THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

ELECTRONIC Servicing & Technology

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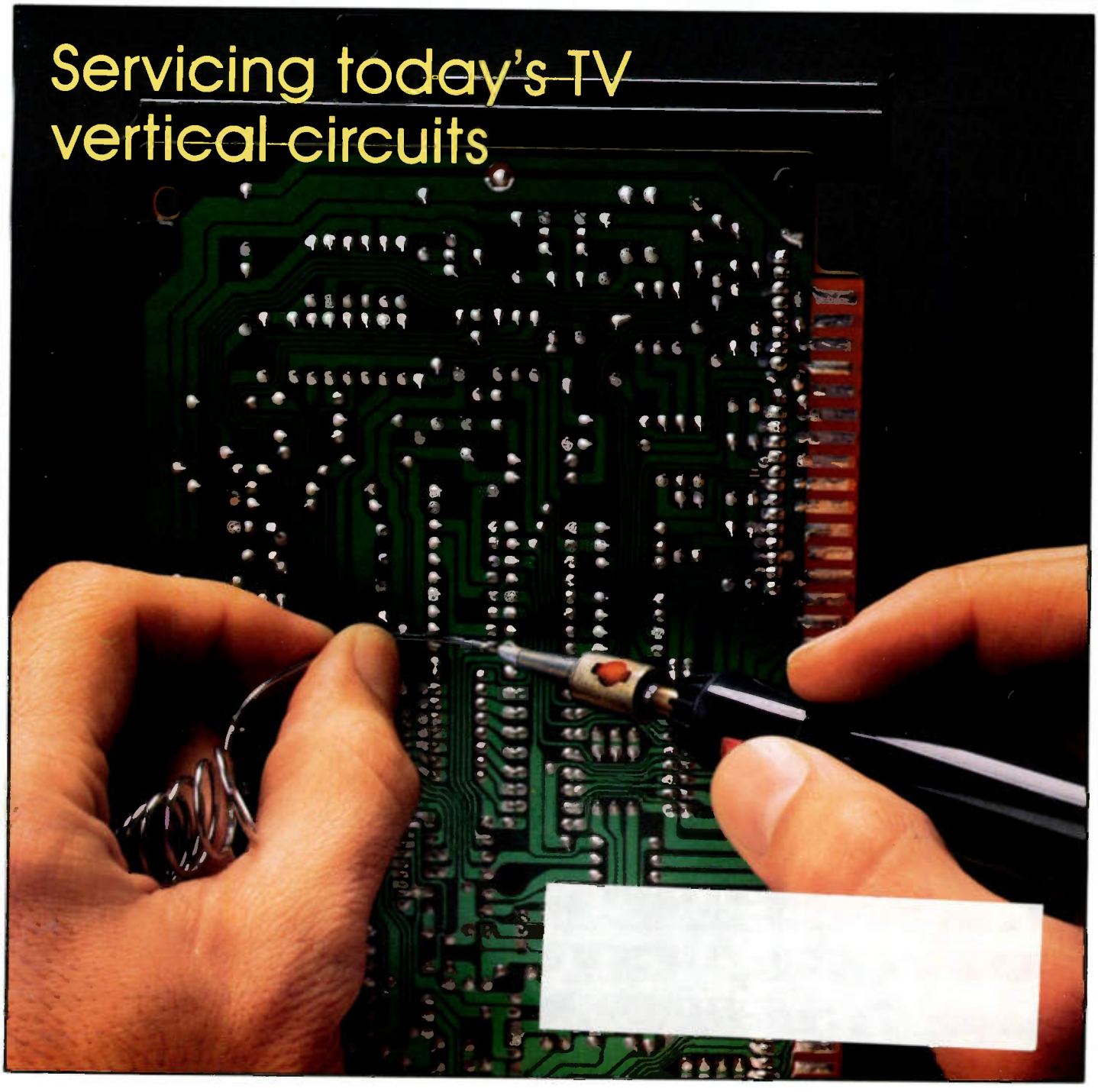
Understanding and servicing computer monitors

Cellular telephone systems—Part III

Servicing today's TV vertical circuits



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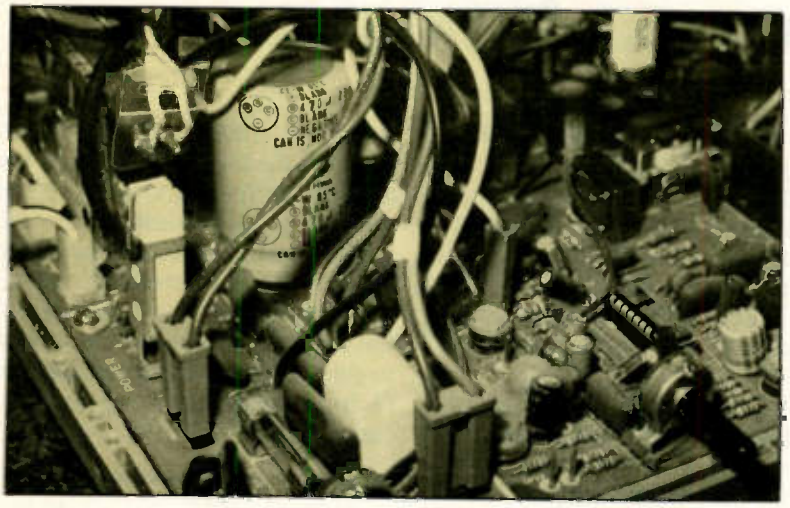

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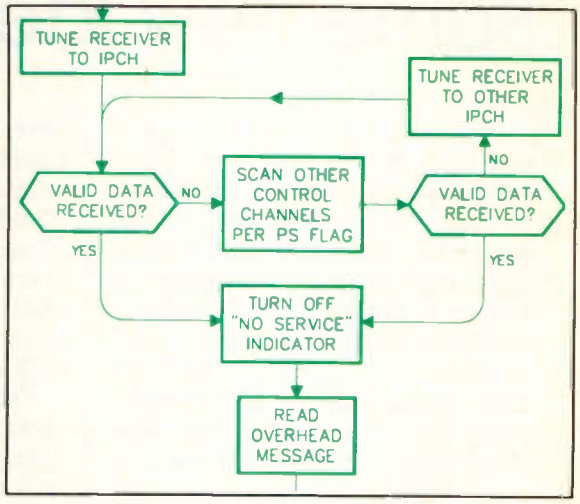

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FEATURES

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Here's our annual update on the articles, departments and Profax published in 1991.

DEPARTMENTS

ON THE COVER

Servicing increasingly sophisticated, complex and tightly packed consumer electronics products like today's color TV sets, as discussed in the article "Servicing Goldstar's CMT and CMZ TV vertical circuits" in this issue, requires advanced soldering skills and the appropriate small profile soldering/desoldering tools. *(Photo courtesy Cooper Tools a division of Cooper Industries).*

THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS
ELECTRONIC
Servicing & Technology

Some new ideas on training

How does a servicing technician who has spent two years or more at a technical school learning the fundamentals of electronics circuitry become proficient at servicing consumer electronics products? Training, of course. And how does a technician who has spent five, ten or twenty years servicing TV sets all of a sudden acquire the skills to tackle a VCR, a personal computer or a facsimile machine? Again the answer is pretty obvious, training.

In fact, if you take a look at the profession of product servicing today, you'll see that it's about as training intensive as a profession gets. Just in the past decade the number of types of products that a consumer electronics technician is expected to be able to service has increased many times over, and the technology used to manufacture the products has changed dramatically.

It should come as no surprise then that consumer electronics service training, already a healthy industry has thrived in recent years. Also, not surprisingly, most service centers of any size have some kind of training system in place; for such purposes as to provide practical servicing techniques to raw recruits just hired from tech school, or to indoctrinate them in the importance of proper customer contact techniques.

For those of you who have some kind of training program, the latest news of interest is that even ideas on training are now changing. A report written by a committee appointed by the National Research Council suggests that whether providing instruction in how to hit a serve in tennis or repair a nuclear power plant, trainers should abandon certain popular techniques that enhance performance during training at the expense of later performance in the real world. Many of the following remarks are reproduced verbatim from a press release describing the study.

At the request of the U.S. Army Research institute, the committee examined a wide variety of techniques for enhancing human performance, including training and altered mental states. The committee's report, a hard cover book, "In the Mind's Eye: Enhancing Human Performance," is available for $29.95 (prepaid) plus $3.00 shipping from the National Academy Press at 2101 Constitution Avenue, N. W., Washington, DC 20418. Many of the reports conclusions apply to the general public, as well as to soldiers.

One of the important findings is that the effectiveness of a training program can't be evaluated by the speed with which the learner acquires new skills during training or by the level of performance reached at the end of training. The only way to determine the effectiveness of the training is to evaluate the learner's performance in real-world settings after training is completed.

The committee also said that trainers should adopt techniques that enhance long-term retention of learning, as well as the learner's ability to adapt his or her new skills to real situations.

For example, training programs often involve several practice sessions held over a short period of time. Such concentrated practice may seem effective because it generally yields high levels of performance during training. But in some cases it yields long-term performance less than one-half the level that results from spaced practice. Two grouped practice sessions are often not appreciably better than a single session.

The real world is messy, rarely presenting people with repetitions of identical problems in similar situations. Training should reflect this variability, the committee said.

Feedback, an essential part of learning a new skill, occurs naturally when a learner practices. Many training programs attempt to enhance learning by augmenting this feedback. For example, instructors often explain how to correct errors while watching a trainee practice a task. Although augmented feedback is valuable, the committee said that it is often used to excess. Reducing augmented feedback, say to once in every five trials, can improve long-term performance.

The committee also noted that training programs should foster the trainee's understanding of the tasks to be learned. And learners should be involved in the training process by such methods as finding answers to their own questions and teaching each other.

The committee stressed the importance of regular refresher courses. Ideally, the same trainers should teach both initial and refresher courses to gain an understanding of how their techniques affect long-term performance.

A new source of information

As we've written over and over, as if you didn't already know, correspondence we've received from readers in the last several years overwhelmingly says that the two biggest problems faced by consumer electronics service centers are locating replacement parts and locating service literature. We've addressed that problem many times and in many ways; from our annual March Buyer's guide to our annual Parts and Literature special in December and the Showcases we present on distributors in April and replacement parts in August.

We'd like to call your attention to a new source of information that you'll now find every month in **ES&T**: the Manufacturers Parts and Literature Directory. It's a special form of paid advertising that gives the companies who manufacture the TVs, VCRs, CDs, personal computers, and all the other consumer electronics products that our readers service, the opportunity to tell those readers how to contact them either to obtain parts directly, or to learn what distributors in their local area can supply them with parts for that manufacturer's products.

This directory will be in the back of the magazine each month, and the information contained there will be just the name, address and telephone number (800 number where available) of the company. We hope that this important information resource will grow.

When you're stuck for a source of parts and literature for a product that's sitting on your bench waiting to be completed, turn to the "Manufacturers Parts and Literature Directory."

Nils Conrad Persson

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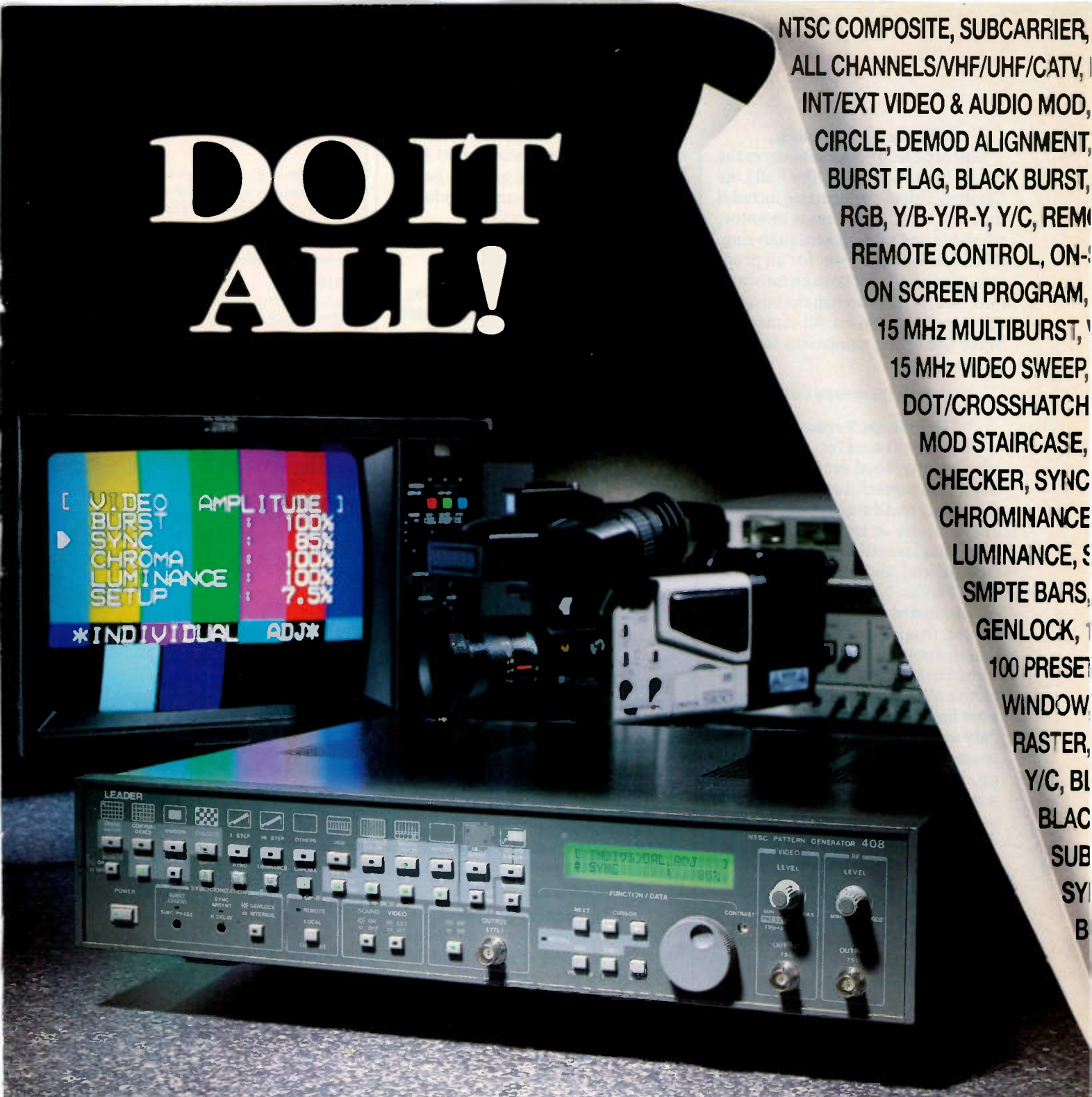

The world of technology has become much less simple than in times past. Equipment once run from a single **composite** feed may now be driven by **S-VHS, Hi-8,** or **component** signals, not to mention **VHF, UHF,** and **CATV.**
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Literature

1991 full-line catalog

Sencore Electronics announces the release of the new 1991 color Full Line Catalog. This 68 page catalog includes the latest in VCR, computer monitor, television and cable system analyzing. Specifications are given for all products, along with application information. Sencore has been in the business of manufacturing an All-American Made line of test equipment for over 40 years.

Circle (35) on Reply Card

DataScope Version 2.0

Paladin Software Inc., is now shipping an upgraded version of DataScope, the powerful communications debugging and data capture tool with applications in the computer programming, manufacturing, industrial automation, and multimedia industries. Version 2.0 saves time and money, eliminated guess work by allowing the user to apply powerful display and search tools to ordinarily invisible transmissions, and provides a cost effective alternative to expensive hardware line monitors. DataScope is the only serial line monitor that includes context sensitive Hypertext, Hyperset-up, and user-alterable multitasking window displays. Version 2.0 offers a user friendly, "windows-like" pull-down menu interface.

Circle (29) on Reply Card

CRT monitor restorer

The Beltron System 200 microprocessor-controlled CRT Monitor Restorer is introduced in a full color product data sheet. Features described include the systems 10-minute, single button automatic and manual test/clean/restore sequences. The system is specifically designed for both monochrome and color and can be used with equal effect on computer and instrumentation CRT's as well as TV tubes. A listing of System and safety features is also included.

Circle (30) on Reply Card

Catalog tools and test equipment

New from HMC is a detailed, fully illustrated buying guide of electronic tools, test equipment and supplies for the manufacture, assembly and repair of electronics. The catalog contains a larger-than-ever selection of brand-name, competitively priced products including test instruments, tool kits, soldering/desoldering systems, lamps and magnifiers, anti-static products, and precision hand tools.

Circle (31) on Reply Card

New issue of Tek Direct Catalog

Tektronix announces the availability of its new fall issue of the Tek Direct Catalog. The catalog, allows buyers to order affordable test and measurement equipment directly from the company. A wide variety of Tektronix equipment suitable for depot and field service organizations is available including meters, hand-held and low-end portable oscilloscopes, probes, plotters, accessories, and training aids.

Circle (32) on Reply Card

Personal computing tools catalog

Personal Computing Tools Inc. announced this week the release of the 56-page October-December 1991 edition of The Catalog of Personal Computing Tools for Scientists, Engineers and Technical Professionals. New products in this edition include solid state IC memory cards, test vector generator software utility for timing diagram editor, turn-key multi-line voice messaging system for your PC, analog and digital I/O products that interface with your printer port.

Circle (33) on Reply Card

Instrument catalog

Extech's Instruments 1992 catalog includes detailed specifications and descriptions of portable and benchtop instruments in the test and measurement, plant maintenance, water quality and engineering fields. New products featured include a vane thermo-anemometer with remote vane wheel, RH temp meter which measures humidity and temperature using remote probe, a fold-up thermometer useful in sample testing, and an LCR meter which measures inductance, capacitance and resistance in a safety yellow drop-proof case. Existing products include a full line of multifunction multimeters, sound and light meters, time controllers, and more. A handheld personal computer and organizer computer and peripherals are also featured.

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THE MAGAZINE FOR CONSUMER ELECTRONICS SERVICING PROFESSIONALS

ELECTRONIC
Servicing & Technology

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

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Updated standard for safety for transformers and motor transformers

Underwriters Laboratories Inc. (ULI) is proposing the updated for Standard for Safety for Transformers and Motor Transformers for use in audio, radio and television-type appliances, UL 1411, for recognition as an American National Standard.

UL 1411 covers transformers, autotransformers, and motor-transformers intended to be used in audio, radio and television-type appliances in which the primary winding is connected across the supply circuit. Transformers intended for use in high frequency switching type power supplies in which the transformer provides isolation from the supply circuit are also covered.

UL1411 does not cover transformers that are intended to transform only audio, video and other signal waveforms.

The proposed standard is a revised version of ANSI/UL 1411-1986, which is presently recognized as an American National Standard. UL is seeking review and comment from interested individuals and organizations to help develop a consensus upon which continued recognition of UL 1411 by the American National Standards Institute (ANSI) can be based. ANSI is a clearinghouse for information on standards and coordinated development of national consensus standards through voluntary action.

Dictionary defines features and terms

Consumer confusion and "technophobia" have been identified as two problems facing the consumer electronics industry today.

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG) has taken an important step to combat this trend by issuing a new Consumer Electronics Product Terminology Dictionary designed as a retail sales aid for personnel to use consistent terms when describing and selling electronics to consumers.

"To explain product features, capability levels, etc. to consumers in such a way that they really understand the products they are purchasing, retail sales personnel need to know the generic terms used to describe these features. By using the same terms for the same features in different products, they can help consumer satisfaction and benefit from their use," says Gary J. Shapiro, EIA/CEG group vice president. According to Shapiro, all definitions were written by EIA members under the direction of the group's Product Education Committee, chaired by Bruce Schoenegge [Hitachi Home Electronics (America), Inc.].

"Our goal in producing this dictionary was to provide a tool to help floor-level sales people understand terms, such as aspect ratio and resolution so that they, in turn, can explain these terms to consumers," says Schoenegge. "It's absolutely crucial that the people who have the most contact with consumers have the most accurate information we can give them to use when describing our products. As technology advances and new features are introduced, we will continue to update the retail sales force on the technologies they are selling. We feel that this new dictionary which will be updated annually, is an excellent tool for doing just that."

The new product terminology dictionary contains terms for product features and technologies in nine categories: accessories, camcorders, computers, home audio, home office, mobile electronics, television and video cassette recorders and home video.

Technicians association redefines occupation titles

ETA-I, the Electronics Technicians Assn., Int'l Inc., of Greencastle, Indiana has published a new set of job titles for eight categories of electronics technicians. It has also assigned a job category number and description to satellite installers and household appliance technicians.

According to Dick Glass, CET, President of ETA, "In the early days of electronics, (1930's thru 1950's) electronics technicians were thought of mainly as radio and TV technicians, As electronics products proliferated, few of these technicians found it possible to be expert on each type of product. To simply understand the type of work any single tech was doing often wasn't always clear. Definitions within the profession have changed. For instance, VTR (Video Tape Recorder) became a product now known by the public as a VCR. In computers the term CPU (central processing unit) frequently was displaced by MPU (microprocessor unit). In the same manner radio techs today can be found servicing consumer AM/FM radios; or communications broadcasting and reception equipment; or data communications hardware. To know what type of products some technicians work on is not always clear."

EIA/CEG forms subcommittee to foster development of digital audio radio technical systems

A new subcommittee designed to direct development of a unified digital audio radio (DAR) technical system in the United States is being formed by the Electronic Industries Association's Consumer Electronics Group (EIA/CEG).

According to Gary J. Shapiro, EIA/CEG group vice president, the DAR Subcommittee, being formed by EIA's R-3 (audio systems) Committee, "will organize and initiate a fair and impartial analysis, testing and standards-setting program to determine which DAR technical system will best serve the consumer electronics industry and consumer."

Shapiro noted that EIA's work in the area of standards development demonstrates the association's commitment to format standardization that benefits both the industry and the consumer. "The coming of digital audio radio represents a major leap forward in radio sound quality for consumers," he said. "The quality of broadcast sound continues to improve, thanks to new technologies developed in the consumer's interest. Digital audio radio promises to be the pinnacle of radio sound in the Nineties."

Servicing Goldstar's CMT and CMZ TV vertical circuits

By Homer L. Davidson

Vertical circuits in today's TV sets are relatively easy to service compared to the older transistor and tube circuits. In most sets of recent manufacture, vertical oscillator or countdown deflection circuits are located in a large IC with other circuits. The output stages of these sets may be transistorized or contain one large IC output component. The low voltage supply for the vertical circuits may come from the regulated low voltage power supply, scan derived secondary circuits or both.

In early CMT and CMZ Goldstar vertical circuits, the vertical oscillator and drive circuits were found in one deflection or count down IC. A time constant circuit consists of R322, R321, R351 and R323, which are connected to terminal 6 of IC401 (Figure 1). Vertical size control function (R352) causes the negative feedback to change.

Q321 and Q322 are shunt regulated push pull (SRPP) transistors of the vertical output circuit. The 42V supply is furnished through D324, D325 and D327. R338, C331, and D323 are a pump up circuit which supplies current for driving the first half of the vertical scan system. The two NPN vertical output transistors are coupled to the vertical deflection yoke via an electrolytic capacitor (C334).

Davidson is a TV servicing consultant for ES&T.

Later vertical circuits

In today's CMT and CMZ TVs the vertical oscillator circuit consists of a deflection count down and driver circuit found in a large IC with other circuits. Vertical hold and horizontal hold adjustments are not required in the count down circuit. The 503.75 kHz ceramic resonance element is crystal controlled in a VCO circuit. The internal vertical drive stage supplies a 1Vpp waveform at pin 23 (Figure 2).

The vertical output pulse at pin 23 of IC501 passes through the current limit resistor R310 and is fed to pin 4 of IC301. The time constant components are C311 and R312. R351 is the vertical height control. The supply

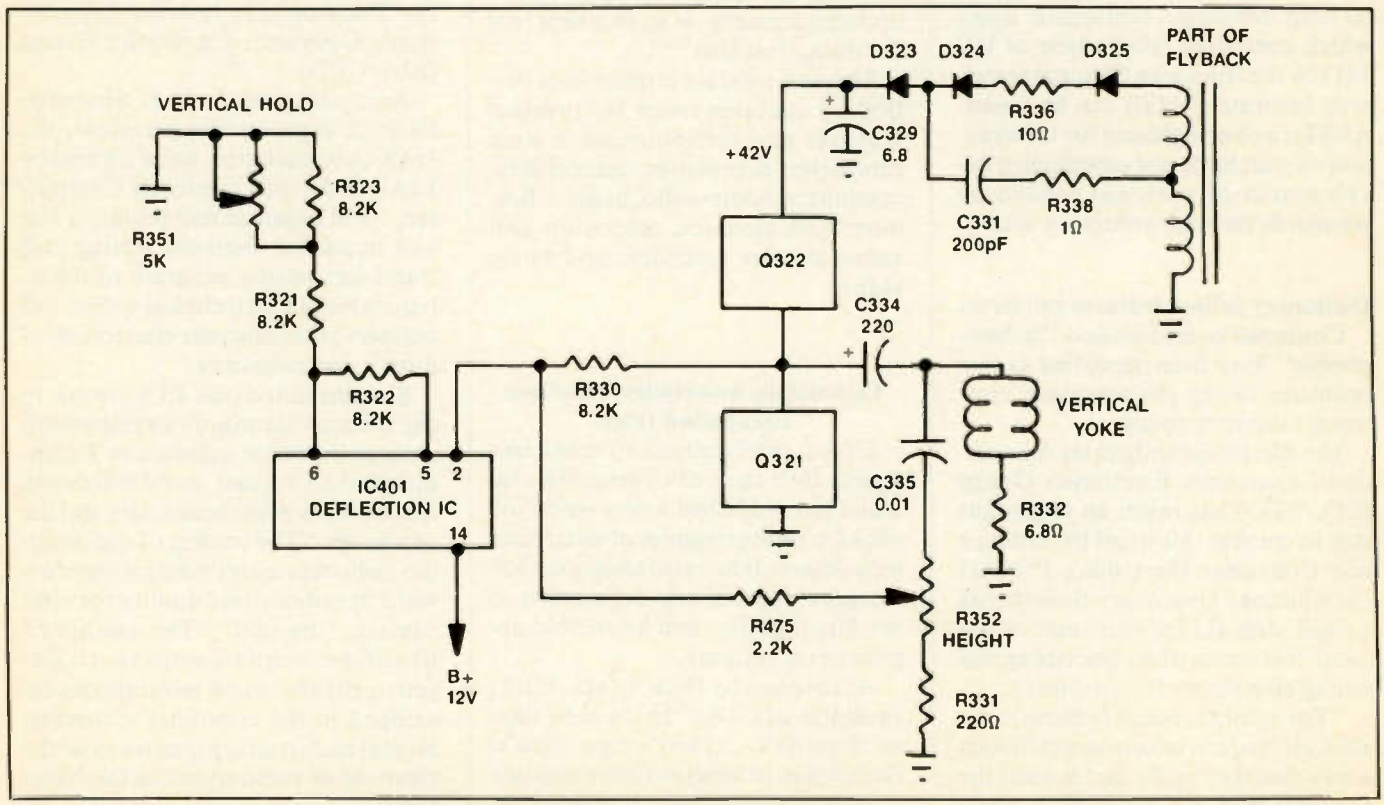


Figure 1.Block diagram of the early CMT and CMZ Goldstar vertical circuits.

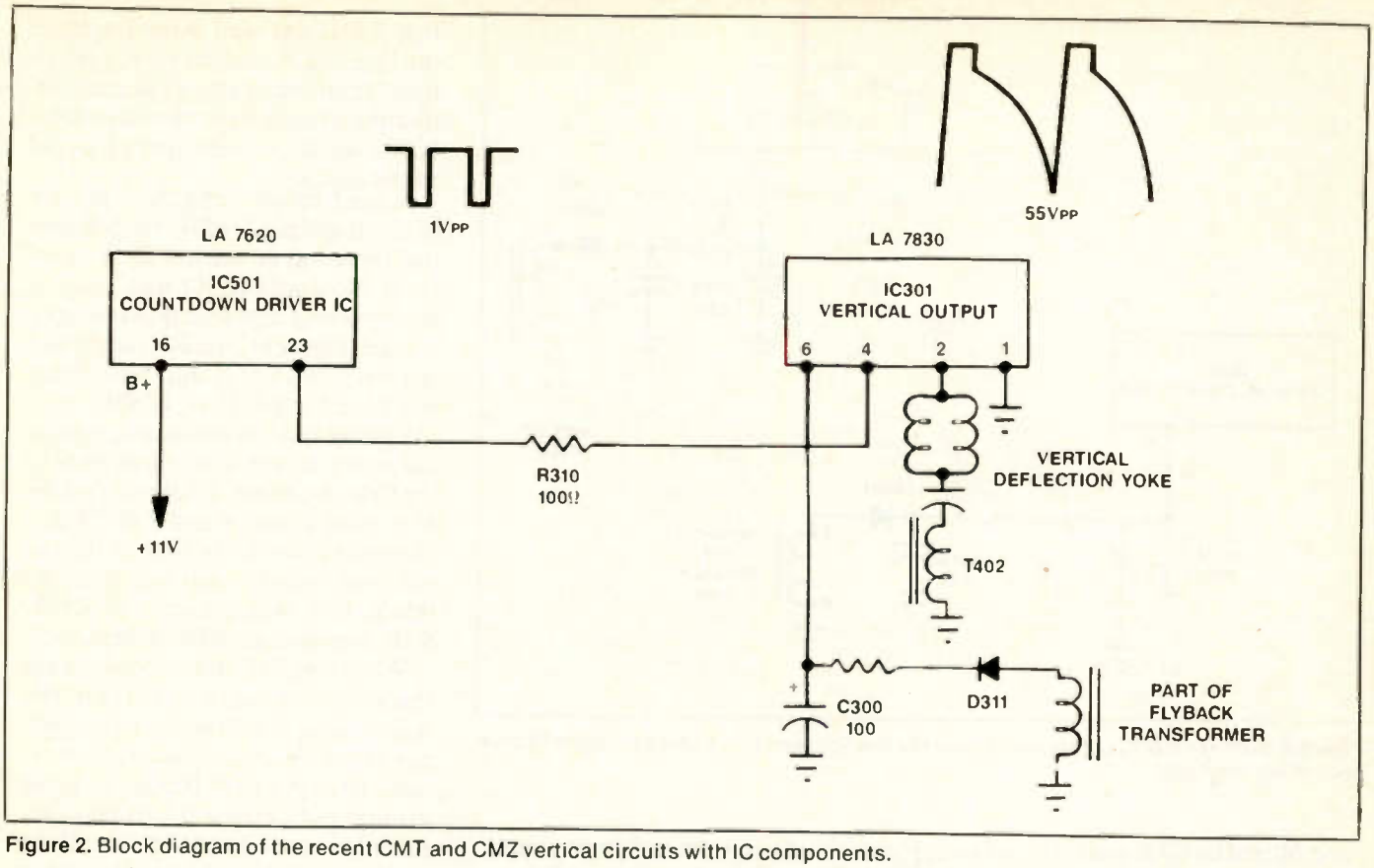


Figure 2. Block diagram of the recent CMT and CMZ vertical circuits with IC components.

voltage at pin 6 (25.3V) is developed in the flyback secondary scan circuits. The 55Vpp waveform at pin 2 of IC301 is tied directly to the vertical yoke assembly. The yoke ground return is coupled through C316 to the primary winding of pincushion transformer T402.

IC replacements

Although universal IC and transistor replacements can be used successfully in the vertical circuits, very few are available. Try to obtain IC components from the manufacturer or area depot. The HA and LA IC parts can be purchased from mail order firms such as MCM Electronics, Consolidated Electronics, and Diversified Parts. Some of the low voltage regulator ICs are available locally, either universal or exact replacements, or can be ordered from mail order firms.

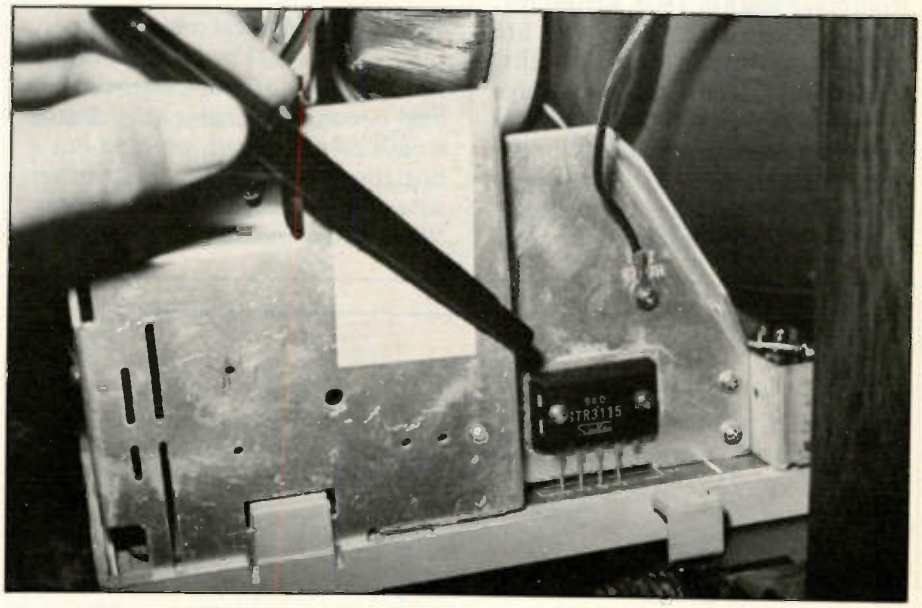


Figure 3. In the early chassis, vertical supply voltage was taken from the low voltage regulator (Goldstar CMZ 4122).

Vertical voltage sources

Very few vertical supply voltages for the oscillator or countdown and output IC components are taken from the low voltage circuits (Figure 3). Most vertical operating voltages are from the secondary windings of the flyback transformer. This means that the horizontal circuits must be operating before any voltage is available to the vertical circuits. For the same reason, a shorted component in the vertical circuits may overload the flyback circuits resulting in chassis shutdown.

In the Goldstar CMT-9428 portable, the vertical countdown IC receives operating voltage from R509 and R505. The 11V source is filtered by C514 and C519 (1000μF). D501 rectifies the ac voltage taken from pins 6 and 8 of the flyback transformer, T403. D504 regulates the 11V source (Figure 4).

The supply voltage for the vertical output (IC301) is taken through R313

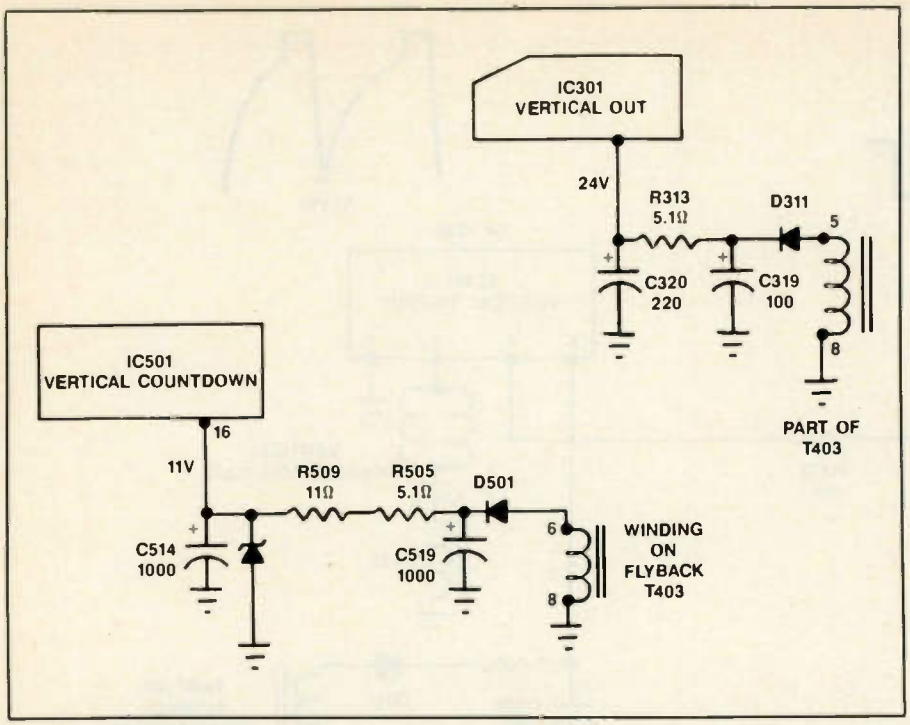


Figure 4. Both vertical IC components have the low voltage source taken from the flyback secondary windings.

and filtered by C320 and C319. Silicon diode D311 rectifies the ac voltage from pins 5 and 8 of T403. Remember, because the vertical circuits are powered from the flyback circuits, horizontal sweep and low voltage power supply must be functioning in order for the set to operate. If the circuits in the set that provide power to the vertical circuits are not operating, you may supply power to the vertical circuits using an external power supply for diagnosis and servicing.

No vertical sweep

One CMT-2132I worked on exhibited symptoms of problems in the vertical circuits. Sometimes the chassis would come on with nothing but a horizontal white line and at other times the chassis would shut down. When I first checked the set, the 3A fuse (F801) was open. After I replaced the fuse and turned the set on, only a horizontal white line appeared, indicating trouble in the vertical circuits. IC301 and IC501 were operating cool to the touch.

A quick oscilloscope check at pin 4 of IC301 and pin 23 of IC501 indicated that there was no vertical drive waveform. No doubt IC501 was leaky or was receiving improper power supply voltage (Figure 5). The 24V supply was normal at pin 8 of IC301. No voltage was found at pin 16 of IC501.

I rechecked the schematic, tracing the power source from pin 16 back to the flyback circuits. D501 rectified the ac voltage at pins 6 and 8 of T403. I checked silicon diode D501 in the circuit and found that it was shorted. R505, 12Ω, was burned and R509, 5.1Ω, was open. I replaced them both.

When I applied power to the chassis the symptom remained. D501 felt quite warm, and I measured no voltage at pin 16. A resistance measurement from pin 16 of IC501 to chassis ground indicated a 0.18Ω leakage. After I blew the dust away from D504 and examined it closely, this zener diode showed burned marks. Even the pc board connections were loose. I removed D504 from the board and tested it. It was leaky. With D504 out of the circuit, the resistance from pin 16 of IC501 was above 2K indicating no leakage. Replacement of D504 with an 11V, 5W zener diode restored the set to service.

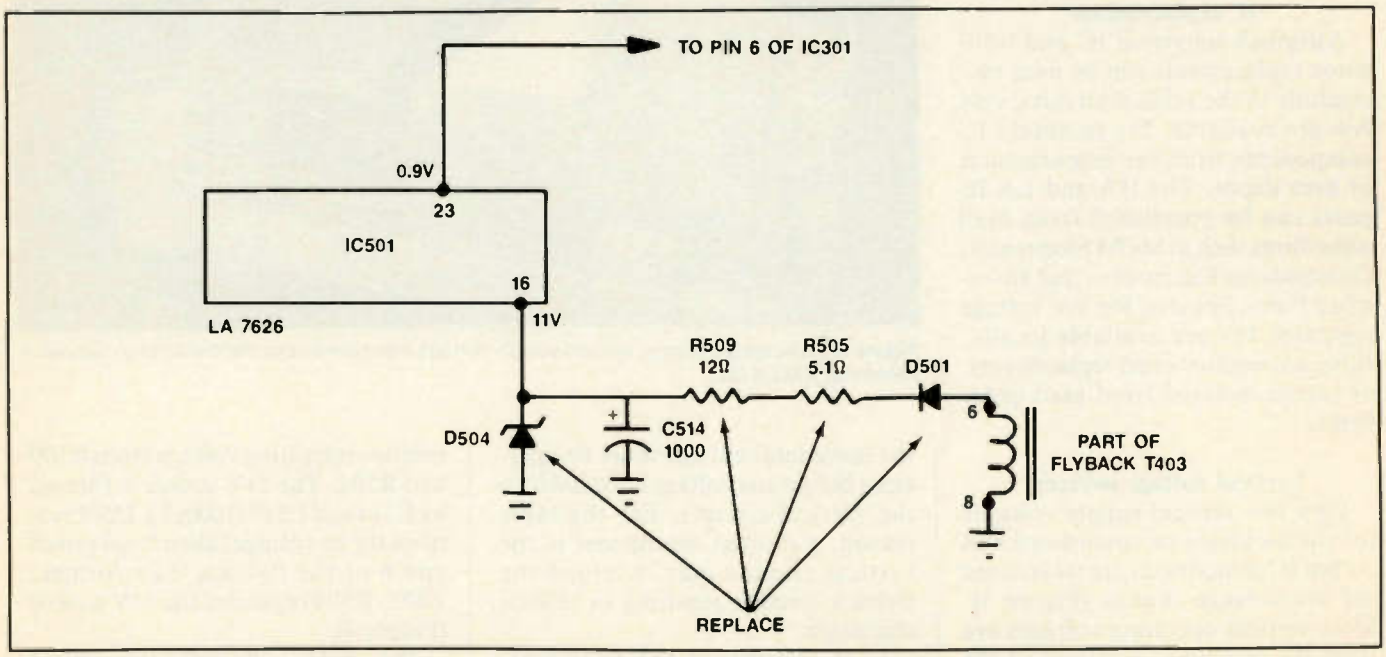


Figure 5. Defective components in the power supply source for IC 501 indicated no drive waveform.

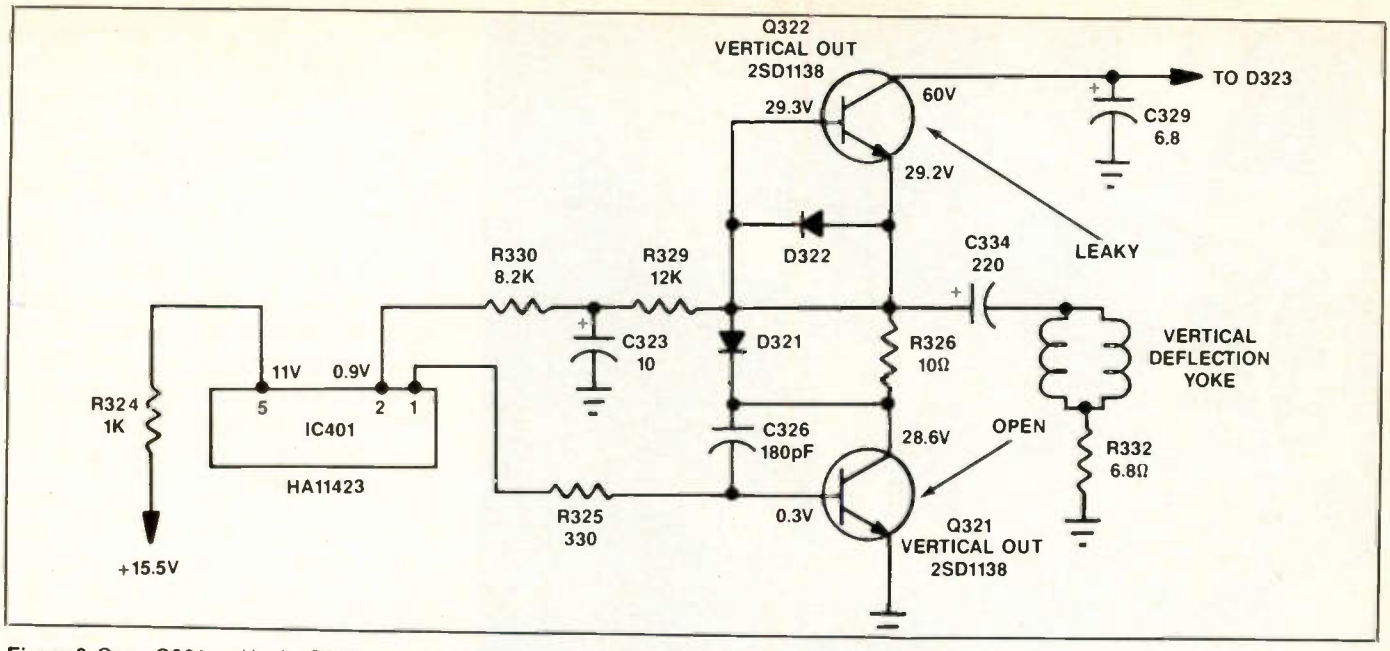


Figure 6. Open Q321 and leaky Q322 produced a horizontal white line in a Goldstar CMT-4442 portable.

Horizontal white line

A Goldstar CMT-4442 that was brought in for service had no vertical sweep. The screen showed only a horizontal white line. Examination of the schematic revealed that a deflection IC provided drive voltage to both vertical output transistors (Q332 and Q331). A quick waveform check at pin 2 of IC501 indicated a fairly normal vertical drive sawtooth waveform. There was no waveform at the output capacitor C334 (Figure 6).

A quick voltage check at the collector of Q322 indicated 63.5V. The emitter measured 61.2V and the same was applied to the collector of Q321. No doubt Q321 was open. When tested in the circuit, Q302 showed leakage and Q321 was open. Both tested the same out of the circuit. When one vertical output transistor is leaky, automatically replace both vertical output transistors.

While the two output transistors were out of the circuit, I checked all bias resistors and diodes. D322 showed leakage in the circuit, but tested normal when removed. I replaced D322 along with the vertical output transistors. Both output transistors, the same NPN type, (25D1138), were replaced with universal replacements (SK9118).

In this case, quick waveform tests and critical voltage measurements revealed the defective output transistors. Higher than normal voltages at the collector and emitter terminals of Q322 indicated that Q321 was open. When the symptom is a horizontal white line, do not overlook the possibility that the cause of the problem is the yoke coupling capacitor, in this set the yoke coupling capacitor is C334.

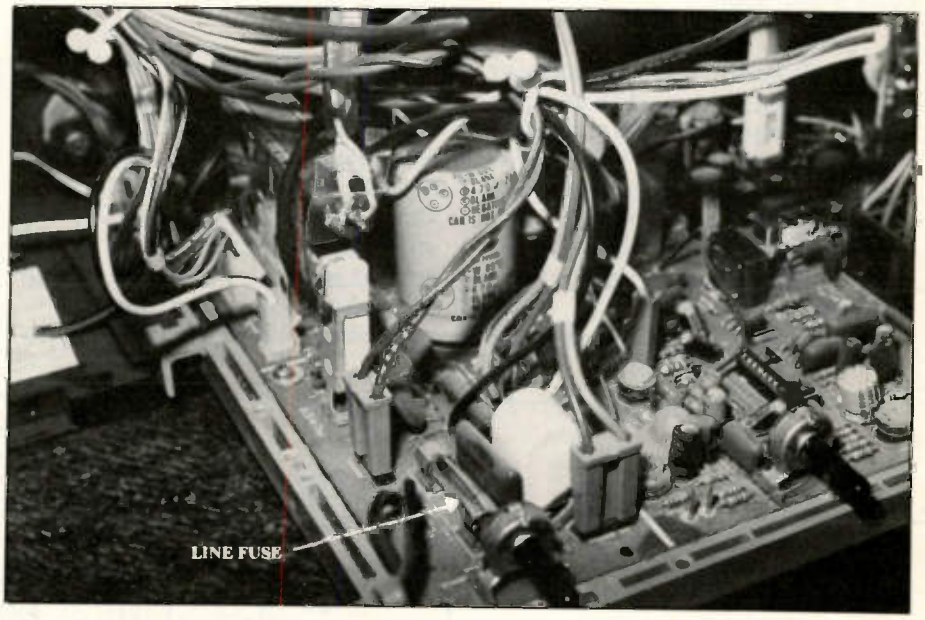


Figure 7. Suspect overloaded conditions in the horizontal, vertical or regulator circuits when the power line fuse keeps opening.

Too many troubles

The customer described the symptom of a problem with a Goldstar CMZ-4122 as a picture that reduced to a thin white line before the set quit altogether. The line and B+ fuses were replaced with a 3A and a 1A fuse, respectively, which blew again when the chassis was turned on (Figure 7). Since I did not have the correct schematic for the CMZ-4122 model, I checked the schematics of some other Goldstar sets. The low voltage IC, IC 801, Q404 and T402 of the CMT-4442 portable schematic looked the same as in the set I was dealing with (Figure 8).

Although fuse F802 blew this time, I made the assumption that D803 and R801 were normal. They checked good in the circuit. The horizontal output transistor, Q404, showed leakage between collector and chassis

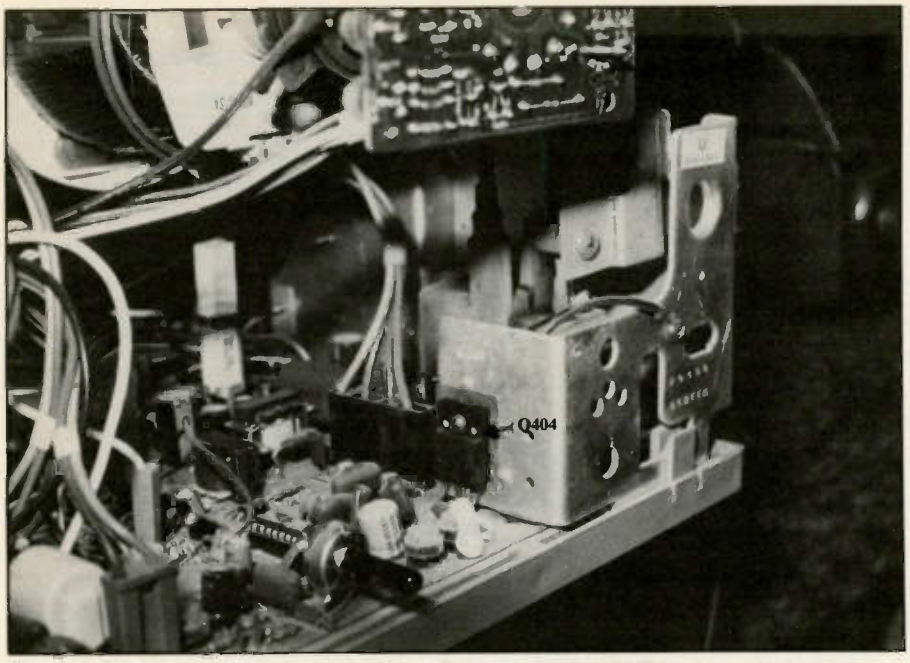


Figure 8. Replacement of a leaky Q404 in a Goldstar CMZ-4122 TV set eliminated the cause of shut down.

ground. When I tested this transistor out of circuit, it proved to be leaky (0.5Ω), so I replaced it with an SK9422 universal replacement (Figure 9). After I installed Q404, a resistance measurement between collector (case) and chassis indicated normal resistance. F802 opened up again when I plugged the chassis in.

Next, I checked resistances in the low voltage IC regulator circuits and gave the components a close visual check. I replaced R802 (1Ω) which bore the signs of overheating. Although IC801 did not indicate leakage, I replaced it with an SK7817 universal replacement. When I again applied power to the set, it came up with a horizontal white line.

Because the vertical output circuits of this set operate from the flyback secondary voltages, I checked each silicon diode in the scan derived circuits. D325 was leaky both in and out of circuit. Replacement of this leaky silicon diode restored the raster to normal.

Sometimes it's difficult to determine what actually causes components to fail. I assumed that Q404 shorted and took out IC801 and both fuses, but wondered if the vertical rectifier could cause all this damage. Perhaps it was lightning or a high voltage surge on the power line. Sometimes we never know.

Leaky IC 301

In checking a CMZ-4442 with no vertical sweep in order to determine if the deflection IC or the vertical output IC was defective, I checked the waveform at pin 2 of IC301 and found nothing but noise. The input waveform (pin 4) had a 5.5Vpp waveform which appeared to be distorted (Figure 10). The input waveform at pin 23 of IC501 is the same.

Next I checked the voltage at pin 16 of IC501. This voltage was normal at 11V. I thought that possibly IC301 was leaky and loading down the vertical drive waveform, because that waveform was only half of its normal amplitude. Voltages at pins 6 and 4 of

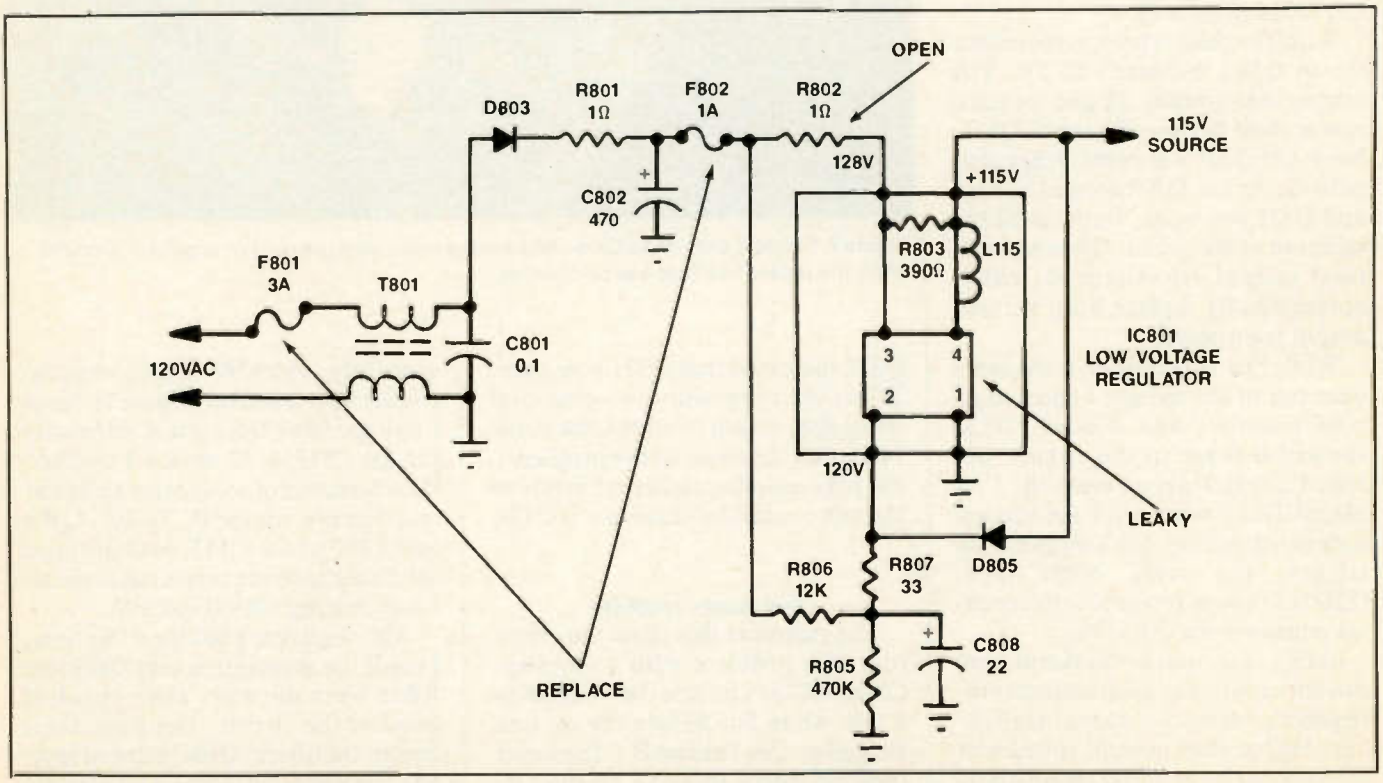


Figure 9. Leaky components in the horizontal and vertical circuits produced a leaky IC801, R802, F802 and F801.

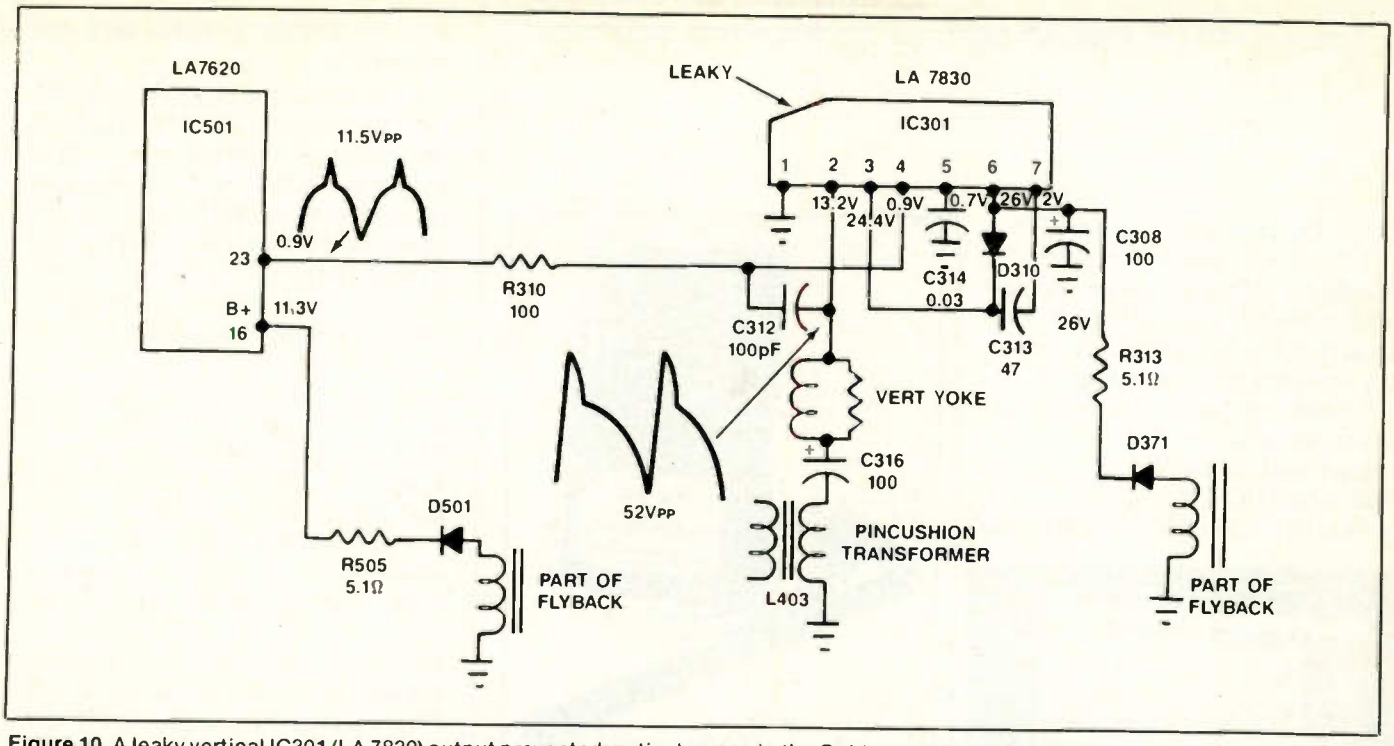


Figure 10. A leaky vertical IC301 (LA 7830) output prevented vertical sweep in the Goldstar CMZ-4442 portable.

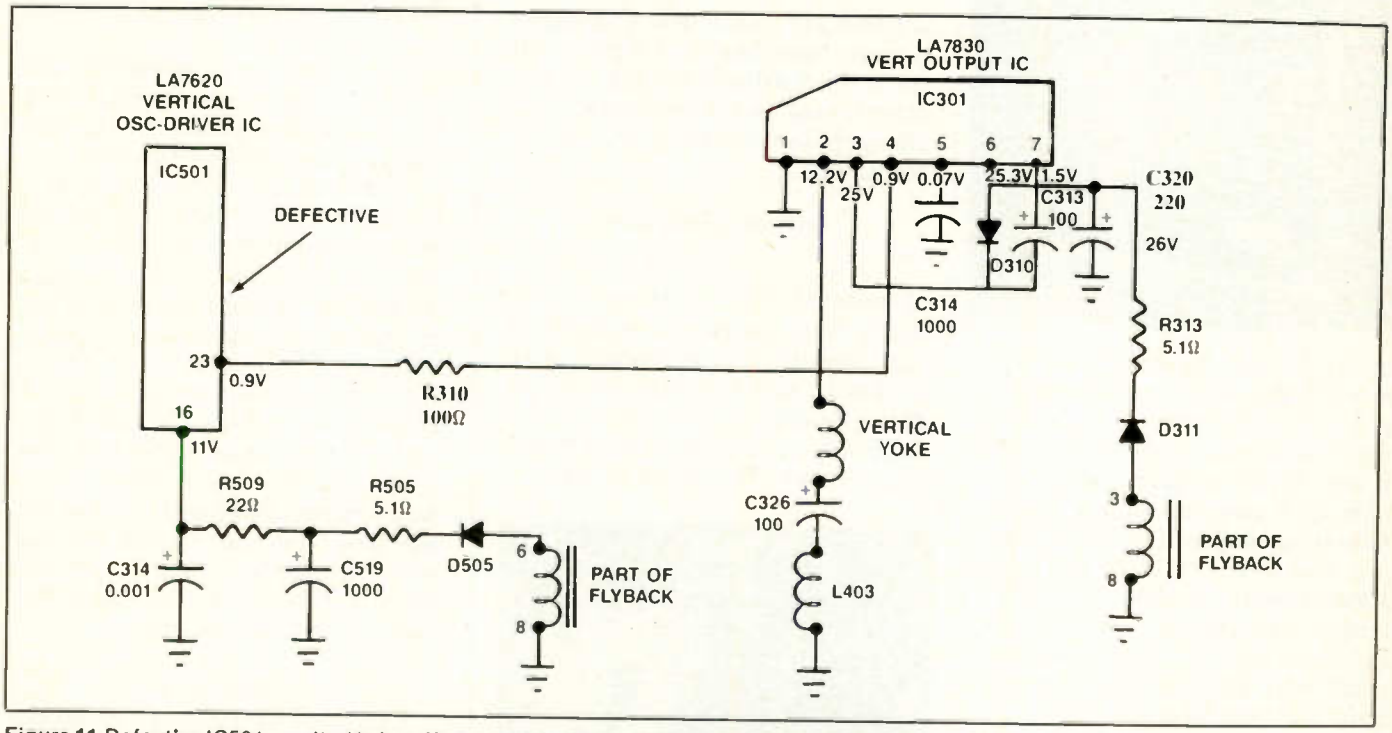


Figure 11. Defective IC501 resulted in insufficient drive voltage to the vertical output IC301 in a Goldstar CMT-9428 TV.

IC301 were quite low, 10.7V and 9.9V respectively.

The 26V power source came from the flyback windings, pins 5 and 8. Although R313 was a little warm, D371 tested normal. A resistance measurement from pin 6 to ground was 57.2Ω. When I desoldered pin 6 from the circuit, the supply voltage to that circuit trace increased to normal, indicating that IC 301 was leaky. No doubt the leaky output of the IC was responsible for pulling down the vertical drive waveform. IC301 was replaced with exact replacement (LA 7830), which restored the set to normal operation.

No vertical drive waveform

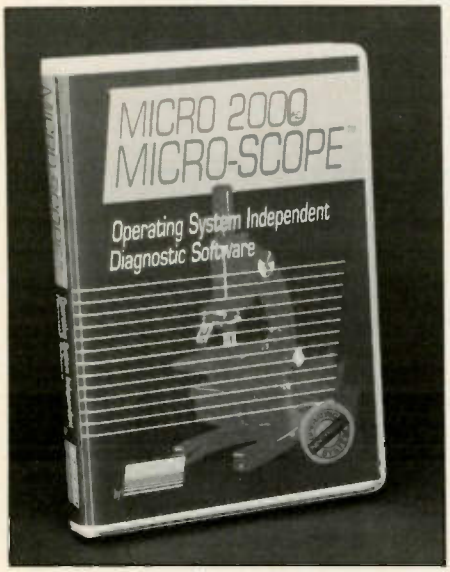
While servicing a CMT-9428 with no vertical drive, I checked for output waveforms on pins 2 and 4 of IC301. Seeing no waveforms to speak of at those pins, I moved on to pin 23. I found no drive waveform at driver pin of IC501 (Figure 11).

Next, voltage measurements revealed that the voltage at pin 16 of IC501 was within specification at 11.5V. A quick resistance measurement on pin 23 to chassis ground showed a high reading. No doubt LA 7620 IC was defective. When LA 7620

PC diagnostic software

Micro Inc. announces a new PC diagnostic software package with seven features not available in any other Intel chip PC diagnostic software according to the manufacturer.

Microscope has its own proprietary operating system so it is truly operating system independent. It functions underneath DOS, Novell, OS/2, Unix, Xenix, PICK, PC MOS, C.DOs, and



others. It reads the whole disk. DOS based diagnostics, for example, limit you to the DOS portion of the disk, which is only 1024 cylinders, or less. It talks directly to the hardware and as a result, it can perform many functions other diagnostic programs cannot. Microscope performs more than 100 diagnostic functions. Some of the types of tests it includes are CPU tests, expanded memory tests, winchester tests, video tests, floppy disks, and serial and parallel tests.

Circle (46) on Reply Card

Infra-red detector

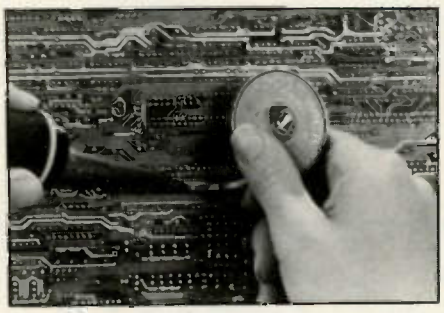
OTI International announces a product that tests for infra-red transmission in TV/VCR remote and control units. The device produces an audible signal and alerts the technician to the function of each of the control keys that are actuated. THe strength or loudness of the audible signal produced can also give an indication of the battery power of the nit being tested. Two auxiliary jacks expand the

capability of the test unit. One allows the use of a probe (which is provided) for use in hard-to-reach places. The other is used for connection to an oscilloscope for visual display of the received data.

Circle (47) on Reply Card

Fine-braid in ESD-safe packaging

Soder Wick announces Fine-Braid and Ultra-Braid static dissipative stet packaging that provides protection during desoldering operations involving ESD-sensitive circuit boards and components. The SD qualifies as a



non-ESD generator per DOD Standard 1686 and DOD Handbook 263. The braid is a line of desoldering products that are engineered of oxygen-free copper wires, braided into geometric patterns, and cleaned in proprietary processes. SD braids are available in

(Continued on page 24)

was replaced the vertical sweep was restored.

If the chassis is in shut down and you don't know if the vertical circuits are causing the problem, inject supply voltages at IC501 and IC301 using an external supply. Both of these ICs operate off of rectified voltage of the flyback circuits. This means the horizontal circuits must be operating before any voltage is applied to the vertical circuits.

Because two different voltages (11V and 25V) are applied to each IC, you'll have to use a dual low voltage power supply. Inject 11V at pin 16 of IC 501 and 25V at pin 6 of IC301.

Sometimes the pins of the IC are so close together that there isn't room to connect the supply directly to the IC pin or circuit trace. If that is a problem, you can solder a bare piece of hookup wire to the pc wiring coming from the pin that you want to connect to. One way to do that is to scrape the coating off the pc wiring and solder in the piece of wire. A one-inch piece will do.

Do this to both voltage supply pins of each IC component. With this method, the leads from the external supply will not fall off and short out some other circuits. After connections are made, increase the voltage of the external supply to the correct operating voltage on each pin. If the voltage does not increase as the control of the external supply is advanced, suspect a leaky IC.

Observe waveforms at pin 23 of IC501 and pins 4 and 3 of IC301. Do this with the ac cord pulled from the receptacle. If vertical circuit waveforms are normal when the circuits are powered from the external supply, move on to the horizontal circuits and begin a diagnosis to determine the cause of chassis shutdown.

Conclusion

Careful observation of waveforms and voltage measurements locate most vertical problems. Universal transistors and IC components can be used for replacements, if available. Use the line isolation transformer and external voltage sources to locate defective vertical parts in high voltage or shut down chassis. Remember, most of the vertical circuits in the CMT and CMZ Goldstar portables operate from the scan derived flyback windings. Try to compare various CMT and CMZ circuit diagrams if you do not have the exact one. ■

Practical applications of filtering circuits

By Dale C. Shackelford

Electronic service technicians are often called upon by prospective customers to cure the ills of various devices which suffer the adverse effects of radio frequency interference (RFI). Whether this interference contributed by an outside influence, or is self-generated, there are some basic steps which may be taken to attenuate these problem signals. In addition to a clear understanding of basic filtering theory however, the tecnhician must learn the practical applications of filtering circuits in order to apply this knowledge to the modification of exisiting circuitry in an effort to reduce the adverse effects of RFI and HFI (high frequency interference).

Line filtering

One of the first lines of defense in combatting HF/RFI is the proper filtration of the ac input line. Often, ac power cords will act as antennas for a broad range of HF and RF signals, allowing "noise" to enter the sensitive circuitry of the device if proper measures were not taken by the design engineers to prevent such an occurrence. Several devices (regardless of cost) rely primarily upon the power transformer to filter out unwanted signals which find their way into the power supply circuit. Standard power transformers however, provide little or no attenuation of these signals as they move into the more sensitive circuitry.

Figure 1 depicts a common line filter configuration which may be applied to a number of ac powered devices with simple modifications to existing circuitry. While the relative value of the individual components may be varied according to need, the values noted within the drawing will provide adequate attenuation of signals up to 100MHz. As added protection, a toroid (ferrite loop) has been placed into the circuit, around which the ac transmission line has been wrapped to reduce eddy currents.

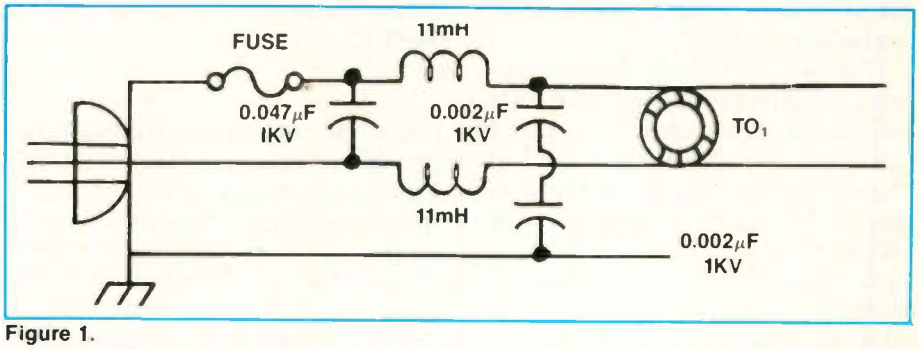


Figure 1.

Because ferrite is a high resistance magnetic material that exhibits low eddy current loss at very high frequencies, it is often formed into small beads which are slipped over current carrying leads, contacts or wires to minimize RFI reception or transmission. The toroid in Figure 1 (TO1) exhibits the same characteristics as the smaller beads, which are commonly found around the leads of transistors and other components used in circuits containing radio frequency signals in an effort to prevent RFI(including unintentional feedback) from adversely affecting circuit/component performance. Any circuit modifications by a service technician should not include the removal of any ferrite bead, loop or shield.

Ripple filtering

While the line filter as described above will provide adequate protection from unwanted frequency invasion through the power cord, power rectification/communication circuits within the device will generate ac ripples that are simply unavoidable by-products of the rectification process.

The graded filter illustrated in Figure 2 is a dc power supply filtering network designed to provide increasing filtration of the dc as it moves along the sequence. The network provides "taps" along the sequence so that circuits within the device may obtain their B+ at any stage.

Cirucits within the device containing the graded filtering network which

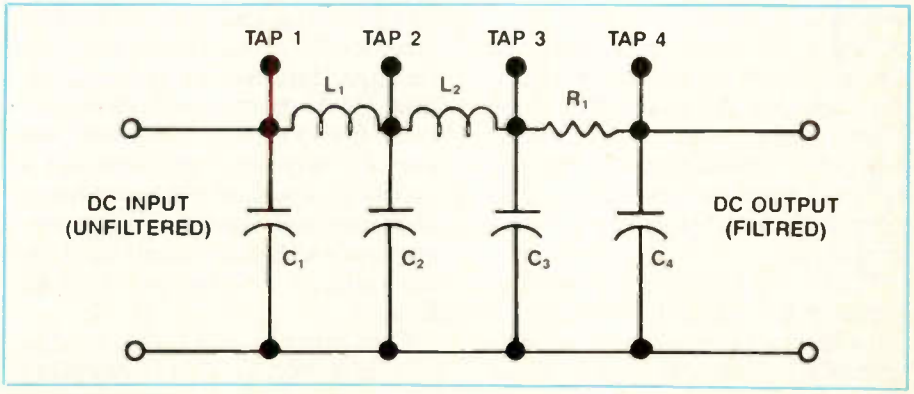


Figure 2.

Shackelford is an independent electronics servicing technician.

are relatively unaffected by ac ripples (not to be confused with pulsating dc) will generally derive their b + from a point near the input of the filter, while those circuits which require relatively ripple-free B + will be tapped off near the end of the network. For added protection, circuits which are considered extremely susceptible to ac ripples are often tapped off near the center of the filter, usually between two chokes. Because of the modular construction of this filter, the number of output branches (taps) may be varied according to need.

The value of the individual components which make up the graded filter will be dependent upon the needs of the circuits within the device. Devices that do not contain a graded filter as part of the original design may well be enhanced with the addition of this circuit, while those devices which do not contain this type of network may be modified through the addition of branches, or an exchange of individual component values if such a need were to exist.

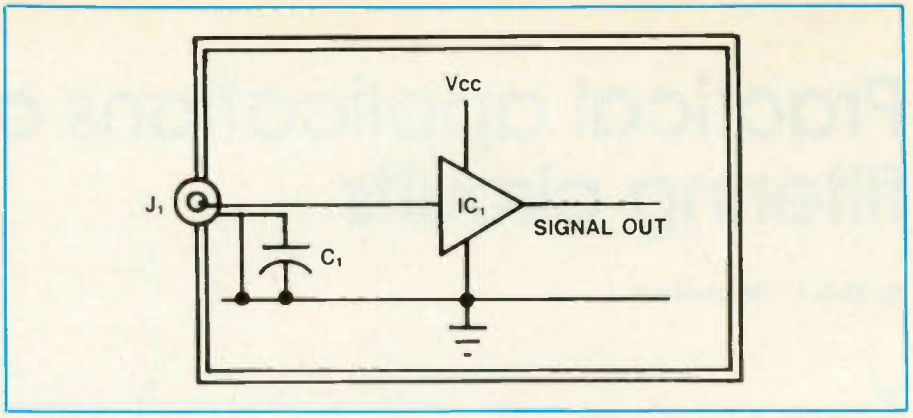


Figure 3.

Peripheral inputs

The peripheral input ports (jacks) on many modern electronic devices often become points of entry for HF/RFI signals into sensitive amplification circuitry. Unless design engineers have taken the precautions necessary to prevent the unwanted signals from entering a device in this fashion, the responsibility for making the proper modifications to the device in order to enhance the overall operation of the appliance may well rest with the service technician.

Figure 3 is a simplified representation of a typical RF amplification circuit which receives its input from the output of a peripheral source (cd player, turntable, etc.) through the input jack (J_1). Although "shielded" patch cords are commonly used to physically connect the devices, these cords often allow HF/RF signals to ride along the shielding until they enter the circuit through J_1. Additionally, these signals may enter the device through any exposed metal contacts, especially if the amplification circuit is in operation near other signal generating devices.

Within the illustration, a 0.001 μf capacitor has been installed in parallel with the factory mounted chassis ground wire extended from J_1. While the factory installed grounding system (input jack to chassis ground) may provide adequate protection from high frequency interference at lower frequencies, these same ground wires/straps will often exhibit the same characteristics normally associated with inductors when exposed to higher frequencies (radio frequency), thereby impeding the path of the interference to the chassis ground.

With the addition of the 0.1 μf capacitor to this circuit (C_1), a low impedance path to the chassis ground is maintained at virtually all frequencies. When making this type of modification however, the service technician should take care to keep the leads of all components (capacitors) as short as possible to prevent increasing impedance or the radiation of HF/RFI inside the cabinet of the device. In the event the leads of the capacitor(s) must be longer than one-quarter of an inch, ferrite beads may be placed over the leads to prevent RF radiation. Obviously, all such input jacks, ports or other exposed metal surfaces should receive the same modification considerations.

Amplification circuits

The source-follower circuit shown in Figure 4 is a common unity-gain amplifier stage used in many devices because of its signal conditioning, buffering and impedance matching qualities. The N-channel field effect transistor (FET) used in this circuit will provide adequate amplification of a variety of signals over a broad range of frequencies, including those frequencies which may be considered undesirable in following stages or circuits.

Capacitors C_1 and C_2 are used in this instance as signal coupling devices, which also act as dc decouplers, preventing any dc from entering the signal path where it could destroy the amplifying component (Q1). While these capacitors will exhibit some frequency attenuation characteristics, their value, if factory installed, should not attenuate any of the desired passband frequencies. These components may however, have to be replaced with those of a different value to meet the needs of the filtering circuit to be added.

In a hypothetical situation, a service technician has decided that a resonant bandpass filter should be added to the source-follower circuit in Figure 4 to increase the overall performance of the device in which it is installed. As a starting point, the technician must determine which type of resonant bandpass filter should be used.

In this instance, either a series or a parallel resonant bandpass filter would provide the proper attenuation of the stopband frequencies. The technician would look next to the configuration which would require the least amount of time and effort to install, the fewest modifications to the existing circuitry and finally, the fewest component additions required to provide the amount of filtering necessary, all of which may be combined under the heading "Overall Efficiency."

With the simple addition of an inductor (coil) to the existing circuit components, a series resonant bandpass filter is constructed (Figure 4A). Because the parallel resonant filter would have required the addition of at least two components (in its most basic configuration), the series filter is more efficient in this instance, and should therefore be used.

Figure 4A shows how the inductor (L_1 was installed, which, coupled with C_1 forms the series resonant

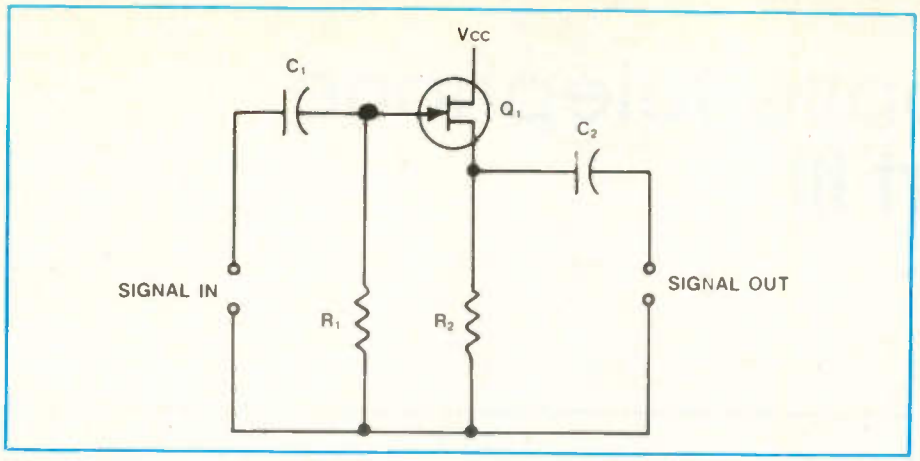


Figure 4.

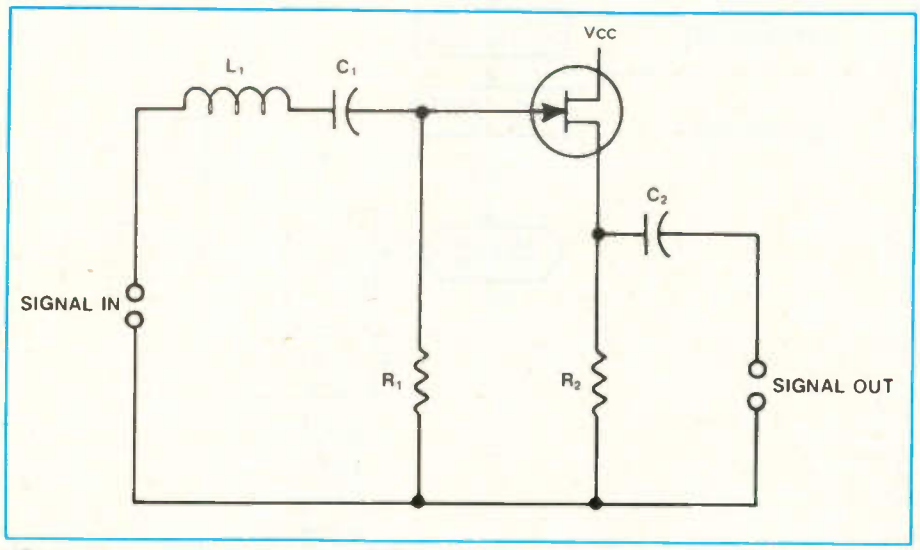


Figure 4A.

bandpass filter for the signal input. As the relative positioning of C_1 has not been changed, it will still perform its function as a dc decoupling device in addition to being a vital component in the filtering circuit. As mentioned previously, the value of C_1 may have to be altered from its original specifications to fit the needs of the filter, (see Filtering Theory, in the December 1991 issue for value calculation information) as would the value of C_2 if the service technician decided to add another inductor (filter) to the output stage of the source-follower amplifier.

Other considerations

Because FET's rely upon a very small gate voltage to control a large drain current for their amplification characteristics, these components are often fitted with shields (usually Faraday shields) to prevent stray electrostatic fields or charges from adversely affecting their operation. If the service technician decides that a ferrite bead should be used around the signal input lead(s) (gate) of the FET to provide protection from, or to contain RF signals, all factory installed shielding devices should be kept intact.

In the event a bipolar transistor is used, a ferrite bead should be placed over the signal input lead (base, collector or emitter), depending upon the circuit configuration) for the same protection against RFI transmission or reception.

As may be observed by the preceding examples of circuit modifications, virtually all stages of an electronic device may be enhanced with the addition of filtering or attenuation circuits, as long as common sense and basic electronic principles are maintained in their development and application. ■

Cellular mobile telephone systems - Part III

By William H. Bowen

This article originally appeared in the July 1991 issue of The Expander, a monthly publication published by Mitsubishi to provide technical information on the company's products for their authorized service centers.

This article is Part III in a series of articles that describes the operation of the cellular mobile telephone system. The focus of previous installments has been on the organization and operation of the cellular system. Beginning with this installment, the focus will shift to the cellular mobile subscriber unit itself, examining how the subscriber unit operates and how it interacts with the system to place and receive telephone calls.

Operational differences

The operational differences between a cellular subscriber unit and a land telephone subscriber unit reflect two fundamental physical differences between the land and cellular phone systems.

The land subscriber unit is operated in a fixed location, the customer's home or business, for instance, and is connected to the land telephone system by a direct physical connection, usually a pair of copper wires called the "local loop".

In contrast, the cellular subscriber unit uses a flexible rf link to connect it to the cellular system, so its use is not restricted to a specific physical location. The cellular subscriber unit can be operated anywhere within the coverage area of a cellular system, such as in a moving vehicle.

These two differences give rise to a third and most important fundamental difference: the land telephone system assigns the network identification or telephone number to a specific telephone line which terminates at a specific physical location, whereas in the cellular system the network identification is assigned to the subscriber unit, which is not tied to a specific physical location.

Nowhere is the effect of these fundamental differences more profound than in the operations performed by a cellular subscriber unit when power is first applied to it.

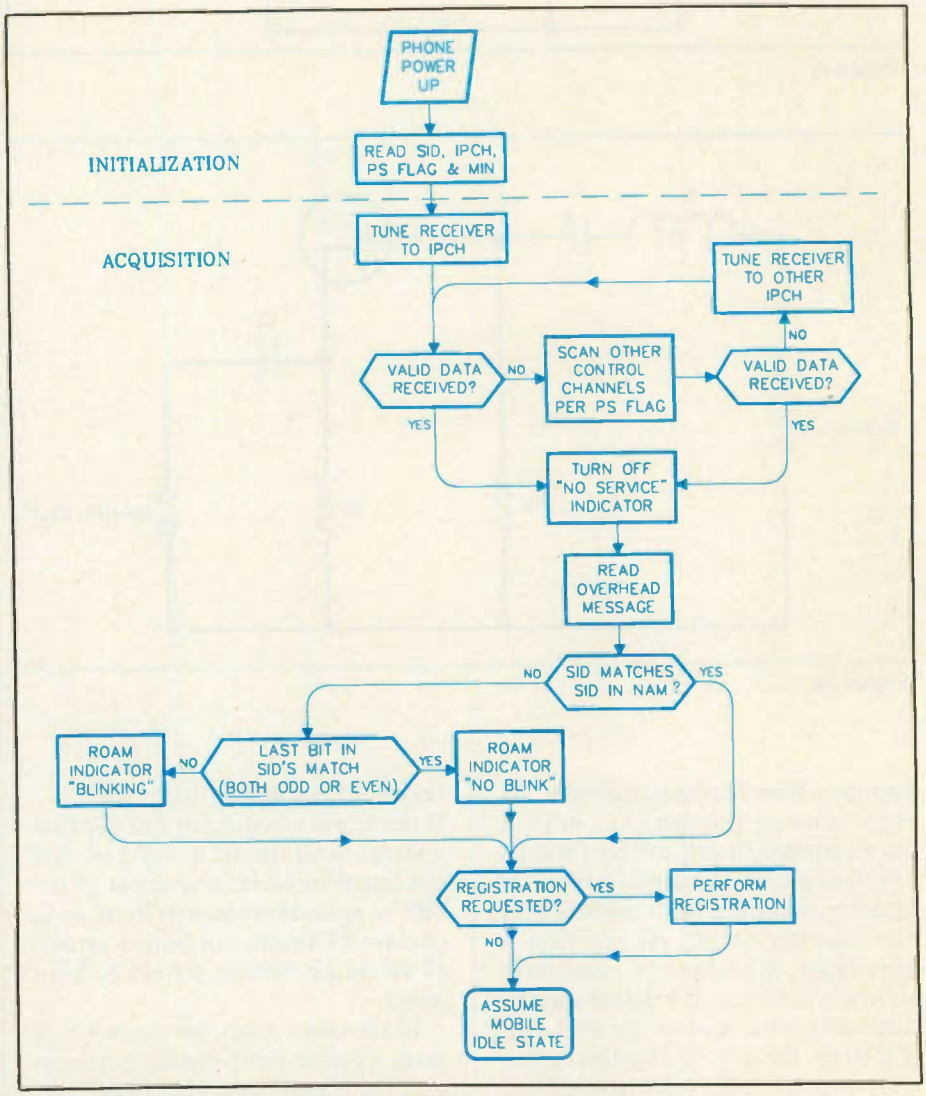


Figure 1. Subscriber unit initialization and system acquisition.

Subscriber unit initialization and system acquisition

When the cellular subscriber unit is first switched on or "powered-up", a two-step process must be completed before a call can either be placed or received. The cellular subscriber unit,

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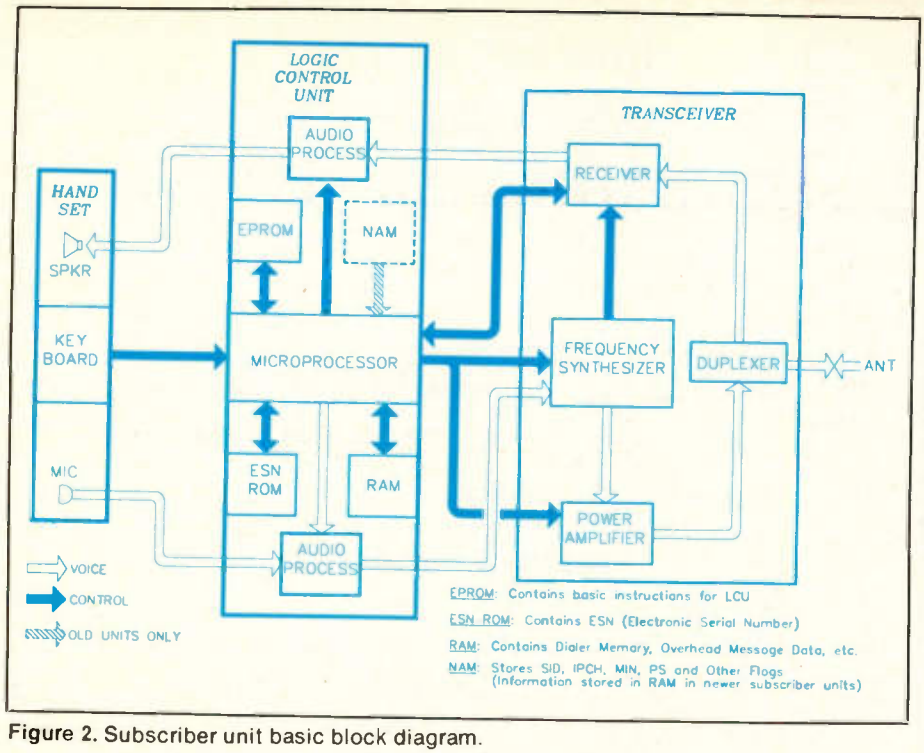

Figure 2. Subscriber unit basic block diagram.

since it is an active device, must first configure itself internally for proper operation: this process is called initialization. Second, the cellular subscriber unit must establish a connection to the cellular system in whose service area it is physically located; a process known as system acquisition.

Both of these processes are diagrammed in Figure 1. The standard land telephone subscriber unit does not need to perform either of these procedures: initialization is not required since the land telephone subscriber unit is a passive device, and system acquisition is accomplished by the fact that the land phone is in a fixed location connected by a specific wire pair to a specific local central office.

Subscriber unit initialization

When the mobile subscriber presses the "ON" button on the phone, the logic control unit or LCU begins its operation by performing the Initialization routine. The LCU's microcomputer is configured for proper operation by reading the necessary information from the program EPROM (electrically programmable read-only memory), the operation of certain subscriber unit circuits is verified, and the data that resides in the number address module (NAM) is read.

The NAM, which is part of the Logic Control Unit, shown in the subscriber unit block diagram in Figure 2, contains information programmed into the subscriber unit when it was activated: in most current subscriber units the NAM data are stored in a special part of the unit's main internal RAM (random access memory).

The data in the NAM includes the SID (system identification) of the home cellular system, the PS or preferred system flag, set to match the band of the subscriber unit's home system (wireline or non-wireline), the subscriber unit's Mobile Identification Number, or MIN, (its telephone number), and other data and control flags that will be discussed later. Also included in the NAM is the correct initial paging channel (IPCH). If the user subscribes to service with the Band A or non- wireline cellular carrier, this channel is usually Channel 333: if the user subscribes to service with the Band B or wireline cellular carrier, this channel is usually Channel 334. We'll see why the IPCH is important in a moment.

Once the Initialization routines are completed, the subscriber unit will proceed with system acquisition. While subscriber unit initialization is a self-contained operation, system acquisition requires the gathering of certain information from the local cellular system. Before we examine the mechanics of system acquisition, let's take a moment to see how the exchange of information takes place in the cellular system.

Cellular system data transmission

The cellular system will have at least one control channel per cell that is designated specifically as a paging channel, and this channel's forward (land to mobile) path will be transmitting a continuous digital data stream. The data transmission scheme used by the AMPS cellular system uses a special error detection and correction code called an NRZ Manchester code; this technique is very similar to the data encoding scheme used in the audio compact disc system. The encoded digital data stream directly FM- modulates the rf carrier at a 10 kilobit per second rate. The construction of the forward control channel's digital data stream is shown in Figure 3.

The digital data stream is comprised of synchronization information, required to permit the subscriber unit's control section to properly decode the information transmitted, and the data message itself. Each data message is repeated 5 times to give adequate error protection against signal fading. The data message is contained in two 40-bit words, and can be any one of three types:

- Overhead Messages
- Mobile Station Control Messages

Control filler messages

Overhead messages contain general data regarding the local system that are "broadcast" to all subscriber units. Mobile station control messages contain data for a specific subscriber unit, such as paging for a land to mobile call. Control filler messages are sent to ensure that the stream of data transmitted is indeed continuous: they may also contain additional data fields.

The mobile station control message will be described during the explanation of call handling procedures, but for now let's concentrate on the overhead message: this is the information that the cellular subscriber unit uses during system acquisition.

Overhead messages

Overhead messages are two-word messages that contain general data regarding the local system directed to all subscriber units. The first 2 bits of an

overhead message (T1, T2) will always be a "1": this is how an overhead message is identified. The next 2 bits are the digital color code (DCC), a code used to distinguish a particular cell from another nearby cell that uses the same rf frequency: this technique is used to reduce the possible effects of co-channel interference.

The remainder of the overhead message includes the channel number(s) of that cell's active control channels (paging and access), system configuration information (including whether the cell uses common control channels or independent paging and access channels), system option messages (determines whether certain system options can be used) and the cellular system's SID.

The SID or system identification is a 5 decimal digit (14 binary bit) number assigned to the system, that permits subscriber units to identify whether or not they have accessed the system to which they are a subscriber: their "home" system. The last digit of the SID also carries significance: the SIDs of all non-wireline carriers have an odd last digit, whereas wireline carrier system SIDs all have an even last digit.

A more complete description of all the particular data fields in the overhead message is beyond the scope of this article: if further detail is desired, please refer to the AMPS Basic Specification, which is available from the Electronic Industries Association (EIA) as EIA Specification IS-3-E.

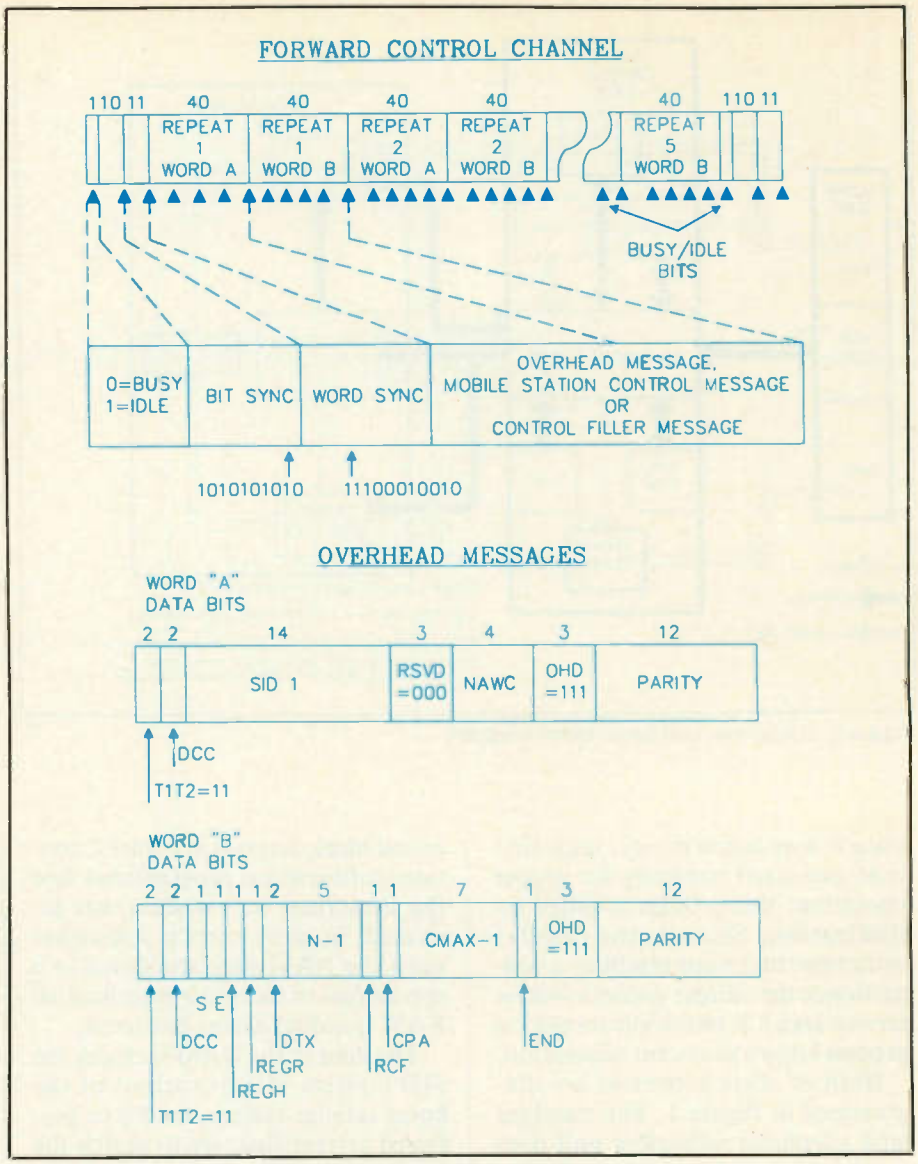

Figure 3. Control (paging) channel digital data stream.

System acquisition

As mentioned earlier, once the subscriber unit has been initialized, the system acquisition routine commences. The receiver in the subscriber unit is commanded to tune to the IPCH stored in the NAM. The IPCH is used as the starting point for system acquisition since this will shorten the acquisition process.

If no signal is found on that channel, the subscriber unit's receiver will scan the other 20 control channels assigned to the PS or preferred system searching for paging channels, capturing the strongest one it receives.

If the receiver is unable to capture a paging channel on the preferred system, and the subscriber unit is programmed for A/B scan (another NAM flag), the receiver will then scan the 21 control channels of the non-preferred system searching for paging channels, again capturing the strongest one received.

Once a valid paging channel is received (signifying that the subscriber is within the coverage area of a cellular system) the "No Service" indicator on the subscriber unit's display will be extinguished. The subscriber unit then decodes and stores the information from the overhead message that was described earlier into its RAM memory.

Where am I?

The first task for which the information from the overhead message is used is the determination of whether or not the subscriber unit has acquired its home system: in other words "Where am I"? The procedure used for this determination is also shown in Figure 1.

If the SID recovered from the overhead message and the SID in the subscriber unit's NAM match, then the subscriber unit has acquired the home system, and the procedure is complete. However, if the SIDs do not match and the roam inhibit flag is not activated, the ROAM indicator is illuminated, indicating another system has been captured.

The final digit of the NAM's SID and the overhead message SID are then compared. If both final digits are odd, or if both are even, the system acquired is of the same band as the home system, and no further action is required. However, if this is not the case, the system acquired is not on the same

band as the home system, and the ROAM indicator is made to blink, indicating to the user that they are on the non-preferred system.

Mobile idle

Once the system identification procedure is completed, the subscriber unit enters the mobile idle state. In this condition, which is similar to that of a land phone which is connected to an active line but is on-hook, the cellular subscriber unit is ready to place and receive calls. It will continue to monitor the paging channel for additional overhead messages.

If the signal strength weakens below a specific level, the system acquisition procedure is repeated, and the subscriber unit scans again to acquire another suitable paging channel. This is a totally transparent process that will continue as long as the subscriber unit is receiving power.

The user will only be aware of this process if their phone has a provision for an "alert on change of status". If such is the case, the phone will alert the user if it acquires a different cellular system or enters an area where no cellular service is available.

Call handling

Call handling procedures require that several digital data messages be exchanged using the control or voice channels. The various call handling procedures include:

- Registration
- Call initiation
- Call reception
- Call hand-off

Since there is not the sharp demarcation between the call processing and call supervision portions of call handling in the cellular system as there is in the land telephone system, the examination of the call handling, which will be discussed in the next installment, will be done on a procedure-related basis.

Vocabulary

AMPS: Advanced mobile phone system.

Control filler messages: Data sent to ensure that the stream of data transmitted is continuous.

DCC: Digital color code. A code used to distinguish a particular cell from another nearby cell that uses the same frequency.

FCC: Forward control channel.

Initialization: The procedure that a cellular telephone system goes through to configure itself internally for proper operation.

IPCH: Initial paging channel.

LCU: Logic control unit.

MIN: Mobile identification number. The subscriber's telephone number; stored in the NAM.

Mobile idle: A state in which a mobile unit has been connected to the local cellular system, but is not in the process of making a call.

Mobile station control messages: Data that the local system sends for a specific subscriber unit, such as paging for a land mobile call.

NAM: Number address module.

Overhead messages: General data regarding the local system that are broadcast to all subscriber units.

PS: Preferred system. Data in the subscriber's telephone unit that identifies the band of its home system.

Roam: A feature of the cellular system that allows a subscriber to make a telephone call while connected to a cellular system other than his home system.

SID: System identification. Data in the NAM that identifies the subscriber's home system.

System Acquisition: The action of establishing a connection between a subscriber unit and the cellular system in which the unit is located at the time.

Computer monitor servicing

By Stan Warner

Just look around you; there are computers everywhere. In the schools, offices, airports, factories, hospitals, stores, homes. According to the Electronics Industries Association (EIA) the computer and computer peripheral market in 1990 was $56.2 billion. The personal computer has become a standard piece of equipment in the work place and is making deep penetration into the home market. According to the EIA, thirty percent of the 93.1 million homes in the United States have a personal computer.

Computers have monitors

Computers all have one thing in common: a monitor (mainframe and minicomputer systems may have hundreds). And these monitors have something in common as well; they are all prone to fail, just like any other electronic device. Because of this, the opportunities in computer monitor servicing are good.

Monitor testing is made easier if you have a tester that can generate the same signals the monitor receives when it is hooked up to the computer. With these signals fed to the computer monitor, you can recreate the symptom reported by the user. You can also do a final alignment and performance test after you've completed the repair.

Separate horizontal and vertical sync outputs and a composite sync output are desirable. Other desirable test signals are separate red, green, blue and "intensity" video outputs (some digital computer monitors have four inputs: red, green, blue and intensity). Some computer monitors receive composite sync on one of the video lines (most generally green video) so you need the capability to add composite sync to video when you are servicing these types of monitors.

Most computer monitors on the market today don't operate on the NTSC television standard horizontal scan frequency of 15.734 kHz and vertical scan frequency of 59.94 Hz. Most monitors don't have 525 horizontal scan lines as on a TV either. Because of this fact, you need to be able to generate the horizontal and vertical scanning frequencies and horizontal and vertical pixel rates to match the input requirements of the monitor you're servicing. (See Figure 1).

Rapid evolution marks the computer market

There is a tremendous evolution in the computer monitor market. New computer monitor standards are introduced every couple of years. With each new standard the scanning frequencies are faster than the previous standard so that the monitor can produce crisper, higher resolution images. Your test equipment and procedures should be able to keep pace.

The bandwidth of a computer monitor increases with the increase in horizontal scan frequency and the increase in the number of displayed pixels. Increased bandwidth increases the computer monitor's ability to show fine detail. While televisions have a maximum video bandwidth of 4.2MHz, the popular video graphics array (VGA) monitors have a bandwidth of over 25MHz. Computer monitors with even higher bandwidths are starting to appear in the mainstream computer monitor market and will probably replace the VGA standard in three or four years.

In order to determine if a computer monitor has the ability to produce clear, high resolution images, you need to be able to generate video sig-

Warner is the application engineer in charge of new product marketing for Sencore.

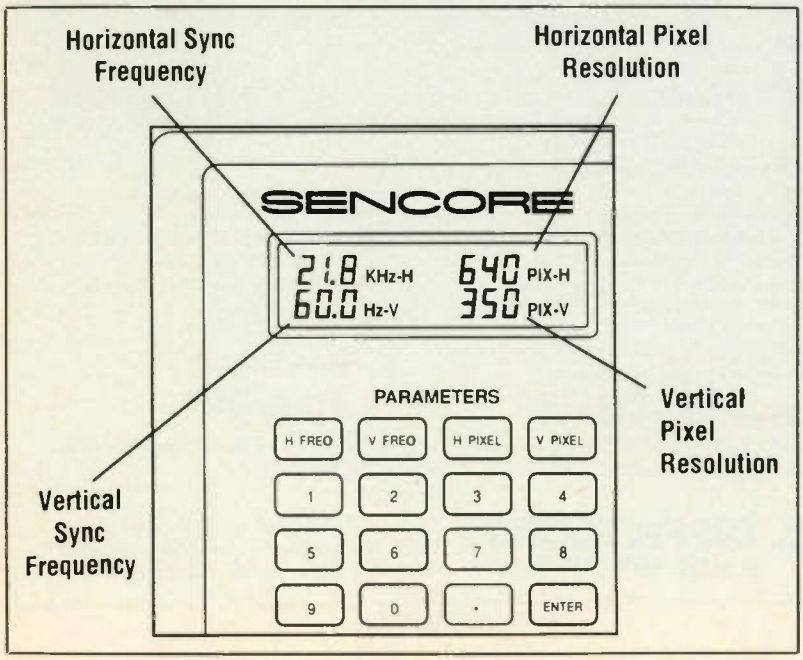

Figure 1. Programmable sync and pixels lets you service the computer monitors on the market today as well as new formats introduced in the future.

Figure 2. A computer monitor tester needs to generate signals for color and monochrome, digital and analog, and interlace and non-interlaced monitors.

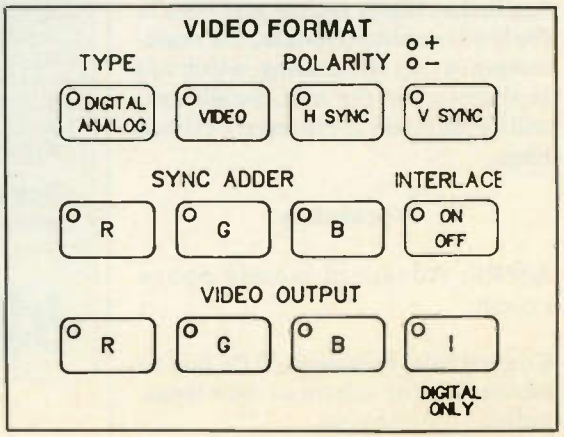

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Figure 3. The raster pattern tests color purity.

Figure 4. The dots pattern tests convergence.

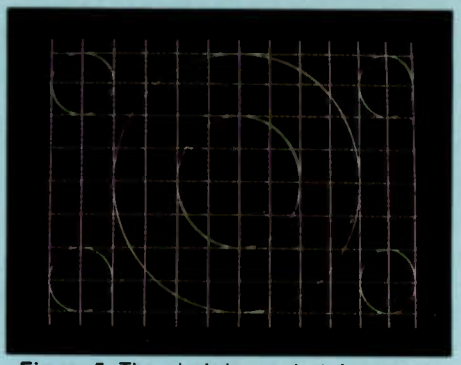


Figure 5. The circle/cross hatch pattern tests linearity and convergence.

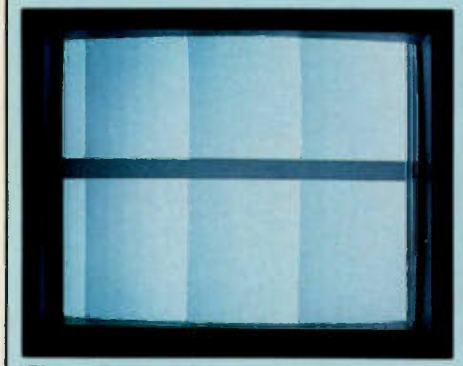


Figure 7. The staircase pattern tests contrast linearity.

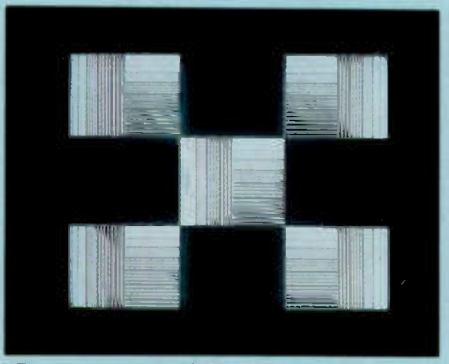


Figure 8. The multiburst pattern tests resolution and bandwidth.

Figure 9. The text pattern makes a final performance test on the computer monitor.

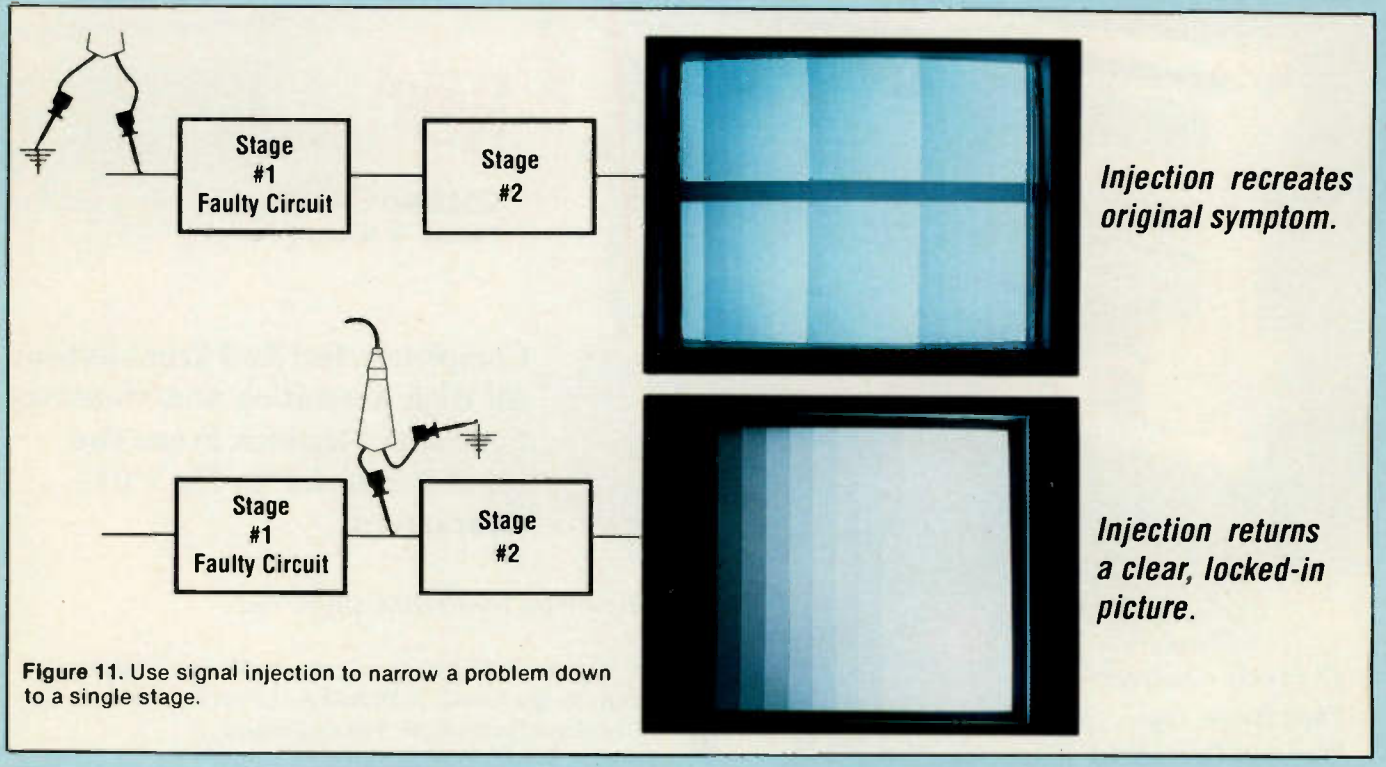


Figure 11. Use signal injection to narrow a problem down to a single stage.

nals that equal or exceed its bandwidth specification. When you are performance testing and making final alignments, you'll have the full assurance the monitor you've repaired is capable of producing clear, crisp images for all of the user's word processing and graphics applications.

Digital and analog monitors

There are two common types of computer monitors: digital and analog. Monochrome digital computer monitors display one or two shades of green or amber. Color digital computer monitors have red, green, blue and intensity input lines. They can display 8, 16, or 64 colors through combina-

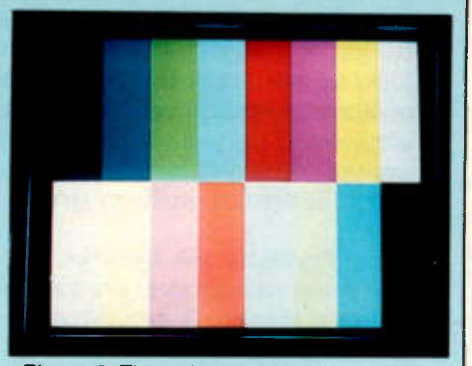


Figure 6. The color bars pattern tests for proper color and uniform color intensity.

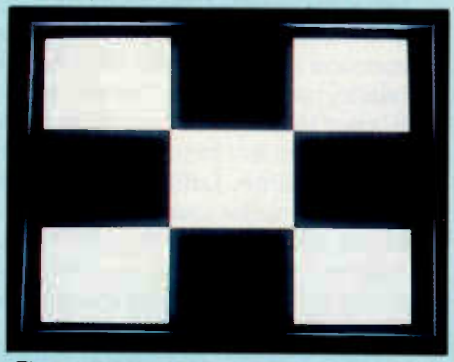


Figure 10. The windows pattern tests power supply regulation and brightness levels.

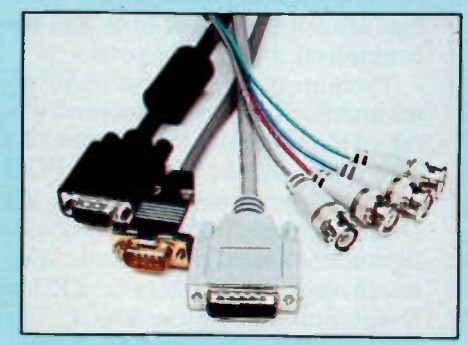


Figure 12. Computer monitors use a variety of different hook-up adapters.

tions of logic "1"'s and "0"'s.

Analog computer monitors can display an infinite number of colors and shades of gray. The video signal fed to an analog computer monitor is 0.7V to 1V. Typically the horizontal and vertical sync pulses sent to an analog computer monitor are at digital levels. Most analog computer monitors require a non- interlaced signal but recently a few models have come onto the market that require an interlaced signal.

For successful computer monitor servicing you should be able to generate the signals for monochrome and color, digital and analog and non-interlaced and interlaced computer monitors. (See Figure 2.)

The patterns displayed on the CRT can provide a wealth of information about what's going on inside the monitor you're servicing. For complete computer monitor servicing and performance testing you should be able to generate patterns for testing purity, convergence, linearity, color, gray scale tracking, resolution and high voltage regulation.

Video Patterns

These problems can be tested with the following video patterns:

Raster - Use the raster pattern to check color purity. The raster should be pure white with no color hue when the red, green and blue guns are turned on. (See Figure 3.)

Dots - Use the dots pattern for checking static and dynamic convergence. Check for white dots with no visible color. A misconverged CRT will show colored dots, instead of white dots. (See Figure 4.)

Circle/Cross Hatch - Use the circle and cross hatch pattern for checking a monitor's linearity, and dynamic convergence. Check that each line is straight and that each box is square and the same size throughout the raster. Also check that each circle is round with no visible distortion. If the CRT is converged properly, the lines will each be a single, white line instead of two or three colored lines. (See Figure 5.)

Color Bars - Use the color bars pattern to test the monitor's ability to produce proper color. Check that each color bar is present. A missing bar, or wrong color sequence, may indicate that a video channel is connected incorrectly or is defective. Also check that the colors are uniform in intensity from top to bottom and left to right. Non-uniform bars may indicate problems in the video amplifiers. (See Figure 6.)

Staircase - Use the staircase pattern for testing the brightness and contrast linearity of analog computer monitors. A properly working and adjusted analog monitor will display 16 evenly spaced bars ranging from black to 100% white. Each step should have a sharp and distinct transition. The bars should be pure shades of gray with no hint of color. If there is a hint of color one of the video guns may be driven on too hard. (See Figure 7.)

Multiburst - Use the multiburst pattern to test a monitor's resolution and bandwidth. The sets of vertical lines test horizontal pixel resolution and the sets of horizontal lines test vertical pixel resolution. The highest resolution lines (1 pixel wide) should be individually discernible on a properly operating monitor. (See Figure 8.)

Text - Use the text pattern to make a final performance test on the monitor. This pattern fills the screen with upper and lower case text characters that create user conditions. All the characters on the screen should be focused and easy to read. (See Figure 9.)

Windows - Use the windows pattern to test the monitor's power supply regulation. Check for clear, distinct transitions between the black (minimum beam current) and white (maximum beam current) portions. All the white boxes should be the same brightness level and the entire screen should be free of ripple. (See Figure 10.)

Computer monitor problem symptoms

Generally computer monitors will come into your service center with the same problems as TVs: poor video response, collapsed vertical raster, failed power supplies, blown outputs, loss of vertical or horizontal sync, or no high voltage.

Signal substitution can help you quickly isolate the faulty circuit stage. Signal injection helps you narrow the problem down to a signal stage by injecting a known good signal into the input of a functional block and monitoring the output. If the output is OK (a clear,locked-in picture on the display), you can be confident all the circuits between the injection point and the output are good. (See Figure 11.)

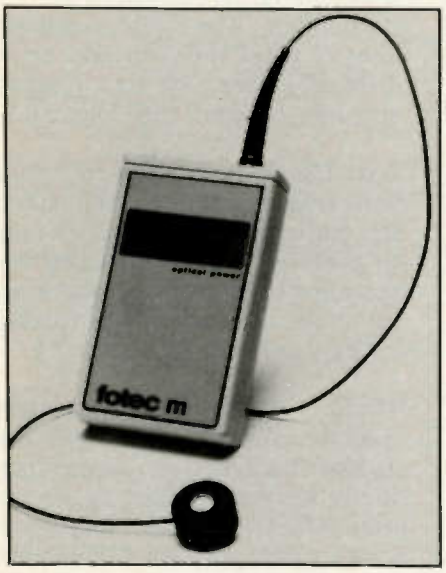
For example, you're servicing a computer monitor that has vertical roll. If you inject a vertical sync pulse

nine widths ranging from 0.022" to 0.210" with unfluxed or rosin fluxed arrangements, and are engineered to meet Mil-F-14256 E type "R" requirements.

Circle (48) on Reply Card

Optical power meter

Fotec's M247 is a special optical power meter designed to test the laser diode source used in erasable optical disk drives or laser printers. The tester was specifically designed for factory testing or field service of such



equipment. The unit uses a separate 5mm diameter silicon photodiode calibrated to measure optical power at wavelengths in the range of 780-850 nm with a power range of up to 20.00mW. Its large area photodiode can be customized for correct placement directly over the optical source to minimize measurement errors. Measurements are shown on a large 0.7 inch (18mm) LCD display.

Circle (49) on Reply Card

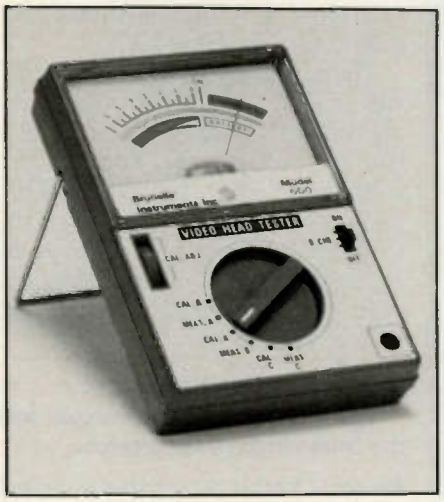
DMM test lead kit

ITT Pomona announces a DMM test lead kit that provides all of the test tips, clips, handles and leads to meet most professional testing requirements. Model 5677 "Maxi-Kit" includes two 48-inch silicone-insulated DMM lead sets, one with permanently fixed extendible "Slip-Tip" probes, the other terminated at "Pop-Jack" connectors.

Circle (50) on Reply Card

Video head tester

The newest addition to the *Brunelle Instruments* line of test instruments is the model 600 video head tester. The model 600 video tester is an analog tester used for determining the amount of wear and condition of



a video head. The model 600 is available for testing either Beta or VHS type of heads. The model 600 is lightweight, portable, battery operated, and has three ranges of measurement to cover all types of VCR heads.

Circle (51) on Reply Card

Integrated circuits library now available

D.A.T.A. Business Publishing has released its 1991 edition of D.A.T.A. Digests Integrated Circuit Library. D.A.T.A. provides information for component engineers, repair and maintenance technicians, and pur-

(Continued on page 44)

into the input of the vertical oscillator (at the same scan frequency as the computer monitor) and the picture locks up, you know that the vertical oscillator, vertical drivers and outputs are good. If the picture doesn't lock up, you know you need to troubleshoot the vertical oscillator circuit.

Problems with flybacks

Flyback transformers are a major source of monitor failure. According to Don Doerr of the National Advancement Corporation, "Lately, there seems to be an increasing number of failing VGA monitors. In fact, in the case of the IBM 8513, larger users are reporting more than a 50% fatality rate within the first two years. It's not just IBM having these problems. There has been an epidemic of VGA monitors failing nation-wide. One of the major sources of these problems has been bad flyback transformers."(see **ES&T**, June 1991, Servicing problems in IBM PS/2 monitors).

High voltage, horizontal output and power supply problems are probably the most time consuming and difficult to troubleshoot because in many cases the computer monitor is in shutdown. A quick way to test yokes and flybacks is to ring them. If the yoke or flyback rings (or resonates) the windings are not shorted or open and the component is probably good.

There are quite a number of different monitor input connectors and wiring configurations. (See Figure 12.) The CGA, EGA, MDA and PGC monitor types generally have a 9 pin D-subminiature. But their wiring configurations are different. Some Macintosh computer monitors use a 15 pin D-sub and others use BNCs. The VGA, SVGA, PS/2 and XGA computer monitors use the 15 pin high-density D-Sub. As a servicer you will either need to research the pinouts and wire up special connectors or the firm that supplies your computer monitor tester will also supply connectors for the most popular computer monitor types.

Other test equipment

Other test equipment you will need for monitor servicing are a dual trace oscilloscope, frequency counter, digital voltmeter, dc power supply, ac leakage tester, variable ac isolation transformer, high voltage probe, transistor tester and capacitor/coil tester. ■

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SIGNAL CIRCUIT SCHEMATIC (ANALOG COMB)

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

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

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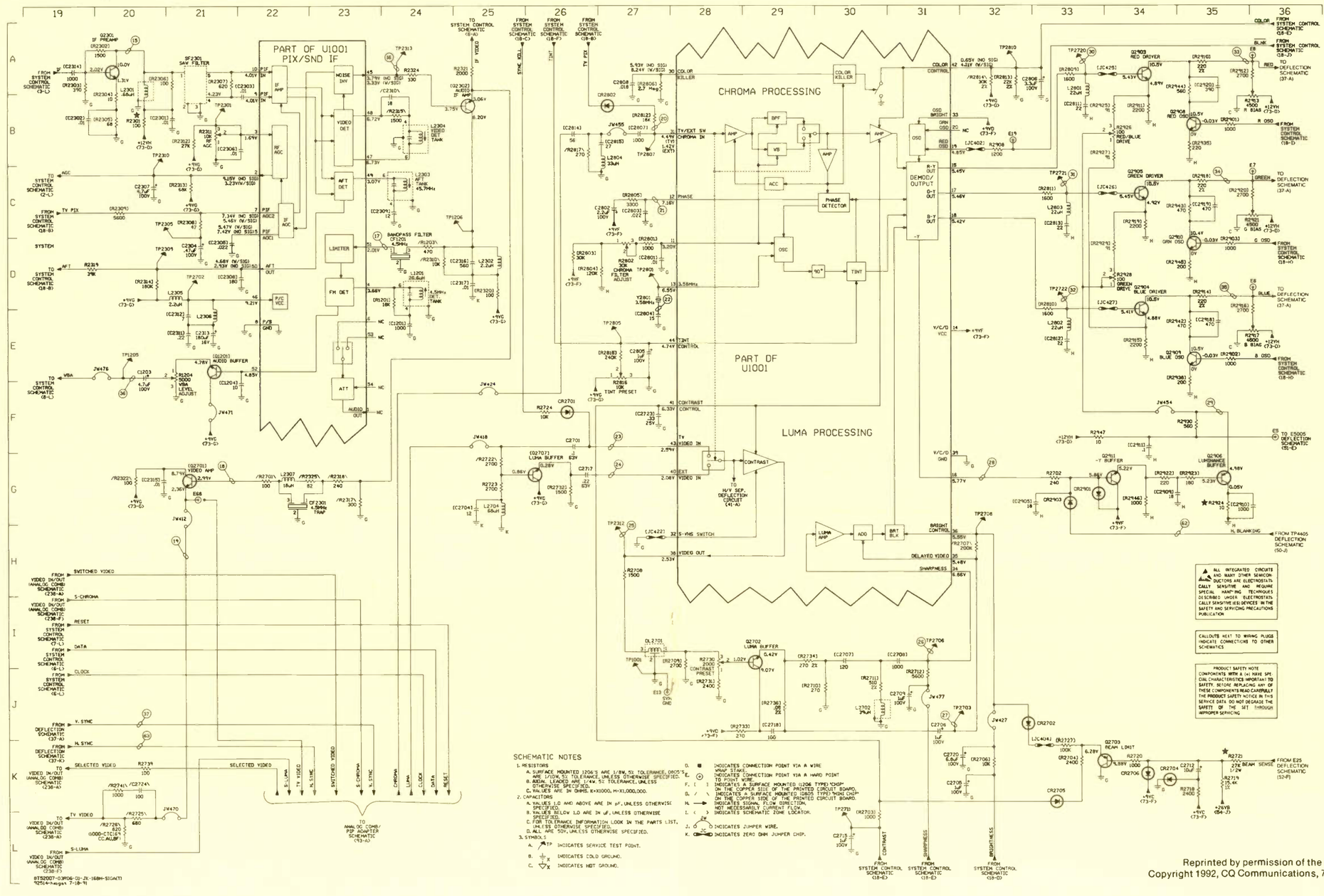

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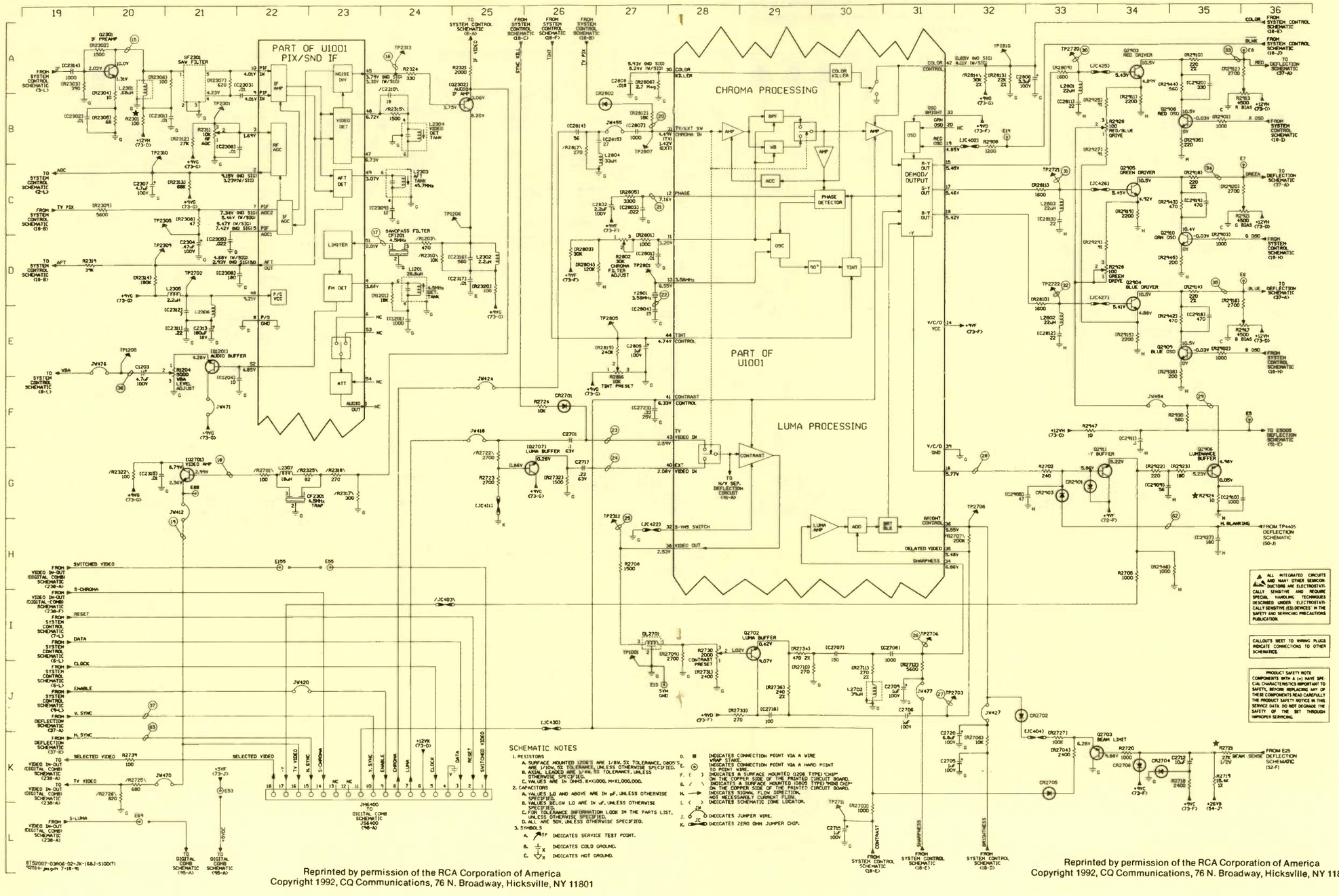

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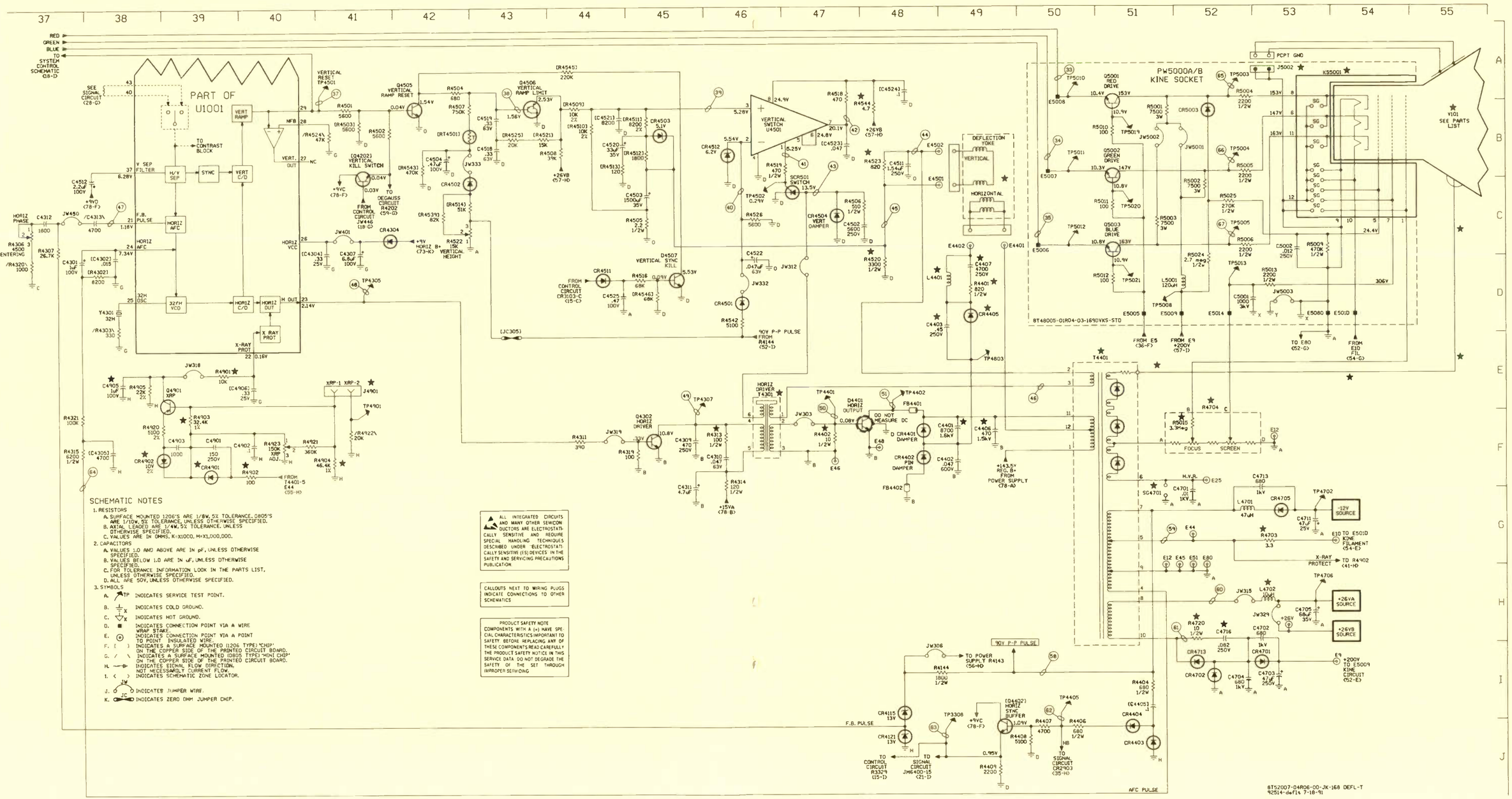

SCHEMATIC NOTES

1. RESISTORS
   - A. SURFACE MOUNTED 1206'S ARE 1/8W, 5% TOLERANCE, 0805'S ARE 1/10W, 5% TOLERANCE, UNLESS OTHERWISE SPECIFIED.
   - B. AXIAL LEADED ARE 1/4W, 5% TOLERANCE, UNLESS OTHERWISE SPECIFIED.
   - C. VALUES ARE IN OHMS, K=X1000, M=X1,000,000.
2. CAPACITORS
   - A. VALUES 1.0 AND ABOVE ARE IN pF, UNLESS OTHERWISE SPECIFIED.
   - B. VALUES BELOW 1.0 ARE IN uF, UNLESS OTHERWISE SPECIFIED.
   - C. FOR TOLERANCE INFORMATION LOOK IN THE PARTS LIST, UNLESS OTHERWISE SPECIFIED.
   - D. ALL ARE 50V, UNLESS OTHERWISE SPECIFIED.
3. SYMBOLS
   - A. TP — INDICATES SERVICE TEST POINT.
   - B. INDICATES COLD GROUND.
   - C. INDICATES HOT GROUND.
   - D. INDICATES CONNECTION POINT VIA A WIRE WRAP STAKE.
   - E. INDICATES CONNECTION POINT VIA A POINT TO POINT INSULATED WIRE.
   - F. INDICATES A SURFACE MOUNTED (1206 TYPE) "CHIP" ON THE COPPER SIDE OF THE PRINTED CIRCUIT BOARD.
   - G. INDICATES A SURFACE MOUNTED (0805 TYPE) "MINI CHIP" ON THE COPPER SIDE OF THE PRINTED CIRCUIT BOARD.
   - H. INDICATES SIGNAL FLOW DIRECTION, NOT NECESSARILY CURRENT FLOW.
   - I. INDICATES SCHEMATIC ZONE LOCATOR.
   - J. INDICATES JUMPER WIRE.
   - K. INDICATES ZERO OHM JUMPER CHIP.

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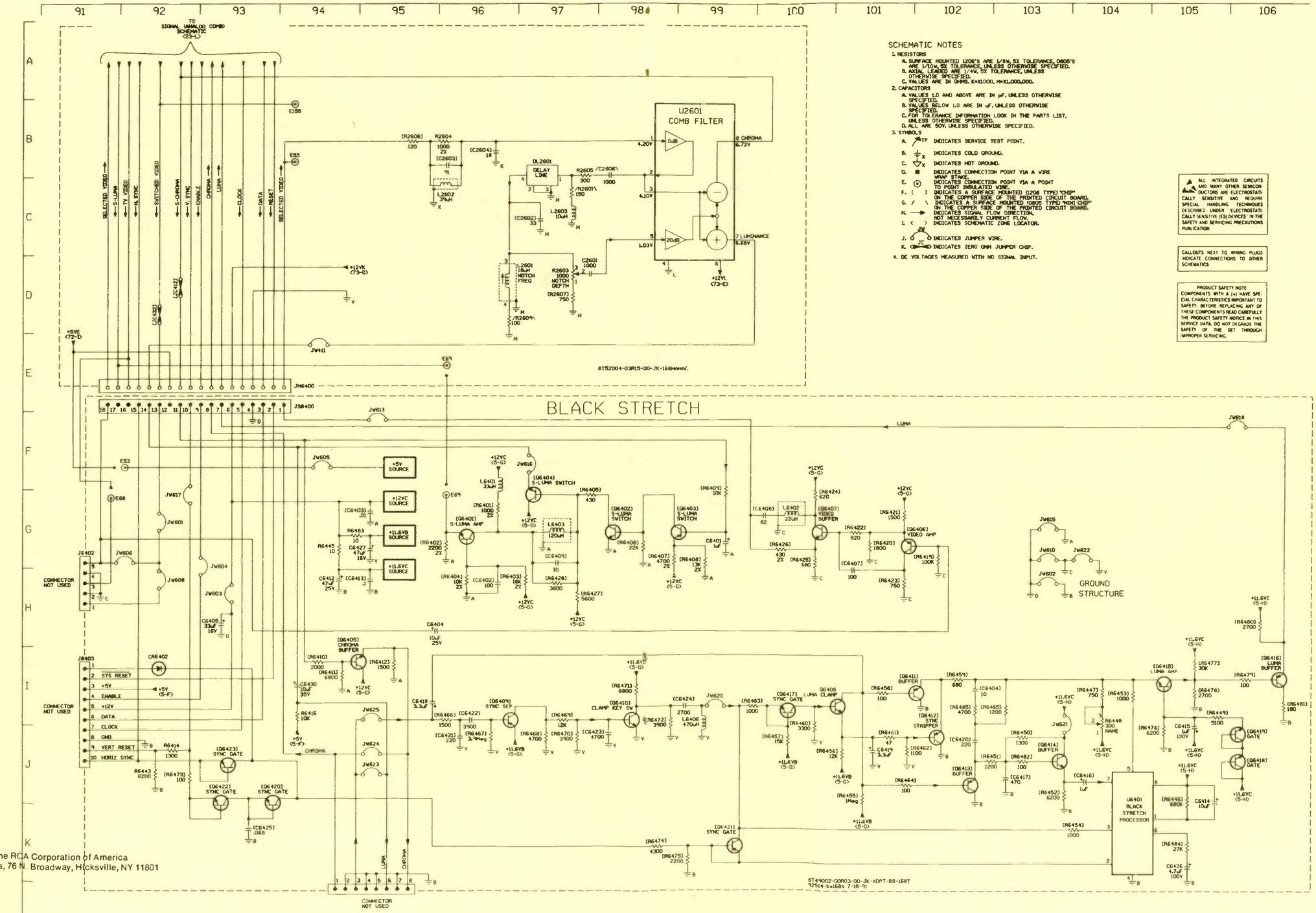


Que's Guide to Data Recovery, By Scott Mueller, Macmillan Computer Publishing, 498 pages. $29.95.

This do-it-yourself manual teaches PC users of all experience levels how to gain complete control of their personal computer. Que's Guide to Data Recovery teaches them to create vital backups, manage files, and avoid data disasters.

This book offers hundreds of performance tips to protect PC systems. Each chapter of the book provides full explanations and examples of the computer's internal components, its advantages, and its problems. The book is designed so that users can eventually rely on their "feel" for what's going on in their system.

Also covering more advanced areas of DOS this guide helps users look at a disk just as DOS does. In a short time, users can identify and iron out disk problems and implement the solution. It covers all IBM PCs and compatibles and teaches users how to avoid disastrous viral infections, prevent software breakdowns, and solve complicated hardware crashes. Users also learn how to designate hard disk parameter tables for efficient use, respond quickly and correctly to DOS error messages, assemble a protective utility library, scan and map software disks for defects and bugs, and handle damaged directories and FATs.

Macmillan Computer Publishing 11711 N. College Ave., Suite 140 Carmel, IN 46032.

Waite Group's MS-DOS Bible, By Steven Simrin, 718 pages, Macmillan Computer Publishing,$29.95.

Intermediate and advanced PC users find expert support from this fourth edition, published by Sams. Complete with DOS 5 coverage, this book is packed with easy tutorials, hands-on examples, and loads of valuable reference pages. The books starts with a quick introduction to DOS 5, where information jump tables quickly take users to commands, procedures, or topics of choice, moves on to familiarizing users with terminology and providing them with hands-on advice. They learn to implement expert file management techniques, to create batch files, and how to modify the MS-DOS system. The book also gives users guidance about automating software and systems with batch files and macros, as well as completing advanced text editing with the DOS Editor.

Macmillan Computer Publishing 11711 N. College Ave., Suite 140, Carmel IN 46032.

Home VCR Repair Illustrated, By Richard C. Wilkins, and Cheryl A. Hubbard, TAB Books, $19.95.

About 80% of all VCR problems are caused by one component that is worn out, loose, bent or dirty - and easily found and repaired. This book provides photos that help illustrate how to find and correct many of the most common VCR malfunctions, such as jammed videocassettes, clogged video heads, blown fuses, and water damage. Readers will also learn trade secrets for repairing problems with: picture and sound quality, fast forward and rewind, dc motors, tension and roller guides, undercarriages, take-up spindles, audio heads and much more. Included is a glossary that defines specialized VCR terminology.

TAB Books, Blue Ridge Summit, PA 17294.

The Electronics Workbench by Delton T. Horn; TAB Books; 264 pages, $18.95.

With such a wide variety of electronic test devices available, deciding which instruments to buy is often the most difficult part of setting up an efficient, well-stocked workbench. Many technicians and hobbyists end up overspending or burdening themselves with a lot of unnecessary equipment, simply because they didn't understand the specifications and features of the products they purchased. Horn provides a complete overview of things to know to design a permanent or portable workbench that best suits their specific needs. Horn examines each major category of test equipment: multimeters, frequency counters, signal injectors and tracers, digital test equipment, oscilloscopes, LCR bridges and capacitance meters, signal generators, semiconductor testers and more. Throughout, Horn includes detailed explanations of the characteristics and capabilities of the various models.

TAB Books, Blue Ridge Summit, PA 17294

Digital Systems Reference Book, By B. Holdsworth and G.R. Martin; Butterworth Heinemann Books, 1,224 pages, $250.00.

Butterworth-Heinemann announces the publication of a comprehensive new reference book offering complete coverage of modern digital electronics. The basic orientation is toward hardware, but coverage includes everything from basic theory to applications. This reference, a companion to the successful Electronic Engineer's Reference Book, currently in its 6th edition, promises to become the bible for the digital field. Over 50 contributors from around the world have lent their expertise to provide authoritative yet concise coverage of the field.

Presented in five sections, the book provides a thorough treatment of fundamentals, devices for digital systems and techniques (software and hardware), system development, and applications.

Butterworth Heinemann Books, 80 Montvale Avenue, Stoneham, MA 02180.

PC diagnostics: One technicians view

By Eric Nay

A bewildering assortment of diagnostics have appeared on the market, and there are a few things you'll need to know to decide what is valuable and what is a paperweight.

The PC sales market is about a $50 billion a year market, with 13.5 million new 386 and 486 machines being sold each year. This adds to the existing base of 43 million PCs. Service and maintenance on those machines is roughly equal to 1/4th of the total market.

The diagnostics on the market fall into roughly three categories, with several subdivisions among them. The major categories are disk-based diagnostics, passive hardware testers, and active hardware testers.

Disk-based diagnostics

These are the most popular form of diagnostic, with the broadest range of capabilities and prices. Price is usually not an indicator of features or abilities. A disk-based diagnostic's primary job is not to help you identify a system board problem, but to help diagnose peripheral devices such as memory, serial, ports, or hard disks.

Some of the most popular sellers of these products include Check-It by Touchstone, PC-Technician by Windsor, QA Plus by Diagsoft, QuickTech by Ultra-X, and AMI-Diag by AMI. They range in price from Check-It's low of about $69 to PC-Technician's $599.

As far as usability, all these diagnostic programs require 80 to 90% of the system to be functional. The system's CPU must be good, there must be a clock signal on the bus, the first 128k of base RAM must be good (or more; one of these products needs 384k of RAM), the floppy drive and controller must be good, and the video card and monitor must be good. If all these parts are functional then troubleshooting is already more than half over.

The strongest point for most of these disk-based diagnostics is in hard and floppy drive testing, and in RAM testing above 256k. The low-end products use DOS to perform their writes to disk. This means you can use DOS to copy a file to a hard disk and get just as useful a test without buying one of these products. The best products such as PC-Technician and QuickTech use their own routines for accessing the hard and floppy drives, and so are much more accurate.

When the system is dead, where it cannot give you an error code on the screen or run one of these diagnostics, then you need to look at one of the hardware-based diagnostic products.

Passive hardware testers

Passive hardware testers , more often referred to as POST cards, rely upon the power on self test (POST) routines built into the basic input output system read-only memory chip (BIOS ROM) on the main logic board. Since they only monitor tests performed by another device they are at the mercy of the author of the BIOS.

Popular sellers of POST cards include the Award POSTcard, the Landmark KickStart, and the Ultra-X QuickPOST. All range in price from about $49 to $549.

The BIOS was written with the goal of making sure the system is in working order before allowing the operating system to take over. If a failure is detected, the BIOS doesn't really care about what went wrong, just that something did fail and the machine should not operate. That is why so often when something simple is wrong the machine will lock up.

The authors of the most popular BIOS (IBM, Compaq, AMI, Phoenix, Award, QuadTel) made one important concession to technicians, however. They all wrote their tests so that you can monitor the test status on an I/O port (usually port number 80). If you monitor this port with a POST card you'll get a 2 digit hex number telling you which test was running when an error was detected. IBM went one step further and made these codes available on the parallel port connector on all PS/2 machines.

As an example, if you had a code OA on an otherwise dead PS/2 system model 70, it would indicate that the POST routines had a problem refreshing RAM in lower memory. Now you would have to figure out whether you had a bad RAM chip on the SIMM card, a bent pin on the SIMM socket, or a bad DMA controller (which provides the refresh signal). An extra note: DTK BIOS doesn't support this feature, so these cards won't work with DTK BIOS.

As you can imagine, this is better than no information but still requires a lot of work to actually fix the problem. To pinpoint what is failing in an otherwise dead system, you need to roll out the big guns: the active hardware testers.

Recently, the BIOS ROM manufacturers have included a much more sophisticated testing sequence than in the past. If, as an example, you lost one of your DMA chips you used to have a dead machine. Quite often now you'll get a series of beeps (3, then 1, then 2 beeps on a Phoenix BIOS) that, when decoded, will tell you the same kind of information as the POST cards.

One note about the KickStart II board: It tries to straddle the low-end disk based diagnostic and passive

Nay is a Senior Instructor with National Advancement Corporation. He has worked on PC systems as a bench technician, a field service engineer, an application programmer, and a network consultant since 1978.

hardware diagnostic worlds by combining features. You normally monitor POST, but if you want a low-end disk based diagnostic it is available in a ROM on the Kickstart II card. It still requires everything that a low-end disk-based diagnostic needs to be working except the floppy drive and controller.

Active hardware testers

These are the most powerful tools a technician would use when working on a motherboard in the field. They range from a low of $300 for Windsor's XT ROM (plus $400 for 286/AT ROM) through $579 for Ultra-X's R.A.C.E.R. board (XT to 486s) to several thousand dollars for a Vista V-ATE or Fluke 9010.

Active hardware testers override the built-in POST tests to run their own tests on the system. Windsor and Ultra-X do this by replacing the BIOS ROM with their own ROMS, and Ultra-X adds their own card to the bus to monitor the test routines and display voltage levels. Ultra-X's R.A.C.E.R. card also allows them to support 386 and 486 machines. By hijacking the CPU to run their own tests, these products can test a DMA chip, for example, and report to the screen that a DMA chip failed. These testers need relatively little of the system to be operational: they need a good CPU chip, a +5V supply, a clock signal, and the buffer chips on the bus to be good. If these cards don't run then your troubleshooting list is fairly short.

More often, the Windsor or Ultra-X product work, and they'll tell you exactly what's wrong. For example, if your problem has to do with memory, these devices will tell you which chip has failed. This is true even if the problem is a RAM chip is in Bank 0.

If you want to know more specifically about why something is failing in a dead system, the Vista Microsystems V-ATE and Fluke 9010 could be worthwhile. They each have their own processor to observe the status of the unit under test (UUT). The Fluke plugs into the CPU socket in the motherboard, while the V-ATE monitors the system from a standard AT bus connector. Both units however, require a fairly well-educated (EE bachelors degree) technician to use them fully. The Fluke should cost $1000 to $20,000 depending on optional CPU pods (one for each kind of CPU chip), while the V-ATE should cost $1000 to $2000 (plus another PC to monitor the results).

Caveat emptor

With budgets being slashed right and left you've got to be more careful than ever with you diagnostic dollars. What's more, check with the company trying to sell you these products; what their return policy is and whether demo or loaner products are available. At least one of the companies mentioned in this article will not return money once they've made the sale.

Source Listing of
Mentioned Companies:

Fluke Nationwide sales offices, call directory assistance in you area
Diagsoft (408) 438-8247
Touchstone/Landmark (813) 443-1331
Ultra-X (408) 988-4721
Vista Microsystems (508) 695-8459
Windsor Technologies (415) 456-2200

DAT: Digital audio tape is near

By John Shepler

DAT stands for digital audio tape, a new technology that complements the compact disk.

DAT is a cartridge that is recorded and played in a machine that looks a lot like a conventional audio cassette recorder. However, looks are deceiving. DAT is really more like video recording; The head rotates. It is this rotating head that provides the bandwidth for digital recordings.

In fact, an earlier system actually used standard video recorders with outboard PCM (pulse code modulation) converters to digitize the audio and reconvert it upon playback.

What does DAT do for the consumer? It provides a record/playback system that rivals the frequency response, low distortion, wide stereo separation, and low noise floor of CD players.

Where are all the DAT recorders? They are currently found in the professional sound recording and broadcast markets. The technology is well proven. What prevents them from flooding the consumer market is the relatively high cost of around $1,200 and fierce opposition from the recording artists.

The opposition comes because DAT is capable of copying digitally. A DAT system can copy a compact disk directly from the digital coded information. One DAT tape can be dubbed to another digitally. Since the information is digital, the copy will be identical to the original. With analog recording schemes, there is always some noise and distortion added every time a tape is recorded. The artists see the perfect digital copies as a potential loss of royalty income from sales of CD, cassette, or DAT original recordings.

With artists and producers threatening to sue the equipment manufacturers, consumer DAT has been on hold until a copy protection scheme could be worked out. Such a scheme is now available and accepted by both artists and manufacturers. It is called SCMS or Serial Copy Management System. A digital code on the master recording tells the recorder that it can make one recording. The consumer DAT deck will not re-create this code while recording, so copies of copies cannot be generated.

In addition to SCMS, the music publishers, writers and artists have managed to get a royalty fee established for the sale of DAT recorders and blank tapes.

As soon as the legal work is completed, you can expect to see DAT recorders on sale and eventually in the service shop. If you understand compact disk and video and analog recorder technology, it shouldn't take too long to come up to speed on this product.

There is competition already brewing for DAT. Philips, originator of the analog cassette nearly 30 years ago, has developed a tape deck that can record and play digital tapes with a non-rotating head. In addition, the digital compact cassette (DCC) system can play today's standard format analog cassettes.

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

DCC recorders will have a dynamic range of 108dB with a frequency response of 5Hz to 22kHz. The sampling frequency can be set at the CD standard of 44.1kHz. DAT also samples at 44.1kHz to make direct digital copies of compact disks. Alternate sampling frequencies are 32kHz and 48kHz and 48kHz, which are used in professional audio equipment and proposed for digital audio broadcasting.

How can DCC get by without a rotating head? The answer is digital compression. Digital compression eliminates sounds that won't be missed by the listener. This can reduce the data rate to the recorder by 4 or even 8 times, making simpler systems possible.

Keep watching for these new developments in audio tape technology. This field is developing rapidly. In fact, it may not be too much longer before someone develops an inexpensive CD recorder/player that will throw yet another wrinkle into the home audio recording market. We'll keep you posted on the technology behind all these developments in future editions of the Audio Corner.

Test your electronics knowledge

The alpha and the omega

By Sam Wilson, CET

In my opinion, it isn't necessary to use the Greek alphabet to identify various parameters in electronics. It is just another way to complicate a subject that already has too many unnecessary complications.

There aren't enough Greek letters for all the stuff that need to be identified, so they have to use the same letters for different parameters. More unnecessary confusion.

O.K. so maybe you don't agree. See how many Greek letters you can come up with in the following quiz.

Wilson is the electronics theory consultant for ES&T.

Example:

$2\pi f\ \omega$_____ (omega)

1. resistivity _____
2. h_{fe} _____
3. phase angle _____
4. magnetic flux _____
5. 2.718281828 _____
6. 3.14159265 _____
7. intrinsic standoff ratio _____
8. wavelength _____
9. magnetic permeability _____
10. common collector parameter _____

(Answers on page 58)

What do you know about electronics?

Resistors continued

By Sam Wilson, CET

The subject of resistors was started in the previous issue. In this issue the subject of resistor noise will be emphasized.

It has been pointed out that a resistor not connected to anything has a noise voltage across it. As a matter of fact *all conductors* of electricity have a noise voltage across them at all temperatures above absolute zero (-273F).

This is an important thing to know. It means that when an antenna is connected to antenna terminals it injects noise into the receiver.

It is important to understand that the only significant noise in a receiver is generated in the first few stages (that includes the antenna). Noise generated in the receiver beyond the tuner is not considered to be significant.

Of interest here is the *Johnson* (or, thermal) noise generated in conductors and semiconductors. It is also called thermal agitation noise. Figure 1 shows how the noise signal is often represented. It consists of a noise voltage generator and a noiseless resistor.

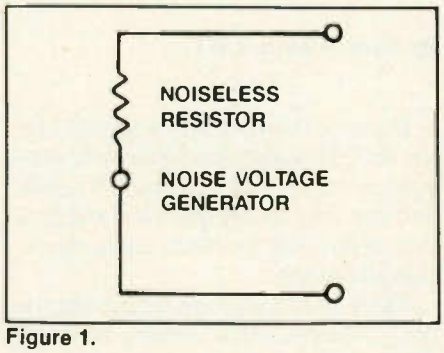


Figure 1.

As this illustration suggests, there is a way of matching the input circuit resistance of an amplifier to the noise resistor to get maximum noise power injected into an amplifier. More important, it is possible to avoid getting maximum noise power into an amplifier by properly designing the amplifier input circuit.

The noise generated by a conductor (or semiconductor) is usually given in two forms:

voltage equation

$$(\text{Noise voltage})^2 = V_n^2 = 4RkTB$$

Power equation

$$\text{Available noise power} = p^n = kTB$$

Equations like these are not used by technicians to use for calculating noise voltage or power. Their importance is in the fact they they show what factors determine the noise.

The factor k is Boltzmann's constant. It will be disregarded in this discussion of resistor noise.

R is the resistance of the resistor or conductor generating the noise. As indicated in the equations, the lower the resistance the lower the noise problem.

The equations show that a system with a wider bandwidth (B) has more noise that one with a narrow bandwidth. Also, the noise increases with an increase in temperature (T).

In many cases nothing can be done about B and T. They are fixed by the requirements of the system and its environment. The input resistance (R) *can* often be reduced to a minimum by proper design.

One thing that will not work is to add an amplifier in an attempt to increase the signal-to-noise ratio. Refer to Figure 2. Assume the incoming signal is from an antenna. The input signal voltage is set by such factors as the transmitter power and distance from the transmitter. As mentioned before, the noise also depends upon the resistance at the input terminals. Those factors set the input signal-to-noise ratio.

The amplifier *adds* noise to the signal. The noise due to the presence of conductors and semiconductors in the amplifier is one of several types of noise added by the amplifier. So, the only method available for reducing the noise is by proper design of the amplifier. However, the output noise will always be greater than the input noise.

The amount of noise generated by a resistor depends upon the type of resistive material. As a general rule, metal-type resistors generate less noise

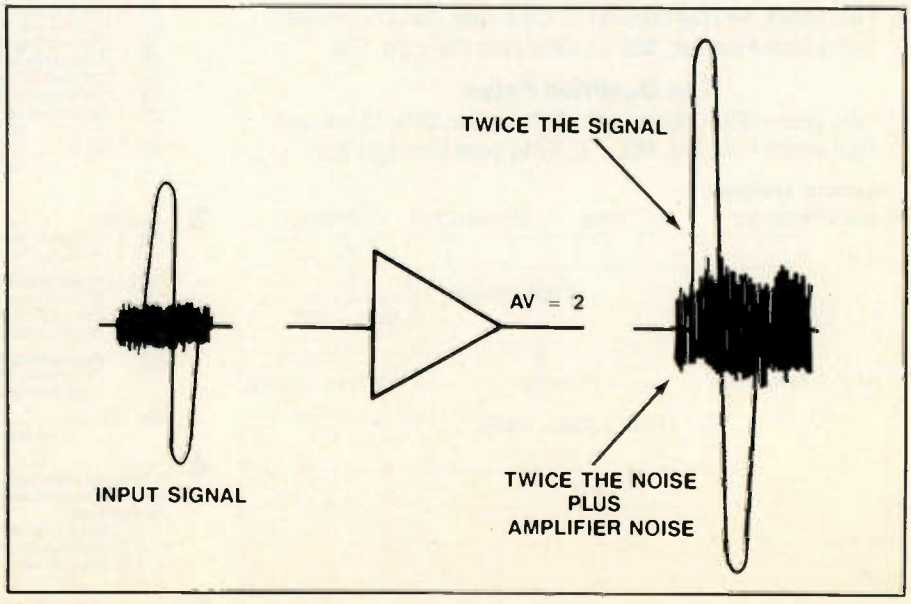


Figure 2.

Wilson is the electronics theory consultant for ES&T.

than carbon composition. Also, film resistors generate less noise than bulk types.

The message here is very plain: If you need to replace a resistor in the front end stages of a receiver, always replace it with the same type.

Wilson's school rules

Occasionally, I get a letter asking what I think about a certain school. That takes a special skill. I have, however, made three important rules for choosing a school. Pass them along to anyone you know who is getting ready for (more) training.

- Never enroll in a school that gives you everything you want.
- Never enroll in a school that has a lot of rules for parking and no rules for passing.
- Never enroll in a school that has a student lounge but no library.

Memories

In every state organization there are special people who make great contributions but get little or no recognition.

Mass storage of data on magnetic tape

A good place to start a discussion of mass storage is with magnetic tape systems. Those systems are used for storing (writing) data and retrieving (reading) data.

Occasionally, magnetic tape systems are used for data storage in small computer systems. However, they find their most extensive use as backup systems for mass storage.

When information is stored in a computer memory it is also stored in these permanent tape backup systems. So, if anything happens to the original stored data the backup system can be used to retrieve the data.

Tape systems range in size from the audio microcassette format to large tape drums that can store 2.3 gigabytes [2,300,000,000 bytes] of information.

One manufacturer makes a tape cassette so small that three of them can fit into a shirt pocket. One of these cassettes holds 1.3 gigabytes of data with 61,000 bits stored per inch of magnetic tape.

So, magnetic tape is definitely one important medium for mass storage.

Bad advice (not taken)

Maybe some well-meaning person has tried to help your troubleshooting technique by giving you some of these items of very bad advice. How many have you heard?

- You can repair most sets by lightly tapping each tube or transistor
- Memorize the picture-tube patterns and you can go directly to the cause of any TV trouble.
- If the trouble is not immediately apparent, replace the power supply with a bench supply. Double the input voltage to the system. That will smoke the defective trouble and make it easy to find.
- Always touch your finger to the transistor electrodes in order to inject a signal and determine the trouble. You can't get hurt if it is a transistor circuit because they all operate at a low voltage.
- Start troubleshooting by replacing components especially capacitors.
- When troubleshooting, disregard the integrated circuits. They never go bad. ■

chasing agents. Specifications, electrical parameters, sources, and substitutes are provided for virtually every standard IC currently produced- over 165,000. Cross reference sections direct a user with limited information to the necessary data for making component selection and replacement choices.

Circle (36) on Reply Card

Digital testers

Protek now stresses a combination of high accuracy performance and significant cost advantages, in its new digital readout 10MHz sweep function generator as well as compact, 0.3% - 0.1% accuracy, digital LCR bridge meter to meet a variety of long-term test needs. The model B-810 sweep genrator features a frequency scan of 0.01Hz to 10MHz in 9

Digital LCR Meter

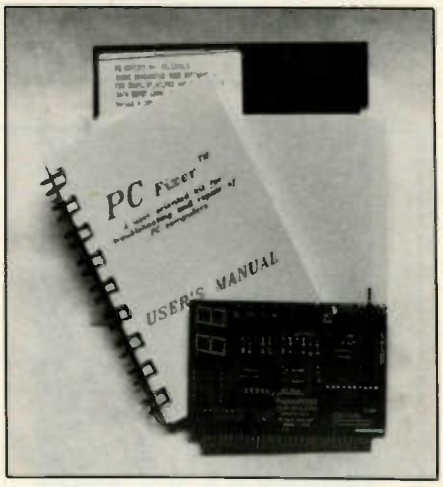
10MHz Sweep Function Generator

ranges. It can generate and trigger functions, and has an overall frequency counter range of 0.1Hz to 10MHz internal, and includes a built-in oscillator that can produce burst waves from 1m Sec. to 10 Sec. The model B-800 digital LCR bridge measures inductance, capacitance, resistance and dissipation factors with a high accuracy 3-1/2 digit display for all parameters, to 1999 (Max).

Circle (37) on Reply Card

Personal computer diagnostic tool

Sibex Inc announces the release of a new product in its line of PC computer equipment, known as the PC Fixer. The PC Fixer is a combination hardware and software tool for diagnosing and repairing PC computers and it is

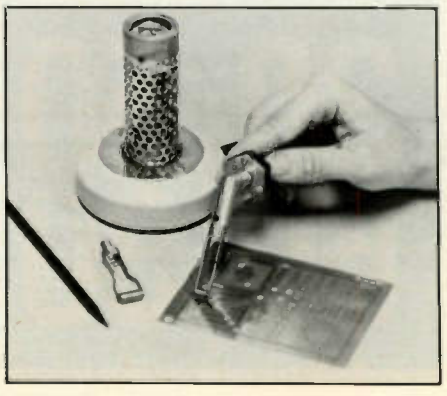


designed for use by computer users as well as service technicians, and provides a fast economical means of diagnosing from simple problems to dead computers. The tool includes a circuit card for testing mother board problems, a diagnostic software program and a detailed, user-friendly manual.

Circle (38) on Reply Card

SMD solder applicator

HMC introduces an ideal, cost effective tool for low volume SMD production and rework where solder paste application using stencils, screen printers, or syringes is impractical. SoldeRoll applies a uniform and controlled layer of solder to fine pitch SMD boards and multileaded components. It can be used for solder leveling or to coat any solder surface

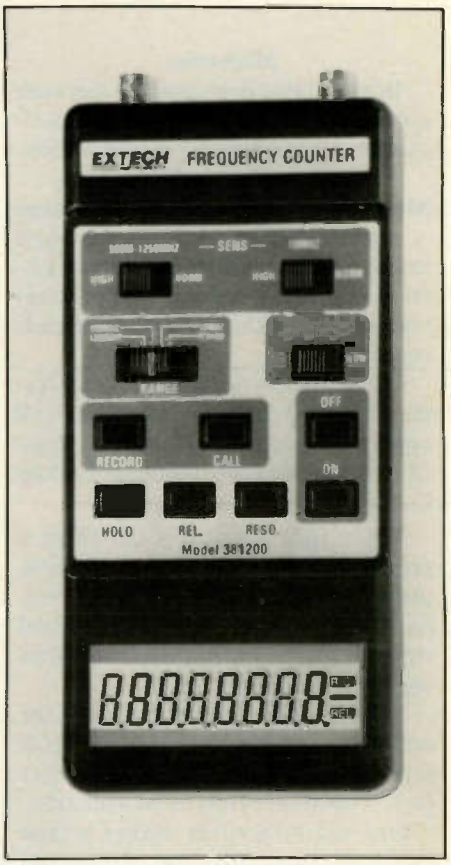


from a single device to an entire prototype board. Solder adheres only to metallic areas on boards or component leads. There is no solder bridging between leads, even at 15 mil spacing. And the tool's small roller head won't disturb adjacent components.

Circle (39) on Reply Card

Handheld frequency counter

Extech now introduces a handheld frequency counter with a built-in microprocessor which measures a wide frequency range from 10Hz to 1.25 GHz with 0.1% resolution plus measures period from 10Hz to 10 MHz. Rugged design with two female BNC input connectors can be used for



field service or benchtop applications. The unit features large 0.5" 8-digit LCD display data hold, fast or slow gate time selector, overload indication, auto power off and built-in stand for benchtop use. Low ppm crystal time base provides accurate measurement to ± ppm ± 1 count. Operates from a standard 9V battery.

Circle (40) on Reply Card

Fluorescent magnifier

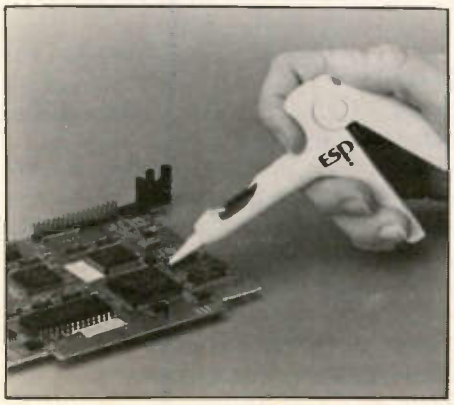
HMC now has the 8MG Series magnifiers which reduce eyestrain and fatigue by combining the two key factors in aiding vision - optically correct magnification and cool, fluorescent lighting. The standard 5" diameter, 3-diopter lens provides 3/4x enlargement of the item being viewed. The

8MG Series magnifier is also available with a 5-diopter (1-1/4x) or 11-diopter (2-3/4x) primary lens. A 13W energy-efficient, compact fluorescent tube, located behind the magnifying lens, casts light at an angle ideal for highlighting object details. This shadow highlighting makes details of uneven surfaces "pop-out" to the viewer.

Circle (41) on Reply Card

Solder kit for surface mount and electronic repair

ESP introduces a compact new Dot Maker kit which contains the tools and materials needed for SMT and electronic solder joint repair. The kit suited for rework stations, repairs or for use by mobile in-plant inspectors, contains a precision hand dispensing tool, assorted solder creams and paste flux in prefilled caplettes which can be snapped quickly in and out of the unit. Dots of solder cream are placed exactly where they are needed, even within fine pitch geometries.



Circle (42) on Reply Card

Hand held power-line monitor

Eastern Time Products has a new handheld power-line monitor which detects power disturbances including spikes, sags, surges, common mode noise, dropouts, power failure, high frequency noise, wiring problems,

and open ground. The unit uses a sine wave tracking design to capture all + or impulses which are measured from their location on the sine wave. Impulses on the hot line of up to 500V and neutral line to 50V (common mode noise) are indicated by LEDs that stay lit until reset by the operator.

Circle (43) on Reply Card

Expanded tool kit line

CooperTools has expanded its line of Xcelite tool kits which offer a choice of spacious and attractive attache style cases to meet virtually every need. Each contains an assortment of Xcelite professional hand tools, mounted in pockets. There's

also space for test instruments, parts boxes, soldering iron, measuring tapes and other tools. And there's a file pocket in the lid for service manuals, circuitry diagrams and literature.

Circle (44) on Reply Card

Format VCR analyzer

Sencore's new VC93 all format VCR analyzer is designed to isolate all video, audio and servo problems in the playback and record circuits of VCRs and camcorders. The VC93 is a companion to Sencore's popular VA62A "Universal Video Analyzer." Together they completely analyze VCRs from antenna to line output. The VC93's exclusive, patent-pending servo tests automatically checkout a VCR without removing the VCR's cover. Exclusive VC93 head substitution signals positively isolate video head defects from other circuit problems. The VC93 is the only unit available to servicers for troubleshooting defects in stereo Hi-Fi audio circuits.

Circle (45) on Reply Card

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Color TV, chassis E54-15	3049	Jun 89
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NEC		
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Video projector, chassis W2A-1	2005	Nov 82
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CTC133 chassis	2081	Mar 86
CTC120 chassis	2083	Apr 86
CTC125 chassis	2085	Jun 86
207 series weather clock	2086	Jun 86
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CTC130-S1 chassis	2090	Sep 86
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CTC135 chassis, color TV	3006	Jun 87
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(additional models: RVM46700, 46GW700, P46000) CTC135 color TV	3051	Jul 89
CSM055 color TV/AM/FM/clock radio	3054	Sep 89
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CTC96 chassis color TV	3077	Jun 91
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PV4661H rear-projector color TV	3056	Oct 89
CM-140/DIGITAL(C) chassis color TV	3059	Dec 89
(Models SE3135P/SE3191H/SE3535H/ ZB2771H/ZB2771H2/ZB2777H/ZB2777H2/ ZB2797P/ZB2797P2/ZB2797Y/ZB2797Y2/ ZB3193H/ZB3193Y/ ZB3539T/ZB3539Y)		
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Customer satisfaction is key to service business

By William J. Lynott

Even those of us who have not been directly affected by it cannot hide from the human devastation it is wreaking. For those of us who have been singled out, the recession has been a true calamity.

On my visits to such cities as Detroit, Pittsburgh, Boston and others, I see a frightening panorama of seemingly abandoned factories, empty parking lots, boarded-up store fronts, and the unsmiling faces of workers who fear they may be next.

More than eight million people out of work, stripped of a fundamental necessity in our society: a source of steady income and the security and dignity that it provides. Like giving birth, it probably isn't possible for someone who hasn't experienced it to understand the pain of a breadwinner unable to find a job—any job.

Given these things it would appear that those of us lucky enough to still have jobs or businesses would be at least a little bit frightened. It seems to me that this is a good time for us to be asking how we might make ourselves more valuable to our employers, or how we might protect our businesses by serving our customers better. But, alas, critical self-examination is not a popular pastime, even in difficult times.

Recently, I was shopping for carpeting for my new office and I wanted to see some samples on-site. The salesman told me, "You don't seem to me to be quite ready to sign on the dotted line yet. Give me a call when you're ready to buy and I'll stop by."

My wife went to the customer service department of a national department store chain to correct an error on our bill. She stood at the counter for nearly 10 minutes while the lone clerk talked on the telephone, presuambly to a customer. Several attempts to flag down passing employees produced nothing more than gestures toward the clerk on the phone. When the clerk finally came to help her, there was no apology for the delay.

My neighbor recently bought a washer and dryer and had to take a day off from work to accept delivery because the company does not deliver in our neighborhood on Saturday.

Another neighbor recently paid a local television servicer over $900 for a repair that did not correct the problem. That was more than a week ago; she is still waiting for the technician to return.

A friend went to a bookstore looking for a book that wasn't in stock. The clerk suggested that my friend order it himself directly from the publisher.

For the eight million people out of work, the recession is real. For the rest of us, it seems, it's business as usual.

Much of the media has been busy in recent years reporting what is described as our transistion from a manufacturing and distribution-oriented society to a new service-oriented economy. The balance of the gross national product has shifted sharply in favor of "services" at the expense of manufacturing. Whatever growth in jobs that has been taking place has been in service type industries, while manufacturing jobs continue in steady decline.

What an opportunity! Only once in many generations will such a massive shift in economic and industrial patterns take place. That shift is taking place right now and those service dealers who recognize the significance of what is happening will realize that the ability to render *service* will be the hallmark of success in our new business environment.

Decades of almost unbridled prosperity have all but erased the standards of service that were formed during times when the customer was king. Now we have an entire generation of workers many of whom have no true understanding of the value of a customer to a business. In the past, as long as a quality product was delivered, the obligation was fulfilled. Now that the product is service, we have to learn all over again how to deliver it.

Those of use who are already involved in the business of rendering services have an unprecedented opportunity to benefit from our prior experience and knowledge, but not before we do a great deal of self-examination.

The definition of service that we have come to accept in recent years will be totally unsatisfactory as we have become further and further immersed in our service economy. The sullen, arrogant employee who is unwilling or unable to accommodate himself to the concept of total customer satisfaction will prove to be an impossible burden for his employer. The business owner who fails to sense and act on the subtle changes in standards of customer service that are already underway will find himself left hopelessly behind.

On the other hand, the servicer who is fully committed to the simple philosophy that customer satisfaction is the basic product of his business will prosper regardless of the general state of the economy.

The current economic climate, like all those that have preceded it, will eventually dissolve into a new phase. In the meantime, your determination to absolutely excel in customer satisfaction will ensure your success in good times or bad. ■

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

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24 electronic manuals, 3858 pages, hundreds of schematics/diagrams. $55.00 postpaid. Send a LSASE for list. *J. Horsley 67 Theodore Street Buffalo, 14211*

SC61, VA48 stand a ns complete documentation $1850.00 or B/O; also boxes of assorted unused boards and semiconductors, approx, value $3000, sellout $4000 call 802-247-8010. *Jack Lenfest, PO Box 6593, Rutland VT 05702.*

Sencore test equip, EX231 accessory jack expander INT64 pattern generator 1-VC63 VCR test accessory all brand new. 402-494-2455 Roger Fahernhold.

Sams photofacts 1676-2725 complete plus 275 more before 1676 mostly above 1000. Also Sams Modular Hi-Fi series MHF 84-230 complete. Will include 4-4 drawer steel file cabinets for $7995 and shipping. *Ken Goetsch 1298 Shorewood Dr. S.W. Seattle WA 98146 (206) 241-0507.*

Multimeter-tests up to 6 megaohms - new $10.00 digital capacitor tester new $45.00 stereo power booster for auto radio new $15.00. *Joseph Oracki 3502 E Northern Parkway 21206 Balto, MD 1-410-254-0284.*

Sencore CG25 -$75; TF46-$250.00; LC75 -$600.00; CR70 restorer -$750 SC61 Scope $1800; SG15 -$500; total package $5775 save $500.00 plus accessories. *Loretta Pozzani (215) 286-9203.*

Deflection yoke 51-3017195-1 used in popular E34-5 Philco chassis. NAP says no longer available. Will pay for new or functional used part. *614-899-9049.*

755 new electronic tubes in their original boxes $375.00 plus 60 lbs. UPS shipping. Send a LSASE (2 stamps) for lists of tubes, transistors, TV parts, test equipment, electronic books, and electronic courses. *J. Horsley 67 Theodore, Buff, NY 14211.*

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FM generator, 415 sweep/marker, B&K 1077B analyst all with manuals. *John Waskowitz 580 83rd Street Brooklyn, NY 11209.*

TF46 transistor checker with PA 208 power supply $375.00 selling entire shop of Sencore SASE (legal size) to *Fred Ingersoll 6845 Lathers Garden City, MI 48135 (313) 427-0499.*

Tektronix Oscilloscope model 475 portable. Dual trace, 200 MHz, delayed sweep. X10 magnifier. 1 nanosecond/division capability. Many other features. Excellent condition with operators manual. $875.00. *Don Mayhak (602) 941-5131.*

Sencore VCR test equipment VA-62, VC-63, NT-69, EX-231 and CR-70, like new, with manuals and cables. Make offer. *Ray's Electronics (912) 862-3033.*

One LC Auto Z meter updated, SC61 WFA 60 MHz, VA62 AVA, VC63 VCR Test Accessory, NT64 NTSC Pattern Generator, EX 231 Expander. *Call Jack all for $6500.00 After 6:00pm (918) 455-7113.*

Multitester ohmmeter tests resistance up to 6 megs. Brand new $10.00, digital capacitor tester new $45.00 auto radio power (stereo) booster $15.00. *Joe Oracki 3502 Northern Parkway Balt, MD 21206 (301) 254-0284.*

Sencore SC61 scope like new VA 48 48 and a CATV field strength meter. Asking $1,650 for scope, $400.00 for VA 48 and $100.00 for meter. *John De Luco, 435 Ocean Blvd., Keyport, NJ 07735 (908) 583-6153.*

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WANTED

Need schematic or service manual for Zenith VCR model VR4000. *John Bourzakis (412) 483-3072.*

H.H. Scott 222C power transformer. Also pre 1950 radios and TVs. *Jon Kummer, 23-35 Bell Blvd., Bayside, NY 11360 (718) 428-9070.*

Need copy of schematic and service manual for a Conar Model #255 oscilloscope. *Taylor Wilson 13123 Serves St. NO, LA (504) 254-0890.*

Horizontal driver transistor BUW84 for Magnavox chassis 13C201. Magnavox chassis 13C-201. Magnavox part number 610417-1. Looking for exact replacement or cross reference part number. *Bruce Dorson RR2 Box 1675 New Ipswich, NH 03071 (603) 878-4270.*

Sams -689 thru 1988. Some ships. *Leonard Smith TV Service, 2000 10th Wichita Falls, TX 76301. (817) 723-2442.*

Switch for Sencore CR168 CRT tester. Part number 125A183. No longer available from Sencore. Will consider boxing used tester. *Call Jim or Andy (216) 289-1299.*

Schematic and wiring diagram for Hammand organ model M2. Will pay for copies. *Arthur Vicekry PO Box 742, Torrington, CT. 06790-0742.*

Need service manual/data for Bearcat 20/20 scanner. *Tom Kepner, 9515 Juliette Dr. Clinton, MD 20735.*

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Need schematics for the following stereo amplifiers Sansui Model A10, ICC-800A. *Lew Thibeau (902) 895-7995.*

Instruction manual and programmable disc for Sirius computer Mod No. 766 also info on manufacturer for above. *James MCCabe (201) 916-0329 or 0529.*

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Sencore VA48 good condition $395.00 B&K transistor checker 520B $195.00. *Don South 4th Street Lebanon, PA 17042.*

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C.B. Manual on how to add channel on CB radio's or conversions.*Johnny Wyatt (501) 268-6151.*

Sams Manual 2578-2788. Also have Sams 381 1400 for trade or sale.*Mack's TV 1022 N 22nd Street Billings, MT (406) 245-0799.*

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Admiral #56C49-1, IF Amp, Sync & AGC, used in TV chassis 7M45. Equivaleny ECG 854. Both number discontinued. *Gilberto Hernandez Calle 10, Bloque 18 #18 Santa Rosa, Bayamon PR 00619.*

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1 - Sylvania IC No 15-37700-1, 1-Admiral IC. No 56C49-2 Both I.C. are discontinued. *Browns TV P.O. Box 146 Peterstown, WV 24963, (304) 753-9549.*

GE EP 77X22, XFMR For GE "YA" chassis; new or used. *O'Fallon TV and Radio 209 East 4th Street. O'Fallon IL 62269.*

Need service manual Kenwood Stereo KS-4000 R, chip #MAB8021P for Capehart TV, manual SONY stereo #STR-V45, will buy or pay for copies. *Main TV, (303) 776-6955.*

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5. 2.718281828 ε (epsilon)
6. 3.14159265 π (pi)
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