

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

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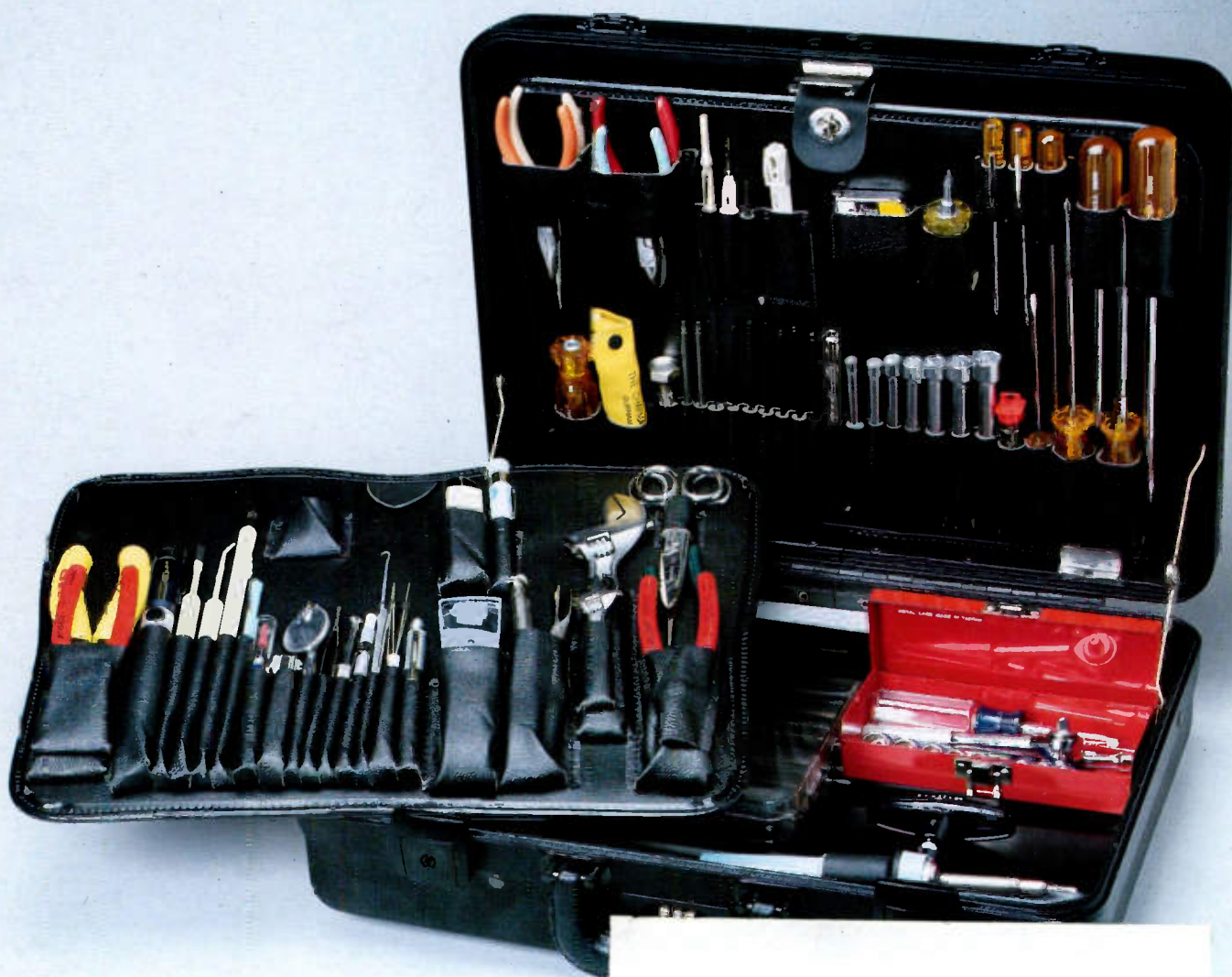
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The service bench: Heart of the service center

Three tough TV dogs

Planning the technician's toolkit



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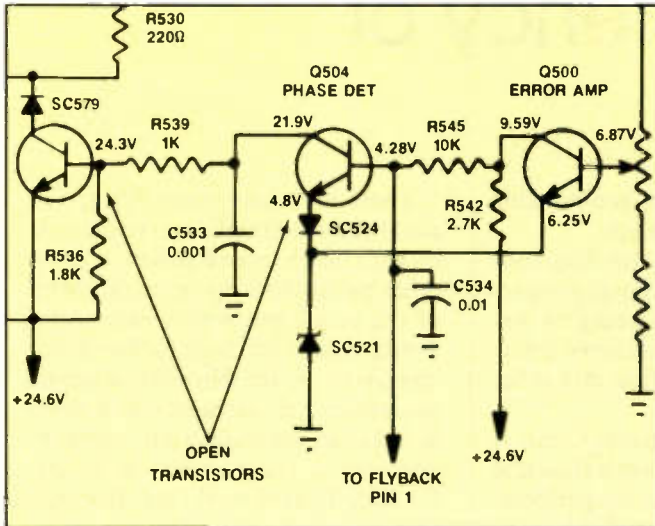


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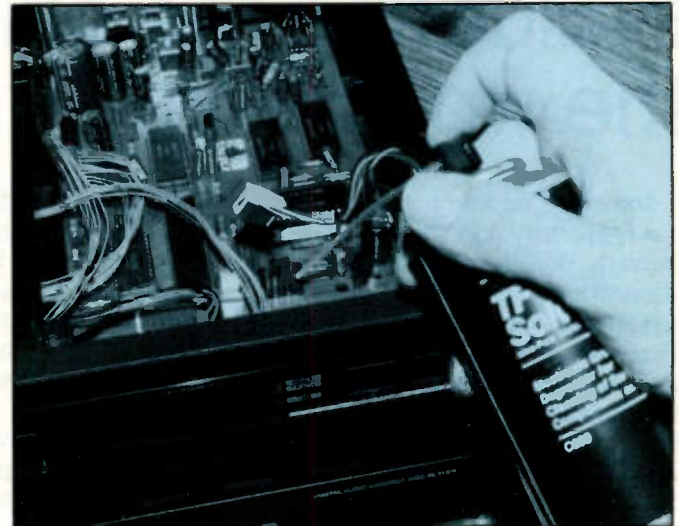
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FEATURES

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By Conrad Persson
 Although most consumer electronics servicing is done on the service bench, servicing on site is increasing. Read this article to see how today's toolkits are providing many of the amenities normally found only on the well equipped bench.
- 11 The service bench: Heart of the service center**
By Conrad Persson
 The best way to make sure that the service bench is an efficient place for servicing consumer electronics products is to think through precisely what tasks are performed there.
- 15 Three tough TV dogs**
By Homer Davidson
 There are many reasons that diagnosing the cause of a malfunction in a consumer electronics product may be difficult. In this article Davidson describes several of these "tough dogs."

- 20 Dealing with poor connections**
By Victor Meeldijk
 Bad connections are among the leading causes of equipment failures, and frequently among the most frustrating to the servicing technician. In this article we will provide some actual examples of this failure mode, and how to deal with them, in products ranging from a hand held calculator to a computer system.
- 24 Cleaning electronic game cartridges**
By Matt McCullar
 Any electronics product, such as a video game, whose function relies on metal-to-metal contact for connections that transfer signals at low power levels will be susceptible to problems.
- 37 Servicing audiocassette decks**
By Sheldon Fingerman
 Most of the problems that a technician will encounter during servicing of audiocassette decks are mechanical. Parts wear out; lubrication fails sometimes, and other times contaminates parts that shouldn't be lubricated; tape heads and other parts of the tape path become clogged with oxide.

for the new products, processes, components, circuits and concepts that are introduced.

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ON THE COVER

With the right tools, servicing a malfunctioning product is a breeze. Without the right tools, that same service job may become a nightmare, or simply impossible to complete. Planning and stocking a toolkit is an important part of efficient servicing. (Photo courtesy Jensen Tools Inc.)

Evaluating the efficiency of the workbench

Somehow we know it intuitively, but frequently don't really think it through, that the work at the bench takes an amazing variety of tools, test equipment, support facilities, supplies. Take for example the servicing of a TV set. For starters, it takes a screwdriver to remove the screws that hold the back of the set on. Then you need some place to temporarily store the back while you work on the set.

Once you have the unit opened up, you will want to have the service literature so you can locate the circuits that the symptoms point to. Where do you place the service literature while you're doing the work? Or do you use a microfiche and reader to read the appropriate information.

Generally, the technician's first step after finding the general area where the problem is suspected to be, is to do a little visual inspection. Do any components look burned, or as though they've been subjected to overheating? Are there any obviously broken wires or traces? Frequently, however, the lighting available to the technician is really not equal to this demanding task. And in some cases, a magnifier would make this portion of the service procedure easier and more effective.

If the visual inspection fails to turn up any clues as to the cause of the malfunction, it's time to bring in the test equipment. Most technicians probably do a little probing with the DMM first, just to see if there are any obviously open or shorted components, and then perhaps to take some preliminary voltage readings.

If the preliminary DMM readings don't point to an obvious cause of the problem, then the technician will ordinarily begin probing the terminals of the suspect devices, to see if the waveforms resemble the waveforms shown on the schematic diagram. This means, of course, that the technician has connected the set being tested through an isolation transformer. Otherwise, he'll be inadvertently forward biasing one of the diodes in the TV bridge rectifier with the 110V supply, which will cause at least the de-

struction of that diode, and possible damage to the oscilloscope.

Depending on how the diagnosis progresses, the technician may in sequence connect such items of test equipment as signal generators, external bench power supplies, and other test devices.

It's not readily apparent, but if someone were to perform a time and motion study of a technician performing a series of tests on a difficult problem and publish the results, the sequence of operations would probably appear more complex than anyone could imagine. It would include connecting and disconnecting the unit under test, connecting and disconnecting various test devices, adjusting the test devices, referring back and forth from the unit under test to the schematic diagram to the pictorials in the service literature.

Of course, absent from this complex flow diagram would be the thought process of the technician. If that could be captured the picture might be almost impossible to follow.

The difficulty of the service task, largely unappreciated even by those who do it every day, makes it imperative that the work environment be as uncluttered and as conducive to order and orderly thinking as possible.

There are many things that service center management might do to remove as many impediments to the technician's job as they can. For example, it might be a good idea to remove isolation transformers from the bench entirely, and provide a single large isolation transformer to feed all benches using a run of conduit/cable completely separate from the ac power line.

The receptacles or power strip that's fed from the isolated supply could be color coded or otherwise differentiated from receptacles that are supplied directly from the ac power line. The technicians would then automatically connect any unit under test to the isolated supply, virtually eliminating any possibility of shorting out a power supply caused by a common ground situation.

There are many other things that could be done to make the typical technician's bench more efficient. Clips or other holders to keep the literature off of the bench but within easy seeing would make it far easier for the technician to refer to the schematic diagrams while tracing the circuits. Good general lighting, magnification, comfortable seating, fume extraction, holders for circuit board work, are all devices that would help the technician get his job done more quickly.

One of the best examples of this kind of excellent organization is the surgeon's operating table. Although most of us have never seen one of these during an actual operation, TV and movies have given us all a pretty good idea of what goes on.

One of the most obvious things about it is the organization and attention to detail that goes into preparing the operating room for business. Every electronics instrument is in its proper place, and ready to be connected to the patient. All of the operating instruments are laid out in a specific order so that the attendant who has the responsibility to hand them to the surgeon can do so without hesitation. The lighting is more than adequate.

It goes without saying, of course, that everything is clean, sterile, so that the surgical team doesn't introduce any disease germs into the incision. At the service bench, the technician should be provided with wrist straps and electrostatic discharge protective work surfaces so that he doesn't cause damage to the products that he's servicing.

Because we're all so busy trying to get every day's work done, we often don't really have the time to step back and look at how things are getting done, and try to make things more efficient. When time permits, however, any available time that's spent in evaluating and improving the workplace and its effect on productivity, will eventually pay rich dividends in the quality and quantity of work produced. ■

Nile Conrad Perum

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Circle 32 For Product Information Only

Circle 33 For Product Information & Demonstration

LAN and PC courses offered in brochure

Ten intensive short courses are described in a new brochure, LAN & PC courses, offered by Learning Group International. Topics covered in the courses include: Hands-on PC Configuration and Troubleshooting, Advanced PC Configuration, PC Networking, Hands-on LAN Troubleshooting, Hands-on Novell Troubleshooting, Managing PC Networks, LAN Cabling Design and Installation, Local Area Networks, Multivendor Networking, Internetworking: Bridges, Routes and Gateways.

This brochure outlines each course and describes the applications and subjects covered, the hands-on activities, benefits, materials provided, authors and instructions, dates and locations, and who should attend.

Circle (53) on Reply Card

Parts Express 1992 catalog

Parts Express announces the release of their 148 page, 1992 catalog. Parts Express is a full-line distributor of electronic parts and accessories geared toward the consumer electronics industry and the technical hobbyist. They stock an extensive line of electronic components including speakers and audio accessories for home and car, CATV and VCR repair parts and accessories, semiconductors, tools and technical aids, computer accessories, chemicals and solvents, telephone products, wire, connectors, instructional books and videotapes, and arcade game parts.

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Surge protection flyer answers questions about surge suppressors

The subject of power surges and how to effectively protect sensitive electronic equipment from the damage they can cause is the focus of a new flyer available from Intermatic. Entitled "Why Surge Protection", the flyer answers a variety of typical questions about power surges that users often ask. Topics range from the definition of a power surge and the types of damage it can cause to effective solutions that can be implemented.

The flyer also includes a residential

applications guide for determining which Intermatic industrial surge suppressor models are most effective for specific types of applications. These products range from plug-in surge protectors to a circuit breaker panel protector.

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New catalog of RF/microwave connectors

Now available from Amphenol RF/Microwave Operations is a 120 page catalog (RF/IS&C) detailing 619 popular coaxial and twinaxial connectors, adapters and accessories for use in non-military industry standard and commercial applications.

Featured in the new catalog are 50Ω and 75Ω BNC connectors and sub-miniature series SMA, SMB, and SMC connectors. Also included are TNC, Type N, Twinax, Twin-BNC, UHF and Mini-UHF, as well as a 15 page RF/microwave connector selection guide with a pictorial frequency range chart, and cable to connector indexes, which enable the buyer to start from the cable to be used and quickly review the connector series options, configurations, and attachment types.

Included are a cross reference for data transmission applications and a complete guide to 64 popular between series adapters, together with plating, dielectric, and dimensional callouts for all parts. Also provided are complete assembly instructions for all of the cable connectors shown, including crimp types and types for plenum cables, together with a selection of cost-effective assembly tools.

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Electronics components catalog

Mouser Electronics announces the release of purchasing manual #570. This comprehensive reference guide provides up-to-date product data and pricing on over 36,000 electronic components and over 80 manufacturers. Product Index Tabs are provided for fast product location. Check the quick index on the front cover for page number correspondence. Look for the new product section which contains the most recent products available. ■

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ELECTRONIC

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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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Cable re-regulation legislation passes

The Electronic Industries Association's Electronics Group (EIA/CEG) applauded the Senate's passage of the cable re-regulation legislation (S.12), and in particular the amendment Sec. 1504 sponsored by Senator Patrick Leahy (D-VT). The bill passed with 73 yeas, 18 nays, and one vote present, a veto proof majority.

The amendment protects consumers from cable service which does not allow full use of all premium features on their television sets and video cassette recorders (VCR).

"The passage of the Leahy amendment is a great success for the consumer electronics industry, but more importantly for the American consumer," said Gary Shapiro, group vice president, EIA/CEG. "Senator Leahy has been a very good friend to our industry and the viewing public and we appreciate the work he and his staff has done." We look forward to working with him throughout the process of making this bill a law."

Shapiro added, "We are eager to work closely with the cable television

industry to develop the necessary technology and means to ensure full compatibility between the consumer's televisions, VCRs and their cable systems." The amendment prohibits scrambling of basic signals if such scrambling has the effect of precluding consumers from making full use of the premium features on their television sets, such as picture-in-picture, on-screen display, stereo surround sound, and the ability to record one program on their VCR while watching a different channel on their set.

Video product sales strong in January 1992

Sales of video products were strong in January 1992 as compared to January 1991, thereby setting one of the mainstay consumer electronics product categories off to a good start in the new year, according to statistics released today by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

VCR decks posted a 40.6% sales increase in January 1992 over the same period last year. Camcorders rose

47.3%, color TV/VCR combination units rose 43.8%, and color televisions rose 5.7% during the same period. Projection televisions had the strongest January of any video product category, rising 91.7% over January 1991.

Overall, the total video products category, comprising sales of color TVs, projection TVs, VCR decks, camcorders, videocassette players, and laserdisc players, rose 20.4% in January 1992 versus January 1991.

"While January 1991 video project sales were somewhat depressed, January 1992 figures point toward a recovery to more normal levels. This gives us hope that the coming months might be more prosperous for and result in modest gains for the category," says Gary J. Shapiro, EIA/CEG group vice president.

"We are particularly excited about the increase in sales to dealers of projection televisions, which also experienced solid growth in 1991. Sales of these units will become more important throughout 1992 as interest in home theater continues to grow."



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Skypix begins launch countdown, offers installer training

With test operations underway at its Oxford, CT broadcasting facility, SkyPix is poised to enter the home entertainment market with the first digitally delivered direct broadcast satellite system.

According to Richard Selvage, president of SkyPix, "We will open the Earth Station in March and demonstrate the system's ability to deliver 80 channels, a virtual in-home video store. The complete system launch will take place in April."

The heart of the service is the pay-per-view offering of movies, sports and live special events. Viewers will be able to select from 200 movies every day with top titles starting on the half hour, 25 movies starting every half hour, in addition to the SkyPackage, SkyNews, SkyKids and other programming.

Programming is easily accessed from menus on the TV screen. Video text screens are designed to help choose programming. The system has 3 main computers: a TV-top receiver, a wireless remote control, and a satellite antenna suitable for mounting on roof tops, terraces, or in windows. SkyPix also announces the schedule for Authorized Installer Training. The one-day training sessions will be offered in over 50 cities nationwide. These sessions will cover all phases of installation of the units hardware, an integrated-receiver decoder satellite antenna. SkyPix can be reached at (206) 834-7596. SkyPix 25528 74th Avenue South, Kent WA 98032

Nakamichi opens retail parts distribution center

Nakamichi America Corporation announces the opening of its new retail parts distribution center, Ruppman Parts Distribution. Ruppman will accept and fulfill Nakamichi parts orders from electronics dealers and service centers, with the exception of Nakamichi's authorized service stations and dealers, as well as from audiophiles and stereo enthusiasts from the private sector. Over 5,000 replacement parts for current and discontinued Nakamichi products are available to these end-users by calling Ruppman toll free at (800) 662-0504.

Facsimile orders are received at (309) 691-2271. Orders are accepted from 7:00 am to 8:00 pm (CST) Monday through Friday. Mail orders should be addressed to Ruppman Parts Distribution, 2130 Townline Road, Peoria, IL 61615.

In-stock items will be shipped within 24 hours of order placement. Owner's manuals, service manuals and schematics are also available for purchase and can be mailed or faxed.

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The technician's toolkit

By Conrad Persson

The same kind of analysis that can help make the service bench a more efficient place to work can also make the outside technician's toolkit a more efficient work aid. After all, what is a toolkit but, more or less, a portable service bench. Of course no one expects the toolkit to contain anything like the selection of tools, test equipment and supplies that are found at the service bench. Nevertheless, careful selection of what the toolkit contains will make the efforts of the technician on site far more effective and efficient.

Making sure the toolkit keeps up with the changes

Consumer electronics servicing in the home has undergone substantial changes over the years. In the early days, sets were vacuum-tube based, and most service calls involved replacing one, or a few, tubes. The typical approach then was for the service technician to stride into the home with the, very impressive looking, tube tester and check out the tubes in the set. It usually wasn't long before the offending tube was located and the set was back in operation.

As tubes gave way to transistors and then ICs, servicing of the set became substantially more involved, and in most cases the technician would stride into the home and stride back out with the set, carrying it back to the service center for thorough diagnosis and correction of the problem.

Today in-home servicing has swung back, at least to some extent, to service on site; in the case of projection TV sets, for example. These products are large and heavy, and just to move a large-screen set from the home to the service center and back costs in the neighborhood of \$100.00. In addition, these units are fairly fragile, and it's not too difficult to put a scratch in the screen or a dent in the cabinet. If



Figure 1. Static control toolkit case.

the problem appears to be relatively simple to correct, the technician may service the set on site, rather than attempt to move it. The modular construction of some of today's sets makes it more feasible in many cases to service on site. Isolation of the cause of a problem to a functional circuit board, rather than all the way down to a component makes it much easier to service these units.

For those companies that have become involved in computer and/or office equipment service, there is a fair amount of servicing being done on site. There are a number of reasons for this. For one thing, many computer

users either can't or won't be without their computers for very long at a time, so the servicing technician is under pressure to complete the work immediately.

But there are also reasons that computers can often be restored to service quickly. For example, the availability of diagnostic software often makes it possible to pinpoint the cause of the problem quickly. In addition, once the offending circuits have been indicated, in many cases because computers are modular the problem board may be replaced quickly and returned to a depot or the manufacturer for remanufacture.

Persson is editor of ES&T

The portable workbench

Many technological advancements have made on site servicing of all kinds of products more feasible. For starters, there's the constantly shrinking size and weight of test equipment even as it becomes more accurate, more reliable and easier to use. Take the DMM, for example. Back in the old days before transistors, the typical portable meter was battery operated, fairly large, measured only volts, amps and ohms, and loaded the circuit under test fairly heavily. Today, you can, quite literally, slip some DMMs into a pocket, and with it measure not only current, voltage and resistance, but semiconductor junctions, capacitance, continuity, and more, while loading down the circuit being tested almost not at all.

But smaller DMMS with greatly increased capabilities are only one facet of the revolution in the tool kit, or portable workbench, that make on-site service possible. Oscilloscopes have also evolved to the point that some are small enough to put into a toolkit.

ESD protection kits

Something else that has been mod-

ified so that it can be slipped into the tool kit is the electrostatic discharge (ESD) protection kit. There is really no excuse to work on any ESD sensitive product anywhere without precautions. Many manufacturers now offer a kit that consists of a mat that dissipates static electric charge as it builds up, with a snap to which the technician can snap his ESD wrist strap, and the whole thing features a cable that can be connected to the nearest ground. These kits are flexible, and the whole thing can be rolled into a tidy little package and slipped into the tool kit.

Battery/gas operated solder/desolder equipment

Soldering/desoldering equipment has been made completely portable. Now even if the service call is somewhere where the technician has no access to 120Vac power, one of these portable soldering irons makes it possible to perform service on site.

Planning a toolkit

In view of these and other recent changes in consumer electronics products and the needs of consumers, the

most important tool for stocking an efficient toolkit is planning. Just as you carefully plan your workspace and decide what products you will service, you must put time and thought into stocking a complete, but still portable, toolkit. (See Figure 1 as an example).

Ask the technicians who actually do the on-site servicing for their opinion on tool selection. You don't have to include every tool they suggest, but their input will contribute to a more efficient toolkit. Evaluate the work your company does, what types of repairs you will make on-site, and what repairs you will only make in the service center.

A toolkit planning checklist

Follow this checklist, or create your own with this as a guide, to help plan what will go into a toolkit.

- Determine what type of products you will service on-site.
- Many components in today's consumer electronics products are subject to Electrostatic Discharge (ESD) damage. Be certain that your toolkit is equipped with a grounding wrist strap

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and antistatic mat. Also include antistatic bags to carry printed circuit boards you may replace.

- If you will service personal computers, a selection of diagnostic disks will help you pinpoint problems. Make sure that the disks are adequately protected from physical and magnetic damage.

- Do not forget the accessories. An angled mirror like the ones used by dentists may enable you to see into the dark recesses of a product. A hand magnifier may let you see details you cannot otherwise see, thus let you complete a repair that would not have been possible. A flexible shaft or angled shaft may allow you to remove and replace screws that you might otherwise not be able to touch without extensive disassembly.

- Inevitably, you will drop a fastener or other important part. According to Murphy's Law, it will land in the most inaccessible spot. To recover the missing part, you should have the two types of part retrievers: the magnetic and the spring loaded grabber. Both can turn desperate scrambling into routine servicing, but be careful to keep the magnetized retriever away

from the diagnostic disks.

- There is never enough light. Carrying a flashlight and an ac-powered lamp in your toolkit will enable you to place enough light wherever you need it. In further deference to Mr. Murphy, you might want to carry spare light bulbs and batteries.

- Another important ingredient in a well-stocked toolkit is a selection of cleaning supplies and lubricants, including paper towels and rags. Dust and dirt love to collect in the warm electrified atmosphere of consumer electronics products. Electromechanical components, such as magnetic heads in VCRs and disk drives, may become clogged with oxides and require cleaning.

Other supplies to consider are a vacuum cleaner, a can of air to use under pressure, soft brushes, isopropyl alcohol, Freon, foam or chamois swabs and screen wipes.

- You should carry basic test and measurement equipment, such as a DMM, an oscilloscope and the appropriate gauges.

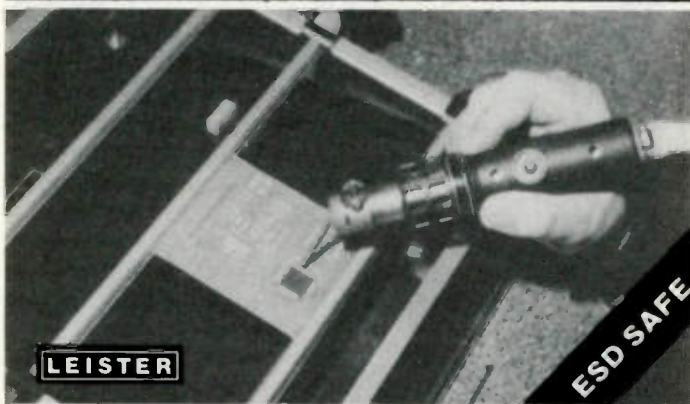
- Two-way communication, either via a two-way radio system or a cellular telephone, or both, might more than

pay for itself. In many cases, if a field technician is faced with a problem he just can't quite solve, consultation with a more experienced technician back at the service center might turn a "I'll have to take it into the service center" situation into a "you're back in business" situation. Another way you might use two-way communication between the field technician and home base is to arrange express delivery of parts from the service center or a distributor to the work site to avoid interrupting a repair or taking a set into the service center.

- The type of carrying case you select is also important. You can choose between an attache case, a soft-sided pouch or a formed aluminum case. Before purchasing a kit, you may want to ask your distributor's advice. Which one is best for you depends on the type of products you will be servicing, how many tools and test instruments you will carry, and how much abuse your kit will have to withstand. If you will equip several technicians, you may want to purchase each type of case, then determine which one lasts the longest and which one the technicians prefer. ■

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The service bench: Heart of the service center

By Conrad Persson

As often as not the service bench is planned merely as a horizontal surface designed to hold the product that has malfunctioned, the test equipment used to diagnose the cause of the malfunction, and the tools, components, and materials at a convenient height while the product is being worked on.

Thinking it out

In most cases, the service bench can be made a far more effective service tool by first thinking through exactly what gets done there, and precisely what is required to get the job done.

It can be revealing to write down the task list. We'll do so here in no particular order. It is understood that different service centers service different products, and in somewhat different ways, so not all service centers will necessarily perform all of the tasks listed. It should also be understood that the compilers of this list have no doubt left out many essential functions, so please feel free to fill in those that you know are missing.

The tasks

Here's a list of the activities that take place at the service bench:

- Disassemble the product and temporarily store the fasteners, cabinet parts, components/assemblies removed.
- Provide power to the product during diagnosis/checkout.
- Visually inspect the product.
- Refer to manufacturers' service literature.
- Connect diagnostic equipment
- Clean/lubricate part or all of the product:
- Adjust/align the product.
- Desolder defective components.
- Handle replacement components.

- Install/solder replacement components.
- Test removed components to confirm that they are faulty.
- Burn in the repaired unit.
- Provide necessary signals to the product being serviced.
- Call manufacturers' servicing consultants.
- Record components needed, work performed, length of time worked.
- Refer to service "tips"; paper, fiche or computer disk based.
- Repair damaged PC boards/traces.
- Touch up cosmetic damage.
- Apply non-standard ac voltages.
- Inject externally generated voltages.
- Make temporary connections.
- See the front of the set while you adjust controls in the back.
- Work on "hot" chassis.
- Perform ac leakage tests.

What's needed to do the job

Given this list of tasks that may have to be performed (and if we've missed any important ones, please let us know), here are some of things that have to be on or at the bench.

- Good lighting. This includes both general overhead lighting and any pinpoint lighting needed to illuminate the product under service.
- Magnification.
- Good organization.
- Adequate tool selection.
- Holding fixtures: vises, jigs, PC board holders, etc.
- Telephone
- Computer terminal
- Variable power supply
- Isolation transformer.
- Electrostatic discharge damage (ESD) protection.
- Vacuum pickup tool for handling ICs.
- Vacuum cleaner for cleaning out dusty products.
- Surge protection for sensitive products.
- Solder/desolder station.
- Lubricants

- Dust off sprays
- Adhesives
- Fluxes
- Solder
- Wire
- Wipes
- Test equipment, probes, leads.

Making the service bench an efficient workplace

One of the things that any service manager has to consider when buying a service bench is what kind of bench to buy. There are the inexpensive benches that consist of, well, a bench. These are nothing more than four legs and a top. In order to make one of these work, it's necessary to supply it with shelves or other provisions for stacking test equipment, outlet strips for power, lights, storage space, and the other things necessary for a technician to perform his work.

An alternative is to buy a service bench that was designed with servicing in mind. Some manufacturers sell benches that come right from the factory with outlet strips anywhere you want them, storage drawers built in, shelves, lighting, even ESD protective tops.

While the first kind of stripped down bench seems like a bargain initially, if you add the cost of all of the accessories needed to truly make it into a servicing bench, especially if you include the time that will be spent by someone who could otherwise be servicing, a fully equipped bench might be a bargain.

Another thought along the same lines, is that while many people, service managers included, look upon tools as just an expense, and a place to economize where possible, this is an area where you must be careful about false economy.

Sometimes it might seem that it's more economical to buy a less expensive tool or piece of test equipment, but tools and test equipment are one-time, or at least infrequent expenses. On the other hand, every minute

By Matt McCullar

As described in the main article, there's no substitute for the proper equipment in servicing today's sophisticated consumer electronics products. On the other hand, as always, a little ingenuity can help organize the service bench, and make the service equipment easier to use. Here are a couple of suggestions from one of our regular authors on improving conditions on the bench.

Cables at a glance

This tip has saved me enormous amounts of trouble. Servicing computer systems involves lots of power cables that look alike. It is very easy to confuse which cables snaking all over the workbench are plugged in or not. This can be dangerous when working with power supplies.

One day I made a run to the office-supply store and bought a package of col-



Figure 1.

ored press-on labels. They come in various colors. Wrap each end of a power cord with a label of the same color and one look at the power strip tells you what's plugged in and what isn't. This sure beats following a power cord by eye to see where it leads (see Figure 1).

This also works on cables for monitors, printers, or whatever you have a lot of on your bench. Colors are much easier to distinguish than small names printed



Figure 2.

on labels wrapped around cords. Wrap a label on each end of the cord, and secure it with clear adhesive tape to keep them from peeling off. If you run out of colors, then make your own patterns — red with blue, green with yellow, etc.

Reducing oscilloscope glare

My oscilloscope has to travel all over the service center because of the variety

McCullar is an independent computer and electronics and servicing technician

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wasted by a technician, who could otherwise save time with a more expensive, more efficient tool or test device, may occur day after day, week after week, year after year, and has to be paid for.

Following are some specific areas that service centers in today's highly

competitive, demanding, economy should give some serious thought to.

Lighting

There was a time when many service centers were somewhat dark places with lighting that was barely adequate. Today, that kind of lighting is a sign

of inefficiency. With today's tiny circuits, effective technicians can't rely on merely decent general lighting. General lighting should be bright enough to be adequate for most tasks, with high-power task lighting and magnification available for the most demanding visual tasks.



Figure 3.

of jobs I use it for. Because of the bright lighting, though, the glare thrown across the screen used to be irritating, because it took my attention away from what I was doing and I couldn't accurately tell what the signal on the screen was doing (see Figure 2).

So I wondered whether there are any glare-reducing screens available for oscilloscopes like the ones that are so popular for computer monitors. While I was sit-

ting at the bench thinking about it, my foot accidentally kicked a spare computer monitor anti-glare screen that happened to be laying on the floor. Someone had bought it for peanuts at a flea market and it wasn't being used. I decided to try cutting out a piece of the screen and using it on the oscilloscope. It worked.

Anti-glare screens are made up of fine-woven fabric. If you try cutting up a spare screen with scissors, you'll see the individual fibers. I calculated the size I would need, but allowed a little extra length on each side just to be sure. Once I got the right size, I used the scissors again to cut thin strips of adhesive tape to hold the anti-glare screen on the face of the scope's CRT. It works very well (see Figure 3). No matter what angle you look at the scope from, the green trace stands out much more plainly. The graticule is still visible, too. Best of all, I had enough fabric left over from the one computer monitor anti-glare screen to make another glare eliminator for the other scope in the service center.

400V. The average human is not aware that a static discharge has taken place unless the voltage approaches 10 times that value. The presence or absence of crackling discharges is not a guide as to whether ESD protection is required.

In today's world, every consumer electronics product, every circuit board and every component should be treated as if it is susceptible to ESD damage. Every bench position and every tool kit for servicing electronics products should be equipped with antistatic wrist straps and antistatic mats. Every technician should be instructed in the use of antistatic products and in the importance of keeping static-generating products away from electronics products that are opened up for servicing.

Test equipment

Although it may be possible to get by in electronics servicing with a simple DMM, a 20MHz scope and a few other basic pieces of test equipment, today's sophisticated consumer electronics products almost cry out for sophisticated tools and test equipment to service them. As a matter of fact, there are some pieces of equipment that are all but essential.

For example, if you're working on a TV set that has a "hot" chassis, and you connect the probes of your grounded scope to the set, you'll be providing a ground path that is certain to destroy at least one diode in the power supply of the set, and possibly even damage the oscilloscope. Testing a hot chassis safely requires that it be connected to the ac line via an isolation transformer.

Quite simply, good, easy to use, high quality test equipment is the foundation of a successful service operation. Just take a tour of any successful service center and see the concentration of test gear.

The Electronic Industries Association/Consumer Electronics Group (EIA/CEG) has compiled a list of test equipment considered essential or desirable for diagnosing and repairing current sophisticated consumer electronics products. (For a pamphlet, write to the EIA/CEG, 2001 Pennsylvania Ave, N.W., Washington, DC 20006-1813).

Cleaning supplies and other chemicals

Many of today's consumer electronics products, such as VCRs and camcorders, are actually electrome-

discharge is through one of these devices. You will find at least one IC in the schematic diagram of most sophisticated home electronics products, such as TVs, CD players, VCRs and microwave ovens.

Some sensitive components will be damaged by discharges in the range of

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WB = Work Benches
T = Tools
C = Cases
L = Lighting

ESD protection

Many of today's tiny ICs employ metallic films that are vanishingly thin. A static electric discharge that can be seen in dim light, and that you can hear as a "crack!" is thousands of volts, and carries enough current to vaporize one of these films if the

chanical devices. Computer floppy disk drives have moving parts that wear and break, and sensing heads and other mechanical components are subject to wear and abrasion and deposits caused by travel of the magnetic medium. Servicing a consumer electronics product may require more than thorough cleaning of the heads or other parts of the tape path.

This kind of service requires specific techniques and the correct supplies, which should be readily available at the bench or in the portable tool kit. If you service VCRs, for example, you will need the right cleaning aids and appropriate cleaning liquids, such as isopropyl alcohol or Freon TF.

Never clean a VCR with cloth, cotton swabs or any other material that might leave lint or residue. The two materials generally recognized as appropriate for cleaning VCR heads and tape paths are chamois and plastic foam. Both of these materials are available in sticks or swabs. Spray the cleaning liquid on the material and carefully wipe the heads and transport parts clean.

You can also use cleaning tapes for VCRs and cleaning disks for computer disk drives. From the information available, it appears that most cleaning disks for computer disk drives are safe to use. In the past, we did not

recommend VCR cleaning tapes. However, there are now one or two (and possibly more) that appear to be safe and effective. Choose among these products carefully. Some are thought to induce the problems they are supposed to eliminate.

Soldering

If you closely examine current compact, light-weight, feature-packed consumer electronics products, you will find components that are smaller than a matchhead, printed-circuit board traces that are almost hair-thin, and packaging that leaves almost no room for you to put your hands in.

The manufacturing process employs fabrication technology that is exacting, including the temperature and other parameters of the soldering.

When a component is desoldered and a replacement component is soldered in, the soldering irons used by the servicing technician must be able to provide sufficient heat at the right temperature if the new connection is to be made to the same specifications that prevailed during the manufacturing process.

Today, soldering and desoldering have almost been raised to a science. High quality solder/desolder stations can control not only temperature, but how quickly the tip reaches the desired

temperature. Because so much of today's consumer electronics circuitry is sophisticated and extremely delicate, it only makes good sense for the service center to take a close look at the soldering tools they are currently using to make sure that they're adequate to do the job.

Safety ac leakage testing

Some things, like the importance of safety, never change. Every TV, VCR and personal computer is connected to the ac line. Many things can go wrong within one of these products to cause the ac line to be accidentally connected to the exposed metal parts of the product. If someone comes in contact with the exposed parts and a good ground simultaneously, the result could be a possibly fatal shock.

Every consumer electronics product that is serviced should be given a safety leakage test. The leakage test, described in most service manuals, allows you to make sure they are safe.

Putting it all together

Technicians are much more than tools and test equipment. The knowledge and skills they bring to the job are the most important part of troubleshooting and repairing products. However, even the most knowledgeable technicians cannot achieve their goals without the proper tools. Whether on the bench or out in the field, well-equipped servicers will be faster, more efficient and more accurate than their unorganized competition — and more profitable.

There are two ways to set up a service bench. One is to just let it happen: buy a bench, provide power, lighting, test equipment, etc., as it occurs to the service technician to request them. The other is to do some prior planning and preparation. This involves thinking through all of the products that will be serviced there, the operations that will be necessary to perform that service, the tools and test equipment that will be necessary to perform that service, etc.

While planning the workbench, it would make sense to do some cost comparison: for example, work out what it would cost to buy a manufactured technician's work bench, with the ultimate cost of putting one together in the service center.

The service bench is the heart of the service center. It's the place where all of the work that brings in the profits gets done. Make sure it's well thought out and planned.



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Three tough dogs

By Homer Davidson

“**T**ough dogs” are the curse of every consumer electronics servicing technician. You may service dozens of products routinely, then all of a sudden run across one that just resists all your diagnostic efforts. Occasionally there’ll be a spate of two or three or more of these products that test your skills and even make you doubt your diagnostic abilities. And just as with beauty, the tough dog is often in the eye of the beholder. A product that you have wrestled with for hours with no results might be a piece of cake for the guy at the next bench, and vice versa.

If it takes longer than about two hours to find the problem in a product that’s malfunctioning, put it aside and work on something else. Some technicians work all day on a tough dog without making any progress.

If you spend more than two hours or so on a tough dog you may wind up agitated and unable to think straight about the problem. Tackle the tough dog again early the next morning, when your mind is fresh, or after work when no one is around.

Intermittent RCA CTC140 chassis

The customer complained that the TV set had acted up for an entire month. Sometimes it would go black and come right back on. Other times the TV might remain inoperative for a half hour. On occasion the set would work without interruption, then malfunction the next time it was switched on. Finally, both sound and raster quit and the set would not come on at all. The set was dead when I was called to service it (Figure 1).

My first step was to replace the fuse and check all diodes. Because I had encountered defective diodes in several CTC140 chassis I had worked on before, I removed the diode SIP board



Figure 1. The technician has just removed the diode SIP board to individually check each diode in the low-voltage circuits.

to test the diodes on it. This board can be removed easily by turning the chassis over and removing soldered pins from the main TV board. In this case, all three diodes on this board tested good.

Now suspecting that the horizontal output transistor (Q4400) was leaky, I checked it. To get at this transistor I had to remove a shield and plastic assembly (see Figure 2). I observed high leakage in the horizontal output

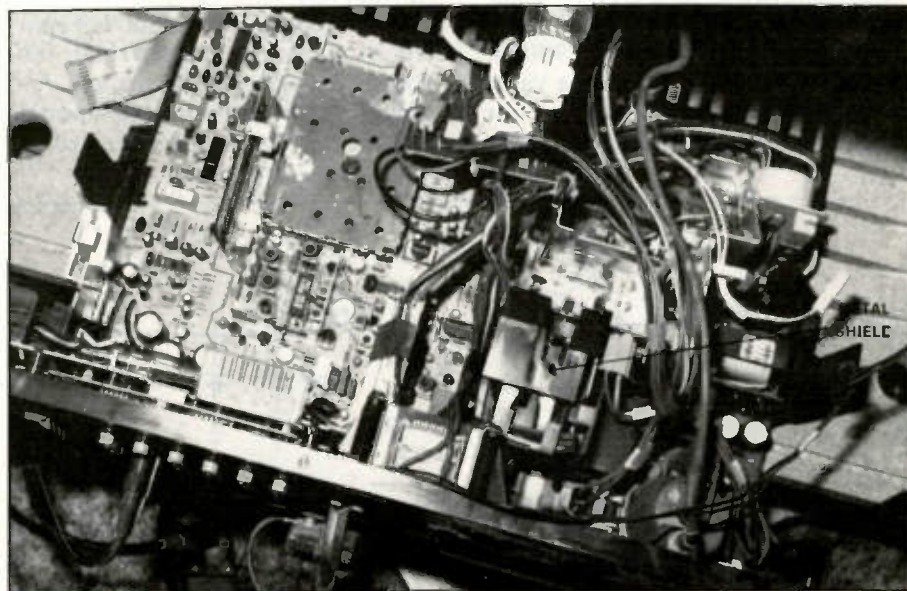


Figure 2. The metal shield must be removed to gain access to the horizontal output transistor, Q4400, in the 27-inch chassis.

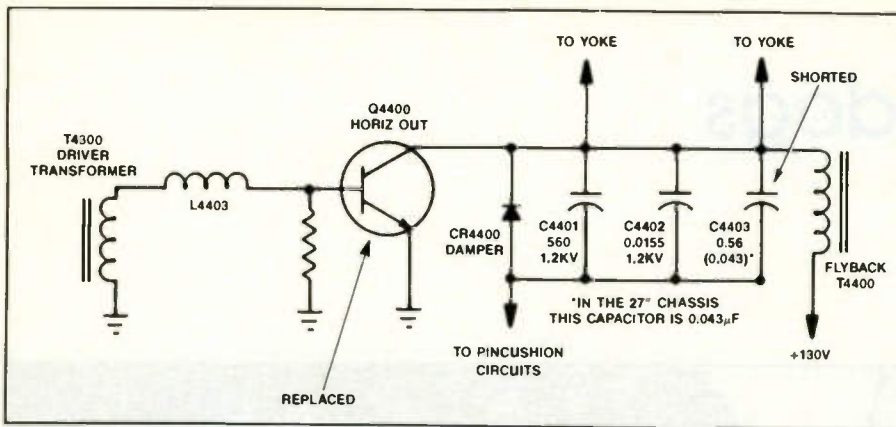


Figure 3. A shorted C4403 (0.56 -) capacitor in the yoke circuit took out the horizontal output transistor and 4A fuse.

circuit, and consequently replaced Q4400 with a 179743 exact replacement. When I turned the set on again, it blew another fuse. At this point I decided to take the set into the service center to complete servicing.

When I tested the set on the bench, I found that only a fuse had blown this time. Q4400 tested normal. I unplugged the yoke assembly from the circuit and turned the set on. The fuse remained intact. This indicated a leaky component in the yoke or pin cushion assembly. The yoke assembly tested normal between horizontal and yoke windings. CR4402 and CR4401 tested good in the horizontal centering circuits. When I tested capacitor C4403, I found a dead short (Figure 3).

It's important to be careful here because C4403 is not the same value in all CTC140 sets. In most CTC140 chassis C4403 is a 0.56µF coupling capacitor. In a 27-inch CTC140 chassis, however, C4403 is a 0.043µF, 2.5V capacitor, part number 190000. Because installing the wrong value capacitor here may result in poor linearity, I was careful to install the

correct 0.043µF, 250V capacitor in this 27 inch color chassis.

After replacing the capacitor, I ran the unit for an hour before making final adjustments. Although the picture was nice and clear, something was still wrong with it. When there was a doorway or telephone poles or other vertical element along the outside edge of the picture, they seemed to bend a little. The linearity in the middle was fairly good.

While some technicians might have let this pass, I felt that there was trouble in the pin cushion circuits that might be corrected by a touchup of the pin and width controls. These pin cushion controls and circuits are found on a separate pin S1P board (PW 4800).

The pin adjust (R4806) and width (R4802) had little effect upon the raster, but the centering control (R4400) had some effect.

When I connected the dot/bar generator to the antenna terminal, the bowing defect really showed up. Although the picture was fairly normal in the center, the sides were bowed in-

ward. Readjustment of the width and pin adjustments had little effect on the vertical lines.

I checked all transistors within the pin cushion circuits using the diode check of a DMM (Figure 4). Everything was fine here. Next, I tested diodes CR4801 and CR4802. CR4802 showed a leakage of 145Ω. I disconnected one lead of CR4802 from the circuit and tested it. CR4802 tested normal out of the circuit. A test of the circuit with CR4802 disconnected from it turned up the same leakage resistance.

Both CR4803 and CR4804 tested normal with one lead disconnected from the circuit. The rest of the circuit, however, still showed leakage. I again checked the pin output transistor (Q4804) and measured a resistance of 145Ω between collector and emitter terminals. After I disconnected the collector terminal from the circuit and again tested this junction, the pin output transistor exhibited leakage. No doubt I missed a correct test on the pin output transistor, or it was intermittent when I tested it before.

I removed Q4804 from the circuit completely and tested it again. The emitter/collector junction resistance was 145Ω. I didn't have the exact manufacturer's replacement for this transistor, so I replaced it with a universal replacement. In this case a SK-3893 or ECG 152 will do. After replacement of this transistor, readjustment of pin and width controls may be necessary to straighten vertical and horizontal lines.

Panasonic ETA-12 with color, height problems

The customer brought in a Panasonic ETA-12 chassis and described the problem as poor color followed by picture collapse into a one-inch-high horizontal line. I decided to correct the vertical problem before checking out the color. Because the chassis was fairly old, the customer wanted an estimate before the chassis was repaired. As all technicians know, you just about have to fix the set before an accurate estimate can be made (Figure 5).

I began by observing waveforms within the vertical circuits. As I did so, the raster would intermittently collapse to a white line. It occurred to me that the cause might be the same thing that was causing the original vertical symptom.

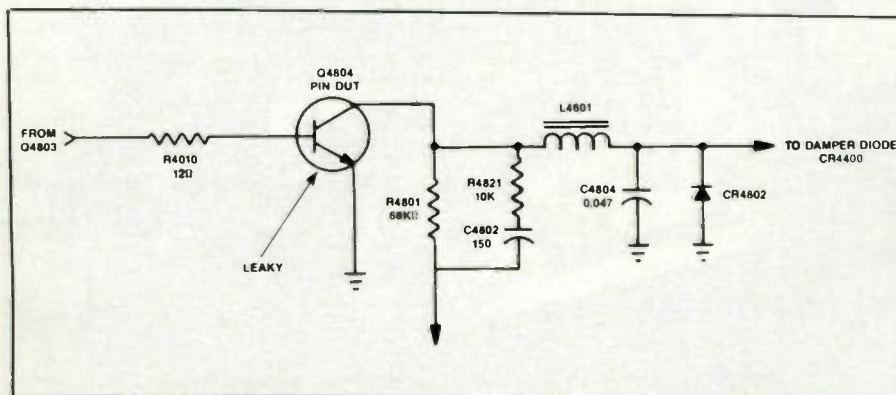


Figure 4. The leaky pin out transistor, Q4804, caused a bowing inward of the picture at the outside edge of the raster.

I found a fairly normal sawtooth waveform on the base terminal of drive transistor (TR453). The amplitude of the waveforms at the emitter and collector terminals was very low.

Because TR453 was connected in the emitter-follower configuration, revealed by the schematic, the amplitude of the sawtooth waveform at these terminals should be only slightly less than the amplitude of the waveform at the base terminal.

Because the waveform at the emitter terminal of TR453 was almost nonexistent, (Figure 6) I suspected a problem in this area of the circuit. I took careful measurements of the voltages at the terminals of this transistor. The voltage at the collector terminal was only 0.1V. It should have been around 25V.

The voltage at the emitter was 0V instead of the normal 0.7V, and the voltage had dropped to 1V at the base terminal. I removed TR453 from the circuit and checked its junction resistance. It was very leaky. I replaced the driver transistor with an ECG 128 universal replacement.

When I applied power to the set and readjusted the vertical height, linearity, sub-line and vertical balance controls the picture filled the screen. My next step was to correct the color problem.

Unfortunately, as soon as I moved the chassis to locate the color circuits, the raster collapsed to a horizontal white line. Back to the vertical circuits. No doubt one of the vertical output transistors was acting up; possibly both. The raster returned as I was connecting the test instruments.

To determine if the problem was being caused by the vertical circuits, I connected the scope lead to the negative side of coupling capacitor C465 (100 μ F). If the waveform at this point disappeared when the raster collapsed, the defective component must be in the vertical circuits. If the raster collapsed but the waveform remained normal, the trouble must be in the yoke or pin cushion transformer circuits. I monitored the 110V power source with the DMM.

Naturally the chassis played perfectly the rest of the day. The next morning when I turned on the service bench power the raster was nothing but a white line. The scope waveform was good, indicating problems within the yoke or pin cushion circuits.

Because poor pin cushion trans-

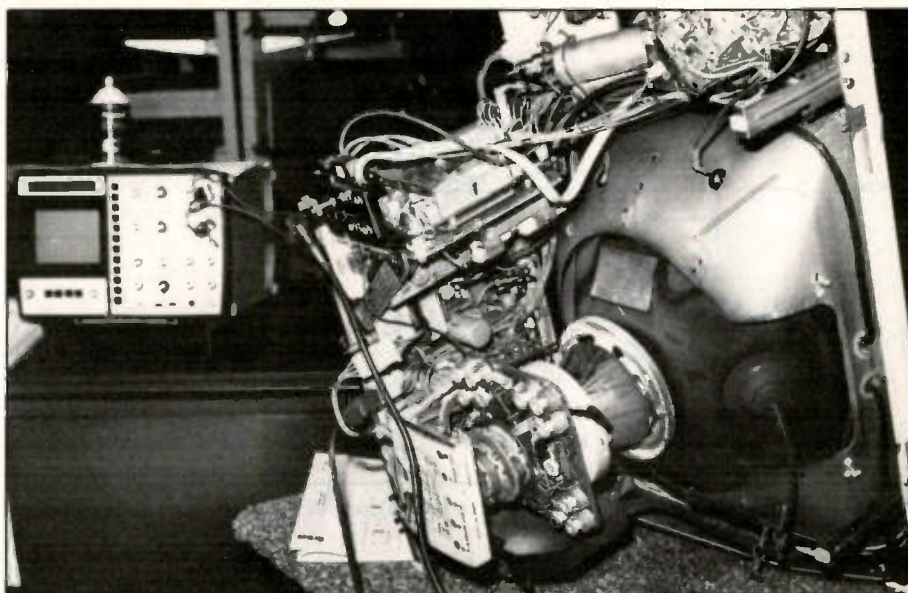


Figure 5. One Panasonic ETA-12 had several different problems, causing it to become a tough dog.

former soldered connections have caused intermittent problems in other sets, I did some poking around on the transformer connections. This caused the raster to return. I located the vertical transformer, TR504, and resoldered all terminals. At the same time, I resoldered the horizontal pin cushion phase transformer (TR503) terminals. This restored the picture to normal, and twisting and prodding around upon the chassis no longer had any effect upon the raster.

To tackle the color problem, I attempted to adjust the color and test controls to obtain a normal picture.

The best I could get was a greenish-blue picture. Red was missing from the picture. This one could be easy.

Voltages at the red output transistor, TR532, measured quite normal. I connected the scope to the base and then to the collector of TR523 to see the color waveform. There was no color waveform at the collector terminal. I tested TR352 in the circuit and it appeared normal. I checked the waveform at the emitter color drive terminal. The amplitude was low. Resistors R352 and R360 were good. When I checked R355, the red would come and go in the picture (Figure 7).

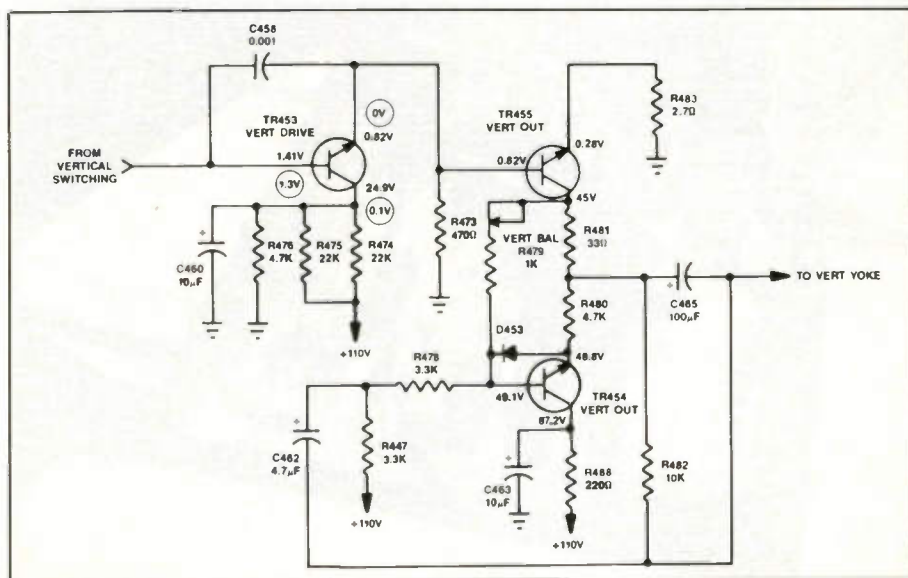


Figure 6. The leaky vertical drive transistor caused only a one-inch raster in the Panasonic ETA-12 chassis.

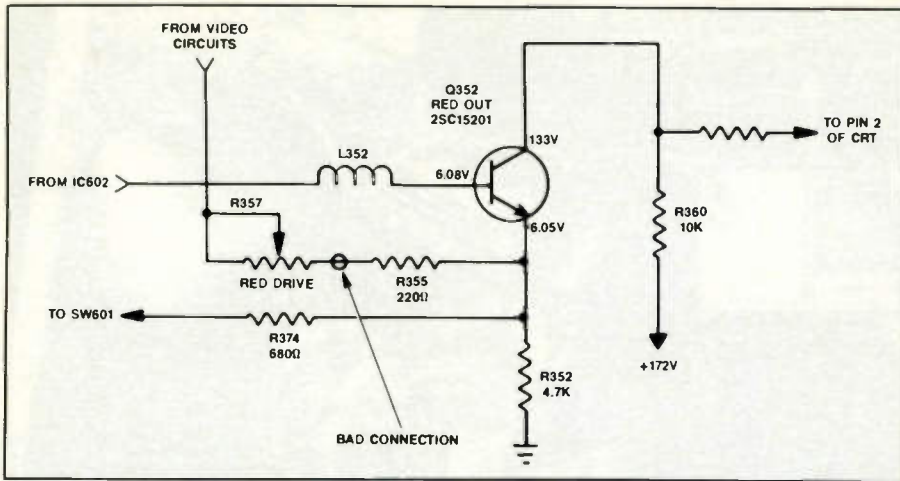


Figure 7. A bad soldered connection at the red drive control R357 removed red from the raster in the Panasonic ETA-12 chassis.

When I touched the red drive control, the color would come and go. The red control (R357) appeared to have a poor soldered terminal. Resoldering the control solved the intermittent red color problem, completing the repair.

Sylvania E32-8 chassis: dead set

After replacing a blown 4A fuse, the Sylvania E32-8 chassis remained dead. My first step was to check the resistance of the horizontal output transistor (Q402) from collector to base. It was shorted. I replaced Q402 with an ECG165 universal power output transistor (Figure 8).

This did not solve the problem. The chassis was still dead with very little dc

voltage at the collector terminal of the horizontal output transistor. A voltage check at the cathode of the switching regulator indicated no voltage. There was +160V at the anode terminal. This indicated that the low voltage diodes were good to this point in the circuit.

These sets employ a scan-derived power source to power the Horizontal/Vertical countdown IC (IC700) and the voltage regulation circuits of the low-voltage power supply. That is, the source of these voltages (24.6V) is a secondary winding of the flyback transformer. This 24.6V supply voltage must be present before these circuits will operate. In order for there to

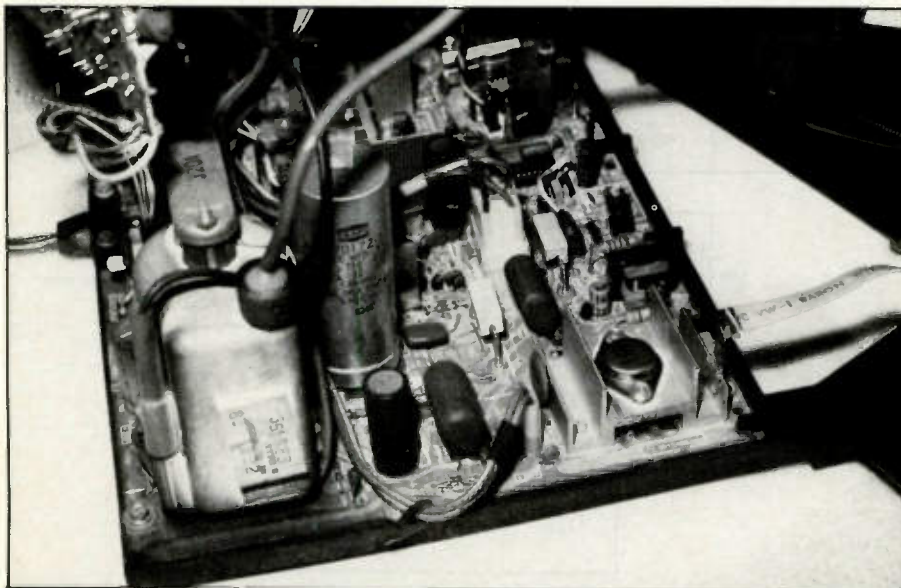


Figure 8. The shorted horizontal output transistor (Q402) in a Sylvania E32-8 chassis was replaced with an ECG165 universal replacement.

be output from the flyback transformer, the horizontal oscillator and output circuits must be working. At the same time, a B+ 112V must be applied to the horizontal output transistor.

When one of these sets is dead, one of the following circuits may be the cause: the low-voltage regulator circuit, horizontal countdown, horizontal output, flyback circuits, scan-derived 24.6V and shutdown circuits. Since the cause of most such problems is the horizontal circuits, they were checked first.

Because the horizontal output transistor (Q402) had already been replaced, the next logical step was to check the horizontal countdown IC. With power to the set disconnected, I applied +24V at SC706 from an external power supply. This point connects to pin 9 (VCC) of IC700.

With 24V applied here, if the IC is operating correctly it should generate the horizontal waveform at pin 8. There was no waveform at pin 8. Likewise, there was no vertical pulse at pin 12. A quick voltage check at pin 9 showed only 1.25V. The working voltage should be between 8Vdc and 9Vdc.

I made resistance measurements at all pins. The resistance at pin 9 was 110Ω, far too low. It appeared likely that IC700 was defective. To be sure that it was the IC causing the problem, and not some other part of the circuit loading it down, I desoldered Pin 9 with desoldering braid to isolate it from the rest of the circuit and again measured the resistance at that point. It was still 110Ω. I replaced IC700 with an exact replacement (15-3017119-1).

I again applied power to the chassis expecting it to operate properly, but the problem remained. I checked the secondary 24.6V circuits using resistance measurements of flyback windings 1 and 2. SC530 was normal. The scan derived voltage source appeared normal, except no voltage is present until the horizontal circuits operate.

I shifted my attention back to the low voltage circuits. Again, SCR513 was tested and appeared normal (Figure 9). SC512 and SC518 diodes checked okay. Because the voltage was normal at the anode of SCR513 but not at the cathode, the low voltage regulator, SCR driver, phase detector and error amp were all suspects.

I tested all three transistors in the circuit. Q502 and Q504 were open.

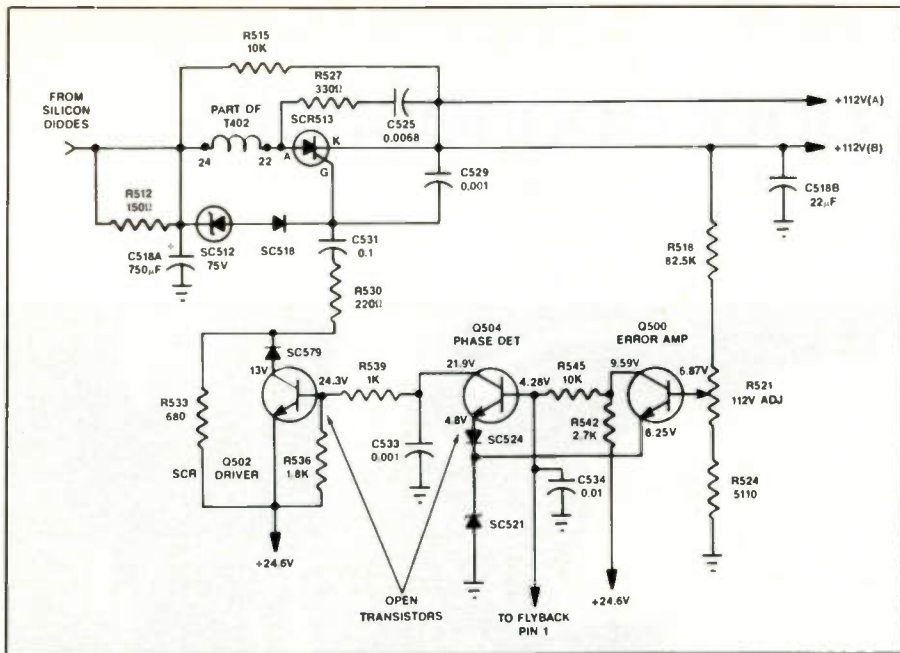


Figure 9. No sound, no raster, no brightness symptom was caused by open Q502 and Q504 in the low voltage regulation system of the Sylvania E32-8 chassis.

Q500 tested normal. I removed both Q502 and Q504 and tested them again. This confirmed that they were both open. I replaced Q502 with an ECG159 and Q504 with an ECG123

AP universal replacement.

To avoid destroying these replacement transistors in case I had not completely corrected the problem, I connected the set to the line via a variable

transformer and set the voltage to 60Vac. Low dc voltage was noted at the cathode of CR513 and Q402. I increased the voltage gradually until the transformer output voltage was 120V. Everything appeared fine and the raster was normal. The chassis operated for several hours upon the bench.

The B+ adjustment was set at +112V at the cathode of SCR513 or horizontal output transistor Q402. The picture tube anode voltage was 28.2KV. Although the chassis did not indicate any signs of lightning damage, I suspect that it may have been damaged by a power surge, because the set is powered from a system that is not especially reliable.

Conclusion

So called "tough dogs" consume a great deal of service time. In many cases, it is not possible to charge the customer for all of the time that servicing of the product actually consumed. Many different problems in several circuits may end up as a tough dog. Always, double check the chassis for other possible defects and adjustments. Look outside the most obvious circuits for possible defects. ■

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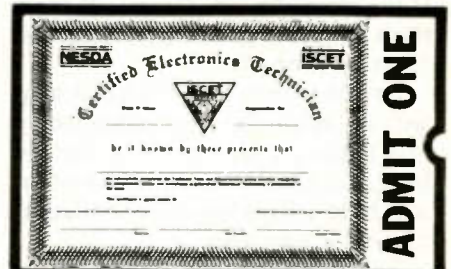
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Dealing with poor connections

By Victor Meeldijk

Poor connections are among the leading causes of equipment failures. In this article we will provide some actual examples of this failure mode, ranging from a hand held calculator to a computer system.

The malfunctioning computer

A two year old ITT Xtra 386 computer (model 401401-104B), occasionally displayed various error messages during the power up diagnostic tests, and would not keep correct time. The first hint of a problem was that the clock began running slow. Later, whenever the computer was turned on, after it went through its power on self test the screen would display the error message "The system configuration does not match the hardware."

The time problem only occurred after the computer was off overnight. If the computer was turned off for a short time during the day, it seemed to function properly.

At first I suspected a failing back up battery. When the power supplied by this battery drops below a certain level, the system set-up information may be lost. This can cause configuration error messages.

Before I replaced the battery, I copied the computer set-up information, just in case the temporary removal of the back-up battery corrupted (or caused the loss of) the set-up information, so that I could configure the system as it was before I began working on it.

This configuration information is displayed by pressing the CTRL-ALT-ESC keys. Be certain to save any files before you press this key combination, because the computer will reboot after you go through this procedure. In this case, replacing the battery did not fix the problem.

While I was replacing the battery, I inspected the system. This examination did not show any visible problems, except for dust and a few spider

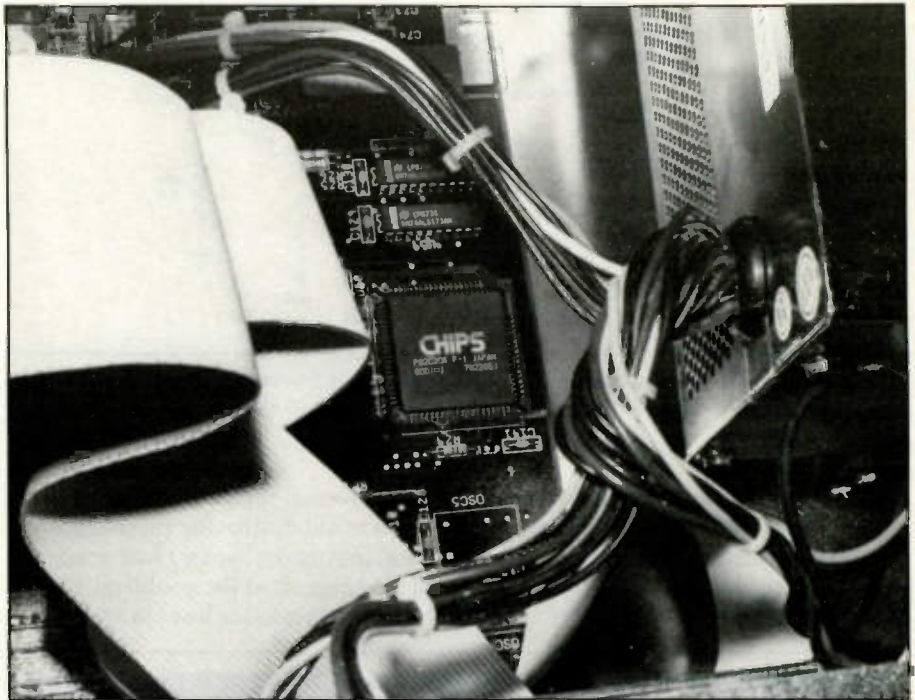


Figure 1. In the 386 ITT Xtra computer, the clock circuit IC, an MC146818, is emulated in an 84-pin PLCC device, part number 82C206, manufactured by Chips and Technology.

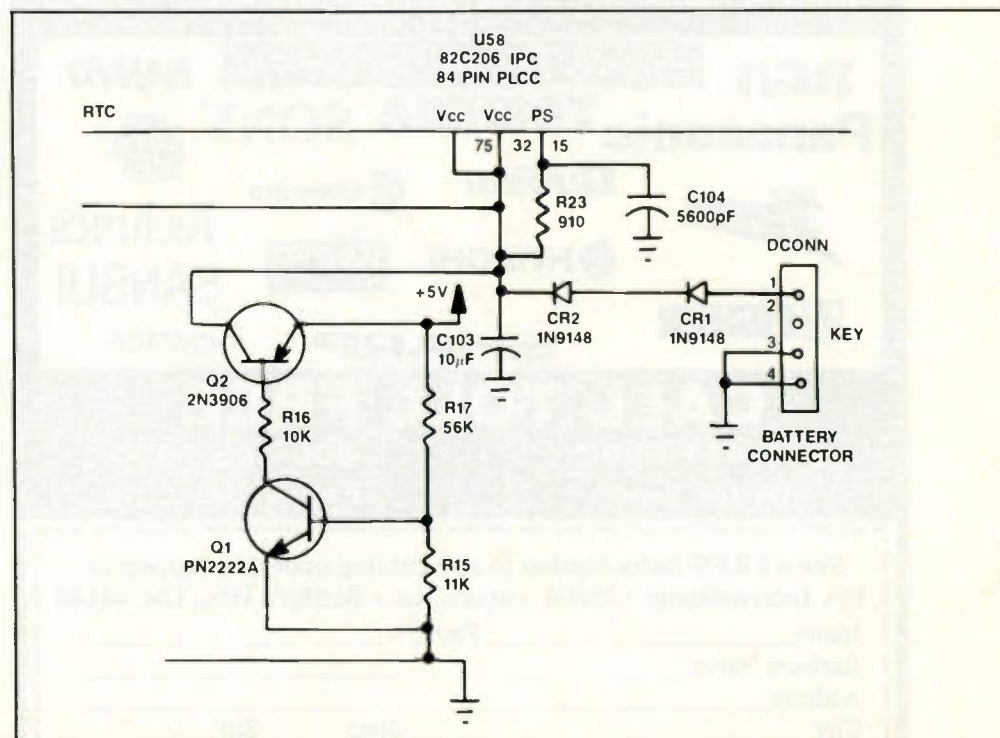


Figure 2. The clock and battery back up portion of the circuit for the ITT 386 Xtra computer.

Meeldijk is the Reliability/Maintainability Engineering Manager for Diagnostic/Retrieval Systems, Inc.

webs inside the case (which I cleaned up).

I looked at the computer mother board again, but did not find any IC's that looked like a clock circuit. A check of the manual revealed that in this computer, the clock circuit IC, an MC146818, is emulated in U53, a large 84 pin PLCC (Plastic Leadless Chip Carrier). (See Figure 1). This device bears part number 82C206, and is manufactured by Chips and Technology, Inc., 3050 Zanker Road, San Jose, CA 95134, 408-434-0600, Fax: 408-432-9226. This part also contains the configuration status of the computer.

Figure 2 is the schematic diagram for the battery and clock circuit, and the pin out and block diagrams for the 82C206. The new battery measured 3.64V when I took it out of the package. The battery voltage measured 3.64V even after it was installed in the circuit. This was strange because the manual indicated that the voltage should be lower when the battery was installed in the circuit.

Taking measurements at various other points showed 3.57V between CR1 and CR2, 3.52V at the cathode of CR2 and 3.52V at pins 75, 32 and 15 of U53. Note: as is the case with smaller IC's, pin 1 of U53 is denoted by a dot, although it is in the middle of one side of the IC and not at one of

the ends. The pin numbers increase in a counterclockwise direction.

I contacted the company that made the computer (ALCATEL Business Products, located in Arizona; 800-528-1400) to see if they had seen this problem before and if repair parts were available. I was given a technical service number, 800-528-6451, which referred me to New York and New Jersey repair facilities.

According to the technicians I spoke to, this company stopped making computers about 3 years ago, and in this region there is a MICI (short for mail in, carry in) center in Edison N.J. (908-235-3131) that replaces malfunctioning assemblies. Repairs are not done to the IC level at the regional centers, but some circuit card repairs are done in Arizona.

I decided to try one more test before going to the trouble of removing the mother board for replacement. It seemed strange that the clock worked with power on and only had problems with power off, and the battery voltage was higher than the manual indicated.

The voltages that I had measured at the IC were actually measured at the socket pins, not at the IC terminals, which were not readily accessible, so it occurred to me that there could be one or more bad connections that I was unable to uncover with these mea-

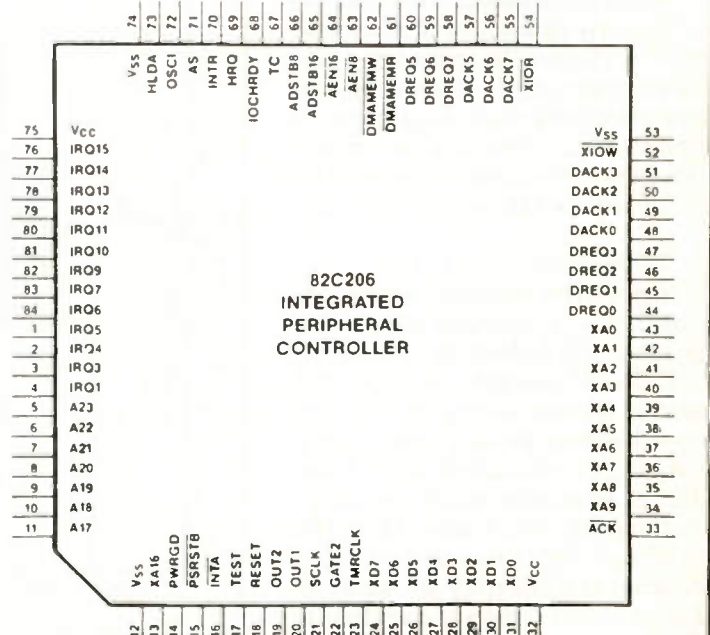
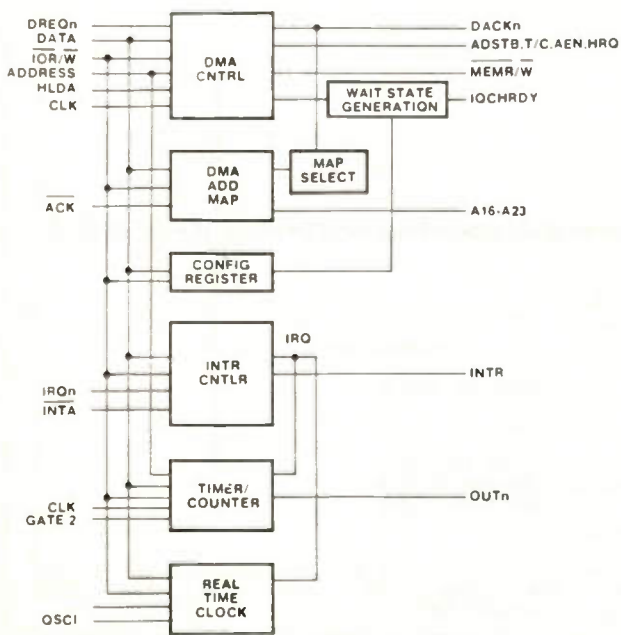
surements. I thought that this might be the reason that the in-circuit battery voltage appeared to indicate that it was not being loaded. I decided to make sure that the IC was properly seated in its socket.

With power to the computer disconnected, I pressed down on U53. The IC did not move, so I used an extractor (if one is not available a smaller jeweler's screwdriver carefully inserted at each corner will also work) to lift up the IC a little so it could be pressed back into place.

When I turned the computer on after reseating the IC, all kinds of error messages were displayed, including: RTC (real time clock) INTERRUPT, SET OPTIONS MAY NOT BE SET, INCORRECT VIDEO, NO REPLY TO SECOND HARD DISK, BOOT SEQUENCE FAILURE. I then attempted to boot the system from a DOS floppy disk, but the error messages were again displayed.

I pressed CTRL-ALT-ESC again to force the computer into the set-up mode. The set-up information had all been lost when the IC was moved, including the fact that a floppy drive was installed. This was the reason the system would not boot from the "A" drive DOS disk.

I set up the computer using the configuration information that I had wisely recorded before I began work-



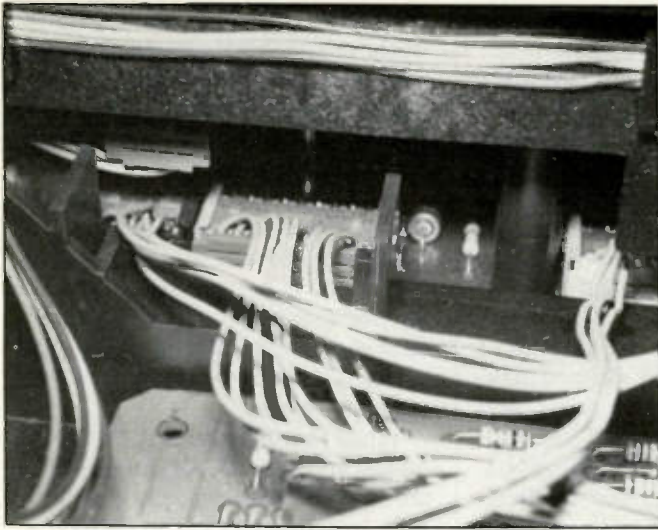


Figure 3. In the CD player, all the connectors were removed/replaced, including the ones underneath the disc mechanism.

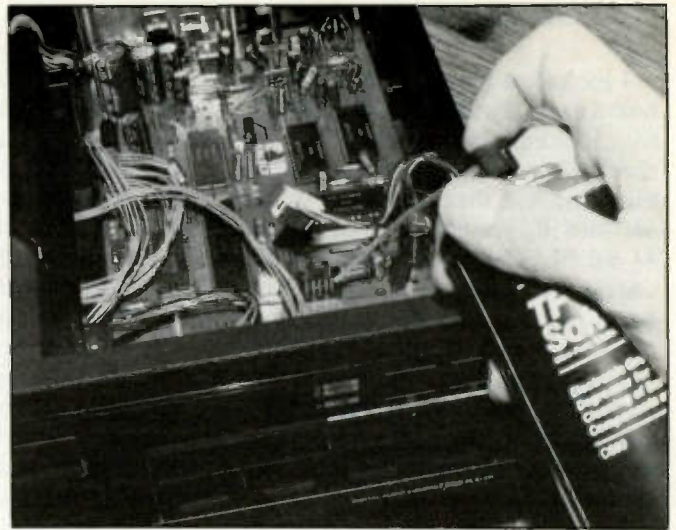


Figure 4. Before the CD player was returned, all the connectors were removed and sprayed with contact cleaner.

ing on it, and then shut it off. The next day when I turned the system on, the clock displayed the correct time and worked fine. All of the strange symptoms in this computer had been caused by some poor connections between the socket and the IC.

CD player repair

A Magnavox model F1041BK01, displayed an error message, instead of the TOC (Table of Contents) when a disk was loaded. The inside of the player was fairly clean, and there were no visible defects. I thought that the problem might be a dirty lens, so I cleaned it. That had no effect on player performance.

Before I even looked at the schematic, I removed and replaced all the connectors (Figure 3), and wiggled the socket-mounted IC. These simple actions restored the unit to operation. As a precaution, I cleaned all the connections with a Freon spray (Figure 4) before I returned the unit to its owner.

Signal processing system

Intermittent problems were occurring in a large computer system. The problem was isolated to intermittent circuit card connections as the malfunctions would disappear after various circuit cards were reseated (removed and reinstalled). This procedure acted as a contact wiping action, cleaning the contact areas. One of the "failing" cards was sent to an independent laboratory for analysis. Figures 5 and 6 show the analysis of the circuit card edge card connections (fingers) and a spectroscopic analysis of the material found, showed it was

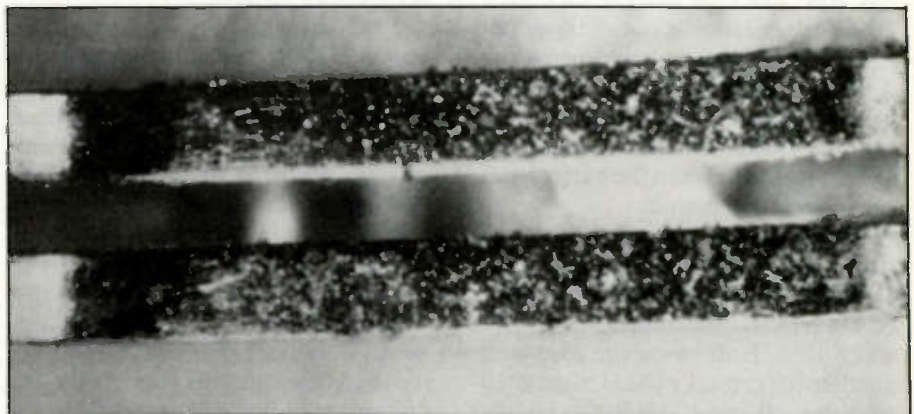


Figure 5. The circuit card edge connectors (fingers) showing accumulated debris.

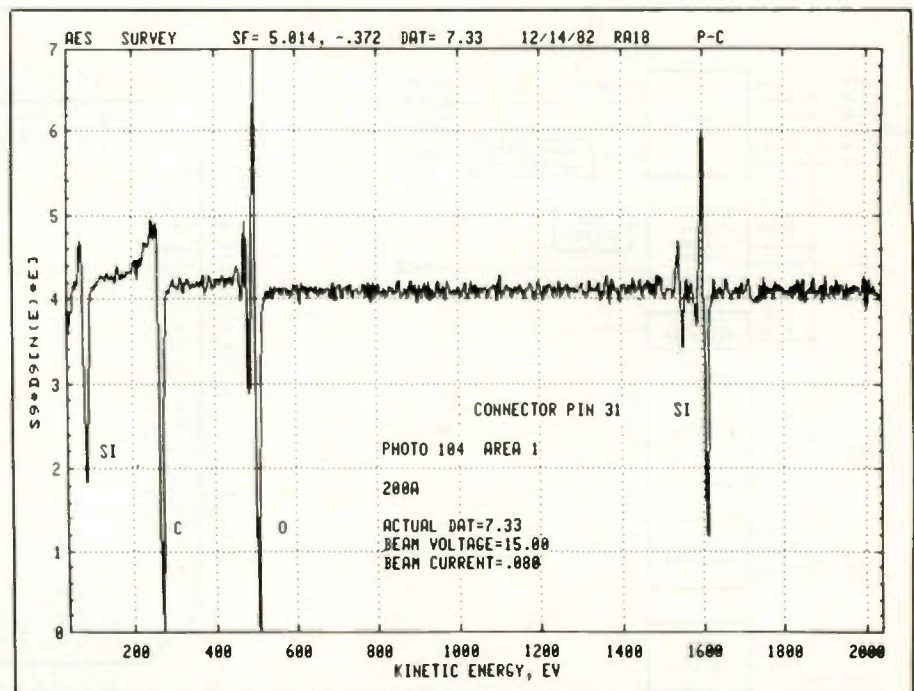


Figure 6. A spectroscopic analysis of the material found on the card edge connector showed it was a mixture of silicon, carbon and oxygen composition, silicon oil and dust/dirt from the environment. Some particles of conformal coating material were also found.

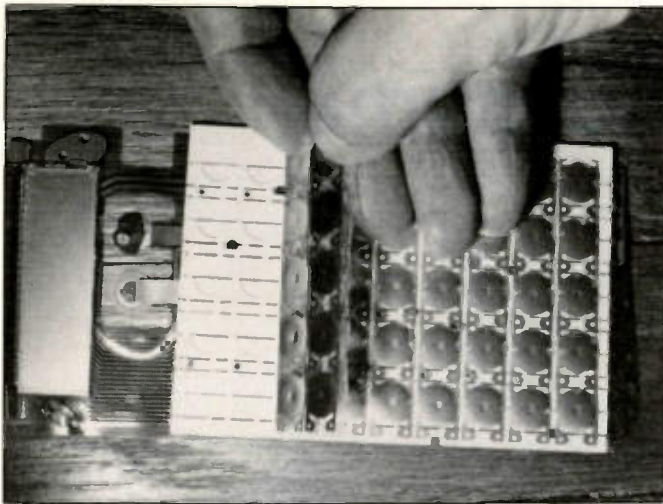


Figure 7. The TI calculator keypad assembly uses dome switches which consist of a metal disk that contacts a wire, when the key is depressed.



Figure 8. Underneath the dome contact point, as seen under a microscope is a dark spot which is some foreign material that prevents proper contact operation.

a mixture of silicon, carbon and oxygen composition, silicon oil and dust/dirt from the environment. Some particles of conformal coating material were also found.

Hand held calculator

The calculator, a Texas Instruments Scientific Model ATA4581, worked

very erratically; sometimes the keys would not respond, and other times double entries would occur. Checking and resoldering some of the connections inside the unit did not solve the problem.

An examination of the keypad assembly showed that it used dome switches which consist of a metal disk

that contacts a wire when the key is pressed (Figure 7).

Figure 8 shows the dome contact point under a microscope. Note the dark spot, which is some foreign material that prevents proper contact operation. Cleaning all the dome switches resulted in proper calculator operation. ■

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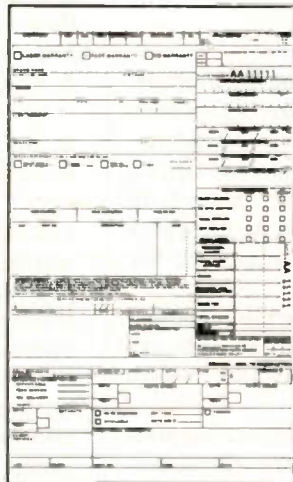
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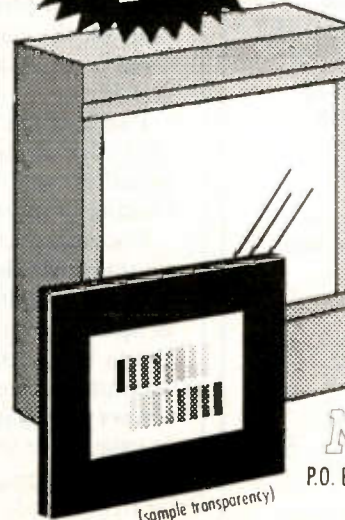
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Circle (88) on Reply Card

Cleaning electronic game cartridges

By Matt McCullar

As Nintendo's Entertainment System continues to appear in more and more homes, so does a peculiar problem. Sometimes players load old favorites into the cartridge slot, turn on the power, and nothing happens. It may take three or four tries before the game loads, if at all. It can get so aggravating that frustrated players heave these \$40 cartridges into the trash.

What is going wrong? The gold-plated contacts on the cartridge's circuit board get dirty preventing solid

electrical connections with the main console. The computer tries to read the program and can't find it.

Obviously a good cleaning is all that's needed. But you have to take apart the cartridge to clean the circuit board. And Nintendo uses some bizarre screws to hold their cartridges together. They look like this:

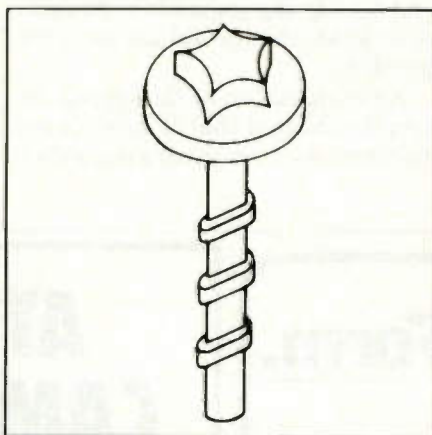


Figure 1.

Don't bother checking the toolbox. You won't find a nut driver that even remotely fits these screws. Instead, use a pair of very long, narrow-tipped long-nosed pliers. They put a firm hold on the heads and a few quick turns is all it takes to pop open the cartridge.

I've had the best luck in cleaning card edge contacts with an ordinary pencil eraser. The contacts end up looking brand-new.

Fortunately, there are interior plastic standoffs that prevent the circuit board from being installed backwards or upside-down. A Nintendo cartridge snaps back together in just a few seconds. I like to use replacement screws with standard heads on them, in case I ever see the cartridge again.

This oxidizing problem is not peculiar to Nintendo games. It happens to

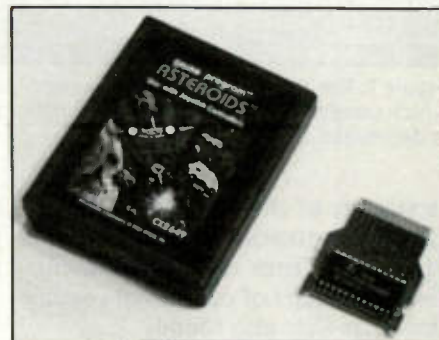


Figure 2.

almost every home video game system and microcomputer that allows ROM cartridges to be plugged in. The card contacts are exposed to everything, right out in the open. The cartridges Atari manufactured for their 2600 VCS did not have this problem because they ingeniously employed a trap-door mechanism that automatically sealed cartridges shut whenever they were not plugged into anything, and therefore were protected from dirt, smoke, oil, etc. (See Figure 2).

Not all manufacturers follow Nintendo's lead in manufacturing cartridges, either. Nintendo's are the only ones I've seen that prevent the circuit board from being installed backwards. With other companies it is possible to forget how the board was resting in there originally unless you make a drawing of it first. It is easy to re-install the circuit board incorrectly, snap together the cartridge, plug it into the game console, and destroy the cartridge's internal ROM chip when you turn on the power.

Knowing this, you can now fix "broken" games that people bring in to the workshop, or fix your own. Perhaps you can find some "faulty" cartridges at a flea market, priced to move, and repair them all before the sun goes down. Cost to repair: nothing.

McCullar is an independent computer and electronics servicing technician

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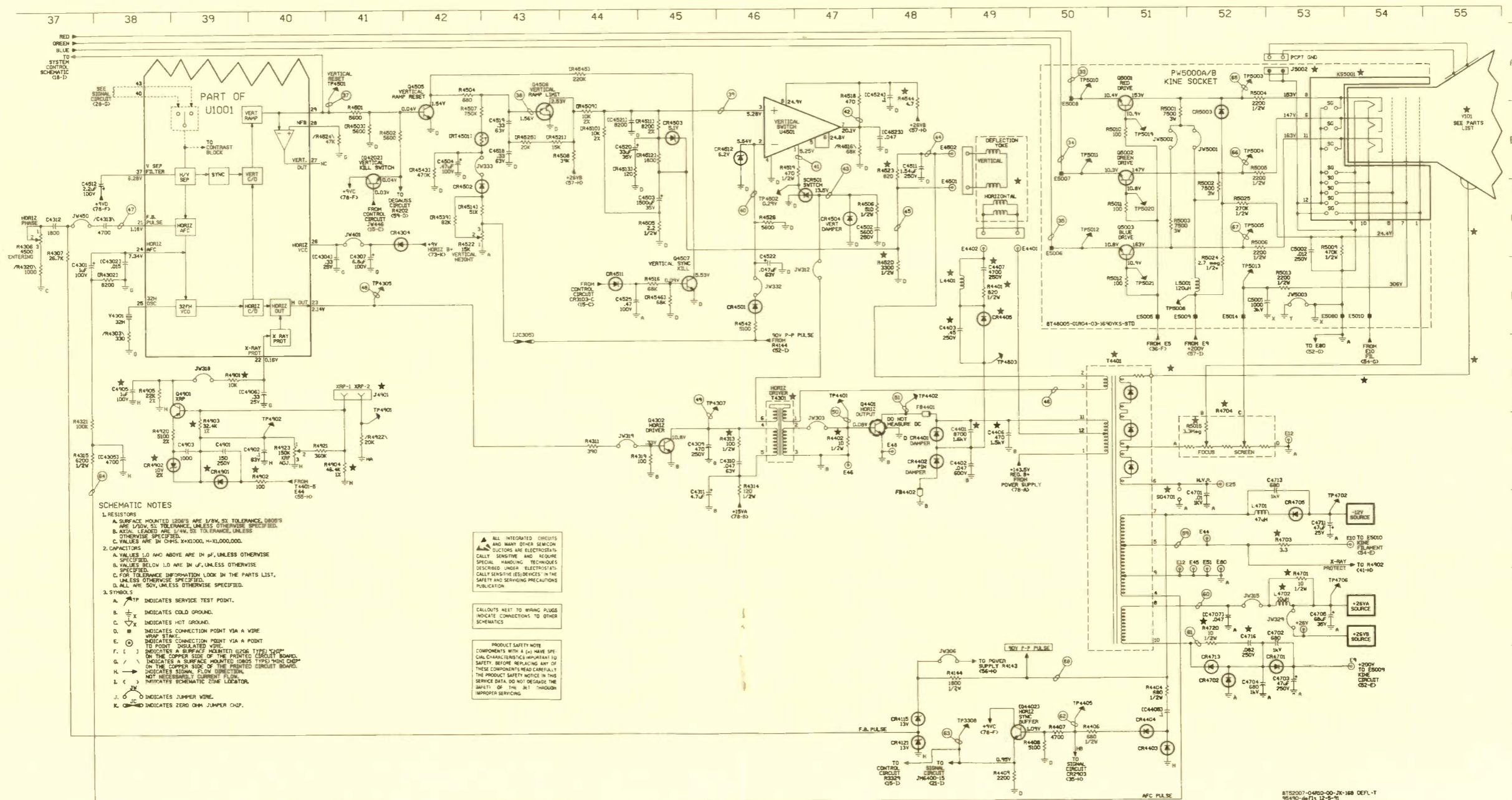
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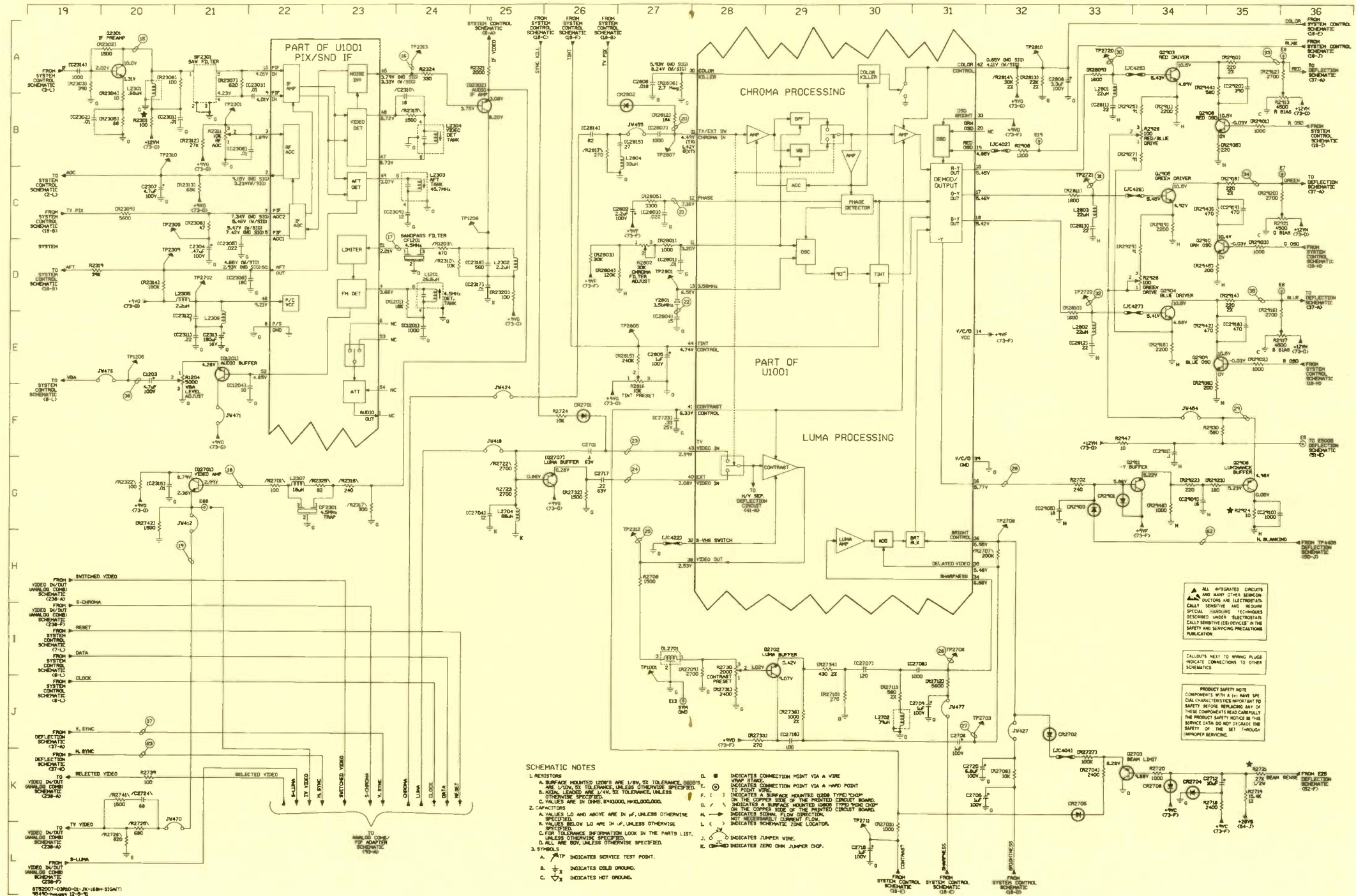
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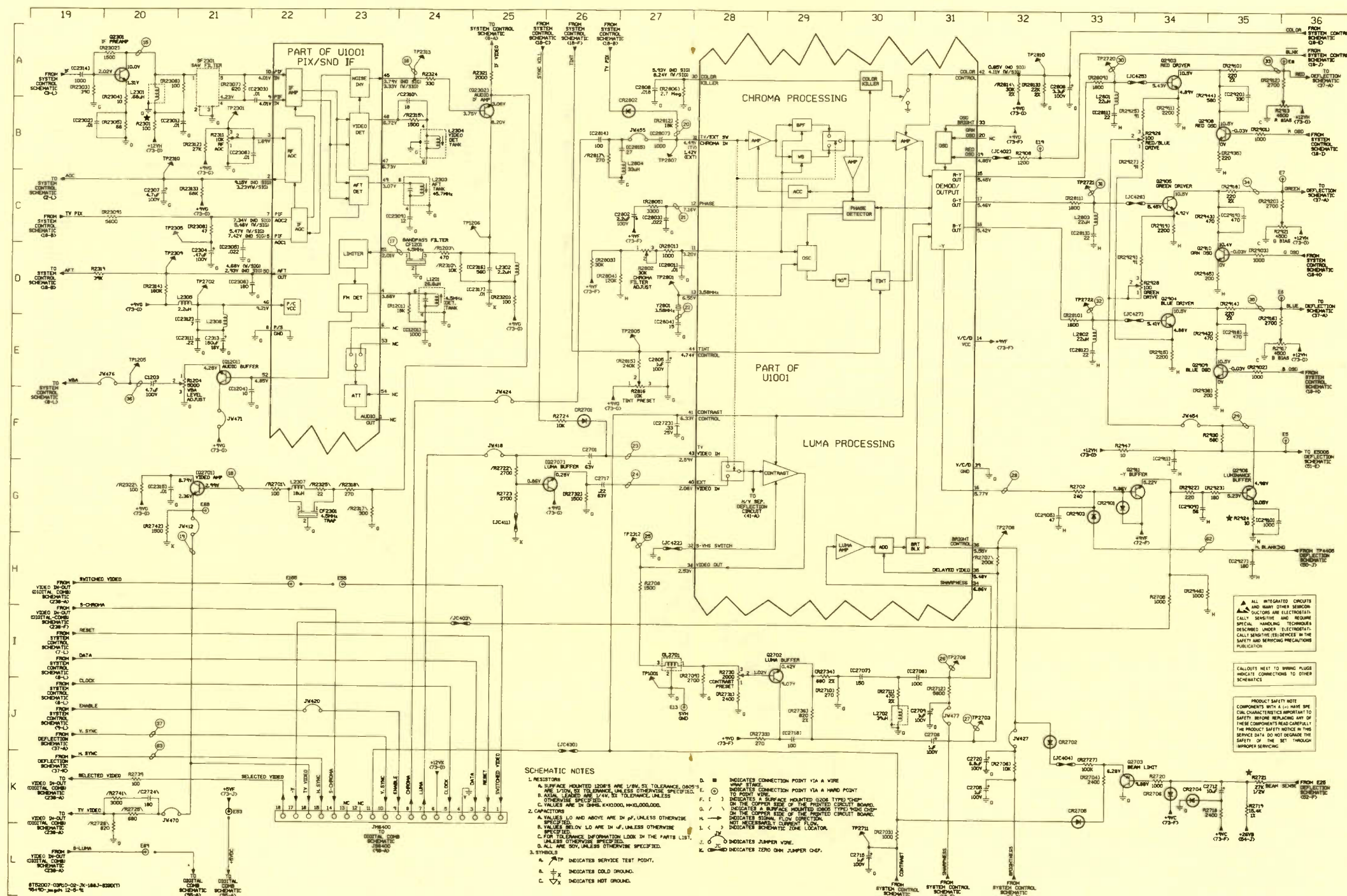
Product safety should be considered when component replacement is made in any area of an electronics product. A star next to a component symbol number designates components in which safety is of special significance. It is recommended that only exact cataloged parts be used for replacement of these components.

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

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

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

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



Servicing audiocassette decks

By Sheldon Fingerman

Repairing audiocassette decks can be a profitable and rewarding experience. Because most audiocassette deck problems are mechanical in nature, they can often be repaired without the aid of service literature. Many of your customers may just want to bring their decks in for a tune up, a service most electronic devices don't need at all.

This article will try to examine some of the more common problems found in the cassette decks you will come across. Keep in mind there are quite a few designs that can confound even the best technician. Though the techniques used here will work in most cases, if you have the proper service literature use it.

The most common audiocassette problems

The most common problems are tapes being eaten, the unit just stopping for no reason, and running slow. Other problems you may encounter are failure of the unit to record, or problems that are caused because the customer is not familiar enough with the deck and how it works.

The two biggest customer related complaints are the deck starting all by itself (in record or play mode) and not being able to record. The first complaint can usually be traced to the timer switch. Hardly used by anyone, this switch is conveniently located right on the front panel. If this switch is accidentally or purposely placed in the play or record mode, the deck will go into that mode when switched on. Since many people plug their deck into the switched outlet on their receiver, if this switch is in the wrong position, the deck would seem to have a mind of it's own.

When you return a cassette deck to a customer, regardless of the reason it was brought in, it is advisable to point out this feature out so that they won't accidentally move the switch while carrying it home.

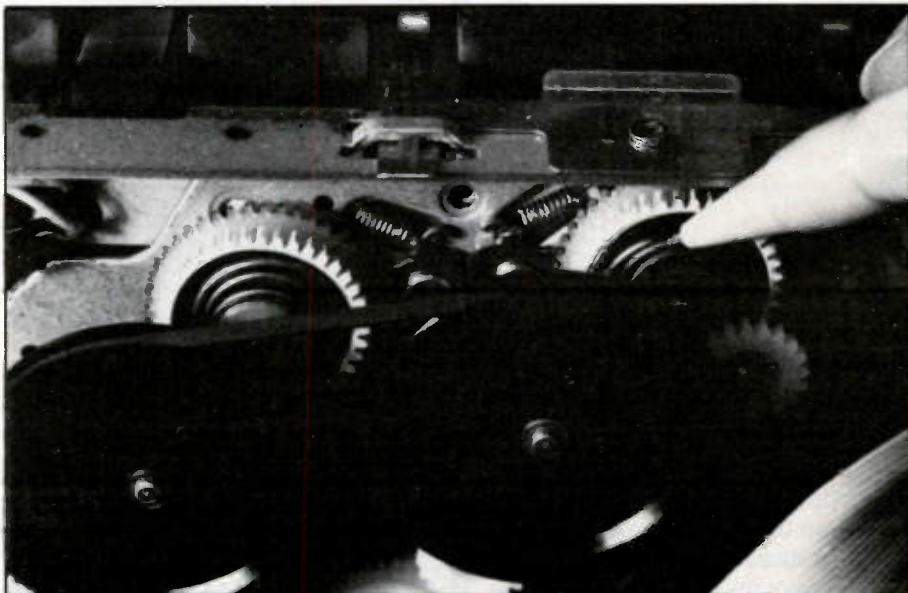


Figure 1. The pencil tip points to a typical clutch arrangement on an autoreverse deck. There are two identical clutches, one for each direction.

Controls built into the audiocassette

A complaint of "won't record" may simply be caused by a cassette from which the record protect tab has been removed. On the edge of the cassette opposite the tape there are two plastic tabs; one on either side. These tabs push up on a switch located on the

left side of the cassette compartment. If this switch, or lever, is not pushed up by the presence of this tab it is impossible to put the deck into record mode. Virtually all prerecorded cassettes are manufactured without this tab at all, while all blank cassettes have some type of removable tab.

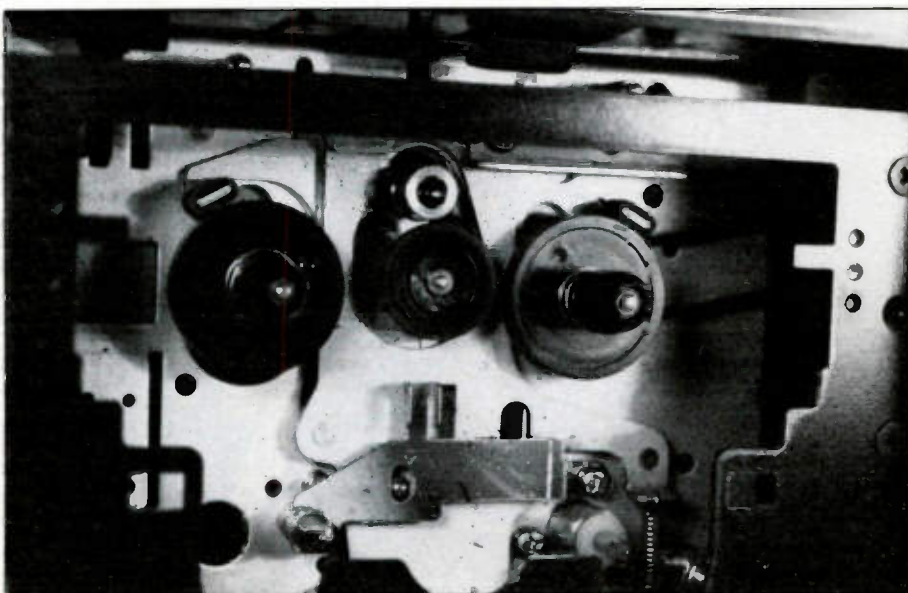


Figure 2. A common reel motor idler assembly used on many Nakamichi decks. Any slippage between the motor, idler, and reel poses a problem.

Fingerman is an electronics and computer consultant and servicing technician.

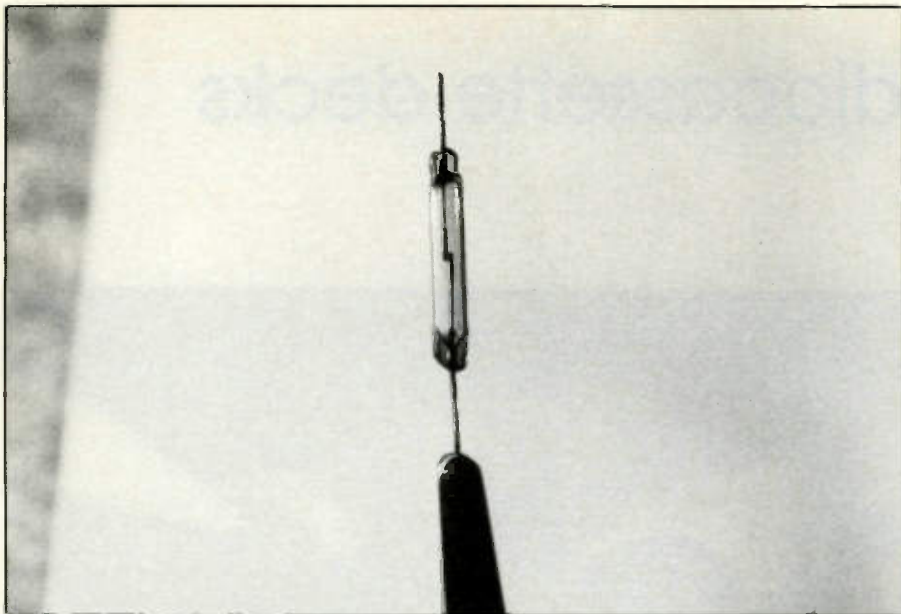


Figure 3. An unusual shut-off device. A small leaf switch sealed in a glass tube sits adjacent to a magnetic wheel. When the magnet in the wheel passes the switch assembly, the switch opens and closes creating a pulse read by the circuit.

Staying on the subject of controls built into the cassette, you may note that in a standard cassette deck, with the tape moving left to right, the tabs on the left side of the cassette control the way the deck may be set. The left-most tab, or lack of it, determines whether the tape can be recorded on.

Adjacent to this record protect tab, you may discover another indentation in the cassette shell. This will be found on most chromium cassettes. Closer to the center of the shell you may find yet another indentation. This is found on metal-tape cassettes. A mirror image of these tabs and indentations can be

found on the other side of the top of the shell.

These indentations control when the tape is playing or recording in the opposite direction. Any switches in the deck not conforming to the three cases described above are probably switches used to sense the presence of the tape itself.

All decks read the presence, or lack of, the record tab. Not all decks will read the other two. Interestingly enough it is the more expensive decks that do not have this chromium/metal sensing feature. Audio purists like to choose their own settings. On decks

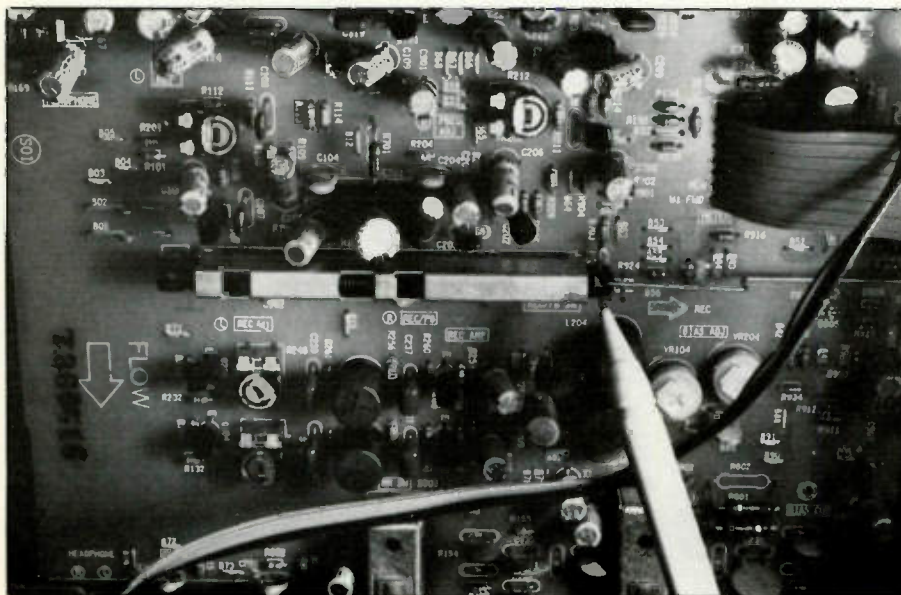


Figure 4. When this record/play switch gets dirty it will cause loud buzzing and pegged VU meters. This problem is more prominent with customers who rarely do any recording.

without this automatic feature you might hear complaints of poor recording or playback. Make sure the customer is aware of the manual setting for each type of tape.

Solving cassette deck torque problems

Low torque on the takeup reel is the cause for most complaints, and is almost always the culprit when the cassette deck eats the tape. Although there are many kinds of torque meters on the market, your finger will work just fine. It's free and it's surprisingly accurate.

After removing the cassette door, usually but not always accomplished by opening the door, lifting the plastic cover straight up, and then pulling it away from the deck, put the deck in play mode.

Some decks use some type of tape sensing device in order allow the unit to run at all. If the deck you're working on won't work without a cassette in it, look for levers and switches inside the cassette compartment. Once you get the deck running you should feel ample resistance on the takeup reel with your finger. Stopping the reel should cause the deck to shut off within a few seconds.

If you encounter little or no resistance to your finger pressure, you have found the problem. Most decks have some type of clutch mechanism on the takeup reel. Figure 1 shows a typical clutch arrangement on a JVC autoreverse deck. You'll note that there are two identical clutches, one for each direction. Excessive wear of these clutches is a common failure and is easily corrected by replacing the part. In the case of an autoreverse deck, where there are two clutches, it's good practice to replace both clutches at the same time, because they are inexpensive, and when one fails the other is most likely soon to follow suit.

On some models the clutch can be reconditioned. A common problem is excess lubrication finding its way into the clutch thereby reducing takeup torque. These clutches are usually made up of some type of spring and a felt pad.

Close inspection may show that the spring tension can be adjusted. Other times you may be able to spread the clutch with a small screwdriver and give it a good spray with a cleaner. Again, your finger can tell you if you've solved the problem. When the wash has completely evaporated the

symptoms may come back. You might try again but when this happens, the only answer may be a new clutch.

On decks that use a separate reel motor there may be no clutch used at all. Figure 2 shows a common reel motor idler assembly use on many Nakamichi decks. Any slippage between the motor, idler, and reel poses a problem. After removing the cover plate all of the parts are well exposed. Again, applying pressure to the takeup reel you should feel considerable resistance.

Correcting slipping, chattering and squeaking

If you notice any slipping, chattering, or squeaking, check the idler wheel between the motor and the reel. If the idler is not split or damaged it can usually be reconditioned. I use some fine abrasive paper taped to the end of wooden stick to remove the glazing that occurs. You might then follow that with some denatured alcohol or Freon, or some other solvent recommended by the manufacturer, on a swab designed for the purpose.

Using your finger, again test the torque on the takeup reel. This should do it. If the idler is damaged or split it will have to be replaced, but I have never had a comeback due to failure of the previously described method.

Dealing with cassette deck motor problems

In some cases the reel motor may have to be replaced. Look at the motor carefully before you completely disassemble the transport. You may be able to carefully pull the motor out of its housing, along with its pulley or bushing, and replace it with the new motor without having to remove a single screw.

Be careful, though. If you've never tried this method before, or it can't be done on the unit you are working on, you may destroy the new motor. If the old motor won't pop out rather easily you will have to do some disassembly to get the motor out.

Another common problem is a dead capstan/flywheel motor. If the capstan motor is dead, even if you can get it started with a slight nudge, you had best replace the motor anyway. It will fail again. Check the motor as you would any other motor. After removing at least one lead (there may be more than two) check the motor supply voltage. Most cassette motors are 12 volts but there are exceptions. Mo-

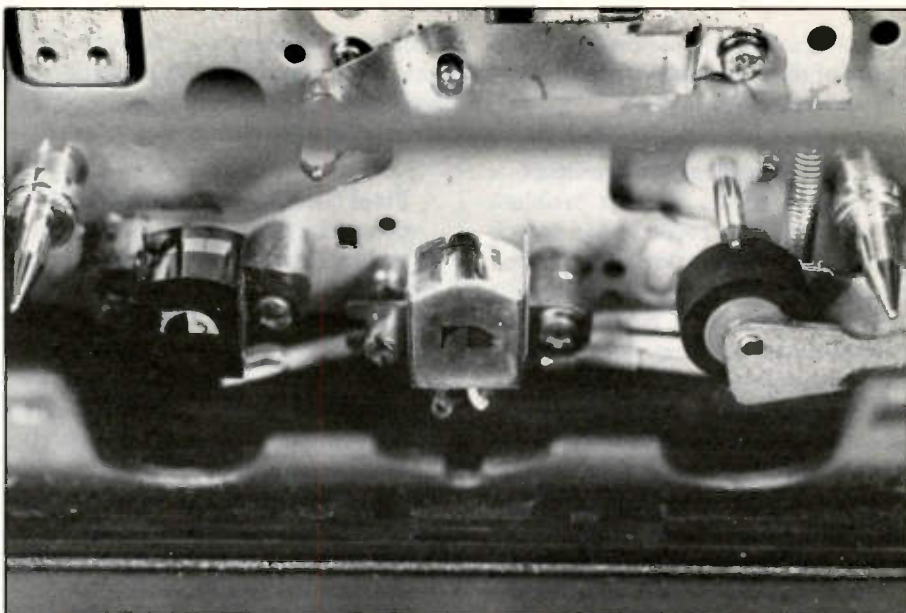


Figure 5. A simple 2-head tape path. The tape travels from left to right passing over the erase head, then the record/play head, being pulled between the pinch roller and capstan.

tor problems are rarely caused by failure of the power supply.

Some motors start to slow or exhibit wow and flutter only after they have been run for a while. Be sure to ask the customer if the problem happens right away, or after a period of time.

Auto-shut-off problems

Failure of a deck to play can also be related to the auto-shut-off mechanisms employed by most decks. Some of the earlier decks used a "Rube Goldberg" type of arrangement that had a lever which rocked back and forth just avoiding another lever moving up and down. A collision between

these two levers would put the deck in stop mode. Most modern decks use a small magnetic wheel which is part of the counter assembly. The wheel, belt driven by the takeup reel, sends pulses to the deck's circuit. When the pulses stop so does the deck.

Some decks use a light and sensor separated by a small rotating shutter. If the problem lies here, replacing the lamp will usually solve it. Figure 3 shows one of the more bizarre shut-off devices. A small leaf switch sealed in a glass tube sits adjacent to a magnetic wheel. The switch opens and closes creating a pulse read by the circuit. Over a period of time this switch wears out causing intermittent stopping pro-

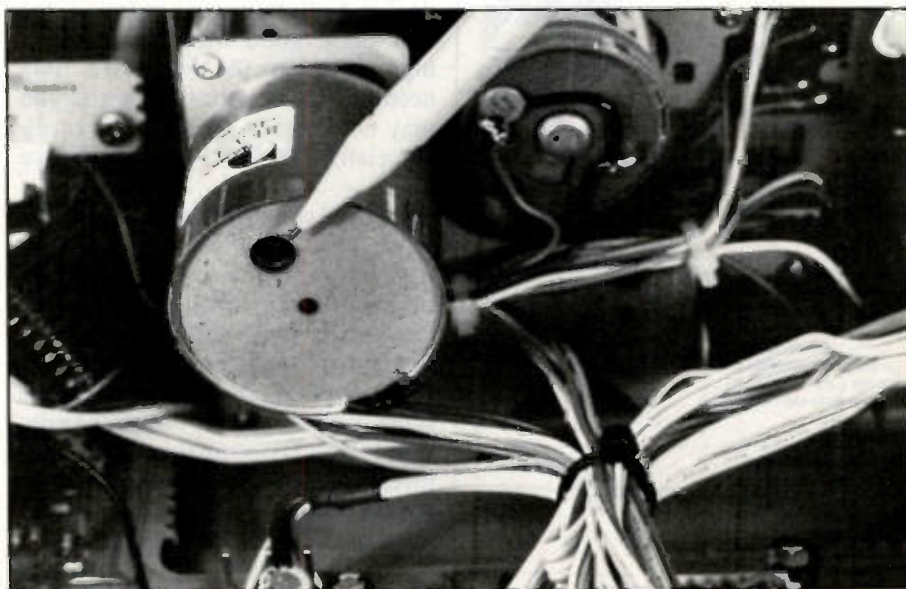


Figure 6. The speed of most decks is adjusted by a pot located in the motor, in this case, pointed to by the pencil.

blems. Persistent searching for the cause of the problem will usually turn up these oddities.

A few miscellaneous problems

Figure 4 shows another problem area. When this record/play switch gets dirty it will cause loud buzzing and pegged VU meters. This problem is more prominent with customers who rarely do any recording. A good foaming switch cleaner will solve the problem. In rare cases you may have to replace the switch. Some decks use a single switch for both channels while others use a pair of switches. Modern decks use relays or electronic circuits to switch between play and record.

Many problems will be obvious. Broken belts, stretched belts, and other worn or broken parts will usually show themselves right away. A broken head wire is a frequent problem on auto reverse decks because of the constant rotation of the heads. This problem may not be obvious at first, and the repair is somewhat time consuming.

If this is indeed the cause of the problem, check for excessive head wear and check on the age and value of the

deck. It may be cheaper, and wiser, for the customer to just replace it. Especially if it's being used in a commercial application.

Final checks, cleaning and lube

Once all repairs have been completed the deck should be cleaned and lubricated if necessary. Check the flywheel, capstan, and pinch roller for smooth operation. A good penetrating oil may free up a sticky flywheel/capstan, but if you've had to remove the plate that holds these parts in place, or they are still binding, you should remove them, clean them, and lubricate them. Otherwise leave them alone. Too much lubrication can be as bad as, or worse than, too little.

The heads, capstan, and pinch roller should all be cleaned as well. Use a chemical recommended by the manufacturer to re-dress the belts and pulleys in the transport. If you use those cleaning swabs with the bamboo shafts they can be bent with a pair of pliers to get around, under, and behind places. Belts that feel stretched or gummy should be replaced. Any time you replace a motor, replace the belts driven by that motor as well.

You should also demagnetize the heads. Wand-type demagnetizers that work on ac do the best job. Make sure the deck is turned off before starting.

Adjustments

Once everything has been cleaned up some adjustments should be made. Alignment of the heads or azimuth should be done first. Using a test tape and a scope there are a couple ways to do this. I adjust for peak output. If the unit sounds good, with crisp and clear highs (listen to the cymbals) it may need little or no adjustment and you may not want to mess with it at all, especially if the deck is an inexpensive one.

Figure 5 shows a simple 2-head tape path. The tape travels from left to right passing over the erase head, then the record/play head, being pulled between the pinch roller and capstan. Some of the more expensive 3 head decks use two pinch rollers and capstans. This is called a "closed loop design." Don't confuse these with autoreverse decks, especially when replacing a capstan/flywheel belt. Both capstans rotate in the same direction.

The record/play head is usually held in place with two screws. One screw holds it tight against the trans-

port while the other is adjustable with a spring behind it. On autoreverse decks there will be an adjustment screw on each side of the head, one for each direction. Because of the constant rotation of the head, causing the adjusting screws to hit their stops over and over, these decks will almost always be out of alignment.

After alignment, lock the screw in place with some nail polish or clear cement. If the deck still sounds "muddy" after alignment check the head again for tape oxides or excessive wear. Sometimes tape oxides can really be tenacious.

Be cautious when aligning more sophisticated decks. Some decks have adjustment for head height, tilt, azimuth, etc. If you start turning the wrong screws you may have to get a service manual (not to mention special tools) just to get the adjustments back to where they were when you started.

If I find a customer's deck to be severely out of alignment I may give them a call before proceeding. Since recordings made on a deck will always play back "aligned" on that deck, all of their recordings may be rendered useless once aligned to specs.

The next adjustment is speed. This should always be performed after replacing a capstan motor. The only way to accurately perform this procedure is with a test tape and a frequency counter. Most but not all decks are adjusted by a pot located in the motor (Figure 6). On expensive, 3-head, closed-loop design decks you can usually set the speed exactly. On inexpensive decks you will find that setting the speed a little fast may be a better compromise.

As with any repair, check your work carefully. Check for excess lubrication, especially on the capstan and pinch roller, and using a known good cassette run the deck for a while checking all functions. Clean the exterior (glass cleaner works well), and that should do it.

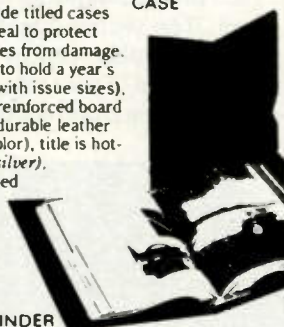
One more thing. There are a lot of very old tape decks out there. Many of them worth only a few dollars. As a professional it may be up to you to tell the customer to just replace it. A brand new inexpensive tape deck will outperform an older deck that may have cost a lot when it was purchased. As you already know, being a successful technician means knowing not only what to repair and how to repair it, but what not to repair as well.

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SATISFACTION GUARANTEED

A servicing technician's glossary

By Conrad Persson

Once a year we normally publish a glossary to help readers keep up with the the constantly changing and expanding world of consumer electronics technology. This time we're going to place emphasis on the rapidly growing world of abbreviations, acronyms and computer terms, plus some of the terms associated with LCDs that a technician faces, or will soon face. Also thrown in will be definitions of a few terms that have piqued the interest of the ES&T staff. Here we go.

Please keep in mind that the number of definitions is limited here because of both space limitations and the speed with new terms are being introduced. If you don't see your favorite term defined here, by all means write or call us and we'll do our best to include it in our next glossary.

All-channel tuning: the ability of a TV set to receive all assigned chan-

nels; VHF and UHF channels 2 through 83.

ASCII: American standard code for information interchange.

ASIC: Application specific integrated circuit. An integrated circuit that is manufactured to perform a specific function, rather than as a general-purpose IC, such as a RAM or ROM chip, or a microprocessor.

ATV: Advanced television system. Television system currently being developed that uses a higher horizontal resolution than the current 525 lines of the NTSC standard.

BASIC: Beginners All-Purpose Symbolic Instructional Code. The most commonly used computer programming language.

Baud: A measure of the speed at which it is possible for computer equipment to send or receive information. It is commonly used as synonymous with characters per second.

Birefringence: When an electric field is applied to LCD material, the molecular orientation of the material is changed, causing it to darken. This change of the refraction index (tendency to bend light coming into or out of the material) is called "birefringence"; literally "two refraction characteristics."

BNC: As in BNC connector. We had heard that this stood for BayoNet Connector. Someone had reported that it stood for "Bayonet: Neill Concelman" after the name of the inventor. That sounded a little far-fetched until someone provided a copy of a page of a technical magazine that printed it in black and white. We're still not totally convinced. Does anyone have any documentation of this?

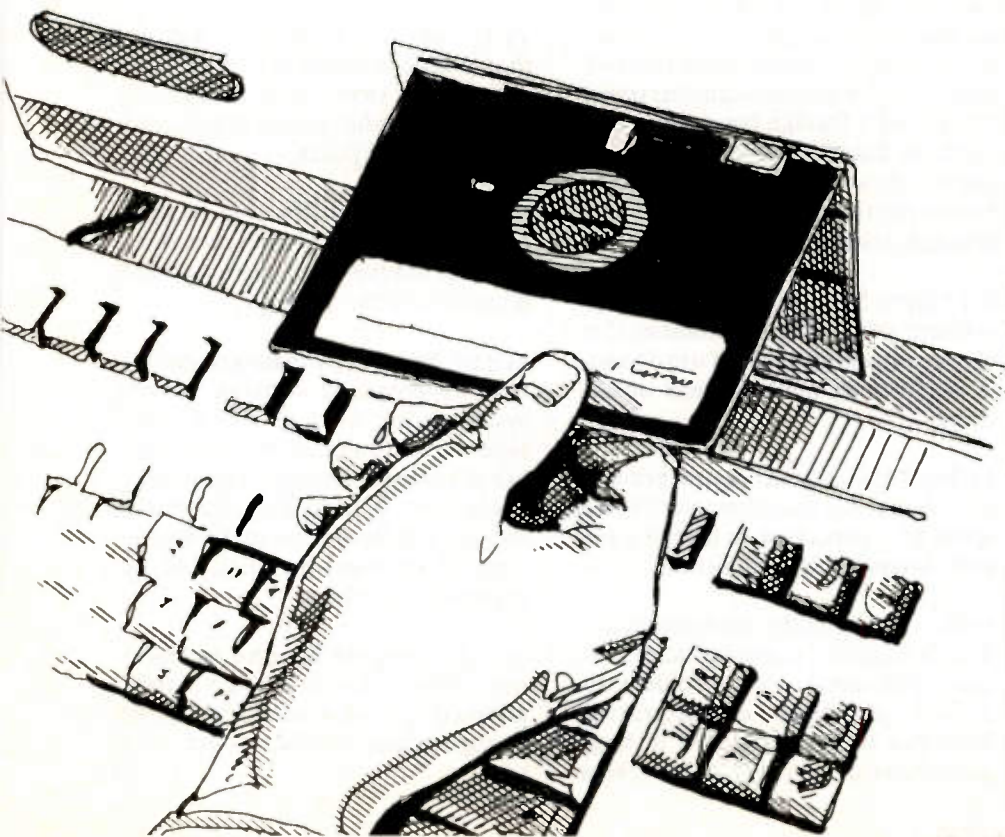
CCIR: International radio consultative committee. This term is also used to describe the 625 line television system used principally in Western Europe.

CCITT: International Telegraph and Telephone Consultative Committee.

CEBus: The Consumer Electronics bus is the home automation standard established by the Electronic Industries Association/Consumer Electronics Group (EIA/CEG). The CEBus Committee, comprised of both member and non-member companies, has developed the premiere standard for a unified control system whereby electronic products from different manufacturers can communicate with one another via existing power lines, twisted (telephone) pairs, coaxial cable and infrared means. The standard includes "bridge" devices that convert signals from one carrier to another to enable data transmission.

DAT: Digital audio tape. A form of audio tape recording and playback that encodes the sound in digital form, in much the same way as compact discs do. The result is superior audio reproduction.

Persson is editor of ES&T.



DISP: Digital signal processing. This is sort of a spread sheet for engineers and others interested in manipulating electrical or other signals using a computer to see what the results will be.

DOS: Disk operating system. This is the software program used by IBM and compatible computers that performs the so-called housekeeping functions; such as taking information from the keyboard, operating the disk drive, etc.

ED: Extended definition. This is the newest technology in videocassette recorders in the Beta format. An improvement over standard Beta, ED-Beta's separation of the luminance and chrominance signals during record and playback, a wider luminance bandwidth, and the use of high density tape result in sharper, more vivid picture quality.

EDTV: Enhanced or extended definition TV. System currently under development which involves advanced encoding and/or transmission techniques, but having less resolution than HDTV. Also called EQTV (Enhanced Quality Television).

ESD: Electrostatic discharge. This is the technical term for the discharge that crackles when static electricity is grounded. Until the introduction of semiconductors, electronics equipment was pretty much immune to damage from ESD. Some recently introduced components, notably MOS components, are so sensitive to ESD damage that a static-electric potential that the average individual can't even feel will destroy one.

HDTV: High-definition TV. A form of television that will, in the future, provide over 1,000 lines in a typical television picture, compared to the 525 currently used in generating an NTSC picture. Another feature of HDTV is wide aspect ratio and digital quality TV. The picture on developmental HDTV sets rivals the resolution of a photograph. No standard has yet been set for HDTV in the U.S.

Home automation: Unified control system whereby electronic products from different manufacturers can communicate with one another via existing power lines, twisted (tele-

phone) pairs, coaxial cable and infra-red means. (See CEBus).

IDTV: Improved definition TV. Intermediate system designed to improve resolution of existing NTSC standard without involving new transmission standard. This system would have less resolution than EDTV and HDTV.

LAN: Local area network. This is a collection of personal computers, sometimes quite varied in size and power, tied together via cables, phone line, etc. with a software program that allows them all to communicate and share information. There are a number of different types of LAN systems.

Laser-optical: A system of video recording on grooveless discs, employing a laser-optical-tracking pickup.

MATV: Master antenna television. This describes the kind of cabling system using a single central antenna, such as those used in apartment buildings and motels.

MTS: Multichannel TV sound. The initials MTS are commonly used to designate TVs, VCRs, tuners and adapters equipped for receiving the stereo audio signal channels, one each for the left and right stereo signals, the other for an independent second audio program (SAP) channel. The most popular use of the SAP channel is for the simultaneous transmission of a foreign language sound track or translation of a TV program. However, broadcasters are free to use the SAP channel for non-program related purposes.

MFLOPS: Million floating point operations per second. A number that characterizes the speed of a processor in performing mathematical operations.

MIPS: Million instructions per second. A number that characterizes the speed of a processor in carrying out software program instructions.

MOS: Metal-oxide semiconductor. This is a type of semiconductor that uses a thin metal oxide to achieve the desired electrical characteristics. They can be manufactured in large quantities on a single IC chip because

of their small size, and are extremely fast, but have the disadvantage of being highly sensitive to ESD damage.

MOV: Metal-oxide varistor. This is a device whose electrical resistance drops rapidly when a voltage exceeding a specific design voltage is placed across it. The result is that the excessive voltage may be shunted to ground very quickly. MOVs are extensively used in spike suppression applications.

SMD: Surface-mount device. An electronic component such as a resistor, diode or transistor that is designed to be soldered directly to a pc board soldering pad without leads that penetrate the board.

Nematic: This term describes a class of liquid crystals that have the long axes of the molecules in parallel lines in large clusters. This material exhibits the characteristic of birefringence.

NTSC: National television system committee. This term describes the TV system designed by this committee, and currently used in the United States.

PAL: Phase alternate line. The color TV system adopted by Germany, Great Britain, and most other Western European Nations.

TFT: Thin-film transistor - a device that is used in liquid crystal technology to allow switching of an LCD device at a rate that makes it useful for TV display purposes.

RISC: Reduced instruction set computer. A computer central processing unit that has fewer instructions that it is capable of carrying out.

SCMS: Serial copy management system. A proposed copying limiting system being used in digital audio tape recorders that restricts the number of generational copies that can be made from a recording. Recording owners will be able to make a taped copy of recorded material, but not copies of the copies.

SECAM: Sequential color and memory. The color television system adopted by France and most Eastern European and Middle Eastern countries. ■

What do you know about electronics?

What is true and what is false?

By Sam Wilson, CET

It is interesting, and often helpful, to know where some of the ideas used in technology come from. I want to take you on a quick trip through the years to explain a concept that is very important in digital and computer circuits.

The trip starts in ancient Greece - sometimes called "The Golden Age of Greece." For some unknown reason there was a high concentration of very intelligent people - called philosophers - who were living in Greece in those days. They were beginning to ask tough questions. More important, they were trying to find a way to answer those questions.

One of the questions - of interest here - is "How do we know what is true and what is false?" They reasoned there must be some way to accept the things that are true and reject the things that were false. Note that they wanted to pick between two alternatives: true (logic 1 today) and false (logic 0 today). They didn't call the choices 1 and 0, but as we move along in time we see that it will eventually get around to those choices.

One approach they used was called a *Syllogism*. That is an argument in three steps and it goes like this:

- Every time it rains the streets are wet.
- The streets are wet.
- Therefore, it is raining.

Of course, that argument is false. I gave that example to show that philosophers who wanted to get to truth along that path had a lot of work cut out for them.

However, philosophers did the work. By the end of the middle ages that type of argument was brought to near perfection in a field of knowledge called *formal logic*. By that time humans were spending lifetimes studying and perfecting the laws of formal logic.

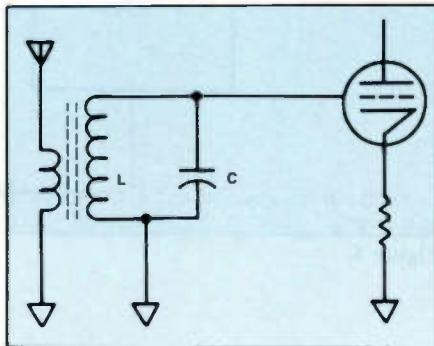


Figure 1.

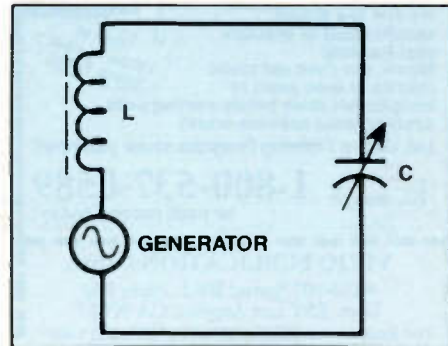


Figure 2.

Somewhere around that time some spoilers came along and threw a wrench into the works. (One of those spoilers was a genius called Lewis Carroll.) Those guys showed that you could follow all of the rules of formal logic and come up with nonsense:

- All zoomphs are callicads.
- Morgle is a zoomph.
- Therefore, morgle must be a callicad.

That argument is actually correct as far as formal logic is concerned but you can't tell it is correct when you read the conclusion. What's wrong here? An obvious answer is that the problem is in the words and in the use of language. That includes the meanings of terms, sentences, grammar, etc. To get around that problem you have to substitute symbols for the words, and you need some way to work with those symbols so you always get the right answers. That's why *symbolic logic* was born!

A lot of people must have dropped out of class when symbolic logic hit the school. It requires people to think in abstract symbols and terms. For some folks that was like trying to push a boxcar uphill with a rope. Once again, some people with a lot of smarts came along and eased logic ahead.

George Boole made some rules for

manipulating the symbols. With those rules it is possible to arrive at truth (1 or 0) by using some well-known mathematics. Boolean algebra was born.

For a time there were no great jumps in logic, but there were further refinements on the rules. Then, a student in the 1930's had one of those mental flare-ups that are called "great moments in history." He showed that Boolean algebra could be used for designing switch circuits. (I'm sorry I can't find his name right now, but, I

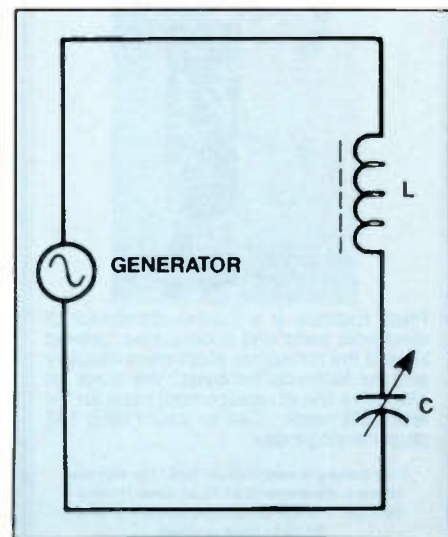


Figure 3.

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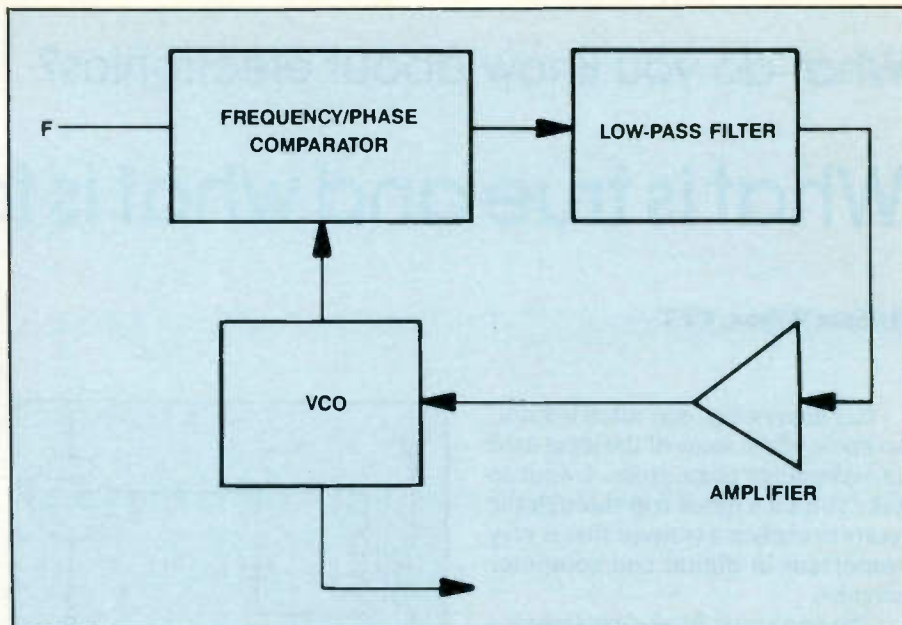


Figure 4.

assure you I will find it later and pass it along. A person like that should be given recognition!)

From switches to relays to diodes to any device that has two stable states, Boolean algebra could be applied in the design. Logic was off dead center again. It was not long before the first digital circuits used in computers were developed.

Teaching vs. practical experience

I'll tell you how far back Bruce Hagen and I go. We go back to the days when I was sure I knew everything and Bruce was convinced I didn't know everything. If you have a friendship that can survive that kind of start - hang onto it. It is special. Bruce had a lot of practical experience and at that time I was mostly into theory.

Let's move ahead 15 years. I was teaching electronics and Bruce had a successful TV business with several people working for him. We were in his office one day and I was getting ready to tell him how difficult my job was.

Intercom: "Bruce - D_____ is one the phone. He says he has to talk to you right away." (D_____ was one of his technicians.)

Bruce (picking up the phone): "What's the problem D_____?" There was a moment of silence. Then -WHAT?!?!?!THE TRUCK IS ON FIRE?!?!?! Another moment of silence, then - "YES! IT'S O.K. TO

CALL THE FIRE DEPARTMENT!!!!

Bruce hung up the phone and stared off into space with a look of complete frustration. We never did get to talk about my teaching problem.

Unusual responses

Note: Letters discussed in the following paragraphs were sent in the 1970's. This will come as a surprise to some readers, but, I spend a lot of time researching the theory that I need for my work. Apparently, some people think I make all this stuff up in my head.

Refer to Figure 1. I once wrote a CET test question on that circuit. The question asked "Are L and C in series or in parallel?" The answer is, of course, that they are in series. The way you tell is to look for the source voltage and current path. In this case the voltage is induced in series with the windings. The equivalent circuit is shown in Figure 2, and the circuit is redrawn in Figure 3 for a better view.

Even if a technician didn't know that, the answer could be deduced from the fact that a series tuned circuit selects one frequency and rejects all others. That is the purpose of the radio tuned circuit.

I got a strongly-worded letter from a guy who said: "Even an idiot can tell by looking at the circuit that L and C are in parallel."

In a way, what he said is true.

I have given both the mathematical

and graphical proofs that resistance in a branch of a parallel resonant circuit affects the resonant frequency. In fact, a parallel resonant circuit can be tuned with a variable resistor in one of the branches. (Series circuits are *not* tuned with resistors.) After digesting the proofs that I gave him, a man in North Carolina sent this short note to me: "Series and parallel circuits are the same thing! period!"

A shop manager wrote to me once and said that one of his technicians cried because there were "several mistakes" in one of my newly-published books. (As it turned out, only two of those so-called mistakes actually were mistakes). That book had gone through three complete proof readings, but, mistakes did sneak through.

I always feel bad about mistakes. But, if I had a technician who cried because of mistakes in a book I'd try to get that technician some help.

I once got a nasty letter from a guy who objected to my drawing of a phase locked loop. See Figure 4. He said that it would not work with an amplifier in the loop. (Of course, he was wrong about that.)

He let me know in no uncertain terms that he had much experience in such things and listed a few of his qualifications. To ice it, he listed his first class FCC license number.

I had never seen that done before, and, I haven't seen it done since. When I answered his letter I gave my driver's license number. You won't believe this, but, he did not see the humor in that. He wrote another terse letter to ISCET and let them know how he felt.

Mnemonics

You are on an errand when someone jumps out of a fast taxi and says: "I must know the value of pi to 14 decimal places and I need to know it now! He offers you a pencil and notepad. You take them and write:

How I want a drink, alcoholic of course, after the eight chapters involving quadric mechanics.

He glances at the note, smiles, and returns to his taxi. (Explanations at the end of this article.)

On your way home you stop at a park to rest. A little girl sits beside you. She is obviously troubled. "Problem?" you ask. "We're having a geography test tomorrow and I'm

not going to pass. I never can remember the names of the great lakes."

"Well," you say, "you only need to remember one word: homes."

"Gee thanks" she says and leaves.

When you return home you have the feeling you can answer any questions. You step inside your house and your wife is waiting. "Can you tell me why it takes so long to pick up a head of lettuce at the store?"

As you turn to go out again you ex-

plain "because it takes two trips."

You can't do everything with mnemonics.

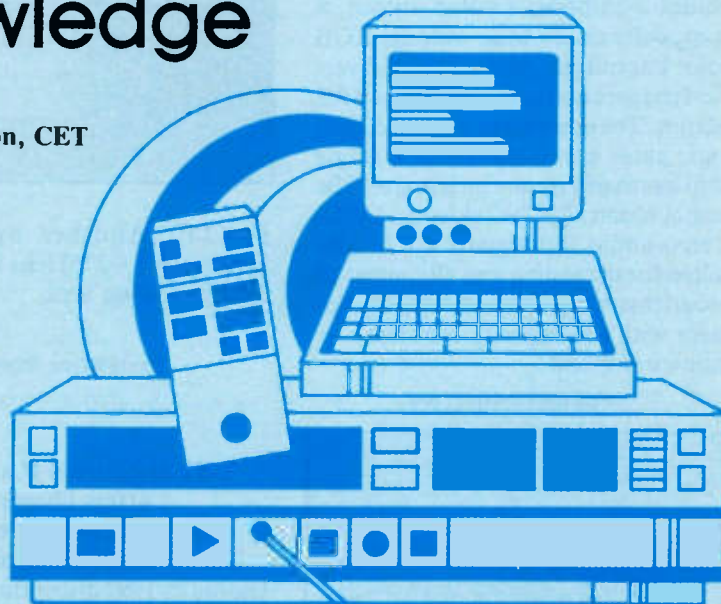
Explanations

The value of pi is obtained from the number of letters in each word: 3.14 159 265 358 979.

Each letter in the word "homes" stands for one of the lakes: Huron, Ontario, Michigan, Erie and Superior. ■

Test your electronics knowledge

By Sam Wilson, CET



This quiz is mostly about digital, microprocessor and computer terms. The definitions are given. Your assignment - should you decide to accept it - is to supply the terms that go with those definitions. All of the terms are in the matrix. They can be forward, backward, diagonal, read up or down. If you don't feel like searching for the answers, they are also given on page _____.

1. The sum of the bits when used for error detection _____.
2. Four bits _____.
3. A signal that results in the suspension of the program _____.
4. Parallel conductors that carry information from one part of a circuit to another _____.

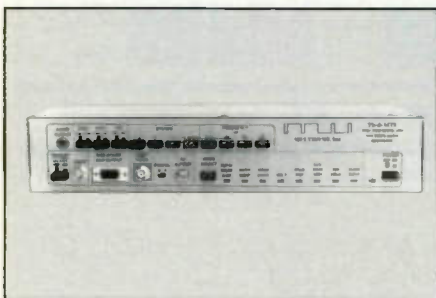
5. A specific number of bits. For example, eight bits _____.
6. An integrated circuit that has between 10 and 100 gates, or, one of similar complexity _____.
7. An integrated circuit with 1000 or more gates, or, one of similar complexity.
8. A type of memory that can be programmed only once. It is a non-volatile memory _____.
9. The number 1 in the binary number 1000.
10. A type of register in which the first output bit is the last bit that was entered.

Answers on page 55

Video test signal and MTS stereo audio generator

Multidyne Electronics, Inc. announces the TS-8 MTS NTSC Video Test Signal and Stereo Multi-channel Television Sound Generator. The unit produces 8 digitally generated video test signals with an accuracy of 8 bits. The unit provides stereo multi-channel television sound (MTS) with second audio program (SAP) and 4 selectable frequencies of tone. The generator includes a composite video output, a composite audio tone output, RGB color bar output, horizontal and vertical triggers and a channel 3 and 4 RF output. The equivalent of 1200 digital logic gates are contained in a single chip less than 1 square inch in size. The combination of NTSC video and MTS stereo audio test signals are ideally suited for the testing and alignment of broadcast video systems and equipment with the capacity for stereo or monaural sound.

Circle (66) on Reply Card



ESD-safe magnifier

This ESD-safe illuminated magnifier from *Dazor* directs light at the proper angle to highlight object details. This hi-lighting magnifier casts light at an angle that makes details of uneven surfaces "pop-out" to the viewer, instead of flooding the viewing area with shadow-free light that washes out details. The highlighting effect makes this magnifying system ideal for inspection of electronic parts and circuit boards. A 13-watt compact fluorescent lamp located behind the magnifier lens produces the desirable light pattern. The crystal-clear crown optical glass lens provides distortion-free magnification. The 5-inch diameter lens is available in 3-diopter (+ 75% magnification) and 5-diopter



(+ 125]. Another option is an 11-diopter (+ 275] lens system with a 3-inch viewing area.

Circle (67) on Reply Card

1992 discounted ICs/discretes offers library of out-of-production components

D.A.T.A. Business Publishing is releasing its 1992 discontinued Semiconductor library covering integrated circuits and discrete semiconductors. This series provides service technicians with detailed specifications on devices no longer produced. The digests are compiled from manufacturer data-sheets and arranged in a logical format to save time when researching obsolete devices. The digest provides informa-



tion on part number listings, technical specifications, package styles, pin-outs, manufacturer directory.

Circle (68) on Reply Card

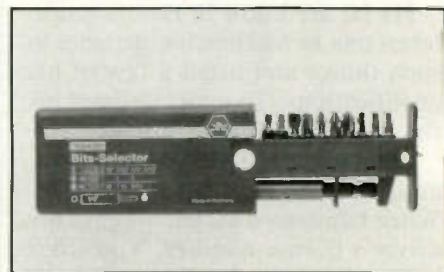
Surge protection for data lines

MCG Electronics, Inc. offers a range of protectors for virtually every Data, Signal or Telephone line application. Protect RS232, 242, 485, 4-20 MA loops, Modems, Fax's, Pabx, LAN's from damage by transient overvoltages. Free 16 page catalog and application guide enables easy selection of appropriate protector.

Circle (69) on Reply Card

Bits-Selector tool accessory

Wiha Tools introduces a Bits-Selector to their popular line of hand tools. Packaged in a compact storage



box, the product has ten assorted bits and a magnetic adapter/extended for power tool use. The device measures 4.25" x 2.0" x .75" and weighs .25 lbs.

Circle (70) on Reply Card

Monitor repair database

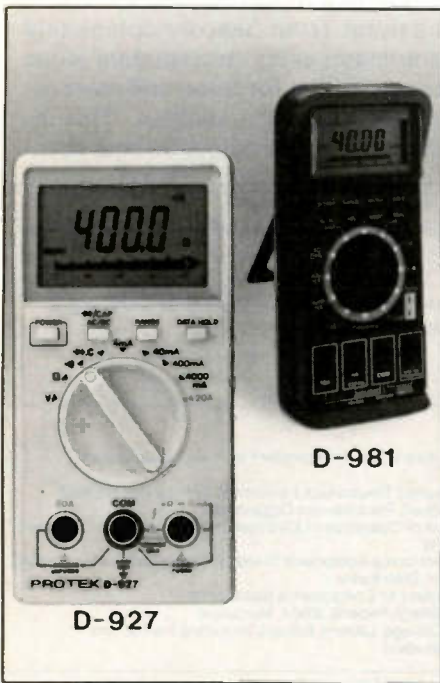
AnaTek Corporation has announced the release of its Resolve Monitor Repair Database. The database provides service information on repair history of hundreds of monitor repairs into an easy to use database. This will supposedly help service technicians find monitor problems and will be useful to self maintainers, repair centers and field technicians who can now repair a monitor in the field instead of lugging it back to the shop. Resolve is written in Paradox 3.5 and runs on any IBM PC, PS2 or compati-

ble system. A runtime version of Paradox is shipped with Resolve and requires 1.8 Meg of hard disk space. The original release contains 425 repairs on monitors made by 21 manufacturers. Upgrade subscribers will receive additional repairs, new manufacturers and updates on old information every three months.

Circle (59) on Reply Card

Multi-function bar graph DMMs

Auto-ranging measurements for temperature, capacitance, frequency, resistance, ac/dc volts and min/max control are among the featured capabilities found with Protek's newest family of 4,000 count, 3 3/4 digit, Bar Graph DMMs. The ultra-high capaci-



ty Model D981, which is ideal for engineering test applications, provides 5 ac/dc current ranges, extra large 1/2" LCD numerals, function annunciators, as well as always-"on" reference numbers for the analog bar graph. Min/Max control with 10ms capture time; diode check, range and data hold; relative mode; data memory and auto-power off round out the principal functions. Key specifications include: 2x/sec., digital and 2000x/sec bar graph measurement rate; dc voltage range - 400mV to 1000V, 5 steps;

ac voltage range - 4V to 750V, 4 steps; Frequency range - 0.5Hz to 1000kHz and much more.

Circle (60) on Reply Card



Leakproof dispensers

New from Ungar is a line of leakproof fluid dispensers for both stand and static dissipative soldering applications. The line includes the widest available selection of flux dispensers, all featuring a specially designed two-piece cap. The inner cap fits tightly over the dispenser needle to create a seal against leakage, eliminating the waste and clean-up problems that can occur when working with flux and solvents. All Ungar flux dispensers hold two ounces of fluid and use 1" long needles for ease of access to work areas. Both standard and static dissipative models are equipped with 0.010", 0.020" and 0.054" I.D. needles.

Circle (61) on Reply Card

ESD meter with certificate of calibration

Chapman introduces the EOS 100 electrostatic field meter. It includes a certificate of calibration traceable to NIST standards (National Institute of Science and Technology), making compliance with ESD program requirements easy to verify and document. The meter reveals the presence, magnitude, and polarity of static charges from ± 5 to $\pm 3000V$ using one of four operator selected sensitivity ranges. The meter includes a belt-attachable carrying case and grounding cord for easy spot monitoring. Its



metal case allows safe use in all ESD sensitive areas. The range can be switched to as much as $\pm 3000V$ for measuring static charges in less sensitive applications.

Circle (62) on Reply Card

Heat resistant soldering iron cover

Jensen Tools Inc. announces a new soldering iron cover which features a protective interior coil and an exterior sheath made of fire and heatproof polyamide fiber - the same material used in the manufacture of garments



for fireman, pilots and race car drivers. The sheath is 4" long and will accommodate any iron with an element of 1/2" diameter or smaller. The cover is designed to prevent accidental burns and combustion, and improve efficiency in bench and field applications by eliminating unproductive cool down time.

Circle (63) on Reply Card

SMT repair kit

HMC has a handy kit that allows users to make easy, accurate and reliable surface mount repairs at the bench or in the field. Also useful for prototyping, training and new SMT

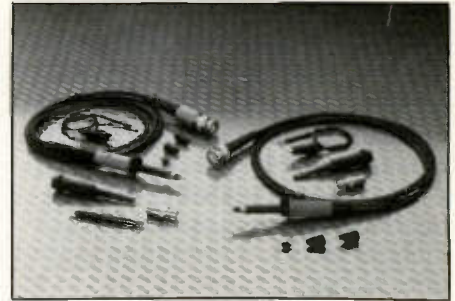


applications, The dispenser applies the exact amount of solder cream or paste flux from pre-filled caplettes. The user only has to snap-in the color-coded caplette, and gently squeeze the dispenser to make accurate dots. Each caplette contains 1/2 gram of material. The kit comes complete with dispenser, vacuum tweezer with five tips, moistening sponge, molded carrying case, and six caplettes (each) of SN43, SN62 and SN63 RMA solder cream, and 411 RMA paste flux. Replacement caplettes are available separately in packages of 10.

Circle (71) on Reply Card

Modular oscilloscope probe kits

Pomona Electronics has introduced a new family of oscilloscope probe kits with interchangeable oscilloscope probes and accessories for the professional oscilloscope user. Available in three configurations, 100MHz, 200MHz and 300MHz, these kits feature modular designs which allows



maximum flexibility and interchangeability of tips and interface connections. The 100MHz standard modular oscilloscope probe kits can be used with any scope up to 100MHz and are available in three attenuation ranges.

Circle (72) on Reply Card

Waveform analyzer

The new model SC3080 waveform analyzer from Sencore completely automates every conventional scope measurement for faster and more accurate waveform analysis. This includes a digital readout on both chan-

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 (please specify)

- 3** Position

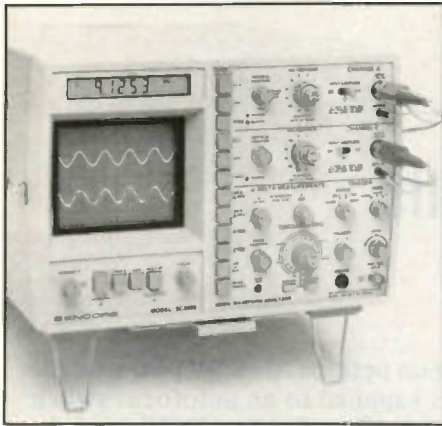
- EE Company Management Such as General Manager, Owner, Partner, President Vice President, Director and other Corporate Personnel
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 (please specify)

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- 1 Make final decision to buy a specific make or model.
 2 Recommend make or model to be purchased.
 3 Have no part in specifying or buying.

- 5** Check the number of Service Technicians employed at your facility.

- A 1-5 26-50
 B 6-10 Over 50
 C 11-25 Not applicable



nels for PPV, DCV, and frequency. The automatic readout eliminates time consuming graticule counting and the calculating associated with conventional scope measurements. All measurements are made through one probe, eliminating any extra time consuming lead hookup. Delta features include PPV, Time, and 1/Time measurement capabilities for both input channels.

Circle (73) on Reply Card

Toolbox kit

The Eraser Company Inc. announces the availability of the E-77 Toolbox Kit. This kit is primarily designed for inclusion in repair kits of tools used in field or in-house repair of electronic products. The kit contains a coarse grade FybRglass eraser with a selection of interchangeable refills manufactured from brass, stainless steel and fine grade FybRglass. The hand held eraser is used much like a pencil eraser and the refill is propelled out of the tool as it wears, by the run of a knurled screw on the top of the tool. It can be used for electrical contact cleaning,



Circle (74) on Reply Card

Probe adapter for video measurement set

Tektronix, Inc. has introduced the 067-1429-00 Probe Adapter, an accessory designed to interface the high-impedance Tektronix P61009 10X probe to the VM700A measurement set. With the probe adapter a 1MΩ - one with impedance high enough to resist circuit loading in the device under test - can be used with the 75Ω video test equipment. The adapter allows VM700A users to conduct equally exacting tests on video gear without purchasing a dedicated tester. Further it, allows them to use the measurement sets powerful screen graphics for visual analysis of test results.

Circle (75) on Reply Card

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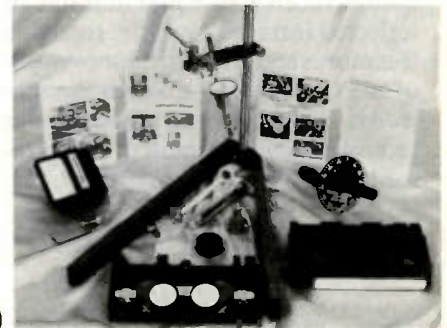
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Circle (96) on Reply Card



Camcorder servicing

Understanding autofocus circuits

By the ES&T Staff

Servicing products such as camcorders requires that the consumer electronics technician reach a little outside the areas of electronics that he traditionally practices in, and learn a little about such things as optics, focus, exposure and other subject areas that used to be the sole province of the camera service technician.

In order to make camcorders easier to use, and therefore more appealing to the consumer, camcorder manufacturers have included autofocus systems so that the user doesn't have to worry about focus. The existence of autofocus on a camcorder, however, means that a camcorder technician has to worry about autofocus: what it comprises, how it operates, how it can go wrong, and how to service it.

The autofocus system on a typical camcorder consists of an infrared LED and infrared photodiodes, signal conversion circuitry, some logic circuitry, motor driver and focus motor.

The automatic focus control system is an external focusing system that operates on the principle of triangulation using the reflection of infrared rays (see Figure 1). Infrared rays emitted by two infrared LEDs pass through a projection lens and reach the subject.

The infrared rays reflected from the subject arrive at a sensor via the receiving lens. The sensor is composed of two photodiodes, A and B. The focusing lens is moved until both photodiodes receive an equal amount of reflected infrared rays (the receiving lens moves according to the movement of the focusing lens). When the subject is in focus, both photodiodes receive the same amount of the infrared light from the transmitting LED.

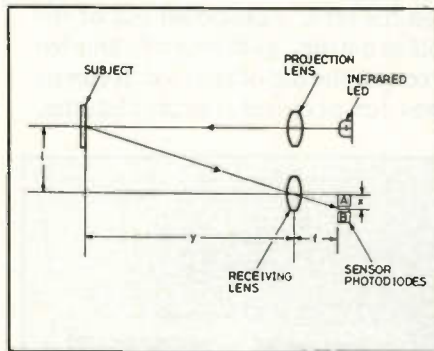


Figure 1. Principle of Automatic Focus.

The distance "y" to the subject is given by: $y = (l \times f) / x$

Instead of two LEDs, this twin beam system uses one infrared LED with a prism that divides the infrared beam into two separate beams. The twin beam system is used because there is a greater likelihood that focus will be achieved using two beams than with a single beam system. Let's say, for instance, that there are two subjects in the foreground in a scene. With a single beam system, there is a possibility that the beam would pass between the two subjects and the camera would wind up focusing at infinity. Neither subject would be in focus.

With the twin beam system, two beams are projected, and so the likelihood that at least one of the two beams will reflect off a subject and be received by the photodiodes is increased.

Automatic Focus switches

See Figure 2 for the circuitry associated with this discussion. When SW51AF (in the lower left quarter of the diagram) is set to manual, no power is applied to the IC, and the autofocus system is disabled. When the focus switch (SW51AF) is set to the auto position, or when the switch is pressed with SW51AF set to the push

auto position, the C9V power source is supplied to an autofocus switch (Q51AF, Q52AF: AFSW), and the autofocus switch turns on and supplies the A6V power source.

The 5V regulator, IC12AF: 5Vreg, regulates and supplies the AF5V power source to the signal processing circuits and automatic focusing is started.

Sensor and Preamp

Infrared rays of 9KHz transmitted by the LED and reflected from the subject are picked up by photodiodes DO1AF and are converted to current, which is supplied to IC01AF. IC01AF converts the current magnitude to a corresponding voltage. The outputs come from pins 5 (A signal) and 6 (B signal) and, after passing through C04AF and C03AF and pins 24 and 23, enter the automatic focus processing circuit.

IC01AF includes circuits that remove dc components arising from external light.

Automatic focus processing circuit: Capacitor (C04AF) and the input impedance of the IC form a high-pass filter. This high-pass filter constitutes a 9KHz bandpass filter with the characteristics of an amplifier. This filter passes signals resulting from reflection of the transmitted 9KHz infrared signal, but removes infrared noise components. The output is supplied to an adder and a subtracter.

Adder and subtracter

The adder and subtracter generate the sum signal, A + B, and the difference signal, A-B, from the A and B signals. The output is supplied to a pulse detection/integration circuit (PULSE DET).

Pulse detection/integration circuit

The input signals are detected synchronously with a 9kHz sync signal from a logic circuit to remove signal components caused by sources of in-

Based on the service manual for the Hitachi VM-E10A 8mm video camera

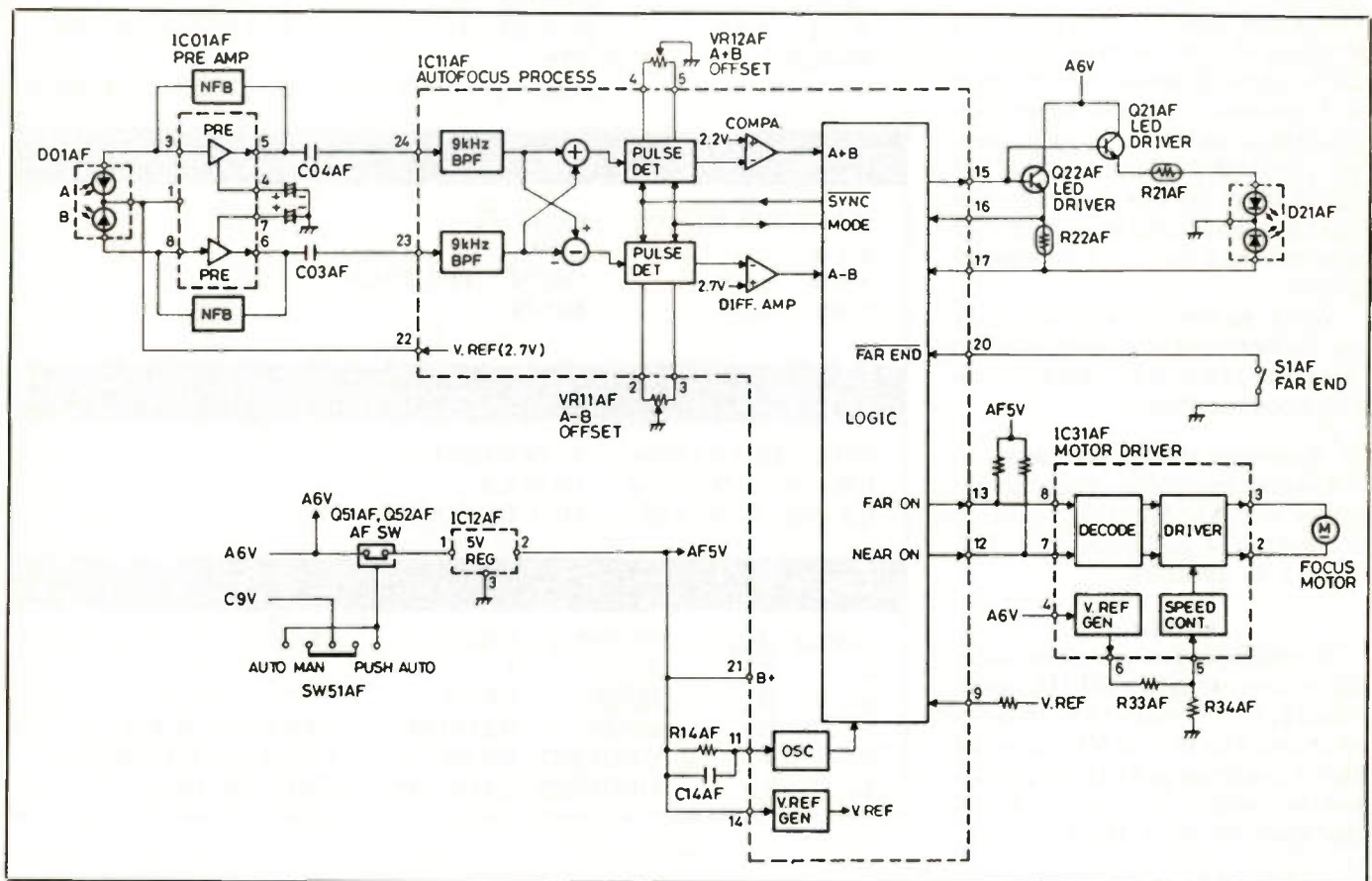


Figure 2. Automatic Focus Processing Circuit.

frared other than the camcorder's LED. The detected signals are integrated by capacitors connected to the output according to the amount of incident infrared light. The integrated A + B signal is supplied to a comparator and the integrated A-B signal to a differential amplifier.

The integration time of the A + B signal is inversely proportional to the amount of infrared light striking D01AF. That is, the more infrared light the shorter the integration time, and the less infrared light the longer the integration time. The integration time of the A-B signal is also proportional to the difference of A and B.

The output of the differential amplifier is as shown in Table 1, depending on the relation between them. VR12AF (A + B offset) connected across pins 4 and 5, and VR11AF (A - B offset) connected across pins 2 and 3, adjust the offset voltages of the pulse detectors so that the output is zero if there are no input signals.

Comparator and differential amp

The comparator and the differential

amplifier compare the integrated A + B and A - B signals with reference voltages 2.2V and 2.7V, respectively, produced by the reference voltage generator V. Ref. Gen.

The signal A - B is a measure of the degree to which the camera is out of focus, and whether it must be focused closer or farther away.

The comparator (COMPA) compares the integrated A + B signal with a divided reference voltage (2.2V). When the A + B signal is equal to or greater than this 2.2V reference, the output is "High." As we'll describe when talking about the logic circuit, when this output is "Low" this tells the logic circuit that there is nothing in the scene to focus on.

The differential amplifier (DIFF. AMP) compares the integrated A - B signal with 2.7V. The output is as shown in table 2. The output is supplied to the logic circuit where it is evaluated.

Logic circuit

On receiving the comparator's output, the logic circuit judges whether or

not the camera is in focus and generates the SYNC, MODE, infrared LED drive and motor drive signals.

If the A + B signal becomes "High" within 28ms after the start of measurement, this indicates that there is something in the scene reflecting the LED's infrared light output, and on which the camera should focus. This condition causes the logic circuit to invert the MODE signal and stop the integration, holding the integrated voltage. At this point the logic circuit judges whether or not the camera is in focus. This judgment is done by comparing A-B with a reference voltage (K) supplied to pin 9 as shown in Table 3.

If the camera is determined to be in focus, autofocus operation is reset for about 350ms then starts again. If the camera is judged to be out of focus, the direction in which the motor should be driven and the duty ratio of the motor drive signal are determined from the magnitude of the A - B signal. The duty ratio of the motor drive signal will be set at 100% (high) or 62.5% depending on the magnitude of the A - B signal and the input sup-

plied to pin 10. The duty ratio is 0% (low) when the camera is in focus.

If the A + B signal does not rise to high within 28ms, the logic circuit determines that no reflected infrared LED light is coming in, which means that there is no subject in the scene on which to focus. This condition generates a motor drive signal (100%; High) which drives the motor to move the lens until the far end is reached. The camera is now focused at its greatest distance.

When the lens presses against the far end switch (S1AF; FAR END), pin 20 falls to low and autofocus operation stops for 350ms.

Reference voltage generator

The reference voltage generator receives the AF5V1 power source through pin 14, and generates V.REF GEN; 2.7V and 2.2V.

Oscillator

The oscillator generates a clock signal of approximately 35KHz, determined by C14AF and R14AF connected to pin 11. The SYNC signal of 9KHz, the infrared LED drive signal and the motor drive signal are generated from the clock signal.

Infrared LED drive circuit

The infrared LED drive circuit drives the infrared LED (D21AF). The signal output from pin 15 drives two LED drivers (Q21AF and Q22AF) to make the LED emit infrared rays of about 9KHz. The infrared LED drive current is varied in two steps according to the LED drive signal, pin 15, and feedback signal, pin 16.

When the subject in the scene is close and the lens has to move to bring it into focus, the drive current is low. This prevents saturation of the pre-amplifier which strong infrared rays would cause. The drive current is high when the lens moves to bring a more distant subject into focus. Pin 17 is the negative feedback input to drive D21AF with a constant current. The constant drive current is 100mA with high and 60mA with low.

The motor driver

The autofocus motor is driven by IC31AF. When the logic circuit has determined that the subject is out of focus because it is too far away, it activates the FAR ON signal (output at pin 13), which causes the lens to refocus farther away. When the logic circuit has determined that the subject is

Table 1.

INPUT RELATION	OUTPUT VOLTAGE	FOCUSING
A > B	LOWER THAN 2.7V	FOCUSED NEARER
A = B	2.7V	IN FOCUS
A < B	HIGHER THAN 2.7V	FOCUSED FARTHER

Table 2.

INPUT RELATION	OUTPUT
A > B	LOW
A = B	OFFSET VOLTAGE
A < B	HIGH

Table 3.

INPUT RELATION	JUDGMENT
$[(A - B) - 2.7V] < = K$	IN FOCUS
$[(A - B) - 2.7V] > K$	OUT OF FOCUS

Table 4.

INPUT (PIN)	OUTPUT (PIN)	STATES OF THE MOTOR
8 7	3 2	
0 0	OPEN OPEN	STOP
1 0	HIGH GROUND	FAR (LOADING)
0 1	GROUND HIGH	NEAR (UNLOADING)
1 1	GROUND GROUND	STOP (BRAKE)

out of focus because it is too near, it activates the NEAR ON signal (output at pin 12) of IC11AF, which causes the lens to refocus nearer. The duty of the motor drive signals are changed from 62.5% to 0% from 100% depending on the distance to the subject (near end or far end to bring into focus). Table 4 shows the states of IC21AF.

Be alert for operator error

Armed with this information, troubleshooting an autofocus system becomes an exercise in logic. It is important, however, to keep in mind that autofocus systems can give rise to some operator-caused problems. For example, the autofocus will focus on the closest object that happens to reflect the infrared light from the LED back to the photodiodes, no matter what the camcorder operator had intended to focus on in the scene. So if a video buff brings in his new camera and complains that he shot an entire videotape cassette of the beautiful mountains, but his new camera chose to focus on the trash can in the foreground, you can explain why.

Something that can cause even more bizarre results is if someone is trying

to videotape through a window. In such a case, the infrared light from the LED may very well reflect off the glass, causing the camcorder lens to focus on the window instead of on the desired scene beyond.

Any time someone brings in a camcorder with autofocus problems, check carefully for the possibility of operator error before beginning service.

Troubleshooting autofocus systems

If a client brings in a camcorder with the complaint that the autofocus system does not operate properly, and you've made the obvious checks to make sure that the problem isn't caused by operator error, one of the first coarse checks to make is to try the manual focus position of the focus switch. If the focus operates manually, you have eliminated quite a few components from suspicion: the focus motor, the focus motor decoder/driver, and portions of the logic circuit.

If the focus motor doesn't operate when you operate the focus manually, the problem will most likely be found somewhere in the motor/drive section of the circuitry, or the

switch/power supply area.

In this case, start by seeing if a signal is applied to the motor when the manual focus switch is pressed. If there is a signal, then check for either a defective motor or a jammed lens mechanism.

If there is no motor drive voltage when the focus is operated manually, check the motor drive IC, the outputs of the autofocus process IC, and the voltages on the input side of the autofocus process IC.

If the preliminary checks point to a problem in the LED/photodiode area, a good first step will be to check the LED for infrared light output using

either a phosphor chip, or some other kind of infrared detector. If there's no output from the LED, then you can confine your troubleshooting to the circuitry starting at the LED, and working your way back to the autofocus process IC.

If you've eliminated the motor/driver, switches, and LED section, then you've pretty much isolated the problem to somewhere from the photodiodes forward to the autofocus process IC. If the LEDs are emitting infrared, the diodes are receiving it, the preamp is providing the correct signal to the autofocus process IC, then the problem must be in that IC.

Applying this information to other systems

No doubt other manufacturers use different schemes to achieve automatic focus in their camcorders. No matter what they use, however, any autofocus system will require some kind of output signal, almost certainly an infrared LED signal, some kind of receiver for the reflected signal, some processing and logic circuitry and a focus motor and driver circuitry.

When faced with an unfamiliar camcorder, adapting the principles described here to the particular product in hand will at least give you a starting point to correct the problem. ■

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Circle (94) on Reply Card

May 1992 *Electronic Servicing & Technology* 53

Data signals coming to radio

By John Shepler

Imagine that you are driving across country and want to enjoy sports broadcasts all the way. As the station you're listening to starts to fade, your car radio automatically selects a stronger one with the same format. If you're tuned to a network broadcast, you can even keep receiving the same ball game.

Perhaps you've just picked up a rental car at the airport and want immediate traffic info. Push the "traffic" button on the radio and you have local traffic broadcasts. Drive to another location and the radio keeps finding the closest stations with traffic reports.

How about nationwide paging or even text via a standard AM or FM radio receiver? It's all possible with a scheme called Radio Broadcast Data System or RBDS.

RBDS is a spin-off of a system currently used by European FM stations called Radio Data System (RDS). RDS transmits groups of data codes on a 57kHz subcarrier riding on the same signal with the stereo audio.

These codes activate various functions in the receiver including identifying the station's call letters, slogan, and channel. In addition, the receiver can be set to permit receiving only those stations transmitting codes related to a particular format such as news, weather, country music, classic rock, jazz, sports, traffic announcements, and so forth.

Subcarriers have long been used on FM stations to carry background music. The station's normal main channel contains the audio frequencies from 50Hz to 15kHz. Mono FM stations only transmit these frequencies. Stereo transmission adds a suppressed subcarrier at 38kHz and a pilot tone at 19kHz. The stereo subchannel oc-

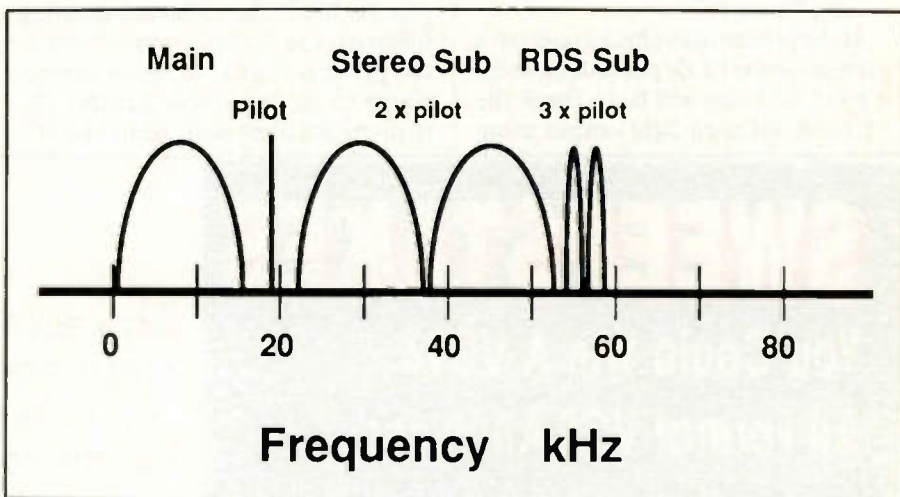


Figure 1. RDS audio spectrum

cupies the frequencies between 23kHz and 53kHz.

This standard stereo spectrum chart is shown in Figure 1. Note that another subcarrier is added at 57kHz. This is a 57kHz tone that can be modulated by voice, music, or data. Since its frequency is higher than any of the audio signal, it will be filtered out in nearly all receivers. A decoder circuit in the RDS receivers demodulated the data on the subcarrier just as a modem demodulates tones transmitted on the telephone lines.

It is interesting to note that the RDS subcarrier is set up much like the stereo subcarrier. It is an AM modulated suppressed carrier at exactly 3 times the pilot frequency. The stereo subcarrier is 2 times the pilot frequency.

RDS operates at a data rate of 1187.5 bits per second, about the same rate as a 1200 baud modem. Each word of information is 16 bits. A data word and a 10 bit checkword are combined to form a block of 26 bits. Four of these blocks make a group. There are 15 groups of data for a total of 104 bits. Particular broadcast stations and receivers can elect to use only some or all of these bits in their functions.

RDS is quite widespread in Europe.

There are over 1,500 stations transmitting the encoded signals in Germany, France, the UK, and Switzerland.

Unfortunately, this is a technology that is coming late to the United States. Although FM stereo is over 30 years old, technical improvements have been slow to develop. The RBDS standards group is currently working out standard codes for US broadcasters. A draft standard is expected by summer.

One snag in making the system universal is that the 57kHz technical standard does not accommodate AM stations. AM stations transmit 10kHz audio on channels that are only 10kHz apart. AM stereo is added by phase modulating the carrier or separately modulating the upper and lower sidebands. The only room for RBDS is on low frequency subcarrier, under 50Hz. AM RBDS is possible, but the data rate would be extremely slow, perhaps only a character per second.

It is likely that FM RBDS will be standardized this year with receivers soon to follow. Within a few years it should be commonplace to enjoy the benefits of this technology in car radios, portables, and home entertainment systems. ■

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

Three dimensional display device

By the ES&T staff

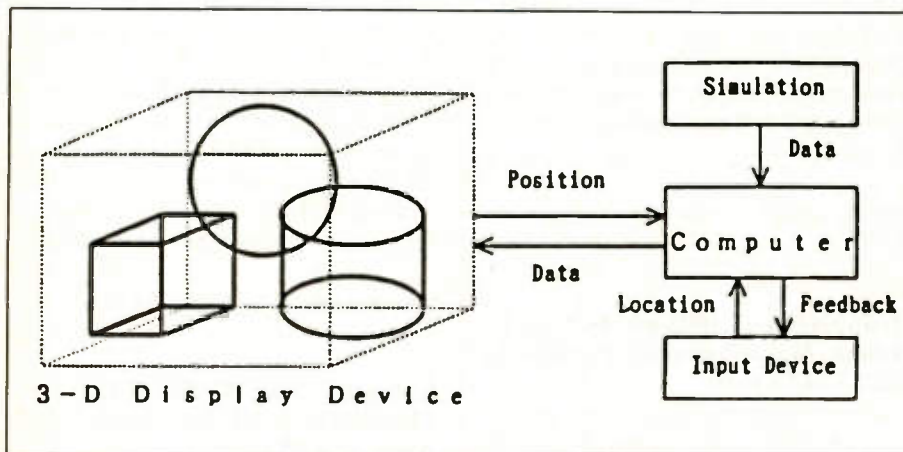


Figure 1. 3-D display device from Toshiba Corp.

Toshiba Corporation has developed a prototype display device that uses 768 light-emitting diodes (LEDs) to simulate and display 3-dimensional images of objects. The new display utilizes the "afterimage phenomenon" to create realistic 3-dimensional images that surpass those offered by the 2-dimensional displays used in current computer graphics simulation. The display device will initially be applied to computer aided design (CAD) of mechanical parts and architectural plans. The company expects a practical system in 1994.

The company also anticipates the display will contribute to design systems incorporating virtual reality, and foresees completion of such a system by 1995.

The display device incorporates a 100mm x 30mm panel mounted with

LEDs that slides 50mm back and forth at a maximum speed of 30 times per second. The diodes are computer controlled, and are switched on and off automatically. By capturing the afterimage phenomenon effect, the display is able to represent such complex images as animations of gear movement and the flow of air currents. The objects displayed appear to be real, and can be viewed from above and different angles. Image shapes can be changed in real-time.

Supercomputers and dedicated CAD computers allow computer graphics to be used to simulate mechanical parts and other objects. However, these simulations lack realism, as the images are actually 2-dimensional. Researchers have developed the prototype 3-dimensional display device in order to meet the need of designers for a more realistic means of displaying images. The company will continue to improve the new device and the quality of the image, including colorization. ■

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(from page 45)

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5. Byte
6. MSI (Medium scale integrated circuit)
7. VLSI (Very large scale integrated circuit)
8. ROM (Read only memory)
9. MSB (Most significant bit)
10. LIFO (Last in, first out)

Mastering Technical Mathematics, By Norman H. Crowhurst, TAB Books, 512 pages, \$24.95.

Originally published as a four-volume set, this book is a one-stop source of math instruction. Geared primarily to people involved in electronics and other technical fields the book offers a complete course that spans the entire spectrum of mathematical computation - everything from basic addition to differential equations. The author provides readers with an encyclopedia of working methods at the same time trying to promote true understanding of the subject by explaining how and why mathematical principles work. Step-by-step, illustrated instructions and alternative techniques make it easy to solve even the most difficult problems in: Algebra, trigonometry, geometry, calculus. Special emphasis is placed on analytical issues in computer programming and the use of computers for calculation. For anyone who wants to improve their math skills and really understand what they're learning this book is sure to prove invaluable.

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Macmillan Book Publishing 1711 N. College Ave., Suite 140 Carmel, IN 46032.

Designing and Building Electronic Filters, By Delton T. Horn, TAB Books, 224 pages, \$14.95.

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Using PC-File, By Trudi Reisner, Macmillan Book Publishing, 408 pages, \$24.95 soft.

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REPAIR MANAGEMENT SOFTWARE: for IBM PC's. Repair tracking, inventory, reports, billing, maillist, more. Demo disk \$15. CAHILL ELECTRONICS, PO Box 568, Kingston, NH 03848. 603-642-4292 3-92-3t

PHOTOFACTS: Folders under #1400, \$5.00. Above #1400, \$7.00, sent same day first class postpaid. Allen Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 516-481-4380. 11-91-5t

COMPUTER AIDED TV/VCR REPAIR SOLUTIONS: 5 1/4" IBM Compatible disks. 1,000 VCR, Printout \$83, Disks \$72. 5,400 TV, Printout \$135, Disks \$113 (Hardrive). Add to or quick scan by chassis, model and stage. Two solutions pays for it. Electronic Solutions, 407 W. Ave. "N", San Angelo, TX 76903. 3-92-5t

VHS-VCR REPAIR SOLUTIONS SETS I,II,III,IV,V,VI. Each contains 150 symptoms and cures, updated cross reference chart, free assistance, \$11.95 each all six \$59.95. Eagle Electronics, 52053 Locks Lane, Granger, IN 46530. 3-92-3t

THE ONLY ANSWER TO REPAIRING ELECTRONICS PROFITABLY (This should have been done years ago) **GET SMART!** Someone somewhere has already repaired the next job you take in for repair. **YOUR BEST TECHNICIAN,** who you have paid for the experience of learning on your customers, and also the manufacturers required training you have paid him to attend to keep your authorized status, just left with all that invested knowledge and ability. **YOU'RE THE BOSS** and now you have put on your rusty technician's cap and appease customer estimates. **TODAY YOUR BANK** sent you three NSF checks that your customers so graciously gave you, can you collect? **IT'S TAKING YOU LONGER** to assess the repairs and your customers are now coming to collect their units. You promised to give them a free estimate, but you just realized you don't have a schematic or time to do it. **NOW YOU ARE DOING NIGHT REPAIRS** because during store hours the phone rings off the hook with nuisance questions about setting VCR clocks and you have parts to order, bills to pay and service literature to file. **CIRCUIT CITY JUST MOVED IN** and your wife tells you that there never was any money in electronics. **FRIEND!! YOU DEFINITELY HAVE AN EMERGENCY!!** Spend \$350.00 NOW & **SAVE THOUSANDS** Available in print or computer disk or by catalog with annual updates. Send for DEMO \$15.00. AMEX/M/C-VISA & CHECKS, 2 weeks delivery 305-474-2677. Factory service 8614 SR-84, Ft. Lauderdale, FL 33324. 4-92-1fb

TV TOUGH DOGS 300 symptoms and cures. Send \$10.95 to Davis TV, 11772 Old Fashion Way, Garden Grove, CA 92640. 3-92-1t

VCR HEADACHES? 500 Most common problems and cures. Printout \$49. 1300 Symptoms and cures. Printout and IBM disc. \$125.00. Guaranteed satisfaction. VCR Tuneup Center, 43 James Avenue, Redwood City, CA 94063 or call 1-800-777-7883. Mastercard and Visa accepted. 3-92-2t

REDUCED 85%, Diehl Mark 111 scanner \$79. Diehl Mark V scanner \$199. New. Restore remote control keypads with our conductive coating \$8.99 ppd. WEEC, 2805 University Ave., Madison, WI 53705. 608-238-4629, 608-233-9741. 12-91-1fb

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DIAMOND DISCOUNT ELECTRONICS: For free catalog write to: P.O. Box 2022, Universal City, TX 78148 or call 1-800-259-7321. 5-92-1t

Retired: Must sell test equipment, SAMS, etc. Please send SASE for listing. Jack B. Williams, 15820 Comus Road, Clarksburg, MD 20871. 301-428-0674 5-92-2t

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WANTED

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1950's TRANSISTOR RADIOS: with civil defense markings brought! Paying \$25-\$500. Harry Poster, Box 1883, So. Hack., NJ 07606. 201-794-9606 Before 7 pm 5-92-3t

TWO SENCORE: CB analyzers model #CB42. Brent Hicks, RR#2, Box 88. Burlington, Iowa 52601. 319-754-6078. Call after 5 pm. 5-92-1t

WANTED: Electronic equipment, older radio parts, condensers, Rider books etc. Also have Rider's for sale. Surplus Sales, Box 258, Plerson, MI 49339 5-92-1t

MISCELLANEOUS

CAMCORDER REPAIR: Don't turn away good profits let our experienced technicians provide your shop with complete camcorder repair service. Also, VCR, "Tough Dogs." Call 1-800-846-4648. Edington VCR/TV, 204 North Kimble Drive, Bloomington, IN 47404. 10-91-6t

Manufacturers Parts and Literature Directory

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

<p>Hitachi Home Electronics 401 W. Artesia Blvd. Compton, CA 90220 800-HITACHI</p>	<p>Mitsubishi Electronics America 5757 Plaza Drive Cypress, CA 90630 800-553-7278 fax 800-825-6655</p>	<p>Panasonic 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672</p>
<p>Philips ECG 1025 Westminister Drive Williamsport, PA 17701 800-526-9354 fax 800-346-6621</p>	<p>Quasar 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672</p>	<p>Technics 50 Meadowlands Parkway Secaucus, NJ 07094 800-545-2672</p>
<p>Thomson Consumer Electronics 2000 Clements Bridge Road Deptford, NJ 08096 800-257-7946 fax 800-524-1498</p>	<p>Zenith Electronics Corp. 1900 N. Austin Avenue Chicago, IL 60634 312-745-2000</p>	<p>Call Jonathan Kummer at 516-681-2922 to reserve space in this special section.</p>

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A.R.C., P.O. Box 802-C12, Carlisle, MA 01741

Advertisers' Index

Company	Page Number	Reader Service Number	Advertiser Hotline
Anatek Corporation	6	78	800/999-0304
Antique Radio Classified	60		506/371-0512
BGI Company	55	79	219/277-8762
Brian R. White, Co.	10	99	707/462-9795
Brunelle Instruments	60	80	800/567-3506
C & S Sales	IBC	81	800/292-7711
Consolidated Electronics	14	82	800/543-3568
Contact East	10	83	800/225-5370
Fluke Manufacturing, John	BC	6	800/87FLUKE
Fox International	19	84	800/321-6993
GE Consumer Service	5	10	800/572-2455
Hitachi Home Electronics	59		800/545-2672
Iscet	19		817/921-9101
International Components Corporation	60	85	800/645-9154
Jensen Tools	9	86	602/968-6214
Kelvin Electronics	60	87	516/756-1750
Leader Instruments	3	32,33	800/645-5104
Mitsubishi Electronics America	59		800/553-7278
NESDA	6,23		817/921-9061
Nutronix	23	88	313/939-4710
PTS Corporation	7	89	812/824-9331
Panasonic	59		800/545-2672
Panavise Products	9	90	702/353-2900
Parts Express	44	91	513/222-0173
Philips ECG	59		800/526-9354
Premium Parts +	55	92	800/558-9572
Quasar	59		800/545-2672
Sencore	IFC,53	93,94	800/SEN-CORE
Sperry Tech	60	95	800/228-4338
Technics	59		800/545-2672
Tentel	49	96	800/538-6894
Thomson Consumer Electronics	59		800/257-7946
Viejo Publications	44	97	800/537-0589
Zenith Electronic Corporation	59		312/745-2000
WRC, Inc.	24	98	800/657-1979

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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(516) 681-2922

FAX: (516) 681-2926

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- Function Generator Sine, Triangular, Square wave forms
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- Fine frequency adjust
- Amplitude adjust
- DC offset
- Modulation FM, AM

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Fast continuity beeper	1.9% basic ac volts accuracy	4000 count digital display
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