of Certified Electronics Technicians (ISCET): a VCR model number and parts cross reference. The Third Edition of the VCR Model Number and Parts Cross Reference is available in both disc and book format from ISCET.

Users of the disc software can search by manufacturer for model numbers and descriptions of part numbers. A parts sub-search by manufacturer and description is also included. The parts editing sequence gives an on-screen view of all substitutes for the part entered.

Both the disc and book versions contain over 180 new parts and a complete price update of all listings. The 276-page laser-printed book sells for $35.00 plus $3.00 shipping. First-time purchasers of the software can buy the program and data discs (one 3-1/2 or two 5-1/4 discs) for $69.95 plus $2.00 shipping. Registered previous purchasers of the original program can purchase the upgrade for $39.95 plus shipping. A combination offer of the book and disc versions sells for $95.00 plus $3.00 shipping.

To place an order, contact ISCET, 2708 W. Berry Street, Ft. Worth, TX 76109; 817-921-9101.

This is a two-part reference that will help any servicing organization that services VCRs to cross reference among different brands made by the same manufacturer. Part 1 of this reference will allow the user to determine when he has a product in for servicing, if it's possible that it's identical, or almost, to a product for which he already has a service manual. Part 2 of the reference cross references parts, so that if you can't find a particular part number for a product you are servicing, you may find

FCC ID numbers

Code Prefix	Manufacturer
A3D	NEC
A3L	Samsung
A7R	Orion
AAL	Phone Mate
AAO	Radio Shack
AAY	Midland International Corp.
ABL	Hitachi
ABW	JC Penney
ABY	Motorola
ACA	Yorx Electronics
ACB	Phonotronics
ACJ	Matsushita
ADF	Carterfone
ADT	Funai
AES	Uniden
AEZ	Sanyo
AFA	Fisher
AFL	Sharp
AFR	Curtis Mathes
AGI	Toshiba
AGV	Montgomery Ward
AHA	RCA
AIX	Sylvania
AJU	GE
AK8	Sony
ASH	Akai
ASI	Victor Company of Japan
ATA	Sharp
BEJ	Goldstar
BGB	Mitsubishi
BOU	Philips
E0Z	Shintom

Figure 1. Every VCR, personal computer, cordless telephone and microwave oven must carry an FCC ID number. The first three characters of that ID uniquely identify the manufacturer of the product. This is a listing of manufacturer vs FCC ID number prefix, alphanumerically by code.

that you have it on hand under a different part number for another manufacturer's product.

Identifying a manufacturer from the FCC ID number

Almost all consumer-electronics products, at least any that have to be plugged in to the power outlet or that might generate electromagnetic interference, carry clues as to who the manufacturer is. One of these numbers appears on every VCR and computer, and any other product that might gener-

FCC ID numbers	
Manufacturer	First 3 Characters of FCC ID
Akai	ASH
Carterfone	ADF
Curtis Mathes	AFR
Fisher	AFA
GE	AJU
Goldstar	BEJ
Hitachi	ABL
JC Penney	ABW
Funai	ADT
Philips	ADT
Midland International Corp.	AAY
Mitsubishi	BGB
Montgomery Ward	AGV
Motorola	ABY
NEC	A3D
Matsushita	ACJ
Phone Mate	AAL
Phonotronics	ACB
Radio Shack	AAO
RCA	AHA
Samsung	A3L
Sanyo	AEZ
Sharp	ATA
Sharp	AFL
Shintom	EOZ
Sony	AK8
Sylvania	AIX
Orion	A7R
Toshiba	AGI
Uniden	AES
Yorx Electronics	ACA
Victor Company of Japan	ASI

Figure 2. To make it easier for readers who may be interested in locating the FCC ID prefix of a particular manufacturer, here is the same information presented in Figure 1, alphabetically by manufacturer name.

UL listing number to VCR manufacturer (Unofficial)

UL Number	Manufacturer	Brand Names
16M4	Samsung	Supra, Multitech, Unitech, Tote Vision, Cybrex, GE, RCA
174Y	Toshiba	Sears
238Z	Hitachi	RCA, GE, Penny, Pentax
333Z	Symphonic	Teac, KTO, Realistic, Multitech, Funai
403Y	Fisher/Sanyo	Realistic, Sears
439F	JVC	Zenith, Kenwood, Sansui
44L6	TMC	Emerson, Llyods, Brooksonic Wards, KMC
504F	Sharp	Wards, KMC
51K8	Portavideo	
536Y	Mitsubishi	Emerson, Video Concepts, MGA
570F	Sony	Zenith
679F	Panasonic	RCA, GE, Magnavox, Quasar, Canon Philco
781Y	NEC	Dumont, Video Concepts, Vector, Sears
86B0	Goldstar	Realistic, JC Penny, Tote Vision, Shinton, Sears, Memorex

Figure 3. The UL listing number on a consumer electronics product identifies the manufacturer who made it. Here's a partial listing of UL numbers vs manufacturer.

ate electromagnetic interference. It's the FCC identification number. Armed with this number, a technician may call or write the FCC:

Federal Communications Commission
1919 M Street, NW
Washington, D.C. 20463,

Give the ID number and ask for the name and address of the manufacturer. A partial cross-reference list of manufacturer name vs FCC ID numbers is provided in Figure 1. Figure 2 is the same information in alphabetical order by manufacturer name.

Identification using the UL manufacturer's code number

Another source of manufacturer identification information is the Underwriters Laboratories code number. The manufacturer of every product that is submitted to UL for certification is assigned a unique code number that identifies who the manufacturer is. Figure 3 is a partial list of UL numbers and the manufacturers they represent. This listing is unofficial, provided by a reader, and so may not be 100 percent correct. We're working on expanding this list, and checking it for accuracy.

Locating the manufacturers

It's not unusual for a servicing organization to have some difficulty finding the address and telephone number of a manufacturer from whom to order parts, even when the manufacturer is well known. The Replacement parts source is a listing of manufacturers, gleaned from the Consumer Electronics Replacement Parts Sourcebook, the

NESDA Professional Electronics Yearbook, **ES&T** reader correspondence, many telephone calls by the **ES&T** staff, and other sources.

Information sources close to home

Those of you who are located in a city that has a good library system have a ready source of information available free. For example, the **ES&T** staff regularly call the local library for information. References that they have available include the Thomas Catalog, a brand-name reference book, and others. And they're always pleased to receive a call for this kind of information. It's what they're there for. Try giving the reference librarian in your local library a call next time you have a question about who makes what brand of TV or VCR, or similar questions.

Replacement parts source

Acoustic Research (AR)
330 Turnpike Street
Canton, MA 02021-2703
617-821-2300
Fax: 617-784-4102

Adcom Service Corporation
11 Elkins Rd.
East Brunswick, NJ 08816
908-390-1130
Fax: 908-390-5657

AIWA America Inc.
35 Oxford Drive
Moonachie, NJ 07074
201-440-5220

Akai American Ltd.- See Mitsubishi

Alpine Electronics of America, Inc.
PO Box 2859
Torrance, CA 90509
213-326-8000
800-421-2284
Fax: 213-533-0369

Altec Lansing Consumer Products
Routes 6 and 209
Milford, PA 18337
717-296-4434
800-258-3288 (ext PA)

Altos Computer Systems
2641 Orchard Parkway
San Jose, CA 95134
408-946-6700

AmPro Corporation
(Replacement parts for Kloss Novabeam and Videobeam)
35 Cabot Road
Woburn, MA 01801
Sales: 617-932-4800
Parts Orders and Customer Service: 617-932-3434
Fax: 617-932-875

Apple Computer
20525 Mariani Ave.
Cupertino, CA 95014
408-996-1010
Tech info: 800-862-7486

Aristo Computers Inc.
6700 SW 105th Ave., Suite 307
Beaverton, OR 97005
503-626-6333
800-3ARISTO

Atari Corp.
PO Box 3427
Sunnyvale, CA 94088-3427
Parts: 408-745-5501
Tech: 408-745-2466
Warr: 408-745-2367

Audio Technioca U.S., Inc.
1221 Commerce Drive
Stow, OH 44224
216-686-2600

Audio Video Technologies Inc.
60 E. Ida
Antioch, IL 60002
708-395-6321

Audiovox Corp.
Parts Department
60 Arkay Drive
Hauppauge, NY 11788
516-231-7750
Fax: 516-231-0867

Audiovox West Corp.
16808 Marquardt Ave.
Cerritos, CA 90701-3581
213-926-7758
Fax: 213-926-6005

Barcus-Berry, Inc
5381 Production Drive
Huntington Beach, CA 92649
714-898-9211
800-854-6481

Blaupunkt
2800 South 25th Avenue
Broadview, IL 60153
PO Box 4601
North Suburban, IL 60189
312-865-5200
Parts: 708-865-5388
Fax: 708-865-5209

Canon USA, Inc.
Service Division
One Jericho Plaza
Jericho, NY 11753-1679
516-933-6300
Parts Center
Cantiague Rock Road
Westbury, NY 11590-1708
516-876-6500

Canton North America, Inc.
915 Washington Avenue South
Minneapolis, MN 55415-1245
612-333-1150
Fax: 612-338-8129

Capetronics USA Inc.
1275 Valley Brook AVe.
Lyndhurst, NJ 07071
201-896-8600

Casio Inc.
570 Mt. Pleasant Ave.
Dover, NJ 07801
201-361-5400
Fax: 201-361-3819

Channel Master
PO Box 1416
Industrial Park Drive
Smithfield, NC 27577
919-934-1484
Fax: 919-934-5722

Chinon America, Inc.
660 Maple Ave.
Torrance, CA 90503
213-533-0274

CIE American, Inc.
(Formerly C. Itoh Electronics)
2515 McCabe Way
PO Box 19663
Irvine, CA 93713
714-833-8445

Citizen American Corp.
Subsidiary of Citizen Watch Co.
2401 Colorado Ave., Suite 190
Santa Monica, CA 90404
213-453-0614

Clarion Corp. of America
Customer Service Department
661 W. Redondo Beach Blvd.
Gardena, CA 90247-4201
213-327-9100
800-821-6693
Fax: 213-327-1999

Columbia Data Products
851 W. Hwy 436, Suite 1061
Altamonte Springs, FL 32714
407-869-6700

Commodore Business Machines
1200 Wilson Drive
West Chester, PA 19380
215-431-9100
Service: 215-431-9208

COMPAQ Computer Corp.
20555 FM 149
Houston, TX 77070
713-370-7040
Sales: 713-374-1434

Connecticut Microcomputer
568 Danbury Road
New Milford, CT 06776
203-354-9395
800-426-2872

Corvus Systems
160 Great Oaks Blvd.
San Jose, CA 95119
408-281-4100

Craig Consumer Electronics
13845 Artesia Blvd.
Cerritos, CA 90701-5001
213-926-9944
Fax: 213-926-9269

Crown USA, Inc.
19300 S. Susana Road
Compton, CA 90221
213-639-5055
Fax: 213-639-0152

Curtis Mathes Corp.
1 Curtis Mathes Pkwy
PO Box 2160
Athens, TX 75751
800-552-6358 (National)
800-344-2368 (Texas)

Daewoo Electronics Corp of-America
100 Daewoo Place
Carlstadt, NJ 07072
201-896-2873

Delco Electronics Corp.
Subsidiary of GM, Hughes Electronics
One Corporate Center
Kokomo, IN 46904-9005
317-457-8461
800-428-0501 (National)
800-428-0531 (Indiana)

Dell Computer Corp.
9505 Arboretum Blvd.
Austin, TX 78759
Sales, Parts and Warranties:
800-426-5150
Service: 800-624-9896

Denon America, Inc.
222 New Road
Parsippany, NJ 07054
PO Box 5370
Parsippany, NJ 07054-5370
201-882-7490
Fax: 201-575-1213

Design Acoustics
An Audio-Technica Company
1225 Commerce Drive
Stow, OH 44224
216-686-2600

Eastman Kodak
Parts Services
800 Lee Road
Rochester, NY 14650
716-724-7278

Electronic Systems Products, Inc.
1301 Armstrong Drive
Titusville, FL 32780-7999
407-269-6680
Fax: 407-267-6211

Emerson Computer Corp.
One Emerson Lane
North Bergen, NJ 07047
Service: 201-854-4800
800-537-3538
Technical Assistance:
213-722-9800
800-922-0738

Emerson Radio Corp.
One Emerson Lane
North Bergen, NJ 07047
201-854-6600

Epson America, Inc.
23610 Telo Ave.
Torrance, CA 90505
213-373-9511

Franklin Computer Corp.
PO Box 518
Mt. Holly, NJ 08060
609-261-4800

Fujitsu Ten Corp. of America
National Service Headquarters
1210 East 223rd Street, Suite 301
Carson, CA 90745
213-513-0411
800-423-8161
Fax: 213-513-6120

Funai USA Corporation
Parts Department
100 North Street
Teterboro, NJ 07608
201-288-2666
Fax: 201-288-8019

GE Appliances/Microwave Products Dept.
Appliance Park
Bldg. 41, Rm. 106
Louisville, KY 40225
502-452-3568

Gemini, Inc.
103 Mensing Way
Cannon Falls, MN 55009
507-263-3957

GoldStar Service Division
127 Jetplex Circle
Madison, AL 35758
205-772-8860
800-222-6457
Tech. Support Fax: 800-448-4026

Grundig/Lextronix Inc.
3520 Haven Ave., Unit L
Redwood City, CA 94063
415-361-1611

Harmon Kardon, Inc. - JBL
240 Crossways Park West
Woodbury, NY 11797
516-496-3400
800-645-7484

Heath Company/
Heath-Zenith Consumer Products Group
Hilltop Rd.
St. Joseph, MI 49085
616-982-3200
800-253-0570 (Orders Only)
Sales: 616-982-3411
Service, Tech. and Warr.:
616-982-3302
Parts: 616-982-3571

Hewlett-Packard
3000 Hanover St.
Palo Alto, CA 94304
415-694-2000
Sales: 415-857-8000
Literature Requests: 800-752-0900

Hitachi Home Electronics Inc.
401 West Artesia Blvd.
Compton, CA 90220
213-537-8383
800-262-1502
Service Center: 800-447-2882

IBM Corp.
4111 Northside Parkway
Atlanta, GA 30327
404-238-2126

INTV Corp.
3541 B Lomita Blvd.
Torrance, CA 90505
213-539-1940
800-421-2826

International Jensen Inc.
Service Department
4136 N. United Parkway
Schiller Park, IL 60176
800-323-0221
Fax: 312-671-6325

JVC Service & Engineering Co.
Division of U.S. JVC Corp.
107 Little Falls Rd.
Fairfield, NJ 07006
201-808-2100

Kawasho International
1500 Clinton St., Bldg. 747
Buffalo, NY 14206
716-821-0747
Kawasho flybacks ar available from:
Electro Dynamics
898 Route 106
E. Norwich, NY 11732
800-426-6423

Kaypro Corporation
4174 Sorrento Valley Blvd.
San Diego, CA 92121-1407
619-535-2155

Kenwood U.S.A., Corp.
PO Box 22745
Long Beach, Ca 90810-5745
Consumer Audio Parts:
213-549-7810
Amateur Radio/Landmobile Radio:
213-639-9000
Fax (Orders): 800-437-7255
Fax (Parts Inquiries): 213-609-2127

Kloss Video Corp.
See Ampro Corp.

KTV Inc.
Service Department
205 Moonachie Road
Moonachie, NJ 07074
Fax: 201-440-6557

Kyocera Electronics, Inc.
100 Randolph Rd., CN6700
Somerset, NJ 08875-1284
201-560-0060

Lloyd's Electronics, Inc.
National Parts
700 N. Commerce St.
Aurora, IL 60504
708-820-5490
Fax: 708-820-8103

Luxman
Division of Alpine
19145 Gramercy Place
PO Box 2859
Torrance, CA 90509
213-326-8000
For non-account customers
Pacific Coast Parts Distributor
15024 Staff Court
Gardena, CA 90248
213-515-0207
800-262-1312 (in CA)
800-421-5080
Fax: 215-538-4919

Marantz Co. Inc.
Division of Dynascan Corp.
700 N. Commerce
PO Box 2066
Aurora, IL 60504
708-820-4800
708-820-5490

Matsushita Services Co.
50 Meadowland Parkway
Secaucus, NJ 07094
201-348-7000
Fax: 201-348-7527

Mattel, Inc.
See INTV

Meguro (See UCM Corporation)

MGA (See Mitsubishi)

Micro Palm Computers
13773-500 ICOT Blvd.
Clearwater, FL 34620
813-530-0128
Fax: 813-530-0738

Midland International Corp.
1690 North Topping
Kansas City, MO 64120
800-MIDLAND

Mitsubishi Electronics America, Inc.
National Service Department
5757 Plaza Drive
PO Box 6007
Cypress, CA 90630-0007
714-220-2500
Parts: 800-553-7278
Fax: 714-220-4792
800-825-6655

NAD (USA) Inc.
575 University Avenue
Norwood, MA 02062
617-762-0202

NEC Technologies Inc.
Consumer Electronics and Computer Products Divisions
1255 Michael Drive
Wood Dale, IL 60191-1094
708-860-9500
Service and Parts: 708-860-0335
Fax: 800-356-2415

Nikko
Replacement parts are available from:
Hesperia Electronics Service
17431 Lilac, Unit C
Hesperia, CA 92345
Phone/Fax: 619-947-3493

Okidata
532 Fellowship Road
Mount Laurel, NJ 08054
609-235-2600
800-OKIDATA

Onkyo U.S.A. Corp.
200 Williams Drive
Ramsey, NJ 07446
201-825-7950
Fax: 201-825-8150

Ortofon, Inc.
Dual Parts and Service
122 Dupont Street
Plainview, NY 11803
516-349-7757

Penney, J.C.
National Parts Center
6840 Barton Road
Morrow, GA 30260
800-527-7115
Fax: 404-961-8408

Philips Consumer Electronics Co.
Philips Service Company
PO Box 967
907 Snapp Ferry Road
Greenville, TN 37744
615-636-5838
Fax: 615-636-5865
Replacement Parts:
Order Entry/ID/Inquiry/Service Manuals:
Phone: 800-851-8885
Fax: 800-535-3715

Pioneer Electronics Service, Inc.
2265 E. 220th St.
PO Box 1760
Long Beach, CA 90801-1760
800-457-2881
Fax: 213-816-0247

Proton
Proton Parts Department
5630 Cerritos Ave.
Cypress, CA 90630
800-829-3444
Fax: 714-952-8525

Radio Shack
Business Products Support Services
1600 One Tandy Center
Fort Worth, TX 76102
817-390-3011
Radio Shack Business Products Parts
812 E. Northside Dr.
Fort Worth, TX 76102
817-870-5695

Ricoh Corp.
3001 Orchard Pkwy.
San Jose, CA 95134
408-432-8800

Rotel of America
290 Larkin Street
Buffalo, NY 14220-8089
800-543-0471

Sampo Corporation of America
5550 Peachtree Industrial Blvd.
Norcross, GA 30071
404-449-6220
Fax: 404-447-1109

Samsung Electronics America, Inc.
Parts Department
18600 Broadwick St.
Rancho Dominguez, CA 90220
800-634-8276
Fax: 800-248-0498
Tech. Assistance: 800-833-6616

Sansui Electronics Corp.
Parts Department
17150 South Margay Avenue
PO Box 4687
Carson, CA 90746
213-604-7300
Fax: 213-604-1664

Sanyo-Fisher (USA) Corp.
Consumer Electronics Sales Div.
21350 Lassen St.
Chatsworth, CA 91311
818-998-7322
For Service: SFS Corporation
1200 West Artesia Blvd.
Compton, CA 90220
213-537-5830

Scott, H.H. Inc.
5601 Westside Ave.
North Bergen, NJ 07047
201-662-2000
Parts/Technical Literature:
H.H. Scott, Inc.
State Route 41 & County Rd. 100W
Princeton, IN 47670
800-695-0095
Fax: 812-386-6502
Tech. Serv.: 800-922-0738

Sears
Sears Tower
Chicago, IL 60684
312-875-5222

Sharp Electronics Corp.
Sharp Plaza
PO Box 650
Mahwah, NJ 07430-2135
Parts: 201-512-0055

Sherwood/Inkel Corporation
13845 Artesia Blvd.
Cerritos, CA 90701
213-926-6337

Shintom West Corp. of America
20435 S. Western Ave.
Torrance, CA 90501
213-328-7200
800-451-2025
Fax: 213-782-0338

Shure Brothers, Incorporated
222 Hartrey Avenue
Evanston, IL 60202-3696
Service: 708-866-5732
Customer Service: 708-866-2553
Fax: 708-866-2279

Signet
4701 Hudson Drive
Stow, OH 44224
216-650-2874

Sony Corp. of America/ Sony Service
Sony Drive (T2-4)
Park Ridge, NJ 07656
201-930-1000

Sony National Parts Center
8281 N.W. 107th Terrace
PO Box 20407
Kansas City, MO 64153
816-891-7550

Soundcraftsmen, Inc.
2200 S. Ritchey St.
Santa Ana, CA 92705
714-556-6191
Fax: 714-662-0750

Soundesign Corporation
115 Kennedy Drive
Sayreville, NJ 08872-1460
201-525-2214
Factory Parts Distribution Center:
53 Hook Rd.
Bayonne, NJ 07002
201-823-2515 Parts Orders
201-823-2577 Parts Information

Sparkomatic Corporation
Parts Department
Milford, PA 18337
717-296-6444
800-233-8831 (Nationwide)
800-592-8891 (In PA)

Symphonic Corp.
100 North St.
Teterboro, NJ 07608
201-288-2606

Studer Revox America, Inc.
1425 Elm Hill Pike
Nashville, TN 37210
615-254-5651

Superscope
See Marantz

Symphonic
See Funai

Tandy Consumer Service Parts
7439 Airport Freeway
Ft. Worth, TX 76118
817-284-8691
800-243-1311
Fax: 817-284-1961

Tandy National Parts
900 East Northside Dr.
Ft. Worth, TX 76102
817-870-5600
800-442-2425

Tatung Company of America, Inc.
2850 El Presidio St.
Long Beach, CA 90810
213-637-2105
213-979-7055
Fax: 213-637-8484

TDK Electronics Corp.
12 Harbor Park Dr.
Port Washington, NY 11050
212-807-1400

TEAC Corporation of America
Parts Department
PO Box 750
Montebello, CA 90640
213-726-0303
Fax: 213-727-7656
Parts Orders: 213-726-0303
Fax for Parts Orders: 800-366-8868

Technics
See Matsushita

Teknika Electronics Corp.
Parts Department
353 Route 46 West
Fairfield, NJ 07004
201-575-0380

Teledyne
See Acoustic Research

Thomson Consumer Electronics
600 N. Sherman Drive
Indianapolis, IN 46201
317-267-5000

Thomson Consumer Electronics
Distributor and Special Products Division
2000 Clements Bridge Rd.
Deptford, NJ 08096
609-853-2201
For Servicing Literature:
TCE Publications
10003 Bunsen Way
Louisville, KY 40299
502-491-8110

Toshiba America, Inc.
Computer Division
15091 Balce Pkwy.
Irvine, CA 92718
714-386-3000

Toshiba America Consumer Products Inc.
National Parts Center
19500 South Vermont Ave.
Torrance, CA 90502
800-345-9785
Fax: 213-515-3725

Unisonic Products Corp.
16 West 25th Street
New York, NY 10010
212-255-5400

Videonics
1370 Dell Ave.
Campbell, CA 95008
408-866-8300

V-M Corporation
The Voice of Music
305 Territorial
PO Box 426
Benton Harbor, MI 49022
616-925-8841

Wells-Gardner Electronics Corp.
2701 North Kildare Avenue
Chicago, IL 60639
312-252-8220

Yamaha Electronics Corp., USA
Parts Department
6722 Orangethorpe
Buena Park, CA 90620
714-522-9105
800-854-3264
714-994-3312
Fax Orders: 800-634-0355

Yorx Electronics Corp
405 Minnisink Rd.
Totowa, NJ 07512
201-256-0500

Zenith Data Systems
1000 Milwaukee Avenue
Glenview, IL 60025
708-699-4800

ZDS Customer Service Division
1900 North Austin
Chicago, IL 60639
312-745-2000

Zenith ElectronicsCorp./ Videotech Corp.
11000 Seymour Ave.
Franklin Park, IL 60131
708-671-7550

Hand-held digital troubleshooting devices - Part II

By Vaughn D. Martin

In Part I of this two-part article, we investigated current pulsers and current tracers. Now we'll continue to see how these and other hand-held digital troubleshooting instruments can help you. We'll also investigate some actual case histories of tough digital troubleshooting problems being solved. Let's start with the logic probe.

The logic probe: the "digital screwdriver"

In 1969, Hewlett-Packard introduced the first purely functional measurement tool for troubleshooting digital circuits: the 10525A logic probe. Since then, logic probes from this and other manufacturers, have become as commonly used by troubleshooters as screwdrivers are by mechanics: they are simple to use, versatile, and out of the way when not in use.

There now are several types of probes, led by the multi-family model 545A (see Figure 1). Each is intended to be highly useful in everyday applications. The greatest benefit of a probe is that the user can take it for granted: its greatest financial contribution, however, is that the probe replaces analog devices costing an order of magnitude more for most digital troubleshooting applications.

The logic probe, for example, uses a single lamp to indicate the various states possible on a digital single path (HIGH, LOW, single pulses, pulse trains, open circuit).

Another main feature of a probe is its ability to "stretch" a 10ns pulse to 100ms so that you can see it. This is accomplished by using the leading edge of a short pulse to trigger a circuit whose time delay is 100ms. Single pulses cause the probe's lamp to flash; pulse trains flash at 10Hz regardless of frequency. The great benefit provided by probes is simply in knowing that pulse activity is present. Usually that is all the information needed.

However simple the probe may appear, it can't simplify many of the

Martin is Chief Engineer in the Automatic Test Systems Division at Kelly Air Force Base.

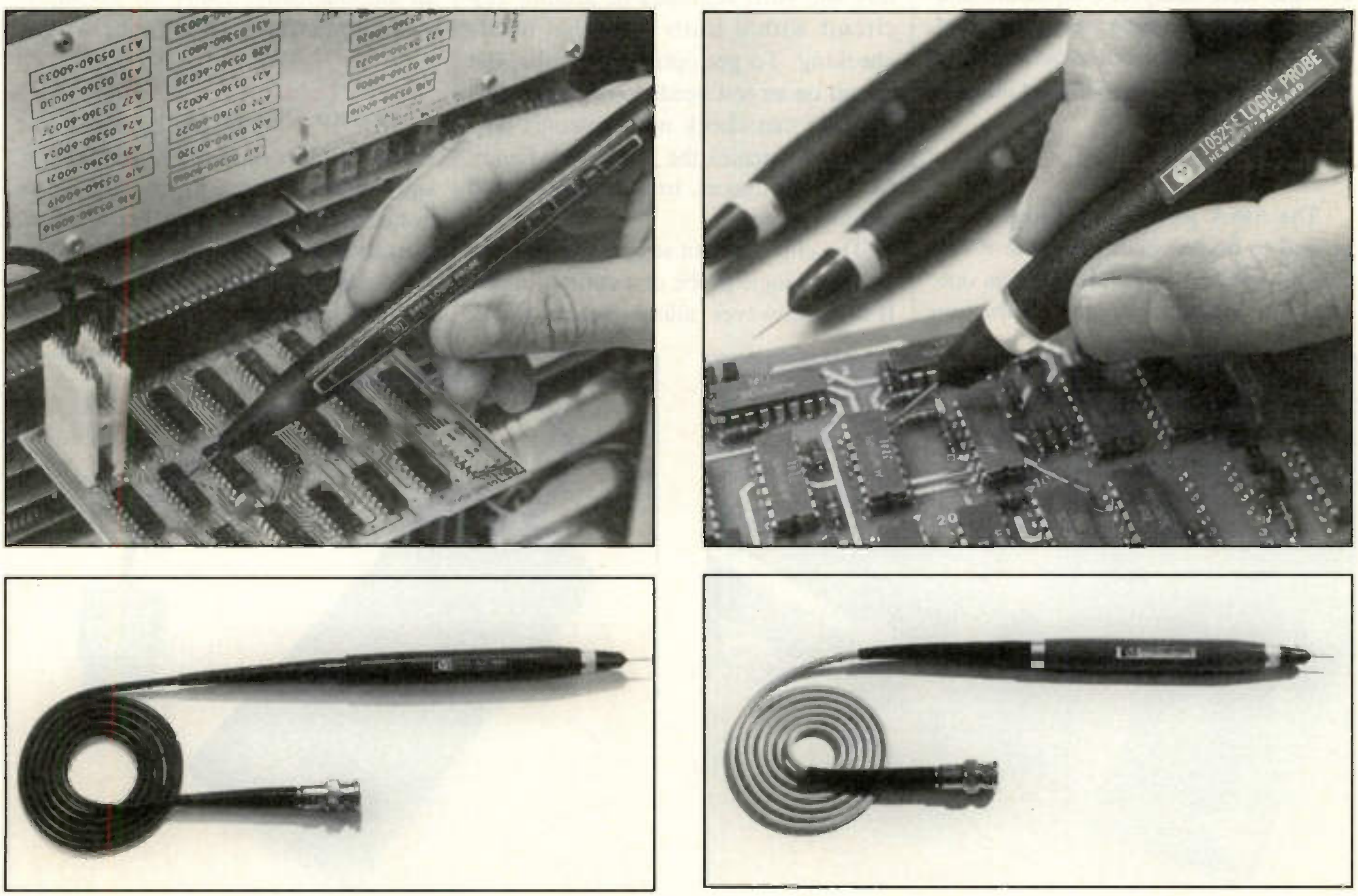


Figure 1. Probes such as these provide a low-cost way to check electronic activity in logic circuits.

Figure 2. The logic clip clips onto any TTL or CMOS IC and lets the user see up to 16 pins of an IC.

FAULT	STIMULUS	RESPONSE	TEST METHOD
Shorted Node[1]	Pulser[2]	Current Tracer	• Pulse node • Follow current pulses to short
Stuck Data Bus	Pulser[2]	Current Tracer	• Pulse bus line • Trace current to device holding the bus in a stuck condition
Signal Line Short to Vcc or Ground	Pulser	Probe Current Tracer	• Pulse and probe test point simultaneously • Short to Vcc or Ground cannot be over-ridden by pulsing • Pulse test point, and follow current pulses to the short with tracer
Vcc to Ground Short	Pulser	Current Tracer	• Remove power from test circuit • Disconnect electrolytic bypass capacitors • Pulse across Vcc and ground using accessory connectors provided • Trace current to fault
Suspected Internally Open IC	Pulser[2]	Probe	• Pulse device input • Probe output for response
Solder Bridge	Pulser[2]	Current Tracer	• Pulse suspect line(s) • Trace current pulses to the fault (Light goes out when solder bridge passed)
Sequential Logic Fault in Counter or Shift Register	Pulser	Clip	• Circuit clock de-activated • Use Pulser to enter desired number of pulses • Clip onto counter or shift register and verify device's truth table

1. A node is an interconnection between two or more IC's.
2. Use the Pulser to provide stimulus, or use normal circuit signals, whichever is most convenient.

Table 1.

inherently complex problems of troubleshooting PC boards holding up to 100 ICs, or more. There are few substitutes for having good circuit documentation, plus some way to narrow down the fault area, such as the combined use of logic state analyzers, signature analyzers, troubleshooting trees, and finally node and gate troubleshooters that positively identify the single fault in a complex system.

The logic clip

The 548A logic clip (Figure 2) has proved to be successful because it's so easy to use and so handy. It clips onto any TTL or CMOS IC and lets the user see up to 16 pins of an IC at once. This feature is particularly useful with counters and shift registers or around any circuit with a truth table that needs checking. To get optimum results, the circuit under test needs to be stopped so the user can check inputs versus outputs. This makes the clip really handy for both designers, troubleshooters and technicians.

The clip does not stretch short pulses as does a logic probe or a current tracer. It does, however, allow users to check out an entire IC at one time, and gets its power from the circuit under test, and all automatically. There are no adjustments, switch settings or knobs to turn.

The logic comparator

The HP 10529A logic comparator, Figure 3, clips onto a TTL or DTL IC and detects failures by comparing the in-circuit test IC with a known good reference. This reference is inserted into the comparator and the outputs of the IC to be tested are tested via 16 minia-

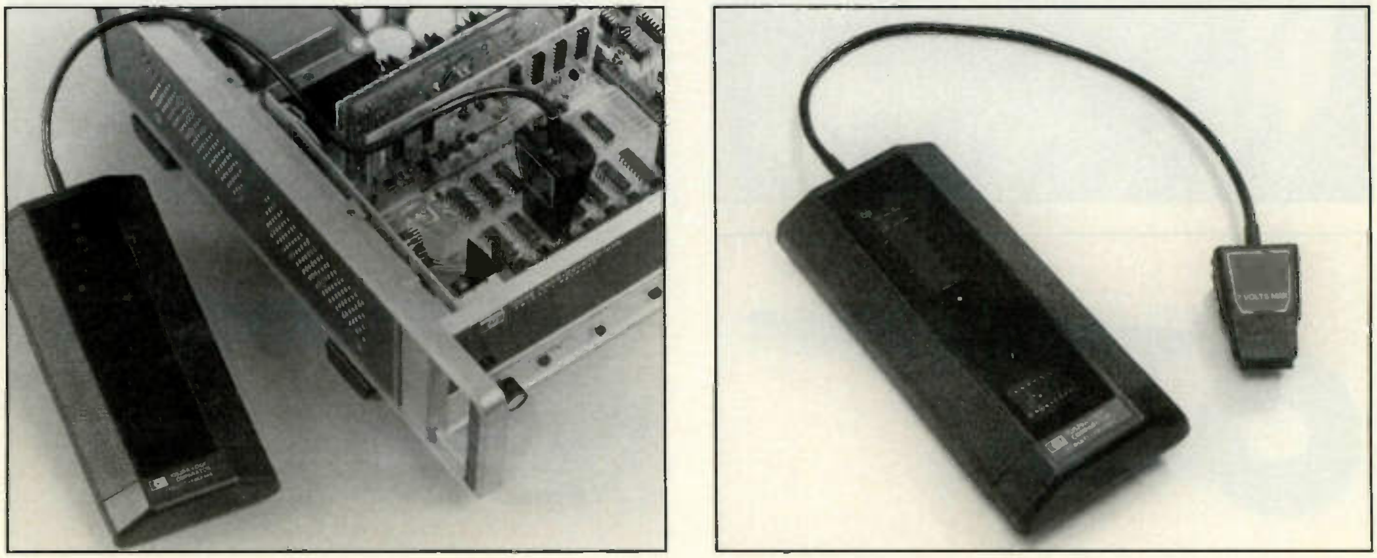


Figure 3. A logic comparator clips onto a TTL or DTL IC and detects failures by comparing the in-circuit test IC with a known good reference.

ture switches which tell the comparator which IC pins are outputs and which are inputs. Any variations from the comparator's IC is identified by a lighted LED.

A failure on any input pin, such as an internal short, will appear as a failure on the IC driving the failed IC. Thus, a failure actually pinpoints a failed or malfunctioning node. A test board is supplied to exercise all of the circuitry. Twenty additional blank reference boards are also supplied for quickly popping in a reference good working IC against which to compare a potentially failed IC.

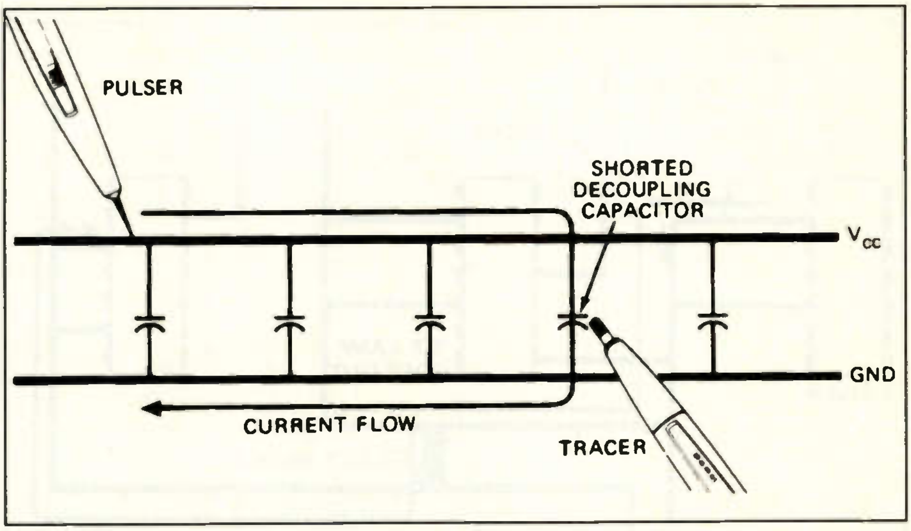


Figure 4. Use of the logic pulser and current tracer provide an efficient, non-destructive method of locating short circuits on logic boards.

Stimulus response testing

In the digital troubleshooting world the idea of stimulus- response testing is a relatively new one. Tools to measure logic states have existed for quite some time, but forcing a state change, especially on a line being held LOW is something that was difficult before the introduction of logic pulsers.

To accomplish such a task meant disconnecting a device's input from the circuit, and then pushing the input with a source. In practical terms, you often unsoldered and lifted an IC leg, or cut a circuit trace, then used a pulse generator to drive a gate's input.

The "why" of such destructive techniques has to do with the internal structure of standard TTL gates. A TTL gate in its LOW state is a saturated transistor to ground. To move a TTL output HIGH requires a great deal of current drive.

The catch here is that continuous high current tends to destroy the TTL gate's output transistor. So, it was usually safer and easier to simply disconnect a node driver from a circuit and replace it with a low current stimulus tool.

The logic pulser changed this because it delivers both high current and low total energy by generating very short pulses sufficient to momentarily override TTL logic LOW states. The 10526T and 546A can both output high current, but pulse width is never sufficiently long to degrade a gate's performance (the pulser will usually generate a TTL HIGH for only about 500ns).

And so, stimulus-response testing using either of these powerful pulsers in digital circuits is as convenient as any technique devised for analog circuitry.

To help show how straightforward digital stimulus-testing can be, Table 1 outlines seven node and gate troubleshooting problems and how pulsers and other hand-held digital IC troubleshooters would be employed to pinpoint the fault.

This section also contains several examples of typical failures to help you derive the maximum benefit from the IC troubleshooters.

V_{cc}-to-ground shorts

Shorts between Vcc and ground on a PC board (Figure 4) have typically been located by using some of the following troubleshooting techniques:

• Hook a high current dc supply up

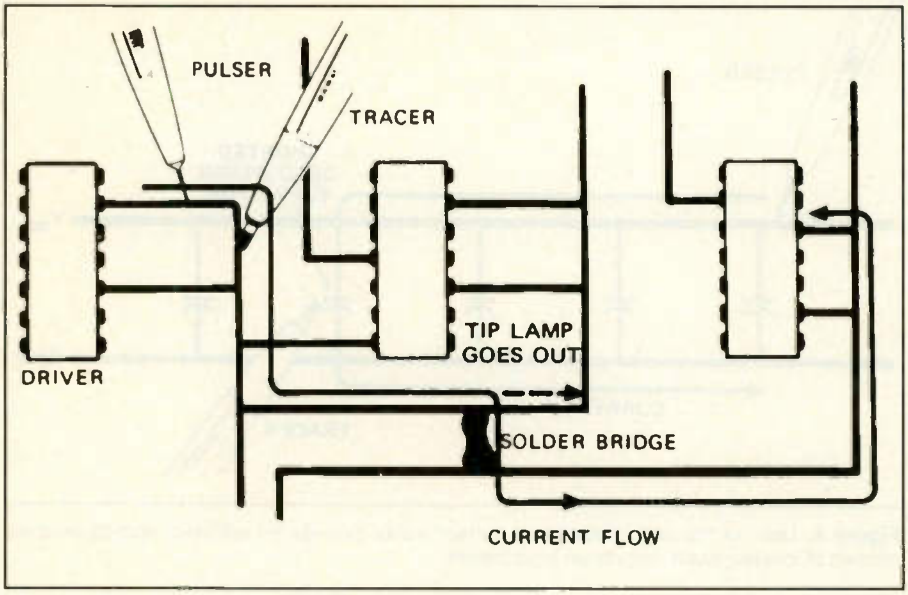


Figure 5. With higher density PC boards, the occurence of shorts, such as shown here. between two nodes or a node and a ground, has become commonplace.

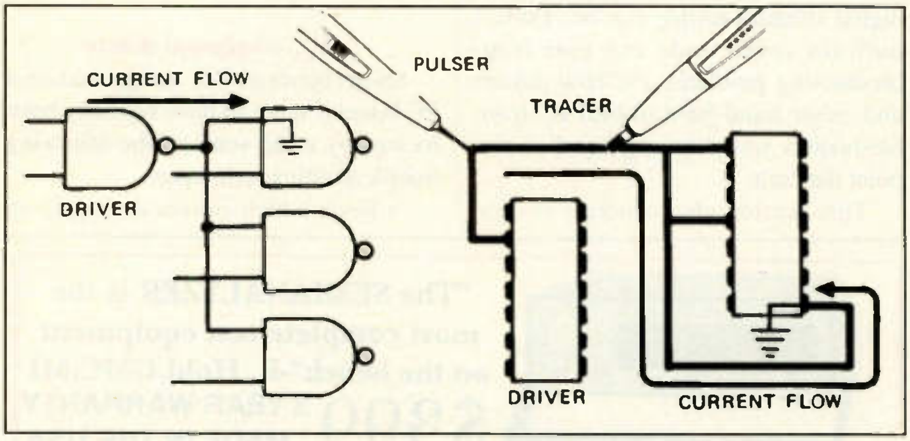
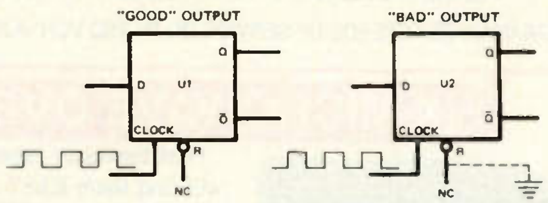


Figure 6. A frequently occurring problem in troubleshooting is a stuck node, such as shown here. The problem is to determine if the driver is dead, or if a shorted input is clamping the node to a fixed value.

Example 1



Here are two D-Flip-Flops. One works normally, the other doesn't change output state although input conditions are identical for both.

a) Use the pulser at the D input and probe Q and Q to see if the outputs change. (In this actual example, they didn't.)

b) The Reset line in the above case was found to be stuck in a LOW state by using a logic probe. Pulsing and probing simultaneously indicated the Reset line couldn't be driven HIGH, indicating the line was shorted to ground.

c) Further use of pulser and current tracer showed that the area near the Reset line drew current when pulsed and that the D-Flip-Flop would not perform operations when the Reset line was pulsed.

d) Using the pulser and tracer the operator found a hairline solder bridge from the Reset line to ground.

Figure 7. Using a logic pulser and current tracer allowed a technician to find a hairline solder bridge in this circuit.

to the PC board and see which traces change color, delaminate, or burn up. Again, refer to Figure 4.

• Measure microvolt drops across active supply traces to see where the current is flowing.

• Replace all the capacitors on the board.

• Replace all ICs on the board.

• Put the board on the "dogpile" and troubleshoot it on a rainy day.

• Scrap the board.

Scrapping the board seems extreme, but most people's experiences show that shorted decoupling capacitors account for most supply-to-ground shorts, and faulty capacitors cause most of the faults. But if there are a lot of bypass capacitors (or if you want to minimize component removal, and thereby limit damage to the PC board) it usually won't pay to take them out one at a time to find the shorted one. To help solve this problem there are IC troubleshooters.

So, to quickly find shorted parts on a board, use the logic pulser and current tracer (and refer to the following troubleshooting tips).

Troubleshooting tips:

1. Remove power from the circuit. Power the pulser and tracer from a 5V supply.

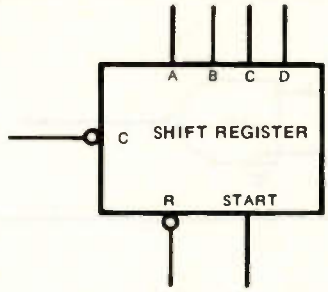
2. Lift one side of the electrolytics on the supply bus. This speeds up troubleshooting time by a factor of ten (electrolytics "eat" pulses creating many different current paths).

3. Pulse across the power supply pins or across components in the corners. Use the cables and grabbers provided with the pulser for this purpose so your hands are free to move the tracer around. Moving the pulsing point around from the corner and tracing current from the pulsing point helps speed fault location on tough-to-solve faults.

4. Because you're pulsing into a short, there is lots of current available. Set tracer sensitivity to 1A.

5. With boards where power enters through more than one connector, parallel current paths can exist. Moving the pulsing point around is helpful because the current path can change between the pulsing point and the short.

6. Sometimes a current path will



Outputs A, B, C, and D are LOW; other circuit inputs appear normal.

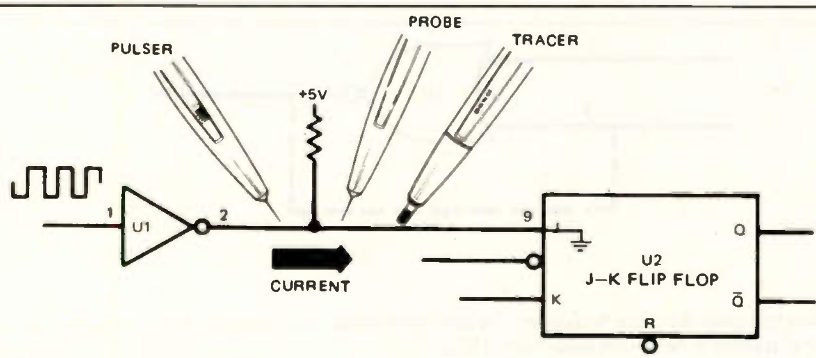
a) Use the probe and pulser to make sure A, B, C, and D aren't grounded (probe and pulse each pin — if ungrounded the states will be changed by the pulses).

b) Probe other pins on the IC and check for normal/abnormal indications.

c) Measure current at pins A, B, C, and D by pulsing each pin, and tracing to see if current flow is indicated from the pulser to the Shift Register.

d) In this example all signals are normal except A, B, C, and D. They are stuck LOW, and are not indicating current flow, which suggests an internal failure in the IC, and not in the circuits connected to it.

Figure 8. Exploration of this circuit with a logic pulser and current tracer led the technician to the conclusion that the problem was an internal failure in the IC.



The node between U1 and U2 was stuck LOW when measured by a logic probe, although probing revealed pulse activity at U1's input.

a) Probe U1 pin 2. If no voltage activity is present, pulse pin 2 and see if the node's state can be changed.

b) In this case the state couldn't be altered using a pulser so current was traced from U1-2 to U2-9, the J-K flip-flops input.

Figure 9. The use of a pulser, probe and current tracer in unison revealed useful information about this logic circuit problem.

seem to disappear. Several things can cause this situation to occur:

• The PC board trace becomes wider and current "fans out", lessening the field intensity under the tracer tip.

• The current may pass through a plated-through hole in the PC board.

• Current "branches" and goes to several different places via several different paths; thereby lessening current density in the path you've been following.

7. When you think you've located the fault, verify it by moving the pulsing point to the short. No current paths should be detected elsewhere on the board if you pulse directly across a short.

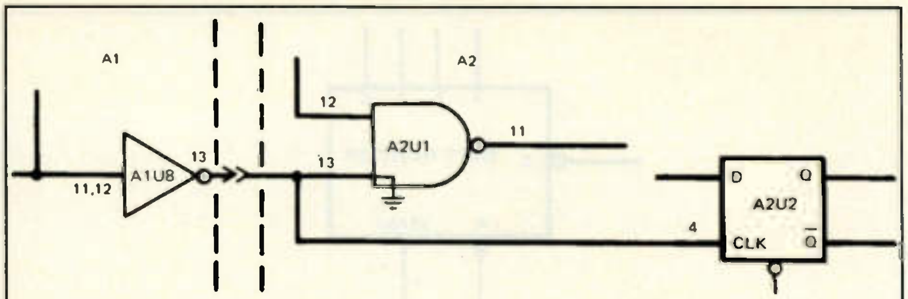
As non-destructively as possible, remove the suspected component and verify that the Vcc-to-ground short no longer exists.

Solder/gold/copper bridge faults

With higher density PC boards, the occurrence of shorts between two nodes and a node and a ground has become commonplace. Refer to Figure 5.

1. Pulse the driver output on the faulty node at the desired pulse rate.

2. Adjust sensitivity of the current



Pin 13 of U1 is being held LOW. (In this case the node consisting of A1U8 13, A2U1 13 and A2U2 4 is spread over two PC boards.)

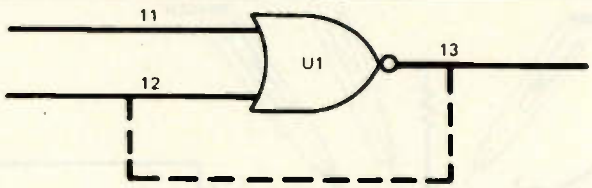
a) Use the HP 10529A Comparator to find the faulty node. The comparator identifies A1U8 13 as bad allowing you to troubleshoot further.

b) Probing and pulsing the node indicates it is stuck LOW.

c) Pulsing and current tracing at A1U8 13 indicates current is flowing toward PC board A2.

d) A2U1 is sinking current and holding the node LOW. As a result, U2 is not being clocked. The comparator located the failure (A1U8 pin 13), but it required the tracer to indicate current flow to verify A2U1 as the cause.

Figure 10. Use of the logic comparator and the current tracer led to the conclusion that in this circuit the problem was casued by a faulty gate, A2U1.



U1 tests bad using the probe and pulser. The problem is to find out the nature of the fault before removing what appears to be an internally shorted IC.

a) Pulse pin 12, and observe with the probe that pin 13 changes state but in the wrong direction (12 and 13 are in the **same** state).

b) Pulse pin 12 and read current at pin 13, then, reverse the two instruments. Current is identical in both directions.

c) Pins 12 and 13 are shorted together by a solder bridge on the back of the circuit board. Although originally located by pulser and probe, the tracer adds important information that keeps you from removing the IC.

Firgure 11. The tracer, in conjunction with the probe and pulser, can provide information that will allow the technician to isolate the problem associated with a gate to the circuitry external to the gate, and therefore make it unnecessary to remove the gate

tracer at the node driver output; use the current tracer to follow the current pulses to the short.

3. The light on the current tracer will go out when the solder bridge is passed.

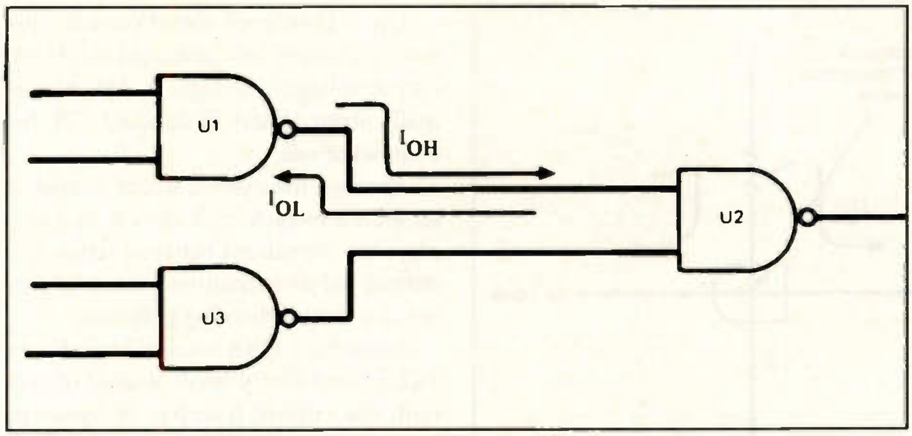
Node and gate troubleshooting examples

A frequently occurring problem in troubleshooting is a stuck node. For this example, refer to Figure 6. The problem is to determine if the driver is dead, or if a shorted input is clamping the node to a fixed value.

1. Use the probe and pulser to test the node's logic state and to see if the state can be changed (shorts to Vcc or ground cannot be overridden by pulsing).

2. Pulsing the node enables the user to follow the current directly to the faulty input.

3. Set the current tracer reference



Figuire 12. Knowing the amount of current flow between logic circuit elements during logic HIGH and LOW states can help you when troubleshooting faults. This illustration shows current flow between two NAND gates under both HIGH and LOW states.

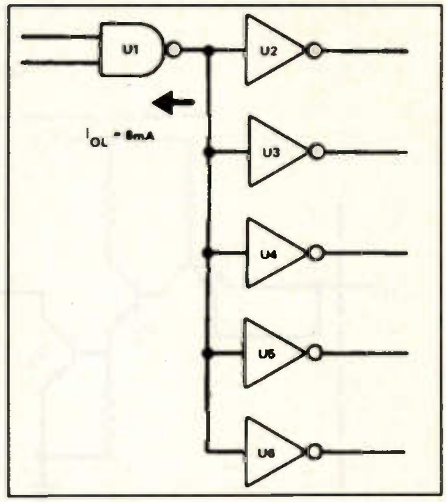


Figure 14. When the output of U1 is low, the current is 8mA.

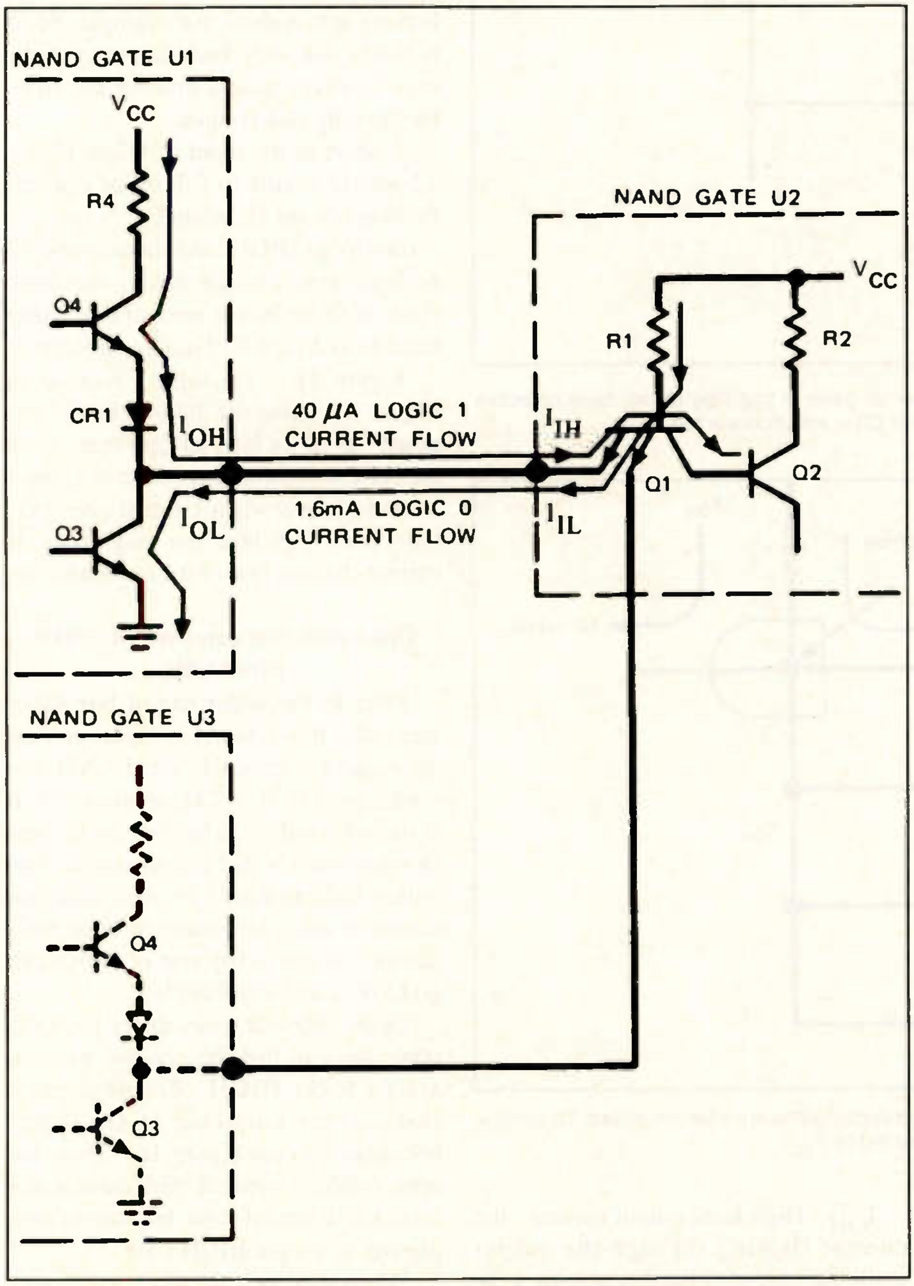


Figure 13. This is the same circuit as in Figure 12, with the actual IC components shown.

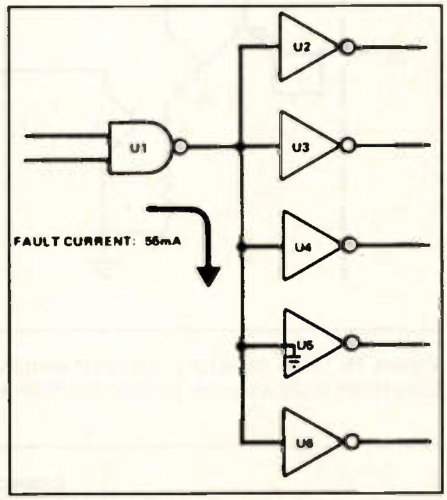


Figure 15. When the output of U1 in this circuit changes from a low state to a high state the magnitude of current changes from 8mA to 55mA.

level by adjusting tracer sensitivity until the light just lights with the pulser in the 100Hz mode.

4. Use the current tracer to locate the fault.

The five examples in Figures 7 through 10 illustrate how to troubleshoot flip-flops and shift registers. Figure 11 describes how the tracer, in conjunction with the probe and pulser, can provide information that will allow the technician to isolate the problem associated with a gate to the circuitry external to the gate, and therefore make it unnecessary to remove the gate.

Current flow in digital circuits

Knowing the amount of current flow between logic circuit elements during logic HIGH and LOW states can help

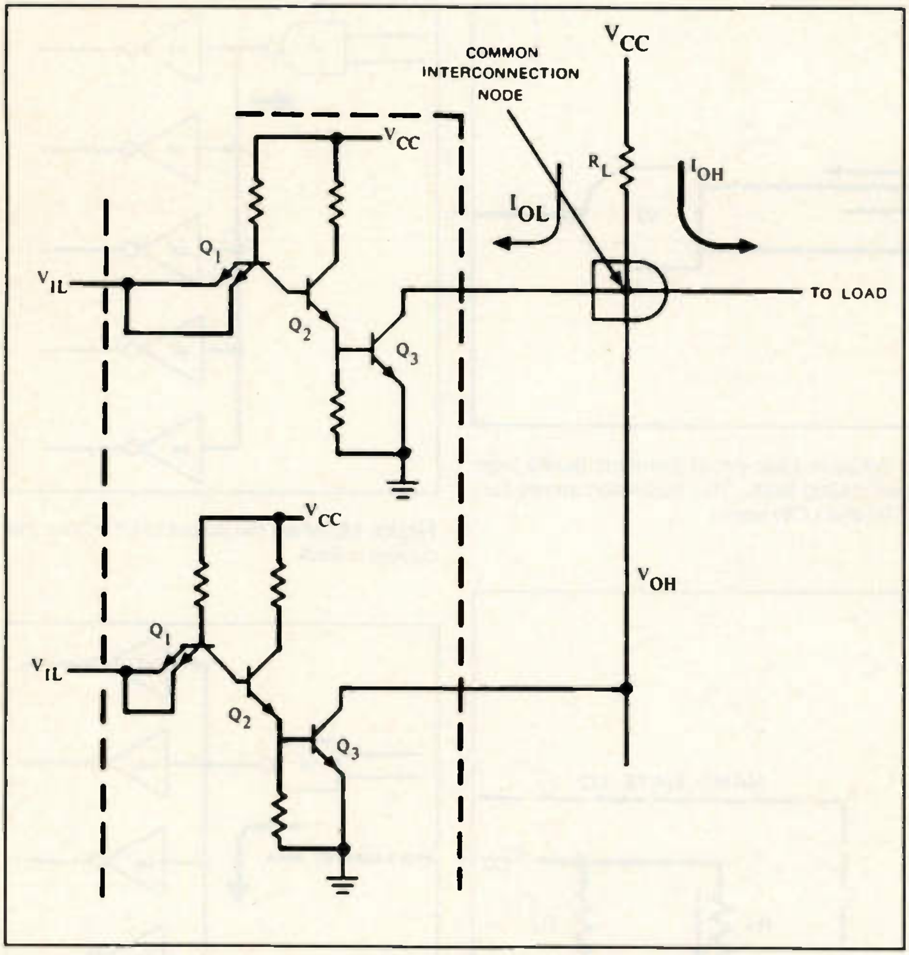


Figure 16. Open collector gates differ from the other gates in that they do not have an active logic HIGH current source. Instead, the collector of Q3 is left unconnected.

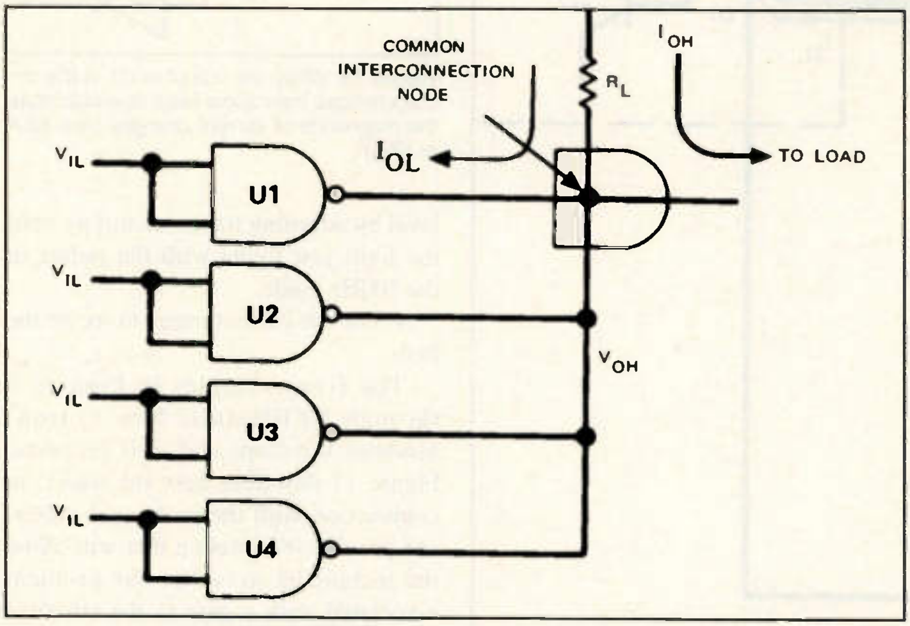


Figure 17. When used in a circuit, several open collector gates are interconnected. To provide logic HIGH current, a pull-up resistor R_L is connected to V_{CC}.

you when troubleshooting faults. Figure 12 shows current flow between two NAND gates under both HIGH and LOW states.

I_{OH} - High level output current - the current flowing through the output while the output voltage is at logic 1. In TTL, this is about 40μA.

I_{OL} - Low level output current - the current flowing into an output while the output voltage is at logic 0. This is normally about 1.6mA in standard TTL for a fanout of one.

Because the current tracer's input is an inductive pickup, it detects and displays the transitions between states. So, current pulses (transitions) must be present for troubleshooting purposes.

Since the 1.6mA usually available in TTL is a relatively small amount of current, the current tracer is designed to see transitions much smaller in amplitude. During troubleshooting of a fault, however, current associated with all logic families tends to be much higher, up to 55mA for standard TTL circuits looking into a short, for example. So, it is likely that only fault current will be seen in many cases, making the troubleshooting task simpler.

A short in the input of U2 in Figure 12 would result in 55mA of current flowing toward U2 when U1 tries to go HIGH, and there would be no logic state change due to the short. Both conditions are measurable using hand-held digital IC Troubleshooters.

Figure 13 is the same circuit as in Figure 12, only the IC has been "exposed" as to its internal operation. Note the current division here. Note in Figures 14 and 15 how when U1 first goes low, then goes high how the magnitude of current changes from 8mA to 55mA.

Open collector gates/wired-ANDs, wired ORs

Prior to the wider use of bus structures like those found in microprocessor-based systems, the wired-AND was used a great deal in TTL applications. It is included only as a brief example here in case you should encounter it. The wired-AND employs an open collector circuit to allow designers to hook up a number of gates, any one of which can go LOW and control the bus.

Open collector gates differ from the other gates in that they do not have an active logic HIGH current source. Instead, the collector of Q3 is left unconnected (see Figure 16). Thus, the open collector gate can sink current in a logic LOW output state, but cannot supply any in a logic HIGH state.

When used in a circuit, several open collector gates are interconnected, as

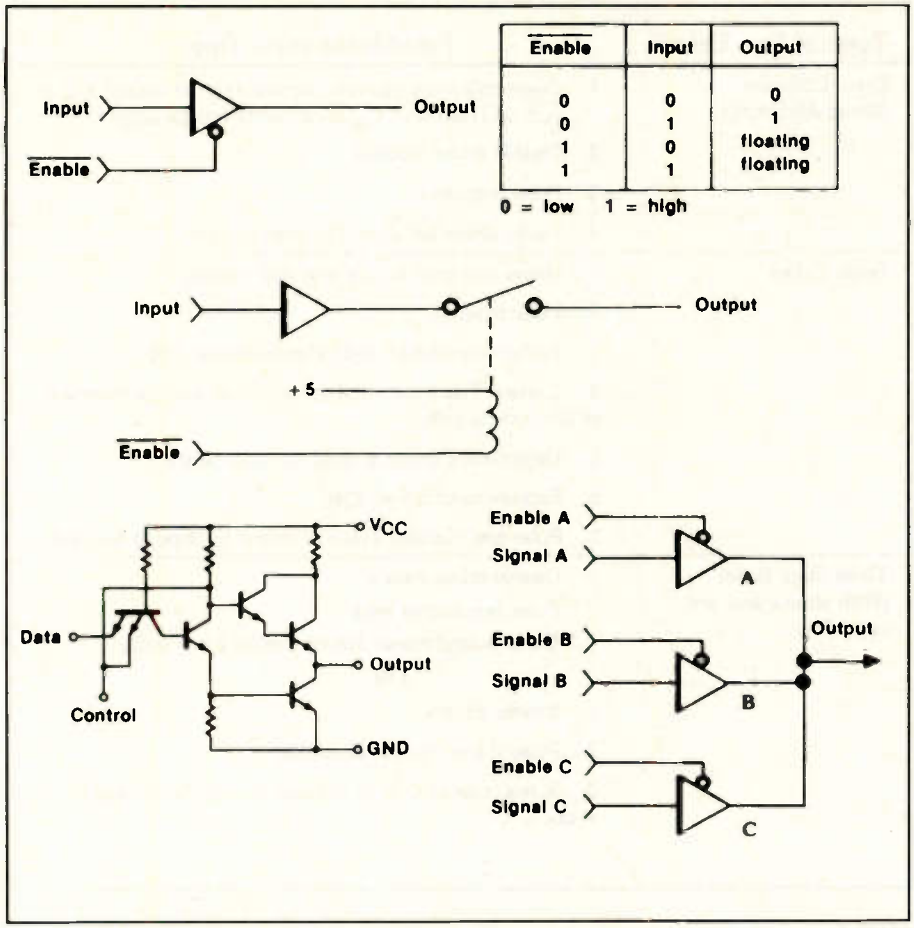


Figure 18. The three-state driver, as shown here, is found extensively in microprocessor circuitry. The three-state driver is built into many of the ICs of a microcomputer to allow common bus usage by all the computer's devices.

shown in Figure 17. To provide logic HIGH current, a pull-up resistor (R_L) is connected to V_{CC}.

As long as transistor Q3 in every gate is turned off, the voltage at the common interconnection node is near V_{CC} (logic high), but when Q3 in any one gate is on, the voltage drops to logic 0.

The result of this interconnection is that the common node acts as an AND gate in itself - it is high only when all of its inputs are logic HIGH. This is usually referred to as an implied, dot, or wired AND configuration. This circuit becomes a wired-OR in TTL if the inputs and outputs are active low. In families other than TTL, a similar connection as shown in Figure 16 also performs the OR function.

For these reasons, the terms wired-AND and wired-OR are often used to mean the same thing. A similar interconnection of outputs is also used with the gates of logic families other than TTL, in which case it also performs an OR function. As a result, the interconnection shown in Figure 17 is sometimes called a wired- OR.

Three-state buses

A further development of the wired-AND idea is shown in Figures 18a to 18d. This is the three-state driver found extensively in microprocessor circuitry. The three-state driver is built into many of the ICs of a microcomputer to allow common bus usage by all the computer's devices.

A read only memory (ROM), for example, has a three-state driver on each of its data output lines. When the ROM is enabled, it puts data on the microcomputer's data bus by turning on the chip's internal three-state driver outputs.

Troubleshooting bus structures

Three-state drivers and wired-ANDs are often difficult to troubleshoot. That's because a bus structure can be controlled by one faulty device which causes the entire bus to be faulty. Since all points on the bus are at the same voltage potential, voltmeters, oscilloscopes and other voltage measuring instruments can't indicate which component is causing the bus to be stuck.

Talkers or listeners?

The first decision to make when troubleshooting bus structures is to decide if the fault exists in the buses' drivers or listeners. The following gives you some general information about talkers and listeners so you can fault isolate a bus problem. The techniques described here also depend on the use of the hand-held digital IC troubleshooters.

The bus driver: dead or alive?

Do you find pulse activity on the bus driver's inputs? Is the driver enabled? Does the driver respond to a stimulus?

These questions are answerable using the probe and pulser to first see the state of the circuit, and then to see if the state changes when the circuit is pulsed. Be sure you enable or disable the driver without stressing it either physically or electrically.

Also, check multiple inputs to drivers to make sure you have control when you want to stimulate the circuit. If you find this impossible to do because of physical packaging of the circuit, check the bus listeners first.

Often, use of PC board testers, logic analyzers, or signature analyzers will have led you to suspect a particular faulty bus line. The following should give you tips to make quick checks of stuck lines and further isolate the fault.

Stuck low/stuck high

When a bus is stuck in one logic state, it is not necessarily inactive. A bus stuck LOW might be shorted to ground at the input to one of the bus listeners. If this were so, the bus driver would still be trying to drive the bus, and failing. The driver wouldn't be able to alter the bus logic state, but there would be a lot of current flowing on the bus from the driver to the fault.

This current activity is traceable using the current tracer. If the driver is good, but no current pulses are available on the bus for tracing purposes, use a logic pulser at the driver output, and then trace the current flow from the pulser to the fault.

Use the IC troubleshooters to check bus listeners as your next step after eliminating shorts as a bus problem. If the line wasn't shorted, verify if the listeners on the bus respond to inputs. An open end could exist there, on the bus line itself, or perhaps the bus driver is faulty. Use the pulser to stimulate lines without activity, then monitor the logic states and current activity present on the bus to pinpoint open lines and open listener inputs using the probe and current tracer.

Open circuits

A stuck bus can occur as the result of an open circuit at one of three points: the bus driver output, the bus line itself, or a listener input. Generally, these can be pinpointed by pulsing and probing, or by using the current tracer to see the existence or absence of current at inputs or outputs.

General tips

Finally, Table 2 contains several generalized bus troubleshooting procedures. They are not likely to describe all buses, or even a specific bus you will run into. There is great variety in bus design. ■

Type of Bus Driver	Troubleshooting Tips
Open Collector (Wired-AND/OR)	1. Open collectors can sink current, but not source it so a pull-up resistor to V_{CC} is connected to the output. 2. Disable driver input(s) 3. Pulse output(s) 4. Faulty driver will draw the most current
Single Driver	1. Driver can both source and sink current 2. Pulse input(s) 3. Probe output(s) for logic state changes, **OR** 4. Current Trace output(s) for amplitude and the direction of the current path 5. Determine if driver is dead or bus is stuck 6. Replace dead driver, **OR** 7. Pulse and Current Trace at output to pinpoint bus fault
Three-State Buffer (With source and sink capability)	1. Disable driver inputs 2. Pulse bus output lines 3. If one output draws current, verify if it is faulty **OR** 1. Enable drivers 2. Pulse driver inputs individually 3. If one output fails to indicate current flow, verify if it is open.

Table 2.

Circle (11) on Reply Card

ES&T Manufacturers' schematics **PROFAX**

DECEMBER 1992

Profax Number

Hitachi
VT - M150A/M151A, AW/VCR NO. 3472E......................3096

LUMINANCE/CHROMA SCHEMATIC DIAGRAM

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

LUMINANCE/CHROMA SCHEMATIC DIAGRAM

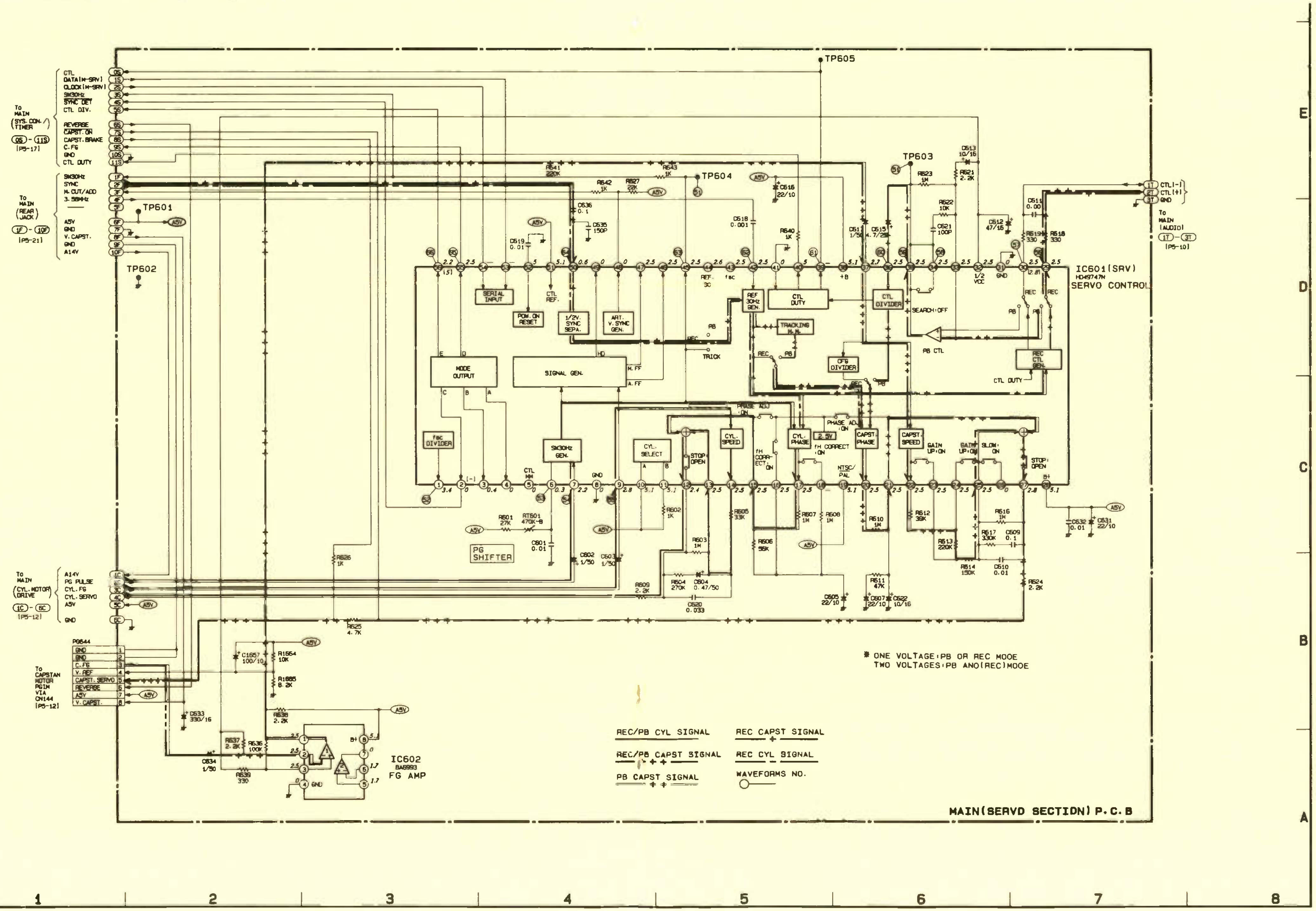
Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



POWER SUPPLY SCHEMATIC DIAGRAM (for A)

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.

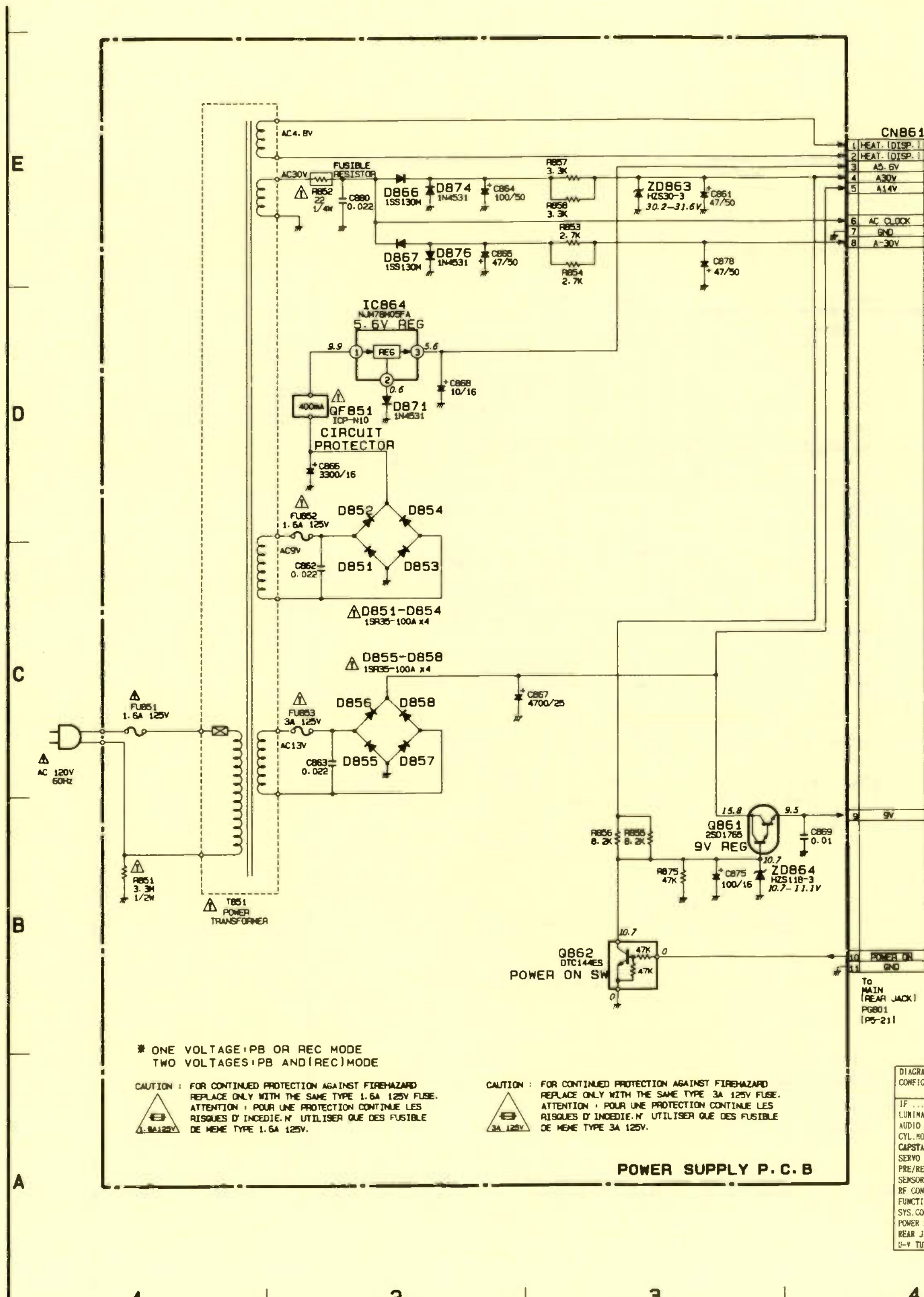


DIAGRAM CONFIGURATION	SCHEMATIC DIAGRAM	CIRCUIT BOARD DIAGRAM
IF	5-6 /	-
LUMINANCE/CHROMA	5-7 /	5-27
AUDIO	5-10 /	5-25
CYL.MOTOR DRIVE	5-12 /	5-25
CAPSTAN MOTOR	5-12 /	-
SERVO	5-13 /	5-25
PRE/REC AMP	5-15 /	-
SENSOR	5-15 /	5-29
RF CONVERTER	5-16 /	-
FUNCTION SW	5-16 /	5-26
SYS.CON./TIMER	5-17 /	5-25
POWER SUPPLY	5-19 /	5-27
REAR JACK	5-21 /	5-25
U-V TUNER	5-23 /	-

PROFAX Manufacturers' schematics 3096

POWER SUPPLY SCHEMATIC DIAGRAM (for AW)

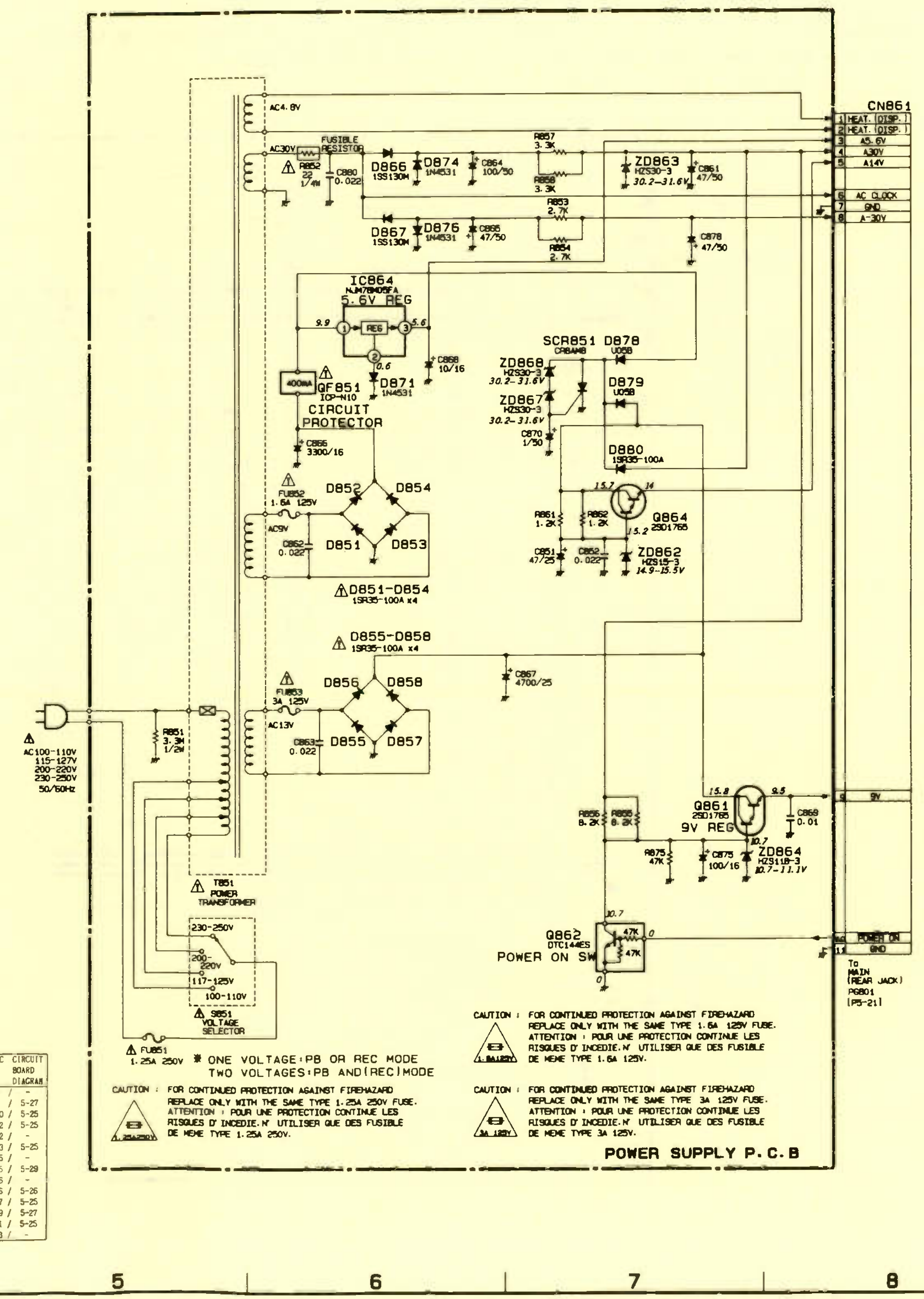
Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



Reprinted by permission of the Hitachi Corporation of America
Copyright 1992, CQ Communications, 76 N. Broadway, Hicksville, NY 11801

SYSTEM CON./TIMER SCHEMATIC DIAGRAM

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.

3096 PROFAX as&t Manufacturers' schematics

SYSTEM CON./TIMER SCHEMATIC DIAGRAM

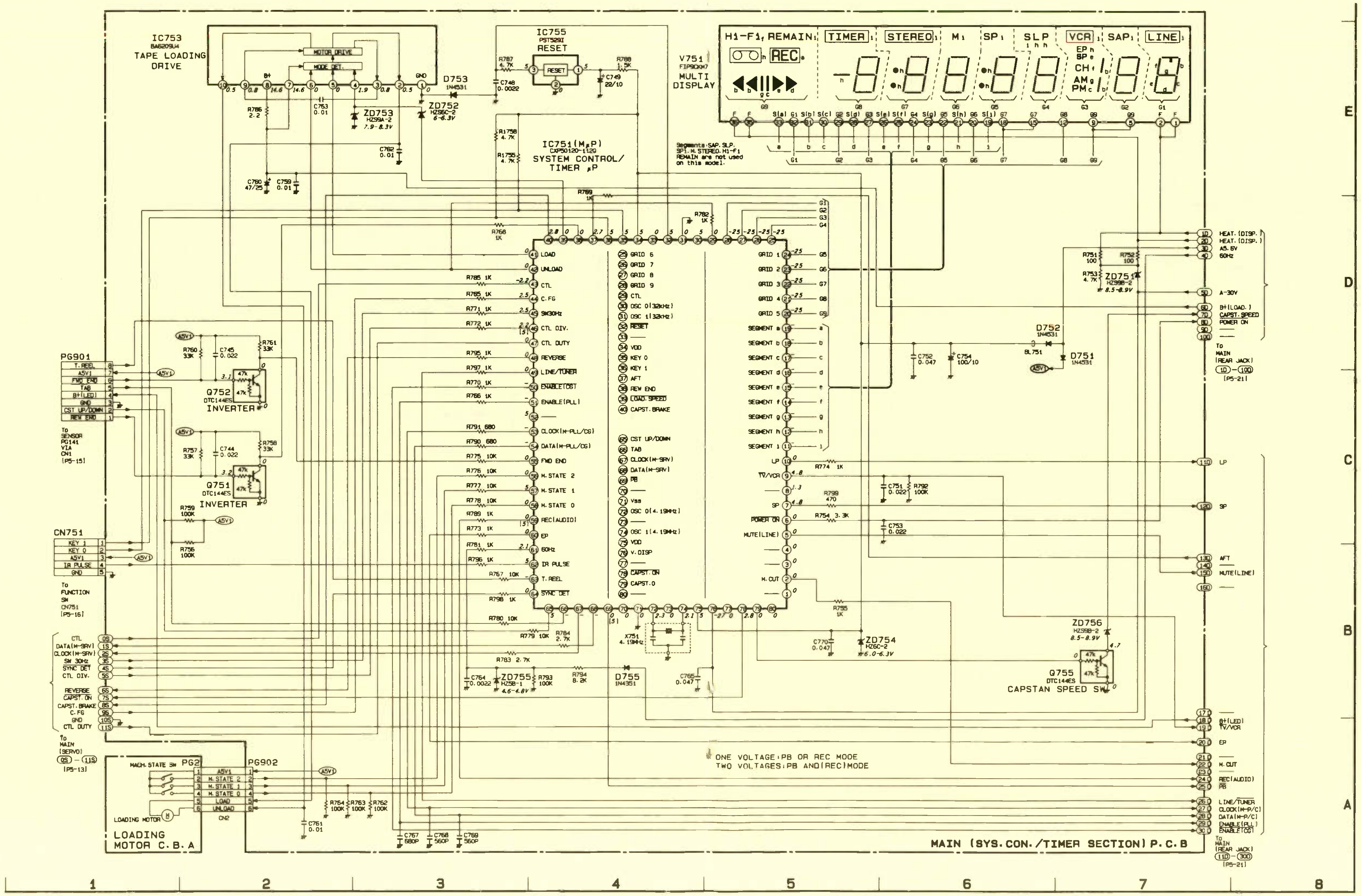
Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



Reprinted by permission of the Hitachi Corporation of America
Copyright 1992, CQ Communications, 76 N. Broadway, Hicksville, NY 11801

PROFAX

ES&T Manufacturers' schematics

Hitachi
VT-M150A/M151A
VCR NO. 3472E

DECEMBER 1992

SERVO SCHEMATIC DIAGRAM

Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

Use of substitute replacement parts that do not have the same safety characteristics as recommended in factory service information may create shock, fire, excessive x-radiation or other hazards.

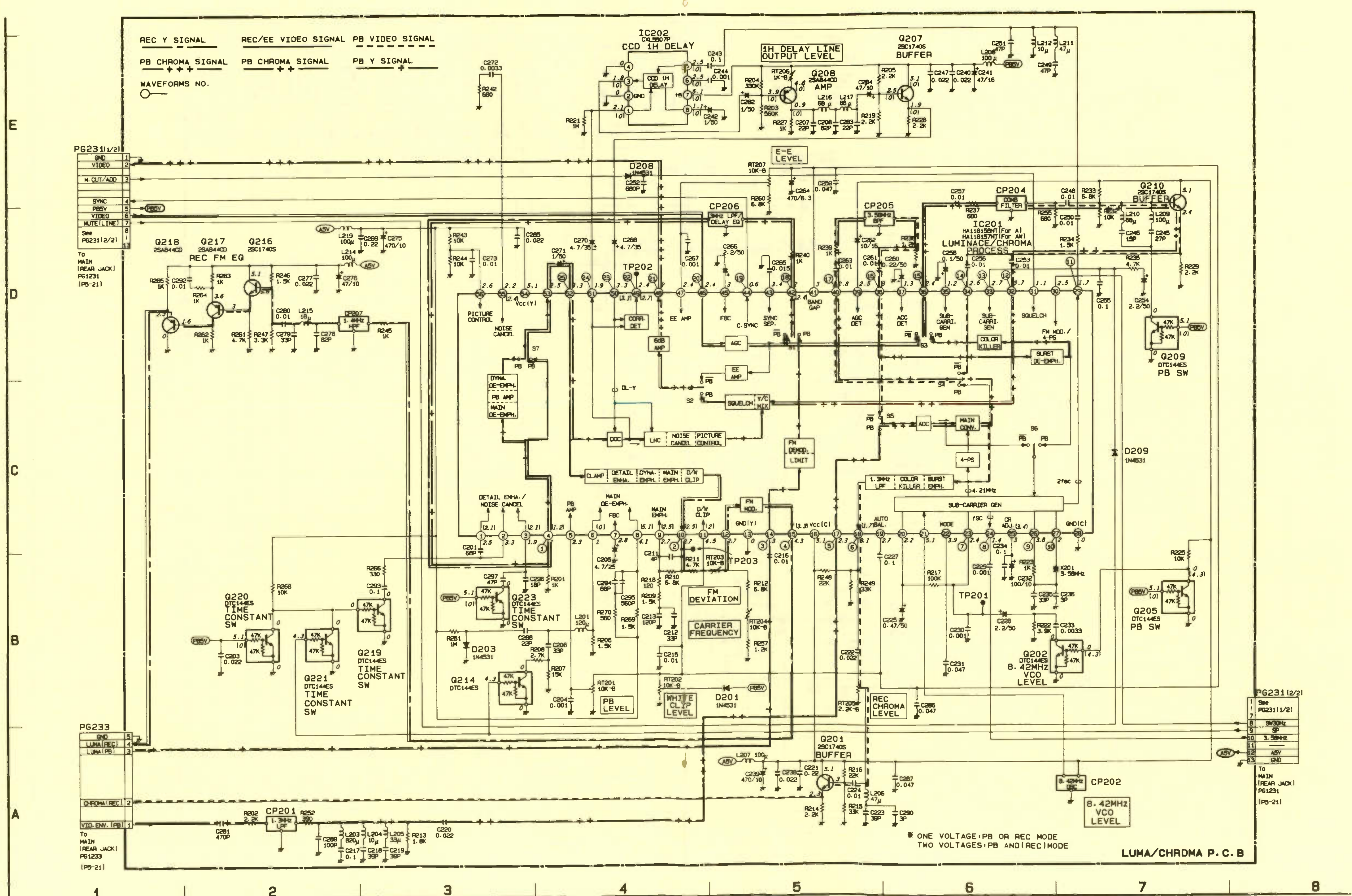
ES&T Manufacturers' schematics PROFAX 3096

SERVO SCHEMATIC DIAGRAM

This schematic is for the use of qualified technicians only. This instrument contains no user-serviceable parts.

The other portions of this schematic may be found on other Profax pages.

All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



Reprinted by permission of the Hitachi Corporation of America
Copyright 1992, CQ Communications, 76 N. Broadway, Hicksville, NY 11801

Test your electronics knowledge

By Sam Wilson, CET

1. A certain memory can store 1024 bits of information in the form of bytes. How many bytes of information can it store? ____________________.

2. Regarding the memory described in Question #1, how many binary input address lines are needed so that any one of the bytes can be selected ______________. Binary inputs.

3. Which of the following is a vacuum-tube diode?
   A. X-ray tube
   B. Magnetron
   C. Flemming valve
   D. Basically, all are vacuum tube diodes.

4. Which of the following is NOT turned on by a current delivered to the control electrode?
   A. PNP transistor
   B. SCR
   C. NPN transistor
   D. All can be turned on by a current pulse

5. The movable part of an electromechanical relay is called the ______________.

6. Show how you would use a resistor to make the circuit of Figure A practical. Show the resistance value and the connection of the resistor in the circuit.

7. What is the Boolean output for A x A ?

8. Which of the following materials is NOT poisonous?
   A. Cadmium
   B. Lead solder
   C. Tantalum
   D. All are poisonous

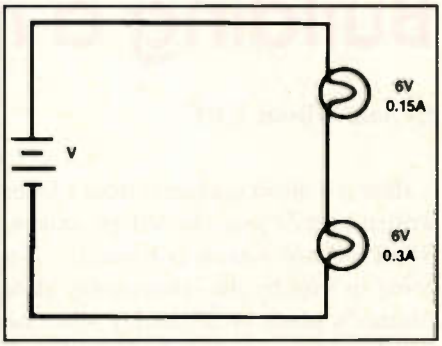


Figure A.

9. Which of the following is measured in Volt-Amperes?
   A. True power
   B. Apparent power

10. The output of a Hall sensor is measured in
   A. volts
   B. watts
   C. amps
   D. RPM

(Answers on page 62)

Wilson is the electronics theory consultant for ES&T.

What do you know about electronics?

Building a microcomputer

By Sam Wilson, CET

Here is a direct quotation from a letter written by a 22 year-old college student. (His Professor's name is Kleiner). "I'm going to stop by the interminably slow Kleiner's place on Thursday since he still hasn't responded. I want to convivnce him to let me work during Christmas vacation. I wonder if I'll succeed.

It's really terrible, all the things these old Philistines put in the path of people who aren't of their ilk....If he dares to reject my dissertation, then I'll publish his rejection along with my paper and make a fool of him."

Can you identify this brash young man with such a load of self-confidence? What is the name of this student who is old to threaten his professor?

His name is Albert Einstein.

(From Albert Einstein and Mileva Marie: The Love Letters, edited by Jurgen Renn and Robert Schulmann, Princeton University Press.)

Starting with this issue we are going to build a microprocessor and its peripheral parts. At least, we will build it on paper. A good place to start is with a memory. It will be clumsy at first, but, we will keep improving it until it fits with today's technology.

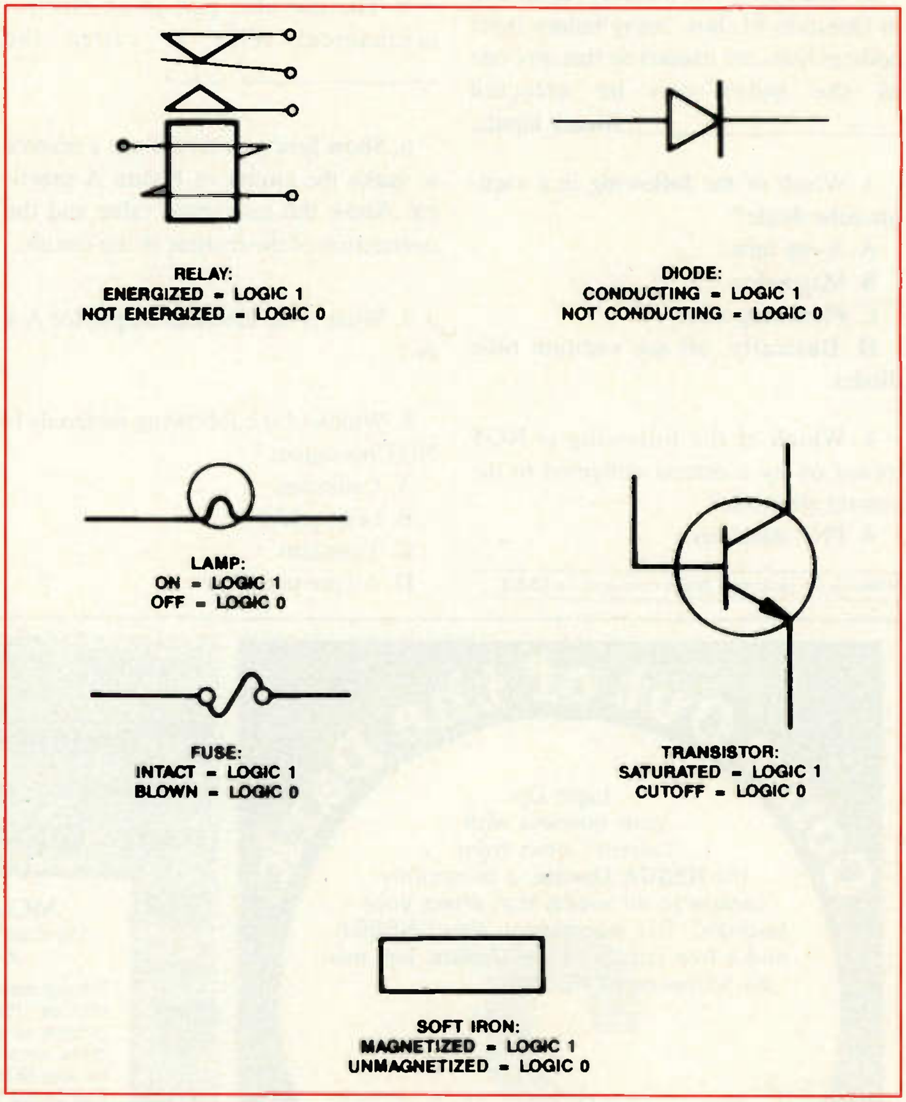


Figure 1.

Readers of this column know my definition of a microprocessor has been: *a device that implements memory.*

One objection raised about that definition is that it isn't broad enough. According to the objectors, the microprocessor does much more than that. It is like saying that a car is a machine that implements fuel.

I can see the point of that argument, but, just as you can't run the car without fuel - you can't run the microprocessor without memory. A better definition of a car would be: *a machine that utilizes fuel to provide transportation.*

I will leave it up to some of you advanced readers to give an improved definition of the microprocessor. Start it this way: *A microprocessor is a device that utilizes memory to.....*

Send your definition to me in care of this magazine. You may get a new Buick or a picture of a new Buick.

In recent months I have been discussing types of mass memory. Some types can store a staggering amount of information. One reason for bringing mass memory into the discussion on microprocessors is to show why the microprocessor was invented. If you know why it was invented, you are a long way toward knowing how it is used and what it is used for.

Not all of the memory utilized by the microprocessor is capable of storing

Wilson is the electronics theory consultant for **ES&T.**

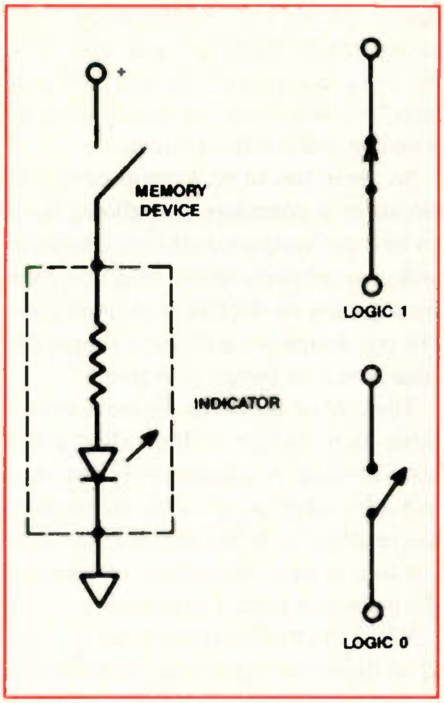


Figure 2.

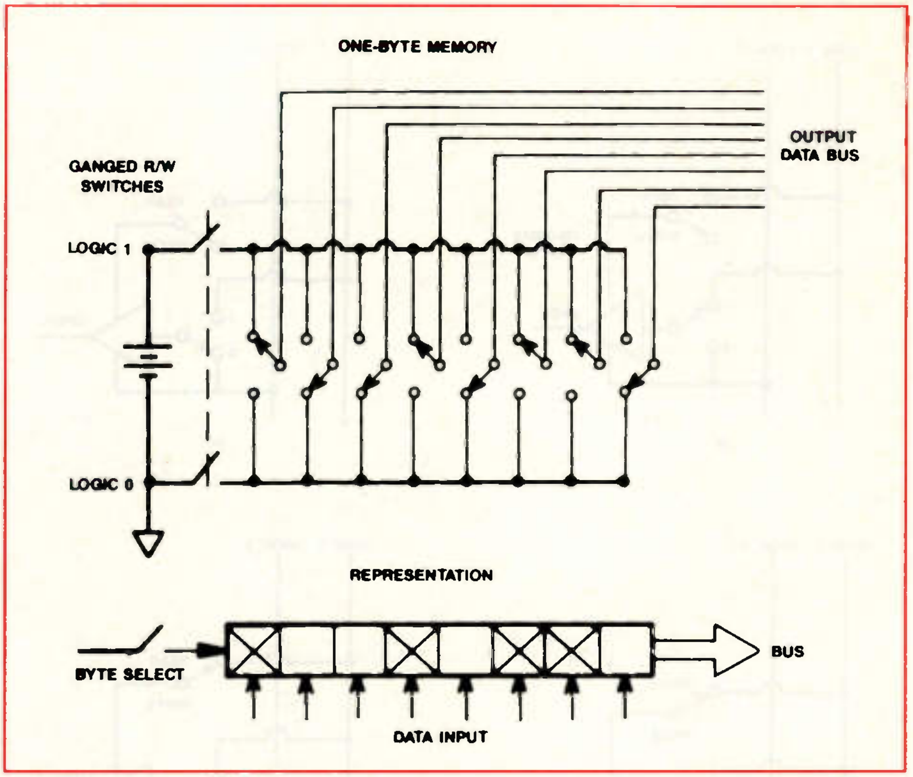


Figure 3.

huge amounts of data. Some basic memory devices are illustrated in Figure 1. They can be called *bit storage* devices because each can be used to store a logic 1 or a logic 0.

As shown in Figure 2, when a switch is closed it can represent a logic 1 and when it is open it can represent a logic 0. That is not a hard and fast rule! In some applications an open switch represents a logic 1 and a closed switch represents a logic 0.

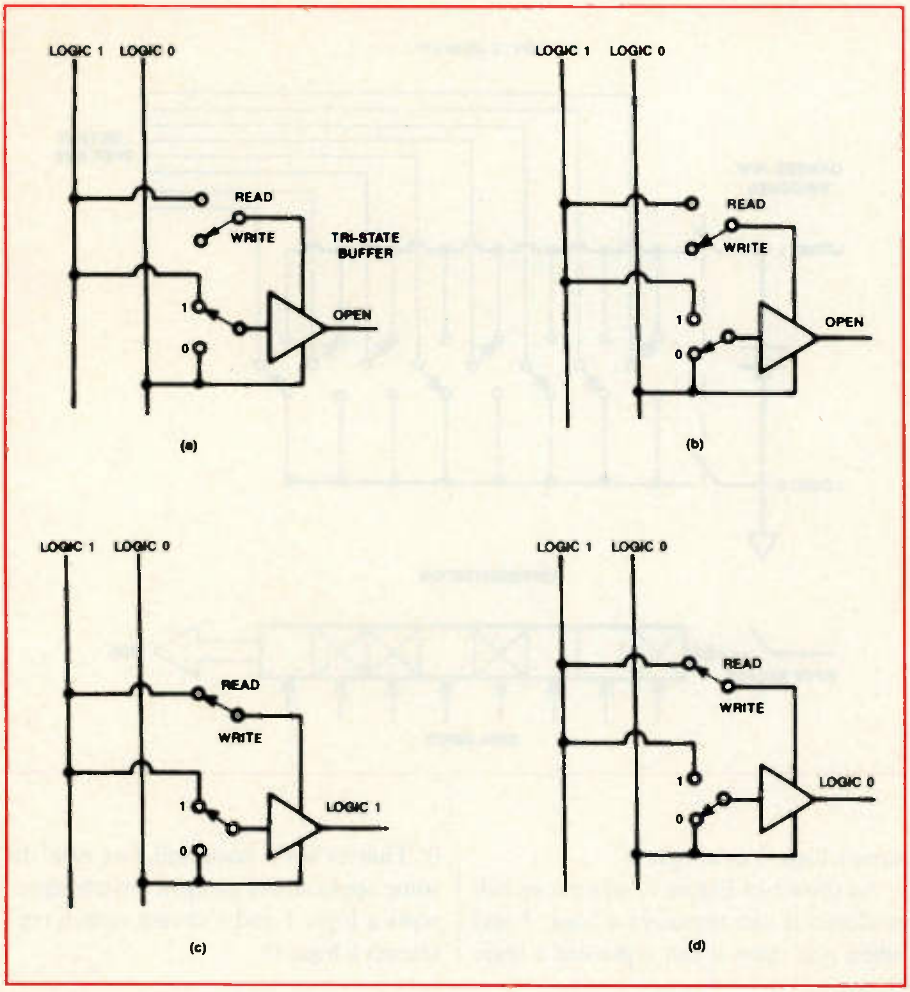


Figure 4.

Switches can be combined in groups as shown in Figure 3. When grouped in 8-bit combinations they represent a *byte* of memory. The output of the one-byte memory is delivered by a group of conductors called a *bus*. In a microprocessor system any group of conductors that carries a specific kind of information is called a bus.

A 10-byte-array

The project now is to arrange the switches into an array. To make the array useful we will connect all outputs to the same bus. It is immediately obvious that the outputs of each byte must be put on the bus one-at-a time.

Suppose, for example, that one byte is delivering a logic 1 to the first conductor of the bus. At the same time another byte is delivering a logic 0 to the same conductor. In that case you have a 1 and 0 on the same piece of wire and that is a short circuit.

So, there has to be a component or a circuit or a procedure that allows us to switch the outputs from byte-to-byte and also prevents more than one byte from getting on the bus at any one time. For our design we will use a simple tri-state device as shown in Figure 4.

The circuit shown in Figure 4 uses a three-state device (often called a tri-state device). As shown in Figure 4(a) and 4(b), when a logic 0 is delivered to the read/write (R/W) terminal the output line is open regardless of whether the input is at logic 1 or logic 0.

When the R/W terminal is set to logic 1, as shown in Figures 4(c) and 4(d) the output of the three-state device is the same as the input.

The memory cells of Figure 4 are used in the byte of Figure 5. For 8 cells per byte and 10 bytes per memory a total of 80 cells are needed for the 10-byte memory.

The output of a tri-state buffer is an open circuit when there is no positive voltage delivered to the third terminal. When that third terminal is switched to a positive voltage, whatever data input is present will be delivered to the output terminal.

When you set the R/W switched in a byte you are *writing data into memory*. It is also called *loading*

the memory. When you set the switch that puts the data of a byte onto the data bus you are *reading data from memory*.

To simplify the drawing of the 10-

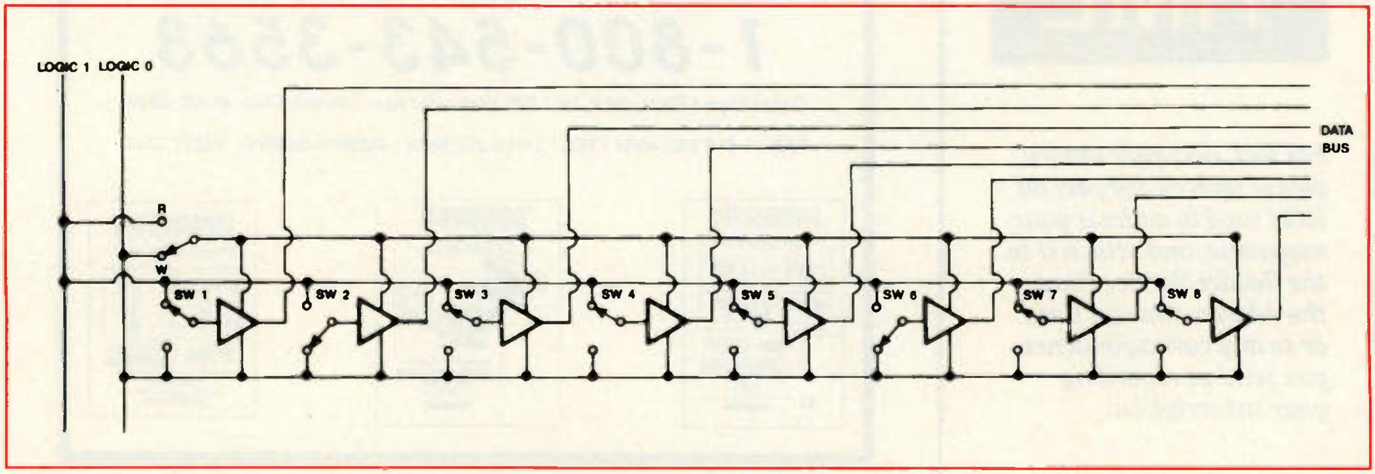


Figure 5.

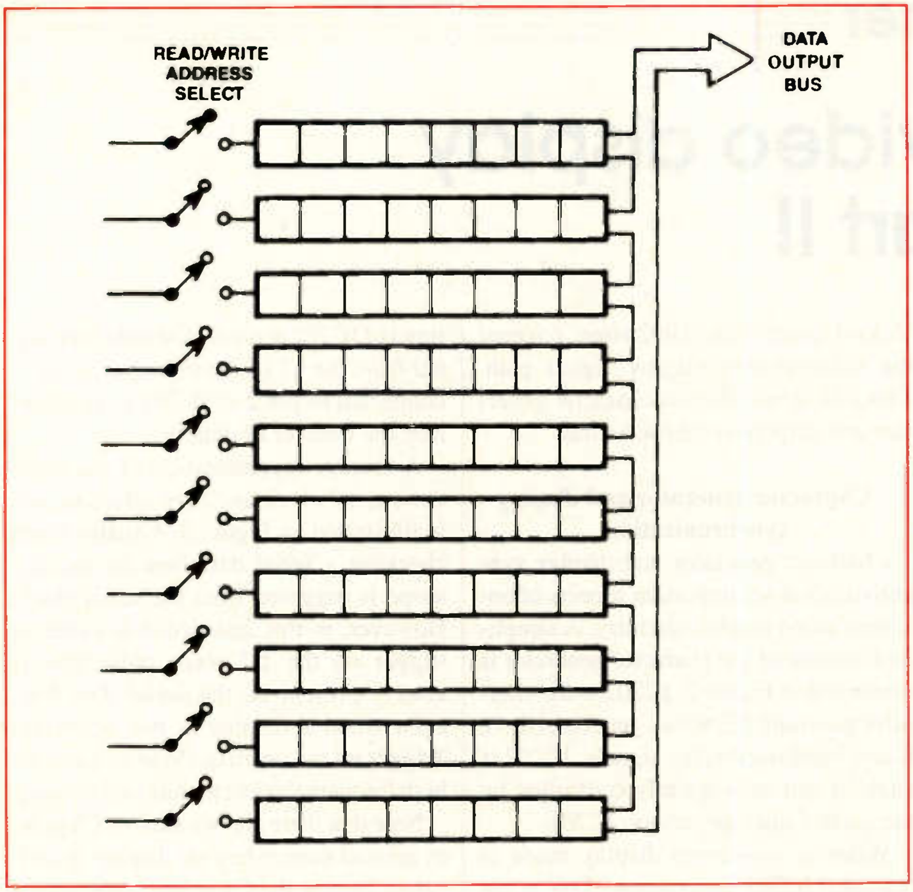


Figure 6.

byte memory, the logic 1 and logic 0 sources and switches are not shown (see Figure 6). Eight-output lines from each byte are connected to an output bus at any one time. All other lines from the other bytes will be open circuits.

Whenever an address select switch for a row is closed, the resulting positive voltage delivered to the three-state buffers turns on all of the cells in that row. The outputs of those cells go to the eight-line bus. For example, if SW2 is closed all of the eight outputs from that row are delivered to the eight lines in the output bus.

In addition to the 80 switches needed for the cells it is also necessary to buy 80 tri-state buffers. Each tri-state buffer requires a power supply voltage. The required supply voltages can be obtained from the logic 1 and logic 0 supplied to the data switches. This was shown in Figure 4. Ten R/W switches are also needed for the memory board - one for each byte.

Now we have a workable memory array. It isn't cheap and it isn't easy to load data into the memory, but it does demonstrate how a memory array can be made. It has ten bytes of storage space and there is a provision to get data into or out of any one of the bytes. The design is non-volatile. In other words, if you shut off the power supply the memory is not lost. Remember that every R/W switch must be in the logic 0 position when data is being written into the memory. Data is written in when switches SW 1 through SW 8 are set. (see Figure 4).

To read data all R/W switches are at logic 0 except for the one selecting the byte of data being read.

This procedure is similar to the one used to read and write data into an integrated circuit random access memory (RAM).

We decide to manufacture our simply memory array

Suppose we decide to go into production with this small memory system. We will have the cells manufactured by an outside vendor. Before we go into production we decide to change the design to make 50-byte memory arrays.

Although the design is crude, we believe we can sell these arrays on today's market. Our chief wirer must do the following for each array:

- connect each cell into the array. There are three connections for each cell, so, 240 connections will be required for this step.
- connect each address switch in the array. That means 20 more connections - one for each side of the switch.

All of a sudden it dawns on us that integrated circuit memory cells are a smart move. The design of the cell is changed. This will be shown in the next issue. Now we realize that we can easily make a memory with 256 bytes having all of the required 2048 cells automatically connected in each integrated circuit memory. However, we still require 256 address switches and that requires 512 solder connections for each memory array.

Figure out how many solder connections we will require for our one megabyte model!

Now you know why a Japanese memory manufacturer needed to find a fast and easy way to get data into and out of memory without hard wiring the bytes into addresses. The logical answer was some kind of *processor* to handle the large number of addresses and all of the data. They didn't want a processor that was a lot bigger than the memory, so they asked two American companies to develop a *microprocessor*.

Basically, the story IS true in the sense that it explains why it is not possible to quickly and easily get into and out of the large memories available. The explanation makes a lot of sense!

Some very important points have been made here. Don't overlook them! If you hard-wire memories you will have to change the basic wiring layout every time you want to improve the memory design. Also, you need two men and a boy to wire just one large memory board. You cannot mass produce this type of memory. The ideas of having address locations and byte grouping are worth saving. In the next issue we will talk about types of circuits that are in large memory arrays and how they are put to use.

In future issues we will go through the complete microprocessor system—piece-by-piece—until we have put together a complete workable microprocessor and its peripherals (on paper).

On-screen video display circuitry - Part II

Adapted from the June 1990 issue of "The Expander" a publication produced by Mitsubishi Electric Sales America Inc., to inform their authorized service centers.

Figures are numbered consecutively, starting with Figure 1 that appeared in Part 1 of this article.

On-screen video displays have been used for some time in both direct view and projection televisions. In today's video products the display has become a crucial factor in the interface between the product and the consumer, informing the user of virtually all current operating conditions. In addition to displaying current channel and time of day, the on-screen display is an integral part of the user adjustments and selection process.

This article is the second part of a series that examines the on screen video display in the V10 projection chassis by Mitsubishi. Part 1, which appeared in Video Corner in the 1992 issue, covered the video/chroma/display signal path. This article will discuss character generator and display synchronization.

Character generator and display synchronization

Character generator and display synchronization are important aspects of on-screen video display circuitry. A simplified version of the character generator is illustrated in Figure 2. IC702 is the character generator IC, which generates R, G, B and blanking display signals. IC702 is enabled and subsequently controlled by the control microprocessor, IC701.

When an on-screen display mode is activated IC701 generates a LOW at pin 11, the OSD-$\overline{CS}$ (On-screen display not chip select) output. The LOW is directed to the $\overline{CS}$ input of IC702, enabling the character generator.

At the same time, control data for the display (in a serial format) is output from IC701 at pin 16 and applied to the SIN input of IC702 at pin 8. A serial clock signal from pin 17 of the microprocessor is connected to pin 2 of IC702 to synchronize the transfer of data.

A graphic representation of the serial data, serial clock and chip select signals is illustrated in Figure 3. Usually when checking a serial data line the oscilloscope is triggered from the serial clock. However, in this instance it is easier to trigger on the 1.2 msec pulse that is always present on the serial data line, even when a display is not activated. Trigger on the positive slope and use the high frequency reject feature of the scope.

Note that there are two narrow $\overline{CS}$ pulses present even when no display is activated. During the $\overline{CS}$ pulses, momentary data signals refresh the previous data in IC702. When a display is activated, the second $\overline{CS}$ pulse, display data and control signals are transferred to IC702. Although it is constantly changing, the data on the serial data and clock lines will be apparent.

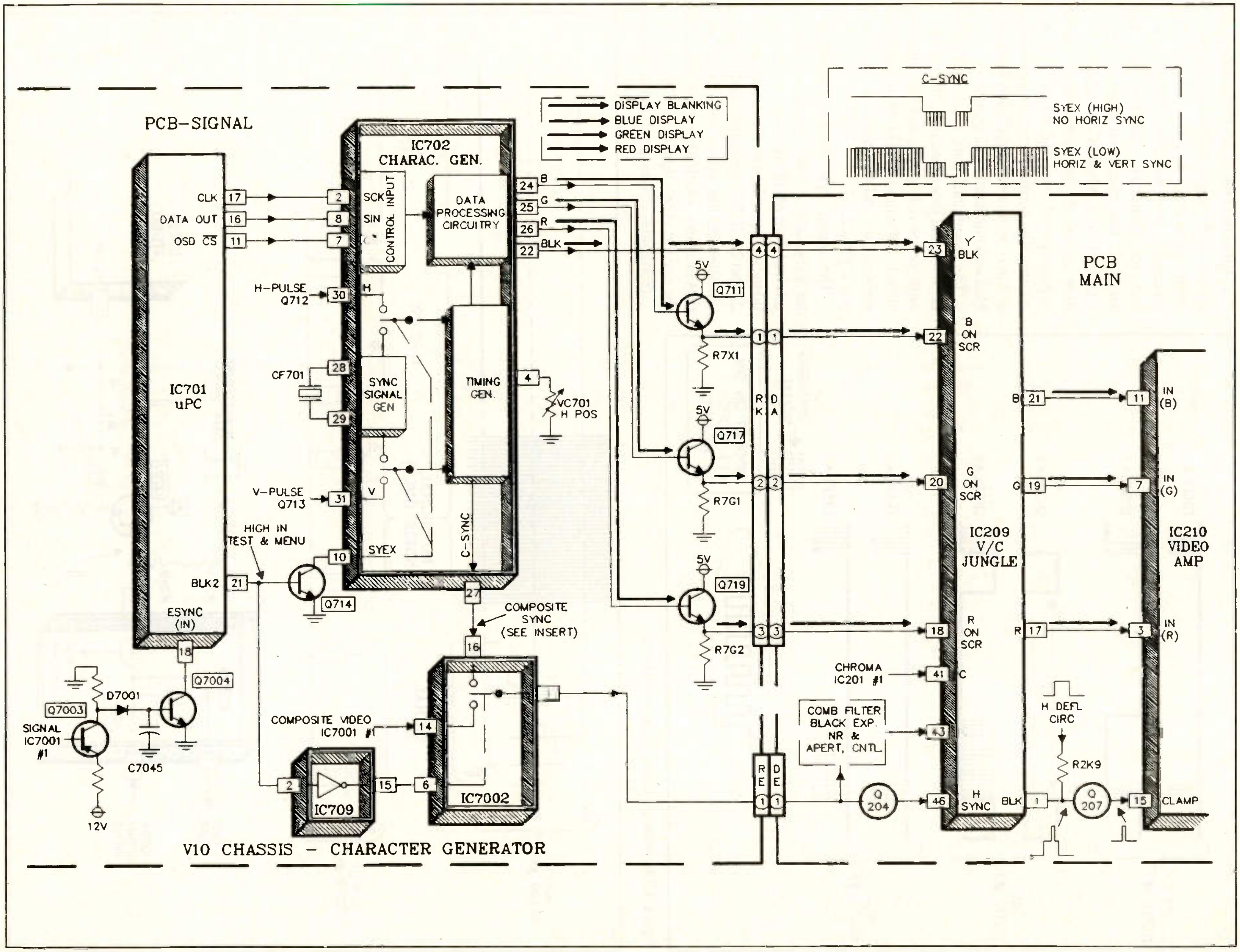


Figure 2. V10 Chassis - Character generator and display synchronization.

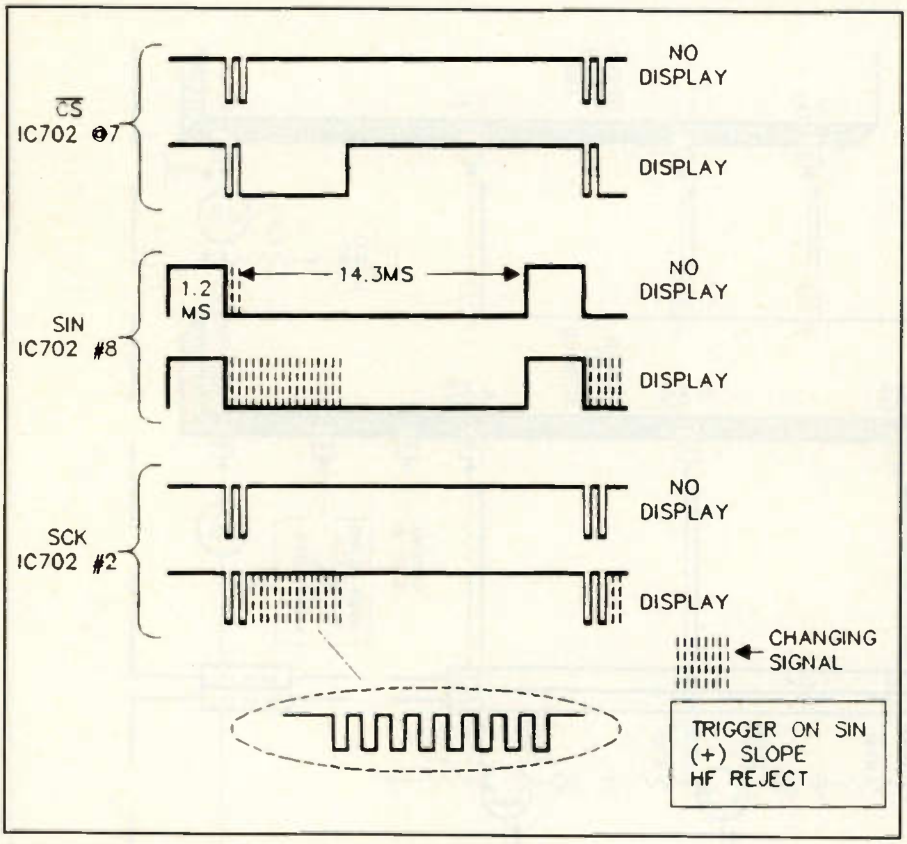


Figure 3. Character generator input commands.

If either the chip select ($\overline{CS}$) or the serial data (SIN) signal is missing, the character generator, IC702 will not be enabled. If the serial clock (SCK) is missing, the character generator will be enabled, but synchronization of data transfer is lost. When this occurs, the display is out of synchronization and is superimposed over the entire existing picture. The normal picture is still visible and in sync, however the display is scrambled and constantly changing.

The command data from IC701 is decoded and processed in IC702, and the appropriate red, green, and blue display signals are output at pins 26 through 24, respectively, and display blanking is output at pin 22.

The internal operations of the character generator, IC702, are timed by an internal 7.16 MHZ oscillator whose frequency is controlled by the Crystal at pins 28 and 29. IC702 operations are also synchronized to the pulses from the deflection circuitry which are synchronized to the current video signal.

Horizontal pulses are input at pin 30

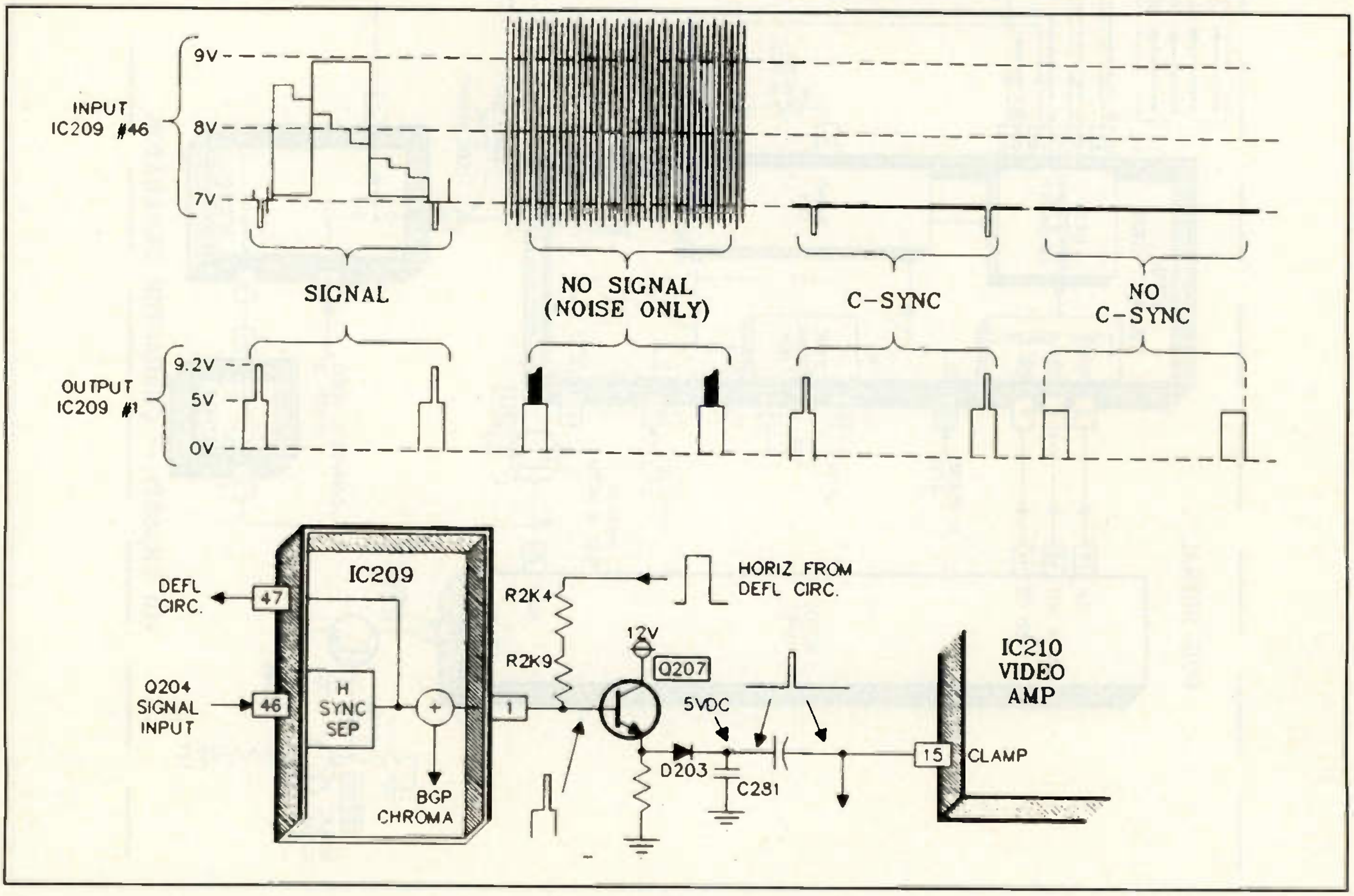


Figure 4. Sync separator - Burst Gate Pulse - Video clamp.

SYMPTOMS			
SIGNAL SOURCE		CAUSE	PROBLEM
TUNER	EXTERNAL INPUT		
● No INSERT Display with or without signal. ● MENU/TEST Display O.K.	● No INSERT Display with signal. ● INSERT Display O.K. with no signal. ● MENU/TEST Display O.K.	No Display is activated unless C-SYNC is used.	No H or V Pulse (IC209 #30 & #31)
● With signal, vertical jitter in MENU/TEST. ● No signal, horizontal jitter in MENU test. ● INSERT Display O.K.	● With signal, INSERT Display O.K., vertical jitter in MENU/TEST. ● No signal, black raster in both INSERT & MENU/TEST.	C-SYNC cannot be activated.	BLK2 (IC701 #21) Remains LOW in MENU/TEST
● INSERT Display O.K. with or without signal. ● Black raster in MENU/TEST.	● With signal, INSERT Display O.K. ● No signal, black raster. ● Black raster in MENU/TEST.	Video Clamp shifts in modes using C-SYNC	C-SYNC signal not generated.
● INSERT Display out of sync with or without signal. ● MENU/TEST O.K.	● With signal, INSERT Display out of sync. ● No signal, INSERT Display O.K. ● MENU/TEST Display O.K.	Display only synchronized when C-SYNC is used.	SYEX (IC702 #10) always LOW.

Figure 5. Display symptoms due to synchronization problems.

and vertical pulses at pin 31 of the IC. VC701, at pin 4, adjusts the delay between the horizontal pulse and the start of the display, and is utilized to position the display horizontally on the screen. The vertical position of the display is automatic and cannot be adjusted.

If either horizontal or vertical pulses are missing, no display is produced. However, the MENU/TEST displays are normal since these modes utilize the internally generated sync signal.

The 7.16 MHZ oscillator is also utilized to develop substitute horizontal and vertical sync signals. This substitute sync, denoted as C-SYNC, is output at pin 27 of IC702. The C-SYNC signal is non-interlaced and is utilized to synchronize the deflection circuitry of the unit in the MENU/TEST modes and under specific conditions, when no current video signal is present

An internal synchronizing signal is required in both the MENU/TEST modes, and when utilizing an external input when no signal exists. When required, the Control µPC, IC701, generates a HIGH at the BLK2 output at pin 21. The HIGH is inverted to a LOW by Q714 and applied to the SYEX input at pin 10 of IC702. When the SYEX input goes LOW, the C-SYNC signal is output at pin 27 and is utilized to synchronize the deflection circuitry.

When the C-SYNC signal is not required (SYEX input HIGH) the output at pin 27 consists of vertical sync and equalizing pulses only, with no horizontal sync pulses. When the SYEX input goes LOW, both horizontal and vertical sync are output at pin 27.

The HIGH on the BLK line (from pin 21 of IC701) is also inverted by IC709 and controls the internal analog switch in IC7002. A LOW at pin 6 of IC7002 selects the C-SYNC signal as the synchronizing source for the deflection circuitry.

The output at pin 1 of IC7002 (composite video or C-SYNC) takes two path: through the comb filter, black level expansion, noise reduction and aperture control circuitry to the Y input of the video/chroma jungle at pin 43 of IC209; and through Q204 to the H SYNC input at pin 46 of the IC209.

Internal to IC209, the sync is separated from the signal at pin 46, and is utilized to synchronize the deflection circuitry. The internal circuitry also generates a burst gate pulse (BGP) at pin 1. The pulse from pin 1 is directed through Q207 to the clamp input at pin 15 of IC210. The pulse at pin 15 is used to determine the dc clamp of the red, green and blue video amplifiers in IC210. If there is no pulse at pin 15, the dc clamp level shifts and all three internal video amplifiers are cut off. The complete loss of output from IC210 results in a black raster.

A closer look at the burst gate pulse and clamp circuitry, shown in Figure 4, illustrates the need for C-SYNC when using an external input and no signal is present. The horizontal sync separator in IC209 clips the incoming signal at approximately 7V, passing only signal below that level. When video is present at pin 46, only the sync pulses fall below the 7V cut off point. Therefore, only sync pulses are output from the sync separator at pin 47 and directed to the deflection circuitry.

The output of the sync separator is also directed to an internal adder, which is keyed by a horizontal pulse from the deflection circuitry, input at pin 1 of the IC. The adder generates an output only during the horizontal pulse. Internal to the IC, the output of the adder is the burst gate pulse, directed to the internal chroma circuitry, and also output at pin 1. The burst gate pulse at pin 1 rides on top of the horizontal pulse used to key the adder.

The combined pulses are directed through Q207 to diode D203. D203 rectifies the pulses, charging C281 to approximately 5V. With the cathode of D203 at a constant 5V, only a signal above

5V forward biases the diode and is coupled to the clamp input at pin 15 of IC210.

When no signal is present on a channel, a high degree of noise is present at pin 46 of IC209, due to amplification by the tuner and IF circuitry. The noise extends below the 7V level and therefore appears at the output of the sync separator and as the burst gate pulse output at pin 1. The noise pulses are coupled to pin 15 of IC210. Since their ampliture is approximately the same as a normal burst gate pulse, the clamp level is not changed appreciably and noise is output from IC210, producing a snowy raster.

When using an external input, and no signal exists, there is no noise at pin 46 of IC209, since the tuner and IF circuitry are not used when using an external input. With no signal or noise at pin 46 no burst gate pulse is generated at pin 1 of the IC. The resulting absence of a pulse at pin 15 of IC210 changes the clamp level and cuts off the amplifiers in the IC, producing a black raster.

To produce a visible display when using an external input with no signal, the substitute C-SYNC signal must be activated. Transistors Q7003, Q7004 and diode D7001 (Figure 2) detect the presence of signal.. When signal is present, it is rectified by D7001, filtered by C7045 and the resulting dc voltage turns Q7004 ON, pulling the ESYNC (IN) terminal of IC701 LOW. The LOW informs the µPC that signal is present. When there is no signal the ESYNC input is HIGH and the µPC responds by generating a HIGH at the BLK output at pin 21, activating and selecting C-SYNC. Although the signal detection circuitry is active when the turner is the signal source, the ESYNC input of the µPC is only enabled when an external input is selected

The loss of display circuitry synchronizing pulses or incorrect logic selecting the synchronizing source, does not necessarily result in a loss of synchronization in the display. The symptom resulting from a specific cause is also influenced by the selected signal source and whether or not signal is present. The variations in symptoms due to synchronization problems as shown in Figure 5.

Digital tuners have arrived

By John Shepler

The age of the digital tuner has arrived. While over-the-air digital audio broadcasts (DAB) are still years away, CD-quality audio is becoming available now via cable television. The digital tuner is the last piece needed to complete an all-digital home audio system.

Radio on cable has been available for many years. The cable operators provide a spectrum of FM services consisting of radio stations and satellite-delivered audio. The appeal of the satellite services is that they have no commercials and often no announcements.

The limitation to standard cable radio is that the signal has to be delivered through an RF carrier with the standard stereo modulation first established nearly 30 years ago. This is true even if the source material is Compact Disc.

The new digital audio services dispense with standard radio transmission completely. A digital program is generated at a remote studio site and uplinked as a digital bitstream to a satellite transponder. At the receiving end, the cable operator extracts the signal and relocates it to a carrier frequency compatible with the cable signal assignments. In the home, the bitstream is demodulated from the cable carrier, kept in digital format, and finally converted to analog audio by a digital to audio converter in the tuner or power amplifier.

The obvious advantage to digital audio is that perfect quality can be maintained from the digitized source material in the studio to the D/A converter in the home. The digital bitstream can also be recorded on to digital audio tape (DAT) or digital compact cassette (DCC) before converting to analog.

Digital's less obvious advantage is that additional data can be sent along with the audio bitstream. For instance, a remote control unit for the tuner can display information about the music on a liquid crystal display. In the future, a listener might program the system to watch for a particular selection or connect and record it in the middle of the night.

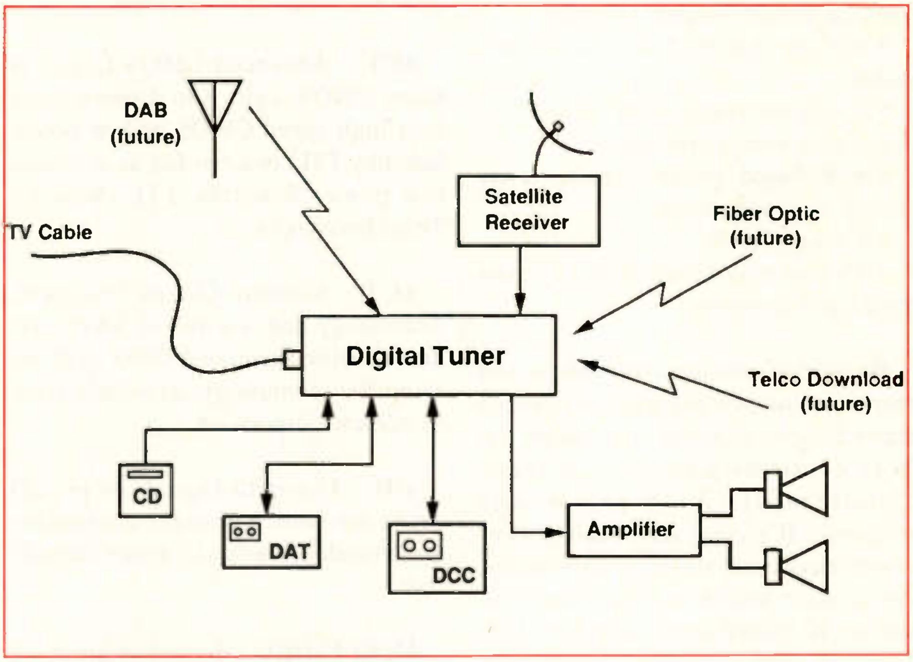


Figure 1. The All-Digital home audio system.

There are two major services now expanding nationally on cable systems. They are Digital Music Express (DMX) with 30 channels and Digital Cable Radio (DCR) with 19 channels, soon to be 29, with 250 planned in 10 years. These services offer a wide variety of specialized music formats and stereo simulcasts of premium TV services, such as HBO. DCR has also experimented with a pay-per-listen service for a special concert event.

Figure 1 shows how a digital home audio system might be configured. While the delivery service now is through cable TV hookup, fiber optic transmission is in the future for both audio and video. Satellite and over-the-air digital audio broadcasting standards are in the process of being standardized and should be available in the home in a few years.

Another interesting concept has been developed by Bellcore Labs for the telephone companies. That's right, it is feasible to send digital audio at 1.544 megabits per second over most phone lines from the central office to the home. Excluded are 25% of the lines that have inductive loading coils to neutralize high capacitance. The digital audio system called ADSL or Asymmetrical Digital Subscriber Line also includes a reverse channel so that the consumer can "dial up" the desired audio service or send other information back to the supplier. While still experimental, this service might become available in as little as two or three years. All-digital audio is a technology whose time has come.. Look for integrated digital audio components, such as tuners and receivers with digital I/O, to become available soon. ■

Shepler is an electronics engineering manager and broadcast consultant. He has more than twenty years experience in all phases of electronics.

A glossary of integrated circuit terms

By Victor Meeldijk

For a number of reasons, virtually every product in which electronic components are used include integrated circuits:

- ICs can contain thousands of transistors
- ICs are extremely small
- ICs are energy efficient
- an IC-based product requires fewer wiring interconnections
- ICs are reliable
- ICs are easily manufactured by mass production methods.

Because ICs are now everywhere, and there are now so many ways to fabricate these devices, an entire vocablulary has been constructed to describe them. Unfortunately, many people who encounter ICs every day, such as consumer electronics servicing technicians, do not have access to a dictionary that defines IC related terms, so much of the literature, such as product specification sheets, component replacement guides, and even magazine articles contain terms with which the technician is not familiar.

This glossary is intended to fill in that gap, and provide readers of this magazine with a reference to which they can turn when they encounter an unfamiliar IC term.

Some of the terms included here are not ordinarily encountered by a technician whose servicing activities are confined to consumer electronics products; they are terms that relate to high-reliability products, such as those used by the military and the space program. However, because these terms are relatively few in number, they are included here in the interest of completeness.

Glossary

ABCMOS - Advanced Bipolar CMOS. A technology from Analog Devices.

Meeldijk is the Reliability/Maintainability Engineering Manager for Diagnostic/Retreivel Systems.

ACE - Advanced Computing Environment. Dual hardware/software platform computer architecture.

ACL - Advanced CMOS Logic. A faster CMOS logic, 3 to 4 times faster than high speed CMOS or low power Schottky TTL, twice as fast as advanced low power Schottky TTL. Sold by Texas Instruments.

ACT - Acoustic Charge Transport. Technology that is a mix of SAW (surface acoustic wave) and GaAs (gallium arsenide) technology, available from Comlinear Corporation.

A/D - Analog to Digital. As in A/D converter, which changes continuous wave (analog) signals to binary (digital) code.

Alpha Particle - A product given off by the decay of radioactive material (usually emitted by traces of radioactivity in IC ceramic packaging materials). It has two protons and two neutrons (the equivalent of a nucleus of a helium atom). This particle has a positive charge equal to twice that of an electron and is emitted at a very high velocity. Alpha particles can cause temporary memory upsets in DRAM's, which is known as soft error rate.

ALSTTL - Advanced Low Power TTL Logic

ALU - Arithmetic Logic Unit

Alumina - Aluminum oxide.

Annealing - Refers to a semiconductor device returning to its normal operating characteristics/performance after exposure to radiation (although not all defects can be annealed). Annealed devices tend to be more susceptible to degradation/failure when subjected to further radiation exposures.

Anode - The electrode from which the forward current flows within a device.

AOQ - Average Outgoing Quality

AQL - Average Quality Level. Used to relate to a sampling plan (such as MIL-STD-105) where a sample of parts is tested, instead of the whole lot of parts, to statistically verify (to a certain confidence level) that the devices meet their specifications. This sampling is expected to be phased out and replaced by TQM (Total Quality Manufacturing) practices.

ASIC - Application Specific IC. An IC customized for a specific product.

ASTTL - Advanced Schottky TTL

BiCMOS - Bipolar and Complementary Metal Oxide Semiconductor. This circuitry combines both bipolar and metal-oxide transistors (CMOS internal circuitry and Bipolar outputs).

BiMOS - Bipolar Metal Oxide Semiconductor

Bipolar - A device in which both majority and minority carriers are present.

BIST - Built-In Self Test. A term generally used in discussions on I.E.E.E. 1149 Testability Standards.

Bitblit - Bit assigned block transfer

Bonding Pads - Areas of metallization on the IC die that permit the connection of fine wires or circuit elements to the die.

Boundary-Scan Testing - I.E.E.E. standard 1149.1 JTAG (Joint Test Action Group) test method for ASIC parts. Due to the nature of ASIC parts, there are ways to apply signals to a device that render some locations inside the device unobservable and uncontrollable. Thus a tester can not determine if the circuitry up to that point is functioning correctly (as the tester can not measure current or voltage at that point or change the control signals to that point). Boundary-Scan testing places extra circuitry at the boundary of the device that is to scan the working circuits and determine the functionally of the part.

BTAB - Bumped Tape Automated Bonding. Solder bumps placed on tape supported IC leads.

BTDL - Basic Transient Diode Logic

Bump Contacts - Contacting pads that rise substantially above the surface level of the chip.

Burn-in - Component testing where infant mortality failures (defective or weak parts) are screened out by testing at elevated voltages and temperatures for a specified length of time.

Burst-Radiation - (Prompt Dose, or Pulse Radiation). Radiation in a pulse form, high levels for a short duration.

Butt-Joint - See I Lead.

CCD - Charge Coupled Device

CDRAM - Cache DRAM

Ceramic - An inorganic, nonmetallic clay or glasslike material whose final characteristics are produced by subjection to high temperatures.

CHMOS - A CMOS. A patented CMOS process of Intel Corporation.

CISC - Complex Instruction Set Computer

Cleanroom - An area in an IC manufacturing facility where IC devices are assembled/manufactured where the temperature/humidity and static air pressure are carefully controlled. The particulate count per cubic foot of air is also carefully controlled and monitored (clean rooms are far cleaner than operating rooms in most hospitals).

CML - Current Mode Logic

CMOS - Complementary metal oxide semiconductor. A device formed by the combination of a PMOS (P channel) and an NMOS (N Channel) semiconductors (metal oxide [field effect type] transistors of differing polarities). These devices exhibit high noise immunity, high circuit density per chip, good operational speed (when compared to other IC logic families) and very low power consumption. They have a very good fan out capability.

CMRR - Common-Mode Rejection Ratio

CMT - Chip Mounting Technology. The mounting of bare chips to a substrate, without any packaging of the chip.

C of C - Certificate of Conformance. A document supplied with material to attest that it meets the required product specification.

Codec - COder-DECoder. A device that converts analog input to digital form and digital input to analog form.

COF - Chip On Flex. A chip mounted to a flexible circuit, wire bond connections are used from the circuit to the chip.

Cofired Ceramic - A type of substrate in which metal is deposited on each layer of a stack of ceramic layers and the two materials are baked together.

COMFET - Conductivity-Modulated FET. Also Conductivity-Modulated MOSFET

Continuity Test - Tests that look for an open circuit.

CPU - Central Processing Unit

CRC - Cyclical Redundancy Checking. An error checking scheme where a character is generated at the transmission side of a signal, with a value dependent on the hexadecimal value of the number of ones in the data block. The receiving end makes a similar calculation and if the there is a mismatch between the received character and the receiver calculation an error has occurred in the transmission and the signal is retransmitted.

CTL - Core Transistor Logic

DAC - Digital to Analog Converter. Also D/A

DAM - Data Addressable Memory

Dambar - A portion of the lead frame that prevents mold compound from flowing beyond the ends of the lead frame.

DC Test - Tests that measure a static parameter, for example leakage current.

DCTL - Direct Coupled Transistor Logic. First commercial integrated circuits. They had poor noise immunity and were high current devices.

DEMP - Dispersed EMP (Electromagnetic Pulse). This effect occurs when a HEMP (High Altitude EMP) pulse propagates along a ray tangent to the earth and back into space, and continues to propagate into the ionosphere creating a swept signal from the original fast transient pulse. The frequency sweeps from a few hundred MHz to a few MHz. If this distributed EMP wave contacts a satellite, currents are produced on system structures and cables which couple into the satellite electronics which can cause system upsets and/or failures.

Derating - The intentional reduction of stresses (voltage, current, power, etc.) on a part to reduce the occurrence of stress related failures.

DESC - Part Used to denote a Standard Military drawing Part that has been approved by the Defense Electronic Supply Center, in Dayton Ohio.

Dicing - The separation of a semiconductor wafer into individual dies.

DIE - A single IC, also known as a "chip".

DIE Bonding - The attachment of an IC chip (or DIE) to a substrate or header.

DIE Separation - Refers to the separation of the actual microcircuit chip from the inside of the package.

Dielectric - An insulating or non-conducting material.

DIFET - Double-Injection FET transistor

Diffusion ("Oxide Diffusion Defects") - Refers to defects in the oxide coating layer.

DIMOS - Double Implanted MOS. See SIPMOS, a trade name of Siemens.

DMA - Direct Memory Access

DMD - Deformable Mirror Devices. Electrically movable micro-mirrors that can be positioned to reflect light in different directions. They are used in some high quality printers. Designed by Texas Instruments.

DMOS - Diffused Metal Oxide Semiconductor

DMS - Diminishing Manufacturing Sources. Part obsolescence.

DMSMS - Diminishing Manufacturing Sources and Material Shortages

DOD Directive 4254.4 - A Department of Defense Directive, issued in July 1988, detailing the DOD acquisition policy for systems that must survive in a radiation environment. The directive affects systems involved in tactical support by conventional forces and non-strategic nuclear forces as well as supporting command, control, communications and intelligence systems. Non-major systems, such as field radios, ground based communications, portable command centers, shipboard electronics and tank electronics, must also have compatible nuclear survivability requirements. Total ionizing radiation doses are 104 rads (Si) are for tactical applications and 105 rads (Si) for strategic applications (MX missiles, Tracking Systems, etc.).

Dose Rate (Gamma Dot) - The amount of radiation exposure per time, in rads (radiation absorbed dose)/second.

DPA - Destructive Physical Analysis. Devices are opened and analyzed for process integrity and workmanship.

DP Linpack - Double Precision Linear programming package

DRAM Dynamic RAM - A memory device having a temporary memory that must be refreshed with data carrying electrical charges.

DRTL - Diode Resistor Transistor Logic

DSP - Digital Signal Processor. A microprocessor that is strong in vector and algorithmic processing. These microprocessors have simple memory interfaces and typically execute multiple operations in parallel. Some DSP processors and peripherals (such as multiply and accumulate units (MACs) are becoming available as standard microprocessors and microcontrollers.

DTL - Diode Transistor Logic. An early logic family that was low in speed.

DUT - Device Under Test

EAROM - Electrically Alterable Read Only Memory

ECDC - Electrochemical Diffused Collector transistor

ECEMP - Electron Caused EMP (Electromagnetic Pulse). Electrons that may be emitted from enclosures (see SGEMP and IEMP) can become trapped in dielectric materials and over time build up. This eventually results in large fields and possibly an arc discharge. This results in electrostatic discharge (ESD), spacecraft charging and deep dielectric charging.

ECL - Emitter Coupled Logic. Very high speed (1ns to 1.5ns) with high input impedance, low output impedance but with high power consumption.

E2CMOS - Electrically Erasable CMOS. E2CMOS is a registered trademark of Lattice Semiconductor Corp.

EDAC - Error Detection and Correction. In this error correction scheme an extra block of data is added to each block of data that is transmitted. The receiver sends this extra block back and if it matches the block that was originally transmitted the entire data block is assumed correct.

EEPROM (E2PROM) - Electrically Erasable Programmable Read Only Memory

EHF - Extremely High Frequency (30GHz to 300GHz)

Embedded Processor - A microprocessor, augmented with on-chip peripherals and with/or without on-chip memory, designed for embedded applications.

EMP - Electromagnetic Pulse. A phenomenon in which an exoatmospheric nuclear explosion can induce transients in power and signal transmission lines which can damage equipment thousands of miles from the blast site. EMP can cause ringing pulse disturbances lasting up to several seconds at frequencies less than 100MHz. EMP and RF propagation effects are strongly dependent upon the burst height above the Earth's surface and the burst yield/energy released. In the 1950's, a number of EMP measurements from surface and near surface bursts were made at test sites in Nevada. Signals were recorded in high altitude tests in 1958 and in high altitude tests in 1962 in the Johnston Island area. Notable are the burglar alarm and street light failures in the Hawaiian Islands, 700 to 800 miles away from the test site. See HEMP, Scintillation and Tree.

Epitaxial - Sharing the same crystal structure as the substrate material. Epitaxy is the growth of a crystalline substance on a crystalline substrate with both having the same atomic structure.

EPLD - Electrically Programmable Logic Device

EPROM - Erasable Programmable ROM

ESD - Electrostatic Discharge. The instantaneous transfer of charges accumulated on a non-conductor to a conductor, into ground.

ESDS - Electrostatic Discharge Susceptibility

Etching - Refers to the etching of the silicon layer in the photolithography process of designing and laying out of the IC.

Facedown Bonding - Attaching a component or chip to a substrate by inverting the chip and bonding the chip contacts to mirror image contact points on the substrate.

FACT - Fairchild (Semiconductor) Advanced CMOS. Fairchild became part of National Semiconductor in 1987.

FAMOS - Floating Gate Avalanche Injection Metal-Oxide Semiconductor

Fan-out - The number of compatible logic inputs that a digital circuit's output can drive without exceeding its output current specifications.

FAST - Fairchild (Semiconductor) Advanced Schottky TTL (Fairchild became part of National Semiconductor in 1987). This design uses smaller transistors to improve frequency response and speed.

FCT - Fast CMOS Technology. Also known as Fairchild (Semiconductor) CMOS Technology, after the company that developed it.

FDDI - Fiber Distributed Data Interface

FET - Field Effect Transistor. The resistance between source and drain terminals in a FET is modulated by a field applied to the gate terminal.

FIFO - First In, First Out. A queue handling method that operates on a first come, first served basis.

FIT - A failure in time. It is equal to the number of failures in one billion (10^9) hours.

FPT - Fine Pitch Technology. Center between connections, of microcircuit packages, is between 0.020 and 0.040 inches.

Flash Memory - A high speed nonvolatile memory. It is used in applications where data must be occasionally changed without removing the memory devices from the application, but where costs preclude the use of more expensive EEPROMS (which can be written a byte at a time). The flash parts can be completely erased with one signal and may be preferred over UVEPROMS that have to be exposed to UV light to be erased and take 15 to 30 minutes for the deprogramming. It generally has the same footprint as a UVEPROM of the same capacity. "Flash" is a trademark of SEEQ Technology.

FLOPS - Floating Point Operations per Second

Footprint - The area of a substrate used, or occluded, by chips mounted above the substrate.

FPGA - Field Programmable Gate Array

FPU - Floating Point Unit

FRAM - Ferroelectric RAM. A nonvolatile memory, which in some applications has replaced EPROM, SRAM and EEPROMs (E2PROMs). Developed by Ramtron Corp., Colorado Springs, CO.

Frit - A relatively low softening point material of glass composition.

FROM - Field Programmable ROM

FSC - Federal Supply Class for discrete devices. This is a number used to denote the type of part being discussed. 5962 is for microcircuits or IC's and 5961 is for transistors.

FSCM - A government assigned number to each manufacturer, it is the abbreviation of Federal Supply Code for Manufacturers.

FTFET - Four Terminal FET

FTTL - Fast TTL

Function Test - A check for correct device operation generally by truth table verification.

Fuzzy Logic - A method of expressing the operational and control laws of a system linguistically, in words. It is a rigorous mathematical discipline that deals with imprecision (as opposed to crisp sets, in which an item is part of a set, or it is not) and allows gradual transitions between being fully a member of a set and fully not a member of a set. Fuzzy logic is based upon fuzzy set theory, created by Lofti Zadeh in 1965. Zadeh is a professor of electrical engineering and computer science at the University of California, Berkeley.

GaAs - Gallium Arsenide

GaAsP - Gallium Arsenide Phosphide

GAL - Generic Array Logic. A programmable array logic. GAL is a registered trademark of the Lattice Semiconductor Corp. See also PAL.

Gamma Radiation - Protons that emanate from an atomic nucleus which travels in a waveform like X-rays or light, but has a significantly shorter wavelength.

Gate Array - A semicustom product, implemented from a fully diffused (or ion-implanted) semiconductor wafer carrying a matrix of identical primary cells arranged into columns with routing channels between the x and y directions.

GCS - Gate Controlled Switch

Ge - Germanium

GEMFET -(Motorola) Gate Enhanced MOSFET

Getter - A material used in cavity hybrids to catch particulate matter which may remain inside the device after it is sealed. It is also an alkali metal introduced in a vacuum during the manufacture of vacuum tubes. The getter appears as a silvery deposit inside the tube and acts to remove any remaining gasses trapped inside the tube.

Ground - A common reference point for circuit returns (shields or heat sinks).

Ground Bounce - Simultaneous switching transients in high speed circuits. For example, if an octal device simultaneously switches 7 outputs into a worse case load of 50pF and the 8th input is held either low or high, ground bounce would be a transient on the eighth output when the switching occurs).

HCMOS - High Speed CMOS

HCT - High Speed CMOS that has TTL thresholds

HDMOS - High Performance Double Diffused Metal-Oxide Semiconductor

HEMP - High altitude Electromagnetic Pulse (altitude range from 70 miles to several hundred miles), generates the most extensive geographic coverage (thousands of square miles) and most severe field strengths outside EMP source regions. Peak HEMP fields are on the order of 50,000V/Meter with a rise time of about $7MW/m^2$. It affects transmission frequencies from 10kHz up to 100MHz. See also SREMP.

HEMT - High-Electron Mobility Transistor

HER - Hard Error Rate

Hermetic - Sealed so that the object is gas tight (usually to a rate of less than 10^6 cc/sec of helium).

HF - High Frequency (3MHz to 30MHz)

HIC - Hybrid IC

HiPPI - High Performance Parallel Interface. An ANSI standard defining a channel that transfers data between CPU's, and from CPU's to disk arrays, and other peripherals, at a basic rate of 800Mbits/second. HiPPI can be striped for operation at 1.6Gbits/second (gigabits/second).

HLL - High speed, Low voltage, Low power

HLTTL - High Level Transistor Transistor Logic

HMOS - High Performance MOS. A patented process of Intel Corporation.

HMOS - High Speed MOS

Hot Dip - The process of covering a surface by dipping it in a molten bath of coating material. For example, hot tin dipping for IC leads where the leads are dipped in a tin-lead mixture).

HTCMOS - High Speed TTL compatible CMOS

HTL - High Threshold Logic. These devices have a greater noise immunity than DTL.

HTOL - High Temperature Operating Life. An environmental stress test, used to calculate field failure rates, where the IC is subjected to temperatures and voltages exceeding normal operating conditions to reflect accelerated aging (use) of the device.

I Lead (Butt Joint) - A surface mount device lead whose ends contact the board at a 90° angle.

ICE - In Circuit Emulator

IEMP - Internal EMP (Electromagnetic Pulse). SGEMP is system generated EMP where photons incident on a system enclosure scatter electrons which produce electromagnetic fields and can couple into cables circuitry. IEMP is another step down, photoelectrons emitted from enclosure walls and circuit boards couple to circuit board traces and upset, or fail components on the circuit board. The coupling to the circuit component traces can be either capacitive, inductive or a direct coupling. See ECEMP.

IF - Intermediate Frequency

IO - Input Output

IOB - Input Output Buffer

IBR - Integrated Bridge Rectifier

IGFET - Insulated Gate FET

IIL - (I2L) Integrated Injection Logic. This logic family has increased circuit density and decreased power consumption over standard TTL devices.

ILB - Inner Lead Bonding. The connection between tape supported leads (TAB) and the IC.

IRAM - Integrated RAM

IRED - Infrared Emitting Diode

ISFET - Ion-Sensitive FET

ISL - Integrated Schottky Logic

I3L - Isoplanar Integrated Injection Logic

JAN - Joint Army Navy, when used when referring to microcircuits indicated a part fully qualified to the requirements of MIL-M-38510 for IC's and MIL-S-19500 for semiconductors. JNA Class B microcircuit level of the SMD (Standard Military Drawing) program is the preferred level for design into new weapons systems.

JANTX - A prefix denoting that the military specification device has received extra screening and testing (such as an 100% 168 hour burn-in). These are the preferred devices for use in new military equipment designs.

JANTXV - A JANTX - part with an added pre-capsulation visual requirement.

JAN Class S - These are Space Level parts for use in space satellites and launch vehicles.

JEDEC - Joint Electron Device Engineering Council; part of the EIA.

JEIDA - Japan Electronic Industry Development Association.

JFET - Junction FET

JPEG - Joint Photographic Experts Group. Usually used to relate to a still motion video standard based on discrete cosine transform algorithms. PX64 is the standard for teleconferencing motion video. PX64 is the international teleconferencing standard from CCITT. (see also MPEG)

JTAG - Joint Test Action Group of the I.E.E.E. A committee on circuit testability. JTAG was organized in 1985 to define industry wide test standards. In 1990, the four-wire serial test bus was proposed by the JTAG technical committee and adopted by the I.E.E.E. as standard 1149.1

Kovar - An alloy of 53% Iron, 17% Cobalt, 29% Nickel and trace elements with a thermal expansion matching alumina ceramics and sealing glasses.

LCD - Liquid Crystal Display

Latch-Up - A condition where a conducting device can not be turned off by the gate (and causes circuit malfunction). In Latch-Up the device typically draws excessive current and may fail (burn-out). The device is usually returned to a normal operating condition by removal and reapplication of power. External noise (which caused the input to be higher than the device supply voltage) or supply voltage drifts are likely causes of Latch-Up (along with radiation exposures). Latch- Up also typically occurs when the output of an LSI device with a large supply voltage is connected directly to the input of an LSI device with a small supply voltage.

Lead - A conductive path, usually self supporting. The portion of an electrical component that connects it to outside circuitry.

Lead Frame - The metallic portion of a device package that makes electrical connections from the die to other circuitry.

LF - Low Frequency (30KHz to 300KHz)

LIFO - Last In, First Out. A queuing scheme where the most recent data to be received is acted on first.

LLTTL - Low Level TTL

LPTTL - Low Power TTL

LSI - Large Scale Integrated Circuit. A device with 100 or more equivalent gates or circuitry.

LSTTL - Low Power Schottky TTL. The speed of TTL logic is increased by the use of specially processed Schottky diodes to increase the transistor switching rate.

LTPD - Lot Tolerance Percent Defective. The highest percentage of failures in a lot (i.e., a production lot) of parts before the whole lot is rejected.

LTTL - Low Power TTL

MAC - Multiply and Accumulate operations

MADE - Microalloy Diffused Electrode

MADT - Microalloy Diffused Base Transistor

Mask - The stencil of circuit elements through which light is shown to expose that circuit pattern onto a photoresist coating on the chip (die). The exposed areas are stripped away leaving a pattern.

MAT - Microalloy Transistor

MBM - Magnetic Bubble Memory

MCU - Microcomputer Unit

MECL - Motorola ECL

MED - Microelectronic Device

Memory Card - A credit-card sized piece of plastic that houses memory chips.

MESFET - Metal Epitaxial Semiconductor FET

Metallization - The deposited thin metallic coating layer on a microcircuit or semiconductor.

Metastability - A flip flop's inability to decide which state it is in (the output is undefined, or oscillates between high and low states for an indefinite amount of time due to marginal triggering). This is a problem of asynchronous systems where timing requirements (specified set-up and hold times with respect to the clock) can be violated, unlike synchronous systems where the timing can be absolutely predicted. (Note: systems with separate entities running at different clock rates, such as keyboards, disk drives and processors, are called globally asynchronous).

MF - Medium Frequency (300MHz to 3 MHz)

MIC - Monolithic IC

Microprocessor - A processor on a chip that may or may not include memory and a MMU (Memory manager Unit). It does have a CPU (Central Processing Unit) with registers and an ALU (Arithmetic Logic Unit) and addressing capability. Some devices have on-chip floating point units, while others use a support IC.

Microcontroller - A single chip microprocessor that has on- chip memory and peripherals. Some devices can access both external and internal memory.

MIPS - Million Instructions per Second

MIS - Metal Insulator Semiconductor

MISFET - Metal Insulator Semiconductor FET

MMIC - Monolithic Microwave IC

MNOS - Metal Nitride Oxide Semiconductor

MNS - Metal Nitride Semiconductor

MOS - Metal Oxide Semiconductor, metal over oxide over silicon layers.

MOSAIC - Metal-Oxide Semiconductor Advanced IC

MOSFET - Metal-Oxide Semiconductor FET

MOST - Metal-Oxide Semiconductor Transistor

MOVRAM - see NOVRAM

MPEG - Motion Picture Experts Group. Relates to full motion video and audio characteristics of a multimedia system (based on discrete cosine transform algorithms). See JPEG.

MPU - Microprocessor Unit

MSB - Most Significant Bit

MSI - Medium Scale Integrated Circuit. Usually an IC with 28 to 48 pins. The complexity of the device is more than 12 gates.

MTBF - Mean Time Between Failure

MTL - Merged Transistor Logic

MTNS - Metal thick nitride semiconductor. A thick silicon nitride, or silicon nitride-oxide layer is used instead of just a plain oxide layer.

MTOS - Metal thick oxide semiconductor. The oxide outside the desired active gate area is made thick to reduce problems caused by unwanted parasitic effects.

MTL - Merged Transistor Logic

MTNS - Metal Thick Oxide Semiconductor

MTTF - Mean Time To Failure

NDT - Non-Destructive Testing

NED - Nuclear-Event Detector. A device that senses gamma radiation, such as from a nuclear explosion, and forces circuits to a predetermined shutdown state to protect the circuits from disruptive or destructive radiation. It can disable write operations, halt CPU operations, disable power supply under/over voltage control circuits and over current shutdown circuits to keep the power supply operating during the period of exposure. It can also cut off the power supply to stop latch-up circuit burn-out.

NEMP - Nuclear Electromagnetic Pulse

NMOS - N-Channel MOS Circuit. These devices are twice as fast as PMOS devices and have a greater circuit density than PMOS or bipolar parts (TTL, DTL, RTL, etc.).

NMR - Normal Mode Rejection

NOVRAM - Non-volatile RAM. Each SRAM cell has an EEPROM element attached to it and in a store operation the EEPROM elements are loaded with the contents of the SRAM cells and in a Recall operation the contents of the EEPROM elements are transferred to the SRAM cells. The memory elements are independent of each other, and independent data can reside in each so that if the SRAM data becomes corrupted a Recall operation can restore proper data in the SRAM. (This device also may be known as MOVRAM for moving RAM or nvSRAM -Shadow RAM where a non-volatile portion of the device shadows the volatile part).

NRZ - Non-Return to Zero. A pulse that ends only at the completion of a cycle.

OIG - Optically Isolated Gate

OLB - Outer Lead Bonding. Connection between the tape supported leads (TAB) and the substrate.

OTP - One Time Programmable

OXICMOS - Oxide-Insulated Silicon Gate CMOS

P2CMOS - Double Polysilicon CMOS

Pad - The metallized area on a substrate, or on the face of an IC, used for making electrical connections.

PAL - Programmable Array Logic (AMD/MMI registered trademark). See also GAL.

Passivate - Protect a metal against oxidation, in particular against water vapor. Passivation also protect the device against shorts if any metallic debris remains in the semiconductor package (metal cans or ceramic packages) which could short out adjacent traces in the device. In IC's a glass layer is generally used to passivate the device.

Passivation - The process in which an insulating dielectric layer is formed over the surface of the die. Passivation is normally achieved by thermal oxidation of the silicon and a thin layer of silicon dioxide is obtained in this manner. Other passivation dielectric coatings may also be applied, such as silicon glass.

PCM - Pulse Code Modulation. A common method of encoding an analog signal into a digital bit stream. It is a digitization technique but is not a universally standard method.

PCMCIA - Personal Computer Memory International Association

PDIO - Photodiode

PECL - Positive Emitter Coupled Logic. ECL referenced to +5V instead of ground.

PEEL - Programmable Electrically Erasable Logic

Percent Per 1000 (%/1000) - The number of failures as expressed as a percentage for 1000 hours of operation.

PGA - Pin Grid Array package. Also, Programmable Gate Array

Phenolic - A type of plastic.

Photocurrents - Transient leakage currents caused by ionization radiation.

Photoresist - A light sensitive polymer material which is used as a mask for etching and ion-implant steps during the IC fabrication process.

PIN - P intrinsic N

PIND - Particle Impact Noise Detection Testing

Pinout - The purpose, function or signal designation, of each pin, or lead of an IC.

PIO - Parallel Input/Output

Pixel Picture Element - (also known as a Pel). Relates to the creation of picture images through the use of tiny dots (or pixels).

PLA - Programmable Logic Array

PLD - Programmable Logic Device

PLL - Phase-Locked Loop

PMOS - P Channel MOS Circuit. These devices have a lower power consumption than bipolar logic devices, but are slower. These devices are the oldest of the MOS type devices and are not recommended for new designs.

PMU - Parametric Measurement Unit. A programmable power supply used for DC tests, that forces or measures a programmable voltage/current.

PNP - Positive Negative Positive

POSFET - Photoelectric-Oxide Semiconductor FET

PPM - Parts Per Million. This is the number of failures in 106 hours. A statistical estimation of the number of defective devices, usually calculated at a 90% confidence level.

PROM - Programmable Read Only Memory

PRV - Peak Inverse (reverse) Voltage

PTML - PNPN transistor magnetic logic

PXSTR - Phototransistor

QML - Qualified Manufacturers List. This is a list of semiconductor manufacturers who have qualified a set of processes and materials to military specifications.

QPL - Qualified Products List. This is a list of products meeting military specifications.

RAD - Radiation Absorbed Dose. It is equivalent to an energy deposition of 100 ergs per gram of substance being irradiated. RAD (Si) is the energy into 1 gram of Silicon. (Note: 1 rad (Si) = 100 ergs/g (Si), 1 Gray = 100 rad)

Radiation Hardened - A device whose resistance to radiation is achieved by special processing or design. This is as opposed to inherent hardness where the device radiation tolerance exhibited by a device is not enhanced or improved by any processing or design changes.

RAM - Random Access Memory. A memory that permits access to any of its address locations in any desired sequence, with similar access time for each location. It commonly denotes a read/write memory.

RCTL - Resistor-Capacitor-Transistor Logic, a higher speed logic family than RTL.

RDRAM - Rambus DRAM

RDTL - Resistor Diode Transistor Logic

REM - Roentgen Equivalent Man

REP - Roentgen Equivalent Physical

RF - Radio frequency. Any frequency between audio sound and the infrared light portion of the spectrum, 10Khz to 10,000,000MHz.

RGT - Resonant Gate Transistor

R/h - Roentgens Per Hour

RISC - Reduced Instruction Set Computer. A special microprocessor architecture which processes fewer instructions and thereby operates faster. A RISC system uses software to do many functions normally done by the microprocessor.

Rise Time - The rate at which a signal changes from logic zero to logic 1 (or from logic 1 to logic zero). This is usually expressed in V/ns.

RL - Resistor Logic

Roentgen (REM) - The radiation exposure dose which produces the same effects on human tissue as one roentgen of X-ray radiation.

Roentgen Rays - X-rays.

ROM - Read Only Memory. Information in this type of memory can be accessed but not altered or erased.

RTL - Resistor Transistor Logic. An early IC logic family. These devices had low speed, poor noise immunity and low fan out capability.

RZ - return to Zero. A pulse that ends at any time during a reference cycle. SAW- Surface Acoustic Wave

SBD - Schottky-Barrier Diode

SBT - Surface Barrier Transistor

SC - Semiconductor

SCFL - Source Coupled FET Logic

Schmoo Plot - An X-Y plot giving the pass/fail region for a specific test while varying the parameters in the X and Y coordinates.

SCIC - Semiconductor IC

Scintillation - Attenuation and distortion of the earth's electron density in a signal's propagation path. This effect can occur naturally or by chemical releases that change the electron density or by nuclear detonations. This effect limits the achievable range resolution (by restricting the coherence bandwidth) of radar systems and causes angle jitter limiting target acquisition and subsequent target tracking. Communication, navigation and space-based radar systems are potentially vulnerable to scintillation effects. See EMP, HEMP and TREE.

SCR - Silicon Controlled Rectifier, Semiconductor-Controlled Rectifier

SCS - Silicon Controlled Switch

SCSI - Small Computer System Interface (pronounced scuzzy). This is an industry hardware and software standard for connecting peripheral devices and their controllers to microprocessors (thus it is a standard for communications between a host computer and a peripheral).

SDC - Semiconductor Devices Council of JEDEC

SDFL - Schottky Diode FET Logic

SDRAM - Synchronous DRAM

SEM - Standard Electronic Module. A subassembly that meets certain U.S. Navy Specifications.

SEU - Single Event Upset

SGEMP - System Generated EMP (Electromagnetic Pulse). Emitted photons that are incident on system enclosures scatter electrons into and outside the enclosure. These electrons generate electromagnetic fields which couple to internal cables and electronics and can cause system upsets and/ or failures.

S/H - Sample and Hold

Shadow RAM - see NOVRAM

SHF - Super High Frequency (3000MHz to 30,000 MHz)

SIC - Semiconductor IC

SIPMOS - Siemens Power MOS (a trade name of Siemens). A transistor structure with a vertical design and a double implanted MOS (DIMOS) channel structure.

SIDAC - Bidirectional Voltage Triggered Switch

SIMOX - Separation by Implatted Oxygen. A form of Silicon On Insulator (SOI) process by Texas Instruments where 200keV is used to bury a layer of oxygen (an insulator) in the active silicon layer of a device.

Slice Preparation - The slicing of the semiconductor crystal material into wafers.

SMA - Surface Mounted Assembly (SMC + SMT = SMA)

SMC - Surface Mounted Components (or SMD, Surface Mounted Devices)

SMD - Standard Military Drawing. These drawings are prepared in lieu of unique original manufacturer source and specification control drawings (Reference MIL-BUL 103 and 108).

SMT - Surface Mount Technology

SNOS - Silicon Nitride-Oxide Silicon

Soft Error - An error, or upset in the output of a part (usually applies to memory devices for a single bit output error) which does not reoccur. Soft errors first appeared in 4K and then 16K memories and was eventually traced to alpha particles coming from the ceramic packaging materials. This problem was solved by purifying packaging materials and applying a special coating to the memory chips.

Solderability - The ability of a component lead to be wetted by molten solder under specific conditions.

Solder Coat - A process used to apply solder to package leads directly from a molten solder bath.

SONET - Synchronous Optical Network

SOS - Silicon On Sapphire transistor device. Silicon is grown on a passive insulating base and then selectively etched away to form the desired device.

SPARC - Scalable Processor Architecture. A microprocessor architecture developed by Sun Microsystems.

SPAT - Silicon Precision Alloy Transistor

SPC - Statistical Process Control. A way of doing business in which the goal is to reduce the variation around a target value.

SPICE - Simulation Program with IC Emphasis. A public domain analog-circuit simulation program from UC Berkeley.

SR - Selenium Rectifier

SRAM - Static RAM. A memory device that continuously retains data except when the power is turned off. It offers high speed access.

SREMP - Source Region EMP (Electromagnetic Pulse). The volume of air where the ionization radiation from a nuclear detonation interacts with the air. The ionizing radiation, predominantly gamma rays, strip electrons from the air molecules and an intense electromagnetic pulse is generated. SREMP refers to either the environment generated in the EMP source region or the effects driven in systems by this environment. See also EMP, HEMP, DEMP, SGEMP, IEMP and ECEMP.

SSI - Small Scale Integrated Circuit. Usually IC's with 14 to 16 leads and a complexity of 12 gates or less.

SSQ - Space Station Qualified. Refers to parts qualified for the Space Station "Freedom" Program (SSFP).

STL - Schottky Transistor Logic

Strobe - A clock that is independent of data patterns.

STTL - Schottky TTL

Substrate - The supporting material upon which the microcircuit (IC) is fabricated on. In hybrids, the part to which the IC and other components, are attached.

SUDT - Silicon Unilateral Diffused Transistor

SUHL - Sylvania Ultra (Universal) High Level Logic. An early logic family (1960's) used mainly in military designs.

SYDAC - Bidirectional Diode Thyristor

TAB - Tape Automated Bonding. A chip bonding process in which the IC chip has gold bumps which connect directly to PC board traces (instead of wire bonds that connect to a the traces or a leadframe).

TCE - Temperature Coefficient of Expansion. The rate of temperature expansion/contraction when the temperature of the material is increased/decreased.

TD - Tunnel Diode

TDL - Tunnel Diode Logic

TFFET - Thin Film FET

TFT - Thin Film Transistor

THD - Total Harmonic Distortion

Three-State Logic - A logic family that has three output states, high, low or high impedance. In the high impedance state the output voltage is unaltered. Logic in the high impedance state may be easily and permanently connected to a bus.

Threshold Voltage - The lowest gate to source voltage at which the channel of a MOSFET becomes conductive.

Through Hole Mounting - The electrical connection of components to the surface of a conductive pattern by using component holes.

Tin Whisker - A hairlike single crystal growth formed on the metal surface.

Total Dose - a The amount of gamma radiation accumulated by an irradiated material during the exposure time.

TRAC - Transient Radiation Analysis of Circuits

Transient Upset - The temporary upset or degradation of a device, usually used in relation to the performance of a device during radiation exposure.

TRAPATT - Trapped Plasma Avalanche Triggered Transit diode

TREE - Transient Radiation Effects on Electronics (see EMP).

TRL - Transistor Resistor Logic

TRTL - Transistor-Resistor-Transistor Logic

TTL - Transistor Transistor Logic, a very popular logic family which has reached the end of its life cycle and should not be used for new designs. These logic devices are faster than RTL and DTL devices and have a high fan out capability with moderate power consumption. These logic circuits have a static threshold of 1.5V. Other TTL family types include 54/74HXX (54 indicates military range -55C to +125C and 74 is commercial temperature range 0C to +70C) for high speed TTL, 54/74LXX, low power TTL, 54/74LSXX Low Power Schottky TTL, 54/74SXX Schottky TTL. Of these logic families only the LS TTL devices should be considered for new designs.

UART - Universal Asynchronous Receiver/Transmitter (USART- with a Serial I/O)

UFL - Unbuffered FET Logic

UFPT - Ultra-Fine Pitch Technology. Distance between connection centers is less than 0.020 inches.

UHF - Ultra High Frequency (300MHz to 3GHz)

UHSIC - Ultra High Speed IC

ULA - Uncommitted Logic Array

ULF - Ultra Low Frequency (0 to 300Hz)

ULSI - Ultra Large Scale Integration

UJT - Unijunction Transistor

UV - Ultraviolet

UVEPROM - Ultraviolet erased, Electrically Programmable ROM

Vapor Phase Soldering (Reflow) - The technique for soldering reflow to form package interconnections. The energy produced by the condensation of an inert vapor is used to heat the solder joints.

VCD - Variable Capacitance Diode

VHDL - VHSIC Hardware Description Language

VHF - Very High Frequency (300MHz-300MHz)

VHPIC - Very High Performance Integrated Circuit

VHSIC - Very High Speed Integrated Circuit

Visual Index - A mark (chamber, notch, tab, depression) used to indicate pin 1 of an IC (and thus the orientation of the device).

VLED - Visible Light Emitting Diode

VLF - Very Low Frequency: (3KHz to 30KHz)

VLSI - Very Large Scale Integration. A device with 3000 or more gates (usually about 10,000 gates), or equivalent circuitry.

VLSIC - Very Large Scale IC

VMOS -V Groove Metal Oxide Semiconductor

Volt - The difference of electric potential between two points of a conducting wire carrying a constant current of 1 ampere when the power dissipated between these points is equal to 1 watt. This is the official International System of Units (SI) definition as adopted by the Comite' International des Poids et Mesures on January 1, 1990.

VRAM - Video RAM. A DRAM with an additional data port.

Wafer - A thin piece of semiconductor material, most often silicon, sliced from a cylinder shaped crystal. Individual semiconductors are formed on the wafer, and after processing, are divided into dice (chips).

Watt - The power which in one second gives rise to an energy of 1 joule (this is the official International System of Units (SI) definition as adopted by the Comite' International des Poids et Mesures on January 1, 1990). More commonly expressed, the watt is unit of power where 1 watt is equal to 1 joule per second.

Wave Soldering - A process in which PC boards are brought into contact with the surface of continuously flowing and circulating solder.

WDT - Watchdog timer. A counter that looks for signal activity and if none occurs within a certain time will produce an output that is a signal that there is a problem (i.e., a peripheral is not responding because it is off line or failed).

Wire Bond - A wire connection between the semiconductor die and the leadframe or terminal.

YAG - Yttrium-Aluminum-Garnet

YIG - Yttrium-Iron-Garnet ■

Test your electronics knowledge

Answers to the quiz

1. There are 8 bits per byte. So 1024 bits ÷ 8 bits/byte = 128 bytes

2. Remember that the number of address lines equals 2^x binary lines, where x is the number of binary address input. Since $2^7 = 128$ it follows that 7 binary address lines will be needed.

3. D. If you consider a diode to be a tube that has one cathode and one anode, then all of those tubes listed are vacuum-tube diodes.

4. The one most often missed in this group is the SCR. That's because most discussions of SCR's are based upon a voltage signal to the SCR. However, current must flow in the SCR gate in order to obtain a cathode-to-anode electron current flow.

5. Armature.... The term armature is used for many electro-mechanical devices. A motor is another example.

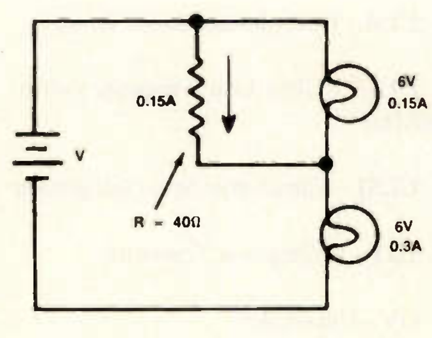


Figure B.

6. See Figure B. The resistor may not be easy to buy. In that case, consider putting another 6V, 0.15A lamp in place of the added resistor. It would be even better if you could find another 6V, 0.30A lamp to replace the lamp and the resistor. Of course, you would not get credit for any answer except the added resistor because of the way the question is worded.

7. A. One of the basic Boolean relationships is A x A = A.

8. Someone, somewhere, sometime we are going to have to address the problem of discarding poisons into the environment! Some states have already passed laws regarding this. I am sure your state electronics association will keep you informed about this!!

9. True power is measured in watts. Apparent power is measured in VA (volt-amperes).

10. A Hall sensor produces a voltage that is directly related to the strength of the magnetic field passing through the sensor. ■

World's smallest electromagnetic motor

Toshiba Corporation has announced that the company has developed the world's smallest electromagnetic motor. The prototype ultra small motor has an outside diameter of only 0.8mm - over three times smaller than the diameter of the electromagnetic motor Toshiba announced last November.

The new motor brings a fresh impetus to work on "micromachines" - the development of minute hardware systems that is being pursued in numerous research projects around the world. Successful micromachines will depend on ultra small motors for drive power, and miniaturization remains the key to capturing the potential these machines offer.

The versatility of micromachines is expected to bring them wide ranging application. Industrial users will include inspection of small diameter tubes and piping in manufacturing plants. In medicine, it is anticipated that a future generation of machines will be directly introduced into the human body to carry out inspection of the digestive tract and the bloodstream. Toshiba's latest motor is a step forward that brings such micromachines closer to realization.

The new prototype is an axial gap type motor, in which the motor is separated into two parts. The stator, which has an outside diameter of 0.8mm houses three coils and a sleeve bearing to support the rotation of the rotor shaft. The rotor section, including the magnet, is mounted on the stator.

In the previous motor the magnet was encircled by three coils. These elements were then incorporated in a cylindrical casing with an outside diameter of 3mm. Adoption of the axial type structure and continuous efforts to improve the company's precision machining technology, has allowed the company's researchers to further cut size and to achieve a motor with an outside diameter on only 0.8mm.

Driving the new prototype electromagnetic force motor requires only 1.7V. Changes in frequency can produce operating speeds from 60 to 10,000 rpm. ■

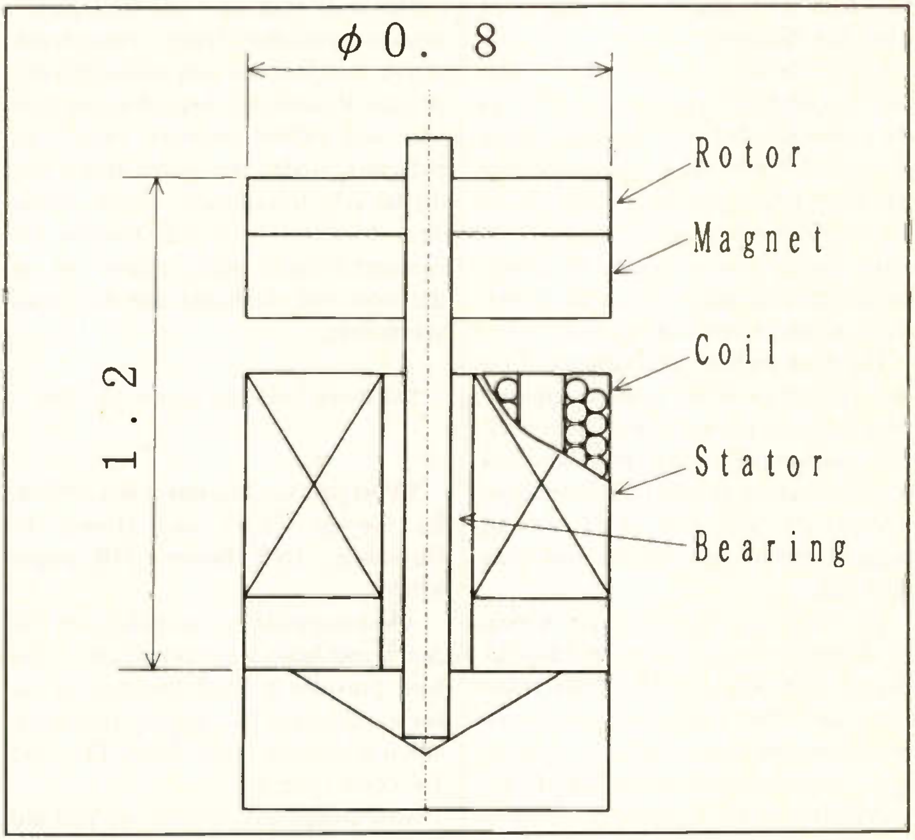


Figure A. Structure of the new motor (cross section).

Using Online Scientific and Engineering Databases, By Harley L. Bjelland, TAB Books, 224 pages, 31 illus, $26.95 paper.

Using Online Scientific and Engineering Databases will prove valuable for the thousands of engineering and science professionals who need to keep abreast of the latest developments in their fields. Step-by-step, easy-to-follow instructions show readers how to conduct successful online searches with a minimum investment of time, effort and expense.

The book includes descriptions of the computer hardware and software required, the advantages of each type of databse service, and sample searches that show how to access and search each type of database. Readers also learn how to cut costs by using command-line searches and other shortcuts.

The book covers a wide range of technical online databases, including EasyNet, Dialog, BRS, MEAD, STN, ORBIT, Dow Jones, and EPIC. It also describes a number of consumer databases, such as Prodigy, CompuServe, Genie, and DELPHI.

With its wealth of practical, hands-on guidance, this book is certain to become the standard reference for anyone who wants to learn how to search online scientific and engineering databases and locate precisely what they need.

TAB Books, Blue Ridge Summit, PA 17294.

Electronic Components: A Complete Reference for Project Builders, By Delton T. Horn, TAB Books, 256 pages, $18.95.

Electronic Components: A Complete Reference for Project Builders, provides technicians, hobbyists, and students with a handy one-stop source of practical information on virtually every kind of electronic component available.

In a well organized format, this book presents the important working characteristics, specifications, and uses for each component listed. It describes the differences between the various subtypes of each major class of component and examines the important factors to consider when making substitutions in existing circuits.

This book is divided into three parts - passive, non-amplifying components, active components, and miscellaneous devices. Readers will find information on wire and solder, resistors, capacitors, inductors, diodes, transistors, linear ICs, digital ICs, transducers, and switches. Armed with this book and a manufacturer's specification sheet, readers can get the most out of almost any electronic component.

TAB Books, Blue Ridge Summit, PA 17294.

TV Repair for Beginners 4th edition, By George Zwick and Homer L. Davidson, TAB Books, 360 pages $19.95.

A learning tool for video hobbyists, students, and beginning technicians, this book provides in depth coverage of the latest solid-state TV circuitry, high-definition television, large-screen TVs, and TV stereo systems.

Now completely revised and updated to cover recent innovations in TV electronics, this book shows readers on how to solve such problems as horizontal streaking, herringbone weaves, Barkhausen interference, picture ghosts, color smears, and picture arcing. Written in clear, nontechnical language it is packed with detailed schematics, matched to illustrations of corresponding physical circuit boards.

TAB Books, Blue Ridge Summit, PA 17294

The Laser Guidebook 2nd Edition, By Jeff Hecht, TAB Books, 512 pages $29.95.

In the mid-1980s, as a proliferation of new lasers became available, The Laser Guidebook became a practical guide and reference for engineers, scientists, and technicians using lasers in their work. For those trying to determine which laser was best suited to a particular application, this unique guide quickly became known as the first place to look for clear, accurate information on the internal workings and functional characteristics of every type of commercially available laser. Now fully updated and expanded to provide information on the latest lasers, optical devices, and techniques. The Laser Guidebook- 2nd Edition features thorough coverage, and techniques. as well as updated chapters on laser theory and principles, gas lasers, fiber lasers, chemical lasers, X-ray lasers, and more.

TAB Books, Blue Ridge Summit, PA 17294

Encyclopedia of Electronic Circuits, Volume 4, By Rudolf F. Graf, TAB Books, 752 pages, $29.95.

A reference guide for all levels of electronics practitioners, the Encyclopedia of Electronic Circuits. Volume 4 contains hundreds of all-new schematics for the latest, most commonly used electronic circuits from industry leaders, such as Motorola, Texas Instruments, National Semiconductor, RCA, and General Electric.

Tightly organized, the encyclopedia presents approximately 1,000 circuits used in computers, controls, instrumentation, telecommunication, and many other fields of electronics. More than 100 alphabetically arranged categories cover circuits for everything from amplifiers to wireless microphones. Brief explanations of how each circuit works are given next to each schematic, and the original sources for the circuits are listed in the back of the book, making it easy for readers to obtain additional information.

The encyclopedia also features an extensive index to all of the circuits presented in the book, as well as for the circuits found in each of the previous three volumes. Not only does this greatly increase the reader's chance of finding the exact circuit needed, but it also provides a choice of several entries, offering the reader an opportunity to select the one best suited for a particular application.

TAB Books, Blue Ridge Summit, PA 17294.

Readers Exchange

Reader's Exchange has been reinstated as a free service.

The following restrictions apply to Reader's Exchange:

• Only individual readers may use Reader's Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your messsage is in paid advertisement, not Reader's Exchange.

• Readers Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

Send your Reader's Exchange submissions to:

Reader's Exchange
Electronic Servicing & Technology
76 N. Broadway
Hicksville, NY 11801

FOR SALE

VCR, Samsung VR2640. Transformer, sell whole unit, or part. *Jackson VCR, 205-643-5906.*

B&K transister tester 520B $140.00, RCA FM signal generator WR-52A $100.00. Sencore tube tester TC162 $50.00. All above in excellent condition. All plus UPS. *Harvey Montgomery, 1602 Antelope Rd., Elberton, GA, 30635. 706-283-3055.*

Sencore VC-93 VCR analyzer. Never used $2200.00. We will ship. Sencore VC-93 VCR analyzer. Never used $2200.00. We will ship. *Call Art, 707-226-6235.*

Sams Photofact folders 1801 thru 2255. $4.00 each approximate 229 sets. Plus shipping, 10 minimum. *Sal Cribari, 1312 Well Drive, Camp Hill, PA 17011. 717-763-4547.*

Power transformer for SMONA 77-1456. Pioneer tuner SaFas board. *Ask for Dr.Paul Smellman or Lawrence Tealman at 619-778-0986.*

Sams Photofacts 1-1380 $500.00. TSM 24-86 $80.00. Plus shipping or make offer. *Music Center 1814 Main Street, Vernon, TX 76384. 817- 552-2321.*

Heathkit component tracer, model IT-2232 with manual and probes. Excellent working condition. $250.00 plus shipping. Also Photofacts sets #864 thru 1092. All 56 sets for $50.00 plus shipping. Service manuals for TV and Radio (years 1957 to 1966) $5.00 each plus shipping. *John Brouzakis, 247 Davidson Drive Charleroi, PA 15022. 412-483-3072.*

Hobbyist collection of quality test equipment. Old to modern, but all work great- scopes, meters, generators, analyzers, etc. *Matthews, 7211 Marshall Rd., Lewisville, NC 27023, 919- 945-9761.*

Tentel torque gauge and Tentel tension meter. Perfect condition with padded carry cases. Includes calibration weight and instructional VHS tape $300.00. *Ray Dorsner 509 Main Street, Windsor, CO 80550. 303- 686-7250.*

Sams citizen band photofacts. Complete set Vol 1-293. Excellent condition. Best offer. *John T. Lewis Rt 5, Box 120-D-7, Defunial Sps. FL. 32433. 904-892-6465.*

Tektronix 100 MHz scope model 2246A in excellent condition. $1800.00. Leader signal level meter model LFC-945 never used, $650.00. *Call 702-454-1623. Ask for John Meyers.*

Deflection Yoke for a Emerson Television, model ECT1900K. New or used, manufacturer only sells yoke with picture tube. *David Hurtle, 6194 Main St. Hailesboro, NY 13645. 315- 287-4083.*

Photofacts folders and specialized books; AR, CB, CM, HTP, MHF, SD, TR, TSM, VCR, A.G. Tannebaum, P.O. Box *110E. Rockaway, NY 11518. 516* 887-0057.

Tektronix scopes. 7704A 200MHz mainframe with CRT readout and the following 4 plug-ins. 7A12 dual channel vertical amplifier, &A18 dual trace amplifier, 7B53A dual time base, 7D11, digital delay with CRT readout. Lab cart model 3,, operators and service manuals. Excellent condition. $2375.00 and more. *Dan Mayhak 602- 390-2400.*

Sencore VA48 $550.00 B&K tester model 530 $190.00. Owners manuals. *Robert Francalla, 518-*286-0710

WANTED

Service documentation for NEC 3550, Burroughs AP1300, B9252 printers. Also any facsimile service manuals. Send list to *Jeffrey Brady, 841 #2 Bonneview Rd., York, PA 17402, 717-755-0494.*

Schematic and parts list or service manual for a Montogomery Ward TV model GSK12826. *James Powell, 4237 FCN, McGuire AFB, NJ, 08641. 609-723-1103*

Volume control for Pioneer QX 8000 4 channel receiver. P/N ACV-303. *F.X. Dougherty, 727 Woodtop Rd., Willmington, DE 19804.*

Power transformer for Zenith TV P/N 95-1456. *Tele-Star TV, 307 E. 17 Cheyenne, WY, 82001. 307-632-5319.*

CTR board for Quasar model SLTS976FA03. CTR board for Quasar model SLTS976FA03. W.T. Smith, 1054 S. Elizabeth, Kokomo, IN 46902.

Main board in working or repairable condition for a Panasonic 19" color TV, model CTL-1942R. Mike's Repair Shop P.O. Box 217. Aberdeen *Provind Ground, MD 21005. 410- 272-4984.*

Pinch roller for my VM model 711 reel to reel tape recorder; Adapter sockets for B&K 470CRT checker; Fisher VCR RF modulator #4-1164-011610. *Ed Herbert, 410 N. Third, Minersville, PA 17954.*

Sencore CR70 in good condition. *John Peters Rt1 Box 129F Port Lauara, TX, 77979. 512- 552-4398.*

Technical information on servicing an AKAI reel-to-reel model #GX-630D-SS. Specifically, low torque on reel motors during FF and REW. Any info will help! *James Roth, 45 Cimarron Cir., Elkton, MD, 21921 or call 410- 392-5591.*

AR-1W woofer; accoustical horn for Yamaha model S-2115H with crossover network. *George Demairs 7387 Pearshing Ave. Orlando, FL 32822. 407- 277-3746.*

Schematic or service information on Kenwood AM-FM stereo receiver. Model KR-2300. Will pay for copy. *G. Pederson, 1447 N. Grimes, McPherson, KS 67460.*

Main board from 19" Panasonic TV, model CTI-1942R. *Mikes Repair Service P.O. Box 217 Aberdeen Proving Ground, MD 21005-0217.*

Two each power amplifier IC's for Pioneer RX-70 stereo cassette receiver (part #SI-1125HDP). Used is fine. *Warren Shukis, 1479 Prince Edward Way, Sunnyvale, CA 94087. 408- 739-2709.*

RCA MTT002A, have MST021A/MSC006A complete with controls and number pad for even exchange. *"CM" Chuck Kelly, 3336 Chatham, Waukegan, IL 60087-2123. 708- 623-2597.*

Schematic or service manual for Samsung model MD 1251 D, Monochrome monitor. *Robert Miller, Rt1, Box 223, Anadarko, OK 73005. 405- 247-6553.*

Lampkin 109 service monitor with FM deviation and sweep functions with bands 0-12, 10-22, and 140-152 MHz. *703- 525-2382. Ask for Robert Biddle.*

Self made test equipment for T/S and Repairing of CD players. Couls use some help. *Murry's Repair Shop, Murry Goldstein, 1622 Granfern Ave. West Palm, Beach, FL 33415. 407- 966-8862.*

Main Board MSA HS318UR VCR part 928B28602, Sony Yolk 1-451-109-21 for KV1722, service manual (copy) Pioneer 4CH RCVR model GX747. *McHenry's TV, 6625 N. 20th Lane, Phoenix, AZ, 85015. 602- 249-2325.*

Manuals, schematics for: CONAR model 255 oscilloscope, Model 315 color TV. Both circa 1974, possibly made by Heath. General Radio Cap Std decade box type 1423A. Elenco Impedance model 1010. Xerox 820-11 computer. Shugart 801 8" DS/DD drive. *Naramore, 28 Pearl #38, Barre, VT 05641. Call collect 802- 479-5009.*

VCR symptoms and cures. Clearing House send your tips and receive larger data base program or printout free. *Rideau Electronics, 613- 283-4902.*

Classified

Classified advertising is available by the word or per column inch.
By-the word. $1.65 per word, per' insertion, pre-paid Minimum charge is $35 per insertion. Initials and abbreviations count as full words. Indicate free category heading (For Sale, Business Opportunities, Miscellaneous, Wanted). Blind ads (replies sent to ES&T for forwarding) are $40 additional. No agency discounts are allowed for classified advertising by the word. Contact Emily Kreutz at 516-681-2922 to place your classified ad (by-the-word). Mastercard, VISA, American Express are accepted for phone or mail orders. Or send your order, materials and payment to **Emily Kreutz, 76 North Broadway, Hicksville, NY 11801.**
Per column inch (classified Display): $235 per column inch, per insertion, with frequency discounts available, 1" minimum, billed at 1/4" increments after that 10" maximum per ad. Blind ads are $40 addition. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.) For more information regarding classified display advertising please contact Jonathan C. Kummer at 516-681-2922. Optional color (determined by magazine) $150 additional per insertion.

FOR SALE

COMPUTER AIDED TV/VCR REPAIR SOLUTIONS: 5 1/4" IBM compatible disks, 1,000 VCR, Printout $83, Disks $72. 5,400 TV, Printout $135, Disks $113 (Harddrive). Add to or quick scan by chassis, model and stage. Two solutions pays for it. Electronic Solutions, 407 W. Ave. "N", San Angelo, TX 76903.

REDUCED 85%. Diehl Mark 111 scanner $79. Diehl Mark V scanner $199. New. Restore remote control keypads with our conductive coating $8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629, 608-233-9741.

THE ONLY ANSWER TO REPAIRING ELECTRONICS PROFITABLY (this should have been done years ago) **GET SMART!** Someone somewhere has already repaired your next repair **YOUR TOP TECHNICIAN,** who's training you have paid for **JUST LEFT TODAY! YOU'RE THE BOSS** and now you have to put on your old rusty technician's cap. **TODAY YOUR BANK** sent you three NSF checks your customers so graciously gave you, and you don't have time to chase them down to collect, **THEY LEFT TOWN. IT'S TAKING YOU LONGER** to assess the repairs and your customers are now coming to collect their units. You promised to give them a **FREE** estimate, but you just realized you don't have a schematic or time to do it. **NOW YOU ARE DOING NIGHT REPAIRS** because during store hours the phone rings off the hook with nuisance questions about setting VCR clocks and you have parts to order, bills to pay and service literature to file. **CIRCUIT CITY JUST MOVED IN** and your wife say's there's no money in repairs **FRIEND!! YOU DEFINITELY HAVE AN EMERGENCY!!** 10,000 repairs 1987 through 1992 with annual updates. References available on request. **I CAN ASSURE YOU THESE TECH-TIPS ARE NOT DUSTY OLD REPAIRS YOU'LL NEVER SEE.** Other programs don't even come close to comparing. **CALL NOW (305) 474-2677 FOR A "FREE" DEMONSTRATION DISK OR PAPER FORMAT** or mail request to **TV-MAN SALES & SERVICE, 8614 SR-84, FT. LAUDERDALE, FL 33324**

ZEN./9-516 MODULE CURE: Repair yourself and save! For instructions send $15.00 to: TEK ENTERPRISES, 702 Overland Avenue, Wilmington, Delaware 19804.

BUY/SELL/TRADE SENCORE SG165's: Buy an SG165 with all probes/accessories like new for up to 60% off list! With warranty! Get up to $1000 for your used SG165! Ask for Kosta 1 (800) 736-2673.

TV-VCR Service near new pier and ocean. Oldest shop in Huntington Beach California. Retiring,. Can help you get strarted. 714-846-1591.

PHOTOFACTS: Folders and specialized books; **AR,** CB, CM, HTP, MHF, SD, TR, TSM, VCR. A.G. Tannenbaum, P.O. Box 110, E. Rockaway, NY 11518. 516-887-0057.

ATTENTION SERVICERS! If you charge hourly rates, you need the DTS125 Labor Tracker! The DTS125 is a unique bench top instrument that automatically measures elapsed service time and computes labor charges for your service work, saving time and money. A large internal memory holds up-to 125 active jobs. The DTS125 Labor Tracker is easy to use and lists for $349.00. On sale now for just $279.00. Satisfaction guaranteed. Call or write for brochure. **Johnson Electronic Technologies**, Dept. E2, 5 Kane Industrial Drive, Hudson, MA 01749 (508) 562-1157.

VHS-VCR Repair Solution Sets I, II, III IV, V, VI, VII. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, $11.95 each, all seven $69.95. Schematics available. Visa/MC. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530.

FOR SALE: Sencore test equipment. NT-64, SC-61, VC-63, VA-62, PR-57, LC-53, IBM large screen reader and more. 704-664-5434.

MISCELLANEOUS

CAMCORDER/VCR REPAIR: Don't turn away good profits let our experienced technicians provide your shop with complete camcorder/VCR repair service. Also, VCR, "Tough Dogs." Call 1-800-846-4648. Edington VCR/TV, 204 North Kimble Drive, Bloomington, IN 47404.

BUSINESS OPPORTUNIES

ESTABLISHED CONSUMER ELECTRONICS sales and service business, located in the beautiful mountains of North Central Idaho, where fishing and hunting is just outside our back door 208-983-0429.

Manufacturers Parts and Literature Directory

This monthly section is sponsored by manufacturers to help you find the parts and technical literature needed to service their equipment. Call them for replacement parts or for the name of their nearest distibutor.

Hitachi Home Electronics **401 W. Artesia Blvd.** **Compton, CA 90220** **800-HITACHI**	**Mitusubishi Electronics America** **5757 Plaza Drive** **Cypress, CA 90630** **800-553-7278 fax 800-825-6655**	**NEC Tehcnologies** **1255 Michael Drive** **Wood Dale, IL 60191** **800-366-3632**
Panasonic **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800 545-2672**	**Philips ECG** **1025 Westminister Drive** **Williamsport, PA 17701** **800-526-9354 fax 800-346-6621**	**Quasar** **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800-545-2672**
Technics **50 Meadowlands Parkway** **Secaucus, NJ 07094** **800-545-2672**	**Thomson Consumer Electronics** **2000 Clements Bridge Road** **Deptford, NJ 08096** **800-257-7946 fax 800-524-1498**	**Zenith Electronics Corp.** **1900 N. Austin Avenue** **Chicago, IL 60634** **312-745-2000**

Call Jonathan Kummer at 516-681-2922 to reserve space in this special section.

Advertiser's Index

We'd like to see your company listed here too. Contact Jonathan C. Kummer to work out an advertising program tailored to suit your needs.

SALES OFFICE

Phone: (516) 681-2922
FAX: (516) 681-2926

Jonathan C. Kummer
Advertising Manager

Emily Kreutz
Sales Assistant

Multi-Choice.

Whether you're doing first-level troubleshooting or component-level diagnosis, Fluke meters offer you one of the widest choice of capabilities and price ranges in the industry. Choices ranging from the basic Fluke 12 with auto function V-Chek™ and Continuity Capture™. To the classic Fluke 77 with Auto Touch Hold® and current measurements. To the advanced Fluke 83 with Min/Max/Average recording, Frequency, Duty Cycle and Input Alert™. Plus a full line of quality accessories to extend those capabilities even further. No matter which Fluke meter you choose, you can count on precise, reliable, consistent performance year in and year out. Plus, strong customer support and product warranties that measure up to any in the industry. Make the choice that gives you the most choices. Look to Fluke for the tools you need to get the job done right. See your Fluke distributor, or call 1-800-87-FLUKE for a catalog and the name of the distributor nearest you.

Fluke 77
The classic
Multimeter
$169.00

Fluke 83
Full-featured
Multimeter
$255.00

Fluke 12
Auto-function
Multimeter
$89.95

FLUKE 12	FLUKE 77	FLUKE 83
The Fluke meters listed above feature DC/AC voltage, resistance, audible continuity and diode test.		
Capacitance measurements	Auto Touch Hold®	Auto Touch Hold® and Relative modes
V Chek™ (auto function)	Current measurements	Current measurements
Min/Max Record with Relative Time Stamp	Analog/Digital display	Analog/Digital display
Two-year warranty	Three-year warranty	Three-year warranty
Continuity Capture™	Yellow holster with Flex Stand™	Yellow holster with Flex Stand™
Basic accuracy 0.9%	Basic accuracy 0.3%	Input Alert™
		Capacitance measurements
		Frequency and Duty Cycle
		Min/Max/Avg. Recording
		Basic Accuracy 0.3%

John Fluke Mfg. Co., Inc.
P. O. Box 9090, Everett, WA 98206
For more information call:
(416) 890-7600 from Canada
(206) 356-5500 from other countries

Prices subject to change. Suggested U.S. list price.
Ad No. 00276

FLUKE®

Circle (77) on Reply Card