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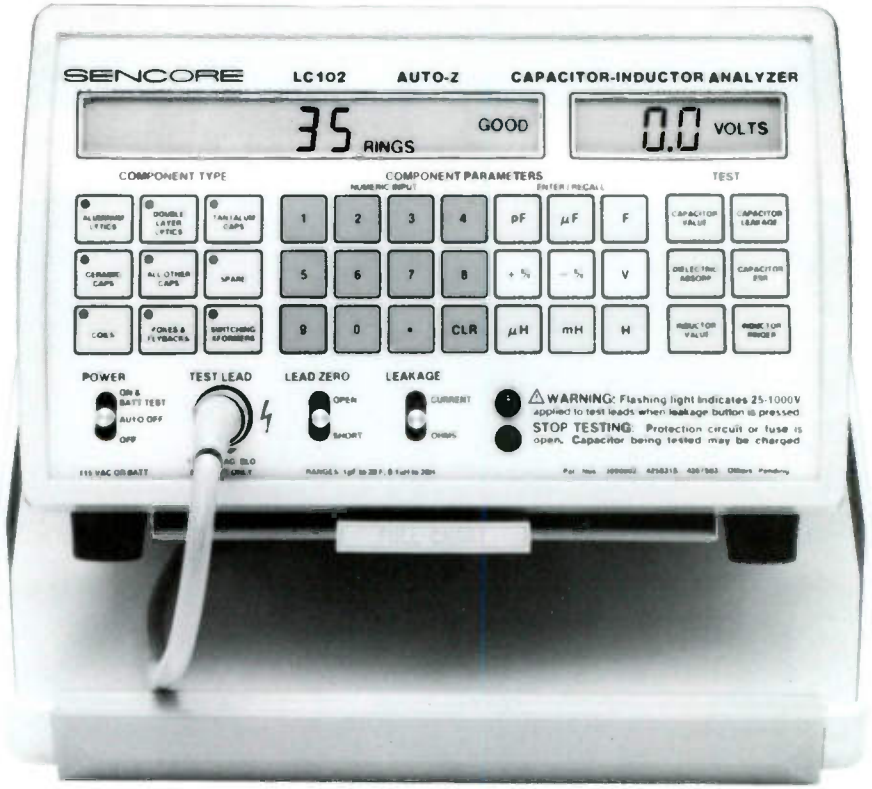

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Circle (43) on Reply Card

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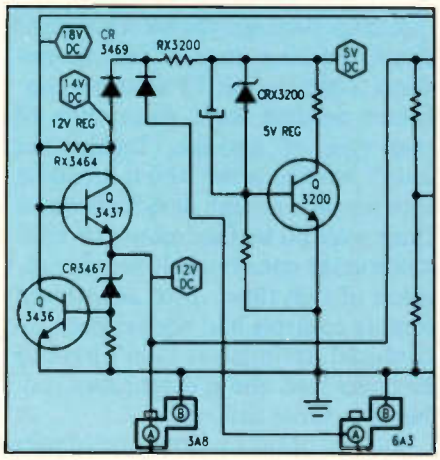

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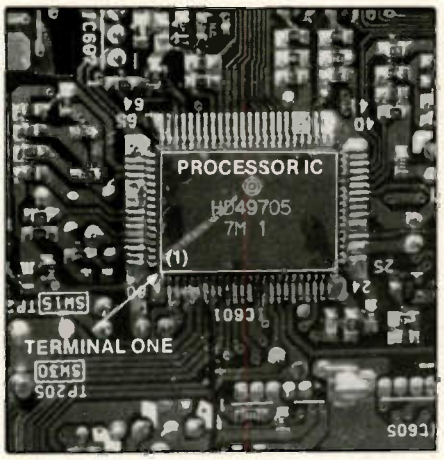

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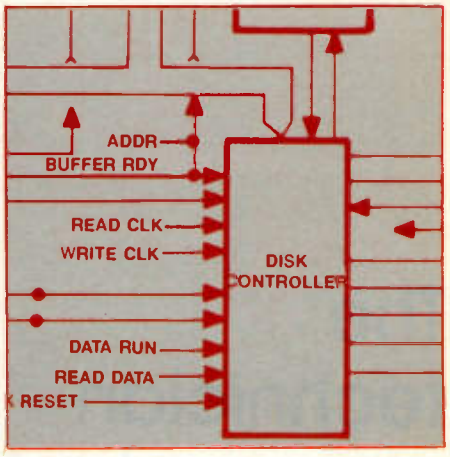

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FEATURES

DEPARTMENTS

ON THE COVER

The ultraminiaturization of electronics circuitry has led to a number of advantages for consumers: products such as camcorders, VCrs compact disc players and earphone radios that are light in-weight, packed with features and capable of high quality output. The same developments have led to increased frustration and difficulty for the technicians who have to service the products that employ tiny components such as surface-mount devices. *(Photo courtesy Pace, Inc).*

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The technician as perpetual student

One of the most commonly used marketing devices is the phrase "new and improved." It doesn't matter whether it's toothpaste, shampoo, dishwashing detergent or a VCR, the manufacturer seeks to set its product apart from its competitors, and its own earlier products by convincing the buying public that it has come up with a newer, better, version of the old product.

In the case of many products, the "new and improved" label is little more than marketing hype. The toothpaste may have a new and improved flavor, the shampoo may come in an improved package. When it comes to consumer electronics products, the new and improved is usually a significant advance, sometimes its a revolutionary change in an existing product; sometimes it's an entirely new product.

Take a look, for example at some of the articles in this issue. Many of the articles concern technology that wasn't even in existence just a few short years ago. Surface mount devices, which are so small that they can barely be seen, have allowed manufacturers to make their products more feature packed, smaller, lighter and less expensive. Unfortunately, they cause problems for technicians with normal eyesight and normal size fingers.

The same ultraminiaturization that makes for smaller, lighter, feature packed less expensive products makes them more susceptible to damage from the occasional (or in some locations, frequent) disturbance on the ac power line - hence the article on power protection devices.

In fact, a casual look through this issue, and many recent issues, will hammer home the fact that the electronics and mechanisms in consumer electronics products are changing faster and to a greater degree than at any time in the past. It's a safe bet that the pace of change will accelerate rather than slacken.

For example, the feature articles in this issue alone speak volumes about the changes in consumer electronics technology. Twenty years ago, the subject of these articles wasn't even being thought of by technicians or the manufacturers who product the products. The subject of electrostatic discharge damage was not a concern, simply because none of the components in the typical TV or other consumer product were susceptible to that type of damage. Technicians didn't have to worry about handling tiny surface mount devices because there were no surface mount components in the consumer electronic products of that time. And, as infrared remote controls had not yet been introduced, technicians didn't have to be concerned about diagnosing problems in those devices.

In view of the extremely rapid pace of change in consumer electronics technology, and the promise of still greater changes to come, it's disheartening to read some of the comments we receive from readers. In the latest batch of reader service cards, several readers included in the area where we ask "What are your two toughest problems?", answers such as: "Motivating our technicians to learn about new technology," or "Finding and hiring technicians who are willing to learn about the new technology."

It's interesting to me that people who were interested enough in learning about the latest technological products to go to school to study them in order to understand them enough to service them, would very quickly after graduating from school become hidebound and unwilling to progress beyond the level they achieved in school.

In a field that's changing so rapidly, there should be only one attitude expressed by technicians: the attitude that they welcome the advances in consumer electronics technology, and are willing to expend whatever effort is required to keep abreast of those advances. It's an attitude that has to be instilled in every technician by their instructors and the school's administration while they're going to school, by the management of the companies they work for, by the technical societies, and by magazines such as this one.

Any technician who remains unwilling to keep up with technology will one day, soon, find that it has passed him by.

Nils Conrad Persson

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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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Literature

Instrument and tool catalog

New from *Contact East* is a general catalog that comes packed with thousands of tools and test instruments for testing, repairing, and assembling electronic equipment. This is one catalog that no engineer, manager, or technician should be without. Featured are brand-name instruments such as Fluke, Leader, Tektronix, Weller, 3M and many more. Product lines are shown in full-color with detailed descriptions, and have been expanded to include new power supplies, oscilloscopes, soldering equipment, light meters, sweep/function generators, LCR meters, and telecom testers. Also included are work benches, precision hand tools, tool kits, and our custom tool kits designed to meet your individual needs. All products are fully guaranteed.

Circle (33) on Reply Card

New 3M products catalog

New from *3M* is a 576 page catalog which includes detailed descriptions, drawings, and photos of 3M electronic products. The Electronic Interconnection Systems Product Ordering Guide is the most comprehensive catalog ever offered, reflecting 3M's commitment to a broad line of electronic interconnects. This catalog is a valuable resource for information on IC socket connectors, boardmount and wiremount socket connectors, "MIX" stacking connectors, headers, plug connectors, DIN connectors, PCB connectors, DIP connectors, card-edge connectors, D-sub, D-ribbon, breadboard systems, cable and assembly equipment. The catalog is easy to use. Extensive cross-reference charts assist in quickly finding products, as well as mating cable, accessories, and assembly equipment. Three complete indexes are included: by grid spacing, part number, and product type. Full physical, electrical, and environmental specifications are included for each product. Complete ordering information is provided, including dimensions, part numbers, accessories, and mating connectors.

Circle (34) on Reply Card

ESD test stress to ICs covered in new app note

Stresses applied to ICs during tests to determine their ESD voltage susceptibility levels are described in a new Application Note 210, from *KeyTek*. It is shown that the delivered energy stress can vary by more than 30% among various MIL-STD test circuits which might at first appear to be the same. Application Note 211 first reviews various internal IC ESD protection structures, emphasizing the more popular two-stage structures which include an input crowbar as the primary protector, and an impedance-isolated clamp as the secondary protector. Voltage, power and energy threats are calculated for typical protection structures. This is followed by a detailed description of the four different stages of protection-circuit turn on for two-stage protectors: neither protector on, secondary (clamp) protector on, primary (crowbar) protector partially on, and primary protector fully on. Application Note 210 then documents the fact that many IC input impedances are as high as several hundreds of ohms, during various stages of turn on. Peak power and total energy stresses are then calculated for such ICs, using typical so-called MIL-STD 883C human-body model (HBM) ESD test waves. Energy variations up to 30 to 50% are shown to occur for different test circuits and typical ICs. The note concludes that the MIL-STD 883C waveform and circuit must be used, without variation, for HBM testing of ICs for their ESD withstand capability, to insure getting repeatable, tester-invariant results.

Circle (35) on Reply Card

NAC announces printer repair class

The National Advancement Corporation schedules their long awaited printer repair class for major cities across the country.

These courses gain a great deal of attention because of the unique method of teaching. Classes are kept small to allow hands-on training to maximize learning. Early response to

(Continued on page 40)

Thomson Consumer Electronics introduces line of Japanese (JEDEC/GENERIC) semiconductors

Thomson Consumer Electronics, has announced the introduction of a line of Japanese (JEDEC/GENERIC) semiconductors. "These devices are genuine, original Japanese namebrand semiconductors, not universal or approximate substitutes," said Barbara McNally, manager of parts and merchandising. "We have assembled a selection of the most commonly used items and the most frequently called for devices."

The servicer, when repairing equipment, is often faced with replacing a device imprinted with the original Japanese manufacturer's device number, but not the equipment maker's stock number. This causes the servicer to take time to search the equipment maker's data to find the stock number. By utilizing the Thomson line, the servicer can order the original Japanese type number from any authorized Thomson distributor.

EIA's consumer electronics group participates in national programs to bolster vocational education and the American workforce

The Consumer Electronics Group of the Electronic Industries Association, continually works to promote quality technical training and excellence in the American workforce. A senior representative of the Group's product services department has recently participated in two national projects designed to develop new strategies for providing quality training and vocational education relating to technology and consumer electronics.

Donald Hatton, Staff Vice President, Product Services was one of 100 representatives from across the United States who participated in a Business and Education Forum sponsored by the National Council on Vocational Education. The session was held in Washington, D.C. in June.

Some sample forum topics include: Where is technology going? How can current and future technology be implemented into education? What should the classroom of tomorrow look like? The relationship of math, science, and technology education and vocational-technical education.

Product services is one of eight departments constituting EIA's Consumer Electronics Group. The Electronic Industries Association is the 66-year-old trade association representing all facets of electronics manufacturing. EIA's Consumer Electronics Group represents most major U.S. manufacturers of audio, video, home office and home automation products, as well as assistive devices for people with disabilities.

1991 Electronic distribution show and conference

The 1991 Electronic Distribution Show and Conference will be held from Monday, April 29 through Thursday, May 2, in the Las Vegas Hilton Hotel, Las Vegas, Nevada.

Monday will be devoted to a new series of substantive educational programs. A prominent keynote speaker will highlight the program, which will also feature presentations on important niche market opportunities for distributors in semiconductors, relays, premise wiring, fastener hardware and power supplies and related products. A new forum for manufacturers to explain their qualification procedures to distributors will also be introduced. Exhibits will be open from 9 a.m. to 5 p.m. Tuesday, April 30 and Wednesday, May 1, and from 9 a.m. to 3 p.m. on Thursday, May 2.

EIA's consumer electronics group welcomes new technical trainer

Ted Wilson has joined the Product Services Department of the Electronic Industries Association's consumer electronics group (EIA/CEG). He will serve in the newly-created position of technical trainer.

Wilson comes to EIA/CEG from Dallas, Texas, where he has served for nearly five years as a technical instructor and director of education for the Video Technical Institute. In his new position at EIA, he will be responsible for the association's new on-site training facility as well as for scheduling the group's field workshops and seminars.

"Ted has a very impressive background in electronics technology and we are extremely happy to have him add his expertise to our training program," says Hatton. "Now that we have a full-time trainer on staff we will be able to develop new state-of-the-art training programs which we will be able to offer on a year-round basis."

Product services is one of eight departments constituting EIA's Consumer Electronics Group. The Electronic Industries Association is the 66-year-old trade association representing all facets of electronics manufacturing. EIA's Consumer Electronics Group represents most major U.S. manufacturers of audio, video, home office and home automation products, as well as assistive devices for people with disabilities.

EIA supports the advanced television standards act of 1990 (H.R. 4933)

The EIA recently offered its support to proposed legislation that provides $4.65 million over two fiscal years and creates the funding necessary to ensure that the Federal Communications Commission (FCC) can select a broadcast NTSC-compatible advanced television standard.

In a letter to Congressman Edward J. Markey (D-MA) chairman of the House Telecommunications and Finance Subcommittee, supporting the Advanced Television Standards Act of 1990 (H.R. 4933), Sidney Topol, chairman of the EIA Advanced Television Committee stated, "The timely selection of the appropriate standard will permit full U.S. participation in the world HDTV marketplace."

Chairman Topol added, "The State Department has traditionally represented the U.S. interests in this area very effectively through an operating mechanism that allows extensive input into the standard-setting process. Altering the existing executive branch consultative process in the manner provided by H.R. 4933 could well result in delays and oversights which could be detrimental to U.S. interests."

Winners announced in the VICA U.S. Skill Olympics Electronic Product Servicing competition

The Vocational Industrial Clubs of America (VICA) is the national organization for students in trade, industrial, technical and health occupations education. It sponsors the VICA United States Skill Olympics annually to recognize the achievements of vocational students and to encourage them to strive for excellence and pride in their chosen occupations. Six vocational students were winners and were announced at the Tulsa Convention and Expo Square in Tulsa, Oklahoma.

The six winners were (High School Division) - 1st place Jacob Dockter of Bismark, ND, 2nd place - James Jula from Chico, CA., 3rd place went to Charles Dixon from Conowingo, MD. In the Postsencondary Division the winners were 1st place - Charles Wood of Bay Minette, AL, 2nd place - Bradley Johnson of Paynesville, MI., and 3rd place went to Eric Stratte of Spokane, WA.

The contest is carefully planned by technical committees made up of representitives of labor and management and are designed to test the skills needed for a successful performance in a given occupational field. The electronic products servicing contest consisted of problems designed by representatives from the Electronic Industries Association/ Consumer Products Group.

UL seeks revisions to the Standard for Safety for Radio and Television Transformers, UL 1411

Underwriters Laboratories Inc. (UL) seeks review and comment from individuals and organizations interested in helping develop revisions to the Standard for Safety for Radio and Television-Type transformers UL 1411. UL 1411 covers transformers, autotransformers and motor-transformers intended to be used in audio, radio and television-type appliances in which the primary winding is connected across the supply circuit. The requirements also apply to transformers intended for use in high-frequency-switching-type power supplies in which the transformer provides isolation from the supply circuit.

Among the items to be addressed by the revisions are the addition of a Table specifying a generic list of materials which have been found to be equivalent to electrical grade paper, the addition of exceptions to requirements for direct support of live parts providing an alternative approach to evaluating dieletric strength and volume resistivity properties of sole support materials addressing transformers having pins intended to be mounted through printed wiring boards, and adding a bobbin material section specifying that bobbin materials may

(Continued on page 58)

Basic support for Troubleshooting

A colored pencil approach

By Thomas G. Vlazny

Vlazny is an instructor at Business Training Institute in Milwaukee. He has more than 22 years in the electronic area and is the owner of Educational Commitments. He is also an active member of NESDA, ISCET, WESA and ASCD.

The "master" technician relies on many available sources of information for repair of the complex equipment in today's electronic world. Times have changed from the "tube tapping" and "shotgun" techniques of the 50's to the skilled, well educated, thinking technician of today. There is always room for improvement. If your troubleshooting skills

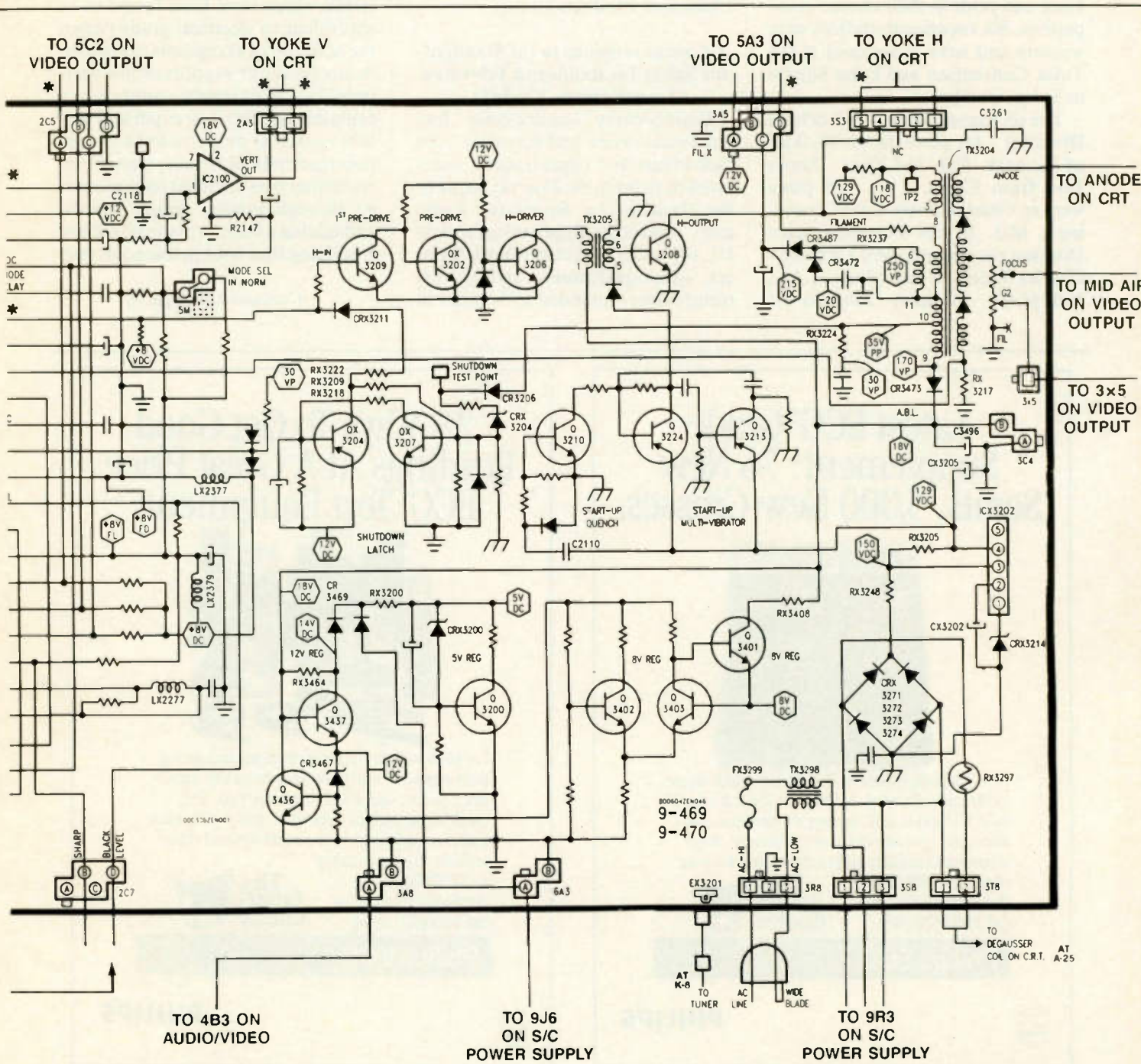


Figure A. Profax schematic without colored pencil.

are a little weak, here are some techniques for building your skills and your confidence.

There are supportive articles written on troubleshooting in many publications. I have selected some articles from **ES&T** as reference for this discussion. Coupled with the suggestions listed here you will have a powerful package of skills for troubleshooting.

In the January issue (88) an article entitled *"Servicing Voltage Regulators"* by Mr. Gregory Carey use simplified schematics and circles to identify important parts or areas. Dotted, dashed or solid lines were used to indicate current or signal flow. Another January 88 article by Mr. Michael Zoiss on servicing Apple II computers used block diagrams to show important connections.

Many articles use pictures, block diagrams or schematics to get you to visualize the action. We can enhance this visualization by using what many feel is a simplistic approach. In troubleshooting, given the technology of today, the simpler, quicker and more accurate the diagnosis the faster the repair. This process does require knowledge of the equipment operation.

We can call this combination the "colored pencil approach," for it deals with an activity using colored pencils to create pictures. Today's picture is a schematic diagram and rather than art, the picture is part of the job. Indeed in many instances the schematic is the picture for survival on the job. Why not give yourself the best chance of success?

Most of the technical manuals in use today started on the basic outline

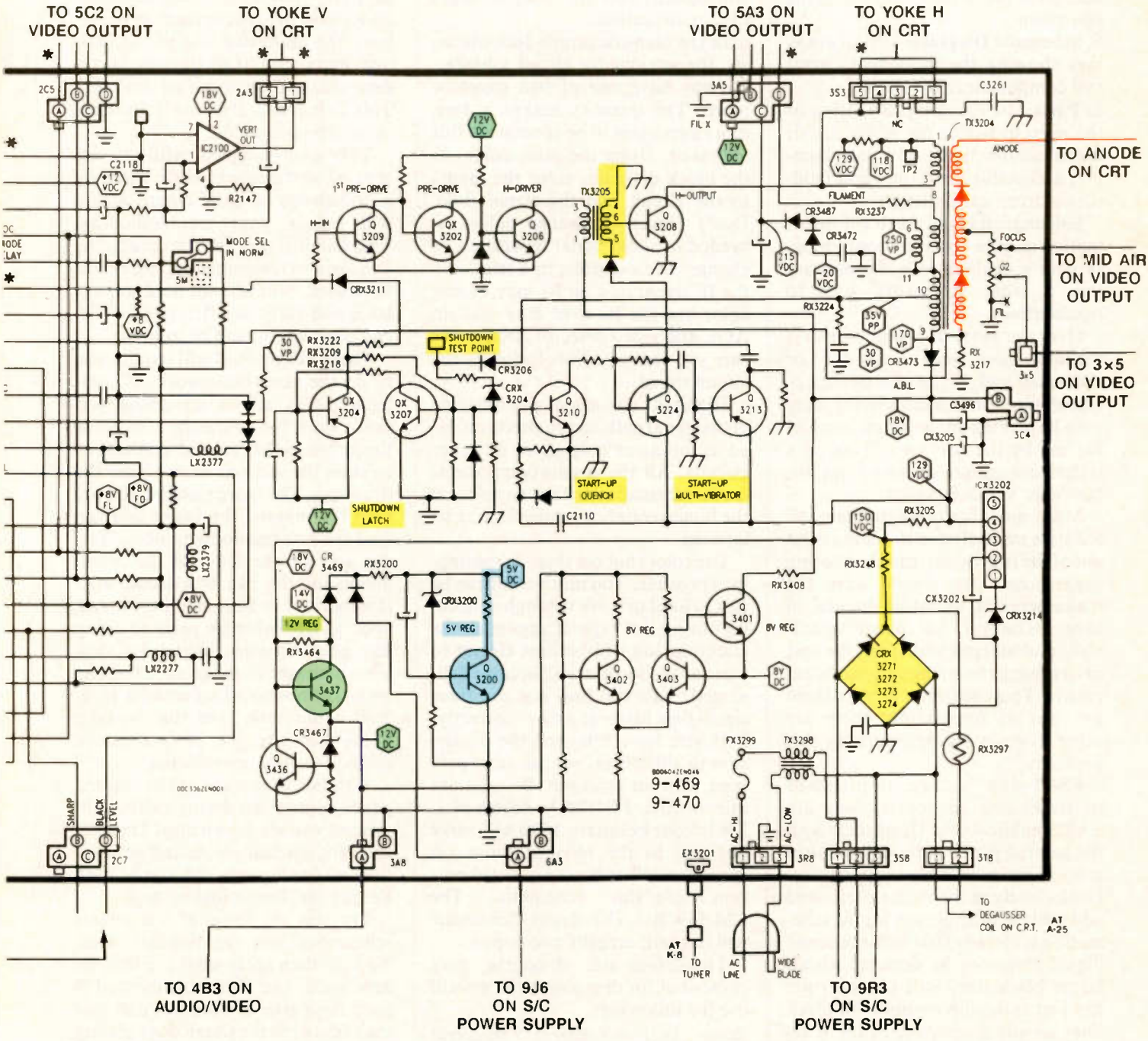


Figure B. Profax schematic with colored pencil.

of the military technical manual. Knowing the format can assist you in the troubleshooting process. In a typical military technical manual there may be as many as six sections to work from:

1. **Theory of operation** - a general description of the device and its function.
2. **Installation procedures** - unpacking, mounting and dimensions with additional material requirements.
3. **Operator's procedure** - the "how to" turn it on, tune and control the machine and implement all the features.
4. **Block diagrams** - a functional connection of major parts making up the equipment.
5. **Schematic Diagrams** - detail drawings showing the individual circuit and component connections.
6. **Parts List** - A complete listing of the parts available for replacement, manufacturer name and part number, acceptable substitutes and module or circuit card listings.

Shifting back and forth for information may be very time consuming. If your'e dealing with the military this is what you work with to troubleshoot.

Over the years of use in industry, sections have been discarded or shortened and, in the case of the operator's section and installation, may even be printed as a separate booklet for use by the customer. You, as a technician, cannot operate from this customer's booklet alone.

Many manufacturers still have the old style manuals and to get the most out of the functional troubleshooting suggestions, you should have the manufacturers technical manual in hand. However, for many technicians and independent shops the cost of obtaining these manuals can be excessive. There are times we need them but just as importantly there are other avenues for approaching this problem.

ES&T places a schematic in each of its issues and of course there are SAMS publications. Using these with the colored pencil approach requires more experience in basic operations. Look closely at these schematics and you find the draftperson for the schematic has already started the process. Signal flow may be depicted with a larger black line. Still you may get lost just in the sheer number of black lines on any given page of the schematic. The signals themselves can also go to or come from different sources.

This approach will help delineate these lines and sources. Regardless of how the schematics and/or block diagrams are obtained; it's what we do to them that is of value.

Using the colored pencil approach to basic troubleshooting

Start with the block diagram and use as many different colors as needed to cover the functional blocks (i.e. power supply, horizontal circuit, audio amplifier etc.). Once you have gone over the block diagram and understand the flow of both power and signals, you are ready to begin the circuit section.

In the manufacturer's tech manuals, the sections for circuit schematics may have one of two pages or more. The quantity makes it even more important to be accurate in this endeavor. Using the same colors as the block diagram, color the inputs to the circuit and the signal flow. Don't forget to change colors as needed to show signal separation or change. For example, in a television the IF signal into an IC may be one color but the IC used may contain AGC and video detector circuits. Be sure you change colors to follow the circuit signals.

Highlight the major components in the signal path and connections used as inputs or outputs to different circuits. All the circuit components on the schematic need not be colored; the nonessential components may be ignored.

Use colors but use them as sparingly as possible. Too much color can be just as hard to work through as nothing. using this type of approach the circuit action will become clearer to you and the sections will become delineated. You will find you can trace signal flow faster and more correctly.

If you have followed the discussion to this point, we can now proceed with an example. We can use one of the PROFAX schematics. 3061 from February 1990 will serve but due to the obvious limits on space; we will only use a selected portion of this schematic. The CM-139/B-1 (Y) *Main Schematic* will be used; actually two copies.

The colors are, of course, your choice but for demonstration we will use the following:

Green: DC Low Voltage (12V regulated)
Blue: DC Low Voltage (5V regulated)
Yellow: Start up Voltage
Red: High Voltage

Both of the schematics are identical but in schematic A; you can see the flow simply by following the colors.

Since most of the initial troubleshooting is done in the power distribution sections, how easily can you follow the power distribution in the start-up circuits? Can you find the 5V regulator easier? Can you determine the distribution of the regulated 12V?

This small example may serve to demonstrate the value of the colored pencil approach to troubleshooting support. The simple circuit schematics we used here become easier to follow. The understanding of the various parts and their interaction is demonstrated in a visual manner. This helps you effectively troubleshoot the equipment.

This skill coupled with an increased confidence brought about by a knowledge of basic circuit action will reduce your troubleshooting time and increase your accuracy. As you learn to remember the colors you have used, you will not need to page back and forth as often to view circuit connections and or sources.

Using this method will require you to do the same homework. If company policy allows (assuming you don't work for yourself); take home the technical manual and use the time to skim the sections and to view the drawings. The more familiar you are with the manual the faster you can find the information you need. You can also get the focus of the circuit action and this can help decide what is important to be remembered. Ask your service manager prior to doing any photocopying. Better yet, ask your manager to make up a booklet with the most used schematics in it. You could then take that booklet home and use the colored pencil method at your convenience.

Another advantage of the colored pencil approach is the logical thought process you are drawn into. Troubleshooting demands logic and your action in tracing out the signal path keeps your flow in logical steps.

Try this on some of the circuit schematics you are familiar with. You can then apply what you learn to new ones. The more this method is used the easier it becomes and you may find even the tough dogs getting more tame. ■

Monitoring and correcting power problems

By the ES&T staff

Power disturbances are aberrations or "glitches" in the power that pose a threat to the smooth operation of your (or your client's) equipment or business operation.

For electronic equipment, power disturbances are defined in terms of amplitude and duration by the electronic operating envelope shown here. When power falls outside the operating envelope, electronic systems are in danger of being damaged or disrupted, and their life expectancy shortened. See Figure 1.

How often do they occur?

One of the most authoritative and comprehensive studies on power disturbances (Allen & Segall) was completed in 1974. It found that a computer system was exposed to 128.9 possibly disruptive power disturbances per month. Experts believe that more power disturbances occur now than in 1974, and new studies are underway to quantify the number. One of these being conducted by the Electric Power Research Institute (EPRI) will for the first time determine the quality of utility-supplied power.

This article was based on the pamphlet published by Ann Scheurell. BMI 335 Lakeside Drive, Foster City, CA 94404.

What steps do you take to solve them

Power disturbances are often viewed as mysterious events which can only be understood by experts and which can only be solved by inexplicable techniques. Even skilled technicians will sometimes abandon rational, step-by-step problem-solving techniques when confronted by a power problem. They shouldn't. Power problems obey the laws of physics. Anyone with a basic background in electricity and an understanding of rational troubleshooting techniques can track them down and solve them. Here's how:

1. Make a visual inspection of the site and surrounding area. Note details like the visitor's sign-in log (to see if any contractors are working in the building) and examine the wiring system for strange smells or buzzing sounds.

2. Connect a power monitor as close as possible to the sensitive load and leave it to monitor for a period of time (typically 1 day to 1 week). Examine the summary data from that monitoring period first. It will show if there is a correlation between disturbances and equipment failure logs, or if there is a pattern to the time-of-day when the disturbances occur. (Perhaps the disturbance can be correlated with shift changes, typical power-factor correction times, or air-conditioning cycles.)

3. If the disturbances are of sufficient magnitude to disrupt electronic loads, examine disturbance graphs. A reference book published by BMI, The Handbook of Power Signatures, presents over 100 examples of common power disturbances annotated with their identifying features,

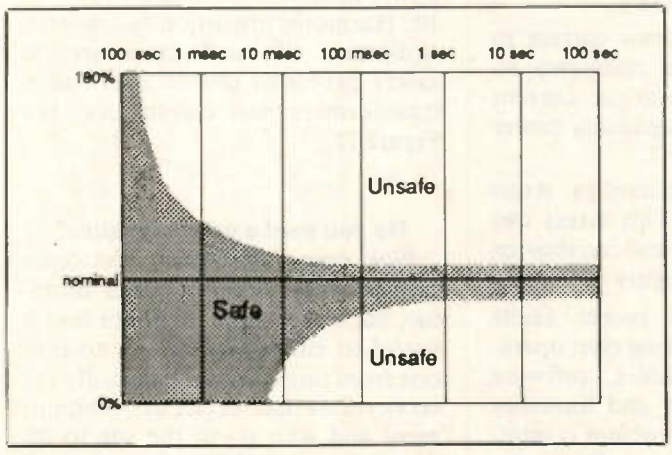


Figure 1. Electronic components tolerate high and low voltage power disturbances only if they are of very short duration.

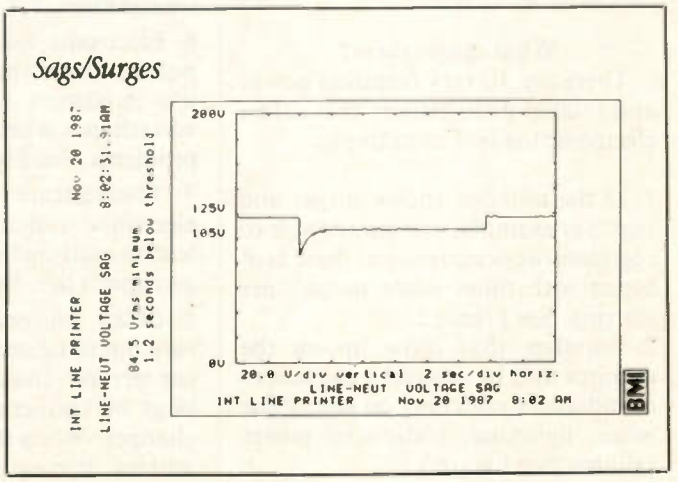


Figure 2.

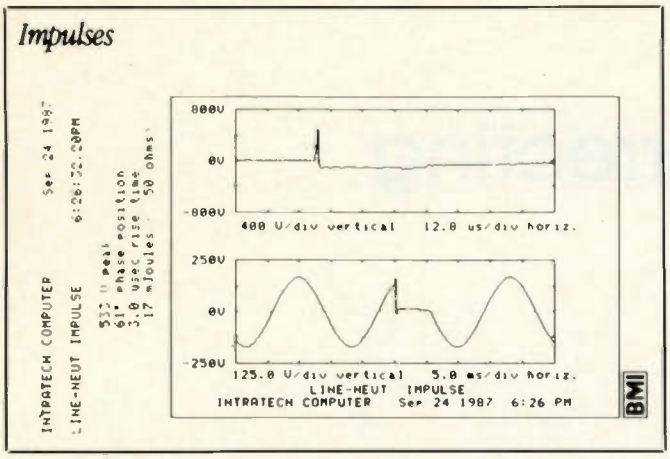


Figure 3.

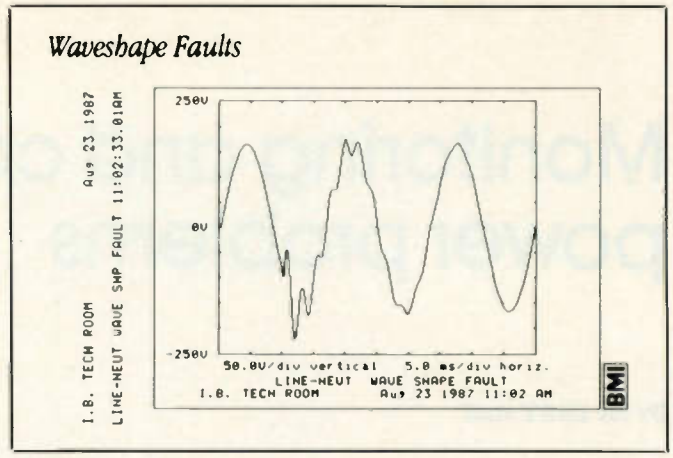


Figure 4.

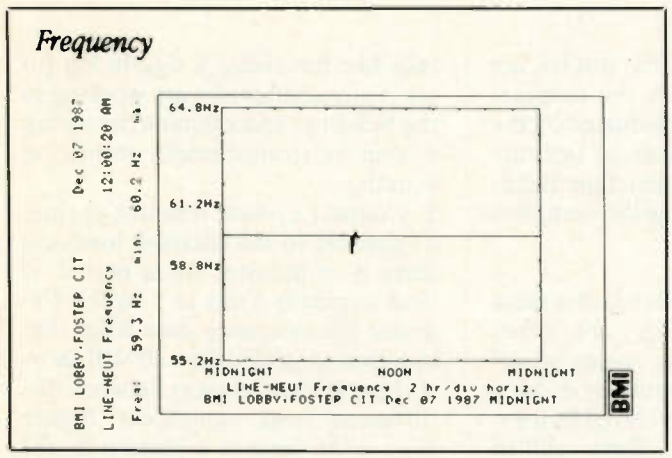


Figure 5.

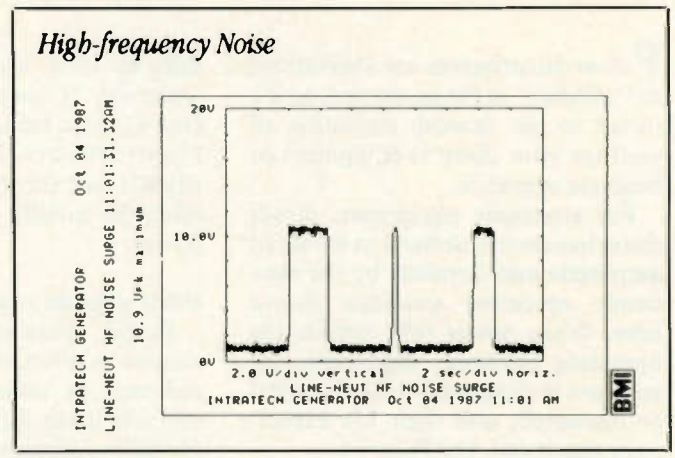


Figure 6.

causes, symptoms, and solutions. It's possible to match a disturbance to one in the handbook, identify the cause of the problem, and find out what to do about it. (The handbook also includes a detailed description of the steps to correct a power problem).

4. Determine the costs of several solutions and choose the one that makes the most sense.

What causes them?

There are 10 very common power and related disturbances that affect electronic loads. For example:

1. If the monitor shows surges and sags, for example, you may be able to correlate the occurrence of these problems with times when motors are starting. See Figure 2.

2. Impulses that show up on the monitor may be caused by capacitors or inductors switching on line, loose wires, lightning, static and power failures. See Figure 3.

3. Waveshape faults may be caused when power is being switched from one source to another, such as from standby to on-line power, for example. See Figure 4.

4. Frequency disturbances may occur during electrical storms or utility brownouts. See Figure 5.

5. High frequency noise may be caused by arcing motors or radio transmitters. See Figure 6.

6. Electronic loads draw current in pulses, rather than in sinewaves, so it's important to look at current waveshapes when diagnosing power problems. See Figure 7.

7. Temperature fluctuations stress electronic systems. This stress can lead to malfunctions and can shorten a system's life. See Figure 8.

8. Often, suspected power faults turn out to be something else: operator errors, loose cables, software bugs or temperature and humidity changes. When the problem is intermittent, it may be most efficient to rule out all other possible causes before troubleshooting the equipment. See Figure 9.

9. Radiated RFI can disrupt sensitive electronic equipment. Typical sources include radio stations, public address systems, radio transmitters operated by security personnel, and arcing contacts or motor brushes. RFI problems can be misdiagnosed as power problems. See Figure 10.

10. Harmonic distortion can shorten equipment life and cause serious safety problems due to overloaded transformers and conductors. See Figure 11.

Do you need a power monitor?

Not every consumer electronics service center needs a power monitor, but some would no doubt find it useful to either buy one, or to rent one from time to time. Especially for servicenters that service office equipment and who go to the site to do some of the troubleshooting, it might

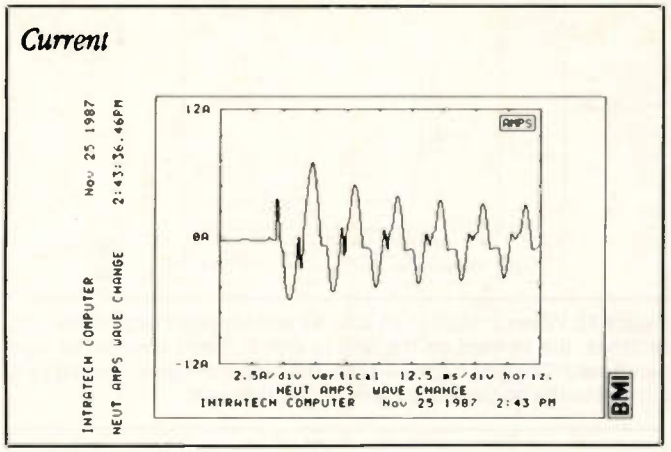
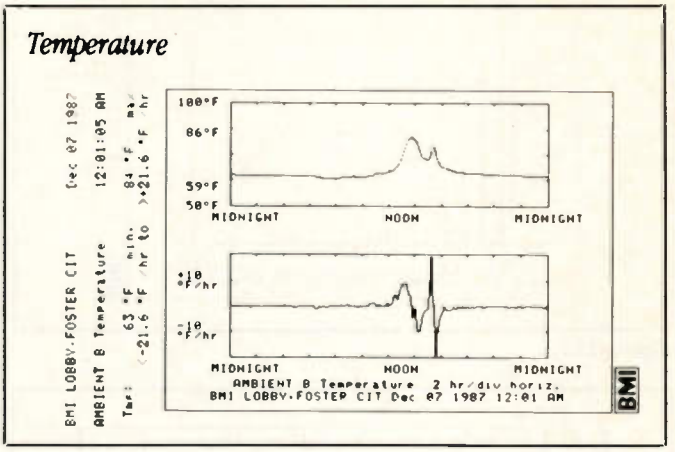


Figure 7.



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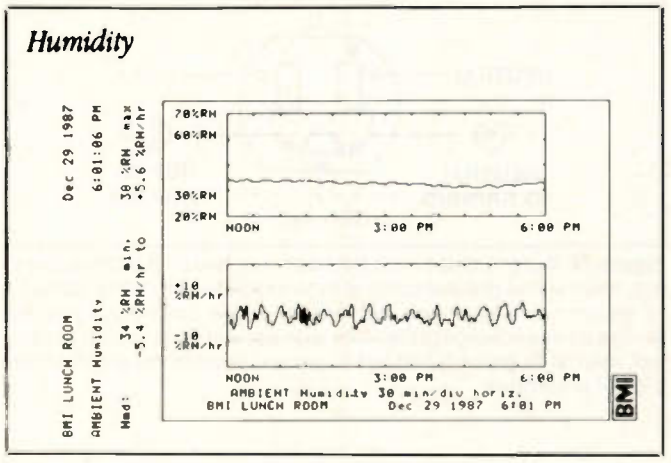

Figure 9.

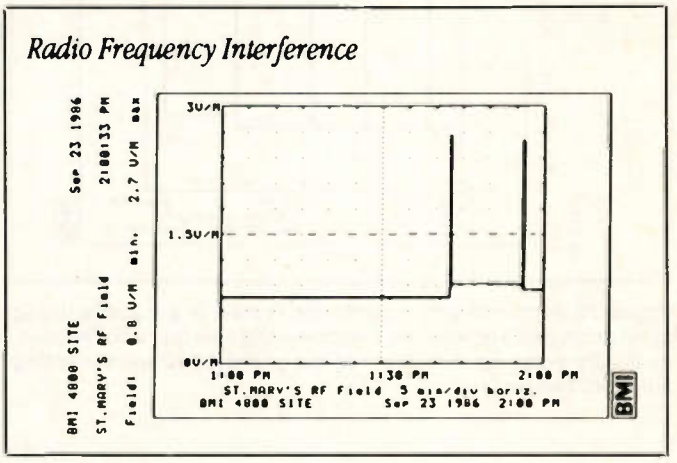

Figure 10.

be worthwhile to keep track of the time spent troubleshooting repeat problems. All types of electronic loads are susceptible to power disturbances, but it's impossible to tell if power is to blame without a power monitor. Ruling out power as the possible source of a problem can also save time.

Generally, there are 2 classes of power monitors: those that print graphs showing the character or signature of the disturbance ($3,000 to $12,000), and text-only monitors that note the time date and amplitude of the disturbance ($1500 to $8000).

If you need only to prove or disprove that power disturbances occurred (so that vendors take appropriate responsibility, for example), text-only monitors are sufficient. If you want to solve power problems, a graphic power monitor is the best choice.

Case study 1

A robot in a car assembly plant began missing routines at odd times, causing expensive delays and rework. The plant engineer was quite certain that the problem couldn't be power related because the robot shared a dedicated line with other electronics on the plant floor, and a power conditioner was installed at the subpanel to insure that the line was protected from transients. Still, he made a visual inspection to confirm that no new equipment had been added to the floor, then he called the robot's manufacturer.

The manufacturer came out and checked the robot while the plant was on break. It operated perfectly. The technician suggested that the problem might be caused by power problems. After discussing the situation, they decided to install a power line monitor and monitor the current just upstream from the robot. As the plant swung back into operation, the monitor printed the graph shown here in Figure 12.

The graph indicates that a motor load was added to the circuit. The current peak in the signature is a result of the starting current of the motor. The level at the right end of the graph is the running current.

After a more thorough investigation, the plant engineer found that in fact a new compressor with a larger motor had replaced an older compressor. The power conditioner protecting the "dedicated" line wasn't sufficient to handle the new motor's inrush current.

In this case the plant engineer solved the problem by moving the compressor to another circuit.

Case study 2

In Australia, a technician was called into the Eastman Kodak Company to investigate a problem with the computer system. About 12 times a day the system would lose data. It would take the company 15 to 20 minutes to rebuild files each time this occurred.

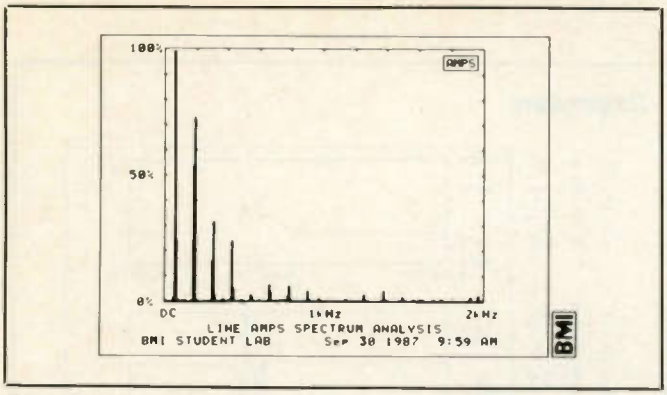

Figure 11.

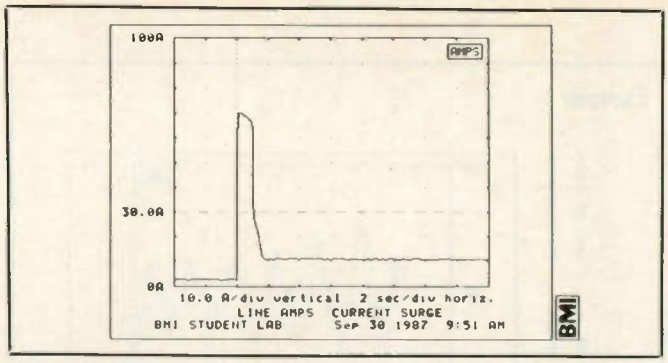

Figure 12. When a robot in an auto as sembly plant began missing routines, the current on the line to which it was connected was monitored. The graph showed that the problems were caused by a current surge originated by a motor on that line.

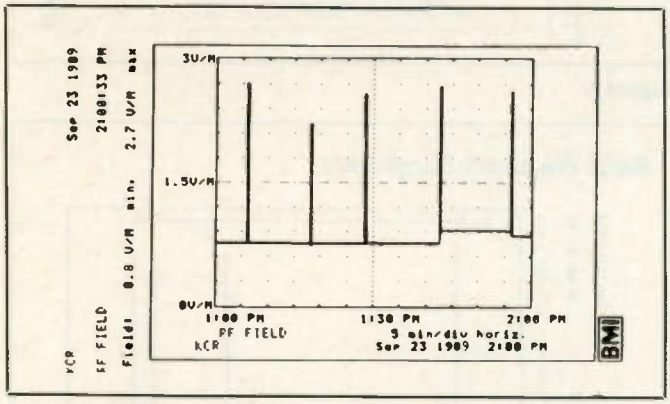

Figure 13. Problems with a computer system in a manufacturing plant prompted a consultant to monitor the area for radio-frequency interference. An evaluation of the graph led to an interesting solution. See text.

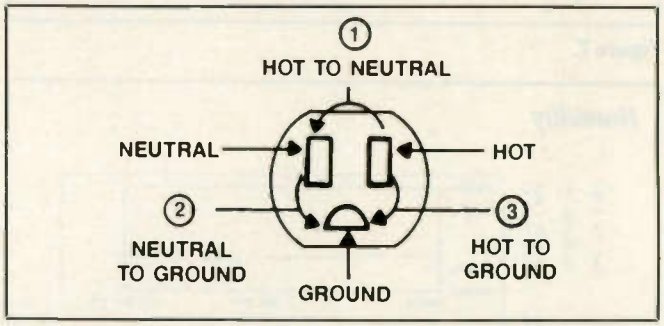

Figure 14. Surges that occur between any two of the three lines; hot, neutral and ground coming in to a facility can cause damage to electronic equipment, but not all surge protectors protect across all lines. Surge protectors with protection from hot to neutral, neutral to ground, and hot to ground provide the greatest degree of protection.

Surge protector features to consider

- UL 1449 rating of not more than 400Vpp
- Protection from hot to neutral, hot to ground and ground to neutral
- EMI/RFI filtering
- Phone line protection
- Listing under UL 1449, and CSA
- Listing under 497A

The facility engineers on site had investigated and thought that the problem was that the system was power starved. They purchased an expensive UPS system, but still the problem continued . . . but only on dry days.

The technician, an electrical consultant, had experience with radio frequency interference. He came in and connected a power monitor with RFI probe in the computer room. He noted regular bursts of interference that correlated with the computer's data loss. Now, where was the interference coming from? See Figure 13.

Using other equipment, he found the interfering frequency and called the Department of Communications to find out who was assigned that frequency. The answer came back: Phillip Harbor Port Authority. This was interesting. They were miles away - too far for the frequency to carry and create the intensive bursts he had detected.

The technician went out with his RFI probe. Radio waves seemed to emanate from the residence across the street. As he got closer the detector showed stronger signals from one side of the house - near the roof - coming from the rain gutter. In fact, this one had rusted almost in half. The remaining portions apparently had the same resonant frequency (on dry days) as the Port Authority's communications. The rain gutter was acting as an antenna aimed right at Kodak's computer.

The computer hasn't lost a byte since they replaced the rusty rain gutter.

UL 1449: The new standard in power protection

Until recently, there was no universal standard to go by in selecting a surge protector. You had to make choices based on hard to understand technical specifications that had little to do with the performance of a surge protector. Then, in 1988, Underwriters Laboratories, Inc. (UL) conducted independent tests of leading surge protectors and developed a new standard for surge protection called UL 1449. The new UL 1449 Standard objectively measures the amount of voltage that can pass through a surge protector after clamping has occurred. The lower the voltage that gets through after clamping occurs, the more effective the protection.

UL 1449 is a mandatory test for all surge protection manufacturers who desire the UL listing. A UL 1449 rating of 400Vpp assures the user that the final voltage appearing at the ac inputs of your equipment is limited to a safe level. The lower the rating, the better the protection. For example, a surge protector with a UL rating of 400Vpp provides better protection than that of another surge protector with a UL 1449 rating of 500Vpp or more.

Phone line protection

Surge protectors used to protect electronic equipment from surges on the ac power line act by clamping the voltage level to some specified value when a surge occurs, therefore limiting the voltage that is applied to the ac inputs of the unit.

If lightning strikes near a telephone line, or if any of a number of other phenomena occur, it is possible to have a surge on the telephone line. If that line is connected to a computer, fax machine, or any other electronic equipment, that surge could do serious damage to the equipment.

For that reason, manufacturers of ac-line surge protection also offer phone-line protection products. In some cases, phone-line and ac-line protection are built into the same package. In other cases, they may be offered separately. Whether the phone-line protection is provided in conjunction with ac power protection, or separately, it is housed in a package that plugs into a standard ac wall outlet and uses the ac line ground. If a surge that is above the level designed into the surge protector occurs on the phone line, the protection circuitry senses it, and shunts the signal to ground.

Unlike surge protectors that protect the equipment connected to the ac line by clamping the ac voltage to a safe level, phone-line protectors only use the ac outlet connection as a place to connect to ground. Because of this difference in design and construction, UL has developed a separate testing procedure for phone-line equipment, and calls the standard UL 497A.

EMI/RFI filtering

Another problem that enters electronics equipment via the power line is electromagnetic interference (EMI) and radio frequency interference (RFI). This kind of problem may be picked up along the way by the power line and introduced from outside, or it may be generated right within the same home or office building by such equipment as motors, copying machines, and so forth. This kind of interference can, in time, cause damage to electronics equipment connected to the power line, or in the case of computers and computer-based equipment, it can cause loss or corruption of data. ■

Servicing infrared remote controls

By Conrad Persson

A fact of life with today's crop of TVs, VCRs, stereo amps, CD players, in fact just about every electronic product aimed at the consumer is a remote control. And just as with all the rest of the circuitry associated with modern consumer electronics products, they are reliable. However, remote controls add another level of complexity to an already complex product, and a little more difficulty for the servicing technician.

Just as with any other part of the circuitry of a consumer electronics product, troubleshooting can be made easier through an understanding of how the circuits work, and with the aid of a methodical troubleshooting procedure. This article will provide you with a little of both.

The infrared remote

Take a look at Figure 1, for a simplified block diagram of the infrared remote transmitter/receiver pair. When the viewer presses one of the buttons on the hand-held remote unit, the remote's circuitry creates a pulse train that represents a binary digit. The appearance of the pulse train will be different for each of the buttons pressed.

The pulse train is applied to the infrared LED, which converts the electrical signal into invisible infrared light. If the remote control is aimed properly at the front of the set, this series of light pulses will strike the PIN diode there. The PIN diode will in turn convert the series of light pulses into a pulse train that's a replica of the one produced by the remote control. This series of pulses will be shaped as necessary, then sent to a decoder which converts the series of pulses into a signal that is used to effect the desired action: Turn the set on, turn the set off, change channels, turn the volume up or down, or whatever other function was selected.

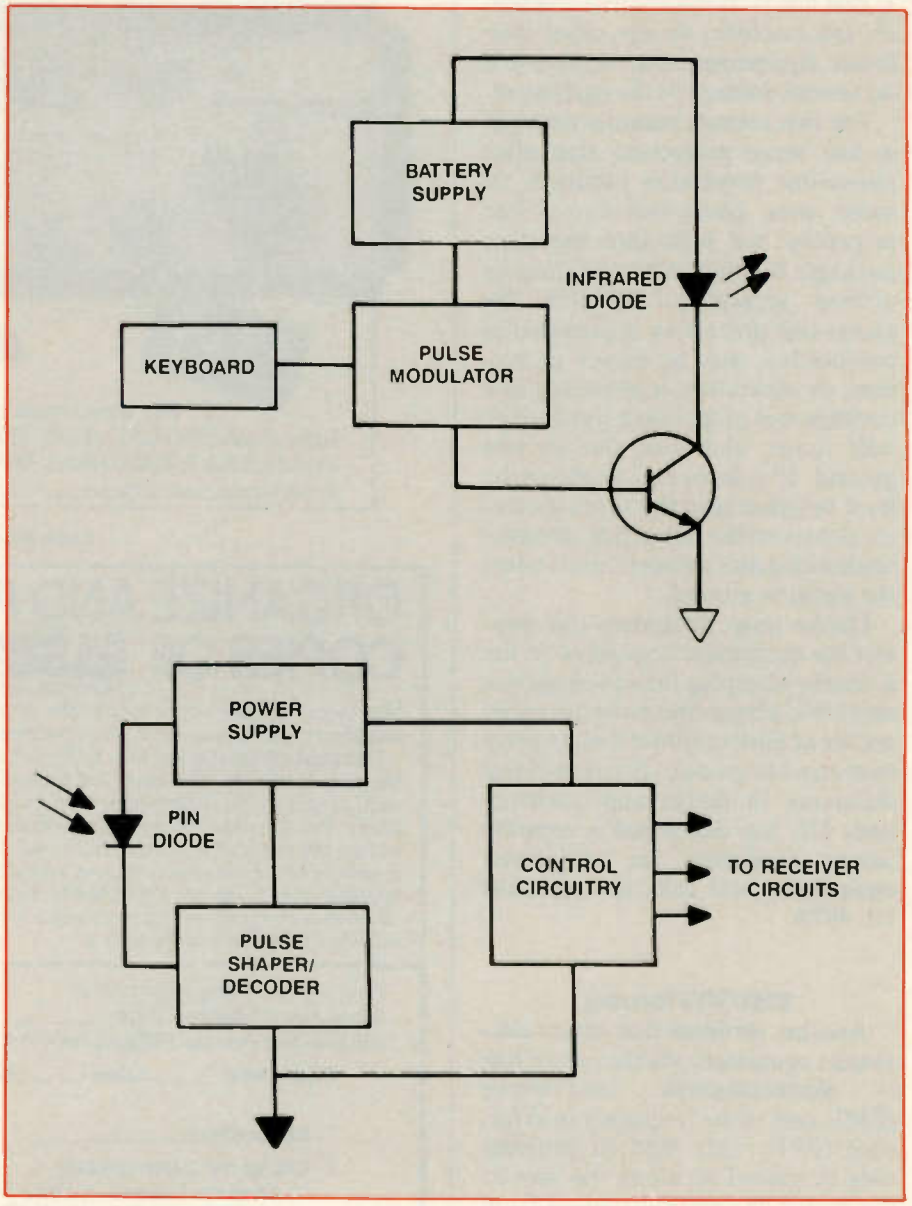

Figure 1.

The remote control code

One of the reasons that remote controls work only with the products that they come with is that different manufacturers use different coding systems. Because the infrared remote control signals are encoded in some kind of binary system, the different elements of the signal must in some way represent 1s and Øs. The pulse code shown here in Figure 2 is for a

Persson is editor of ES&T.

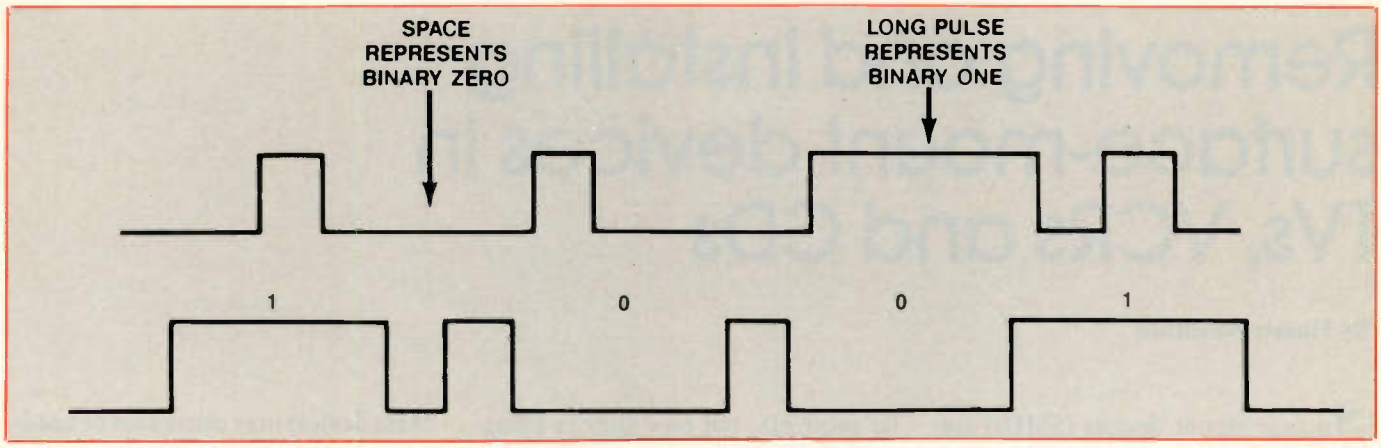

Figure 2.

system manufactured by Fisher. In this code, a wide space represents logic Ø, while a wide pulse represents a logic Ø.

In a consumer electronics product, there are two different general kinds of function that are needed to operate the unit: momentary functions and continuous functions. For example, when you want to turn the set on or off, you need only a single signal to the on/off circuitry. If you sent the on/off signal continuously, the set would simply continue to turn on and off. On the other hand, sometimes it is desired to send a continuous signal; for example, when you want to increase the volume, or change the channel up or down.

The desirability for having both of these types of signal has led manufacturers to incorporate both types in the remote control. Figure 3 shows how this is accomplished. Keys 1 and 2 connect the pulse control circuitry to T_1, which causes a single burst of the pulse to be transmitted. Keys 3 and 4 connect the pulse control circuitry to T_2, which causes the generated pulse to be transmitted continuously, until the viewer releases the remote key when the volume is loud enough, or he has counted up to the desired channel.

Here are some steps to follow in servicing of remote controls:

1. Replace the battery and try it. Most remote control problems are the result of a weak battery.

2. Clean off both transmitter and receiver with an approved cleaner and try it again. Any dirt that's introduced into the visible transmission path between the remote and the set being controlled, especially if in conjunction with a poor signal caused by a weak battery can cause problems in reading the signal.

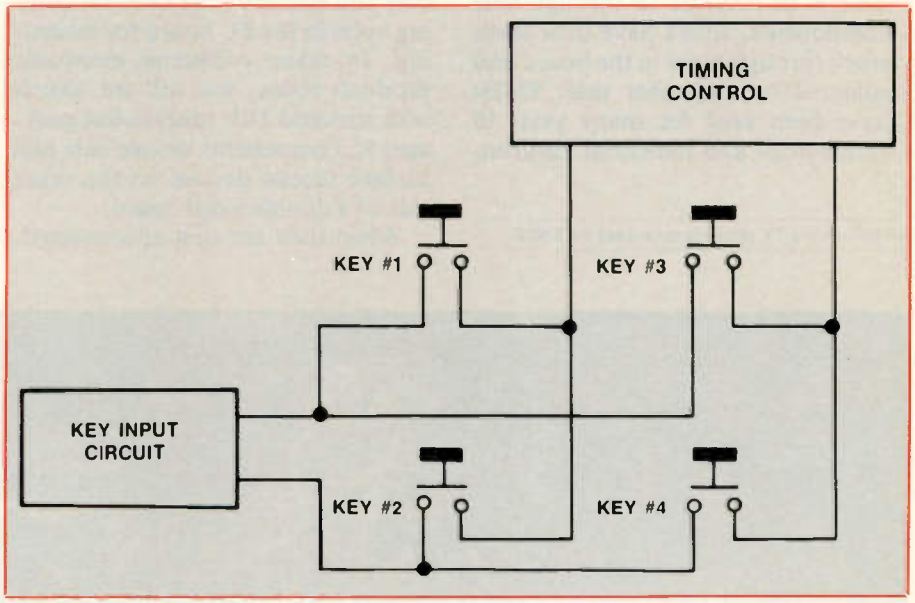

Figure 3.

3. Bring the remote closer to the set. If this results in operation, you know at least that the system works.

4. Try the transmitter near the antenna of an AM radio, or use an IR sensitive card. When a remote control infrared diode is pointed at the am antenna of a radio when the radio is tuned to an unused portion of the am band, if you hear a pulsating sound, you know that the transmitter is operating.

5. Check the output of the sensor diode when activating the transmitter. If you see a train of pulses here, the transmitter and the PIN diode in the receiver are working. The problem is most likely in the amplification/decoding circuitry, in the remote receiver/tuner interface, or in the tuning section.

6. Substitute a known-good transmitter.

7. Keep in mind that some sets have to be manually turned on before the remote control will operate the set. ■

Removing and installing surface-mount devices in TVs, VCRs and CDs

By Homer Davidson

Surface-mount devices (SMDs) are those tiny components and ICs that are soldered directly to the circuit traces on the surface of the pc board. This is in contrast to through-hole components, which have their leads stuck through holes in the board and soldered on the other side. SMDs have been used for many years in commercial and industrial electronics products, but now they're being used more and more in TV sets, VCRs, camcorders and compact disc players. SMDs save space, reduce cost and eliminate the need for drilling holes in the PC board for mounting. In many consumer electronic products today, you will see boards with standard DIP (dual-in-line package) IC components on one side and surface mount devices on the other side of a double sided board.

When they are first encountered, these devices may cause a lot of headaches for the electronic technician, in the same way that the change from the vacuum-tube chassis to solid-state required consumer electronic servicing technicians to change their servicing techniques. It takes steady hands, little thumbs and a lot of patience to remove and replace surface mounted devices.

Actually, the surface mount devices are electrically identical to their counterparts in more traditional

Davidson is a TV servicing consultant for **ES&T**.

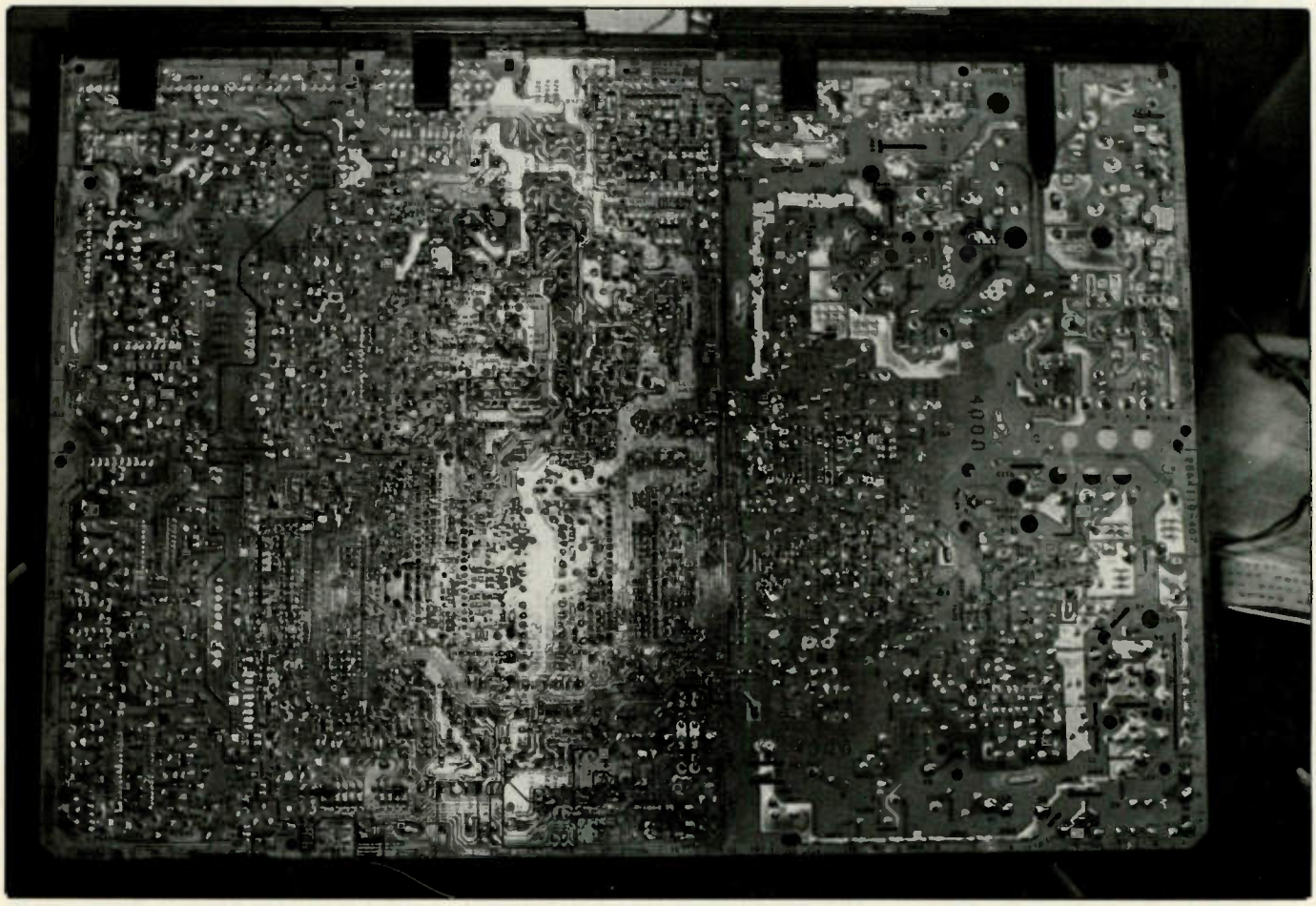

Figure 1. Here is the bottom side of the RCA CTC 140 TV chassis with many surface mounted devices.

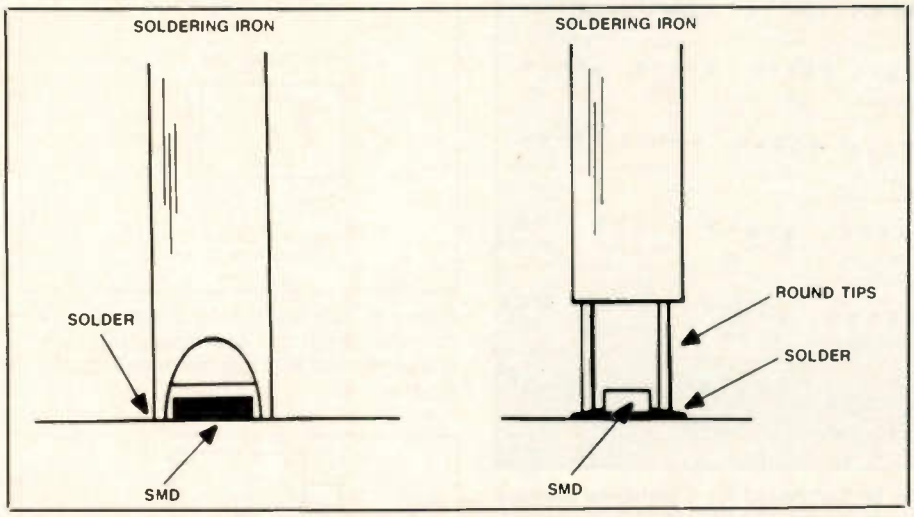

Figure 2. Special soldering and temperature controlled equipment is needed to easily remove and replace SMD components. Special soldering tips are used to straddle the SMD part.

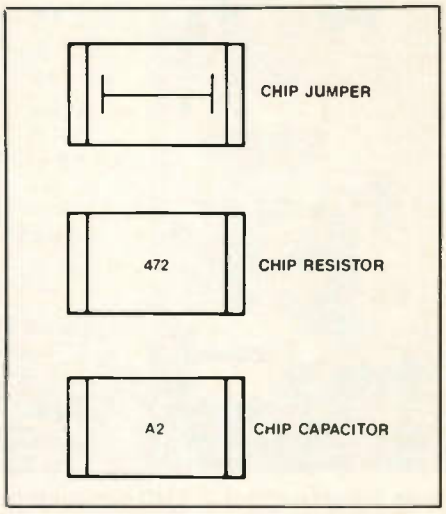

Figure 3. The markings of the fixed passive SMD components.

packages, and the operation of the circuits that they're used in do not change. The only difference is that the SMD components are greatly reduced in size. When you examine the RCA CTC 140 chassis, the transistors and resistors look like small rectangular pieces of black rubber (Figure 1). Taking a closer peek reveals brown pieces which are fixed capacitors. The surface mount jumper looks like any other SMD, except that a marking on the body identifies it.

Basic tools required

Many consumer electronics servicing technicians already have most of the required tools at the service bench: a good pair of needle nose pliers, forceps, stainless steel tweezers, hand-held magnifying glass and lighted magnifying lamp, sharp metal picks, 25W to 35W sharp point soldering iron or a controlled heat iron, desoldering braid, sharp wooden dowel and tooth picks. When you're taking voltage readings, or looking at signals on the oscilloscope, even the test probes should be changed to a needle nose point or ground down to a fine point.

Applying test probes to a minuscule component terminal without shorting it to the adjacent terminal requires correct equipment. The proper small soldering iron tips or special temperature-controlled soldering equipment is a must for efficient removal of surface mount components (Figure 2). These soldering iron tips straddle the SMD, loosening solder on both sides of the device at the same time to remove the terminal. The temperature control should fall between 350 and 600 degrees.

Circuit precautions

It has always been good practice to treat printed circuit boards carefully; not dropping or banging them and being careful not to flex them excessively. With SMDs, care in handling is of paramount importance. Circuit boards containing SMD devices should not be bent or flexed. Simply pulling the board over a rough work bench could damage the small components. You must be careful when using hot air and spray coolant so not to damage components or soldering terminals which could result from excessive expansion and contraction. Coolant spray could generate electrical charges that might damage SMDs.

Handling electrostatic discharge (ESD) sensitive devices

Many surface mount devices, processors and microcomputer IC's are classified as ESD sensitive devices. Insofar as static electricity is concerned, treat these small components just as you would those large IC processors found in the TV chassis. Handle all ESD sensitive devices in a static-free work place. Use a conductive work mat and a wrist strap with everything grounded together. Use only a grounded-tip soldering iron or antistatic type temperature control soldering equipment.

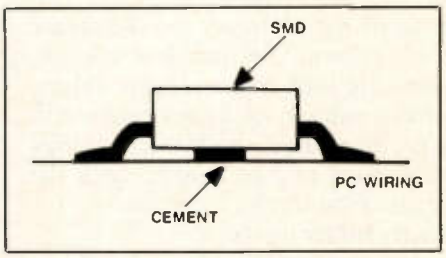

Figure 4. Many small components have glue or epoxy under the original component.

When applying test equipment to the SMD component, touch the probes to the conductive mat before touching the component. Keep ESD sensitive components in their protective envelopes until you're ready to solder them into the circuit. Make sure the TV chassis is unplugged from the power line before installing the ESD sensitive devices.

Circuit isolation

Because the solder connection between the SMD and the printed circuit board is flat, and the lead does not pass through the board, many problems in surface mount circuits may be traced to the simple problem

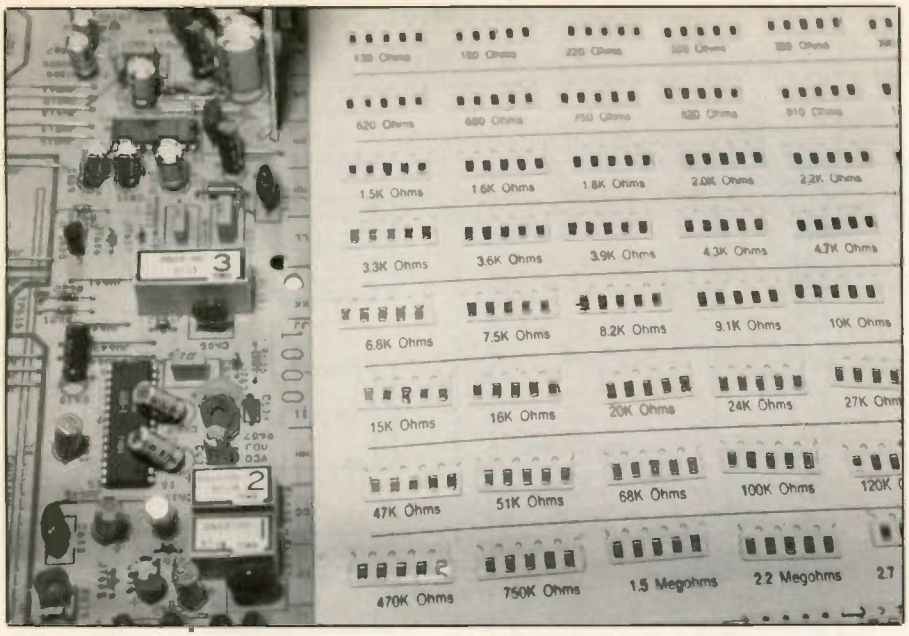

Figure 5. Replacement of SMD components may be purchased for a particular chassis from the manufacturer. This card contains SMD parts for the RCA GPR 2639 P TV chassis.

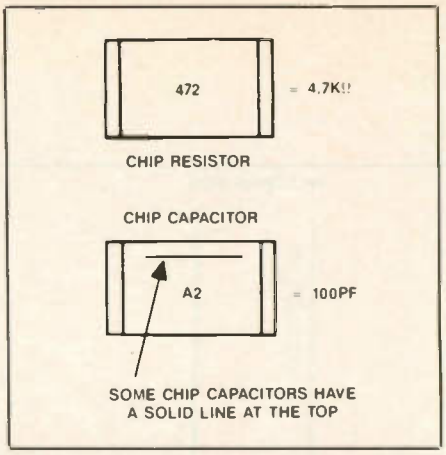

Figure 6. The surface-mounted chips of ceramic resistors and capacitors are marked on top with dashes, numbers and letters.

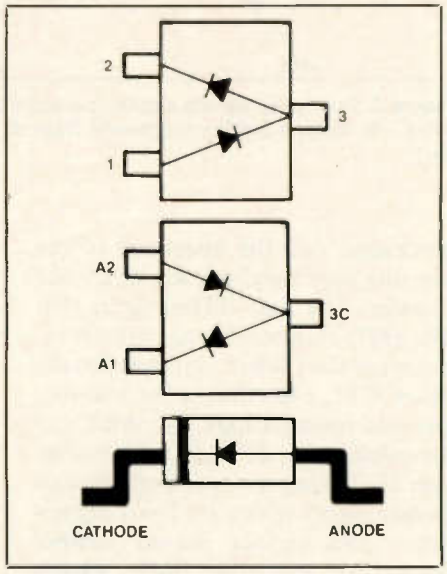

Figure 7. SMD diode identification.

of bad connections. Improper tinning of the pc traces can aggravate this problem. Because bad connections are such a prevalent problem, after troubleshooting any problem in a product based on SMD technology to an area of a pc board, check the areas around the components for faulty solder joints.

Use a magnifying lamp for closer visual inspection. You can't see the separated joints, poor connections or broken components with the naked eye. Remember, some of these SMD components will be, by design, a direct short across the terminals, indicating a chip jumper or extending the circuit. These chip jumpers are marked on top with a dead-end line (Figure 3).

Chip resistors and capacitors

Chip devices, also known as leadless chips, are constructed with no leads and only end type connections. The fixed resistor or capacitor contains soldered ends so they will mount directly upon the PC wiring. Keep in mind that most chip components are glued to the pc board in order to hold them in place before and during wave soldering. This is a specially formulated glue that will fracture easily when stressed (Figure 4).

The leadless resistor is made of a resistive material on a ceramic base. Each end has a leadless solder connection. The chip capacitors are made up of layers of ceramic dielectric material with layers of conductive film sandwiched between. The capacitance is determined by the many layers of conductive film and insulation. Again, each end has a leadless soldered connection. The leadless or metal-electrode free bonding resistor may have a round body instead of flat type mounting with circular metal end electrodes.

The surface-mount chips of ceramic capacitors and resistors are marked on top with dashes, numbers and letters. More than one resistor may be found in a package. Often, many of the manufacturers will show the markings of the SMD devices and part numbers. Always, replace the chip with exact manufacturers part number, since it is the right size, will fit exactly as the original and is of the correct value. Here is a card containing the various SMD resistors for the RCA GPR 2639 P TV chassis (Figure 5). An example of the standard value codes for chip resistors and capacitors is found in Figure 6.

Chip diodes and transistors

Surface-mount transistors and diodes may look alike when viewed from above the printed circuit board. Sometimes the diodes are marked to identify the cathode terminal. More than one diode may be found inside one component package, with different terminal connections (Figure 7). These diodes are easily tested using the diode-test function of the DMM.

Chip transistors may have gull wing or flat type soldered tabs. You may find a heat sink tab on some transistors. The gull wing connections are so called because they come out of the body of the transistor and bends downward then outward, while the flat tab terminal solders directly to the board wiring.

In compact disc players and camcorders, you may find switching type transistors, the type used in digital logic circuits. These transistors have base and bias resistors in the same package (Figure 8). Replace these NPN and PNP type transistors with the original part numbers.

Integrated circuits

SMD IC's may have gull wing leads or flat type connections. In consumer electronics products, these

ICs ordinarily will be packaged in one of three different types of package: a small-outline integrated circuits (SOIC), the flat pack, or the plastic leaded chip carrier (PLCC). Look for a round white dot on top of the package indicating terminal one. The IC or microprocessor inside the package will be identical to its counterpart in a standard IC, package (Figure 9). You may find the identification dot on the end or in the middle of the flat SMD IC. It's important to be extremely careful when making voltage measurements on these SMD IC's to avoid shorting out adjacent terminals.

Before removal

Before attempting to replace a SMD, be absolutely certain that it is defective. Because SMDs are delicate, the heat and physical abuse that they experience during removal will most likely destroy them if they were good to begin with. Never put a surface mounted component that has been removed from a circuit back into service. It should be considered useless. Throw it away. As with any other circuit, check all resistors, capacitors and diodes connected with the suspected semiconductor component. Take critical voltage and resistance measurements at the terminals of suspected transistor and IC SMD devices. Look for the supply voltage terminal of the suspected SMD IC or microprocessor and measure the supply voltage. Extremely low supply voltage may indicate a leaky SMD component or improper applied voltage from the power supply or source. Make sure that the probes you use to take these measurements have fine points that will not cause short circuits between adjacent IC terminals.

Removing SMDs

After locating the defective surface mount device, remove solder from the connecting terminals. With a fine point soldering iron, alternately heat both ends to remove some solder. Be careful not to damage the PC wiring (Figure 10). Desoldering braid may be used in conjunction with the iron to remove excess solder. A specially designed soldering iron tip may heat all tabs at once for easy removal.

Once you're sure that all solder bonds are either free of solder, or molten, grasp the part firmly with a pair of tweezers and twist to break loose the cement that was used to hold it in place during manufacturing.

Be very careful when twisting the part not to damage the PC wiring. Do not try to lift up the part unless the soldered bond is loose. Avoid using excessive heat, as this could lift the copper wiring from the PC board. Remove any remaining glue from the center of the mounting area to prevent breakage of the replacement.

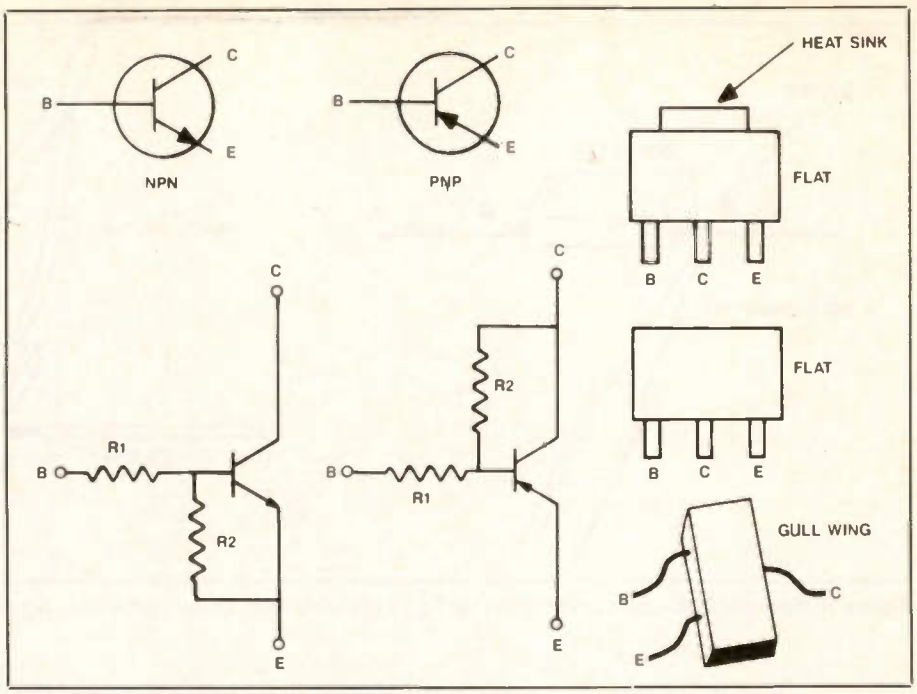

Figure 8. Linear and digital transistors may both be found in the camcorder and compact disc players.

To remove gull wing or tab components, apply heat to each tab and raise up the connection with a screwdriver blade or tweezers. Likewise, heat each terminal lead or tab of the IC or microprocessor and pull up. Before removing a package with multiple connections, make a mark on the PC board where the white dot is located, for reference when you're installing the replacement (Figure 11). Throw away all removed SMD components and install new ones.

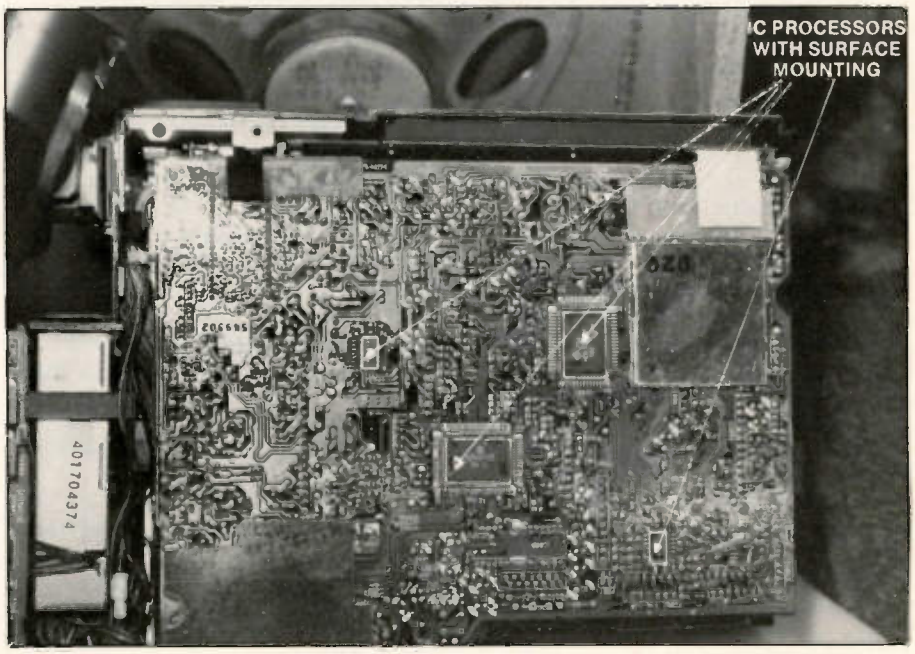

Figure 9. Look for the identification dot for pin number one on the SMD integrated circuit.

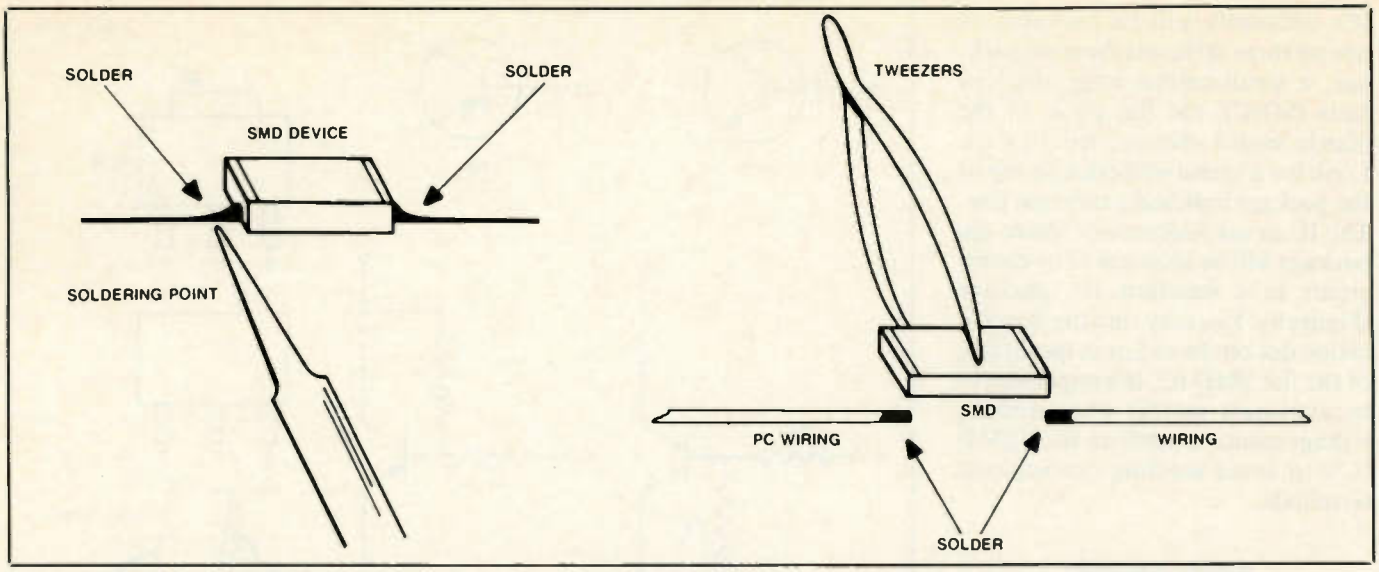

Figure 10. Remove SMD component with iron tip by applying heat to each side connection and twist off part with a pair of tweezers.

Installing SMDs

Before mounting a replacement SMD, make sure the bonds on the wiring are clean and not shorted together with solder. Remove excess solder with desoldering braid and the soldering iron. Tin each pad or wiring with a thin coating of solder. Be careful not to leave the iron on the soldered joint for more than a few seconds. Try to get each pad of melted solder at about the same size or height.

Remove the component from the protective package or container and place on the correct wiring pad with a pair of tweezers. Hold the part directly in place and align with the tweezers or wooden dowel. Make sure each terminal or tab is on the correct PC wiring pad. Apply solder to wiring and terminal. Tack in each side of the component. Now fill in each terminal connection with solder. Be careful not to touch the part itself with the iron. Do not leave the iron tip on too long or you may damage the copper wiring or the component.

With diodes, capacitors, transistors and IC's, make sure the polarity is correct and the white dot is in the correct place (Figure 12). Make sure that some solder is left on each terminal PC wiring. A small bead may be left to tack down the new terminal of the IC or microprocessor. It's best to tack down one terminal on each side before soldering up all connections. After all connections have been soldered, clean any solder bridges between two terminals with the iron and desoldering braid.

Testing and inspection

After the SMD component is soldered in place, use a hand-held magnifying glass to inspect the connection of each terminal. Run the edge of a pocket knife or metal point between terminals to check for sharp points of solder. If you suspect any two terminals of being shorted, make a contin-

Tip and tiplet care techniques

This information is taken from a fact sheet, "Tip and Tiplet Care Techniques," offered by Weller Division of Cooper Tools. The following are suggestions and preventive maintenance techniques to extend life and wettability of tips and tiplets.

1. Keep working surfaces tinned, wipe only before using, and retin immediately. Care should be taken when using small diameter solder to assure that there is enough tin coverage on the tip working surface.

2. Do not leave tips uncoated for any length of time (during lunch, breaks, change of shifts, etc.).

3. If using highly activated rosin fluxes or acid type fluxes, tip life will be reduced. Using iron plated tips will increase service life.

4. If tips become unwettable, alternately apply flux and wipe to clean the surface. Smaller diameter solders may not contain enough flux to adequately clean the tips. In this case, larger diameter solder, or liquid fluxes, may be needed for cleaning. Periodically remove tip from tool and clean with suitable cleaner for flux used. The frequency of cleaning will depend on the frequency and type of usage.

5. Filing of tips will remove the protective plating and reduce tip life. If heavy cleaning is required, use a polishing bar, available from soldering equipment manufacturers or distributors.

6. Do not remove excess solder from heated tip before storing. The excess solder will prevent oxidation of the wettable surface when the tip is reheated.

7. Anti-seize compounds should be avoided, because they may affect the function of the iron. If seizing occurs, try removing the tip while the tool is heated. If this fails, it may be necessary to return the tool to the manufacturer for service. Removing the tip from the tool on a regular basis will also help in prevent the tip from seizing.

8. It is best to use distilled water when wetting the cleaning sponge. The mineral content in most tap water will affect wettability.

9. Steps in preparing a soldering iron for storage after use:

A. Clean hot tip thoroughly with damp sponge.
B. Apply coating of solder to tip.
C. Turn unit off to allow tip to cool.
D. Put tip away in proper storage or in iron holder.

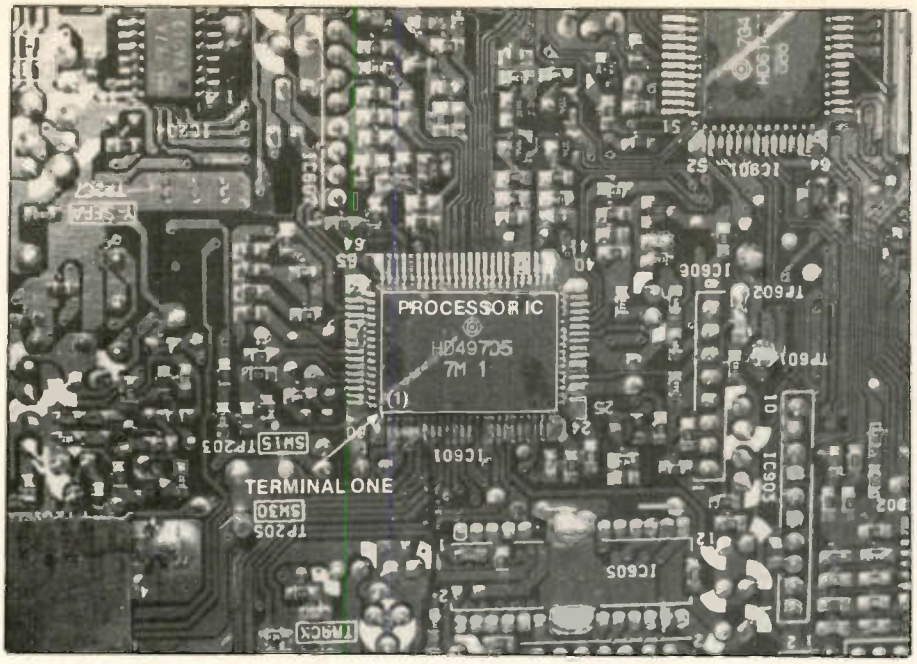

Figure 11. Close up view of a microprocessor found in the camcorder. Check the terminal one for replacement and volt-age measurements.

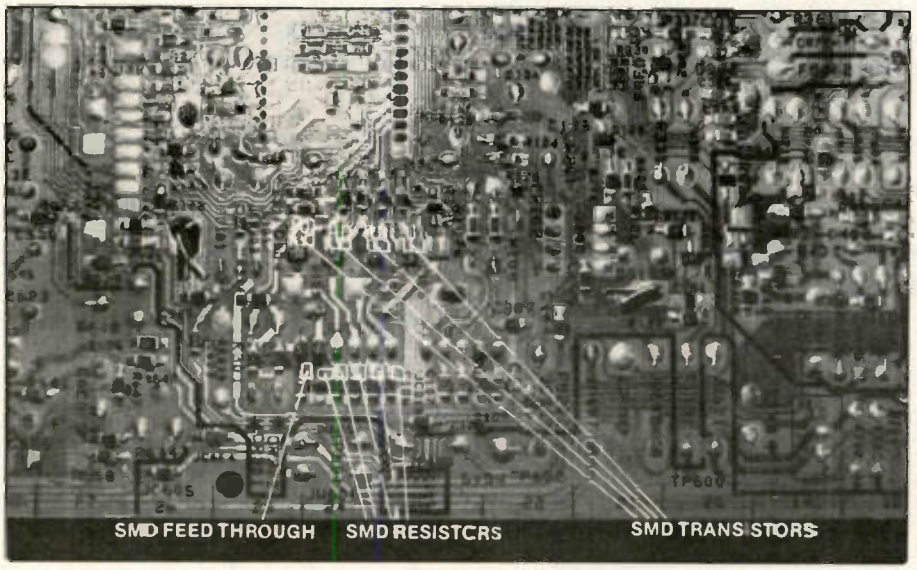

Figure 12. Camcorder PC board with several ESD sensitive devices.

uity measurement to be sure. Make a resistance measurement between terminal and common ground for possible leakage. Inspect each connection just once more for poor or cold soldered joints. Careful touchup with a hot tinned soldering iron, or if necessary desoldering braid, should remove any remaining solder bridges.

Conclusion

Although, there are some SMD components available by other suppliers, it's best to replace each component with the correct part number. Make sure the SMD transistor is an NPN or PNP and regular type or digital transistor for replacement. Handle all ESD sensitive devices with extreme care. Remember, the SMD resistor or capacitor may be flat or cylindrical type component.

There are many different soldering devices and temperature control equipment on the market. The soldering device with temperature control is ideal in removing and replacing SMD components. Large soldering irons and solder guns are out of the picture. Spraying cleaning fluid or coolant practices should be eliminated. Above all, removing and replacing SMD components requires a lot of patience. ■

Coming Soon In:

ELECTRONIC
Servicing & Technology

1. Servicing LANs—more and more offices are installing local area networks to allow several computers to share data. Consumer electronics service centers that have computerized and have more than one computer connected together for tracking products through the facility are using a LAN. This article will describe the use of traditional test equipment, as well as some newly developed special-purpose test devices to diagnose and correct problems in LANs.

2. Troubleshooting start-up and shut-down circuits—this article is full of references to the use of oscilloscopes, multimeters, isolation transformers, signal generators, soldering and desoldering techniques, and replacement components. This should be a great background against which test equipment and replacement component suppliers can effectively advertise their products.

3. Servicing Zenith microcomputers Part 9—Serial and parallel communication describes the operation of this portion of the computer's circuitry and looks into some of the fault modes, what might cause these faults and how to deal with them. **ES&T** readers who have responded enthusiastically to this series of article on servicing the Zenith computer (an IBM compatible unit), are still new to servicing computers and are constantly looking for sources of supply parts, information on computer-specific test equipment and technical servicing information on manuals This should be a powerful medium in which manufacturers of computer test equipment, replacement components and other computer related products might advertise.

4. Operation and application of Triacs, SCRs and related components—When asked what their two biggest problems are, the readers of **ES&T** respond overwhelmingly that finding servicing information and finding sources of replacement components are their biggest problems. These three articles that deal with three aspects of components will address those problems each in its own way.

Servicing Zenith microcomputers

Part Eight: The Hard Disk Controller Card

By John Ross

In the October issue, we discussed the electronic circuitry needed to control the transmission of data to and from the floppy disk drive, as well as the relationship between that circuitry and the microprocessor. This month, the discussion moves to a somewhat related topic — the hard disk drive controller. On the surface, the relationship seems simple. Both controllers govern the operation of a mechanical device that reads and writes data. Indeed, some functions of both cards bear more than a passing resemblance. Nevertheless, because of the differences in the two types of disk storage media types, there are new signal types on the hard disk drive controller.

Ross is a technical writer and a microcomputer consultant for Ft. Hayes State University, Hays KS.

The hard disk drive controller

Figure 1 depicts the circuit layout of the hard disk drive controller. Like the other cards used in the 158-series of Zenith microcomputers, the hard disk drive controller card plugs into the bus connector slots found on the backplane. When you encounter a hard-disk drive problem, preliminary fault diagnostics should include checking the card to make sure that

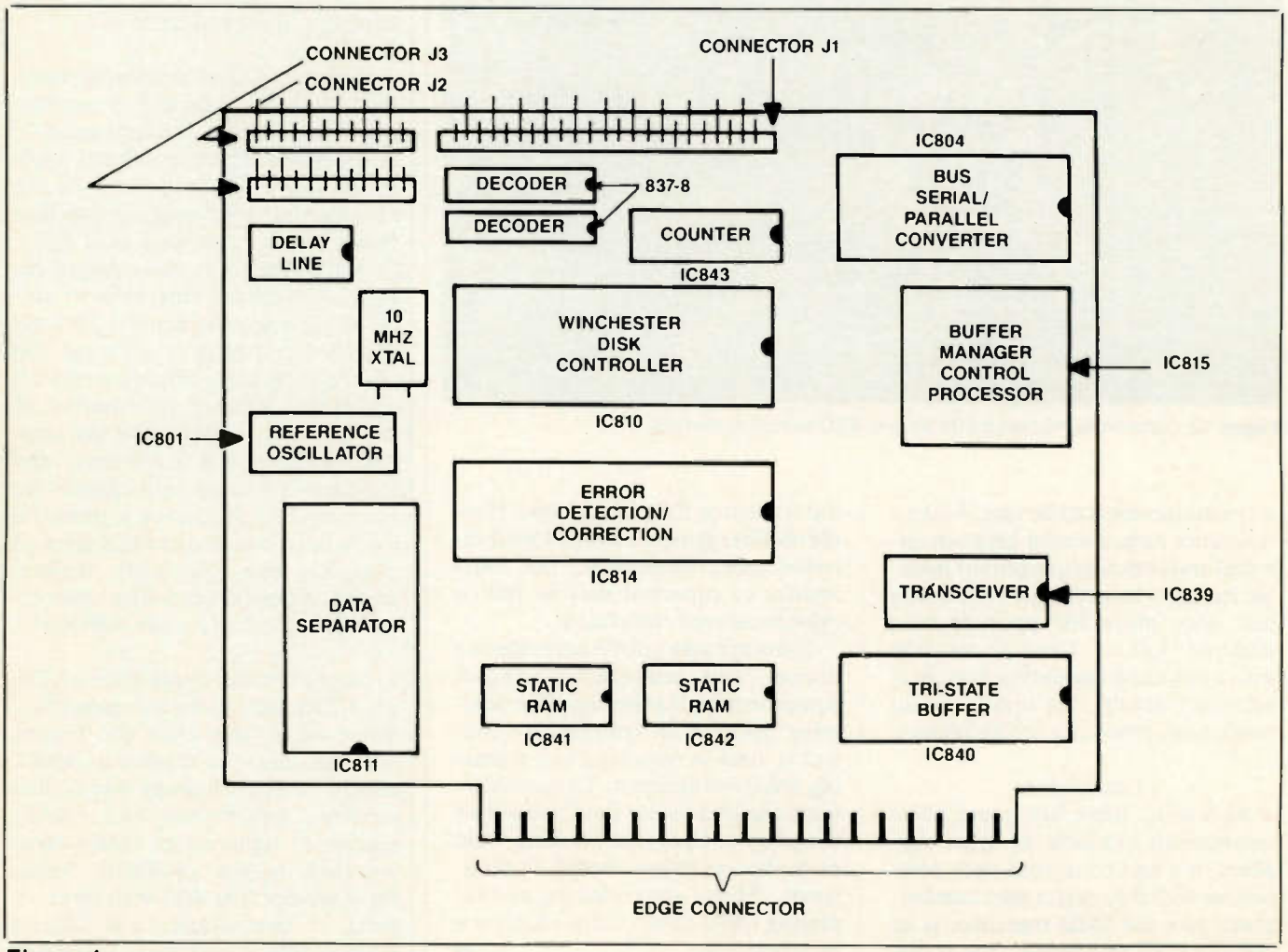

Figure 1.

it's properly seated into the bus connector slot and checking the power supply voltages. Five-volt and twelve-volt supplies provide the operating voltages for the card. In the hard-disk controller, as with the floppy disk drive controller, an on-board microprocessor, IC815, communicates, via the system input/output bus, with the central processing unit. In addition, this eight-bit control processor receives and sends the command and status information. Controlling firmware within the processor provides all command processing, decoding, error correction, self-diagnostics and read/write control.

Control signals from the microprocessor fall into three broad categories: 1. data transfer signals, 2. status signals, and 3. non-data transfer signals. One way of looking at the non-data transfer signals, perhaps with the exception of the format commands, is as controller card internal signals. While the manufacturer provides listings on the interface connectors for the data transfer and status signal, there are no listings for the non-data transfer signals. Those two connectors, located on the upper edge of the card, tie the control signals to the hard disk drive. As we progress through this article, we'll break those broad categories into more specific descriptions.

Looking at each broad category of signals simplifies the operating theory of the controller card. Figure 2 shows a representation of the signal action found on the hard disk controller card. Naturally, data transfer signals involve operations such as reading and writing data to a sector buffer on the hard disk drive. Commands such as all the self-diagnostics, recalibrate, format disk drive, read verify and seek, make up the non-data transfer category. Status signals include the request sense status, selection status, write fault, seek complete, index, ready and track 000 signals and appear at the Winchester disk controller integrated circuit.

As mentioned, the MFM Write Data and Read Data signals fit into the data transfer category. Any transfer of data takes place on two pair of balanced differential lines.

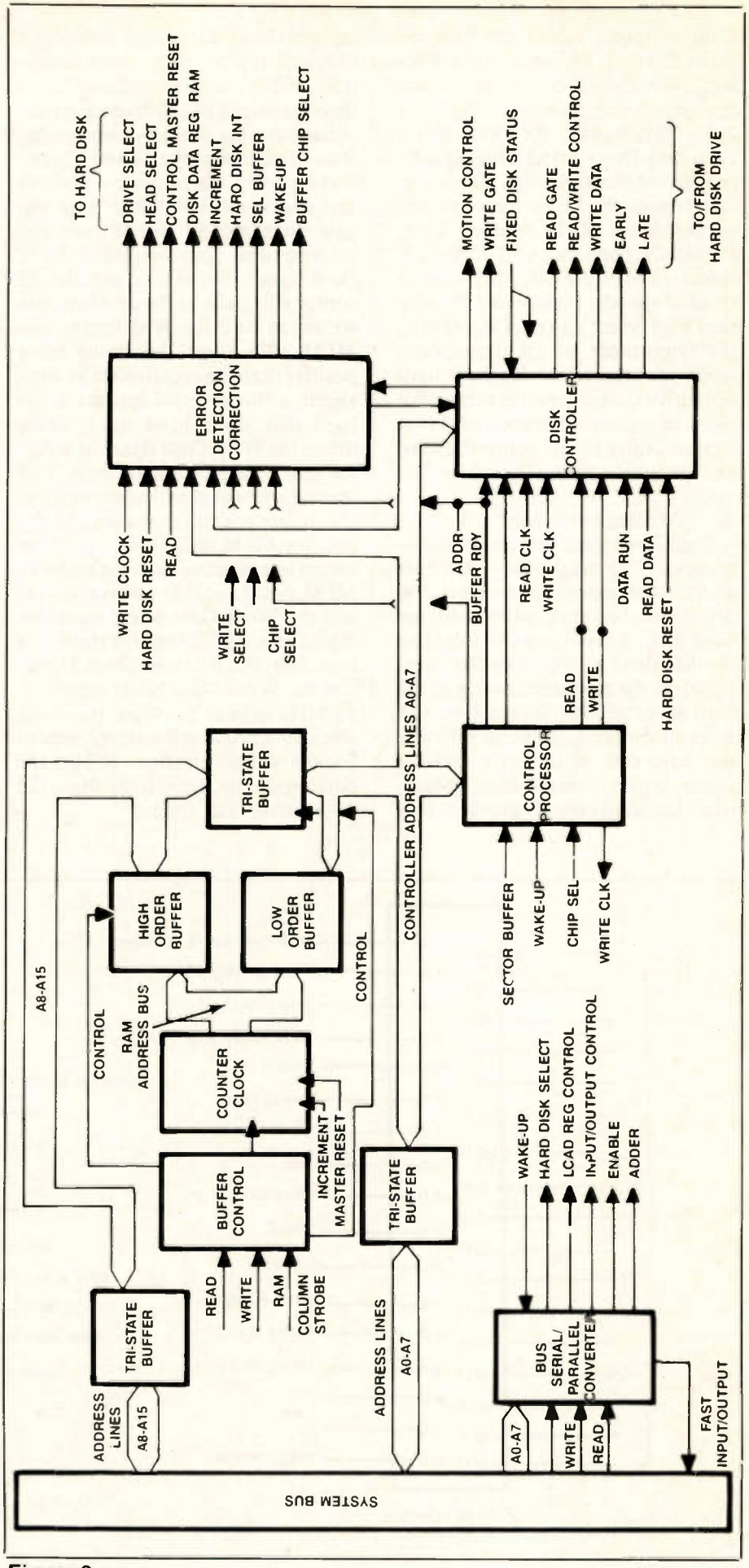

Figure 2.

Control signals, such as the Reduced Write Current, Write Gate, Head Select, Step and Direction signals, on the other hand, flow on multiplexed lines. Two signals, the Drive Select Zero and Drive Select One signals, trigger the multiplexing. These signals trigger the input receivers and output drives of the selected drive. Physically, connectors J1, J2 and J3, shown in Figure 3 carry the various types of signals. Pins 26 and 28 carry the Drive Select signals. Considering the importance of all the signals, when you start to troubleshoot hard disk drive controller errors check for both the proper connection of the interface cables to the controller card and for breaks within the cables.

Writing to the hard disk

Data flows from the system microprocessor, through the controller and the connectors to the hard disk drive and becomes written to the hard disk. Encoding of the data to the disk drive appears as polarity reversals in the magnetic coating of the hard disk. IC810, Winchester disk controller integrated circuit provides the drive control interface and the sector buffer control logic. Moreover, the controller IC provides timing and the data protocol conversion required for the read/write operation. IC801, a reference oscillator, determines the phase reversal of the voltage during the write operation. Pins 13 and 14 of the J2 and J3 connectors carry the respective positive and negative MFM Write Data signals while pins 17 and 18 carry the positive and negative MFM Read Data signals. Write data signals will continually pulse as the data becomes written to the drive. With the positive MFM write signal becoming more positive than the negative MFM write signal, a flux reversal appears at the hard disk drive head track which drives the Write Gate signal to a digital active state or a logic zero. This Write Gate signal will again pulse as the write operation occurs. If the positive MFM write data signal becomes less positive than the negative MFM signal, no flux reversal occurs and the Write Gate Select signal remains at a digital inactive state or a logic one. Pin 6 of connector 31 carries the Write Gate Select signal. A 10-MHz crystal provides the write clock synchronization signal needed for the write operation. IC811, the data separator, conditions the serial data for the disk drives.

Additionally, another signal called the Reduced Write Current signal flows through pin 2 of the same connector and causes the write circuitry to write data at a reduced current level. Like the floppy disk drive controller, the hard disk drive controller provides precompensation for the inner tracks to correct bit shift. Delayed data appears as early, nominal and late signal inputs at the data separator. As the drive writes to the inner track on the hard disk, the Reduced Write Current will swing to a digital "true" state. An inactive Write Gate Select signal leads to the other condition of data transfer signals—the MFM read signal.

Like the write data signals during the write operation, the read data signals continually pulse during the read operation. Figure 4 shows how the signal waveform shape and amplitude changes as the data becomes an input signal to the controller. Data recovered through the reading of a pre-recorded disk track flows to the controller through the differential lines of the connector. IC804, the serial to parallel converter, converts the original serial data to parallel

(Continued on page 37)

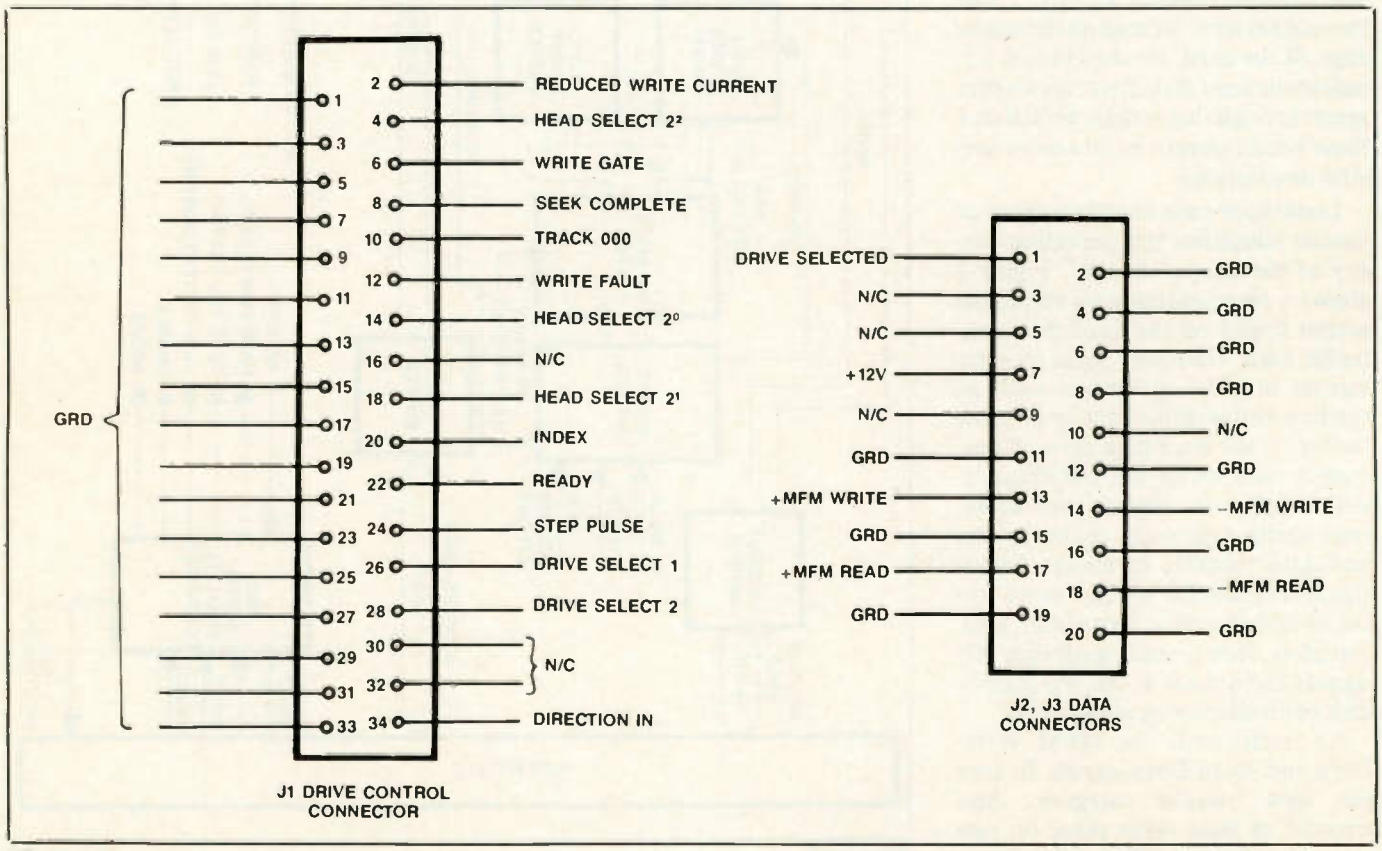

Figure 3.

ES&T Manufacturers' schematics **PROFAX**

November 1990

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SIGNAL CIRCUIT SCHEMATIC

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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.

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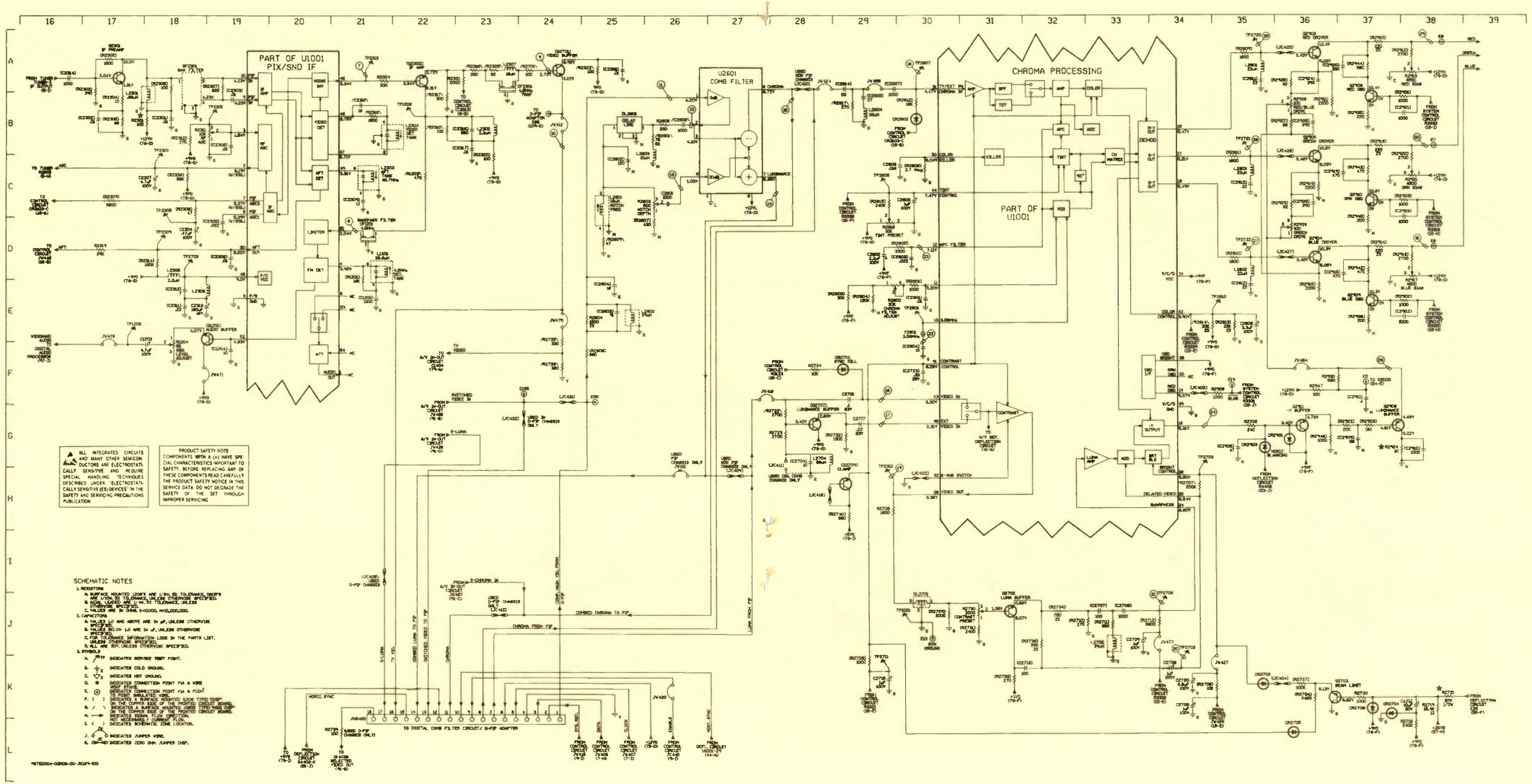

NOTE: Waveforms Located on 1-D1.

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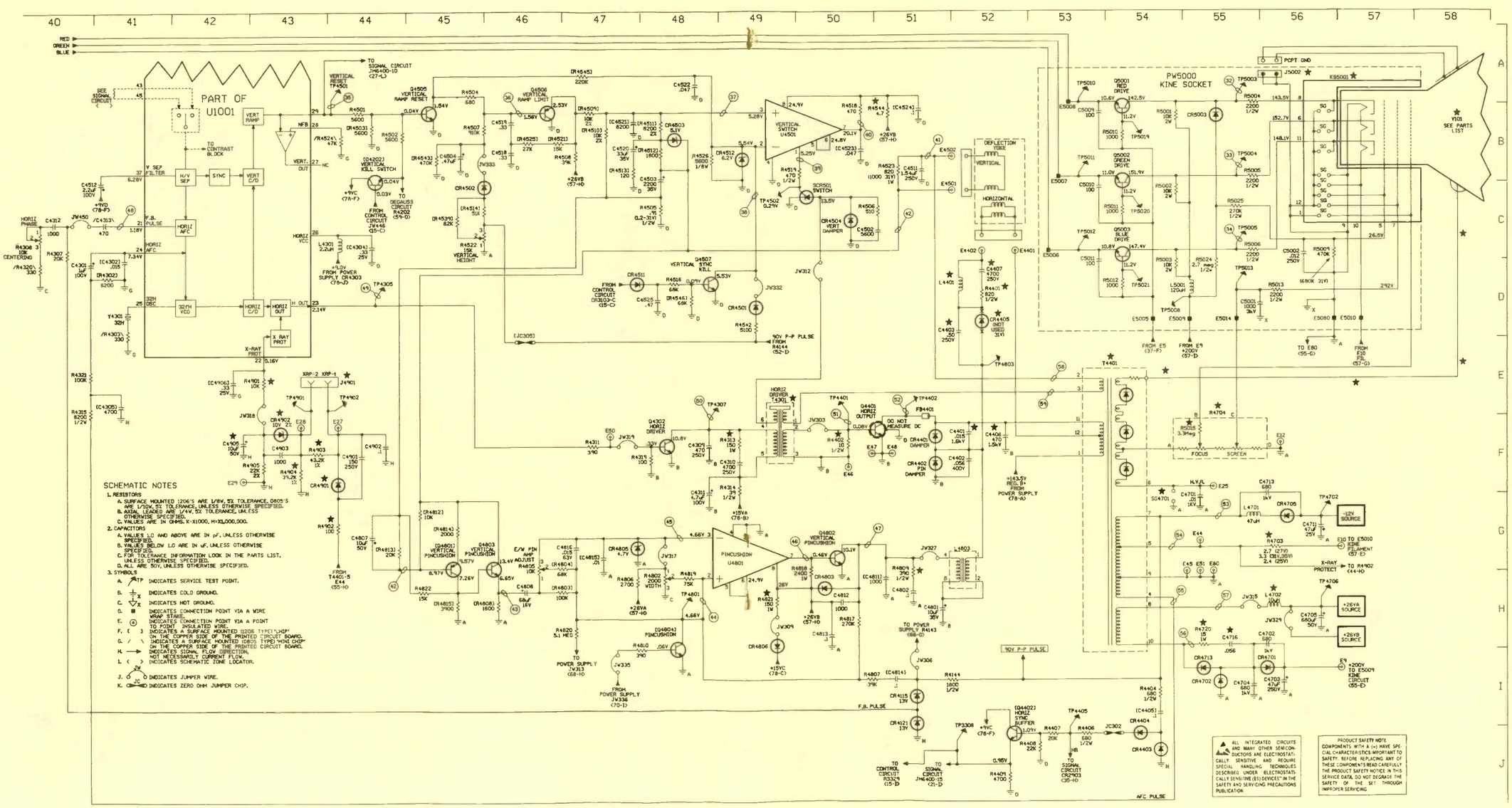

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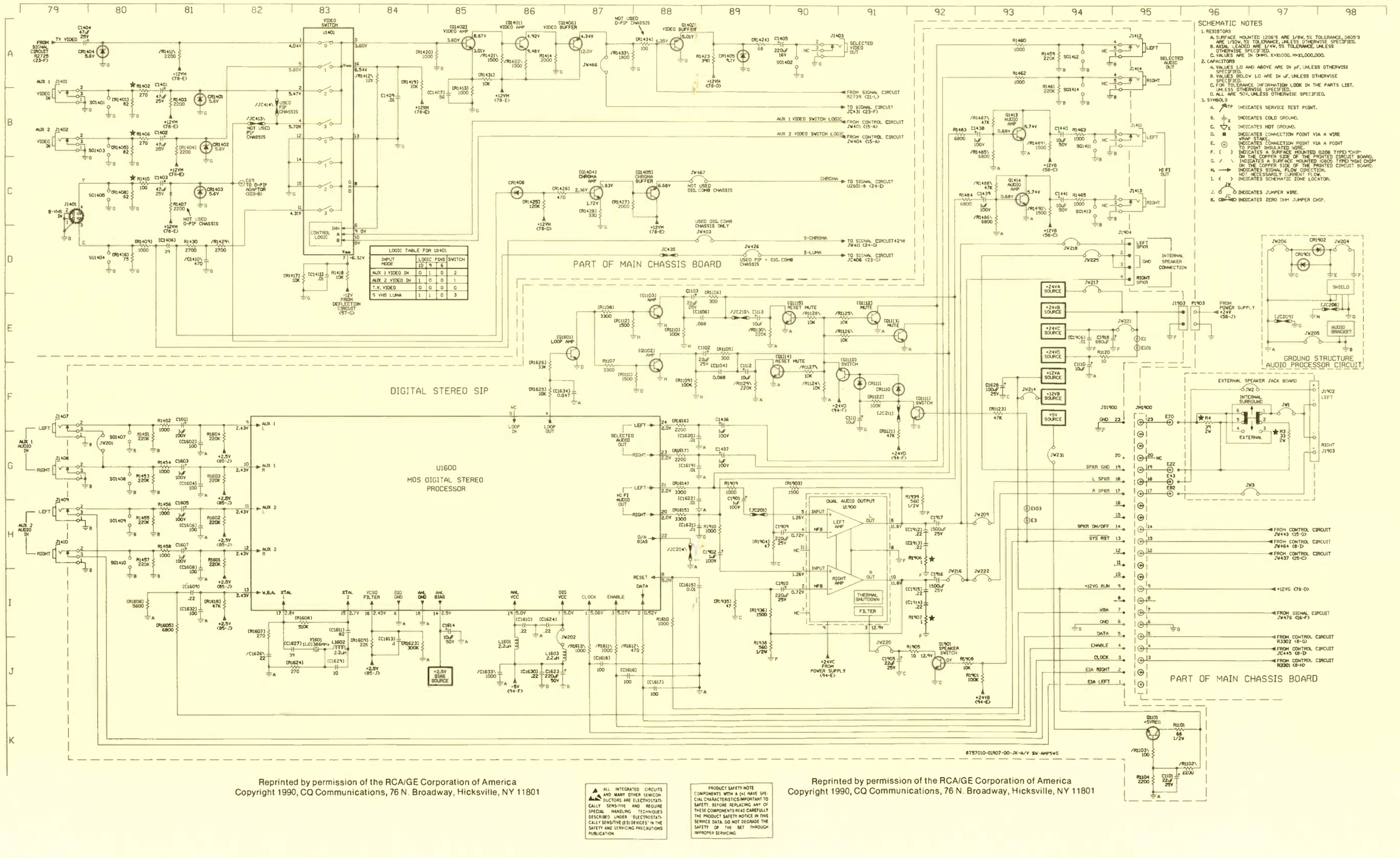

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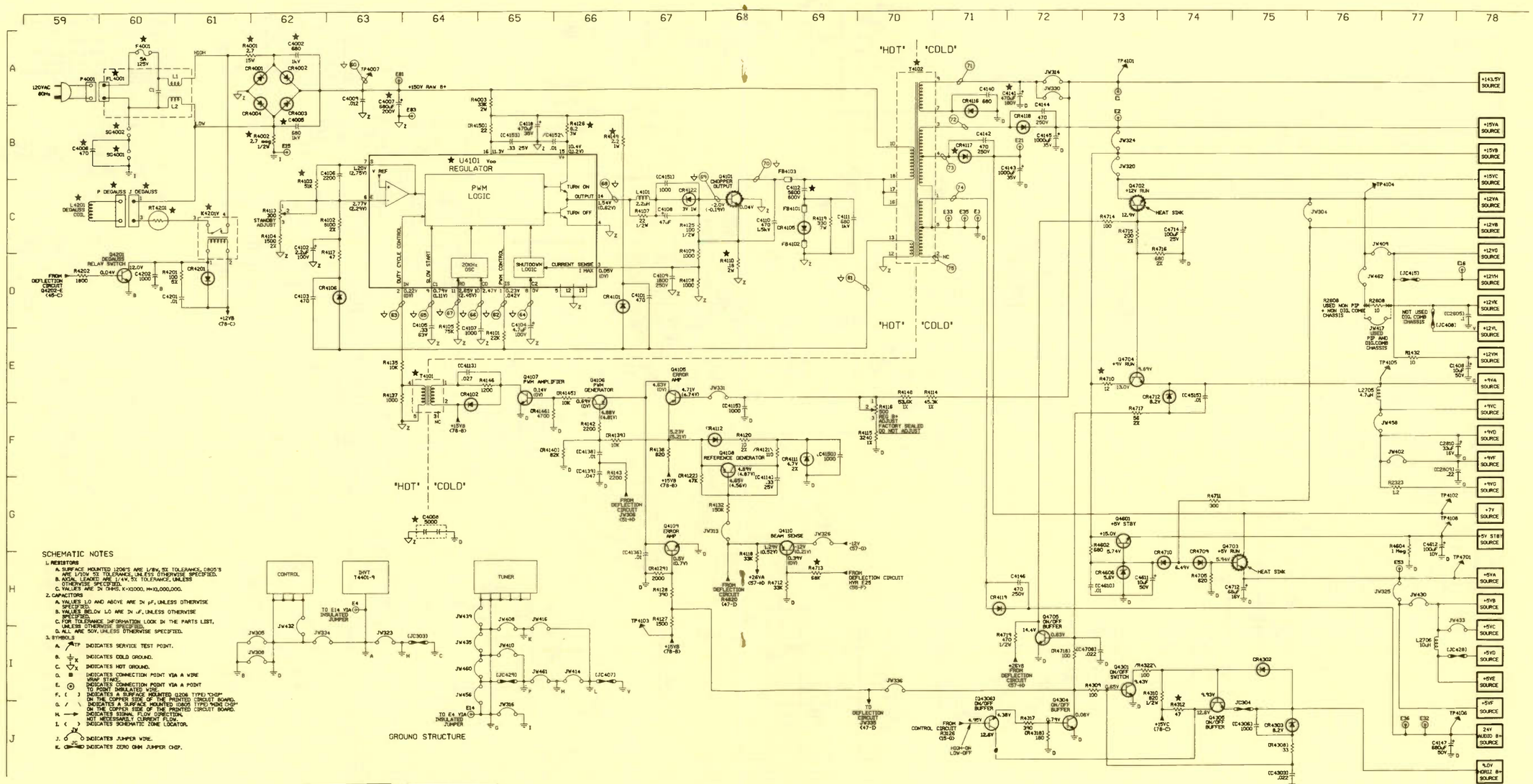
Manufacturers' schematics PROFAX 3070



NOTE: Waveforms Located on 1-D6.

Servicing Zenith microcomputers *(from page 24)*

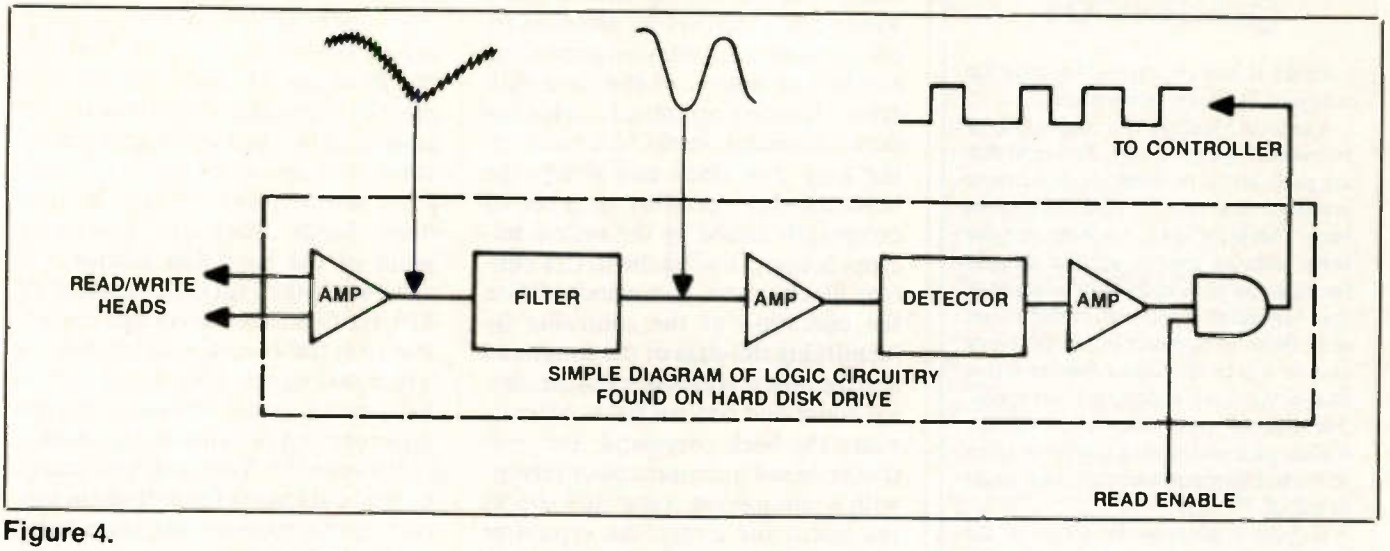


Figure 4.

data. Again referring to Figure 1, the data separator performs phase-locked loop data synchronization on the read data. After decoding, the separated data becomes applied to the controller integrated circuit as read data, clock information and read valid gate signals. As the read/write process takes place, other signals come into play. Relying on a binary coded sequence, the head selected signals arrive on three lines and causes the choosing of a specific head for the read/write sequence. Connector J1 shows pins 4, 14 and 18 as the tie-points for the Head Select 2^2, Head Select 2^2 and Head Select 2^1 signals.

Because the head select signals are a series of digital highs and lows, you can see the digital states of those signals swing back and forth as the drive uses different read/write heads. When the Write Select Gate signal goes to an inactive state, the inactive state enables the step pulse. Stepping the read/write actuator, the control signal pushes the read/write head in the direction of motion defined by the Direction In signal. Pin 24 of the J1 connector carries the Step pulse. This pulse will constantly vary as the head moves in and out. As the name implies, the Direction In signal defines the direction that the read/write head will travel. A logical false condition causes the head to move away from the center of the disk while a logical true condition causes the head to move toward the center of the hard disk. Understandably, these signals vary from a digital high state to a digital low state as the head moves from one direction to another. Pin 34 of the J1 connector carries the Direction In signal.

Controller-card self diagnostics

Self-diagnostics for the controller card take the form of several tests that check the decision-making capability of the controller microprocessor, program memory, error detection and error correction circuits. Specifically, the diagnostics test for errors within the controller random-access memory by reading and writing to the RAM. In addition, the controller checks the parameters of the connected hard disk drives for a match with the controller default parameters. Error correction circuitry, seen as IC814 on the controller, tests the hard disk drive for bad sectors. If the sector appears as bad after a number of error detection passes, the controller sends an error message such as "Bad Sector" or "Invalid Address Mark"to the system microprocessor. Because of the number of error detection passes, transient data errors, sometimes caused by noise or electrical interference within the heads, read amplifier or interface cables will not register as errors. IC815 sets the number of error correction retries before sending the error message to the system.

If the drive arm has an incorrect position, the control processor will give the Recalibrate command which moves the arm back to the track 00 position. This command steps the drive arm cylinder by cylinder until it reaches the track 00 position. At the track 00 position, the drive again becomes active. The Direct Seek command works much like the Recalibrate command in that the Direct Seek command moves the drive arm to the track 00 position. However, the Direct Seek command moves the drive arm at the preprogrammed step rate.

If you install a new hard disk drive or if problems continually appear during data transfer operations, you may have to use the format command. Implementing this command causes the recalibration of the drive which involves resetting the seek address to the default. Not surprisingly, the format operation always begins with the first sector of the hard disk drive track.

Occasionally, the format process will encounter a hard error while formatting a track. Hitting a hard error immediately stops the format process.

While most technicians are familiar with the format command, two other less-used forms of the command also exist. Issuing the format track command again recalibrates the drive and then seeks to the target track. After finding the target track, the format sequence will either clear the defective track bit or reformat the bad track. Bad tracks lack data integrity. Another format command, the Format Bad Track command, takes the process one step further. Instead of writing data fields, this command looks for the bad track flag set in the sector identification field.

Symcure guidelines

ES&T is now paying $60 per page for accepted Symcure submissions.

The term *Symcure* is a contraction of two words: symptom/cure. Problems that are published in the Symcure department are those that have occurred more than once. This is the kind of problem you can solve without even a second thought because you've already seen so many of that particular brand and model of set with those symptoms. In almost every case, it will be the same component that fails or the same solder joint that opens. Submissions must follow these rules:

- Each submission must consist of *seven* individual symptom/cure units on a single brand of TV set.
- If there is no Sams Photofact on the unit, we cannot accept the submission.

Troubleshooting Tips guidelines

ES&T is also paying $25 per item for accepted Troubleshooting Tips.

A Troubleshooting Tip describes a procedure used to diagnose, isolate and correct an actual instance of a specific problem in a specific piece of equipment. Its value, however, lies in the general methods described.

A good Troubleshooting Tip has the following elements:

- It should be a relatively uncommon problem.
- The diagnosis and repair should present something of a challenge to a competent technician.
- It should include a detailed, step-by-step description of why you suspected the cause of the problem and how you confirmed your suspicions—anything that caused you to follow a false trail also should be included.
- It should describe how the repair was performed and any precautions about the possibility of damage to the set or injury to the servicer.

For Symcures and Troubleshooting Tips, please also include:

- the manufacturers name;
- the model and chassis number;
- the Sams Photofact number;
- a sketch of the schematic area where the fault was found. (Include a major component such as a transformer or transistor to provide a landmark.)

Send to:

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Unlike the read command, the Read Verify command does not control a data transfer operation. Read Verify checks the header and data error correction circuitry on a specified number of sectors of the hard disk drive. Another command, called the Seek command, looks to a track on the hard disk drive and selects the head number specified in a set of commands issued by the system microprocessor. Called the device control block, these commands define the operation of the controller by identifying the class of the command and the disk drive head, cylinder, sector count and control field. After issuing the Seek command, the controller-based microprocessor returns with a completion status and checks the status for errors. An error-free return status records a correctly-issued seek command. If a seek timeout error surfaces in the return status, then the controller does not issue the seek command.

Status signals inform the controller microprocessor that an operation has completed, that an operation can take place or that an error has occurred. When an error happens during a read or write operation, the Request Sense Status command returns the address of the failing sectors to the controller. After each Request Sense Status command, the status report becomes updated so that the microprocessor will not attempt to write data to the failing sectors. Because the controller can accommodate more than one hard disk drive, the select status signal tells the microprocessor which drive to select. Seen at pin 1 of both the J2 and J3 connectors, the select status signal verifies the connection of the interface cable to a specific hard disk drive port. After receiving the select status, the microprocessor allows other operations to take place. With the digital high Ready signal, found at pin 23 of the J1 connector, the controller receives an acknowledgement that the drive can read, write or seek. A digital low Ready signal will not allow any controller activity to occur.

Another signal, the Seek Complete signal found at pin 8 of the J1 connector, works in tandem with the Ready signal and informs the controller that the disk drive heads have settled on the final track of the disk during a seek operation. A false Seek Complete signal will disallow any reading or writing to the hard disk. When the heads arrive at a new track, the Seek Complete signal will pulse. After each revolution, the hard disk drive issues an Index signal, found at pin 20 of the J1 connector, to indicate the beginning of the track for the controller IC. An Index signal should constantly pulse as the hard disk drive motor turns. When the disk drive heads reach the outermost point of the hard disk platter, the drive sends the Track 000 signal to IC 810, the controller integrated circuit. Pin 10 of the J1 connector carries the Track 000 signal. This signal continually pulses as the drive accesses the directory and file allocation tables.

Because the hard disk can accept or send data much faster than the system microprocessor response time, the controller card also contains a set of data buffer RAMs. Two static RAMs, IC841 and IC842, buffer one sector of data between the selected drive and the system bus. Sixteen-bit data transfers flow between the controller microprocessor and the system microprocessor. IC841 supplies the low-order byte while IC842 provides the high-order byte. As the system accesses the controller card RAM, two counters, IC843 and IC844, provide the addressing.

This look at the operation of the hard disk drive controller card has concentrated on the presence and activity of digital signals. When troubleshooting the controller card, knowledge of how each signal affects the operation of both the card and the disk drive becomes essential. Because the controller card has no socketed integrated circuits, you must determine whether the fault lies in the card, the cables or the disk drive.

Thus, starting with the interface cables, you can check for the presence of operating signals. By simply using a multimeter, you can check the quality of the interface cable. Additionally, through the use of a logic probe, you can check for signal activity. Generally, you should find +5V, TTL level signals.

Activating the drive through the use of DOS commands or through the use of a diagnostics disk will cause the signal fluctuations seen during normal drive/controller operation. Following this process will allow you to use the process of elimination when diagnosing hard disk drive or controller problems.

Beware of coupling capacitors

By John Shepler

Nearly all audio equipment is chock full of capacitors. Some of these are used for filtering ripple from the dc power supplies. The rest are used to shape the audio frequency response of a circuit, or simply to isolate circuits from each other. It is these isolation or coupling capacitors that cause many service headaches.

Here's a typical experience with a failing coupling capacitor. A reel to reel tape recorder appears to work properly, except "it doesn't sound quite right." You mount a test tape and observe that the output is constant for all frequencies above 500Hz, but drops off to −10dB at 50Hz. That's strange. Recorder alignment problems should affect the high frequencies, not the lows.

Probing around with an amplified voltmeter and headphones shows that the response is different at the output of the preamp stage than at the output of the booster amp. This is a good indication of coupling capacitor problems.

Figure 1 shows how a resistor-capacitor network is used to isolate two operational amplifiers. The purpose is to prevent dc offset from one amp from affecting the following stages. Since the capacitor, C, exists only to block dc, you would expect that it has no audible effects. In fact, the value of C is chosen to be large enough so that the frequency cutoff of the RC combination is at least 1/10 of the lowest frequency the amplifier is designed to handle. The equation included in Figure 1 makes it easy to calculate the low frequency cutoff frequency. This is the frequency where the response is -3dB from a reference tone (typically 1KHz).

You can find a faulty coupling capacitor by using a scope or amplified audio meter to measure the response on both sides of the cap. If there is a change, the cap is probably bad. Lift one end of the cap and substitute another cap of the same value. In many cases, you can simply connect a substitute cap in parallel with the suspect and the response will improve immediately. Sometimes, but not always.

The reason that paralleling the suspect cap with a good one will not always improve the response of the circuit is that the failing capacitor may be leaking dc as well as losing capacitance. This is common with electrolytic capacitors, especially those that have been exposed to high temperatures. Paralleling a second cap solves the capacitance problem, but the bias levels in the following circuit are still affected by the dc leakage through the faulty cap.

This suggests another indication of failing coupling capacitors. When dc levels at test points in an amplifier are incorrect, the problem could be a bad semiconductor or it could simply be a bad cap. If the problem is poor frequency response, especially low frequency response, with distortion and incorrect bias levels, try lifting the coupling to that stage. If the levels settle back to normal, you have found the culprit.

Another serious problem with dc leakage involves amplifiers with dc output coupling. Often this is a 2,000μF or so electrolytic connected directly to a loudspeaker. See the example in Figure 2. If the cap leaks, the speaker can overheat or blow. There should be no dc reading at the speaker terminals if the capacitor is good.

Many new circuits avoid these problems by using op amps with low offsets coupled directly together. Coupling caps, when they're used, are small value ceramic, plastic, or mica caps in high impedance circuits. These circuits are less likely to exhibit the response problems that are typical with electrolytic coupling capacitors.

While this column has talked primarily about coupling capacitors, please be aware that bypass capacitors are also notorious service headaches. The same troubleshooting techniques of isolation and substitution will work for both applications of capacitors. ■

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

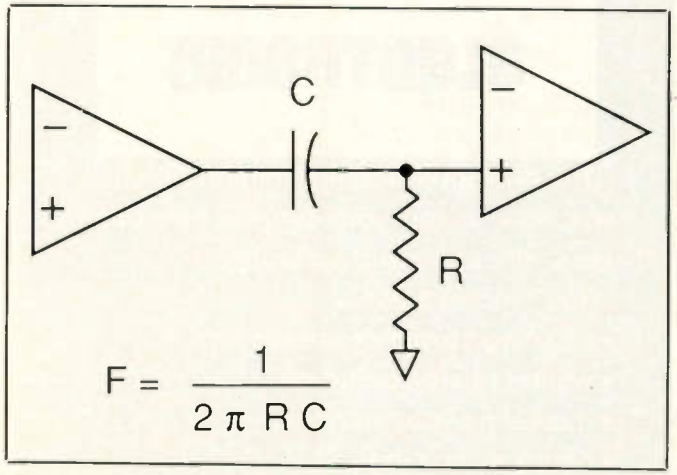


Figure 1. Resistor-capacitor coupling

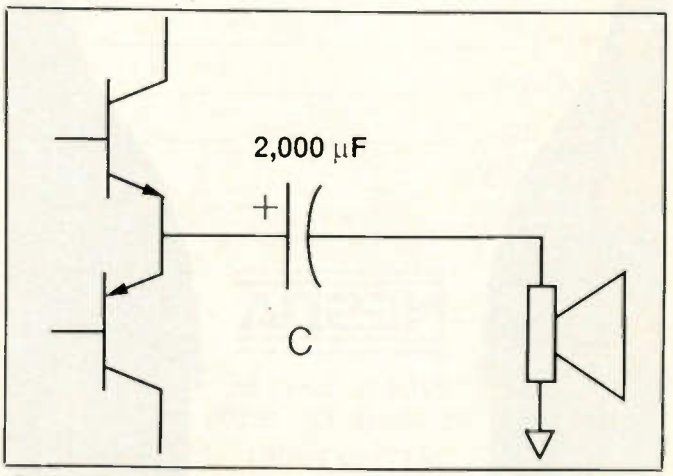


Figure 2. Output coupling capacitor

class has been excellent with classes filling and students placed on waiting lists.

NAC's printer repair class will teach the student to diagnose and solve printer problems for HP Laser Jet I, II, IIP and III; HP Thinkjet; Epson; Okidata; IBM QuietWriter, ProPinter; Toshiba P351, NEC Spinwriter, and other printers. Repair techniques are component level and meet Return-On-Investment requirements to maximize profits and minimize costs and downtime. This class is backed by NAC's documentation; and one year of toll-free support, technical update and bulletin board services. The classes are two and a half days long and cost $1050.

Circle (36) on Reply Card

Catalog for wireless cable products

A new catalog, "Wireless/90" describes microwave filters and accessories for MMDS/ITFS/MDS reception. The book begins with a section on how the Wireless Cable industry evolved, equipment used and the nature of this video delivery system. Details on video - aural C combiners, channel combiners, channel group combiners, preselectors and interference filters are contained with response test curves and dimension drawings. Appendices also list domestic and international frequencies, other manufacturers and service providers to the industry and a listing of articles about Wireless Cable in the trade press.

Circle (37) on Reply Card

Federal warranty's newsletter advises dealers about legislation

The Legislative Watch is a featured column in Federal Warranty Service Corporation's quarterly newsletter, Service Contract newsletter. This issue, the second published this year, reports about legislative attempts to curtail service contracts in California, Florida, and New York. In addition to the Legislative Watch, Issue No. 2 features an editorial questioning who benefits from all these restrictive legislation attempts, written by Federal Warranty Service Corporation president, Mutual Stevenson. Other articles in the four-page newsletter offer selling tips. The newsletter is available free to consumer electronic dealers and others interested in offering service contracts to their customers.

Circle (38) on Reply Card

Satellite interference reprint

Electronic Specialists announce immediate availability of a FREE Satellite Reprint entitled "Curing Satellite System Electrical Interference & Interruptions." Sources of interference, interruptions and possible damage are described in the article. Steps that have been successful in preventing these problems are also suggested. Both winter and summer conditions are discussed along with problem solutions. Several examples of frequently occurring situations are included.

Circle (39) on Reply Card

IBM scientists demonstrate densest chip for high-speed optical link in computers

IBM scientists have demonstrated two experimental computer chips for transmitting and receiving data over fiber optic lines at speeds of a billion bits per second. They believe the receiver chip is the densest optoelectronic chip ever reported.

One quarter-inch fingernail-size "receiver" holds 50 times more optical and electronic components than ever previously assembled on a chip for the optoelectronic receiving and processing of data. The receiver chip contains more than 8,000 transistors with characteristic features as small as 40 millionths of an inch or one micron.

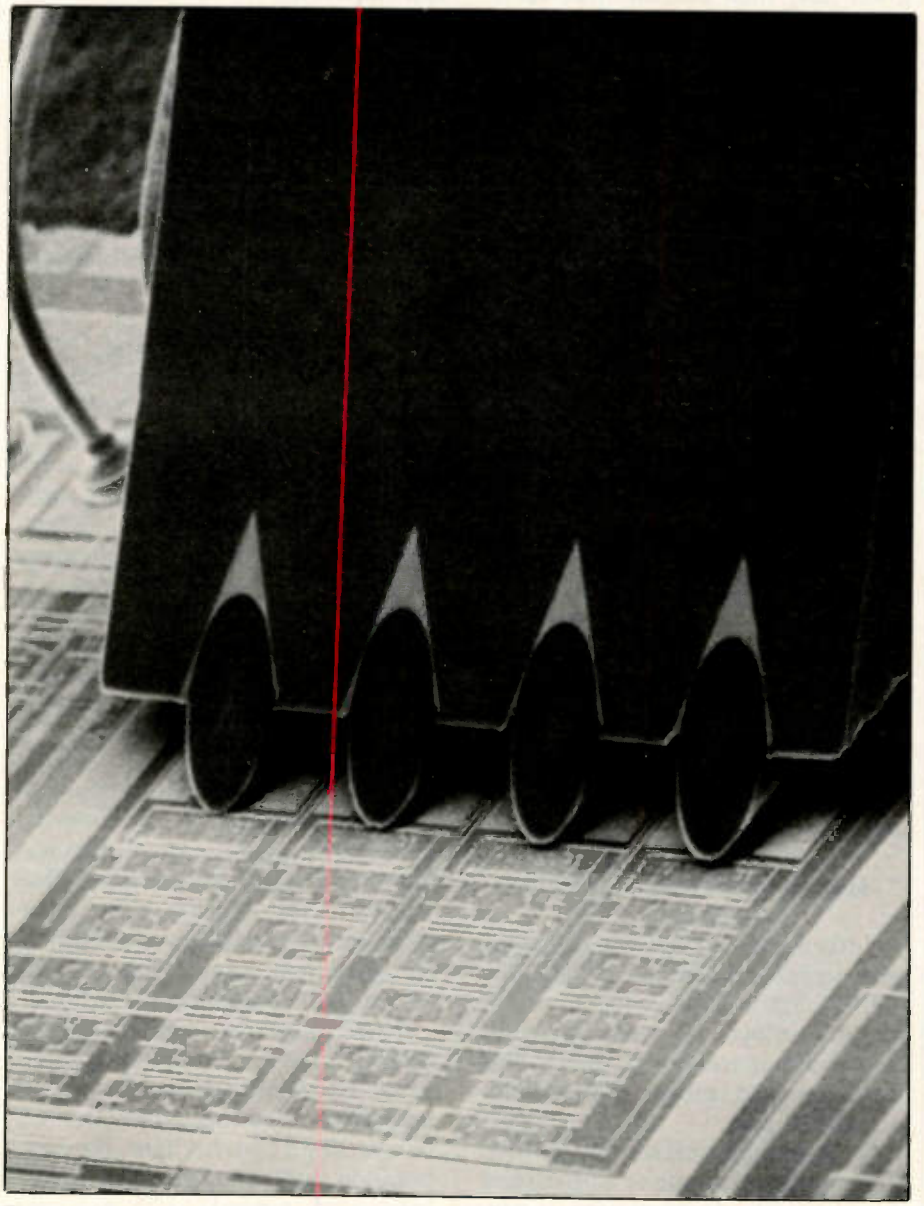


Figure 1. Shown here magnified several hundred times is the receiver portion of IBM's experimental optoelectronic computer chip set.

Optoelectronic technology permits electronic devices such as computers to communicate using pulses of laser light as the carrier of the information. IBM believes the ability to provide the transmitting and receiving functions on a two-chip "set" creates the potential for more reliable, faster and less expensive data communications.

The IBM scientists see these chips as precursors of the high speed, economical and efficient optical links that will be needed to connect a wide range of computers—from supercomputers to individual home computers. Chips such as these from IBM would serve as transmitter/receivers inside or adjacent to the computers exchanging data.

Many complex and potentially fruitful computer applications—for example, national economic forecasts, hypersonic aircraft simulations or demographic studies, will create detailed images composed of billions and even trillions of data bits. Sending such images from one laboratory, business or home to another will require new transmission techniques that are efficient and affordable.

Much of the advanced and dense IBM circuitry translates the laser light—flashing on and off billions of times per second—into the electrical "language" computers understand and back again into laser light.

Smooth merge

This conversion process might be compared to the challenge facing

traffic control officers who must merge parallel traffic lanes into a single-file tunnel. The vehicles represent the many messages going from one computer to another.

They must be smoothly merged into the serial passage (the optical fiber linking the computers) by the transmitter. As they emerge at a very high rate from the other end, they must be put back into the right lanes by the circuitry in the receiver.

Integrating optical, data transmission and data conditioning functions facilities this high speed information exchange more reliably, with less power consumption and at a much lower cost than current fiber-optic link technology. It is easier to manufacture a more integrated set of chips than assemble a series of packages which must be linked by costly wiring that can also slow the data flow.

The IBM scientists made the transmitter and receiver chips from gallium arsenide (GaAs), a material which is uniquely suitable for optoelectronic devices because it can produce very fast, small lasers, can be made into detectors of light pulses and can serve as the basis for high performance electronic circuitry at low power levels. A GaAs injection laser array that employs advanced "quantum well" technology is used to create the light pulses. Quantum-well devices make use of the unusual behavior of electrons confined in extremely thin semiconductor layers to efficiently create light. This laser array serves as a light source for data transmission.

Although these chips are experimental, they have been put into packages and operated on fiber links sending a billion bits every second.

How the chips send and receive information

Information to be sent from one computer to another enters the transmitter chip in "byte-wide" streams of data—a byte being the basic unit or word that computers use. In this case, the word consists of 10 individual bits of data.

This parallel stream of 10 bits, each bit a digital one or zero carried on a separate electrical wire, is converted into a serial stream. Converted from digital to analog form by the advanced IBM circuitry, this high speed stream drives a GaAs injection laser. This laser uses the unique advantages of "quantum wells" to achieve fast, efficient electrical-to-optical signal conversion.

The data, now in the form of light, travels through an optical fiber to a photodetector in the optoelectronic receiver chip. There, the conversion process is reversed: the incoming stream of high speed optical signals is converted to electronic signals by the photodetector and reformed and retimed into the digital byte-wide stream that the receiving computer can understand.

The integration of these elements on chips operating at 1 billion bits (1gigabit) per second and the testing of a complete fiber optic communications link at the same high speed represents significant advances. Future progress can be expected as research continues to improve the density, speed and reliability of this technology.

Technical background

The quest for increased processing power in computers has resulted in today's large scale integration (LSI) of thousands of digital circuits on individual chips. The result is that computers have become much smaller, more powerful, and less expensive, opening up many new applications in business and science. Future waves of new applications will depend on the connection of many computers which will exchange massive amounts of data at very high speed.

For this to be practical, network technology must likewise become faster, more compact (to be compatible with the small computer size) and much less expensive. Fiber-optic data links offer this promise, if the interfaces between the fibers and computers can be implemented with integrated, low cost components.

These interfaces require a mix of optical, digital and analog components. Digital devices use discrete on and off states pusling at fixed time intervals, like a blinking light, for computation and communication. Analog devices respond to all amplitudes and time behavior of the signal pat-

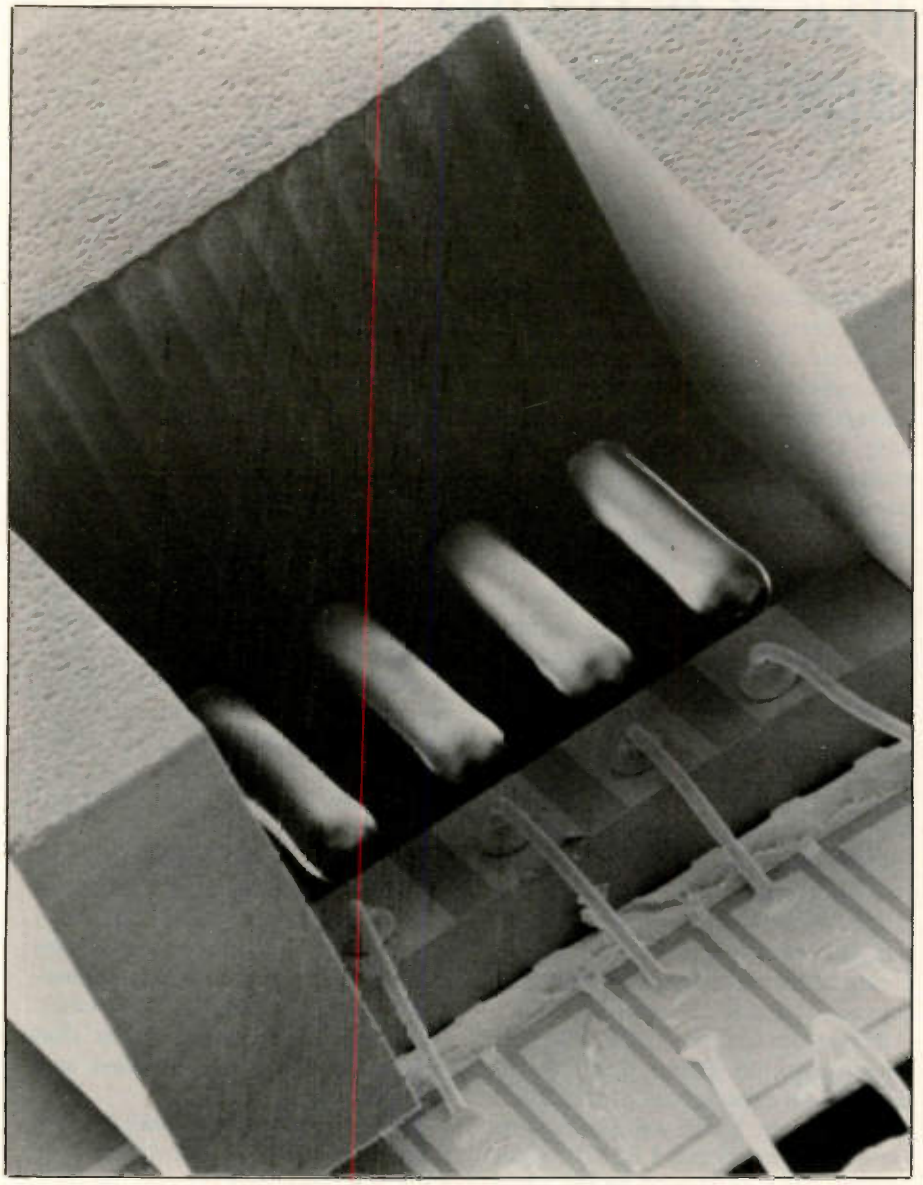


Figure 2. Shown here magnified several hundred times is the transmitter section of IBM's experimental optoelectronic computer chip set.

terns—more like the rise and fall of sound volume in a melody.

Integrated chips containing the interface functions must operate at billions of bits (gigabits) per second, much faster than the computers they link. All this must be accomplished with a technology that assures error-free operation. Today, gallium arsenide is a unique semiconductor, able to support large numbers of very fast electronic transistors and light emmitting and detecting devices on the same chip.

The GaAs metal semiconductor field effect transistor (MESFET) process used to fabricate these chips is a reliable and low cost technology for LSI in communication chips. Making this technology compatible with photodectors, and combining the analog and digital functions without using expensive and bulky separate components, moves the ability of computers to communicate at very high speeds one major step closer to widespread practicality.

By integrating many of the optical, digital and analog functions on two chips, the IBM GaAs MESFET technology attains high speed using relatively little power. The experimental fiber-optic link has been successfully operated at a billion bits per second.

Your service truck is more than just transportation

By William J. Lynott

Advertising is an essential part of the never-ending process of finding and developing new customers for your business. No matter how good your service may be, there will always be some turnover of customers. Every year, a certain number of people die, move away, or simply decide to do business elsewhere. If your business is to prosper, there must be a steady flow of new customers to replace them. The principal means for accomplishing this is advertising.

Of course, most electronic service dealers must watch their advertising budgets very carefully. And that's why I'm always disappointed when I see service dealers missing out on advertising opportunities that cost little or nothing.

Trucks are a good example. Even if you have only one truck - especially if you have only one truck - it is important that you take full advantage of this "mobile billboard."

I was reminded of all this when I happened to look out my office window this morning in time to see a service van from a local TV repair company pulling away from the building next door. It was dirty and sorely in need of painting. Worst of all, the only lettering it had was one of those stick-on magnetic signs with the company name and phone number. What a shame.

A single truck driving around city streets will make hundreds of thousands of advertising impressions per year. They can be either positive impressions or negative ones. You can guess what kind of impressions this truck was making.

It's no accident that operators of large fleets take great pains to develop a positive image through their truck fleets. Consider the distinctive chocolate-brown trucks of United Parcel Service. Have you ever seen a dirty one on the road? Chances are you haven't, since the company requires that every one be washed every day. That's one of the ways UPS creates a positive image of the company in your mind, whether or not you are consciously aware of it.

On the other hand, a dirty, carelessly painted truck may actually be out there every day working against you - creating negative instead of positive impressions.

What can you do to capitalize on the advertising potential of your truck? Here are a few ideas: First, choose a bright, pleasant combination of paint colors. Stay away from that dull blue and white that seems to roll off so many assembly lines. In combination with the truck's lettering, you want colors that will help to create a distinctive and original impression that will be remembered.

Have your lettering done by a skilled professional. Please don't skimp on this. An experienced professional will be able to blend your ideas with his experience to build just the right image. The sign should be the same on both sides of the truck, large lettering, with your company features on all panels.

If you have a trademark or company logo, make sure it is featured. If you don't, consider having an artist draw up a distinctive cartoon character to illustrate some feature of your business such as "lightning-fast service."

If you specialize in a few well-known brand names, include them in the lettering. But please don't try to put too much information on your truck. Don't take up space with your own name. Ego trips have no place in productive advertising. Your prospective customers couldn't care less who the owner is. And your present customers already know.

The idea is to create a recognizable and distinctive image with good taste and without clutter. People have only a second or so to glance at a moving truck. You want them to be able to see and remember your company name and what you do. A truck that is too busy with lettering and drawings will be counter-productive.

If you have more than one truck (this is important) make sure that they all look exactly the same. Some of the big national fleets go so far as to eliminate local phone numbers, just so that every truck in the nation looks exactly like every other truck. Never mind that you have only two trucks, this consistent identity is important.

Once you have created just the right image for your trucks, an image that makes them stand out in a crowd, don't squander your efforts by failing to keep up their appearance. Regular washing is a shrewd investment. It shows the public that you care about your business and your customers

I know that many small service dealers elect to use personal cars for whatever road work they do. As logical as this may sound for the very small dealer, there are two basic mistakes in this approach. First, it can create a poor impression on customers. With everyone else using vans for service work, it may appear that the business is not successful.

And then there is that failure to capitalize on the powerful advertising potential of an attractive service truck. As I said earlier, advertising is a vital part of every healthy business. With conventional advertising sure to become even more and more expensive, it's simply good business to take advantage of every opportunity to keep your name in front of prospective customers. A skillfully designed mobile billboard is one of the best of those opportunities. ■

Lynott is president of W.J. Lynott, Associates, a management consulting firm specializing in profitable service management and consumer satisfaction research.

Understanding computer terms

By Glenn R. Patsch

Just as with servicing a TV, radio or VCR, knowing what all the abbreviations and terminology mean can save you a lot of time. More important, if you comprehend the terms you will understand better what you are servicing. I have always found it easier and faster to troubleshoot something when I understand how it works and the terminology involved.

Adapter - A card that plugs into the personal computer bus; for example the card that allows you to connect a monitor, such as an EGA or VGA card. Also a cable connector like a 9-pin to 25-pin adapter for serial ports, or a gender changer (male to female, or vice-versa).

BIOS - Basic Input Output Services. Software included with the PC that exists in ROM. Also called ROM-BIOS. The BIOS provides an interface with the hardware. BIOS is often revised with new hardware.

Boot - The process of starting up the PC and loading DOS. Once DOS loads, the AUTOEXEC.BAT file, if there is one, runs. To reboot a PC, press the CTRL, ALT and DEL keys together. See POST.

Bus - The link between adapter cards and the microprocessor. The bus accepts cards with memory, serial ports, parallel ports, fax, modem, scanner, etc. cards to extend the capabilities of the PC. The IBM AT uses a 16-bit bus. Most compatibles use this and call it the AT bus. Compaq is nowusing the EISA bus in its high end PCs. IBM is using the microchannel bus in the PS/2 PCs.

Cache - Memory used to improve the performance of a hard disk. The most often used information is stored in memory that takes less time to access than the disk.

Centronics - parallel connection. Used to refer to the parallel printer connector on the printer or cable.

CGA - Color graphics adapter. The card that plugs into a personal computer bus to give it graphics capability. Often used to mean both the adapter and monitor together.

CGM - Color graphics monitor.

Conventional memory - This is the standard 640Kbytes of random-access memory (RAM).

CPU - Central processing unit. The microprocessor chip in a PC. IBM and compatible PCs have an Intel (or compatible) 8088, 80286, 80386, 80486, etc. Apple Macintosh PCs use a Motorola 68000 or 68030 microprocessor.

DB25 - A 25-pin connector

Device driver - Software that is installed using the DOS config.sys file. This is usually a mouse driver or memory manager.

Diagnostics Disk - IBM software testing disk included with PC/XT and PC/AT systems. Diagnostic software is also available from other software companies for diagnosing PCs. An Advanced Diagnostics Disk is available for more thorough servicing and testing. The equivalent of a diagnostics disk for the PS/2 system is referred to as a Reference Disk.

Disk - Normally refers to the hard or fixed disk. These are usually 20Mbytes and larger. Also used to refer to a floppy disk. See "floppy."

DMA - Direct memory access. This is a controller that allows input/output (I/O) devices (such as the hard disk) to directly transfer data to and from memory without going through the microprocessor. DMA is much faster.

DOS - Disk operating system. MS-DOS, PC-DOS, and DOS are often all used interchangeably to mean the operating system software created by Microsoft for the personal computer. IBM sells PC-DOS. Compatible PCs, like Compaq and Zenith use MS-DOS.

DTP - Desktop Publishing. Used to refer to software and/or hardware used.

EGA - Enhanced graphics adapter. The card that plugs into a personal computer bus to give it better graphics than CGA. Often used to mean both the adapter and monitor together.

EGM - Enhanced graphics monitor

EMM - Expanded memory manager software. See expanded memory.

EMS - Expanded memory specification. Also referred to as LIM EMS. See "expanded memory."

Expanded memory - Also referred to as LIM (Lotus Intel Microsoft) memory. This is a memory paging method that allows access to the memory outside the one Mbyte memory address. This works on an 8088, 80286, 80386, etc. Memory adapter cards that support expanded memory are often referred to as EMS cards. The use of expanded memory requires expanded memory manager (EMM) software. Expanded memory can also be simulated from extended memory with a software memory manager like QEMM-386 or 386-MAX.

Extended memory - Memory is accessed in protected mode and this only works on an 80286, 80386, etc. This is memory above the first one Mbyte. Up to 15 Mbytes of extended memory can be added to a PC for a total of 16 Mbytes of memory.

Extension - A name of up to three characters that is used to indicate the type of file. COM and EXE indicate binary files that are commands and

Patsch is a consultant specializing in the selection, evaluation and installation of IBM personal computer and compatible hardware and software.

executable code. BAT is a batch file. DOC is a document file for a word processor. WKS, WK1 and WK3 are used by 123 spreadsheets.

File - Information stored on a floppy or hard disk. A file is stored and retrieved by a filename and extension.

Filename - Up to an eight character name used to describe a file.

Firmware - Software stored in ROM.

Floppy - A removable disk that comes in various sizes and capacities. Floppies are available in 3.5, 5.25 and 8-inch sizes. The most common floppy is the 5.25-inch which comes in 360Kbyte and 1.2Mbyte capacities. The 3.25-inch floppy comes in 1Mbyte and 2Mbyte sizes that format to 720K and 1.44Mbytes of usable space. To specify a floppy disk: 1S or SS is single side; 2S or DS is double side; DD is double density; HD is high density; RH is reinforced center hub ring; TPI stands for tracks per inch. A 3.5-inch DS HD disk is a 1.44Mbyte floppy. A 5.25-inch DS DD 48 TPI RH disk is a 360K floppy with a reinforced hub ring. All IBM and compatible PCs use soft sector floppy disks.

Format - The process of preparing a floppy or hard disk for use. Formatting places marks on the disk where data goes and sets up a directory to store the file names. The DOS FORMAT command is used to format disks. Before formatting a hard disk, it must be partitioned with the FDISK command. Formatting a disk that has previously been used erases all the files on it.

HGA - Hercules graphics adapter. The card that plugs into a PC bus to give it graphics with a monochrome monitor (MDM). Also referred to as HERC. Once very popular but rapidly being replaced by EGA or VGA.

K - Kilobytes or 1024 bytes. A 360K floppy actually can store 368,640 bytes.

LIM - See expanded memory

MCGA - Multi color graphics array. A slightly less capable VGA. Used on low end PS/2 systems.

MDA - Monochrome display adapter. The card that plugs into a personal computer bus to give it the ability to drive a monochrome video monitor.

MDM - Monochrome display monitor.

Monochrome - Single color monitor, usually green on black screen. Also white on black and amber on black.

MS-DOS - Microsoft version of DOS for all IBM compatible PCs. See DOS.

PC - A personal computer. Also refers to the first personal computer IBM released that did not have a hard disk. All later computers are referred to as XT or PC/XT, AT or PC/AT, etc. The newest computers released by IBM are the PS/1 and PS/2, the PS standing for personal system.

PC-DOS - IBM version of DOS. See DOS.

POS - Programmable option select. This allows the PS/2 with microchannel to query and set the system configuration. On an XT or AT, the individual cards often had DIP switches (small switches mounted in dual-in-line packages) that must be set. POS eliminates the switches. Adapter description files (ADF) describe each adapter card. The adapter IDs are stored in the system battery-backed CMOS RAM. System configuration is set with the Reference Diskette software.

POST - The power on self test checks that the hardware is working when the PC is first turned on. POST is stored in the BIOS. After the POST completes, the boot record of the disk is loaded, which in turn loads DOS.

Protected mode - Available only on the 80286 and later CPU chips. A special mode the chip can switch to that allows it to use up to 16Mbytes of memory. See Real mode.

RAM - Random-access memory. Most memory on a PC is RAM. The 640K of memory on a PC is RAM. See extended and expanded memory.

Real mode - The operating mode of the CPU chip. This is the normal operating mode used by 8088, 80286, 80386, 80486 CPU chips. Real mode is limited to one megabyte of memory and normally can use only 640K. DOS works in real mode. The 80286, 80386 and 80486 chips can also support protected mode.

Reference disk - Included with the IBM PS/2 personal computers, this disk has the configuration and testing software. XT and AT PCs use a diagnostic disks.

ROM - Read-only memory. Also referred to as firmware.

RS-232 - Serial data transmission scheme.

SRAM - Static RAM. Very fast RAM. Available on high end 386 or 486 systems.

VGA - Video graphics array. A graphics card that plugs into a personal computer bus or included on the motherboard of a PC. Better than EGA, and much better than CGA.

VGM - Video graphics monitor.

Terminology can make the understanding of a complex technology such as computers even more difficult to understand. While this list of terms could not possibly include everything, it should help you with computer servicing. If you run across terms that you don't understand or feel should be added to this list, please write in and let me know. ■

The VHS VCR GII chassis

By the ES&T staff

The chassis of the typical VHS VCR is referred to by the manufacturers as the G model. Recently, a newer model has been introduced that provides a number of significant improvements over that model. It is called the GII model. The following information might help you if you're called on to service one of these.

Features of the GII model are a slimmer appearance, significantly faster, fast-forward and rewind times, quicker and quieter mode changes, and two new features called **jog** and **shuttle**.

Jog and shuttle required the addition of an IC within the VCR circuitry to control the operation of these functions, and exterior controls: a pushbutton and a dial/ring that looks much like a tuning dial. This control is separated into two segments: a jog dial and a shuttle ring.

When the VCR is stopped or in playback mode, the viewer engages the shuttle capability by pressing the JOG/SHUTTLE button. This causes the VCR to activate the jog/shuttle system. In this condition, the VCR goes into the still mode and a JOG/SHUTTLE LED lights.

Turning the shuttle ring clockwise causes the tape to move in the forward direction at slow speed, proportional to the amount by which the ring is turned. The effect is a slow motion picture, which can also be used as a search mode. When the shuttle ring is turned counterclockwise, the tape turns at a slow speed in the reverse direction, the effect being a slow motion reverse picture or slow reverse search.

The jog function is also engaged by pressing the JOG/SHUTTLE button during stop or playback. Again, the VCR goes into the still mode and the LED lights to confirm to the viewer that the mode has been engaged. In this case, the viewer rotates the jog dial. When the dial is rotated clockwise, this causes the tape to move forward a frame at a time rather than in continuous fashion as happens during shuttle. The farther the jog dial is turned, the faster the frame-by-frame effect occurs.

Turning the jog dial counterclockwise causes the tape to move in the reverse direction a frame at a time. As with the forward direction, the farther the dial is turned, the faster the frames go by. In either direction, if the speed of the tape exceeds a preset value, the VCR resumes normal playback.

When either jog or shuttle has been engaged, once the shuttle ring or the jog dial is allowed to return to its normal rest position, the VCR goes back into still mode. As with any VCR, if the unit is left in the still mode for 10 minutes, it will go into stop mode.

Another feature of the GII chassis is that it has a second still position. In the G chassis, when the VCR is in still mode, the tape is "half loaded" that is it only is brought tangent to the head drum. A second still or stop position in the GII chassis has the tape wrapped 180 degrees around the drum, or fully loaded, just as the tape is loaded during play.

One of the big differences between the G mechanism and the GII mechanism is that in the G, the capstan motor drives the whole mechanism from tape loading to loading. The GII, on the other hand, has a second motor, called a review motor. The review motor is used to drive the supply reel table during any reverse mode (Review, reverse x2, reverse slow, and unloading between stop 2 and stop 1) while the VCR is in the play mode.

The second function of the review motor is to control the back tension post release during the full loaded stop mode (stop 2), and any reverse mode function that is selected while the unit is in playback. This allows the VCR to change modes more quickly. ■

This article was based on information contained in the Training Manual for VCR and VHS Movie, 1989 products, published by Video Recorder Division, Matsushita Electric Industries Co., Ltd.

Books

Writing Better Technical Articles, by Harley Bjelland; Tab Books; 208 pages; $12.95 paper, $19.95 hard.

Writing Better Technical Articles is everything the scientist, engineer, or technician needs to know to get published. For those who have an idea for a technical paper, magazine article, manual, or book - but lack confidence in their writing and editing skills, this will give them the tools they need to get published. Bjelland shows how to write query letters to publishers, locate and research information, access on-line information services and get good results with word processing. It also goes into how to write and prepare a manuscript, how to use graphics to enhance an article and much more. Readers will find out exactly what today's major publishers of technical articles require in a manuscript so that they can approach their projects from the outset with confidence and determination. Bjelland is an electrical engineer who has had more than 30 technical articles published in national magazines and has worked as an editor for two engineering periodicals. He has also provided technical writing support for IBM, Motorola, American Electronics, TRW and many more.

TAB Books, Blue Ridge Summit, PA 17294-0850; 800-822-8138.

Practical Guide to Electronic Amplifiers, by John D. Lenk; Prentice Hall; 438 pages; $39.00 hardbound.

This is a guide to electronic amplifiers with something for everyone including, experiments, students, serious hobbyists, service technicians and field-service engineers. Beginning with the guidelines for selecting necessary components on a trial-value basis, the book takes you step by step through assuming a specific design goal to developing and testing the desired results. The book focuses on pratical applications, serving as an all-around sourcebook for all types of solid-state/IC amplifiers. Thorough coverage is provided for amplifier basics; mounting techniques and thermal considerations; AF amplifiers; RF, IF and BF amplifiers; differential amplifiers; operational amplifiers; and operational transconductance amplifiers.

Prentice Hall, Englewood Cliffs, NJ 07632; 201-767-5937.

Photofact

GE
2772-1 . . . 26GC4O3MO1, 415MO1, 46OMO1, 461MO1, 63OMO1, 631PO1, 632MO1, 671PO1, 672PO1, 26GT443FO1, 445FO1, 64FO1, 642FO1, 642UO1, 27GT6O7FO1, (CH. CTC157B/C/E/H/R)

JC PENNEY
2768-1 . . . . . 685-4029-OO
2770-1 . . . . . 684-4014-OO

JVC
2773-1 . . . . . AV-2649S, AV-2659S

MITSUBISHI
2771-1 . . . . . CK-263OR, CK-2631R

PANASONIC
2772-2 . . . . CTL-135OR/51R/52R/50R-1/52R-1/53R-1, PC-14T50R-1/51R-1 (CH. ADP181, ADP193, YADP193)
2774-1 . . . . . CTK-1O4OR, CTL-1O4OR/41R, PC-11S4OR, PC-11T4OR (CH. ALGP159, YALGP159)

RCA
2769-1 . . . . . F2O68OWNFO1, F2O681DGFO1

SEARS
2771-2 . . . . . 564.4293695O
2773-2 . . . . . 58O.41OO495O

SHARP
2769-2 . . . . . 27RV79, 27RV729

SONY
2768-2 . . . . . KV-27TS3O
(CH. SCC-C7OC-A, SCC-A5OP-A)

ZENITH
2770-2 . . . . . E1914W, E2O14W, E396OW, E522OW/30W/7OS, SE1915W, SE2O17W, SE3935W, SE5221W/61W/91H, SS8915W
2774-2 . . . . . E13O8W, E191O8

Loudness control with impedance matching

By Sam Wilson

This subject was suggested by Joe Risse of Dunmore, PA. It is an explanation of how a loudness control is used to improve low- and high-frequency response at the same time it maintains a nearly-constant impedance to the input audio amplifier. Don't confuse the loudness control with the volume control—they are definitely not the same thing.

The gain of an audio voltage amplifier is directly dependent on the load impedance connected to its collector, drain, or plate. A well-designed loudness control, used as a load impedance, is designed to maintain a constant impedance throughout the range of adjustment. That assures a constant amplifier gain throughout the range of the control adjustment. At the same time, the control uses filter circuits to shape the overall response of the audio signal delivered to the next stage.

By way of contrast, when a volume control is adjusted it varies the impedance seen by the audio input amplifier. Also, it has no provision for frequency compensation.

There are a few exceptions to this, but if a manufacturer goes to the trouble and expense of including filters for shaping the frequency response, it will surely call it a loudness control. Consumers know that loudness controls are on more expensive equipment. At least that is what they think they know.

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

The simple volume control

Consider the simple volume control shown in Figure 1. If the variable resistor is adjusted all the way to the bottom, the impedance—as seen by the audio amplifier delivering the signal—is maximum. In this discussion, R_L represents the load resistance. The reactance of the output signal is disregarded.

If the variable resistor is adjusted all the way to the top, the impedance —as seen by the amplifier delivering the signal—is minimum. In that case, the volume control resistance is in parallel with R_L.

The actual range of impedances, looking from the generating amplifier, depends on the load resistance of the device that is represented by R_L.

It also depends upon the amount of coupling capacitance, distributed capacitance and input capacitance of the following stage.

If the following stage is a bipolar transistor, it is necessary to deliver current to the amplifier input, which means the input impedance of the next stage R must be low. For that application, adjusting the volume control causes a much greater change in the circuit impedance as seen by the input audio amplifier or any type of generator. In fact, when the volume control is at the top of the adjustment, its load [current] may be too great for the generating amplifier to deliver.

That explains why the stage following a diode detector in a bipolar transistor radio may be an emitter follower. The diode is the generating device, and it cannot supply much current. The follower offers a higher impedance to the detector, and it acts as a buffer between the diode detector and the next stage.

Figure 2 shows the frequency response of the input amplifier and volume control that is shown in Figure 1. The frequency response of the human ear drops off at low and high frequencies. The curve in Figure 3 shows the kind of amplifier frequency response needed to overcome the inability of the human ear to hear the lowest and highest audio frequen-

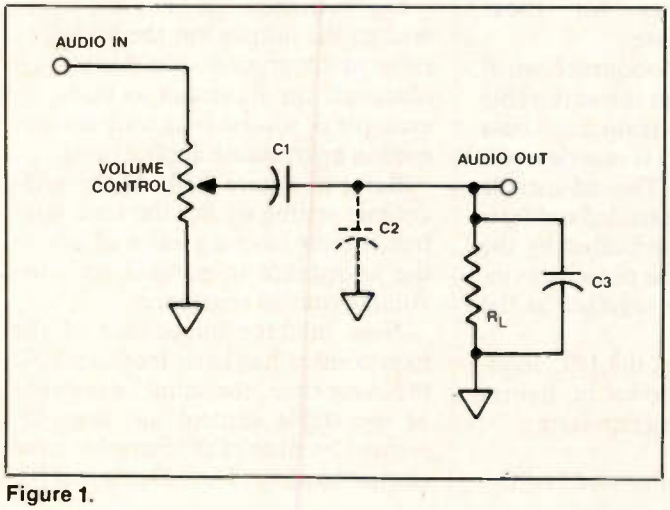


Figure 1.

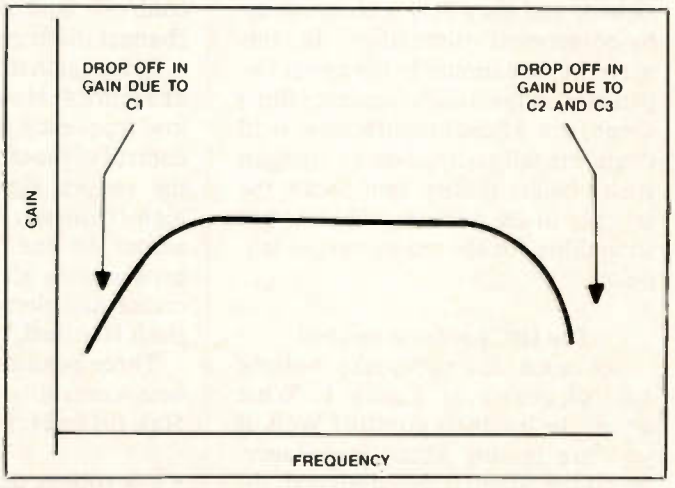


Figure 2.

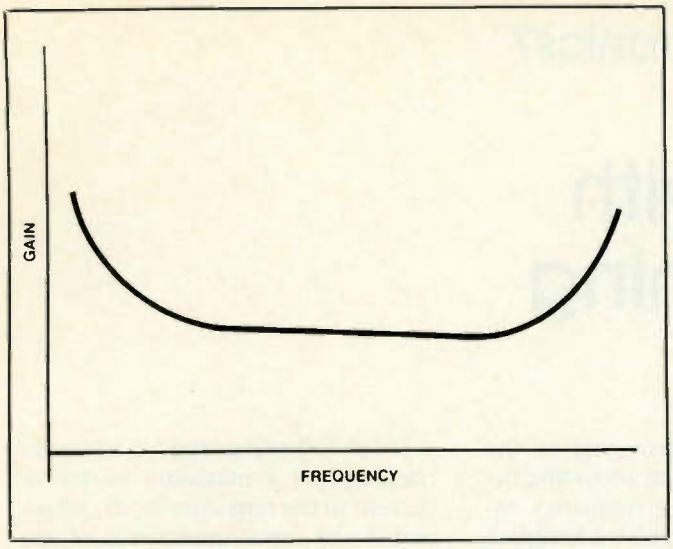


Figure 3.

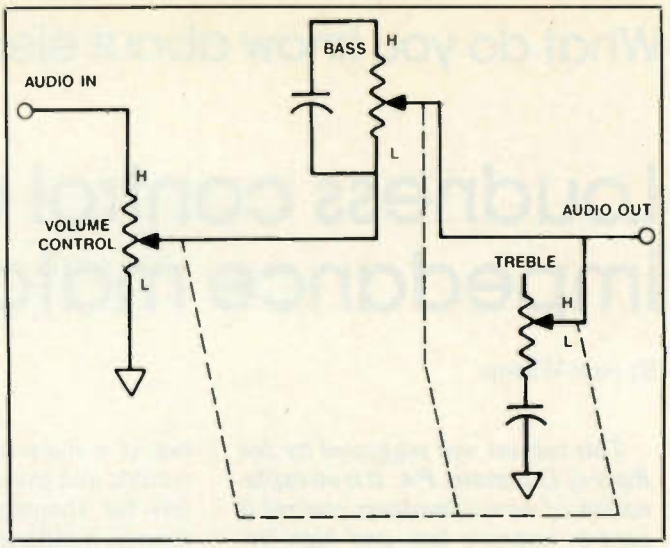


Figure 4.

cies. In other words, the low-frequency bass, and high-frequency treble sounds must be boosted in order for the human ear to hear them with the same loudness as the center frequencies.

Clearly, the response of the volume control circuit works against the needed boost at the end frequencies. A loudness control circuit has the frequency response shown in Figure 3.

Understand that there are well-designed loudness controls and then there are poorly-designed loudness controls. Unfortunately, the poorly designed versions don't work much better than the volume control circuits of Figure 1.

What the whole thing boils down to is whether we are talking about a high-quality system, or a $99.98 "high fidelity" discount store special. As for me, I would buy the discount store special because I have a zinc ear (that's worse than a tin ear). Some of the high-quality loudness control circuits are computer designed, and they defy a component-by-component discussion. In this way, they are similar to the newer impedance-coupled high-frequency (h.f.) amplifiers. I have manufacturer field engineers tell technicians to shotgun such circuits if they cant locate the trouble in 20 minutes. That is not something for the tender ears of students.

The IRC loudness control

So much for the junky volume control circuit of Figure 1. What about the loudness control? Well, if you are talking about impedance, and if the circuit is well designed, the impedance can be made more nearly constant as the loudness control is changed from a low to a high setting. This is accomplished by using three ganged variable resistors (see Figure 4). This circuit is called a loudness control.

One variable resistor is for adjusting volume and the other two are parts of adjustable filters. Since the volume control and the filter controls are ganged, the impedance of one circuit can be made to increase as the other decreases. That way, the overall impedance can be made nearly constant throughout the range of adjustment. An L is marked on the drawing at the low-resistance settings, and an H is marked at the high-resistance end.

Operation of the loudness control

The Fletcher-Munson curves show that the human ear has a loss of low-frequency response at low volume, and a loss of high-frequency response at high volume. The loudness control compensates for those changes in ear response.

Refer again to the loudness control of Figure 4. Note that the adjustable low-frequency filter (called the bass control in the circuit) is in series with the output signal. The adjustable high-frequency filter (called treble) is across the line. As indicated by the broken lines, all of the resistances increase and decrease together as the shaft is turned.

Three positions of the IRC loudness control are shown in figures 5(a), (b) and (c). They represent:

- low volume (and improved low-frequency response) - 5(a)
- medium volume - 5(b)
- high volume (and improved high-frequency response) - 5(c).

It is assumed that the output impedance of the circuit is a pure resistance. That is not a basic requirement of the circuit but it simplifies this discussion.

Refer to Figure 5(a). Looking in at point x, the audio generating amplifier sees practically no resistance of R_1 and R_2. At the output from the arm of R_2 there is the parallel impedance of two circuits: the treble tone control (and the load resistance). Since the arm of R_1 is near the bottom end, the tone control circuits impedance have very little effect on the impedance seen by the generator.

At this setting, the resistance of R_1 is negligible. Most of the high frequencies are shunted to ground through C_2. The low-reactance path of C_2 does not affect the impedance seen by the audio generator because of the low-resistance setting of R_1.

Summarizing, the lows are delivered to the output but the highs are shunted to ground. No doubt you recognize the R_3 circuit as being an example of a false bass tone control used in many audio applications.

Refer to Figure 5(b). At the mid-volume setting of R_1, the tone control circuits have a greater effect on the impedance in parallel with the volume control resistance.

Note that the impedance of the bass control has been increased. At the same time, the shunt impedance of the treble control has been increased because of the increase in the resistance of R_3. The effect is that the

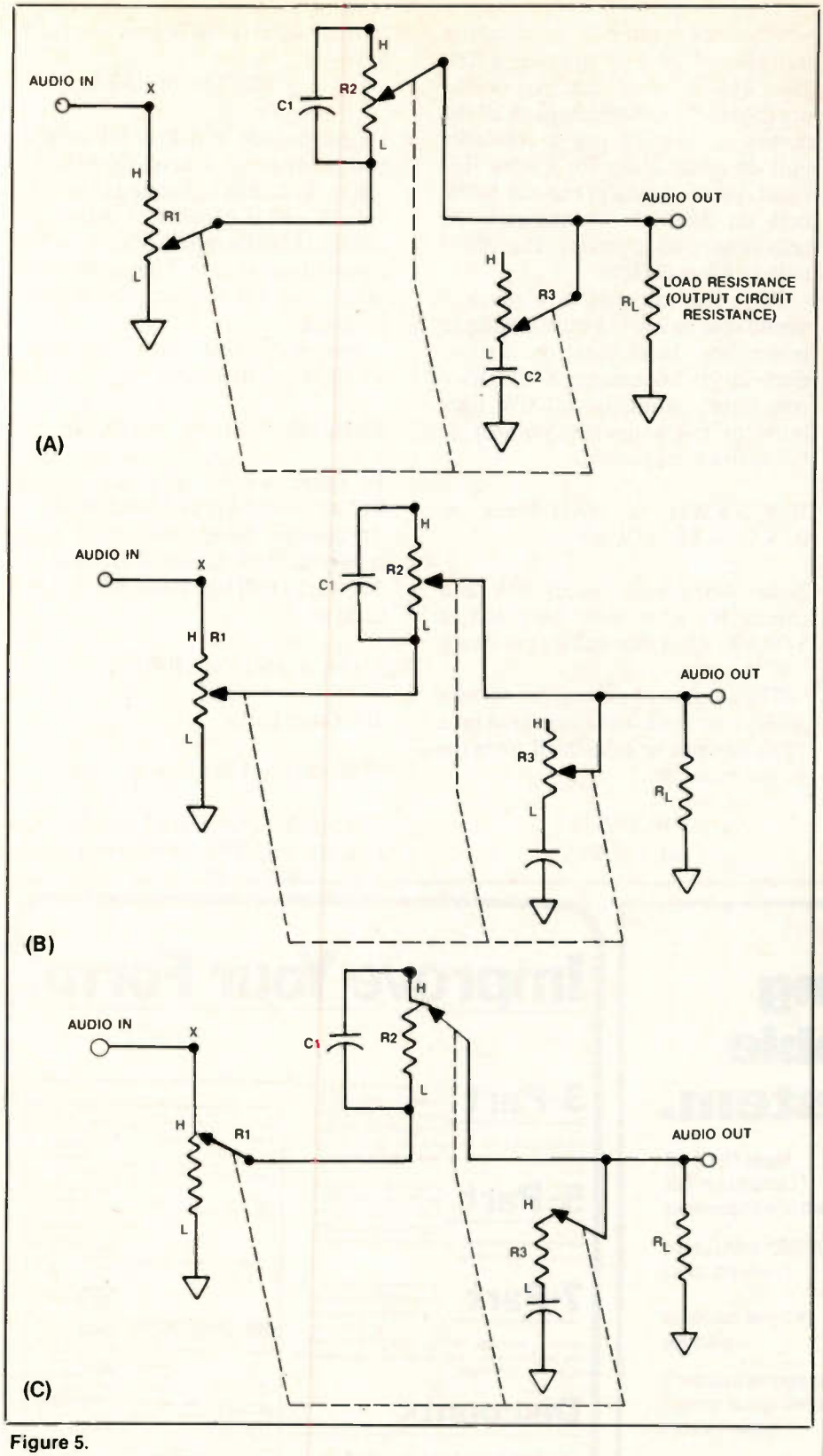


Figure 5.

impedance in parallel with R_L is higher. The resistance at the arm of R_1 is also greater. The overall impedance has not changed by increasing the loudness control setting.

At the highest volume setting of R_1 [Figure 5(c)], there is a parallel circuit comprised of R_1 in one branch and the tone control circuits in the other branch. Both tone controls now have their highest impedance settings so that the parallel impedance of the parallel branches is nearly the same as for the resistance of R_1 see Figure 5(a).

Capacitor C_1 passes the high frequencies easily to the audio out terminal, but the lows are attenuated by

the high opposition of R_2 and by C_1. At the same time, the high impedance of the treble circuit prevents the highs from being grounded. Therefore, the high frequencies are emphasized at the audio out terminal.

You can see that as the arm of the volume control is moved from its minimum to maximum volume setting, the impedance of the tone control branches increases. At the same time, the tone controls deliver maximum bass at the low-volume setting and maximum treble at the high-volume setting. If the circuit is not properly designed, the audio generating amplifier will not see a great change in impedance throughout the range of loudness settings.

How to raise a $4905 chicken; or batteries are great for operating portable equipment, but that electricity is expensive. Everyone knows that the electric bills are too high. Right? Well I'm going to show you one way to use alternate energy. Maybe you are paying more than you need to. Let's find out.

Suppose you are going to raise a few chickens to cut your food bill. You start with four little chicks and you need a brooder. Here is where your knowledge of electronics comes into play. You're going to use a 100-Watt bulb for heat, but you decide not to give the power company all the money it takes to run a 100-Watt bulb 24 hours a day for a week. Instead, you're going to run the 100W bulb on flashlight "batteries"—(C cells connected in series). The 100W bulb requires 0.1KW.

First, lets calculate how much it would cost to run the bulb off the ac power line. In Florida, the cost of electricity is 7.6 cents per KWH (kilowatt-hour). Running a 100W light bulb for 168 hours (the number of hours in a week) costs:

$0.076/KWH × 168H/Week × 0.1KW = $1.28/Week

Note: when you cancel KW and cancel H, what you have left is $/Week. Read that dollars per week.

The amount of current drawn by a 100W light bulb when operated on a 120V line can be calculated from the power equation.

$$P = V \times I$$
$$\text{so, } I = P/V$$

In this case P is 100W and V is 120V so

$$I = 100/120, \text{ or } 0.83A$$

To get the bulb to deliver full brightness (and heat), you need 120V/1.5V/cell = 80 C cells connected in series.

Each cell is capable of delivering 500mAH (milliampere hours), or 0.5 ampere hours (AH). That is the same number of AH you get from 80 cells in series.

Assuming that each cell costs $0.88, the cost of 120V is:

$0.88/cell × 80 cells = $70.40

In other words, you are paying $70.40 for 0.5AH or $140.80/AH. To operate the brooder 100W light bulb you must deliver 0.83A for the full week (168Hours). In AH that is a total of

0.83A × 168H = 140AH

It follows that:

$140/AH × 140AH = $19,600!

That is the total cost of electricity to operate the 100W bulb for one week.

Test your electronics knowledge

By Sam Wilson

By reading **ES&T** you are keeping up to date with today's technology. It is useful to periodically review what you have learned. The questions in this issue are based upon articles that were in 1989 issues.

1. In a stereo FM receiver, you can expect to find a de-emphasis circuit:

A) in the rf amplifier circuit
B) in the L + R circuit
C) in the L − R circuit
D) at the input of the audio power amplifier.

2. The crystal oscillator input frequency in Figure A. is 1.2 MHz. If $N_1 = 2$, and $N_2 = 7$, what is the output frequency of the VCO?_____.

3. The circuitry for a certain computer is contained on modular printed circuit boards. All of the boards are connected to one interconnection area in back of the computer. What is the name of the interconnection area?
_____.

4. With reference to computer systems, UPS stands for _____.

5. To demonstrate an information retrieval system, a computer was fed a day's worth of stories transmitted by a financial news service. It automatically picked those dealing with mergers and acquisitions. This system understands and categorizes information in two ways: bottom-up _____ and top-down _____.

6. If you increase the gain of an amplifier, you automatically decrease its _____.

7. For the familiar thru-hole printed circuit board _____ desoldering is the preferred method for removing components.

8. The ratio between the non-linear (repetitive peak) current, and the linear (RMS) value is called the _____.

9. Varactor tuning systems are divided into two types: _____ and _____.

10. The IEEE-488 format interface system used to connect test instruments to computers is also called the _____ _____ _____ _____, or Hewlett Packard interface bus (HPIB).

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

(Answers on page 55)

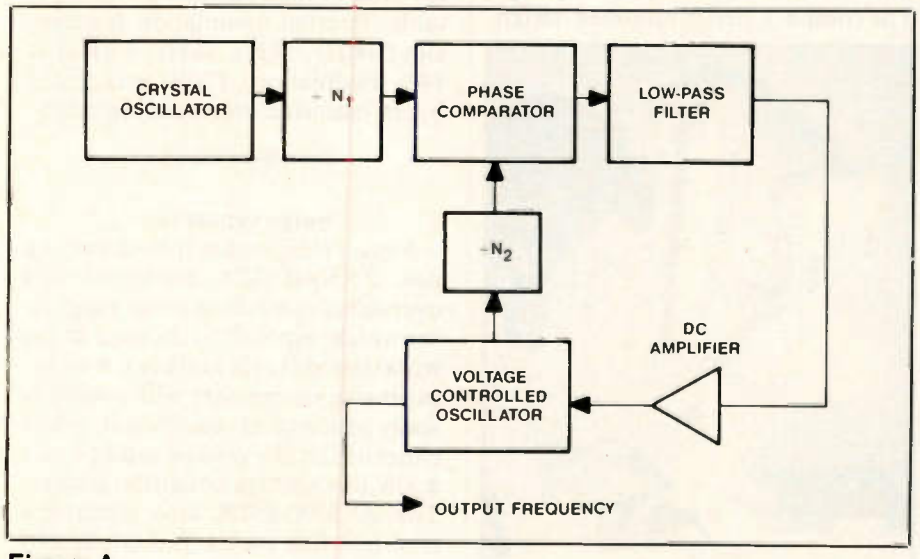


Figure A

Pen multimeter with logic

Extech Instruments has announced their new autoranging pen-sized 8 function digital multimeter with built-in logic probe tester for indicating CMOS/TTL threshold levels. Functions include dc/ac voltage

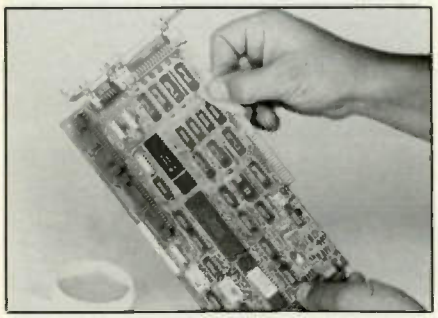
to 500V, dc/ac current to 200mA, resistance to 20MΩ, diode test and continuity test. Large 0.5" LCD displays function and measurement, plus indicates low battery and polarity.

Other features include data hold button which freezes displayed value, audible and visual overrange indication, and fuse protected AC/DC current range. Comes complete with two 1.5V button type batteries, test clip for multimeter use and power leads for logic test.

Circle (5) on Reply Card

DeOxidizer wipes

Cramolin Laboratories introduces their new DeOxidizer in convenient and economical WIPE applicators that are non-flammable, non-toxic and ozone safe. The DeOxidizer is a

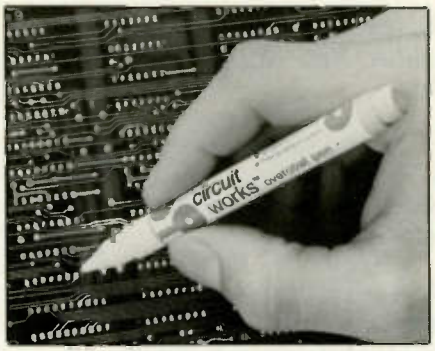


fast acting deoxidizing solution that cleans, preserves, lubricates and improves conductivity on all metal contacts, connectors and other metal surfaces, including gold. Kit includes 50 wipes in a pocket size polypropylene container. Ideal for usage on edge connectors, batteries, interconnecting cables, plugs, sockets, switches, relays, etc.

Circle (6) on Reply Card

Overcoat insulating pen

Planned Products introduces the 3300 Circuit Works overcoat pen to insulate, protect and repair circuit boards, components and delicate electronics. The 3300 pen applies a conformal overcoat to insulate against shorting, arcing and static discharge while protecting against moisture, abrasion, chemicals and other environmental hazards. When used to repair solder mask the overcoat pen improves the reliability and safety of circuit board modifications and repairs. The overcoat pen uses proven pen technology to apply the



overcoat protection as easily as writing. Engineers, technicians and hobbyists use the circuit works overcoat pen primarily in the prototype, manufacture and repair of circuit boards.

Circle (7) on Reply Card

Mini extractor

Nederman announces the Mini extractor which removes dangerous airborne contaminants at the source. The compact, bench mounted design

is engineered to remove soldering and chemical fumes, while providing an aesthetically pleasing addition to a lab, soldering station or clean room. The unit can also be mounted on a wall or ceiling with an optional bracket. The addition of an optional charcoal filter will allow the Mini Extractor to remove odors as well. Other options include a 20W halogen lamp and hood. The unit can be installed to an individual fan or manifolded with a central system. The arm and optional hood are constructed of polypropylene, which has a temperature resistance of 250 F degrees at a continuous use level. The arm has three joints and a base swivel. Air velocity within the Mini extractor is 1575 FPM at a recommended air volume of 60 CFM.

Circle (8) on Reply Card

TV stereo signal generator

New from *Leader Instruments* is a low cost/high performance MTS signal generator, model LMS-238 which complements the company's laboratory grade MTS signal generator, model LMS-237. This versatile generator provides the necessary signals for test and alignment of both stereo and SAP (secondary audio program) decoders.

On screen character displays (L + R,L,R,L − R) indicate the selected mode of stereo or mono operation. Composite stereo and SAP outputs at baseband, pinpoint the area of malfunction. Four selectable, internal modulation frequencies (300Hz, 1kHz, 3kHz, 8 kHz) at 14% modulation (-17dB) as required by the manufacturers, are provided.

Circle (9) on Reply Card

Surge suppressor

Sutton Designs has introduced the new ZX5000/GTX brownout and overvoltage switching surge suppressor which responds to the need in the workstation/LAN market for an inexpensive device that will automatically disconnect equipment when either a high line voltage condition or a low line voltage condition occurs. The ZX5000/GTX also eliminates transient line surges and conducted line noise and contains the compa-

(Continued on page 56)

Test your electronics knowledge

Answers to the quiz

1. B - The pre-emphasis circuit is in the transmitter L + R audio signal path. In the stereo receiver, the de-emphasis circuit is also in the L + R audio circuit path.
"Troubleshooting problems in the de-emphasis circuit - Part II," August 1989 issue.

2. $f_1 = 1.2MHz/2 = 0.6MHz$
$f_2 = 0.6MHz \times 7 = 4.2Mhz$

3. Backplane. "Troubleshooting Zenith microcomputers," July 1989 issue.

4. Uninterrupted power supply. [also called uninterruptable power supply] "Assuming an uninterrupted power supply," September 1989 issue.

5. Parsing. According to the American Heritage Dictionary, parsing is breaking sentences down into their component parts of speech with an explanation of the form, function and syntactical relationship of each part. "The computerized library," December 1989 issue.

6. Bandwidth. "Test your Electronics Knowledge," July 1989 issue.

7. Continuous vacuum. "Focus on soldering and desoldering," November 1989 issue.

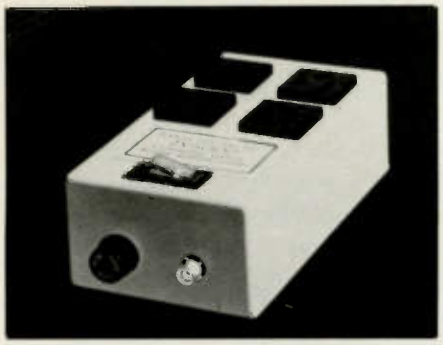
8. Crest factor—"Selecting a UPS," November 1989 issue.

9. Voltage synthesis and frequency synthesis—"Troubleshooting varactor tuners—Part 1," November 1989 issue.

10. General purpose interface bus (GPIB)—January 1989 issue.

If you knew the meaning of parsing —without looking it up—give yourself 100% for the test. There have to be SOME benefits for geniuses.

(from page 54)

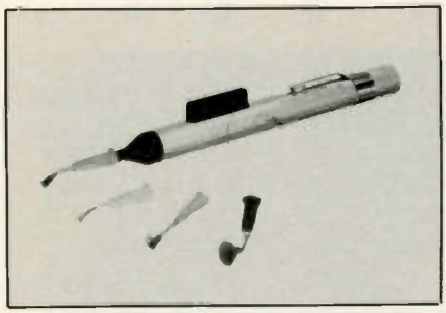


ny's positive shutdown circuitry, which prevents a catastrophic line surge caused by lightning from damaging the protected equipment. It also has an energy dissipation rating of 480 joules and has earned the best U.L. suppression rating of 330V.

Circle (10) on Reply Card

Vacuum pickup tool for SMT components

Desco Industries, announces the Vacpik which is a fully self-contained vacuum handtool (no pumps or hoses) that, through suction, picks up and places small parts. It is designed for use on and around circuit boards



and is perfect for picking and placing surface mount devices of all kinds. The Vacpick's maximum pickup capacity is 2 oz and it requires only one hand to operate. It is available with six different tip sizes in a variety of kits.

Circle (11) on Reply Card

Digital analog multimeter

New from *Protek* is a full function ing digital and analog multimeter known as A-455. The analog scale is easy to read and an excellent indicator for nulling, peaking and trend indications while the bold 3 1/2 digital LCD read-out delivers precise measurement value. The "DAMM" is true rms indicating for both ac voltage and current. The ac frequency response is over 100kHz on the 200mV range, 20kHz on the 2 volt range. This plus dB measurement capability makes this meter very useful to telecommunications, audio and industrial technicians. Seven ranges of ac and dc current provide for measurement from 10A to a low 10nA which is desirable when checking circuits and components for leakage. Diode test and audible continuity check are also provided.

Circle (12) on Reply Card

Hand held parts tester

B&K Precision has introduced a new hand-held parts tester with digital read-out and has been designed for field service or general industrial applications. The model 815 tests

capacitance and resistance in a variety of components; and tests transistors, SCRs, diodes, LEDs and batteries in 26 ranges. Designed to withstand a five-foot drop, the 815 is also water and overload resistant. Its case will seal out rain, grease, dirt and other adverse environmental contaminants.

Circle (13) on Reply Card

Literature for all-in-one LAN tester

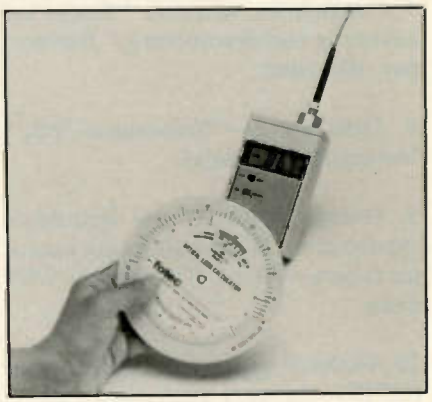
Beckman Industrial is offering a free six page, full-color brochure for the TMT-1 used in Local Area Networks (LANs) certification. The TMT-1 is a small (9.5"x 6.3"x 2.0"), lightweight (less than five pounds)

portable instrument designed to verify the capability of installed LANs to conduct high reliability information traffic. It performs a series of electrical test in automatic sequence (Auto-Test) or individually under operator control (Diagnostic mode).

Circle (14) on Reply Card

Fiber optic survival kits

Fotec has introduced a new series of fiber optic survival kits designed to allow the user of fiber optic networks to quickly diagnose network faults for easier restoration. These kits are easy to use and inexpensive, making them ideal for even the smallest user of fiber optics. The survival kit is a simpler, more inexpensive kit that contains only a Fotec Mini-series fiber optic power meter, connector

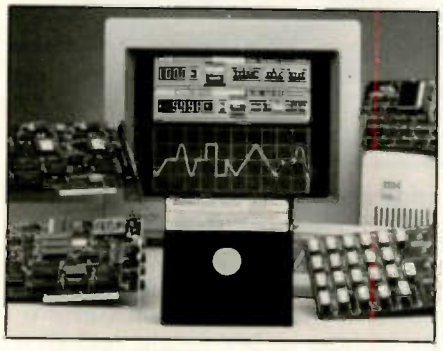


adapters and a optical loss calculator. This is adequate test equipment for diagnosing network problems and costs less than half the cost of a normal test kit.

Circle (15) on Reply Card

Demonstration disk

Keithley Instruments, announces the PCIP-DEMO which is a free easy to use, menu-driven demonstration disk featuring the Personal Comput er Instrumentation Product (PCIP) family of plug-in instruments on a board. It is available on a 5 1/4 inch disk, 360K format and requires 256K RAM and DOS 3.00 or greater. The

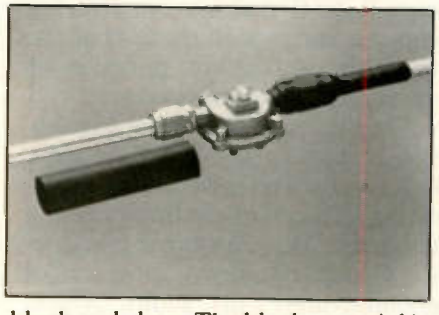


PCIP-DEMO is an overview for MetraByte's line of single board instrument products for IBM PC/XT/AT and PS/2 computers and compat ible computers. These products are designed to provide the user with a full featured yet low cost alternative to bench top/rack mount instruments. It is easy to use, displays up to four instruments simultaneously on the PC screen from a selection of six instruments plus the demo.

Circle (16) on Reply Card

Dual wall heat tubing

New from *Electro Insulation* is their dual watt heat shrinkable tubing rated for continuous operation at 125 C. New DWP-125's adhesive liner melts and flows to seal and encapsulate components or splices contained within. Standard colors are

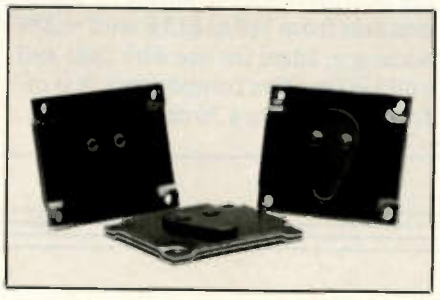


black and clear. The black material is flame resistant and the jacket conforms to UL 224 VW-1 requirements. Sizes range from 1/8" to 2.0". Several applications include: strain relief on connectors, encapsulating crimp splices, and for non-slip markers by using the clear material over standard markers.

Circle (17) on Reply Card

Radio cases

A.W. Enterprises, features two-way radio cases with stamped metal quick-release swivels. The swivel's patented tear drop design allows the user to quickly disconnect the carrying case from the belt, or comfortably swing it out of the way. Formed from strong cold-rolled steel, it has a longer life and is two ounces lighter than the diet cast swivel it replaces. The new swivel is just one-quarter inch thick, holding the radio 46% closer to the body where it is less likely to bump against objects. The



stamped swivel is compatible with all of A.W.'s previous teardrop swivels and available on the company's full line of two-way radio cases which are made from 8 ounce leather, nylon thread, and corrosion-resistant stainless steel hardware.

Circle (18) on Reply Card

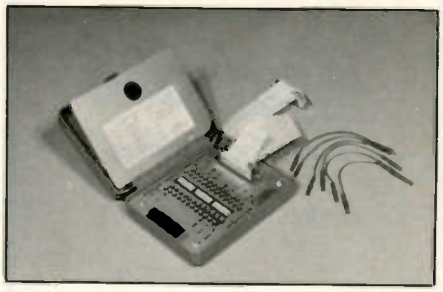
New circuit designers

Philips ECG Introduces the ACD100 Analog circuit designer for designing and testing linear circuits and the DCD100 digital circuit designer for designing and testing digital circuits. They include a solderess breadboard system, power supplies, signal sources, support circuits and components allowing the user to design experiment or test electronic circuits or components with one convenient unit. It is equipped with two adjustable regulated 300mA DC power supplies (#1.25V to #15V) and two fixed AC power supplies (15V and 250mA and 30V 500 mA). Other features include an adjustable 200Hz to 200 kHz function generator with triangle, square and sine wave outputs.

Circle (19) on Reply Card

Interface analyzer

Electro Standards Laboratory, Inc. has announced its model 600 EIA RS-232 interface analyzer. It is a diagnostic tool designed for use at the



standard EIA RS-232 or CCITT V.24 data interface modems, multiplexers, terminals and computers. It is simply inserted in series between the Data Terminal Equipment (DTE) and the Data Communications Equipment (DCE) to provide access to and monitoring of all data, timing, and control signals. The Model 600 utilizes high efficiency Red LED's to clearly display polarity, activity, and validity of all interface signals.

Circle (20) on Reply Card

ACL conductive cleaner

ACL Inc, announces the availability of its new improved conductive

cleaner. ACL is ideal for cleaning any production area. It cleans without leaving any film, and is safe to use on any surface, and is non-abrasive and non-flammable. The cleaner is ideal for all conductive surfaces, anti-static mats and work stations. They are available in quarts and gallons.

Circle (21) on Reply Card

Temperature control soldering station

M.M. Newman announces a fully adjustable temperature control soldering station and choice of either 30 of 40 watt soldering irons for use with heat and voltage sensitive components. The Antex TCSU-1 temperature control station features a sliding potentiometer to adjust tip temperatures from 160 to 815 F with ± 2% accuracy. Ideal for use with heat and voltage sensitive components, it is offered with either a 30 or 40 watt soldering iron which has a thermocouple in the tip for positive feedback.

Eliminating RF interference and magnetic fields, the Antex TCSU-1 is powered by 115 VAC and converts line voltage to 24V for the soldering irons. Equipped with 4 foot burnproof silicone cord and a 5-pin DIN connector, the soldering irons accept a full range of slide-on tips.

Circle (22) on Reply Card

News

(from page 5)

be rated 94HB or less flammable if encapsulated by a material rated 94V-0 or better.

UL welcomes suggestions on functions or charateristics to be evaluated, ideas regarding the test methods or other means of evaluation, and other suggestions or comments that may help in the development of this standard. Participation will be by correspondence.

UL seeks revisions for Safety for Radio Receivers, Audio Systems, and Accessories, UL 1270.

Underwriters Laboratories Inc. 1270 covers powered-operated radio receivers, audio systems, and accessories, involved with the reproduction of audio signals, that are intended for household use on supply circuits in accordance with the National Electrical Code. These requirements also cover amateur radio equipment, amplifiers, head demagnetizers and much more. It does not however, cover combination units consisting of a television receiver and some other appliance, such as a radio or phonograph or tape player and the like. Among the items to be addressed by the revisions are polarized attachment plugs and dated references to the National Electrical Code. UL welcomes suggestions on functions or characteristics to be evaluated, ideas regarding the test methods or other means of evaluation, and other suggestions or comments that may help in the development of this standard.

Lauterback appointed to EIA/CEG Member Services Post

Thomas K. Lauterback has been appointed staff vice president, member services, of the Electronic Industries Association's Consumer Electronic Group (EIA/CEG) according to an announcement by Gary J. Shapiro, EIA/CEG vice president.

"The increasingly competitive and sophisticated consumer electronics marketplace requires a strong member services program. Tom's industry experience combined with this knowledge of EIA will provide a strong base for solidifying our member services program. This appointment is the first step in our effort to improve and expand the level of service our association provides its members," Shapiro stated.

The Electronic Industries Association is the 66-year-old Washington, D.C.- based trade association representing all facets of electronics manufacturing. The Consumer Electronics Group represents most major manufacturers of audio, video, home office and home automation products, as well as assistive devices for the handicapped, in the United States.

Classified

Classified advertising is available by-the-word or per column inch. By-the-word: $1.65 per word, per insertion. Initials and abbreviations count as full words. Blind ads (replies sent to ES&T for forwarding) are $40 additional. Minimum charge: $35 per insertion.

Per Column Inch (Classified Display): $235 per column inch, per insertion, with frequency discounts available. 1" minimum, billed at ¼" increments after that. 10" maximum per ad. Blind ads are $40 additional. Reader Service Number $25 additional to cover processing and handling costs. (Free to 4-inch or larger ads.)

Optional color (determined by magazine) $150 additional per insertion. No agency discounts are allowed for classified advertising.

Contact Jeff Uschok, 516-681-2922, for information on frequency and pre-payment discounts, or to place your classified ad. Or send your order and materials to Jeff Uschok, Electronic Servicing & Technology, 76 North Broadway, Hicksville, NY 11801.

BUSINESS OPPORTUNITIES

LARGE AUDIO/VIDEO SERVICE BUSINESS: In sunny S.W. city. Established 20 yrs. Well equipped. Price and terms negotiable. (602) 298-8827, Eves. 8-89-tfn

AUDIO, VIDEO, SERVICE BUSINESS: In Kingston, NY, 100 miles north of New York City. Factory authorized service for over 70 brands. Fully equipped and well established in community. Turn key operation. Days 914-331-2812, Eves 914-339-5251. 11-90-1t

TV/VCR SERVICE BUSINESS: In beautiful east Tenn. Over $20,000 in inventory and test equipment. Will sacrifice for $15,000. Call Don 1-615-623-5025. 10-90-3t

FLORIDA SUN COAST: Zenith - sales and service. Good opportunity for young ambitious technician. Will finance. (813) 746-2404. 11-90-1t

PROFITABLE: Well established VCR Repair Service For Sale. Equipment and Inventory. Kerrville, Texas (512) 896-1669 $35,000. 11-90-1t

WELL ESTABLISHED: TV and Antenna Sattelite business and home in Northern Wisconsin. Both shop and home overlooking Plum Lake. Sayner Wisconsin (715) 542-2452. 11-90-1t

FOR SALE

TELEVISION AND MONITOR TROUBLESHOOTING BOOKS: 336 Problems/Solutions, $12.00, 35 Steps to Easier Television Repairs, $15.00 Add $1.50 shipping. Refunds if not satisfied. Fred Jones, 407 Morningbird, Niceville, FL 32578. 12-89-tfn

REDUCED 85%, Diehl Mark 111 scanner $89. Diehl Mark V scanner $219. New. Restore remote control keypads with our conductive coating $8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629. 608-233-9741. 6-90-tfn

TV TOUGH DOGS: 300 symptoms and cures. Send $9.95 to DAVIS TV, 11772 Old Fashion Way, Garden Grove, CA 92640. 10-87-tfn

VHS-VCR Repair Solutions Sets I,II,III,IV,V. Each contains 150 symptoms and cures, cross reference chart, free assistance, $11.95 each all five $49.95. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530. 12-89-tfn

TV/VCR REPAIR SOLUTIONS: Printout or IBM compatible with hard drive. 3,400 solutions. time saver, quick scan by make, model chassis or stage $90.00. Post paid to electronics Solutions 407 W. Ave "N", San Angelo, TX, 76903. 7-90-tfn

COMPUTERIZE: With the Service Manager. COD and warranty service, NARDA Forms, Inventory and Accounting. The Service Manager does it all. See our demo or video before purchasing any software (from $495). CMI Computer Systems (516) 584-8188. 9-90-3t

PHOTOFACTS: Folders under -1400, $4.00. Above -1400, $6.00, sent same day first class postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 9-90-3t

SAVE TIME AND MONEY: The DTS125 Digital Timekeeping System automatically tracks service time and charges for your repair jobs. Large memory stores up to 125 in-process jobs. Trial period. $289.00 + $3.50 S&H. Johnson Electronic Technologies, 5 Kane Industrial Drive, Hudson, MA 01749 (508) 562-1157. 11-90-2t

VCR SYMPTOMS & SOLUTIONS: Including Emerson, Fisher, RCA. Over 100 Symptoms and solutions for the most popular brands - $1095. Johnsons TV - Video, Helmwood Plaza, Elizabethtown, KY 42701. 11-90-1t

SENCORE EQUIPMENT: Like new-VA62 Video Analyzer-VA63 VCR accessory and NT64 pattern generator all for $2800.00. SC-61 Oscilloscope for $2100.00. CR-70 Picture tube rejuvinator -$850. Call 1-614-446-2713. 11-90-1t

SENCORE VCR REPAIR EQUIPMENT: SC 61, PR 57, VC 63, NT 64, DVM 37. Excellent condition. Call Glenn Brooks for information (708) 864-9352. 11-90-1t

TEKTRONIX: 2247A oscilloscope with 5 probes and cover. Near new condition, original shipping box. (707) 823-1103. 11-90-1t

EQUIPMENT WANTED

TUBES WANTED: We buy receiving and transmitting tubes. Send your list for bid. New tubes in original boxes only. Also need radio. I.F. XFMRS. Antique Electronic Supply, 688 West First St., Tempe, AZ 85281. Phone 602-894-9503, Fax 602-894-0124. 3-90-tfn

MISCELLANEOUS

LOTTERY NUMBERS: With a built in 100% guarantee! Hit the lottery on purpose! Catalog of 80 IBM/Comp. programs $5. Sigma Box 24759 Dept: 02 Baltimore, MD 21220. 11-90-12t

VCR TECHNICIANS: Tech tip to remove any Fisher idler wheel quick. $5.00. Berge Systems, P.O. Box 95, Buffalo, NY 14205. 11-90-1t

ATTENTION: Hiring! Government Jobs in your area. Many immediate openings without waiting list or test! $17,840 - $69,485. Call (1) 602-838-8885, Ext R-13464. 11-90-1t

Readers' Exchange

Readers' Exchange has been reinstated as a free service, effective with the February issue.

The following restrictions apply to Readers' Exchange:

- Only individual readers may use Readers' Exchange, and items must be restricted to those that are ordinarily associated with consumer electronics as a business or hobby. If you're in business to sell the item(s) you want to offer for sale, the appropriate place for your message is in a paid advertisement, not Readers' Exchange.
- Readers' Exchange items must be restricted to no more than three items each for wanted and for sale, and may be no more than approximately four magazine column lines in length (about 20 words).

Send your Readers' Exchange submissions to:

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

WANTED

Sams Photofact -1937-3. *Joe Mehalko 324 4th Street Blakely, Olphant PA., 18447.*

Owners manual for Realistic Comp 100 scanner-1 copy. *Keith Tonn, P.O. Box 103 Coleman, WI 54112.*

Knobs for H.H. Scott 357B stereo receiver. (Tuning and volume, balance and input select.) *Douglas Ellis, 129 Sycamore, Grandview, MO 64030.*

Supremes TV-1, TV-2, TV-11, and R-17 "Most Often Needed Manuals." *Charles T. Huth 229 Melmore St., Tiffin, Ohio 44883. (419) 448-0007.*

6267/EF 86 Tubes, new only; also SAMS TR Manuals, Singles or complete, reasonable. *A. Wieland, 1374 Wright St., Holly Hill, Florida 32017. 904-258-5659.*

Need out of print schematics for JVC boombox Model No. RC-M70JW. *Jerry Beisbier, 314 S. 9th avenue., West Bend, WI 53095. (414) 338-8663.*

Old time 25A-Amphere meter. Vertical board or whole chassis for Sony Model #KV-1722. Frequency counter 10HZ to 150 KHZ. *Ralph Dorough 117 Pecan St., Terrell, TX 75160. 214-563-7105.*

Information of schematic for a CODE-A-PHONE answering system Model No. 1400, made by Ford Industries Inc. Will buy or copy and return. *Sal Cribari 1312 Well Drive, Camp Hill, PA 17011. (717) 763-4547.*

Early Color TVs-pre 1955 and or 15GP22/15HP22, parts related literature. Call collect eves and weekends—*John Folsom 407-725-3462. 450 Golden Dove Ave. Palm Bay, Florida 32907.*

Schematic for EICO wide band scope model #460. Will copy and return or pay for copy. *Gerard Gara 11 Craig Lane, Levitown, NY 11756*

Service literature for Panasonic wide screen TV model CT-4600. Discountinued from Panasonic. *Glenn Hering 18 Brookview Circle. Jamesburg, N.J. 08831. (201) 521-5618*

Advertisers' Index

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

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ELECTRONIC Servicing & Technology

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

Readers' Exchange

Schematic for SONY TV 700U portable B & W TV. Will buy or preferably copy and return. *Andy Berger/Metro Camera 1470 South Federal, Denver, Colorado, 80219. 303-934-2471.*

Surge suppressors, new ZX-500 (PSC). Rally circuit to surge. Atrovent 500 dd tuner, CAT scan tuner. Paul Smohen, 17 Salmon Lane, Scrittna, FL 33125.

FOR SALE

B&K V.V.O Meter model #177 with book-$85. RCA WV 98C Senior volt O Hemyst meter with book-$75. *Alex Minelli 718 Michigan St., Hibbing, MN 55746. (218) 263-3598.*

Sams Photofacts sets #500 to #571. $1.00 each or all 118 sets for $75 plus shipping and handling. *John Brovakis, 247 Valley Circle, Charleroi, PA 15022, 412-483-3072.*

Sams AR #18-323 missing a few would like to sell all (271 total) $3.00 each or best offer. *A.J.'s Electronics 601-A Herbert St., Portorange, FL 32119, 904-767-0672.*

Test Equipment-waveform analyzer, video analyzer, pattern generator, VCR test accessory, variable isolation transformer, digital volt meter. *Video Clinic 136 11s Dixie High, Sweet 106 Miami, FL 33176 (305) 253-0044.*

Devry Electronics TV-Home entertainment correspondenance course. (Vintage 1979)-Best offer. You pay for shipping. *D. Young 117 North Holly Ave., Highland Springs, Va. 23075.*

BDK 80 MHZ frequency counter like new $125.00. *L.J. Pedensen, 6001 Fsenont St., Lincoln, MI 68507, 402-466-4585.*

Sencore equipment: Good condition. SG165 AM/FM stero analyzer-$965. CR31A picture checker and restorer $550. LC53 CAP Meter and Coiltester $600 and much more send for list. *(313) 427-0499.*

1-4 ft. Yeats appliance Dolly. 1-24 x 24 x 30" tubular frame, T.V. table, revolving casters. Both in excellent condition-$60. *Robert S. Rash, (714) 696-2019.*

Tubes and Sams: send large stamped envelope for complete list. *William Maida 274 W. Sabal Palm Pl., Longwood, FL 32779 (407) 869-6138.*

Heathkit: 0-10 Scope-$49, V-7A VTM $35, tube tester-$39, AJ21 AM tuner (unwired)-$25. DR1-Dec Res-$39. In-11 Dec Res $49, Simpson 305 tubetester $30, RCA WV97A VTM, $35. Riders Vol 12 $10. Sams TR and AR Books Low Noise $4 each. *718-463-4110.*

Standard brand new tubes in manufacturers cartons 90% off list price, service manuals, radio and TV parts, magazines, text books. Send Large S.A.S.E. *Max Seligsohn 1455-55th Street, Brooklyn, NY 11219.*

Kenwood CS-1044 40 MHZ dual trace oscilloscope. Approx 2 1/2 years old. Used very few times. $500. *Jim Thiessen 337 W. 1st Buhler, Kansas 67522. (316) 543-2609.*

Sencore test equipment SC61 scope, VA62 with NT64 pattern generator, VC63 VCR Head Tester and EX31 expansion Jack-$4,000. Call Mike (503) 656-8655

FLUKE®

PHILIPS

High Resolution Digital Meter: 4000 count digital readout; 20,000 count mode (Fluke 87) for 4½ digit resolution

Backlit display: Makes it easy to read the DMM in dark, cramped quarters. Automatically shuts off after 68 seconds to save the battery.

Recorder: records minimums and maximums, plus true arithmetic average; audible Min Max alert; selectable response times—1 second and 100 ms (all models) plus 1 ms Peak Min Max (Fluke 87)

Holster with Flex Stand™: Protects meter and provides test lead storage. Flexible leg allows meter to be hung from peg, bent around a pipe, or used almost anywhere.

Analog Meter: High-speed analog display updates 40 times/second—as fast as the eye can follow; X10 Zoom bargraph mode (Fluke 83 and 85) makes high resolution offset measurements a snap.

Frequency counter: Accurate down to 0.5 Hz; also measures duty cycle

Capacitance meter: Autoranging, with manual ranging at the touch of a button

FLUKE 83	FLUKE 85	FLUKE 87
Volts, ohms, amps, diode test, audible continuity, frequency and duty cycle, capacitance, Touch Hold® relative, protective holster with Flex-Stand™		
$215*	$255*	$300*
0.3% basic dc accuracy	0.1% basic dc accuracy	0.1% basic dc accuracy
5 kHz acV	20 kHz acV	20 kHz acV
Analog bargraph and zoom	Analog bargraph and zoom	High resolution analog pointer
Three year warranty	Three year warranty	True-rms ac
		1 ms PEAK MIN MAX
		4½ digit mode
		Backlit display
		Three year warranty

*Suggested U.S. list price

Multi-Meter

Meet the meter that brings an entire test bench to your job. The versatile Fluke 80 Series do-just-about-everything "Multi" Meter.

It offers everything you'd expect from an advanced handheld DMM, plus a lot you'd find only in dedicated instruments. *Plus* Fluke-exclusive features you can't buy anywhere else. All built with the most advanced surface mount design and single-chip ASIC technology for a thinner, tougher, more reliable package.

There's a fully annunciated display for clear operation. Duty cycle function. High-speed analog indicator. A protective holster with innovative Flex-Stand™ for easy, adaptable operation. Audible Input Alert™ to reduce the risk of damage to the meter, the user, and the unit being tested. Plus the strongest warranty in the business.

All good reasons to move up to the truly-multi Fluke 80 Series today. You'll find 80 Series DMMs at your Fluke distributor. For immediate, off-the-shelf delivery. Call

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