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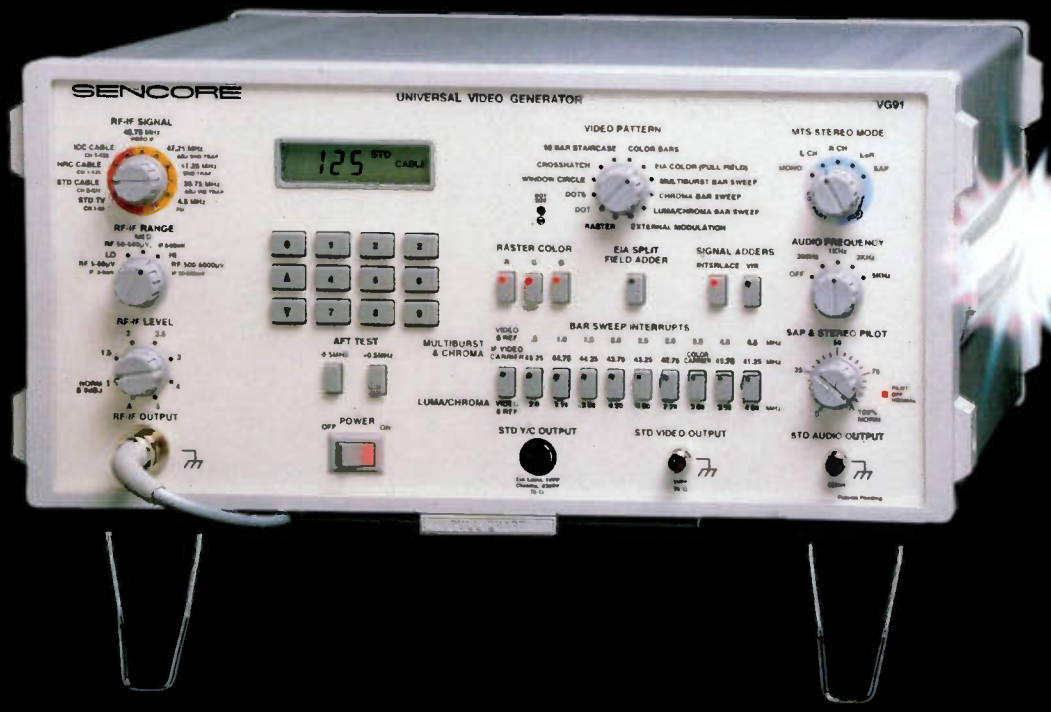

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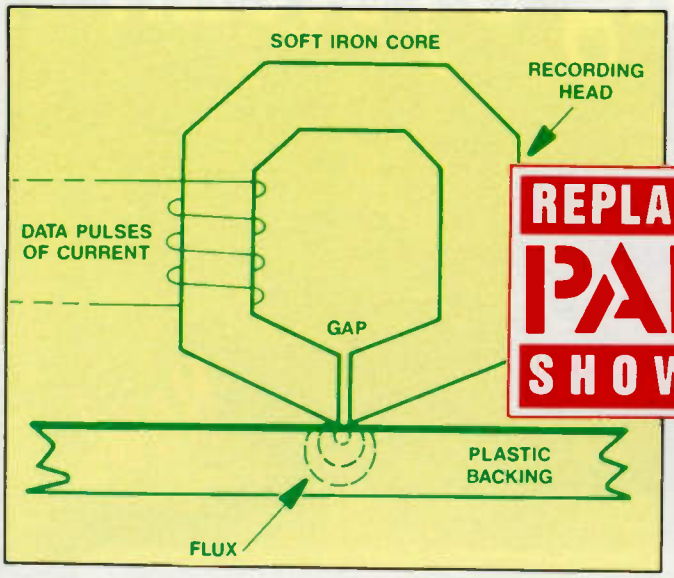

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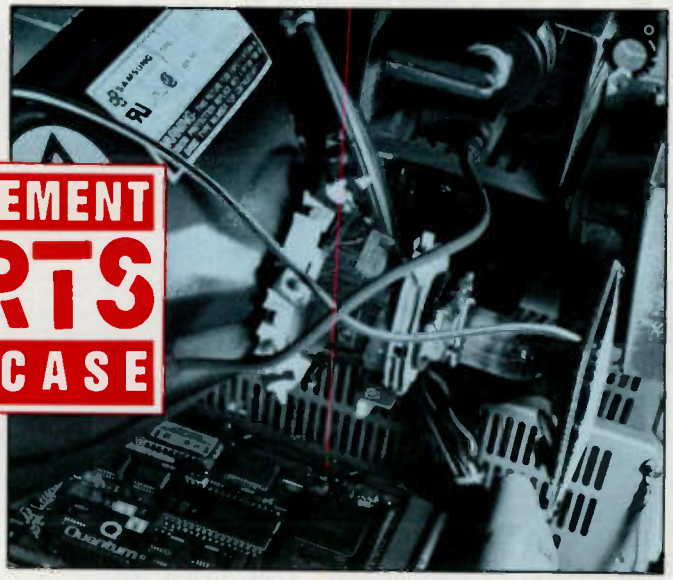

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Replacement Parts Showcase

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ON THE COVER

CDI, or compact disc interactive, is a multimedia system that is capable of delivering audio, graphics, pictures and text in such a way that the user can interact with the system to alter the order in which the system retrieves the disc information, and which portions of the information will be retrieved. This technology represents a new challenge and a new opportunity for consumer electronics service. *(Cover photo courtesy Phillips Consumer Electronics)*

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
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Are you listening?

A year or so ago I came home from a trip to find my car in the driveway with a flat tire. It was a hot sticky day, and having just flown for several hours, the last thing in the world I wanted to do was to change that tire and bring the flat in to have the tire repaired. But I felt that I might as well get it done, so as soon as I put my luggage in the house I jacked the car up, put the spare on and went to a local garage to have a patch put on the tire.

Before I went to the garage, I looked all over the tire tread to see if I could see what made the puncture. It didn't really take a close inspection, there was the head of a nail sticking out.

When I spoke to the service representative at the garage I told him what was wrong, and offered to show him, or the person who would fix the tire, where the nail was. He assured me that the person who would fix the tire would be able to find the nail, and they didn't need me to show them.

Satisfied, I sat down in the customer lounge and watched some afternoon TV show. It wasn't long before the service representative called me and told me that my tire was ready, and the wheel had been put back on the car. I paid the bill, and as I was getting ready to walk away from the counter he said, "Oh, by the way. There was no nail in the tire. The service man checked it in a water bath and found no bubbles, and no nail."

I responded to him, "There was a nail in the tire! If I have to change that tire and bring the car back to have it fixed again, I'm going to be mad." He again assured me that everything was fine.

Not wanting to be stranded somewhere with a flat tire and have to change it on a busy road, or in the dark of night, or in the rain I carefully inspected the tire that had just been repaired. I had mentally noted the position of the nail the first time I found it. The same nail was still there. The tire was still fully inflated, but driving would have caused air to escape, to say nothing of further damaging the tire.

I walked back into the garage and invited the service representative to come outside with me and see the nonexistent nail. We went out together and I showed it to him. He apologized, asked me to wait in the lounge for a little while longer, and proceeded to point out to the tire service person the error of his ways.

A short time later, the service representative called me and assured me that this time, not only was the tire fully inflated and on the car, but also that it was now minus the nail.

Whether it's a flat tire or a TV set that doesn't work, the service company can often gain useful information by simply listening carefully to the description by the owner of the problem symptoms when he or she brings it in for service. If the information is totally useless, you can just ignore it. But the owner of the product has been using it for some time, and, if he or she is observant, might just be able to provide a clue that will save a considerable amount of time in diagnosing the problem.

The worst thing that can happen is what happened in the case of my tire: to ignore the customer, and then to find out later that the repair was not effected properly because the customer's information had been ignored.

In my case, I regularly bring my car to this garage, and they ordinarily do good work, so they still have my business. But if this had happened the first time I brought my car there, I might just be taking my business somewhere else, even though this is the most convenient place to take it.

In these days, when people have so many products that can and do fail, even if the product is ordinarily reliable, it's frustrating to have to bring a product in for repair then find that the service wasn't done thoroughly because the service company wasn't paying attention when you described the problem.

Are you listening? ■

Nils Conrad Persson

Application notes cover data acquisition buffering and more using a LabView 2 as an Oscilloscope and VXI/MXI Tutorial

National Instruments has published four new application notes. The first, "Double Buffering for Continuous Data Acquisition," discusses the fundamentals of double-buffered data acquisition, how double buffering works, the factors that affect the throughput rates, and a double buffering application - streaming data continuously to disk in real-time.

The second application note, "Solve Your GPIB Problems Quickly with the GPIB-4100," explains how to use the GPIB-410 bus analyzer to monitor and diagnose system failures, and quickly locate the source of a GPIB problem.

The third application note, "Using LabVIEW 2 as an Oscilloscope," describes how to use to LabVIEW 2 and an NB-MIO-16 multifunction plug-in data acquisition board to build a virtual instrument that duplicates the basic functionality of a single oscilloscope using a Macintosh computer.

The final application note, a Short Tutorial on VXI/MXI, is a brief introduction to VXI and MXI high performance instrumentation bus interference standards and their performance.

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High-speed CMOS ICs semiconductor replacement line

The 74HC and 74HCT device families are part of the ECG Replacement Semiconductors product line, which comprises over 4000 distinct solid state devices. Among the logic functions provided by ICs, are gates, flip flops, multivibrators, multiplexers, shift and storage registers, counters, drivers and others.

HCMOS ICs feature the low-power consumption, high-noise immunity and wide operating temperature range of earlier silicon gate CMOS circuits together with the high speed and drive capability of bipolar, low-power Schottky LSTTL. They are also immune to latch up, compatible with the operating frequencies used in many microprocessor applications and provide broad power supply range and fan out capabilities. ECG HCMOS are provided in dual in-line packages, many having the same pinout as comparable 74LSTTL and 4000 series devices.

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Application notes explain DSP fundamentals and hardware

National Instruments Corporation has published two new application notes. The first, "Digital Signal Processing Fundamentals," explains how scientists and engineers can develop powerful PC-based data acquisition and analysis systems using digital signal processing (DSP) technology, and discusses DSP from a hardware, software, and applications point of view. The note explains that DSP is not just for signal processing or FTTs, but also can be used in any application where the user must perform extremely high-speed, real-time calculations of large amounts of data. The note also explains DSP from an applications point of view to demonstrate the many different environments in which digital signal and array processing are effective.

The second application note, "Digital Signal Processing Hardware," explains the fundamentals of DSP boards and their use in real-time tasks. Rather than waiting for PC microprocessors to become powerful enough to fulfill real-time processing requirements, system designers are now introducing plug-in DSP boards into their PCs. This produces multiple processor environments that are more powerful for numerically intensive applications than many single-CPU minicomputers and workstations. The note discusses how users can change the architecture of their PCs using DSP boards to ensure greater processing power and performance, and lists various applications that typically use DSP technology.

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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.

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Free Trade, Harmonization of standards and mutual acceptance of test data

Underwriters Laboratories Inc. (UL) and the Canadian Standards Association (CSA) have a process in place for the reciprocal acceptance of each other's test results, based on a jointly developed test report, for a wide variety of product categories. This process falls within the framework of the Memorandum of Understanding (MOU) signed by UL/CSA in 1989.

"Accepting each other's test data in these product categories allows both CSA and UL to streamline the certification of these products for manufacturers in both countries," said John E. Kean, CSA President. "This continuing effort is an important step in extending our cooperative relationship and is in line with the Canada/U.S. Free Trade Agreement."

In 1989, UL and CSA revised a 1986 MOU to work towards harmonization of their respective standards with a goal that there eventually be a single standard applicable for each type of electrical/electronic equipment in both Canada and the United States.

According to UL President Tom Castino, the benefits of standards harmonization are clear. "Harmonizing requirements helps simplify product manufacturing for our clients since they need only to build one version of a product to meet the safety requirements of both organizations. We've got three harmonized standards now - covering heating and cooling equipment, vacuum cleaning machines, and hermetic refrigerant motor-compressors - with more than 500 other harmonization projects in the works."

The 1989 MOU covers the following product categories: Air Conditioning Equipment, Attachment Plugs and Receptacles, General-Use Snap Switches, Industrial Control Equipment, Circuit Breakers, Fuses, Programmable Controllers, Communications Cables, Information Processing Equipment, Home Entertainment Equipment, Vacuum Cleaners, and Implosion-Protected Cathode Ray Tubes.

Within the framework of the 1989 MOU, UL and CSA have worked closely with each other to make it work. A number of clients have used the MOU to their satisfaction. Through the MOU, clients can consolidate the safety testing of specific types of products at one organization - either UL or CSA - and end duplicate safety testing. This will lead to the smooth acceptance of each other's test results.

Industry associations such as the Electrical and Electronic Manufacturers Association (EEMAC) in Canada and the National Electrical Manufacturers Association (NEMA) in the U.S. are urging their members to make more use of the system.

EIA Digital Audio Radio Subcommittee begins process of identifying system proponents; adopts voting procedures

The Electronic Industries Association's Digital Audio Radio (DAR) Subcommittee has initiated the process of identifying DAR system proponents with the mailing of a letter to known proponents, manufacturers, and other organizations.

The letter requested the submission by system proponents of a statement of intent to participate in the subcommittee's process and a description of their proponent systems by June 15, 1992. The letter noted that system proponents will be asked to submit detailed technical descriptions of their systems by December 15, 1992, and that hardware should be provided to the Subcommittee for testing by April 15, 1993.

At its meeting the Subcommittee unanimously adopted specific procedures for voting on proponent systems, and decided that these systems will be voted on by seven "common industries," or industry segments. Each segment will consider the submitted systems on the basis of how effectively they address specific performance requirements. The seven segments include:

- Radio broadcast equipment manufacturers
- Radio broadcast networks
- Radio broadcast stations or groups
- Radio receiver manufacturers
- Component (IC) manufacturers
- Satellite broadcast providers
- Software providers (including audio program and data service)

A decision on how many votes each of the seven industry segments will be allocated will be made at the Subcommittee's next meeting on July 16.

It was announced that a testing program for proponent systems will be developed this summer. Funding for testing, which may rely on proponent support and contributions by each voting industry segment, proportional to their voting allocation, was scheduled for discussion.

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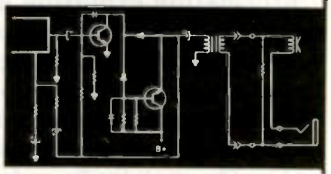

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Continuing education in servicing

By Conrad Persson

As many of the sages and philosophers of our time have said, we are living in the age of information overload. According to a recent magazine article, the average daily issue of the New York Times contains more information than the typical individual who lived during the 16th Century processed *in an entire lifetime*.

There are many reasons that so much information is available today. One reason is simply that history from the beginnings of history to the 20th Century is so much longer than from the beginning of history to the 16th Century. Another reason is that there are so many more people living now, so many more countries, so many more different kinds of organizations about which there is much more information.

Another reason for the existence of so much information is that we have so many more ways of recording information, and so many more people whose profession it is to develop and record information.

Still other reasons for the explosion of information are the advances in technology that we have enjoyed in the past few centuries, which have provided humanity with far more information concerning technology than could have been thought possible in the 16th Century, and information about the products of that technological development.

The impact on servicing

There are few professions where the information explosion has had a greater impact than on the profession of electronic servicing. In the few short years since the introduction of electronics, the very fundamentals of the technology have changed at a rapid pace. The crystal radio and the Edison phonograph have spawned a wealth of electronic products for people to use in their homes.

Persson is editor of **ES&T**.

Technicians have to keep up

Many people can simply refuse to put forth the effort to learn about much of the new technology. Many do. For example, there have been many articles and stories in the media about writers who refuse to use a computer word processor, preferring to continue to bang away at the old mechanical typewriter. There are the people who do not know how to program their VCRs to record a program at a later time; and who will not learn. There are many people who use the products of modern technology but who have no idea of how they operate and no desire to learn.

An electronics servicing technician who takes that attitude today is already obsolete. Technology is changing so rapidly today that every technician, service manager and service center owner must make a career out of constant study. For example, technicians have barely had a chance to become comfortable with VCRs and camcorders, and now the next technologies: compact disk interactive (CDI), multimedia, HDTV, DBS, digital compact cassette and digital broadcast radio are either already here or soon to be available.

Never has the profession of servicing been so interesting, fascinating, challenging or frustrating. And never has the necessity to study constantly just to keep up been greater.

Rethinking service

As a result of all of the changes that have come about because of the new circuitry, servicing the products requires a new approach to thinking about it. For example, even products that seem to be straightforward and very much like the products of years ago may be very different under the skin. TV sets, especially those that contain such enhancements as picture in picture, on screen readouts, and other advancements are likely to contain a great deal of complex, microprocessor circuitry.

Every VCR is a complex system of mechanics and electronics that requires precise control to produce an acceptable picture.

Audio and video disc players have to have digital and computer circuitry in them in order to convert the digital bits on the disc back into the music that it represents.

In sum, no matter how innocuous and familiar any of today's consumer electronic products may look, they most likely contain circuitry that is at the cutting edge of today's electronics technology.

Servicing these products requires skills and equipment greatly advanced beyond the skills and equipment that was needed to service the products of a few years ago.

There is lots of help

Fortunately, there is a wealth of training resources available to service technicians today. For example, manufacturers of today's consumer electronics products, who want to have competent technicians available to service their products, offer training courses and many kinds of training materials. Private and public schools that want to attract students offer technical courses. Book publishers can sell a lot of books if they publish good, helpful texts that offer detailed information on the theory of operation and servicing of modern consumer electronics products.

Training from EIA/CEG

One of the best, and least expensive sources of training for servicing of consumer electronics products is the Electronics Industries Association/Consumer Electronics Group (EIA/CEG) Product Services Department. This organization offers free 2-day and 5-day on-site workshops for technicians who are actively working in consumer electronics servicing.

EIA is the association to which manufacturers of TVs, VCRs, stereo equipment, etc. belong. They are

working very hard through this organization to attract and train technicians to service all of the products that they manufacture and sell. Every service center that can do so should take advantage of this superb training resource.

In addition to the workshops, EIA/CEG also offers video cassettes, manuals and the like on a wide range of subjects from "Troubleshooting with modern electronic test equipment (Parts I and II)," to high-tech soldering and microprocessor troubleshooting, and more. These tapes are priced very inexpensively, just enough to offset the cost of producing them.

If you, or someone in your service facility is in need of training, you should at least explore what EIA has to offer. See their name and address in the listing in this article.

Doing it

Most consumer electronics servicing technicians are aware that they need to upgrade their skills. The problem is complex, but there are usually two questions that the technician needs to get answered: "What training do I need?" and "How do I get the training I need?"

It's important to analyze these questions thoroughly to determine beforehand exactly what it is you need to study. It's not enough to just say "I need to learn about the technology of compact disk-interactive (CDI) and then to look for a correspondence school or a local school that might offer a course on CDI. It's important to examine the situation and determine exactly what you need to learn. Do you just want an overview on CDI technology? Or do you really have a pretty good idea of how CDI works and really need a course in digital signal processing?

Once you set the specific goals, the question becomes how to achieve them. One simple but effective method might be to contact other technicians in your area. If you have a skill that they lack and vice versa, you might be able to arrange for a session in which you educate each other.

Self study

Another way to learn is to buy a book on the subject and study it yourself. Depending on the complexity of the subject, the quality of the book, and your own self discipline, this approach might make you an expert or cause you to become totally frustrated.

Home-study courses make learning easier and more fruitful than simply studying from books. The material is broken down into study units, someone tells you what is expected of you, and you get feedback through regular tests, and possibly through telephone and mail contact with an instructor who has been assigned to you.

Schools and seminars

If time and money permit, a more effective way to learn is through structured class and lab courses. There are many options available for a technician who can attend such classes. Technical schools throughout the country offer anything from the most elementary introductory courses to detailed theory, design and servicing courses. If you have the time and the budget to travel, consumer electronics equipment manufacturers offer seminars on the operation and servicing of specific products to servicing technicians. A list of manufacturers, including addresses and telephone numbers, accompanies this article.

There are also many organizations, especially in the computer area, that offer seminars of a few days to a week or so, usually in a number of locations throughout the country.

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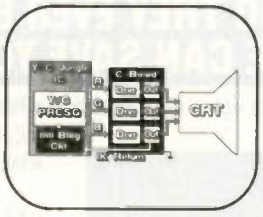
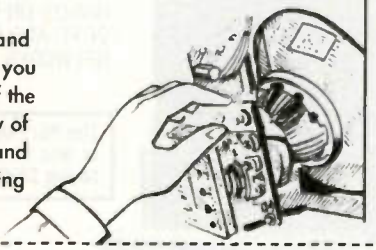


Learn how the new TV receivers operate with Sony's video training package. It comes with an instructional videotape and training manual to help you master the mechanics of the ANU Chassis technology of the 90's. Order now - and customers will start putting you in the picture!



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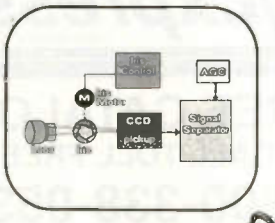
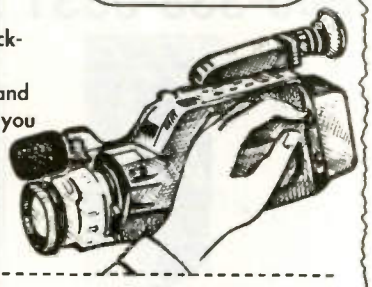


Learn how the new 8mm camcorders operate with Sony's video training package. It comes with two instructional videotapes and training manuals to help you master the electronics of 8mm technology. Order now - and customers will start putting you in the picture!



Title	Part Number	Quantity	Price Each	Total
ANU Television Chassis: Digital Communicaftons	T-ANU-9		$45.00	
8mm Camcorder Fundamentals: The Sony Advantage	T-8MMA-9		$75.00	
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In addition, manufacturers of test equipment and tools such as multimeters, oscilloscopes, soldering tools, etc. offer instruction in using their products. Some offer books and pamphlets, and some even have videotaped instructions, that help you understand how to most effectively use their products. Some companies offer formal courses for home study, and others offer courses and seminars that travel to different areas of the country so you can take a formal course taught by the experts near home. Some of the instruction is free, and some will cost a substantial amount, so check before you proceed.

Identifying the available resources

A local school may offer just the course you need. A book publisher might have just the book or series of books to fill in the gaps in your knowledge. One of the associations related to home electronics equipment manufacturing sales or service may have just the item of information you need or be able to point you in the right direction.

Accompanying this article are several lists of companies and other organizations that offer some kind of training and/or training materials, but space doesn't permit a comprehensive list. There are a number of detailed lists available that will provide someone who is serious about training many avenues to explore. One such list is the **ES&T** March Buyers' guide. That issue contains a large list of consumer electronics manufacturers, tool and test equipment manufacturers and associations with addresses and phone numbers.

Try experimentation

Many of today's consumer electronics products, such as VCRs, camcorders and CD players include a lot of electromechanical components and systems, and it's frequently the mechanical portion of these products that cause problems. To understand a mechanical system, it's frequently useful just to open the unit up and watch how things work; even to introduce some problems to see what happens. This approach may not be advisable in the case of a $1,000.00 hi-fi VCR, but some of the low-end units cost in the neighborhood of $200.00. If you take a look at the cost of books these days, or the cost of seminars, or even just the cost of travel, lodging and meals to attend a seminar, $200.00 is pretty cheap for a unit to take apart, observe, check with DMM and oscilloscope, and you might get a pretty good education from it.

Try the product manufacturers

Many of the manufacturers of consumer electronics equipment provide training in a number of ways. Some of the manufacturers restrict the training they provide to technicians from their own authorized servicing facilities. Others not only offer courses to anyone who is both qualified and interested, they make it a point to make their courses universally applicable.

The listing of consumer electronics product manufacturers provided contains a listing of some of the manufacturers that according to the latest information available to us offer consumer electronics training. This list makes no pretension at being comprehensive. By all means, contact other manufacturers to find out what training courses and materials they might have available.

Test equipment manufacturers

Test equipment manufacturers not only know a great deal about the test equipment they sell, but they are fa-

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miliar with applications of their products. They talk to the engineers and technicians who buy and use their products and learn what their problems and needs are.

The test equipment manufacturers also recognize one other important fact: the more their customer knows how to apply their products, the more likely they will be to buy their product in the first place, to be happy with it once they've bought it, to recommend the company's products to a friend, and to buy that same brand the next time they need a piece of test equipment. In order to enhance the customer's or potential customer's understanding of the testing/diagnosing function in general and the company's product in particular, many manufacturers of test equipment offer courses, manuals, videotape courses, and other training opportunities.

For example, B&K Precision offers booklets such as a "Guidebook to Function Generators," a "Guidebook to Test Instruments," and a "Guidebook to Oscilloscopes." Sencore offers seminars throughout the country as well as their "Tech Tips" binder, the periodical "Sencore News" and other training materials.

Tektronix Oscilloscope Division puts out booklets such as "The XYZs of using a scope" and "Basic Oscilloscope Operation."They even sell a training kit that allows a scope user who needs to learn more about use of an oscilloscope to practice on circuitry for which the scope traces are known. The Tektronix Television Business Division offers application notes such as "Basic NTSC Video Testing" and "Checking VCR Performance."

Hewlett-Packard offers manuals such as "The fundamentals of signal analysis" and "Feeling comfortable with digitizing oscilloscopes," that provide in depth information about the state of the art in circuits and signals, and the test equipment and techniques needed to study and understand it.

You should also check with any of the other well known manufacturers of test equipment to determine what kinds of training materials they have.

Learning about computers

Personal computers have become consumer electronics products. It's now possible to put together a low-end equipped 8088-based computer, including monitor and printer for around $1,000. Advancing technology and competition among manufacturers and sellers is causing higher powered computers to come down in price correspondingly. And the increasing availability of useful, user-friendly low-cost software such as word processing, spread sheet, data base, desktop publishing, accounting, on line data bases and more is making them more and more attractive to more and more people.

The changing economy and the changing workplace are resulting in more people establishing offices at home. Along with fax machines and answering machines, personal computers are considered essential tools for the home office.

One result of this increasing population of personal computers in homes is that personal computers have become products that are serviced by consumer electronics technicians. And while making the transition from servicing TVs and VCRs to servicing computers does take something of a mental adjustment, it's usually far easier than it first seems, especially for someone who has made a lifetime study and a business of understanding and servicing electronics circuits.

These days it becomes yet easier as the number of organizations that offer training in computers increases, and in most cases the level of training gets better. The companies that offer computer related service training include not only companies that are traditionally computer oriented such as American Institute, Heath/Zenith, Learning Tree, National Advancement Corp., but also includes some of the companies that you might not think of as computer oriented, like the consumer electronics manufacturers.

Trade associations

Another superb source of training for service center owners, service managers and service technicians are the trade associations: organizations like ETA, NARDA/NASD and NESDA/ISCET, and their state and local affiliates. These associations offer a great variety of training courses that are useful to service center people.

For example, a state or local chapter of one of the associations might invite a technical training instructor from a consumer electronics manufacturer to one of their monthly meetings to lead a seminar on servicing the digital circuitry in the company's new line of VCRs.

Another example of this type of training are management seminars offered to service center owners and service managers at monthly meetings of local/regional/state association affiliates as well as those offered at the associations' annual meetings.

Some of the most successful service center owners and managers belong to these trade associations, and attend the meetings, seminars and annual conventions religiously. Most, if not all of them attribute a great deal of their success to their membership in the organization and their participation in these training activities. If you don't belong to such an association, you should at least look into it.

Learning from service software

Finally, service oriented computer software provides a source of training; of sorts, at least. For example, there are several software programs that provide problem/solution type of assistance for servicing technicians. This is the type of program that you load

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up, then key in the make and model of product, and then select the symptom that most closely describes what you've observed. The program then offers a number of possible solutions, starting with the most common. Such programs are available from a number of suppliers.

Of course these programs are primarily designed to provide quick fixes for technicians who have a sick product on the bench that they want to get fixed quickly. But a fledgling technician, with a schematic diagram of a given electronic product in front of him could look at the schematic while going through the various symptom/suggested cure units. This kind of exercise could be a powerful training exercise.

As another example, computer diagnostic software could also be used as a learning tool. A competent but still learning technician could sit down with a malfunctioning computer product, and compare his observation of the symptoms with the conclusions drawn by the software as it runs.

Don't remain in the dark

If you, or someone who works for you, is lacking in some of the important skills required to diagnose and service some of today's sophisticated consumer electronics products, it's almost a sure bet that there is someone out there, or more likely several someones who offer the training that's needed. If you don't find reference to the kind of training you need in the list that follows, perhaps a little research will lead you to just the training you need.

For example, do you need training on soldering and desoldering the new surface mount devices? Contact one of the manufacturers of soldering/desoldering equipment. Do you need information on applying an oscilloscope to diagnosis of some of today's sophisticated VCR circuitry? Try one of the well known test equipment manufacturers. The information is there; it's just a matter of finding it.

Some of the sources

The accompanying text lists a number of correspondence schools, book publishers, associations, product manufacturers, and test equipment manufacturers whom you might want to contact for further information on what educational opportunities they have to offer.

Trade associations

Electronic Industries Association/Consumer Electronics Group
2001 Pennsylvania Avenue, N.W.
Washington, DC 20006-1813
202-457-4919

Electronics Representatives Association
20 E. Huron
Chicago, IL 60611
312-649-1333

Electronic Technicians Association
604 North Jackson St.
Greencastle, IN 46135
317-653-3849

Musical Instrument Technicians Association, International
8216 Audrain Drive
St. Louis, MO 63121-4504
314-389-3290

National Association of Business and Educational Radio
NABER
1501 Duke St, Suite 200
Alexandria, VA 22314
703-739-0300

NARDA (National Association of Retail Dealers of America)
NASD (National Association of Service Dealers)
10 East 22nd Street
Lombard, IL 60148
312-953-8950

National Association of Service Managers
650 W. Algonquin Road, Suite 204
Des Plaines, IL 60016
708-640-8133

National Electronic Distributors Association
35 East Wacker Drive
Suite 3202
Chicago, IL 60601
312-558-9114

National Electronic Servicing Dealers Association
2708 W. Berry Street
Ft. Worth, TX 76109
817-921-9062

Technical book publishers

CRC Press, Inc.
2000 Corporate Blvd., N.W.
Boca Raton, FL 33431
407-994-0555

McGraw-Hill Book Company
1221 Avenue of the Americas
New York, NY 10020
212-512-2000

MacMillan Publishing
Front and Brown Streets
Riverside, NJ 08075
800-257-5755

PCS Publications
PO Box 10492
Clearwater, FL 34617-8492
800-741-DATA
Fax: 813-446-3157

Prentice-Hall, Inc.
Rte. 9W
Englewood Cliffs, NJ 07632
201-592-2455

Tab Books
PO Box 40
Blue Ridge Summit, PA 17214
717-794-2191

Van Nostrand Reinhold Company
135 W. 50th St.
New York, NY 10020

Publishers of schematic diagrams

Eagan Technical Services, Inc.
1380 Corporate Center Curve
Suite 107
Eagan, MN 55121
612-688-0098

Howard W. Sams & Company
2647 Waterfront Parkway East Drive
Indianapolis, IN 46214
317-298-5400

Schematic Solutions, Inc.
11120 Wurzback Rd., Suite 206
San Antonio, TX 78230
512-696-0404
Fax: 512-696-7135

Software sources

Service Tips programs

FixFinder
TCE Publications
10003 Bunsen Way
Louisville, KY 40299
502-491-8110

High Tech Electronics
1623 Aviation Blvd.
Redondo Beach, CA 90278
213-379-2026

Higher Intelligence Software
60 Farmington Lane
Melville, NY 11747
516-643-7740

Diagnostics/utilities

Fessenden Technologies
116 3rd Street
Ozark, MO 65721
417-485-2501

Gibson Research Corp.
22991 La Cadena
Laguna Hills, CA 92653
714-830-2500

Micro 2000, Inc.
1100 E. Broadway, Third Floor
Glendale, CA 91205
818-547-0125

SyncPulse
7730 Foothill Blvd.
Tujunga, CA 91042
818-353-9595
818-353-7016

Track Mate
Diagnostics and disk drive maintenance
305 East Shore Drive
Conyers, GA 30208
800-486-5707

Windsor Technologies, Inc.
130 Alto Street
San Rafael, CA 94901
415-456-2200
Fax: 415-456-2244

Home study

Cleveland Institute of Electronics
1776 E. 17th St.
Cleveland, OH 44114
216-781-9400
Fax: 216-781-0331

Cook's Institute of Electronics Engineering
Desk 15
PO Box 20345
Jackson, MS 39209

Electronic Institute of Brooklyn
4823 Avenue N
Brooklyn, NY 11234

Grantham College of Engineering
P.O. Box 5700
Slidell, LA 70469-5700
504-649-4191

Heath/Zenith
PO Box 167
Hilltop Rd.
St. Joseph, MI 49085
616-982-3411

National Technical Schools
456 W. Santa Barbara Ave
Los Angeles, CA 90037
213-776-3202

NRI Training for Professionals
McGraw-Hill Continuing Education Center
4401 Connecticut Ave. NW
Washington, DC 20008
202-244-1600

Private trade schools

National Association of Trade and Technical Schools
2251 Wisconsin Ave. N.W.
Washington, DC 20007
202-828-2614

Consumer Electronic Equipment Manufacturers

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

Akai America, 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

AOC International
10991 N.W. AirWorld Drive
Kansas City, MO 64153
816-891-8066
Fax: 816-891-7882

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 Technica 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

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

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

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

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 (America), 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

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

JVC Service & Engineering Co. of America
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 are also 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

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.
700 N. Commerce St.
Aurora, IL 60504
708-820-5490

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

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

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

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

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

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

Philips Consumer Electronics Company
Philips Service Company
PO Box 967
907 Snapp Ferry Road
Greenville, TN 37744
615-636-5838
Fax: 615-636-5865
Replacement Parts:
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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 Av
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

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

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
201-529-8200
Parts: 201-529-9118

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

Sony Corp. of America/Sony Service Company
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

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

Parkomatic 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

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

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

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

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

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

Other Training Programs

Computer Training

American Institute
Institute for International Research
437 Madison Ave., 23rd Floor
New York, NY 10022
212-826-3340

Learning Tree Inter
6053 West Century
PO Box 45028
Los Angeles, CA 9(
313-417-8888
Fax: 410-2952

National Advancen
2730-J South Harb
Santa Ana, CA 927
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Compact Disc Interactive (CD-I) - Part 1

By Marcel R. Rialland

CDI, or compact disc interactive can be described as a multimedia system that is capable of delivering audio, graphics, pictures and text interactively. The term "interactive" means that instead of simply listening to music or watching a movie, the user can interact with the system to alter the order in which the system retrieves the disc information, and which portions of the information will be retrieved. The Philips CDI910, shown in Figure 1, was introduced last October as the first consumer CDI player. This player can also play standard digital audio compact discs (CD-DA) as well as the new Photo CDs.

The user interacts with the system

The CD-I player basically uses the compact disc format as a storage medium for both audible and visual information, as well as text and control data. More importantly, it provides interactivity for the user. For example, the user may use a CDI system to learn to play a musical instrument, learn a language, "visit" a museum, or play an interactive game. Software in the area of education (interactive training), entertainment, information, and reference are available in the consumer market.

In addition, the CD-Interactive system has had commercial applications in business and industry. Because of the software demands of these applications, expanded forms of formatting information on the disc had to be developed. It also means CDI players require additional decoding circuits.

The CD-I operating system

The CD-I operating system is the compact disc Real Time Operating System (CD-RTOS), based on the OS-9 operating system. CD-I software enables synchronization of audio and video information through the interleaving of digital audio and video data on the disc. CD-I may combine audio, video (stills or moving), and text in a single application.

For example, a CD-I application may consist of a narration (audio) along with text on the screen while a picture (video) is displayed on the monitor (standard TV monitor). Another application may use animation in sync with the audio. CD-I also allows for the selection of one of several languages, depending on the application. For example, a disc may include selectable narration in English, French, Japanese, and Spanish.

CD-I player operation depends on the application and type of disc. All compact discs have some common features, including error correction, interleaving, EFM (Eight-to-Fourteen Modulation), and a storage capacity of up to 650MBytes of digital information. Figure 2 illustrates the compatibility of each disc type. Let's now review and compare each disc type.

Compact disc-digital audio (CD-DA)

CD-DA is the most familiar and popular application of digital compact disc. The compact disc is recorded to provide high fidelity audio with virtually no distortion or noise. The CD-DA format is the basis for all other CD formats. CD-DA makes use of 16-bit PCM (Pulse Code Modulation) to

Rialland is a Senior Service Training Specialist with Philips Consumer Electronics Company, Service Company

Figure 1. CDI, or compact disc interactive is a multimedia system that is capable of delivering audio, graphics, pictures and text interactively from a compact disc. This CDI player can also play digital audio CDs as well as photo CDs.

place data on disc. In the encoding process, the analog audio is converted to 16 bits per channel at a sampling rate of 44.1kHz. Each 16 bit sample is then divided down to an eight-bit symbol.

The CD-DA encoding process arranges six stereo sample periods of 192 bits or 24 bytes (6 samples times 32 bits, or 4 bytes for right and left audio) into a frame, known as a Small Frame. A Control and Display code (subcode data), parity codes, merging bits, EFM, and a sync code are all applied to the six stereo samples. Thus, a CD-DA small frame consists of 588 bits. This results in a frame frequency of 7.35kHz and a bit clock frequency of 4.3218 megabits per second.

Ninety-eight small frames make up a Large Frame or Subcode Frame (see Figure 3). The subcode repetition rate is 75Hz. The Subcode Frame is equivalent to a CD-ROM sector, which contains 2352 Bytes of data (98 small frames times 24 Bytes). The subcode is necessary to provide the CD player with information such as elapsed time and control data as illustrated in Figure 4. There are eight channels used in the Frame format, labeled P through W. The lead-in track contains the Table Of Contents (TOC) information, incorporated in the Q-channel. The CD-DA format specifications limit the total playing time to 72 minutes of high-fidelity stereo.

Compact disc read only memory (CD-ROM)

CD-ROM is another type of disc based on compact disc technology. A CD-ROM disc may contain more than 600 megabytes of data. CD-ROM defines data in the form of sectors. Each sector contains 2352 bytes of information and is recorded using the same EFM (Eight- to-Fourteen Modulation) technique used in CD-DA. EFM provides a first level of error protection well suited to audio data as well as binary data in general.

The sector contains synchronization, address and mode information. In addition, a sector contains a user data area of either 2048 bytes for Mode 1 or 2336 bytes for Mode 2 (See Figure 5).

The difference between these two modes is that Mode 1 uses 288 bytes to provide an additional level of error detection (ED) and error correction (EC). This ensures a level of data integrity essential for critical informa-

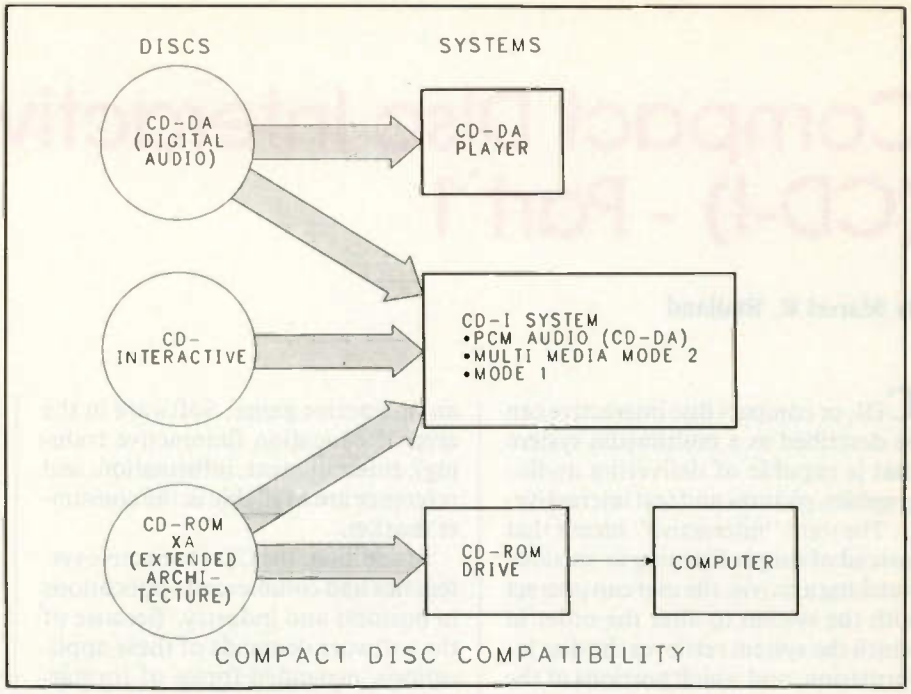

Figure 2. Compact disc compatibility

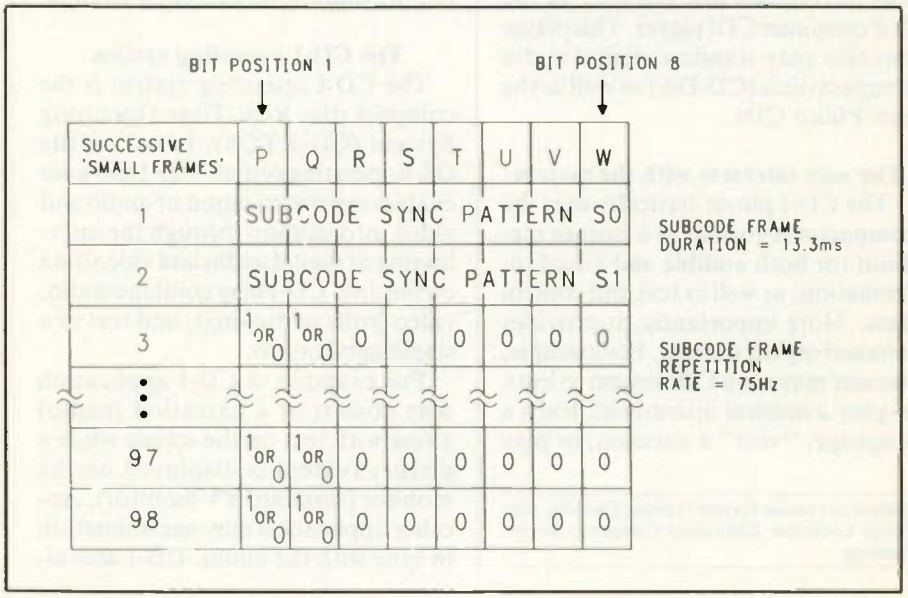

Figure 3. Subcode frame format

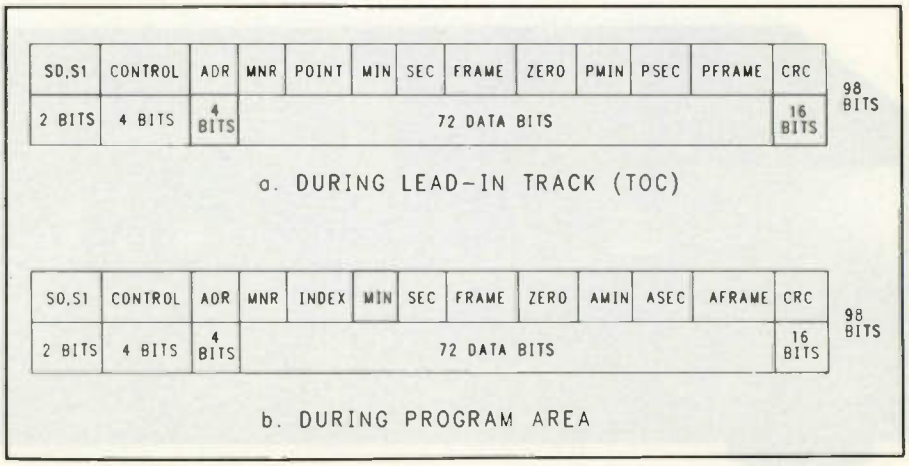

Figure 4. Q-channel format

tion that does not degrade gracefully, such as text and binary data typically contained in databases.

Mode 2 trades this benefit of additional data security for a maximum data transfer rate by making the additional 288 byte area available as user data. In this case EFM is adequate for error protection of data such as video and audio.

The standard CD Table of Contents (TOC), although not available to the computer program, may be used by the CD-ROM player to locate a requested track. The TOC appears in the Q channel in the lead-in area of each disc. There are two types of tracks that the TOC can identify as stored on a CD-ROM disc: CD digital audio tracks, and data tracks.

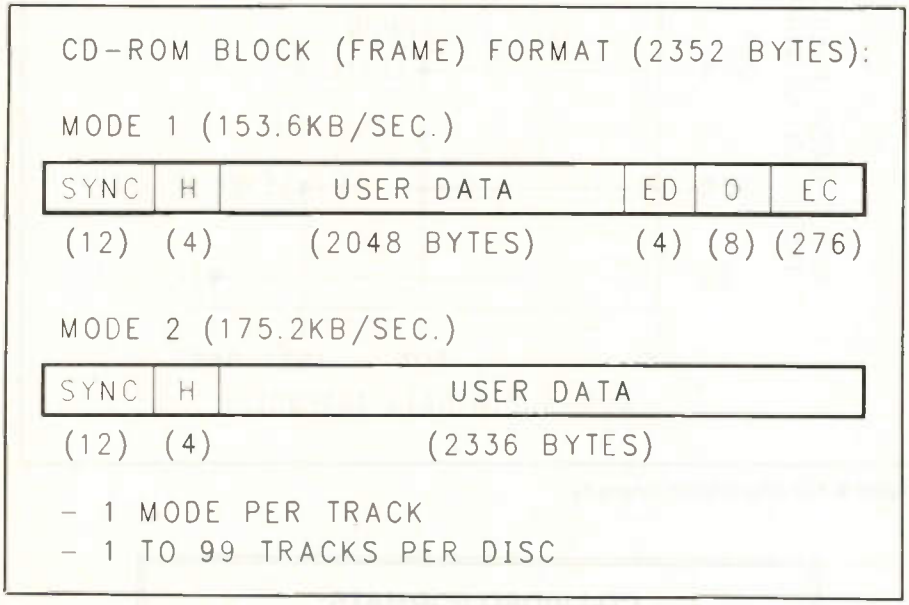

Figure 5. CD-Rom sector

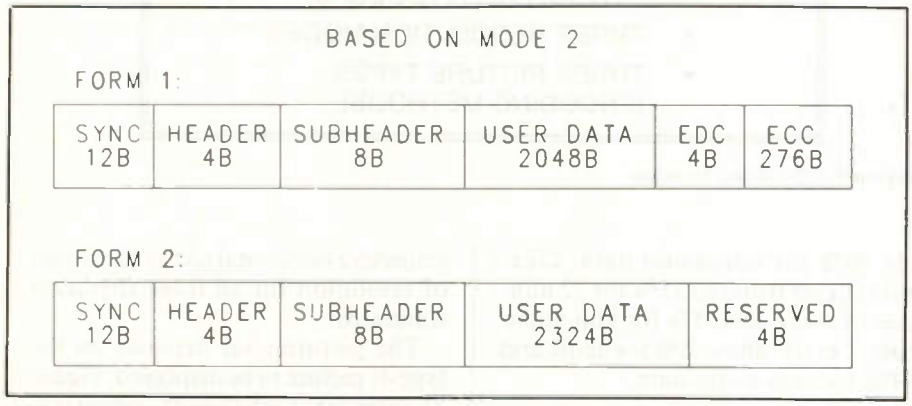

Figure 6. CD-I forms

FORMAT	fs IN kHz	SIGNIFICANCE bits per sample	BW IN kHZ	CHANNELS	XSYS IN MHz	t MAX IN MIN STEREO (MONO)
CD-DA (PCM)	44.1	16	20	1 STEREO	11.2896	72
LEVEL A (AD-PCM)	37.8	8	17	2 STEREO 4 MONO	9.6768	144 (288)
LEVEL B (AD-PCM)	37.8	4	17	4 STEREO 8 MONO	9.6768	288 (576)
LEVEL C (AD-PCM)	18.9	4	8.5	8 STEREO 16 MONO	4.8384	576 (1152)

Figure 7. CD-I formats

Compact disc interactive (CD-I)

CD-I specifically meets the needs and requirements of the CD-I player. Since CD-I information may include audio, video, text, and program data, several different encoding methods are used. Encoding standards are established for CD-DA, CD-ROM, and CD-I. Formats may be mixed on the disc, but Track One must always identify the disc as CD-I.

As with CD-ROM, CD-I defines data in the form of sectors. Each sector contains 2352 bytes (see Figure 6). The CD-I physical format is based on CD-ROM, Mode 2. CD-I is primarily an audio/video driven medium. Thus, video must be synchronized to the audio with the CD data rate of 75 sectors per second. At the same time, there is a need for real-time interactivity. Thus all three data types, audio, video, and text (binary data), are physically interleaved. The sub-header (SH) mechanism is used for real time physical interleaving of data.

The two forms define two levels of data integrity. Some data degrades gracefully, such as audio and video, whereas text does not degrade gracefully. Text is either present or not. Maximum bandwidth is the main requirement for audio and video information, whereas an extra layer of error correction is required for text. Thus there is a need for two different formats in Mode 2 for CD-I: Form 1 and Form 2.

The first of the two physical formats, Form 1, is tuned to the needs of text, computer data and highly compressed visual data. Thus, Form 1 uses 280 bytes for additional error detection and correction (Error Detection Code or EDC and Error Correction Code or ECC), leaving 2048 Bytes as user data. The second physical format, Form 2, is used to fill the requirements of real time audio and visual data, leaving 2324 bytes of user data plus 4 bytes of reserved data.

The CD player is designed so that the rotational speed of the disc can be varied to ensure constant linear velocity at the readout head, resulting in a

constant data transfer rate (frame rate) of 75 sectors per second. The resulting data transfer rates are 153.6KBytes/s for Form 1 and 174.6KBytes/s for Form 2. Let's now look at what type of data can be encoded in the CDI format.

Audio formats

The audio formats are illustrated in Figure 7. There are four audio formats that may be applied to CD-I. The first is the familiar CD-DA. The standardized format for encoding CD-DA as Pulse Code Modulation (PCM) includes the 16-bit samples (Significance), at a sampling rate (f_S) of 44.1kHz. This results in a dynamic range of greater than 90dB with a bandwidth (BW) of 20kHz and a maximum playing time of 72 minutes of hi-fi stereo audio. This format limits the quantity of information which can be placed on the disc. Thus the CDI standard allows for three other audio formats.

The audio data coding used in CD-I is 8 or 4-bit Adaptive Delta Pulse Code Modulation (ADPCM). A lower sampling rate and a different coding technique is used since no more than 50% of the time is allocated for audio information. The Adaptive Delta PCM (ADPCM) coding technique used to store audio information more efficiently, requires additional processing beyond 16-bit PCM for both encoding and decoding.

The chart of Figure 8 shows the specifications for each level. The level used depends on the application. For example, to provide maximum time where high fidelity is unnecessary, such as a narration, Level C is used. Using this level limits the frequency response to 8.5kHz, but allows up to approximately 19 hours (with no other data: video, CD-DA, text) of mono audio or 9+ hours stereo on a single disc.

By using the three levels of ADPCM, information other than audio (video, text, and program) can be included on a disc, while still allowing 72 minutes of audio, as illustrated in Figure 8. The CD Information Intensity Chart shows the percentage of data which can be allotted for non-audio data for each level compared to CD-DA. Thus, 100% of a CD-DA disc is used when 72 minutes of audio is encoded onto the disc. If the same 72 minutes is encoded using ADPCM Level A, only 50% of the disc is used for audio, leaving 50% for non-audio data. Likewise, Level B allows 25% for 72 minutes of audio and 75% for non-audio data. Level C allows 6% for audio and 94% for non-audio data.

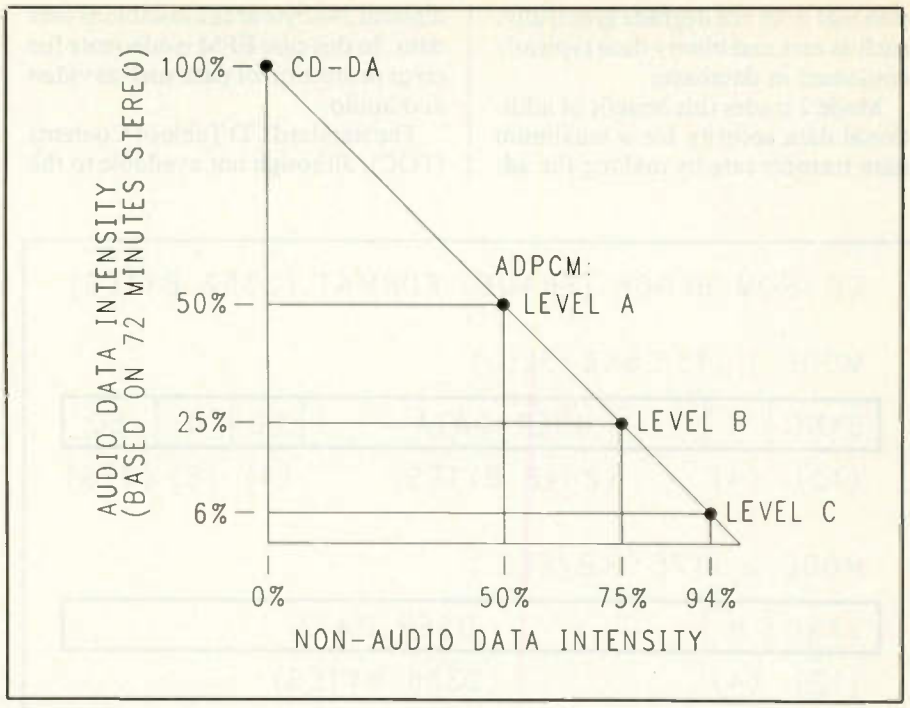

Figure 8. CD information intensity

CD-I VIDEO FORMATS:

- WORLD-WIDE FORMAT
  - NTSC, PAL, AND SECAM
- THREE RESOLUTION MODES
- THREE PICTURE TYPES (ENCODING METHODS)

Figure 9. CD-I video formats

Video formats

Because there are several different television systems used around the world (see Figure 9), the video encoding system for CD-I allows for a world-wide standard. That is, the video data can be decoded to play on NTSC, PAL, or SECAM television systems. Besides the various audio quality levels, there is a need for various video quality levels. The video quality levels offer a choice of resolution and picture type.

The resolution modes provide for both present and future television systems as illustrated in Figure 10. The three modes are Normal, Double or Enhanced, and High resolution. The chart shows the three modes with their respective horizontal and vertical lines of resolution for all three television standards.

The picture code depends on the type of picture to be displayed. Figure 11 compares each type of coding system. Picture coding provides for two picture quality levels: natural pictures and graphics. Natural stills are best handled by YUV (Y, R-Y, B-Y) coding for an equivalent of 24-bit color depth. Color Look-up Tables (CLUT's) provide high quality complex graphics. Absolute RGB coding is best used for user manipulated graphics. Run Length Encoding is used for text, graphic animations, and graphic images which require few colors in large areas of the screen. Compression techniques are required to provide full screen animation in the graphic modes.

Natural pictures, using YUV (Y, R-Y, and B-Y) coding, occupy about 325kB per picture without interlacing

	NTSC 525 Lines	PAL/SECAM 625 Lines
Normal	360X240 Pixels	384X280 Pixels
Double	720X240 Pixels	768X280 Pixels
High	720X480 Pixels	768X560 Pixels

Figure 10. Video resolution modes

FORMAT	APPLICATION	MEMORY	COLORS
DYUV	NATURAL STILLS	108KB/PICTURE	ALL
CLUT	GRAPHICS ANIMATION	108KB/PICTURE	256 of 16 Million
RGB	USER MANIPULATED GRAPHICS	215KB/PICTURE	32,768
RLE	GRAPHICS	10-20KB PICTURE	128

Figure 11. Picture types (Encoding Process)

(650kB with interlacing). To decrease throughput times and maintain a high quality image, all natural pictures are compressed with DYUV (Delta-YUV) coding. DYUV reduces the memory requirements to 108kB/picture. Thus, the DYUV coding system provides a transfer rate of one full-frame in about 0.6 seconds at a data rate of 174.6kB/s (Form 2).

The CLUT (Color Look-Up Table) mode is used for graphics animation. CLUT can be used as 256 colors out of 16 million, requiring 108kB of storage capacity per picture. Compression can reduce this to less than 10kB per picture. CLUT with compression provides full-screen animation with the interleaving of pictures and sound. A picture refresh rate of 17 frames per second is achievable in Form 2.

The other graphics mode is based on absolute RGB coding and is applied to user manipulated graphics. Fifteen-bit RGB graphics (32,768 colors) produce exceptionally crisp pictures at a cost of about 215kB per picture. No compression is used in this encoding system.

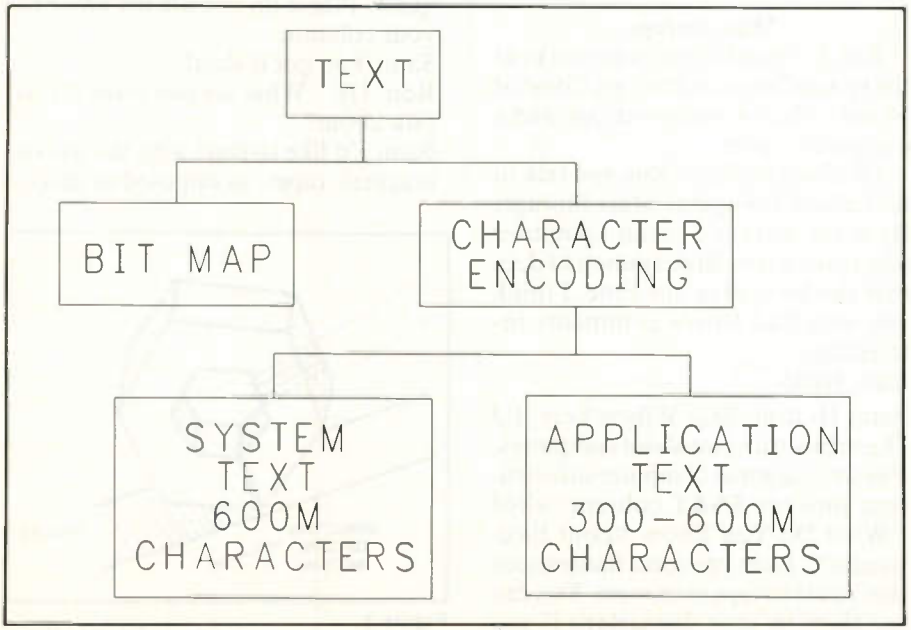

Figure 12. Text coding

Text coding

Text encoding may by handled using two basic methods, by a bit map process or with character encoding as illustrated in Figure 12. The bit-map process requires five bytes for each character. This limits the number of characters to a maximum of 120 million per disc, if only 16 colors are used in an 8 x 10 matrix of any shape.

Character encoded text can be system text or application text. The standard character encoded text (system text), using one byte per character, allows 600 million characters in a full disc. Application text is encoded with two bytes per character. The second byte specifies factors like color, font type, and size. This extended coding method allows 300 to 600 million characters per disc.

There is a need to limit the number of characters on screen due to the limited resolution of a normal TV. Thus, text is limited to 40 characters on 20 lines. The characters are contained in a safety area of 320 x 210 pixels in the center of the screen. With the high-resolution screens used in computer monitors and future high definition or digital TV's, the High Resolution mode allows 80 characters to be presented on up to 40 lines. The safety area for the High Resolution mode is 640 x 420 pixels. The text is only stored once since compatibility between the two resolution modes is maintained.

Video effects

A wide range of visual effects are provided in the CD-I system, including: wipes, cuts, scrolls, overlays, dissolves and fades. Up to five overlaying video planes are provided, with both transparency and translucency for all except the background plane. One plane is reserved for the background and another for the cursor.

Decoding process

The CDI player must have the ability to decode information stamped on the disc. Decoding is straightforward in the standard CD-DA since it uses only one type of encoding method. However, the CD-I system uses more than one type of encoding process, which includes audio, video, and text. The data, once read from the disc, must be routed to the correct decoding circuits to be converted to its respective analog signal, whether audio, video, or text. Part 2 of this series will cover the decoding and control system for CDI. ■

What do you know about electronics?

Taking care of business

By Sam Wilson, CET

I want to thank Lou Frenzel for giving permission to use some of the material in this article.

Mr. F Cecil Grace of Asheville, North Carolina has sent a different version of the mnemonic I gave in the May 1992 issue. It was a way of remembering the value of π. His mnemonic goes like this: How I want a drink, alcoholic of course, after the heavy chapters involving quantum mechanics. The number of letters in each word gives the value of π. Norma says to use the word chocolate instead of alcoholic.

Mr. Grace says his mnemonic is better than the one I gave because:

- with his you don't need to know the number of chapters; and,
- more people have heard of quantum mechanics than quadric mechanics.

I agree.

Thanks to Mr. Martino - proprietor of View Electronics in Bradenton, Florida - for responding to a previous column. He informs me that it was Dr. Claude Shannon of Bell Labs who was responsible for reducing George Boole's algebra to a viable switching theory.

When I wrote Congratulations to TESA of St. Louis for their 40 years of continued publication I received two letters from readers: Mr. Thomas M. Van Vleet of Vans TV Sales and Lyle T. Green of Lyle's Radio. Both informed me that the publication called The Word has been in continuous publication for 42 years. It is published by the Electronic Service Dealers Association (ESDA) in Chicago. (I had lost their names in the previous issue.) In 42 years *The Word* has had only two editors: Frank J. Moch and George J. Weiss.

Wilson is the electronics theory consultant for ES&T.

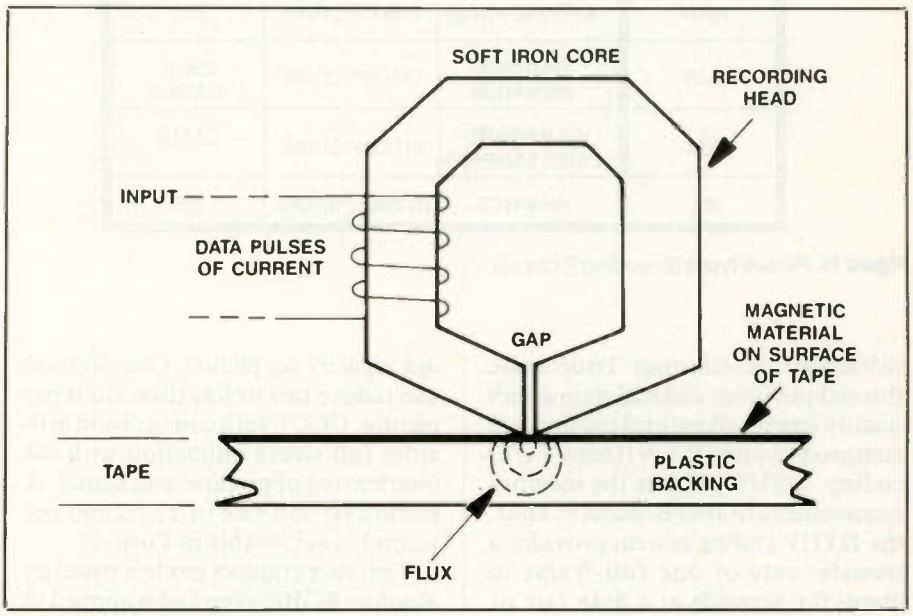

Figure 1.

Congratulations to both TESA of St. Louis and *The Word* of Chicago.

Mass storage

Ron is a good friend who works at the Space Center on the East Coast of Florida. He is a mathematician and a computer expert.

I decided to phone Ron and talk to him about Computer Mass Storage. By mass storage I mean computer storage of a very large amount of data that can be used at any time. I think you will find Ron's comments interesting:

Ron: Hello

Sam: Hi Ron. Sam Wilson here. I'd like to talk with you about computers. I'm writing some computer information into my ES&T column called "What Do You Know About Electronics?" I sent you some illustrations that relate to tape memories. You can use them in your discussions if you want to, or, you can modify or replace them. Did you get them?

Ron: Yes, I have them. I have a request. Please do not use my name in your column.

Sam: You got it Ron!

Ron: OK - What do you want me to talk about?

Sam: I'd like to start with the use of magnetic tapes, as opposed to disks,

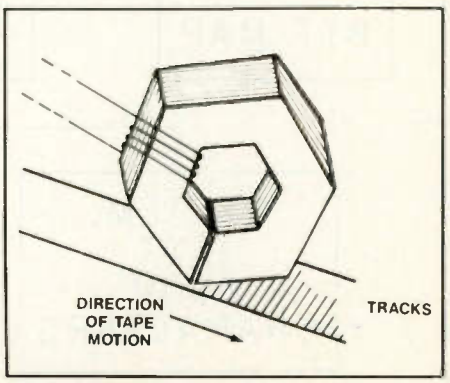

Figure 2.

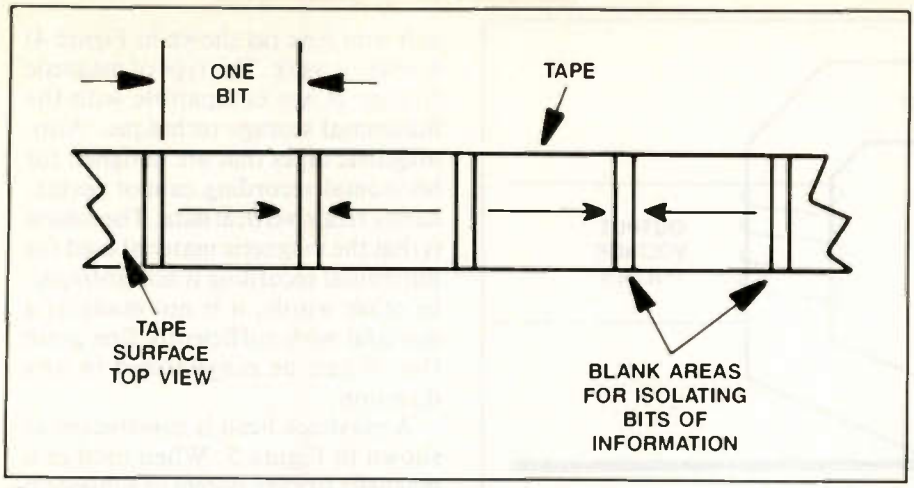

Figure 3.

for mass storage. Can you get enough data onto a tape to make it useful for mass storage?

Ron: Magnetic Storage Subsystems are used to store and retrieve data in a computer system. They are not normally used on small computer systems. They find their most extensive use as backup for other mass storage techniques.

As the data is placed in mass memory, it can also be saved on permanent tape backup. Then, if anything happens to the original stored data, backup information can be used. So, information stored on backup tapes can be used to retrieve data that is lost in the computer mass storage system.

Tape storage subsystems range in physical size from the audio microcassette to the large tape drums that have storage capacity of 2.3 gigabytes (that is 2,300,000,000 bytes) of data.

One manufacturer makes a microcassette capable of holding 1.3 gigabytes of data with 61,000 bits per inch stored on the magnetic tape system and it is so small that three of them can fit into a shirt pocket.

One method of storing data on magnetic tape is shown in Figure 1. A recording head is shown in the illustration. It is made with a core of soft iron and a coil. The soft iron material is magnetized by a current in the coil.

A gap in the read/write head is against the magnetic material on the surface of the tape. To make a recording a pulse of current is delivered to the coil. There are flux line at the gap. Those flux lines bow out at the gap and cause the magnetic material under the gap to become magnetized.

The direction of the magnetization depends upon the direction of the flux in the head. That, in turn depends upon the direction of the current in the coil. Movement of the tape past this gap into the read/write heads causes the tape's magnetic surface to become permanently magnetized as shown in Figure 2. Magnetic tracks are formed on the tape surface.

Sam: What you have said so far is that the tape used for storing digital data could work the same way as tape is used in the entertainment industry. The only difference so far is that only ones and zeros are being stored.

Ron: Well, so far that's true. Now let's get into some of the differences.

The direction of the permanent magnetic field on the tape determines whether a binary 1 or binary 0 has been stored. As shown in Figure 3 there is a gap between each stored bit. That makes it easier to read the data.

On large computers, normally called mainframes, and on minicomputers - which are a size in between microcomputers and mainframe computers - tape storage is often in the form of large detachable reels. For the smaller computers tape storage is accomplished with cartridges or cassettes. Digital cartridges are normally physically larger than cassettes. They are, in some cases, the same size as a VCR cartridge.

Storage of data on a one-fourth inch wide cassette tape is in a serial format. Serial format, which is one bit at a time on one track, is also used for other magnetic and optical disk recordings.

For larger one-half inch wide tapes, data can be recorded in parallel mode. This requires eight or nine parallel tracks. One track is used for each of the bits in a byte.

Sam: How do they get so much data on tape?

Ron: The maximum number of bits that can be recorded in a given length of magnetic tape depends upon the way the magnetic material is fabricated. Density is a measure of how much information, in the form of binary digits, can be stored on tapes. Density is normally given as a number of bits that can be stored in one inch of tape (or, on one sector of a magnetic disk).

There is a problem with the recording procedure shown in Figure 3. It takes too much horizontal space to store digital data. The amount of information stored is greatly increased by the use of vertical recording. It is shown in Figure 4. (This technique can be used for magentic disks as well as for magnetic tapes).

There is a soft iron slug on one side

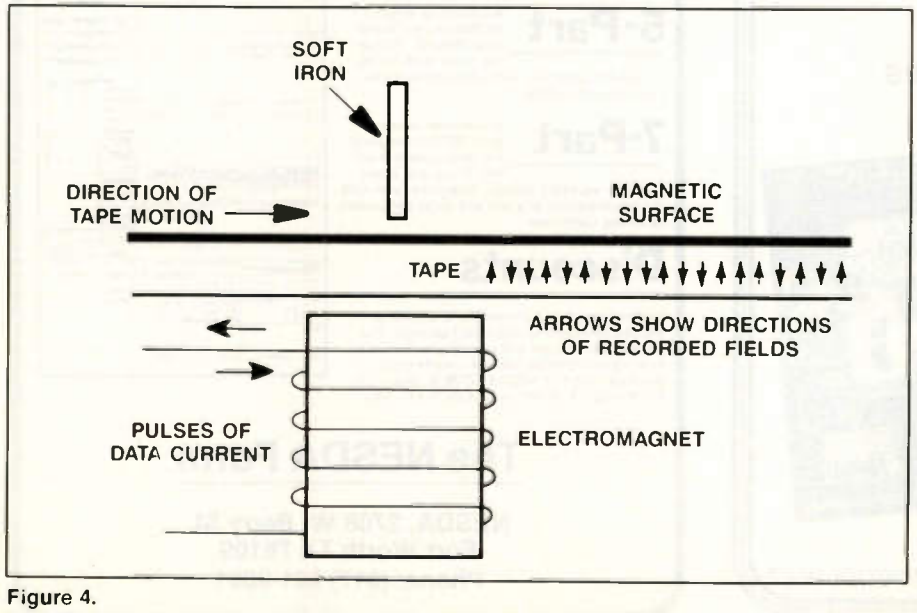

Figure 4.

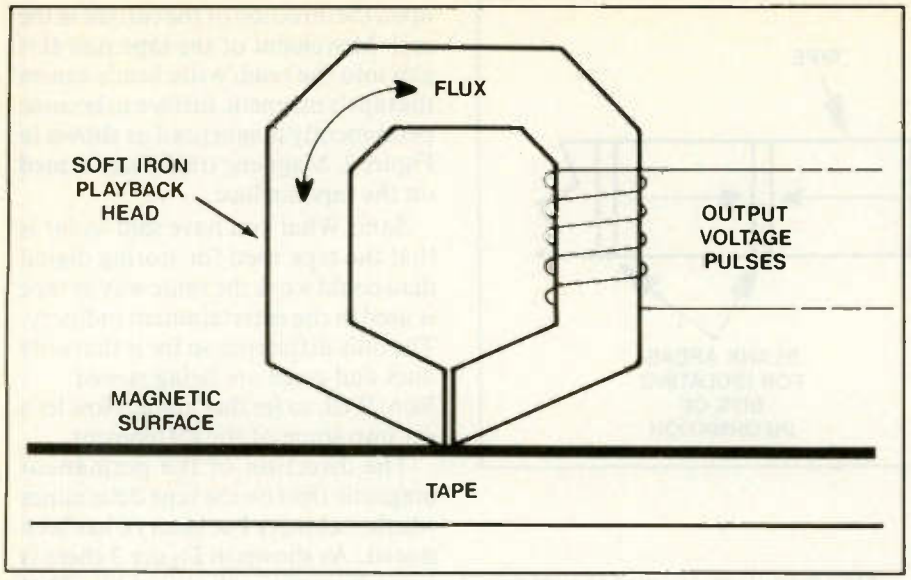

Figure 5.

of the magnetic storage media, and, there is an electromagnet on the other side. The magnetic field of the electromagnet is not sufficient to produce permanent magnetic storage on the tape. However, the induced magnetic flux lines in the soft iron core are greatly concentrated. The concentrated lines *can* produce permanently recorded data. A vertical field in one direction represents a binary one and in the opposite direction represents a binary zero.

The use of vertical recording greatly increases the amount of data that can be stored on one of the tapes. However, there has to be a physical arrangement of the electromagnet and soft iron core (as shown in Figure 4) to make it work. This type of magnetic storage is not compatible with the horizontal storage technique. Also, magnetic tapes that are designed for horizontal recording cannot permanently retain vertical data. The reason is that the magnetic material used for horizontal recording is not *isotropic*. In other words, it is not made of a material with sufficiently fine grain that it can be magnetized in any direction.

A playback head is constructed as shown in Figure 5. When used in a magnetic storage system or subsystem it is also called a *read head*. A permanent magnetic field on the tape moves under the gap and induces a magnetic flux in the head. That flux threads through the output voltage coil and induces the digital 1 or 0 - depending upon the direction of the flux.

Ron: Sam I have to go. I have an appointment. We can continue this later if you want to.
Sam: I'd like that.
Ron: Remember, do not use my name in your column!
Sam: You got it! Don't worry about it! So long.
Ron: So long. ■

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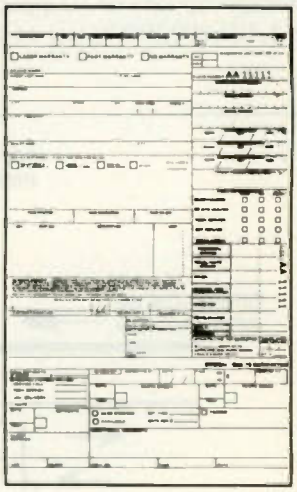
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Test your electronics knowledge

By Sam Wilson, CET

In this test you are given the definition of terms. For each question select the term from the list. These are primarily computer terms, and, there are more terms than definitions:

1. Machine Language
2. Repeater
3. ISDN
4. Modem
5. Bit Rate
6. FDDI
7. LAN
8. Front End Processor
9. Local Area Network
10. Fortran
11. Cobol
12. Basic
13. Bit
14. EBCDIC
15. Balun

Definitions:

1. A device that is used to interface a computer with a telecommunications system. It converts the binary code to a form that can be transmitted. It also changes them from and to their assigned frequencies for transmission over coaxial cable. This device is used in broadband networks.

2. A computer that relieves a host computer of certain processing tasks, message handling, code conversion and error control is called a _____ _____ _____.

3. One digit (0 or 1) in a binary number.

4. An eight-bit data-exchange code that is used in IBM mainframes, other computer systems, and associated communications equipment. This code and ASCII are the two most widely used data codes.

5. A collection of information stored together - without unnecessary redundancy - to serve one or more applications.

6. What is the name of a LAN technology that permits 100-megabit-per-second (Mbps) data transfer?

7. Name an impedance-matching device that connects a balanced line and an unbalanced line.

8. A set of protocols capable of carrying voice, computer, data, facsimile, and video signals.

9. What is the name of a network component that regenerates digital signals in order to extend the length of a network?

10. The rate at which digital information is transmitted through a channel, often equivalent to bits per second, is called _____ _____.

(Answers on page 58)

Wilson is the electronics theory consultant for ES&T.

Circle (71) on Reply Card

Books

Electronic Market Data Book, By the Electronic Industries Association (EIA), 140 pages, $125.00.

This annual statistical encyclopedia includes coverage of consumer electronics, electronic components, government electronics, international trade, employment, and research and development. Containing over 140 pages of easy to read figures and tables, supplemented with detailed explanations of sales and production data, the Electronic Market Data Book, is referred to as an authoritative reference yearbook by electronic manufacturers, market research firms, consulting agencies, financial institutions, academic institutions and libraries, U.S. government agencies, and electronics related businesses around the world. For further information or to place an order, contact the EIA Marketing Services Department, 2001 Pennsylvania Avenue, N.W. Washington, D.C. 20006-1813, or call (202) 457-4955. Credit card orders are welcome.

EIA 2001 Pennyslvania Ave, NW Wash, DC 20006

Electronics Pocket Handbook, 2nd Edition, By Daniel L. Metzger, Monroe County Community College, 272 pages, Prentice Hall Books.

This handy pocket-guide puts a shelf full of electronics data at your fingertips. It contains dozens of standard formulas, charts, tables, definitions, and data required by the electronics technician - and serves as a comprehensive source of information as diverse as wire tables, radio frequency assignments, new computer terms, battery cross-reference tables, and much more. Best of all, it fits in your pocket or in a corner of your briefcase or tool box. Appropriate for electronics engineers and technicians, computer technicians, and hobbyists.

Prentice Hall Books, Englewood Cliffs, NJ 07632

Master Handbook of Electronic Tables and Formulas 5th Edition By Martin Clifford, TAB Books, 544 pages, 490 illustrations, $22.95 paper, $39.95 hard.

This 5th edition is a source of quick, accurate, and easy-to-use solutions to electronics problems for hobbyists as well as professionals.

The author has added new chapters on microphones, magnetic data, modulation methods, filters, and analog-to-digital and digital-to-analog technology, as well as updated material on audio/video recording, antennas, TV broadcasting, computer logic. Readers will also find the latest information on everything from resistance formulas, meters and meter multipliers, to sine waves, capacitors, impedance vectors and formulas and decibels.

With this handy reference at their side readers will never again have to stop in the middle of a project to make complicated calculations or figure out component substitutions.

TAB Books Blue Ridge Summit, PA 17294

Regulated Power Supplies 4th edition, By Irving G. Gottlieb, TAB Books, 472 pages, 361 illustrations, $24.95 paper, $39.95 hard.

Regulated power supplies play a vital role in electronic circuits and systems - they provide the constant voltages needed for many modern solid-state devices. Now in its fourth edition, this reference has been updated and expanded to include information on all types of regulated power supplies.

Geared to the practical needs of engineers, technicians, and hobbyists involved in regulated power supply design, testing, and implementation, this volume explains regulation techniques, static and dynamic characteristics. It also describes the components used in both the "older" types of switching power supplies and the newer state-of-the-art regulated supplies. In addition, this 4th edition contains a detailed discussion of the actual circuitry and operation of the latest solid-state regulators, numerous circuits designed to fit almost any application and linear and switching type circuits.

With more than 400 pages and over 300 illustrations, the practical guidance offered in this information-packed book makes this an indispensable reference that will be referred to again and again for all aspects of building and using regulated power supplies.

TAB Books, Blue Ridge Summit, PA 17294

Upgrading and Repairing PCs 2nd Edition, By Scott Mueller, QUE, 850 pages, $34.95.

This book is written for hardware and software consultants, computer hobbyists, technicians, and anyone with an interest in upgrading or maintaining PCs. It focuses on choosing, installing, and repairing all devices related to personal computers. It offers users of all experience levels a quick introduction to and background of PCs, then progresses to details about system maintenance, backups, upgrades, and diagnostics.

Covering new developments in PC technology, Mueller's text includes essential information about PS/2s, PS/1s, compatibles, 486 SX and DX processors, SCSI and IDE hard drives, and high density memory technology. Also, it discusses topics like third party diagnostic packages, troubleshooting tools and equipment, optical disk drives, and new video technology.

In addition to the comprehensive coverage that the 2nd edition offers about current technology, it provides readers with a glossary of terms, detailed reference charts that cover all aspects of PC hardware, and expert recommendations.

QUE, 11711 N. College Ave., Suite 140, Carmel Indiana 46032

Electronic Assembly Soft Soldering and Wire Wrapping, By Geraldine Herrick, San Jose College 224 pages, Prentice Hall Books.

A complete presentation of state-of-the-art electronics assembly technology, this book details the techniques of soldering, parts mounting, wire wrapping, wire harnessing, and cabling in a straight-forward, easy-to-understand manner. Written for the beginner, the book covers safety, hand tools, and their proper use, component identification, soldering, soldering iron, use and care, application of soldering to most types of connectors, removal of defective parts, wire wrap techniques and tools, and the list goes on. It also includes details on modern assembly, automated and manual part mounting and automated and manual soldering.

Prentice Hall Books, Engelwood Cliffs, NJ 07632

ES&T Manufacturers' schematics **PROFAX**

AUGUST 1992

Profax Number

RCA
COLOR TV NO. 7-7800A 3091

INTERCONNECT WIRING 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.

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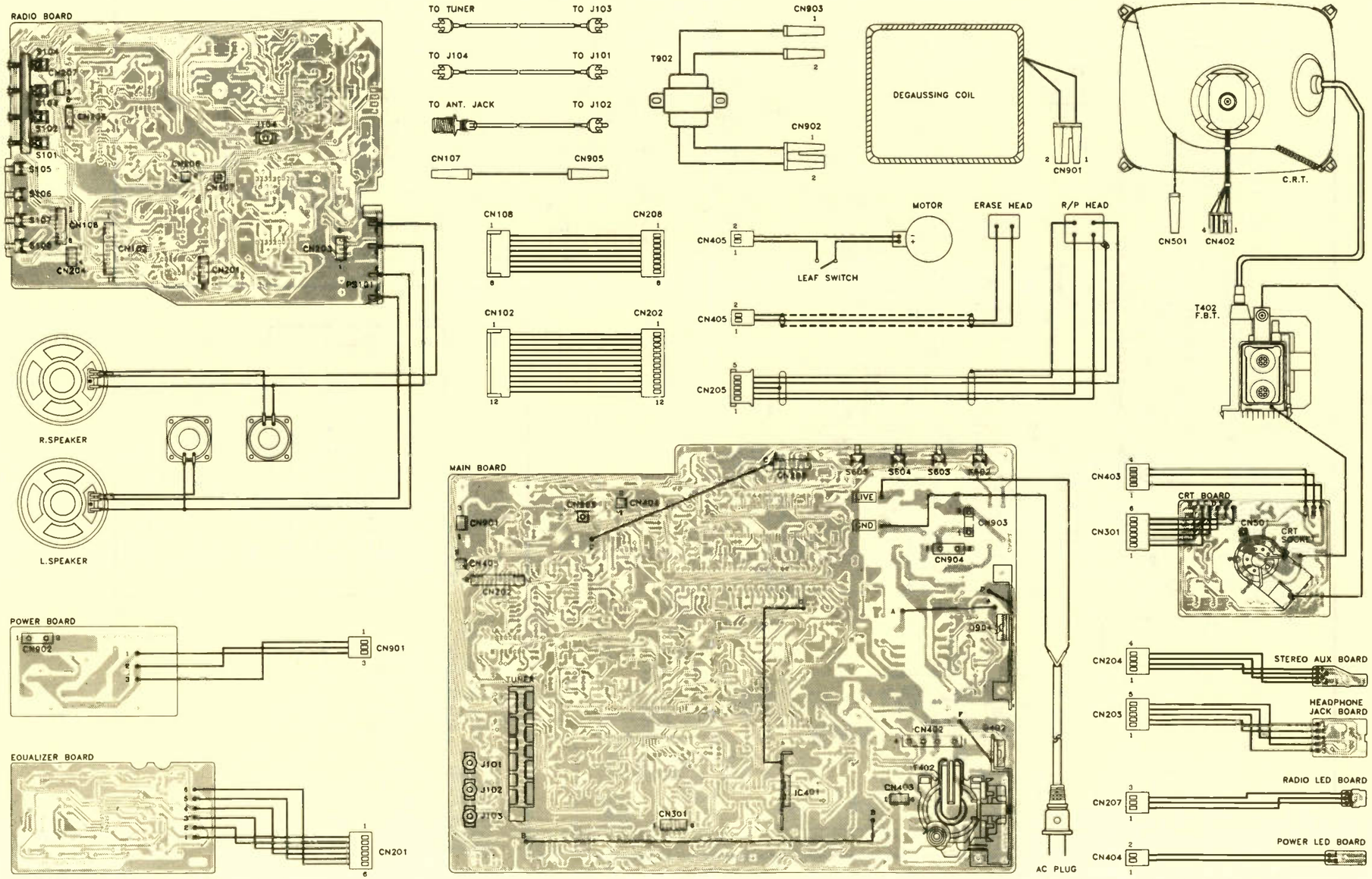
All integrated circuits and many other semiconductors are electrostatically sensitive and require special handling techniques.



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COLOR TV SCHEMATIC

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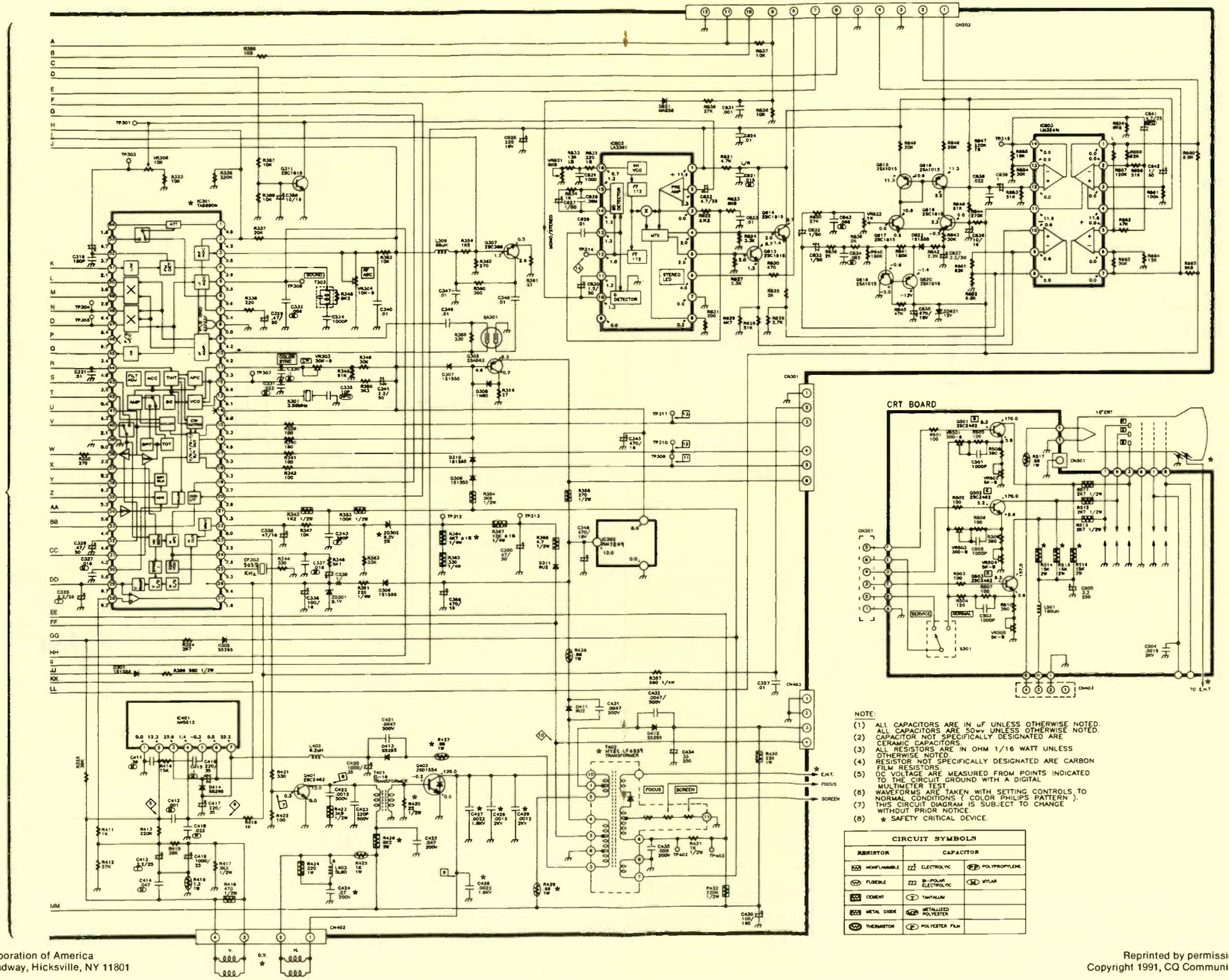

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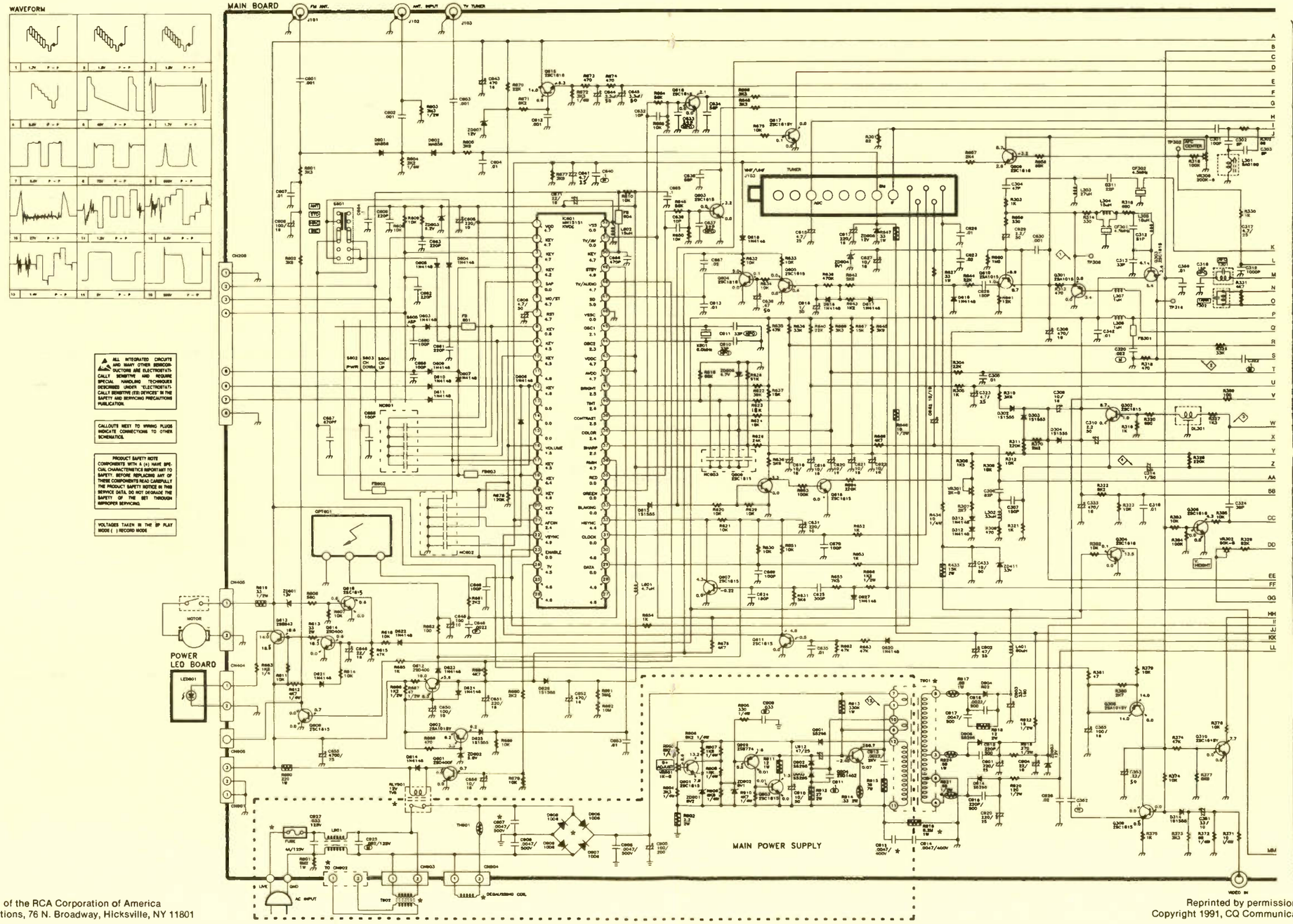

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RADIO-CASSETTE PLAYER SCHEMATIC

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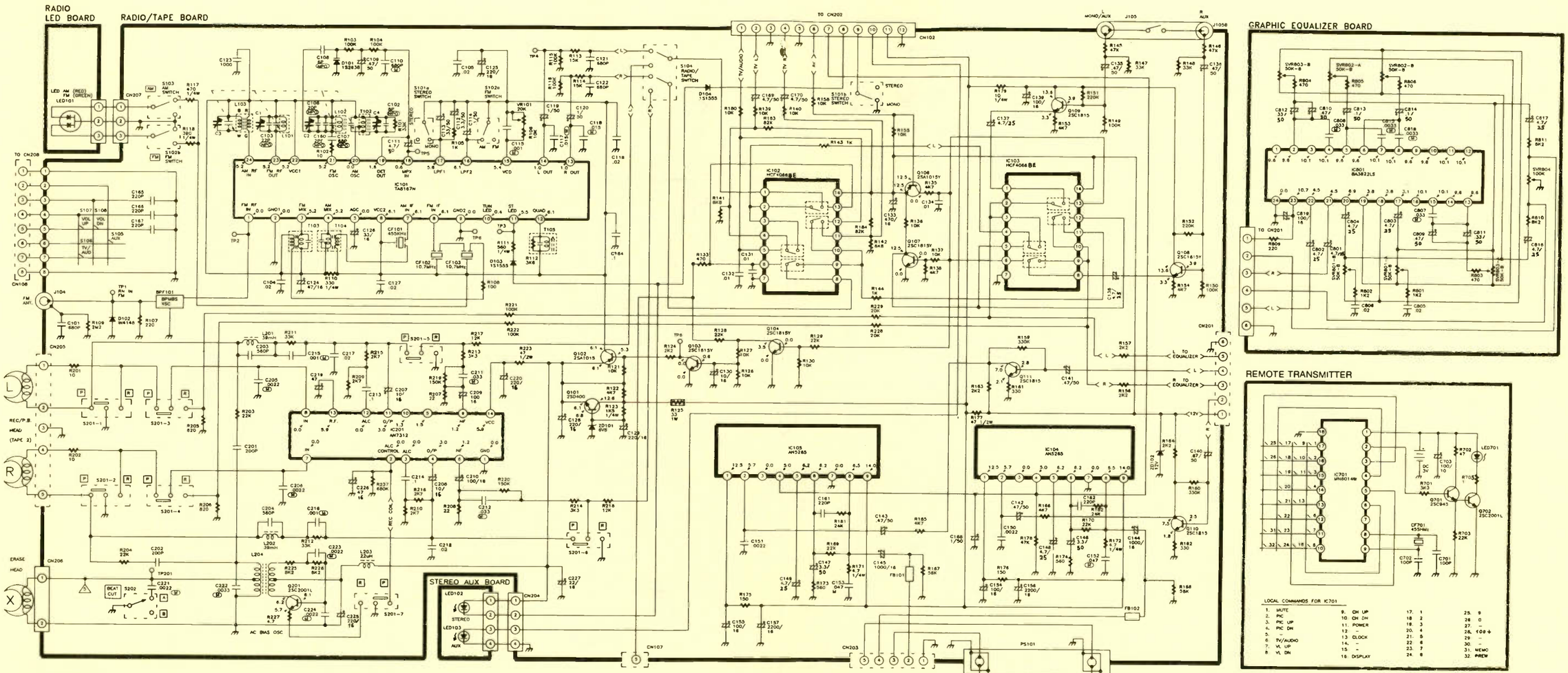
PROFAX Manufacturers' schematics 3091



NOTE:
(1) ALL CAPACITORS ARE IN uF UNLESS OTHERWISE NOTED.
ALL CAPACITORS ARE 50wv UNLESS OTHERWISE NOTED.
(2) CAPACITOR NOT SPECIFICALLY DESIGNATED ARE CERAMIC CAPACITORS.
(3) ALL RESISTORS ARE IN OHM 1/16 WATT UNLESS OTHERWISE NOTED.
(4) RESISTOR NOT SPECIFICALLY DESIGNATED ARE CARBON FILM RESISTORS.
(5) DC VOLTAGE ARE MEASURED FROM POINTS INDICATED TO THE CIRCUIT GROUND WITH A DIGITAL MULTIMETER TEST.
(6) WAVEFORMS ARE TAKEN WITH SETTING CONTROLS TO NORMAL CONDITIONS (COLOR PHILIPS PATTERN).
(7) THIS CIRCUIT DIAGRAM IS SUBJECT TO CHANGE WITHOUT PRIOR NOTICE.
(8) ★ SAFETY CRITICAL DEVICE.

CIRCUIT SYMBOLS

RESISTOR	CAPACITOR	
NON FLAMMABLE	ELECTROLYTIC	POLYPROPYLENE
FUSIBLE	BI-POLAR ELECTROLYTIC	MYLAR
CEMENT	TANTALUM	
METAL OXIDE	METALLIZED POLYESTER	
THERMISTOR	POLYESTER FILM	

ALL INTEGRATED CIRCUITS AND MANY OTHER SEMICONDUCTORS ARE ELECTROSTATICALLY SENSITIVE AND REQUIRE SPECIAL HANDLING TECHNIQUES DESCRIBED UNDER 'ELECTROSTATICALLY SENSITIVE (ES) DEVICES' IN THE SAFETY AND SERVICING PRECAUTIONS PUBLICATION

CALLOUTS NEXT TO WIRING PLUGS INDICATE CONNECTIONS TO OTHER SCHEMATICS.

PRODUCT SAFETY NOTE
COMPONENTS WITH ★ (+) HAVE SPECIAL CHARACTERISTICS IMPORTANT TO SAFETY. BEFORE REPLACING ANY OF THESE COMPONENTS READ CAREFULLY THE PRODUCT SAFETY NOTICE IN THIS SERVICE DATA. DO NOT DEGRADE THE SAFETY OF THE SET THROUGH IMPROPER SERVICING.

VOLTAGES TAKEN IN THE SP PLAY MODE ( ) RECORD MODE

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When adding noise improves audio

By John Shepler

Audio components are designed to minimize noise, the hissy background sound that is always present to some extent. Cassette tape is particularly noisy. Dolby encoding was developed to reduce tape hiss to a level similar to record albums.

Compact Discs have almost no noise, you say? In fact, you say that if it wasn't for the minimal noise introduced by analog audio amplifiers and passive components, CDs would be completely quiet with no distortion whatsoever?

Well not exactly. Digital audio systems may sound pure at high levels. At very low audio levels, though, they can add enough distortion to sound much worse than traditional audio systems. The problem has to do with how analog signals are converted to digital.

Remember that sound in nature starts out as an analog signal. In order to store the signal digitally on a DAT tape or compact disc, it is first necessary to convert the analog microphone signal to digital numbers. This is done in a chip called the A to D or analog to digital converter.

One practical consideration of A to D converters is that they have a limited resolution. A good converter uses at most 16 bits. This divides the analog waveform into 65,536 different levels. High audio levels that use most of the bits have more than enough resolution to fool the ear into thinking the audio is analog and not digital.

At low, levels, only a small number of bits are available to represent the sound. A quiet passage might use only a hundred or a dozen bits to recreate the voice or music. Near the noise floor, only a couple of bits are available to represent a tone or voice.

The result is that low passages on CD's or digital tape are so dependent on the accuracy of a few bits that any errors show up as gross distortions. In a way, this is similar to amplifiers that exhibit crossover distortion. At high levels the distortion is masked by louder sounds that are not distorted. At low levels, the sound is gritty because you hear only distorted sound.

A clever solution is adding noise during recording to reduce distortion. This is not just noise to mask the problem. Instead, the noise is used to modulate the low level audio at a random rate so that inaccuracies of the A/D converter cancel out.

Dither is a term that comes from mechanical controls where a moving part is kept vibrating slightly to eliminate friction. The random dither noise reduces the signal to noise (S/N) ratio by 2 to 4 dB.

Strangely enough, the dither noise is not all bad for the S/N ratio. True, instruments will show that the noise from a CD is greater when the dither is added. However, a characteristic of the human ear is that it can detect clean audio buried in the noise. By adding the random variations to clean up the low level audio, it is possible to hear sounds that were previously distorted. The subjective effect is that the audio sounds clearer, not noisier. Strange but true.

Be sure not to confuse dither with wow and flutter. The noise modulation added by dither is at a fairly high frequency and is random. Wow and flutter are low frequency variations caused by mechanical characteristics of turntables and tape decks. They tend to be audible as a constant and annoying variation in the pitch of the sound. Dither is not something you hear, other than its effects on distortion and S/N ratio.

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

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REPLACEMENT PARTS SHOWCASE

Choosing a replacement parts supplier

Ask any servicing technician or manager what their two biggest problems are, and it's a good bet that one of the problems mentioned will be locating replacement parts to bring a TV or VCR, or other consumer product back to life. It's a better than even bet that the other problem mentioned will be finding service literature. More and more no-name products are being sold, with nary a clue as to who made the unit or where the service center can go for parts and information. More and more of the circuitry is highly sophisticated, with unique components for which only the manufacturer has the replacement. What can a service center do when faced with this increasingly common problem?

The answer is to talk to a good replacement parts distributor, the kind who's responsive to the service center's needs.

The nature of the problem

Today's consumer electronics products are more sophisticated than most people realize. In many cases these days a consumer electronic product is far more than a product; it's an intricate system. Take a VCR, for example. There's the electromechanical portion of the system, which loads the tape and records or plays it. There's the electronic portion that manipulates the video signal. There's the control section, which makes sure that all other sections work properly together, and just for good measure senses conditions like the presence of moisture or end of tape and shuts down the system if there's danger or damage.

Because there are so many components with so many specific characteristics, designers of today's sophisticated consumer electronic products have a wide choice of ways in which to design the circuits for the product they want to build. If they should want to achieve a function but they don't want to do it with the components available, they can go to an integrated circuit manufacturer, or in some cases the IC division of their own company, and have a new, proprietary IC designed and fabricated.

All of this leads to a huge variety of components that the technician will encounter any time he services a product. The problem is compounded by the fact that each manufacturer has his own part numbering system. In many cases, when a technician has identified a particular faulty component, he can find a cross reference that will allow him to determine if he has an equivalent in stock. Unfortunately, in as many cases, there is no cross reference, and even if the service center has a needed part on hand, no one is aware of it.

What to do

There are many things that can be done to make finding the right replacement component easier. The most obvious is to obtain copies of every cross reference that exists and become familiar with them so that when a part is needed it can be identified. Some of the cross references are available free from manufacturers through distributors, and some cost a pretty good chunk of change. If a technician adds up all the long distance calls, and all the time spent on the phone, to say nothing of the toll charges for those long distance calls, any cost for cross references might be found to be money well spent.

Talk to a good distributor

Whether you've identified the replacement component needed to complete servicing of a product through your own research, or if you've come up with a blank, obtaining a part from the distributor is your next step. Just as with any supplier, distributors are not all equal in their commitment or ability to solve your problem.

The advertisers who are represented in this special advertising supplement have taken this opportunity to tell you a little more about themselves than they can in just an ad. The want the service centers to be aware of what kind of facilities they have, what kinds of people work for the company, the efforts they are making at customer satisfaction, and how to contact them when you need a replacement component.

Here are some of the questions we asked the manufacturers and distributors to address in their articles:

- How many locations do they have?
- How often are they able to fill orders from stock?
- What payment options do they offer- open order account, credit card?
- How soon after receipt of an order do they ship?
- Do they have a toll free number?
- What ordering options do they offer?
- What is their return policy
- Do they offer a warranty?
- Is there a minimum order amount?
- What shipping options do they offer?
- What special services do they offer?
- Do they have a research department to help technicians find a specific part?

When you're searching for a replacement part supplier you can count on for convenience and service, keep some of those questions in mind. Just finding someone who stocks the part isn't the only consideration. If you have to wait until you fill a large minimum order amount before you order, or if you have to wait weeks for the part to arrive, you're stuck with a defective TV and probably an irate customer. The impulse to order from the first name in the book might be high, but take the time to ask some questions. It could save time, money and aggravation. The following section will give you a good head start in answering some of those questions.■

REPLACEMENT PARTS SHOWCASE

MCM Electronics

650 Congress Park Dr.
Centerville, OH 45459-4072
800-543-4330
FAX: 513-434-6959

MCM Electronics is a company of dedicated people committed to offering only the best electronic parts, components and service to the customer.

Because needs in the electronic industry are constantly changing, MCM Electronics continually and thoroughly researches the market and reacts to the changing demands. And MCM is constantly in touch with national and international manufacturers to bring both commonly used and the hard-to-find products to its customers. In fact, two full-sized catalogs are mailed each year and the last issue introduced more than 1500 new items. MCM is a full-line distributor for RCA/GE replacement parts and an exclusive distributor for MultiTech/DynaTech. We also carry other brand names including: Chemtronics, Fluke, Panavise, Sams, Photofacts, Weller, Xcelite and many more.

Sales flyers are mailed regularly which feature specially priced products. These flyers keep the customers continually informed of new items that are being added.

The Sales Department has been thoroughly trained to answer all calls on the toll-free lines promptly and efficiently. These representatives are professionals who can provide immediate information on stock availability and pricing. They are available Monday through Friday, 7:00 a.m. to 8:00 p.m. EST, and Saturday 9:00 a.m. to 6:00 p.m. EST. Orders can be placed after hours with a national toll-free number, ensuring service 24 hours a day, seven days a week. Also, MCM has highly trained electronic technicians available to answer the customers product questions. With a separate toll-free "Tech Line" customers can receive prompt answers to their questions by calling 1-800-824-TECH.

The company's Distribution Center houses an enormous inventory of parts and components. Every order is pulled and double-checked to strive for timely and error-free shipment. Because more than 17,000 of the items in the catalog are stocked and ready for shipment, orders are shipped within 24 hours.

MCM offers a broad range of shipping options. Customers can establish Net 30 accounts or have their orders shipped COD, charged to MasterCard or Visa, prepaid or picked up at the Distribution Center's will Call area. There is a $20 minimum order for COD, checks and open accounts, and a $25 minimum for MasterCard and Visa orders.

For more information and a free catalog, call 1-800-543-4330, in Dayton, OH call 513-434-0031. ■

SPECIAL ADVERTISING SUPPLEMENT

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REPLACEMENT PARTS SHOWCASE

Matsushita Services Company

50 Meadowland Parkway
Secaucus, NJ 07094
201-348-7589; FAX:201-348-7527

From headquarters in Secaucus, NJ, Matsushita Services Company (MSC) coordinates a U.S. network of factory servicenters, independent servicenters, self-servicing dealers, parts and accessory stocks and training sessions.

Matsushita Electric Industrial Company (MEI) manufacturer of Panasonic, Technics and Quasar products, is the world's largest manufacturer of consumer electronic products. MEI sales worldwide have passed the $46 billion mark. At the heart of this success is a tradition of service.

The life blood of Matsushita is a blend of state-of-the-art products, accurate anticipation of market demands, effective manufacture and distribution, and a compelling program of sales promotion and marketing. But the heart of its business is the quality of service it renders to each customer.

That's why Matsushita Services Company (MSC) was established to meet the service and parts needs of customers. These customers include Matsushita authorized servicenters, authorized replacement parts distributors, the nationwide network of Panasonic, Technics and Quasar dealers, and the many millions of Americans who purchase Matsushita products each year.

The total commitment to service quality at MSC is evident everywhere. It is the philosophy that guides every person in the organization. Even if an employee doesn't deal directly with one of the customer groups, the goal of everyone is to provide excellent service so that customers receive maximum satisfaction of their service needs. The MSC service organization is Matsushita's way of saying to customers, "Thanks for your business and we hope you will select a Panasonic, Technics or Quasar product again."

To meet its service commitment in North America, MSC has a support operation second to none in the consumer electronics industry. A staff of 900 trained men and women provide a wide range of services to customers. Twentyfour MSC factory servicenters (FSCs) are strategically located throughout the country. Technicians in each FSC are well-trained in diagnosing and correcting malfunctions in sophisticated electronic products. Independent authorized servicenters and self-servicing dealers, backed by a factory training and a comprehensive stock of original equipment replacement parts, complete the network that makes service easily available to owners of Panasonic, Quasar and Technics. ■

REPLACEMENT PARTS SHOWCASE

Twenty-four MSC factory servicenters (FSCs) are strategically located throughout the country.

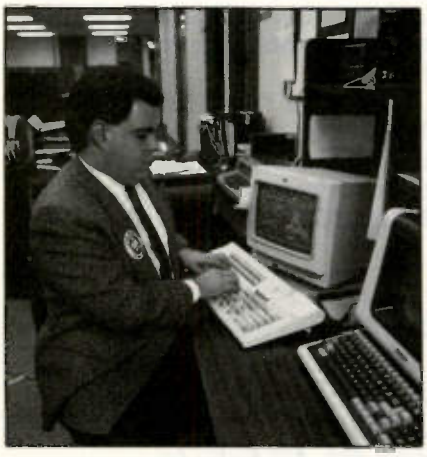
Distributors of:

Panasonic **Technics** **Quasar**

Factory servicenters at convenient locations throughout the United States provide repair services and replacement parts.

Owners of Panasonic, Quasar and Technic products are never far from factory-trained service technicians.

Trained parts and service personnel provide a telephone link to customers seeking product and service information.



The MSC Parts-Link computer system quickly locates the nearest source of original equipment parts needed to service products.

Highly trained technicians use sophisticated instrumentation to speed and improve the quality of customer service.

In thousands of service departments, service procedures developed by MSC speed product repair.

DELIVERY IS THE MOST IMPORTANT FUNCTION OF A PARTS DISTRIBUTOR. BUT IT'S NOT ENOUGH.

MATSUSHITA AUTHORIZED PARTS-LINK™ DISTRIBUTORS. BECAUSE IT PAYS TO BE SURE.

Some distributors are quick to promise fast delivery of replacement electronic parts. But they may not always be the right parts. That's never a problem when you put your trust in a Matsushita Authorized PARTS-LINK™ Distributor—your best source for Panasonic, Technics and Quasar original replacement parts. For basic stocking, each distributor maintains over 1,000 of the most demanded part numbers for off-the-shelf delivery. Even if the part you need isn't so common, your Matsushita distributor is tied into our exclusive PARTS-LINK™ network, tracking over 385,000 part numbers, so that we can locate the part you need, lock in the order, and deliver it—if overnight delivery is requested to your doorstep within 24 hours. They can even cross-reference these original replacement parts to other Matsushita built products so that you can retain the high quality and reliability of Matsushita's design.

THE DIFFERENCE BETWEEN A PROMISE KEPT, AND A PROMISE BROKEN.

Your Matsushita Authorized PARTS-LINK™ Distributor isn't authorized by accident; each has met (and continues to meet) stringent requirements to ensure fast, courteous and responsive service backed by Matsushita's replacement parts warranty.

The right part at the right time from the right source. For the name and location of your Matsushita Authorized PARTS-LINK™ Distributor—see our listings at right.

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MATSUSHITA

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Arizona Wholesale Supply Co (C/M) • 2020 E. University Dr., Phoenix 85034 • 602-258-7901 • FAX 602-258-0800

Electronic Parts Co. (C/V/M) • 3059 W. Indian School Rd., Phoenix 85017 • 602-277-7281 • FAX 602-279-4429

CALIFORNIA

Andrews Electronics (C/V/M/A) • 25158 Avenue Stanford, Valencia 91355 • 800-289-0300 • FAX 800-289-0301

Audio Video Parts, Inc. (C/V/M/A) • 1071 South La Brea Ave., Los Angeles 90019 • 213-933-8141 • FAX 213-933-7008

Cass Electronics (C/V/M/A) • 801 Seventh Ave., Oakland 94606 • 510-839-2277 • FAX 510-465-5927

Chuck Hurley Electronics (C/M/A) • 2557 Albatross Way, Sacramento 95815 • 916-927-5891 or 800-655-4004 • FAX 916-927-5956

E and K Parts, Inc. (C/V/M/A) • 2115 Westwood Blvd., Los Angeles 90025 • 310-475-6848 • FAX 310-474-0846

Pacific Coast Parts (C/V/M/A) • 15024 Staff Court, Gardena 92048 • 310-515-0207 • FAX 800-782-5747

Star for Parts (V) • 12930 E. Sunnyside Place, Santa Fe Springs 90670 • 800-525-6046

Blakeman Wholesale/Tacony (V) • 14281 Franklin Ave., Tustin 92680 • 714-544-0446 • FAX 714-544-0792

Wholesale Vacuum (V) • 5811 Rose Ave., Long Beach 90813 • 310-428-6411

COLORADO

Denver Walker Wintronics (C/M) • 1001 W. Arizona Ave., Denver, 80223 • 303-744-9505 • FAX 303-777-9357

Star for Parts (V) • 2350 Arapahoe St., Denver 80205 • 303-296-2117 • FAX 303-296-2120

CONNECTICUT

Signal Electronics Supply, Inc. (C/M/A) • 589 New Park Ave., West Hartford 06110 • 203-233-8551 • FAX 203-233-8554

FLORIDA

Herman Electronics (C/V/M/A) • 1365 N.W. 23rd St., Miami 33142 • 305-634-6591 • FAX 305-634-6247

Layco, Inc. (C/V/M/A) • 501 South Main St., Crestview 32536 • 904-682-0321 • FAX 904-682-8820

Vance Baldwin (C/A/M) • 2207 S. Andrews Ave., Fort Lauderdale 33316 • 305-523-3461 • FAX 305-523-3464

Vance Baldwin (C/M/A) • 1801 NE 2nd Ave., Miami 33132 • 305-379-4794 • FAX 305-373-8855

Vance Baldwin (C/V/M/A) • 1007 N. Himes Ave., Tampa 33607 • 800-443-2606 • FAX 813-870-1088

Vance Baldwin (C/V/M) • 500 Clematis St., West Palm Beach 33401 • 407-832-5671 • FAX 407-833-8191

GEORGIA

Buckeye Vacuum Cleaner (V) • 2870 Plant Atkinson Rd., Smyrna 30080 • 404-351-7300 • FAX 404-351-7307

Wholesale Industrial (C/M/A) • 5925 Peachtree Corners East, Norcross 30071 • 404-447-8436 • FAX 404-447-1078

HAWAII

Panasonic Hawaii, Inc. (C/V/M) • 99859 Iwaiwa St., PO Box 774, AIEA, HI 96701 • 808-488-1996

ILLINOIS

B-B & W, Inc. (C/V/M) • 2137 S. Euclid Ave., Berwyn 60402 • 708-749-1710 • FAX 708-749-0325

Hesco, Inc. (V) • 6633 North Milwaukee Ave., Niles 60648 • 708-647-6700 • FAX 708-647-0534

Joseph Electronics, Inc. (C/M/A) • 8830 N. Milwaukee Ave., Niles 60648 • 708-297-4208 • FAX 708-297-6923

Union Electronic Dist. (C/V/M/A) • 16012 S. Cottage Grove, South Holland 60473 • 708-333-4100 • FAX 708-339-2777

INDIANA

Electronic Service Parts (C/V/M) • 2901 E. Washington St., Indianapolis 46201 • 317-269-1527 • FAX 800-899-1220

IOWA

Jones Distributing Co. (C/V/M/A) • 2650 Bridgeport Dr., Sioux City 51111 • 712-277-8600 • FAX 712-252-5645

KANSAS

G & A Distributors, Inc. (C/V/M/A) • 635 N. Hydraulic St., Wichita 67214 • 316-262-3707 • FAX 316-262-6494

Manhattan Electronics, Inc. (C/V/M) • 9086 Bond St., Overland Park, 66214 • 913-888-1115 or 800-821-3114 • FAX 800-255-6239

KENTUCKY

Major Distributing Company (C/M/A) • 449 S. 16th St., Paducah 42003 • 502-443-5345 • FAX 502-444-6237

MARYLAND

Fairway Electronics (C/V/M) • 3040 Waterview Drive, Baltimore 21230 • 410-576-8555 • FAX 800-955-2119

Fairway Electronics (C/V/M/A) • 4210 Howard Ave., Kensington 20895 • 301-564-1440 • FAX 800-955-1358

Tritronics, Inc. (C/V/M/A) • 1306 Continental Dr., Abingdon 21009-2334 • 410-676-7300 • FAX 410-676-7658

MASSACHUSETTS

MIL Electronics (C/V/M/A) • 1500 Main St., Waltham 02154 • 617-891-6730 • FAX 617-891-6733

Signal Electronics Supply, INC. (C) • 484 Worthington St., Springfield 01105 • 413-739-3893 • FAX 203-233-8554

Tee Vee Supply Co. (C/V/M/A) • 407 R Mystic Avenue, PO. Box 649, Medford 02155 • 617-395-9440 • FAX 617-391-8020

MICHIGAN

G.M. Popkey Co. (C/V/M/A) • 5000 W. Greenbrooke Dr. S.E., Grand Rapids 49512 • 616-698-2390 or 800-444-3920 • FAX 616-698-0794

Remcor Electronics (C/V/M/A) • 10670 Nine Mile Rd., Oak Park 48237 • 313-541-5666 • FAX 313-398-1016

MINNESOTA

Ness Electronics, Inc. (C/V/M/A) • 441 Stinson Blvd. NE, Minneapolis 55413 • 612-623-9505 • FAX 612-623-9540

Mid America Vacuum Cleaner Supply Co. (V) • 666 University Ave., St. Paul 55104 • 612-222-0763 • FAX 612-224-2674

MISSOURI

Cititronix, Inc. (C/V/M/A) • 1641 Dielman Rd., St. Louis 63132 • 314-427-3420 • FAX 314-427-3360

Tacony Corp. (V) • 1760 Gilsinn Lane, Fenton 63026 • 314-349-3000 • FAX 314-349-2333

NEW YORK

Dale Electronics (C/V/M/A) • 7 E. 20th St., New York City 10003 • 212-475-1124 • FAX 212-475-1963

Green Tele-Radio Dist. (C/M/A) • 84-00 73rd Avenue, Glendale 11385 • 718-821-1114 • FAX 718-821-3987

GMB Sales (C/V/M/A) • 140 N. Belle Mead, Setauket 11733 • 516-689-3400 or 800-874-1765 • FAX 800-635-0596

Mill Electronic Supply (C/V/M/A) • 2026 McDonald Ave., Brooklyn 11223 • 718-336-4575 • FAX 718-627-4023

Panson Electronics (C/V/M/A) • 268 Norman Avenue, Greenpoint 11222 • 718-383-3400 • FAX 718-383-2425

Radio Equipment Corp. (C/A) • 196 Vulcan St., Buffalo 14207 • 716-874-2690 • FAX 716-874-2698

Star for Parts (V) • 250 Rabro Drive East, Hauppauge 11788-0255 • 800-525-6046 • FAX 516-348-7160

OHIO

Fox International, Inc. (C/V/M/A) • 23600 Aurora Rd., Bedford Heights 44146 • 216-439-8500 • FAX 800-445-7991

Nirav Corporation (A) • 27243 Wolff Rd., Bay Village 44140 • 216-835-8130 or 800-982-8273 • FAX 216-835-3122

OREGON

Diversified Parts (C/V/M/A) • 2104 S.E. 9th Ave., Portland 97214 • 800-338-6342 • FAX 800-962-0602

Northwest Wholesale (V) • 426 NE Davis St., Portland 97232 • 503-232-7114 or 800-234-8227 • FAX 503-232-7115

The Moore Co. (C/V/M) • 333 SE 2nd, Portland 97214 • 503-731-0100 or 452-0500 • FAX 503-731-0105

PENNSYLVANIA

CRS Electronics (C/M) • 818 Brownsville Rd., Pittsburgh 15210 • 412-431-7700 • FAX 412-431-5666

S.E.I. Electronics, Inc. (C/V/M/A) • 2520 N. Broad St., Philadelphia 19132 • 215-223-9400 • FAX 215-223-9423

Steel City Vacuum Co., Inc. (V) • 919 Penn Ave., Pittsburgh 15221 • 412-731-0300 or 800-822-1199 • FAX 412-731-3205

RHODE ISLAND

Jabbour Electronics (C/V/M/A) • 345 Fountain St., Exit 30, Route 95 No., Pawtucket 02860 • 401-727-3370 • FAX 401-727-3374

SOUTH CAROLINA

Wholesale Industrial (C/V/M) • 515 E. Bay St., Charleston 29403 • 803-722-2634 • FAX 803-723-8182

TENNESSEE

Mills Morris Co. (C/V/M/A) • 677 Phelan Ave., Memphis 38101 • 901-774-9810 or 800-284-4984 • FAX 901-946-5603

Shields Electronics Supply, Inc. (C/V/M/A) • 4722 Middlebrook Pike, Knoxville 37921 • 615-588-2421 • FAX 615-588-3431

TEXAS

Electronic Component (C/V/M/A) • 2401 Bissonnet, Houston 77005 • 713-525-3290 or 800-531-3224 • FAX 713-528-1046

Fox International (C/V/M) • 752 So. Sherman, Richardson 75081 • 214-231-1826 • FAX 214-231-0177

Interstate Electric Co. (C/V/M/A) • 11292 Leo Lane, Dallas 75229 • 214-247-1567 or 800-527-4029 • FAX 214-247-2137

M-Tronics (C/V/M/A) • 3201 West Ave., San Antonio 78213 • 512-340-4069 • FAX 512-340-4569

Sherman Electronics (C/V/M) • 1701 Morgan Ave., Corpus Christi 78404 • 512-888-9454 • FAX 512-888-4942

VCP International Inc. (V) • 2285 Merritt Dr., Garland 75040 • 214-271-7474 • FAX 214-278-5981

VIRGINIA

Avec Electronics Corp. (C/M) • 711 Granby St., Norfolk 23510 • 804-627-3502 • FAX 804-627-1710

Avec Electronics Corp. (C/M) • 2002 Staples Mill Rd., Richmond 23230 • 804-359-6071 • FAX 804-359-5609

Avec Electronics Corp. (C/M) • 2009 Williamson Rd., Roanoke 24012 • 703-344-6288 • FAX 703-344-0081

Fairway Electronics, Inc. (C/V/M) • 2304 Chamberlayne Ave., Richmond 23222 • 804-321-7255 • FAX 800-955-7043

WISCONSIN

G.M. Popkey Company (C/V/M/A) • 2035 Larsen Ave., Green Bay 54307-2237 • 414-497-0400 • FAX 414-497-4894

G.M. Popkey Company (C/V/M/A) • 2355 So. Calhoun Rd., New Berlin 53151 • 414-786-5887 • FAX 414-786-9031

CODING:
(C)...Consumer Electronic Parts
(V)...Vacuum Parts
(M)...Major Appliance Parts
(A)...Accessories

(as of 6/19/92)

REPLACEMENT PARTS SHOWCASE

Russell Industries, Inc.

3000 Lawson Blvd
Oceanside, NY 11572
516-536-5000
FAX: 516-764-5747

Russell Industries has supplied top quality replacement components into the electronics distribution market for over 25 years.

Current product categories include antennas, solderless terminals, heat shrinkable tubing, rubber bumpers, and grommets, flyback transformers, fuses (through their Seneca division) and VCR repair parts including belts and idler wheels (through their EVG division).

All products are marketed by a network of over 1500 recognized distributors throughout the entire continental United States and Alaska and Hawaii.

Russell Industries is famous for their policy of "same day shipping and no back orders." Their knowledgeable and courteous customer service department is ready to assist in any situation from taking orders to locating and cross referencing difficult hard to find parts.

Cataloging and literature are a high priority at Russell. Constant updates are published to reflect on current trends in the industry. All catalogs are available on a no charge basis.

Russell has maintained efficient operations through continual innovation. One of the first companies in America to utilize a toll-free (800) number (in use since 1972) they have recently added a toll-free (800) fax number to improve customer communications.

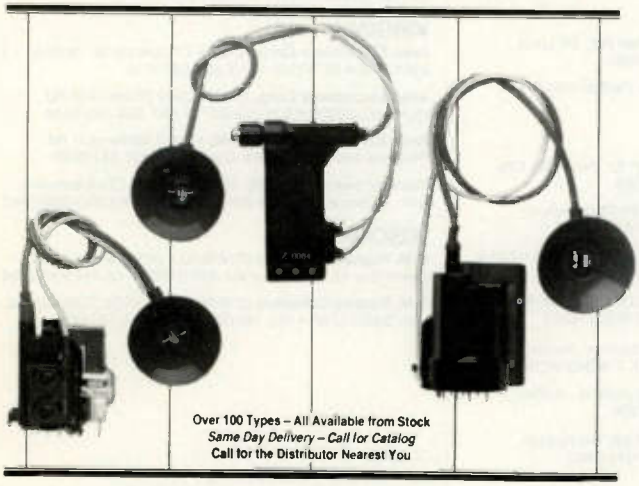
Existing product lines are periodically reviewed to guarantee that new items are being added as necessary. Entire new product categories are frequently introduced in order to allow customers "one stop shopping."

The latest product category to be introduced is Russell's full line of replacement flyback transformers for television. As with all other Russell merchandise, the quality of the transformers has been stringently tested. Over 100 types are now available to replace almost any requirement. Look for computer monitor flybacks to be introduced in the near future.

Family owned and operated. Russell Industries is firmly committed to the electronics servicing business. Russell Industries will continue to invest and innovate in order to provide the best products and services available in the industry. ■

SPECIAL ADVERTISING SUPPLEMENT

The Industry's Most Complete Line of Flyback Transformers.



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REPLACEMENT PARTS SHOWCASE

Andrews Electronics

P.O. Box 914
Santa Clarita, CA 91380
805-257-7700
FAX: 805-295-5162

It was 1950 when Andrew Futchik opened a small branch operation for a radio supply distributor. Not long after the young firm had become quite successful in its surrounding area. Soon "Andy" would move the company to larger facilities now under its own name: "Andrews."

Although the company was able to earn a solid reputation early on, we have never rested on past accomplishments. Andrews Electronics has maintained and improved upon the basic concepts that Andrew Futchnik pioneered many years ago. The success of the company was built on these principles:

- an inventory-control system that insures fast, efficient, accurate merchandise delivery
- specialization in O.E.M. replacement parts
- a constantly updated cross-reference system
- establishment of a good relationship with suppliers by stocking each line broadly as well as in depth.

Andrews Electronics is able to provide a variety of support services as a result of the company's commitment to those basic principles. We can automatically generate backorder reports showing ETAs and send them biweekly. We offer easily obtainable factory service literature, usually right from our stock. We are able to perform parts research quickly, because in most cases our computerized referencing system allows us to find what you need instantly. We don't charge extra for our expert handling and packaging. We regularly send out flyers that feature money savings buys, or promotions that anyone can benefit from.

Services such as this that will make it easier for you to obtain and control parts are naturally very important to us, but one feature that sets us apart from the rest is that we have the part you need when you need them.

Stocking the right parts is really what Andrews is all about. In fact, we are so committed to having parts in stock that in late 1988 we ran out of warehouse space. That's when we moved into out present location in Santa Clarita, with over an acre of total floor space. And you may be assured that we are not letting any of that space go to waste. Our average fill rate manages to stay steady at over 90%.

If you have not given us a try yet, please do. You can call or fax an order 7 days a week, 24 hours a day. If our order personnel are all busy, or if you call during off hours, our sophisticated telephone answering system will make sure that we don't miss your call. Our regular office hours are 8:30 a.m. to 5:00 p.m., Pacific Standard Time. We are closed for lunch between 12:00 and 12:30 p.m. ■

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Dial our 24-Hour Orderdesk:
Phone: 800-289-0300
FAX: 800-289-0301

Circle (69) on Reply Card

REPLACEMENT PARTS SHOWCASE

Philips ECG

1025 Westminster Drive
Williamsport, PA 17701
800-526-9354

Since its introduction in 1966, the ECG® brand name of solid state devices has been synonymous with outstanding quality, keeping Philips ECG positioned as the nation's leading replacement semiconductor supplier. Our concept of universal replacement has enabled us to establish a select range of components and parts that replaces more industry part numbers than other lines. This means distributors and repair facilities can enjoy the benefits of stocking fewer devices yet providing extensive replacement parts coverage, thus realizing a substantial savings.

Geared toward the needs of the commercial, industrial/MRO, computer, home entertainment and communications markets, Philips ECG offers the widest range of universal replacement semiconductors available, including transistors, integrated circuits, SCRs, TRIACs, rectifiers, diodes, optoelectronic devices, and others. The current ECG Semiconductors Master Replacement Guide (15th Edition) cross references over 262,000 industry part numbers to their equivalent ECG replacements and additionally features data for about 4,000 total ECG devices.

Also now offered is an exclusive new floppy disk version of the same semiconductors cross reference section contained in the current ECG Master Guide. Called the "ECG Semiconductors INSTANT CROSS™ Master Guide", the software enables users to instantly access the full replacement semiconductors base of over 262,000 industry numbers on their personal computers. The program displays the best ECG device replacement, description, case style and a reference to any note that applies. INSTANT CROSS software runs on IBM PCs and compatibles having MS-DOS, 640K RAM, hard drive and 3 1/2 or 5 1/4 -inch floppy disk drive. Several versions are available to support 360K/1.2M and 720K/1.44M disk drives.

Among the some 20 product lines offered by Philips ECG is the most comprehensive family of replacement electromechanical and solid state relays and accessories on the market together with a brand new product line catalog, which cross references over 39,500 industry part numbers and 177 different brands to 538 ECG types (71 ECG styles). ■

Philips ECG offers breadth and depth of product lines, a responsive literature support program and extensive industry part number cross reference guides to its customers.

ECG Instant Cross™ software instantly gives ECG semiconductor replacement devices for over 262,000 industry part numbers plus related information.

Industry's Largest Semiconductor Cross Reference—Now On Disks!

New INSTANT CROSS™ software gives ECG® replacement, description, case style, special notes instantly. Over 262,000 industry numbers and 4,000 ECG semiconductors. For IBM-PCs and compatibles with MS-DOS, 640K RAM, hard drive and disk drive. At 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

Circle (81) on Reply Card

New ECG® Semis Master Guide Marks Silver Anniversary.

From the pioneer and leader in universal replacement semis, 300 new products, 21,000 more crosses. Easy cross-referencing of 4,000 ECG devices to 262,000 industrial and entertainment part numbers. At 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

Circle (82) on Reply Card

ECG® Flyback Transformers Fit 39 TV/Monitor Brands.

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The Smart Choice

Philips ECG

PHILIPS

Circle (83) on Reply Card

45 ECG® Ni-Cad Batteries Fit Camcorders, Cordless Phones And More.

Rechargeable replacement batteries and packs for cordless phones and camcorders cover 99 brands, 1,000 part numbers. Power for memory backup, radio-controlled model vehicles, too. Ask for catalog. At 900 Philips ECG distributor locations or call 1-800-526-9354.

The Smart Choice

Philips ECG

PHILIPS

Circle (84) on Reply Card

REPLACEMENT PARTS SHOWCASE

C & S Sales

1245 Rosewood Dr.
Deerfield, ILL 60015
800-292-7711
708-520-0085

C & S Sales is a major distributor of high quality test instruments and electronic educational equipment. The company currently carries such name brands as: Hitachi oscilloscopes, Fluke multimeters, Standard amateur radio equipment, Beckman multimeters, Elenco test equipment and educational equipment, MOVIT robotics kits, and many other popular brands.

C & S Sales is a master distributor for Elenco, Hitachi, Standard, and MOVIT. This means that C & S Sales sells to other distributors as well as end users. In this way one is assured that C & S Sales will have the products you need at the lowest possible prices available.

C & S Sales has been servicing the industry since 1984. Its friendly and knowledgeable sales staff is committed to offering the highest quality test equipment at the guaranteed lowest prices.

The company publishes a free 32-page catalog listing thousands of items. Their 25,000 square foot warehouse assures that these items are readily available for immediate delivery.

The company prides itself on being the most price competitive distributor in the industry. Its huge inventory capability and large sales staff assures one will get the best possible service. Since they are able to buy in volume they are able to pass these savings on to their customers. Their motto is "We will not be undersold" and this is true. They guarantee to not meet, but beat any authorized distributor's price on any products they sell. Call them and see for yourself.

The sales/customer service department has been thoroughly trained to answer all calls promptly and efficiently. These representatives are professionals who can provide immediate information on stock availability and pricing. They are available 8 a.m. to 9 p.m. (CST) Monday through Friday and 9 a.m. to 6 p.m. (CST) Saturday. Orders can also be mailed or faxed to us. Our fax machine operates 24 hours a day, seven days a week. Technical questions about a particular product can be answered by C & S Sales highly trained electronics technicians, who are available to provide the answers customers need.

Even though most orders are shipped by UPS ground service, C & S Sales offers a broad range of shipping options for a nominal charge. Some of these include UPS overnight service, UPS two day service, US Mail, Federal Express, or truck. C & S Sales has the capability to ship by whatever method the customer prefers.

C & S sales offers a wide range of payment methods. These include: VISA, Mastercard, money orders, cashiers check, certified check, company check, personal checks, or COD. COD orders are only acceptable if shipped by UPS or Federal Express and only to addresses in the Continental U.S. They accept cash, certified check, company checks, or money orders only for COD orders. There is a small additional charge for COD orders. Businesses, schools, or government agencies can apply for credit terms: Net 30 days. There is no service charge for credit card orders. Foreign customers may pay by credit card, prepayment, wire transfer, or letter of credit. All payments must be in US dollars.

C & S Sales knows that there are certain risks involved in mail-ordering, and that is why the company guarantees 100% of all their products for at least 2 years from date of purchase. They also offer a 15 day unconditional money back guarantee. Volume discounts are always available and special discounts are available to educational institutions.

For more information and a free catalog description, call 800-292-7711 or 708-541-0710. You can also write to us at the above address or send us a fax at 708-520-0085.

SPECIAL ADVERTISING SUPPLEMENT

Circle (70) on Reply Card

REPLACEMENT PARTS SHOWCASE

Herman Electronics

1365 N.W. 23rd St.
Miami, FL 33142
800-327-8378
Fax: 305-634-6247

Herman Electronics is a diverse, full-line distributor of everything in electronics. Over the past 40 years, the company has acquired many major lines in order to provide better service to all phases of the electronics industry.

Herman Electronic's product base varies from transistors to satellite antenna systems, including all types of batteries; audio, video and telephone accessories; cable; connectors; capacitors; semiconductors; test equipment; speakers; tools; transformers; line conditioners; relays; antennas; chemicals; audiotape and videotape.

The parts department, at the heart of the business, has several sales representatives to serve your needs from 8:30 a.m. to 5:30 p.m. (EST) Monday through Friday and from 8:30 a.m. to 12:30 p.m. (EST) Saturday. Whether your request is for pricing, stock availability or research, the company's toll-free lines and 24 hour fax lines are readily available to fulfill all of your requests. Herman Electronics uses a state-of-the-art parts distribution computer system, enabling the sales representatives to provide efficient, effective and professional service and to assure that the parts is in stock when you need it.

Herman Electronics is a factory authorized, original replacement parts distributor for Sony, General Electric, Quasar, Casio, Samsung, Panasonic, Technics and RCA, catering to the consumer and industrial parts clientele. Stocking one of the largest and most comprehensive inventories, the company fills approximately 80% of its orders out of its 15,000 stocking items. All in-stock orders placed before 1 p.m. are shipped same day-guaranteed.

The company has always prided itself on being flexible and accommodating to its customers requests. "We realize that there are many good distributors throughout the country," says Jeffrey A. Wolf, Vice President and son of one of the company's founders. "It is our job to be better by taking that extra step in giving our customers professional, personalized service. Our industry has clearly become predominately service-oriented; therefore, we are committed and dedicated to maintaining a standard of excellence in servicing clientele."

The company provides several key fringe benefits that makes it service and customer satisfaction one of the best in the business. Herman ships all out-of-state orders UPS second-day at no extra charge to the customer. Individual computerized monthly backorder reports are provided upon request, and the company makes its toll-free lines available for research requests. Herman basically does whatever it takes to achieve customer satisfaction.

Herman Electronics also offers several shipping alternatives, including over-night service and drop shipments. The company offers customers many payment options, including a Net 30 open account (based on credit approval) MasterCard, Visa, or C.O.D. The company has no minimum order.

Call Herman Electronics toll-free at 800-327-8378 and see how the company is constantly working harder to serve you better. ■

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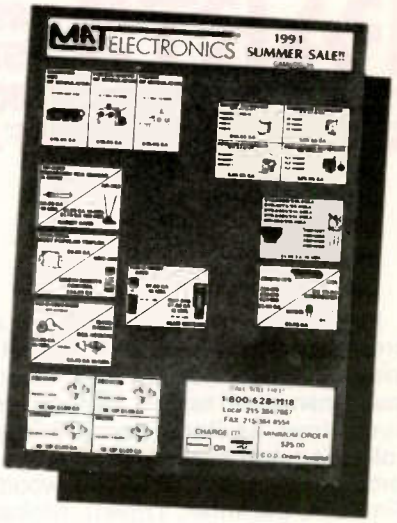

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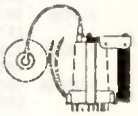

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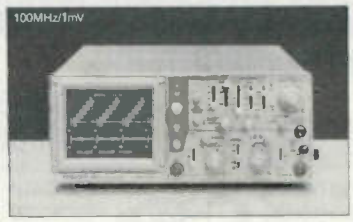

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Apple Macintosh computer repairs

By T. V. Kappel

Any competent consumer electronic servicing technician can service Macintosh computers, even though no schematics exist and there is little or no service literature available. The computers are electronic. They use chips and components that electronic servicing technicians are familiar with. Many of the failures that they experience can be diagnosed and repaired without major board replacement. All it takes to begin is a little courage, a little time, and some basic knowledge. Let's start with the knowledge.

The original Macintosh computer stands one inch more than one foot tall, weighs sixteen to twenty pounds, has a built in handle, is relatively small and portable, and uses a nine inch monochrome monitor (Figure 1). The design was

Kappel is the telecommunications engineer for the District Library, Instructional Technology Services, for the Albufquerque, NM, Public Schools.

Figure 1. The original Macintosh is a convenient computer package. Millions of this style of machine have been sold and they do need occasional repairs.

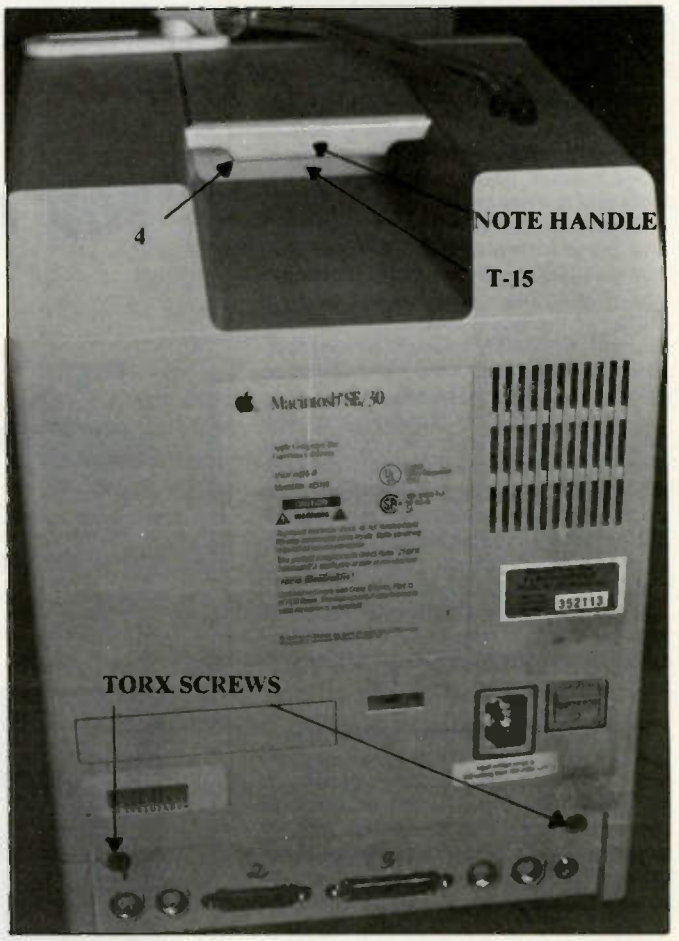

Figure 2A. The case of the Macintosh is held together with four T-15 Torx screws and some special friction tape. You'll need a long reach Torx driver and a spring loaded clamp to get inside.

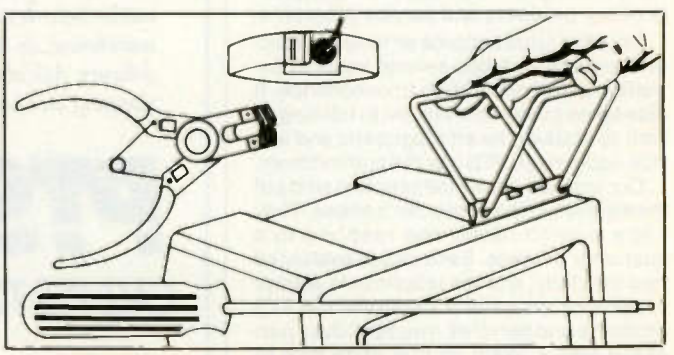

Figure 2B. At least one distributor sells a kit of tools to work on the Macintosh.

Figure 3. Once you have opened up the Macintosh, this is what you'll find inside. Note the locations of the flyback transformer and the J1 yoke connector.

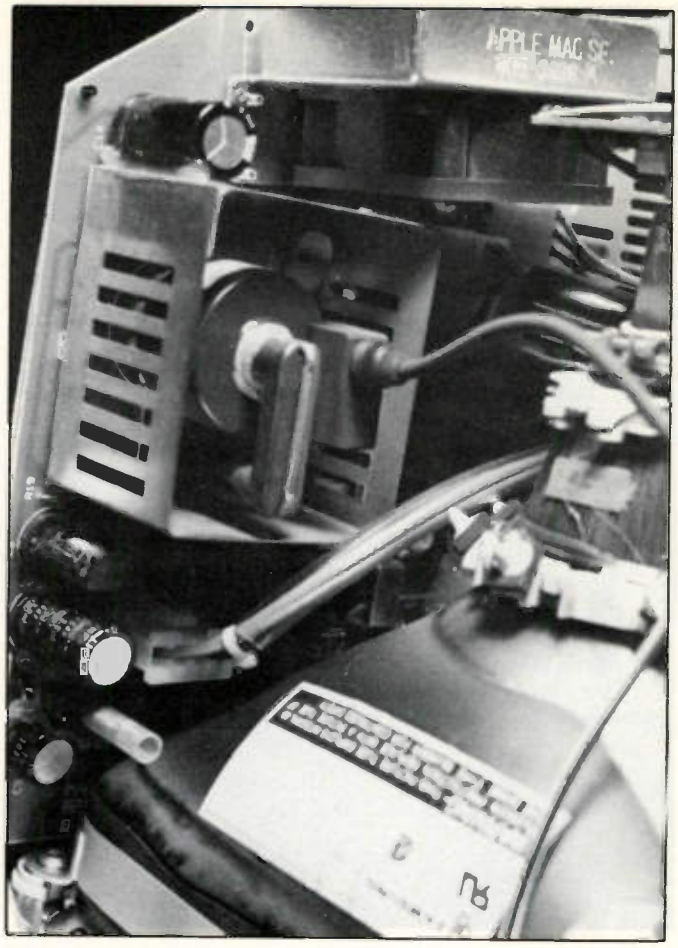

Figure 4. Here's a closer look at the flyback transformer and the yoke connector.

and still is a winner. Millions upon millions of this style of machine have been sold and they do need occasional repairs.

Machines of this style were the original Macintosh, called the Mac, the Mac Plus, Mac SE, Mac SE 30, and now the Mac Classic and Mac Classic II. This is definitely a market that a good service technician or service center can work and reap the rewards and benefits.

Cracking the Mac

Regardless of the symptom of the defective machine, if it is a hardware failure you have to get inside the machine to begin troubleshooting and repairs. So opening up the case is really the first problem.

The case is held together with four T-15 Torx screws (Figure 2A) and some special friction tape. You'll need a long reach, eight inch or longer, Torx driver to remove the screws. Then you'll need a spring loaded clamp to pry apart the case along the bottom once the screws are removed. This is a two-handed job with one hand working the spring clamp and the other lifting up on the back case cover.

The Torx drivers are available from a variety of tool supply sources. The special spring clamps are a little harder to find. A one inch spring clamp can be used, or a three inch or longer letter clip if you are desperate.

Techni-Tools, located in Plymouth Meeting, PA, sells a nice Mac Kit. The complete kit contains an extra long number 15 Torx driver, a static wrist strap, an IC puller, and a "MacCracker" case separator. This will definitely get you inside the Mac (See Figure 2B).

The electronics you'll find inside

Inside there are two main boards (Figures 3 and 4). The board across the very bottom of the unit is the Main Logic Board. Most computer service technicians will recognize the components on this board and will be familiar and comfortable with it. The board up the side is called the Power Supply/Sweep Board see (Figures 5 and 6).

A television or monitor service technician will instantly recognize the components on this board and be familiar and comfortable with it. *Most major Macintosh board problems are on this Power/Sweep board*. So regardless of what you may be comfortable with, this is the board you need to know about. It is often called the Analog Board, for obvious reasons, and that term will be used here.

Some common Analog Board problem symptoms

The major problem with this board is that when it malfunctions it causes a variety of symptoms. The computer may be completely dead. The unit may have smoke rising straight up out of the machine. In other cases there may be a vertical line down the center of the screen.

When you observe one of these symptoms, once you have gained access to the electronics within the computer go straight for J1, the yoke connector (Figure 7). J1 is in the upper left corner of the Analog Board, not too far from the flyback transformer. Often even before you disconnect the plug the plastic connector will appear burned and black. The

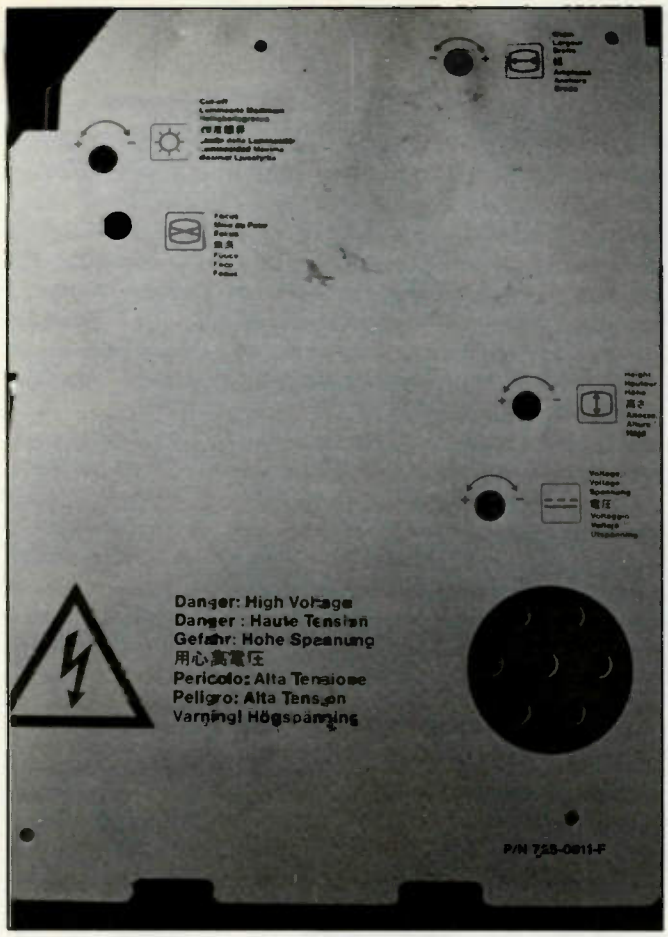

Figure 5. The back side of the analog board looks like this. Note the locations of adjustment controls and the directions marked.

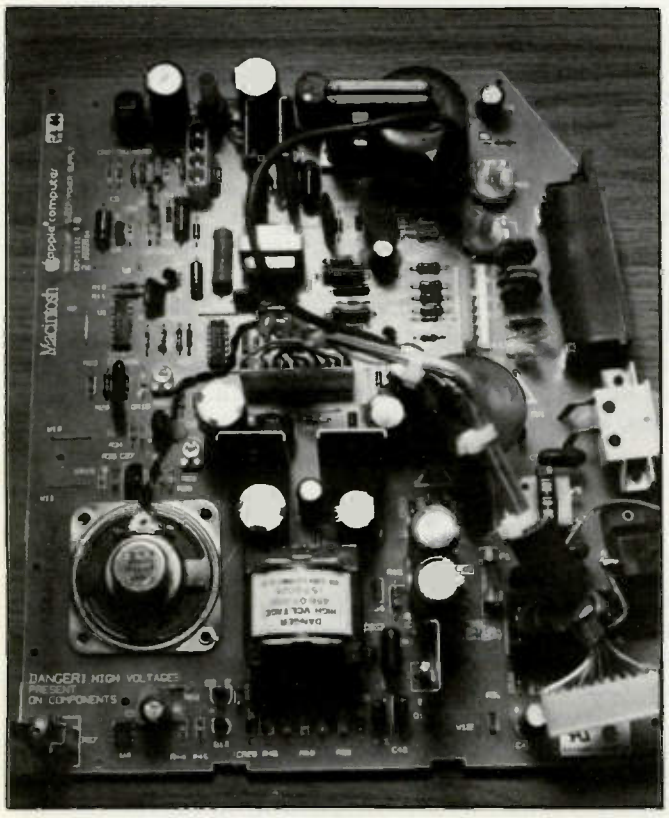

Figure 6. A look at this view of the analog board will show that J1 shows signs of having been overheated.

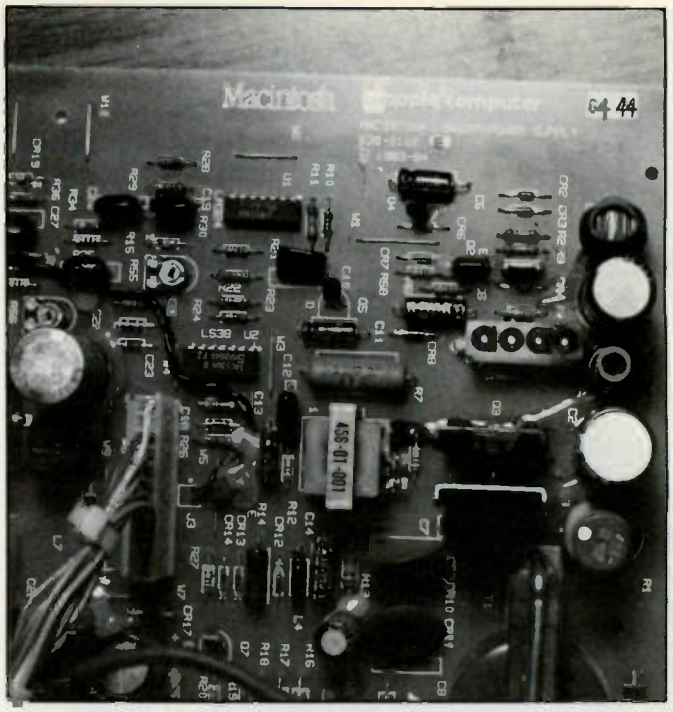

Figure 7. When the symptom is a dead unit, or smoke rising straight up out of the machine or a vertical line down the center of the screen go straight for J1, the yoke connector in the upper left corner of the Analog Board, not too far from the flyback transformer.

burned area is always pin 4, the horizontal sweep connection to capacitor C1.

Electronics is really wonderful. It is so predictable. Anywhere that you have heat with its accompanying expansion and contraction, current flow, and high voltage, you have failures. They should be expected there and should be the first place examined. Computers are definitely no exceptions.

Figure 7 shows the top side of the Analog Board with pin 4 of J1 clearly burned. The plating will be gone from both the jack and the plug and both must be replaced. Figure 8 shows the bottom of the PC board. You'll immediately notice the burned pin 4 connection and it will also be obvious that in the manufacturing process this was a spot chosen to place a sticky pad. The residue of this pad will have to be thoroughly removed and a new pad installed at a new location before the job is completed.

Replacement of the plug and the jack may solve the whole problem, but you should also replace C1. C1 is a high frequency 3.9μF non-polarized or bipolar electrolytic capacitor. It may be rated at 25Vdc, but capacitors in later models are of higher voltage rating.

As with all replacements, use good judgment especially regarding physical size and voltage rating. The board has to fit back into the unit and the cover must also slide on. Tolerances here can make it a tight fit. One final note, C1 can fail by itself, and even though J1 and the plug look good, the symptoms will be the same.

HOT failure

Those who examine closely will have noticed another dark burned spot on the edge of where the sticky pad was to the lower left of J1 plug. This brings us to a second common problem with the Analog Board. This second burned spot is Q3 the horizontal output transistor (HOT). It is a BU406, and rarely fails by itself. It can, but it's rare.

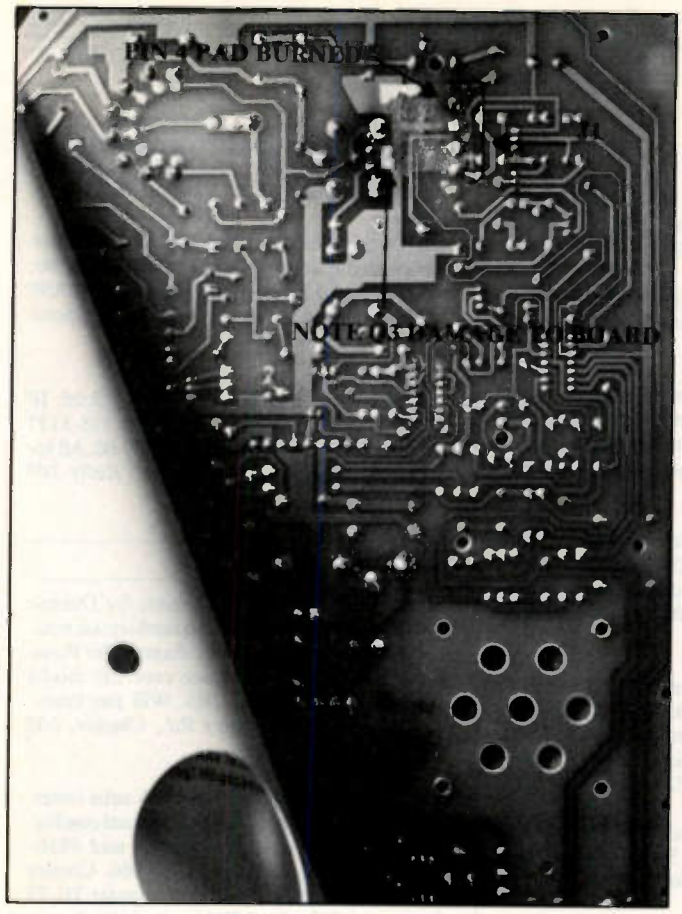

Figure 8. In this view of the back of the PC board, notice the burned pin 4 connection.

When you encounter a failed horizontal output transistor where the heatsink has changed color from overheating, the board underneath is burned, the glue used on the assembly line that is around the transistor is charcoaled to ash, and the solder buttons have gone from shiny to dull, in almost every case the flyback transformer as well as the transistor itself are shot. The symptoms can be ozone in the air, smoke from the computer, dark picture, jitters in the picture, and an arcing or sizzling sound.

Flyback transformers for some of these models are available from Dalco Electronics. This company has complete Macintosh repair kits which include the flyback transformer, capacitors, and transistors. The two kits, part number 10-915 for the Mac 128/ 512/Plus, and 10-920 for the Mac SE/SE30 sell for less than $30.00 (See sidebar).

The bottom line is that Macintosh computers definitely can be repaired, and repaired profitably. That, also can definitely, and favorably, affect your bottom line. So, armed with this knowledge, take some time and explore the Apple Macintosh computer repair market. You'll be glad you did.

Tools and components for servicing Apple Macintosh computers are available from these two companies:

Dalco Electronics	**Techni-Tool**
223 Pioneer Boulevard	5 Apollo Road
Springboro, OH 45066	Box 368
Order: 800-445-5342	Plymouth Meeting, PA 19462
Phone: 513-743-8042	Sales: 215-941-2400
Fax: 513-743-9251	Fax: 215-828-5623

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Zenith tuner modules as listed in March 92 Exchange, $55.00. Panasonic modules as listed in June Exchange $35.00. Both for $75.00. *Chuck Kelly, 3336 Chatam, Waukegan, Ill 60087, 708-623-2597.*

Established North Dade County, Florida carry in service business. TV, VCR, microwave oven. Sencore equipped, Sams and factory schematics. Parts inventory etc. $16,000. *Gary Maddux, 305-652-8700.*

B&K 415 sweep/marker generator with cables and manuals $115.00. B&K 1077B television analyst with slides, cables and manuals, $115.00. Both items plus shipping. *Scott Lewis, Rt.3 Box 44D, Four Oaks, NC, 27524. 919-934-2712.*

Text books, service manuals, diagrams, parts, tubes -90% off list price. Send large SASE to *M. Seligsohn, 1455-55th Street, Brooklyn, NY 11219. 718-851-6487.*

VCR clinic, equip, parts, business and small building with small apartment, $34,900. Lease/financing possible. Will train. Near Rocky Mountain Park, Ft. Collins. *Ray Dorsner Video Master, 509 Main Street, Windsor CO 80550. 303-686-7250.*

B&K analyst model #1075. Sencore transistor tester and color generator model #GC141. Have other test equipment as well. *Keith Staly, RR2 Box 31, Tecumseh, NE 68450. 402-335-2716.*

Sencore TF-46 for $425.00. Used two months. Still under warranty. *John D. Mangrum, Rte #1, Box 18-B Batesville, MS 38606, 601-563-3070.*

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New SC-61, PR-57, LC-102. Low hours: SG-165, YF-33, DVM-37, TF-26. *Bob Baker, A-Z Electronics, 35326, Shenandoah Dr., Shingletown, CA 96088, 916-474-1650.*

Magnavox color video camera model# VR8280BK02 camera part only, excellent condition $100.00. *Joe LaGuardia, 305-245-1012.*

B&K portable transistor tester model 510 with case and leads, new $100.00. Tektronix portable digital oscilloscope model 222 with probes, battery, case, and manual, new 1000.00. *Ted C. Lietzau, 313-777-5661.*

Many TV and VCR parts for sale, 50% off many dealer price; used 1 year guarantee. *G. Barzily, 84-39 126th, Jamaica, NY 11415, 718-847-7465.*

Service manuals from large shop has 22 year collection of duplicates. All original manufacturer. All new audio $2.00, video $5.00. Send SASE for list. Tape Recorder Clinic, 4850 East Speedway, Tucson, AZ 85712.

Zenith modules: tuner 9-175-2030 $25.00, IF 9-151-O2B $15, tuning select pad 175-5127 w/tuning control 9-165 and LED $40.00. All for $60.00 add $5.00 COD. *Chuck Kelly 708 623-2597.*

WANTED

Service manual or copy (will pay) for Dukane amplifier model 1A1400. Also need service manual or at very least schematic diagram for Panasonic UVISION 3/4" video recorder model NV2120, S..N. LSHE21085. Will pay costs/ *Leonard Stern, 465 Derry Rd., Chester, NH 03036.*

Transformer for a 6000A Hickok tube tester. Any of the following Dynamic Mutual conductance tube tester. Hickok 6000A and 593B-triplet. Sencore MU150 or Eico 666. Crosley Dynacone speaker type F, test adapter TC-75 for model 707. *Paul Williams, 2364 Beaver Valley Pike, New Providence, PA 17560. 717-786-3803.*

Dust cover and owners manual for Panasonic home stereo model RS876AS. *David Moore, 104 Peeler St., Kosciusko, MS 39090.*

A 180ACB22R CRT for RCA projection TV. Used is fine. Contact *Dave at 506-387-4060.*

Used VCR remote controls; VCR service manuals, Panasonic flyback #TLF 14712F, Fisher VCR RF Modulator #4-1164-011610. *Ed Herbert, 410 N. 3rd St. Minerville, PA 17954.*

Sears TV model# 564-4170150. Focus network (M901) part# 46-13120-3. *Joe LaGuardia, 1521 Flamingo Ct., Homstead, FL 33035. 305-245-1012.*

Ic's for Pioneer SX-1280 (AM/FM receiver) tuner board or entier tuner board assy (working!). IC's (-'s from PIoneer schematic PA1002, PA1002A, or PA4004. *Daniel McCammon, 7761 S. Pistol Hill Rd., Tucson, AZ 602-647-3306.*

Magnavox Power Supply module #703661-1, VCR remote control. *Ed Herbert, 410 N. Third Street, Minersville, PA 17954.*

Schematic/service literature for Technics FM/AM stereo receiver, 50/60hz 540W 110V, 120V, 220V, 240V. Serial No. FA1702A123, Model No. SA-727. *John E. Taylor, 209 West Peabody St., Staunton, VA 24401.*

Sencore CR70 CRT restorer. Will consider an equivalent CRT restorer, must be complete and in good condition. *Charles D. Martinez, 303-575-1662 msg. PO Box 21401, Denver, CO 80221.*

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 distributor.

Hitachi Home Electronics 401 W. Artesia Blvd. Compton, CA 90220 800-HITACHI	**Mitsubishi Electronics America** 5757 Plaza Drive Cypress, CA 90630 800-553-7278 fax 800-825-6655	**NEC Technologies** 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.

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REPAIR MANAGEMENT SOFTWARE: for IBM PC's. Repair tracking, inventory, reports, billing, maillist, more. Demo disk $15. CAHILL ELECTRONICS, PO Box 568, Kingston, NH 03848. 603-642-4292 6-92-2t

PHOTOFACTS: Folders under #1400, $5.00. Above #1400, $7.00, sent same day first class postpaid. A. G. Tannenbaum, P.O. Box 110, East Rockaway, NY 11518. 516-887-0057. 11-91-5t

TV TOUGH DOGS 300 symptoms and cures. Send $10.95 to Davis TV, 11772 Old Fashion Way, Garden Grove, CA 92640. 7-92-1t

VCR HEADACHES? 500 Most common problems and cures. Printout $49. 1300 Symptoms and cures. Printout and IBM disc. $125.00. Guaranteed satisfaction. VCR Tuneup Center, 43 James Avenue, Redwood City, CA 94063 or call 1-800-777-7883. Mastercard and Visa accepted. 6-92-2t

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ATTN. VCR SERVICERS: 1600 VCR symptoms/cure by make and model printout $45. IBM disk $85. VCR Tune-Up Center, 2610 Bay Road, Redwood City, CA 94063. VISA, Mastercard on phone orders. 1-800-777-7883.

REPAIR FAX MACHINES WITH INTRAVIA'S SERVICE GUIDE Theory, operation troubleshooting, diagnostics, common & uncommon problems, manufacturer's information. Mechanical, optical, electrical and communication problem solving. Thermal heads. softswitches, attenuation, equalization settings etc. etc. $42.00 Knight Business Systems, Ltd. 266 Middle Island Road, Building 2-13, Medford, New York 11763. Phone 516-736-4440, FAX 516-736-4228. 8-92-1t

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