THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

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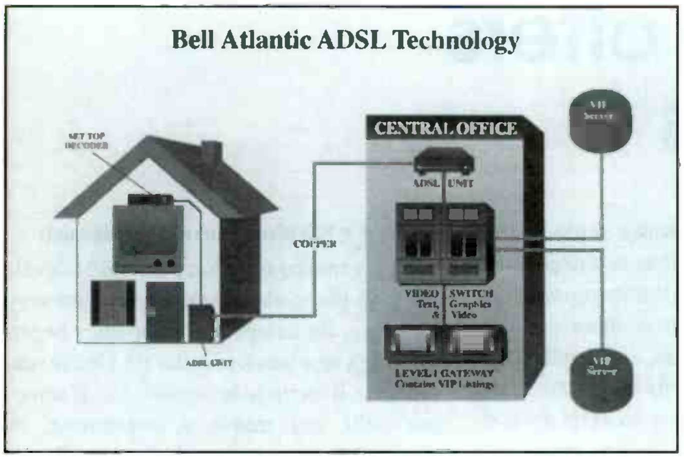

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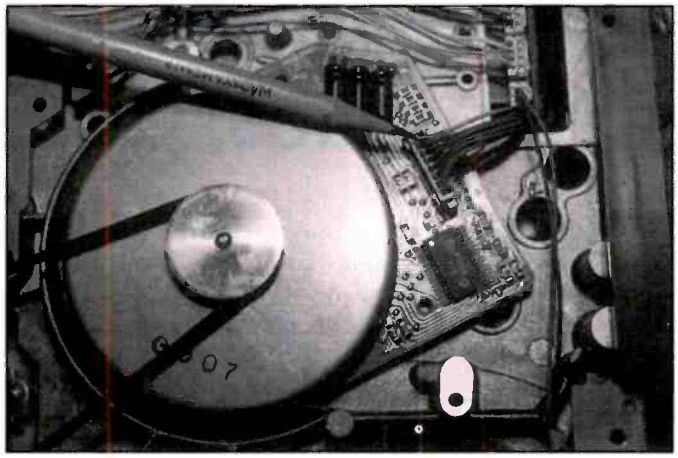

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THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING
ELECTRONIC
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ON THE COVER

Consumer electronics technology today is advancing on so many fronts that it's difficult to keep track of it. A telephone company will soon deliver television and other programming via the phone line. A small innovative company offers a fiber optic system for audio signals. An established company offers speaker systems that provide a wide sound stage. And a major electronics component manufacturer continues development on a brand new type of video display system. (Photo courtesy Texas Instruments)

Editorial

ES&T special issue offers schematics, prizes

The growing complexity of consumer electronics products makes it increasingly important that servicing technicians have available service literature for as many products as possible. It's this insatiable need of servicing technicians for service literature that led us to include schematic diagrams in this magazine in the first place, and that prompted us to begin producing an annual oversize issue dedicated to nothing but schematic diagrams. This year's special annual schematics issue will be sent to subscribers in the October/November time frame. Look for it.

You might win a prize

This year's schematics issue will be a little different from those we have published in the past. This one comes with an entry form for a prize drawing. We wanted to let you know well ahead of time that there will be a special opportunity for readers in the schematics issue this year: the first-ever prize drawing in **ES&T** history. You may have an opportunity to win a DMM, a gift certificate for $250 worth of replacement parts, some other prize that any consumer electronics technician would be happy to win, or the grand prize. Sencore's business management software package, the SM2001 Service Center Manager.

There will, of course, be specific instructions in the issue, but in essence, all you will have to do will be to pull out one of the special entry cards in the issue, fill out the requested information, including which prize you'd like to receive, and mail it in. Pass the second card along to a good friend. Don't fill out the second card yourself: the folks handling the drawing have informed me that they will discard duplicate entries.

And please keep in mind that you must provide all of the information that's requested of you on the card. All questions must be filled out, or the entry will not be valid.

And good luck. I wish I could enter the contest myself.

Consumer electronics countermeasures

Have you ever noticed that for every electronics innovation for which some kind of countermeasure is possible, engineers/technicians seem compelled to come up with *that* countermeasure? Some of these countermeasures are good ideas, and legal, while some of them are distinctly illegal, and some fall into some kind of gray area that depends on what the local and state laws are.

For example: when satellite TV systems began encoding their signals, some clever technologists were able to design circuits that would decode the signals that had been encoded and allow unscrupulous consumers to receive free, programming that is supposed to be received only by those who pay for it. That was definitely illegal, it's called "theft of service," and quite a few people were prosecuted and punished for it.

And how about radar detectors? That has provided a lot of electronics geniuses with a lot of fun. Someone initially came up with a radar system that would allow police to determine for certain if a given car on the road was speeding, and how fast that car was going. That led to a number of arrests, as well as convictions.

Then some clever fellow came up with the idea of the radar detector. This device detects the presence of a police radar signal, and alerts the speeding driver that he should slow down or he may be stopped and ticketed.

The existence of these detectors then led the police radar people to change their frequency so that existing radar detectors wouldn't be able to detect the new signals.

The next step was predictable: the radar detector folks redesigned their products so that they would detect the new radar signals.

Then the folks who make the radars decided that they would do something that would make radar detectors unusable: design a laser system that would provide the same function as the radar, but using laser light that is not detectable by a radar detector.

Of course, the radar detector folks then designed a laser speed system detector.

Actually, I don't know what the present state of the art is in traffic radar/radar detector technology, but it sure has been a lot of fun to watch it.

Now a telephone product skirmish

Now a similar situation seems to be developing in the world of telephones. Not very long ago, the telephone companies began offering a new service: caller ID. On the surface of it, it seems to be a great idea. If someone calls and makes a threatening, or obscene or harrassing telephone call, the called party knows the telephone number of the caller. That's great.

However, this capability is not without its drawbacks. Let's say you call a local store and want some information about some product, or pricing, etc., but you don't really want them to know who you are, so they won't be able to bother you. If the store has caller ID, they've got your number.

There are many other legitimate reasons that you wouldn't want someone you call to know the number you're calling from. If the called party has caller ID, however, they will definitely know.

Just the other day, we received a flyer from a small company somewhere in New England. Now they're offering a product that's designed to attach to your telephone to defeat caller ID. I wonder if next someone will come out with a device to defeat the device that's designed to defeat caller ID.

That's the excitement in electronics

But that's one of the things that's so exciting about the world that we live in: the world of electronics. Because integrated circuits have made it so easy to pack a lot of functionality in such a small package, and the integrated circuit fabrication processes are flexible enough to accomodate a wide variety of components, electronics manufacturers can realize such a wide variety of wonders.

And while it's a challenge, and frustrating, to try to constantly keep up with the products that the manufacturers have just brought to market, it sure is a fun ride, isn't it.

Nils Conrad Persson

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

ELECTRONIC Servicing & Technology

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

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NSCA Buyer-Seller Locator takes on new format

The National Systems Contractors Association (NSCA) has announced that its Buyer Seller Locator membership directory will be published on disk this Fall; available in both Macintosh and PC-DOS formats. NSCA members and sponsors will be asked to supply their data on diskette, and will be receiving special diskette questionnaires in late July.

The phone-book-size Buyer-Seller Locator is the only industry directory and reference guide of its kind, containing the roster of all electronic systems contractor members, with detailed profiles specifying the areas of expertise of members who supply data. Also listed are supporting independent sales representative companies, consultants, associates, and manufacturers (sponsors). "In hard copy, the 2000-page book was valuable, but hard to handle," said Member Benefit Chairman, Jon Glans, Kamco Music and Sound Systems, Calgary. "In its convenient new format, the Locator will be invaluable," he said.

Initially, NSCA members and sponsors will be asked to provide their profiles on disk. Once the initial data has been entered, the information will only need to be updated annually.

The Buyer Seller Locator is distributed each year to all NSCA members and sponsors. The book version of the Locator will still be available, at a nominal additional cost to members.

As the association for sound and electronics systems contractors, the NSCA provides services, activities and information in a non-competitive arena to its members. Over a thousand contracting companies throughout the country are members, and some 800 manufacturers, sales representatives and consultants are sponsors of the association.

For more information on the new Buyer-Seller Locator, contact General Manager Mary Beth Rebedeau at NSCA headquarters, 1-800-446-NSCA.

Bell Atlantic wins first approval of commercial video dialtone

On July 6, Bell Atlantic Corporation received federal regulatory approval to proceed with the nation's first commercial video dialtone (VDT) service. VDT allows customers to choose among a host of optional video program and information services, such as entertainment, education and health care services, including basic video services that compete with cable television.

The Federal Communications Commission (FCC) action paves the way for Bell Atlantic to construct the network components needed to provide video dialtone in Dover Township (Ocean County) NJ. The company can now file a tariff for FCC approval to sell network channel capacity to information providers. Bell Atlantic plans to provide VDT in Dover Township in early 1995.

"This is an extremely significiant first step for Bell Atlantic and the FCC," said Jim Cullen, president of Bell Atlantic. "Bell Atlantic will continue to lead the way by building a full-service network that will transport video as quickly and efficiently as voice is carried over our network today. We hope for speedy approval of other construction requests we now have before the FCC."

One of the first information providers to use Bell Atlantic's VDT network will be Future Vision of America Corporation, based in West Conshohocken, PA. It will compete with the existing cable television companies in Dover Township, NJ. Potentially hundreds of information providers could use the Bell Atlantic network as a platform to deliver their products or services to residents and businesses.

In addition to the traditional video entertainment providers, potential information providers include schools, newspapers, hospitals, local merchants, community organizations and others.

"This Dover Township project is the first time switched digital fiber-to-the-curb technology has been deployed commercially," said Larry Babbio, executive vice president and chief operating officer, Bell Atlantic.

"This exciting technology, provided by BroadBand Technologies, makes it possible to deliver hundreds of channels to customers. We believe companies like FutureVision will flourish with the ability to deliver their products, and customers will have virtually unlimited choices for health and education services and a variety of entertainment."

Under the Opportunity New Jersey plan, approved in December 1992, by New Jersey's Board of Regulatory Commissioners, Bell Atlantic Corporation is committed to accelerating the installation of advanced capabilities in its statewide, public network.

"The FCC's approval of our application to provide video dialtone is a welcome event," said Al Loeppe, Bell Atlantic-New Jersey president and chief executive officer. "Our goal is to construct a video dialtone network that will carry the highest quality and widest variety of video programming information and interactive services in the world to New Jersey's residents and businesses."

All information providers will be able to deliver their products and services to residential and business customers and those providers will have access to the network on equal terms and conditions. See related story in "New consumer electronics technology," in this issue.

EIA announces new trade show: CES Interactive

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG) announced today its new trade show, CES Interactive. The announcement was made by Gary Shapiro, group vice president of the EIA's Consumer Electronics Group, during the opening ceremonies of the 1994 International Summer Consumer Electronics Show.

"This show will meet the stated needs of new technology companies," stated Gary Shapiro, EIA's Consumer Electronics Group's group vice president. "We are responding to our members, exhibitors, and attendees business interests by creating a new trade show consistent with their business strategies. Today, 68% of our SummerCES exhibitors are committed to multimedia, electronic gaming, software, and interactive technologies. That's the direction in which SummerCES has been going. And, since we've never been ones to stand still and wait for the future to happen, we created a new show to help the mainstream distribution channel focus on one event for all interactive technologies. The show's timing will meet buying cycles of retailers planning their Christmas selling season."

Philadelphia, PA will host CES Interactive '95, from May 11 through 13, 1995, in the Pennsylvania Convention Center. For three days, manufacturers, distributors, retailers, financial analysts, and members of the media will have an opportunity to see the latest in products designed specifically for the interactive age. Never before has the consumer electronics industry had the opportunity to combine all of its assets into one show as they will with CES Interactive. CES Interactive '95 will be sponsored, produced and managed by the EIA.

Staged as a stand-alone trade show, it will provide a concentrated forum with workshops and exhibits for manufacturers, developers, distributors, and retailers. Like the other shows managed by EIA, one major strength will be the advantage of being the only consumer electronics trade show that attracts the international and domestic buyers who reach the mainstream consumer. CES Interactive fits nicely into the EIA/CEG strategic trade show plan: one megashow, such as Winter CES in Las Vegas, and product specific or vertical shows throughout the year like CES Interactive, Mobile Electronics Show (MES), and international shows such as CES Mexico and CES Brazil.

Seminars for CES Interactive will fall into eight categories: electronic gaming, virtual reality, interactive software, multimedia, converging technologies, business of business (for retail & management topics), executive forums (for product categories from a business perspective for senior managers), and financial perspectives (business/financial).

"As society becomes more dependent upon being interconnected, we are witnesses to an industrial explosion in multimedia products of all kinds. Competition to be on the information highway, to become more data savvy, and to become technologically literate is taking on new meaning. CES Interactive will not only enhance these efforts, but allow retailers to show the consumer benefits of owning lifestyle altering products," concluded Shapiro.

Additionally, the Personal Communications and Computing (PCC) Show will continue to be associated with the CES Interactive, maintaining its traditional focus on computing and communications.

High-end audio manufacturers were surveyed about their preference of having one or two trade shows per year. Most exhibitors stated their preference for only one show a year—the Winter CES. The 1994 Summer CES marks the last Summer CES to be held, and the 50th

Consumer Electronics Show sponsored by the EIA.

Video/TV sales grow

Video sales posted their best growth of the year in April rising 6 percent over April of last year, according to the Electronic Industries Association's Consumer Electronics Group (EIA/CEG). After a slow first quarter, TV sales surged in April with a 10 percent increase over last year's figures.

"These latest figures are another example of the strength in the video market, and not just in one segment. Dealers continue to feel the strength of consumer spending throughout the video market, in TVs, projection TVs, TV/VCR combinations, and laserdisc players. We view this as reassuring news of the economy and its continued strength in consumer electronics goods," stated Ron Poole, General Manager of audio products with Sharp.

Dealers purchased an all-time best for April, purchasing 1.6 million direct-view color TVs in the month, topping the previous high, set only last year. Sales of 19 inch sets were particularly strong in April, rising 29 percent to just over 378,000 units, and sales of models 27 inches and larger increased 56 percent.

In addition, projection TV sales continued their blistering pace in April with sales surging 41 percent, boosting growth for the year to date to 34 percent. Projection TV sales have increased at least 40 percent in each of the last three months showing that there is continued interest in the home theater concept.

With sales in the TV/VCR combinations moderating a bit in April by rising only 21 percent, sales in the VCR market moved into positive territory for the year after a 2 percent increase in April. For VCRs, monaural 4-head models were the strongest selling components of the VCR market in April increasing 22 percent.

Mr. Poole continued, "we hope April will be a benchmark month. As summer arrives, expectations are that consumers will be relieving some of their pent-up demand, and will look specifically to the video market to acquire new products. We're confident that retailer, and ultimately consumer, demand will continue to be strong for the remainder of the quarter, and the industry is well poised to take advantage of that enthusiasm." ■

Application note explains importing harmonics data to the PC

BMI's Application Note #231, Importing BMI 155 Harmonics Meter data into your PC, describes how to transfer information from the BMI 155 Harmonics Meter to a PC, import data into spreadsheets, convert into graphs and analyze and write reports. Examples are provided using the data with Microsoft's Excel, Word, and Windows software.

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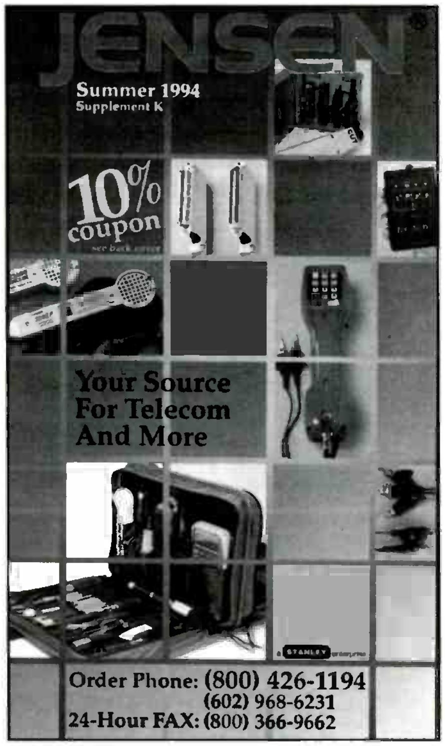


Catalog of products for low-voltage installation and maintenance

The Jensen Connection, a new catalog from Jensen Tools, provides answers to questions about the installation and maintenance of low-voltage systems and equipment. This new 52-page, slim-line catalog offers a single source for tools, test instruments, cable, connectors, and installation hardware for CATV, security systems, PC LANs and more.

No matter what equipment or cable type, there are assemblies, tools, testers, and technical guides to assist. Included among the products offered are network outlets, patch panels, wiring blocks, equipment racks, converters, boosters, adapters, gender changers, breakout boxes, cable testers, and fiber optic products, plus specialty tools and tool kits. Reference books offered include the Network Interface Guide, Technician's Guide to Fiber Optics, and the Novell Companion. The Novell companion condenses years of experience in planning, configuration, installation, and maintenance of communications systems into a single reference for people of all experience levels.

Circle (16) on Reply Card

Catalog features telecom/network tools and test equipment

Jensen Tools, Inc., offers the telecom/network service technician a new catalog featuring test sets, tool kits and accessories for installation and service.

With more than 50 pages of full-color pictures and detailed descriptions, the catalog features such products as calibrated meters, voice/cable test sets, power probes, and tone generators.

Brand names such as Fluke, Microtest, Tektronix, Harris Dracon, Walker, Metro-Tel, and most other major manufacturers are represented.

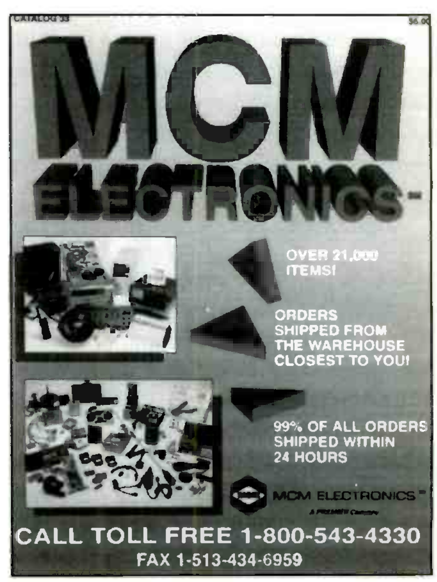
Circle (17) on Reply Card

Electronics catalog

MCM Electronics introduces their newest catalog—number 33.

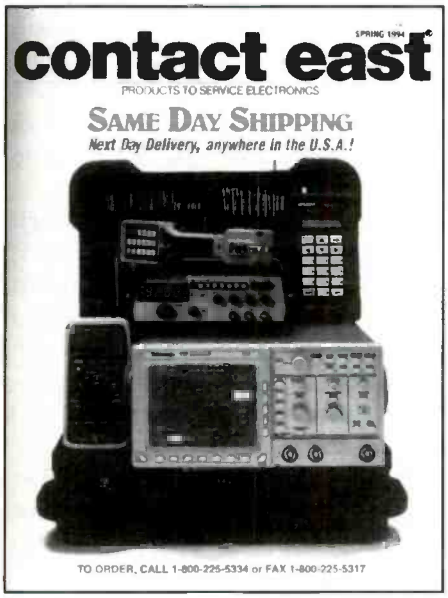
The catalog contains over 2,800 new items, including semiconductors, speakers, project accessories, connectors, test equipment, computer products, audio, TV, VCR, and appliance repair parts. This catalog also introduces three new product categories including amateur radio, CCTV and wireless security systems.

Circle (14) on Reply Card



Catalog of test equipment, tools, and supplies

A 48-page catalog supplement from Contact East features new test instruments and tools for engineers, managers, technicians, and hobbyists. Featured are



quality products from brand-name manufacturers for testing, repairing, and assembling electronic equipment. Product highlights include new: DMMs and accessories, soldering tools, customer tool kits, EPROM programmers, power supplies, ELF meters, helpful reference books, breadboards, scope meters, datacom tools and testers, adhesives, measuring tools, precision hand tools, and porta-ble bench top digital storage scope.

Circle (92) on Reply Card

Application/selection guides for benchtop cleaners

A series of application and selection guides outlining the benefits of the latest alternative benchtop cleaners for electronic circuitry is now available from Micro Care Corp.

The literature provides inputs on major brand chemicals and consists of a three-fold pamphlet entitled "Straight Talk About Alternative Cleaners" as well as two single sheet handouts featuring easy-to-read charts.

The "Straight Talk" pamphlet discusses the whys and wherefores of non-CFC cleaners at the workbench and specifically details the application and effect of the new HCFC cleaners, PFC cleaners, alcohol and de ionized water, plus several new chemistries formulated to meet the latest environmental regulations.

The single page "Product Selection" guide discusses the use and effect of mild, moderately strong and highly active cleaners along with their abilities to substitute for old-style solvents.

The companion Technical Applications bulletin outlines critical handling characteristics of "planet-safe" chemicals and charts product characteristics such as strength, health, safety, and environmental effects along with brief summaries.

Circle (93) on Reply Card

Catalog of wire stripping and cutting tools

The Ripley Company's Miller Tool Division has published a new catalog of wire strippers and cutters. These hand tools are precision made for cutting, slitting and stripping many types and sizes of wire and cable. All tools have hardened and ground cutting surfaces and are used by electricians, telco (telephone and cable TV) installers, electronic and electrical product assembly workers, plant maintenance people and do-it-yourselfers.

Circle (94) on Reply Card

Catalog features expanded external power product lines

An expanded selection of external power adapters; single and multiple output, regulated external power supplies for domestic and foreign use; as well as switchers and chargers, plus a wide range of power and telecom transformers are among an assortment of new products featured in the latest external power catalog from Multi Products International.

This comprehensive, 24-page publication fully explores MPI's external power product capabilities, furnishing complete technical data, ratings, cases and case sizes, and a variety of output connectors. It also contains unique, quick-reference design guides to ease the choice of application-specific, off-the-shelf or custom developed products. A customer requirement data form is also incorporated to expedite final product selection.

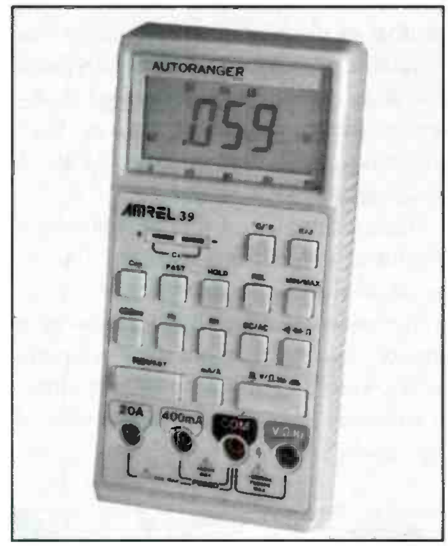
Within eight clearly indexed sections are summaries of custom capabilities for special applications.

Circle (95) on Reply Card

DMM

Four 30-Series handheld digital multimeters, two offering true RMS measurement, and three with two-year warranties, are featured in a two-page literature sheet from American Reliance Inc.

Models 35/37 are 3-3/4-digit meters with 0.3% basic accuracy. Both have a 0.67 inch height display with analog bar-



graph. Measurement ranges are 4nF to 4μF for capacitance measurement, 100Hz to 600KHz for frequency measurement, 400mV to 1000Vdc, 400mV to 650 Vac, and 400mr to 40MΩ for resistance measurement. They also offer relative mode, data-hold, min./max., memory/read function and true RMS (Model 37).

Model 39 is drop-proof to 10, has a basic accuracy of 0.25%, provides temperature measurement and a fast display mode. It also offers min./max. data hold, auto power-off, continuity beeper, diode test, and range hold to disable autorange when desired.

Circle (96) on Reply Card

DMM test probes and accessories

Richard Hirschmann of America, manufacturer of high-end digital multimeter probes and accessories announces that it will set its specialty test probes, clips, adapters and leads through retail distributors of test equipment. Previously, the company's primary marketing thrust entailed selling these products directly to the manufacturers and suppliers of the test meters.

Circle (97) on Reply Card

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Special Report: New consumer electronics technology

By The ES&T Staff

The technology used to design and build consumer electronics products, and to generate the media that they use for communications and entertainment reception, continues to develop and evolve on a number of fronts. As an example of this evolution, one of the local Bell telephone operating companies is working to construct a system that will deliver huge amounts of information capacity and a wide variety of entertainment.

Other examples of this technological evolution abound: one company has introduced fiber optic technology to home stereo; one company has introduced a speaker system that provides listeners with a wider sound stage, and still another company has refined a new method of projection TV delivery.

One day soon, service technicians will begin to encounter some of this technology when they're called on to correct problems in their customer's consumer electronics products. We publish this overview of some of the new technology to help technicians become aware of it.

Interactive digital network

Bell Atlantic has launched a program to begin building a full service network, the Bell Atlantic Network (BAnet). The company's customers will be the first in the nation to receive video services provided by their local exchange carrier over its own network.

"We will start by offering video programming, including entertainment, news and other information services over the new system," said Jim Cullen, Bell Atlantic president. "The system will be capable of two-way service, and it will carry both traditional analog and digital information as well as the new interactive services. We plan to make interactive multimedia television (IMTV) available starting in 1995."

Bell Atlantic is the only regional Bell company that has authority to offer customers video services, having won a court ruling in August 1993 to provide video programming in its service area.

Bell Atlantic is supporting a multi-industry coalition, the "Open Set-top" Executive Interest Group, representing major technology and service providers. The group will work to create standards so that customers can use one set-top terminal to

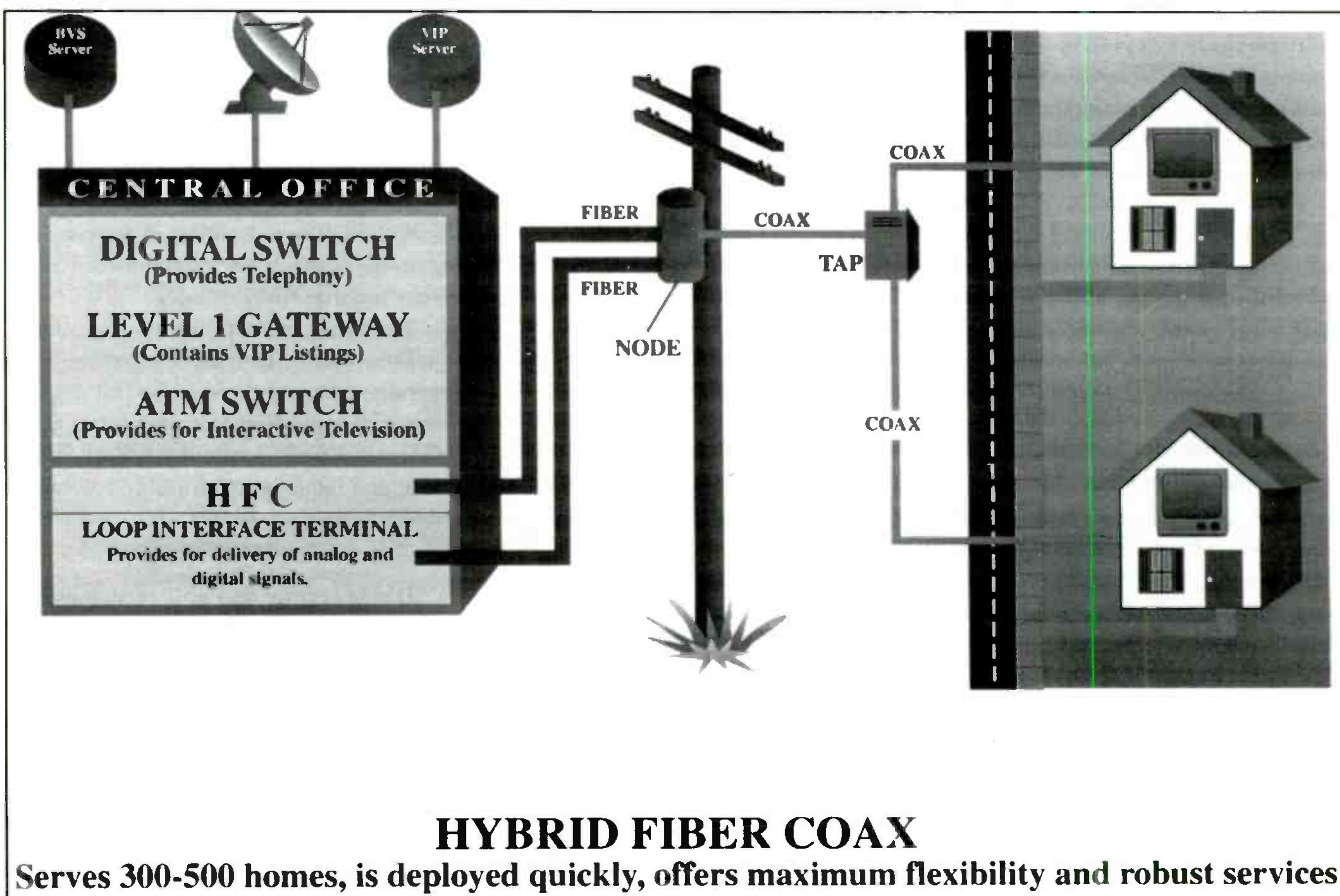


Figure 1. A switched digital hybrid fiber-coax platform will be used in the initial mass deployment of the Bell Atlantic Network. This system, which combines properties of fiber and coaxial architectures, can provide 100 or more analog channels using a bus architecture.

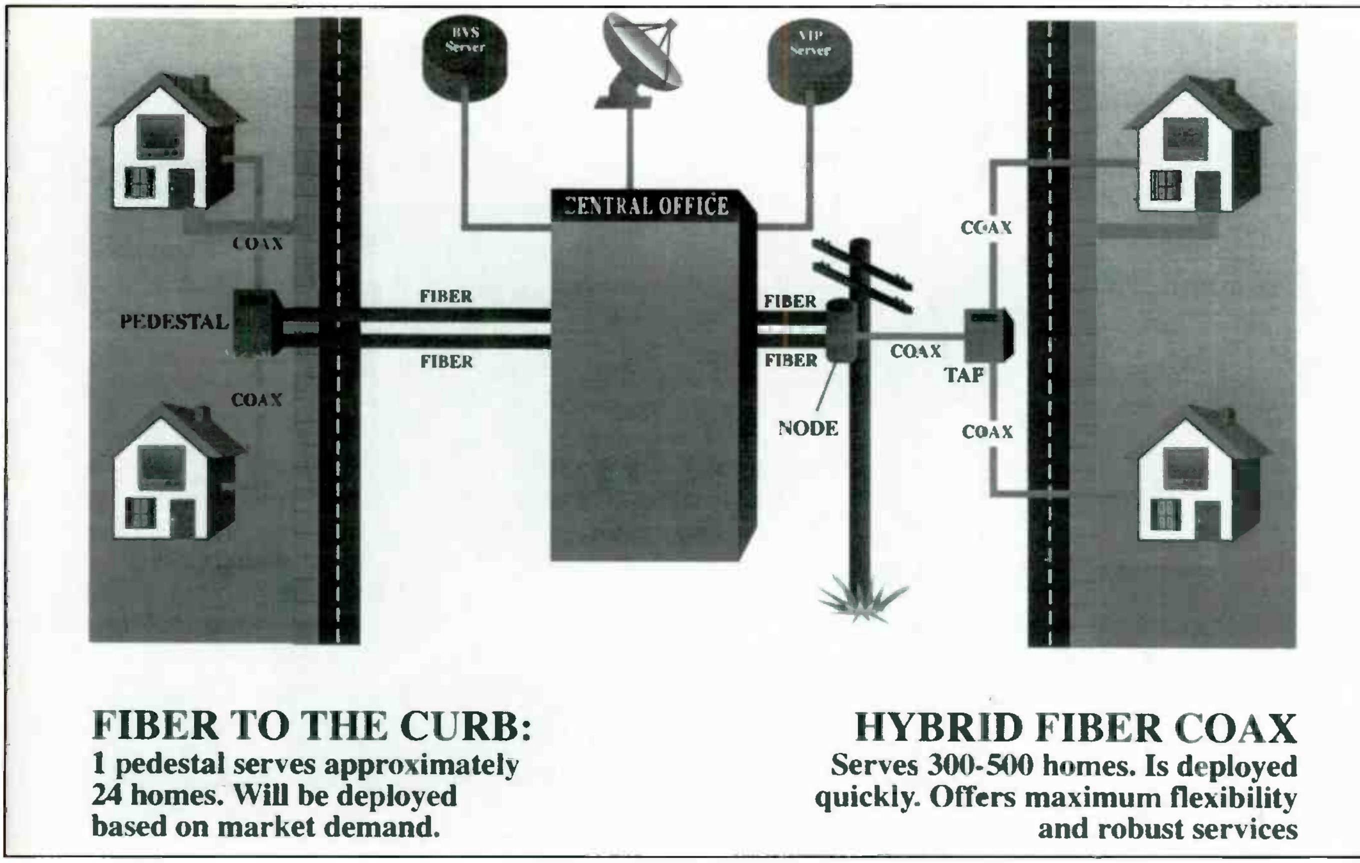


Figure 2. In a switched digital fiber-to-the-curb system, video programming and information are provided in a digitally compressed format (MPEG) by the video information providers and transported digitally by fiber optic equipment to the central office.

receive broadband services from a variety of video information providers.

A variety of technologies

Bell Atlantic will rely on a variety of technologies in its full service network. The company will use a switched digital hybrid fiber-coaxial platform, a switched digital fiber-to-the-curb platform or an ADSL (asymmetric digital subscriber line) approach which employs the copper network already in place.

Under the network's just-in-time deployment strategy, the essential elements of the full service network will be put in place, but the final link from the network to the home—cabling and electronics to actually deliver service to an individual customer—will be installed only when the customer wants it.

Ultimately, today's telephone services will be fully integrated with the new system. Customers will have the same basic telephone service they've always had, but they also will have the opportunity to use advanced IMTV services.

Stargazer programming

One of the services that will be offered is Stargazer, Bell Atlantic's own brand of an interactive multimedia television service (IMTV) which provides movies-on-demand, home shopping, health information, travel services, and educational and children's programming.

Switched digital hybrid fiber-coax (HFC)

A switched digital hybrid fiber-coax platform (Figure 1) will be used in the initial mass deployment since it has cost advantages over switched digital fiber-to-the-curb.

Switched digital HFC combines properties of fiber and coaxial architectures. The technology for mass deployment can provide 100 or more analog channels using a bus architecture. This tree and branch structure allows many customers access to the same information, thereby reducing requirements for both the transport medium and the associated electronics as compared to a switched star type communications architecture.

In Bell Atlantic's system, 20 channels of analog AM-VSB (Amplitude Modulation - Vestigal Side Band) video and over 650 digital signals are combined in the HFC system at the company's central office. A linear analog laser transmitter converts the radio frequency (RF) electrical signal to an optical one.

The optical signal is split and sent downstream over multiple fibers in the feeder network to an optical node. An optical receiver converts the signal back to an RF electrical signal. The electrical signal is amplified and broadcast over a large diameter coaxial backbone cable. Finally, the signal is delivered to individual subscribers over taps and coax drops.

This system allows for maximum flexibility, including interactive multimedia connections that allow each consumer to choose his or her own programs. As demand for interactive multimedia applications increases in the neighborhood, another architecture, switched digital fiber-to-the-curb, can be deployed based on customer demand.

Switched digital fiber-to-the-curb

The company plans to deploy a switched digital fiber-to-the-curb platform in one area.

Switched digital fiber-to-the-curb has huge capacity and can be deployed selec-

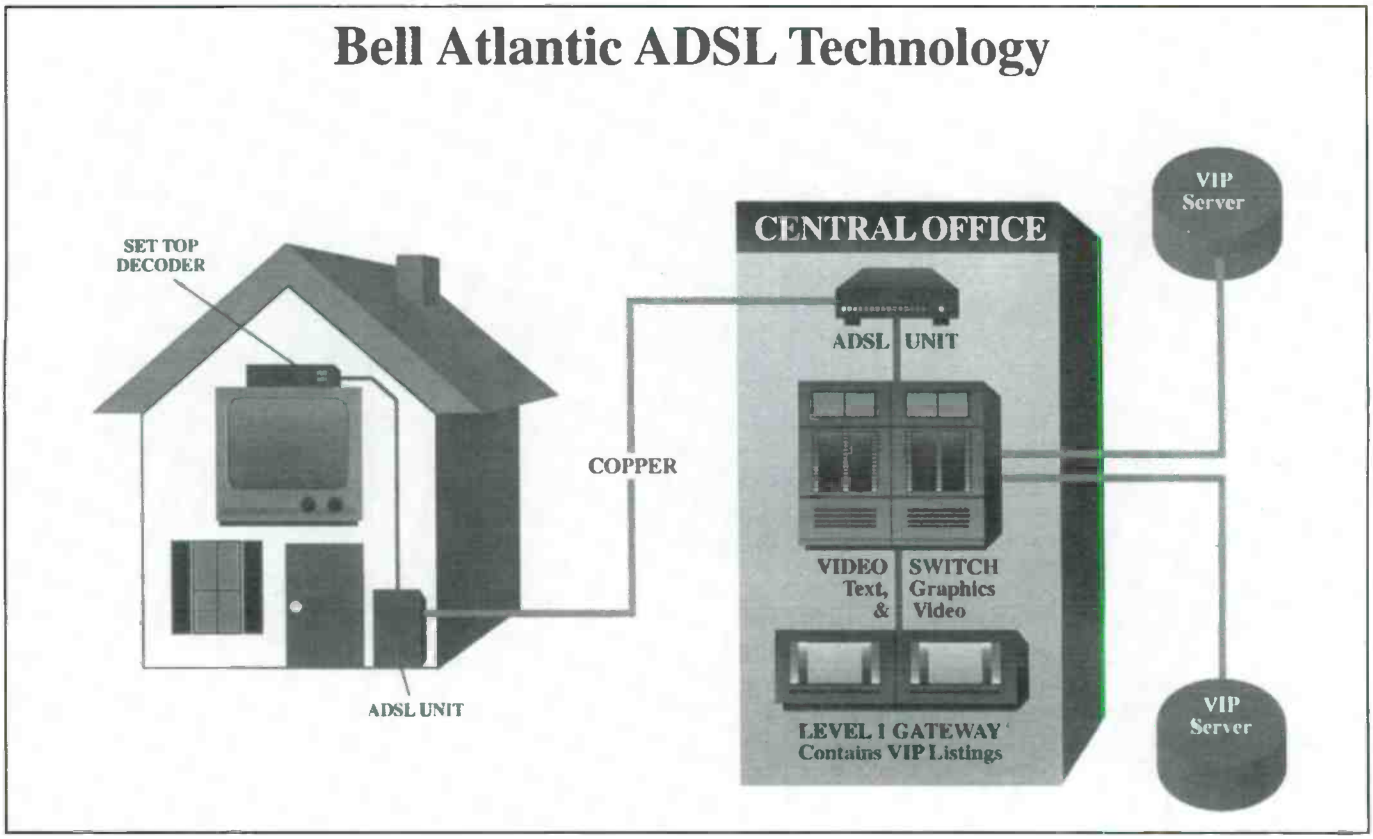


Figure 3. ADSL, in its present state of development, permits the multiplexing and transmission of a one-way, 1.544 Mbps digital signal along with the POTS (Plain Old Telephone Service) or basic rate ISDN (Integrated Switched Digital Network) signal, and a two-way signaling channel on an integrated basis over a single non-loaded copper pair.

tively in the short term and then expanded later. Each platform can provide video services and can be migrated to higher capacity as demand increases for interactive video services.

In a switched digital fiber-to-the-curb system (Figure 2), video programming and information are provided in a digitally compressed format (MPEG) by the video information providers and transported digitally by fiber optic equipment to the central office. The digital video signals from all providers are combined on a video distribution element known as a Host Digital Terminal (HDT).

Fibers are extended from the HDT to the pedestal. Coaxial cable carries the signal from the pedestal to the home. Only programs that are requested by the subscriber are transmitted.

ADSL (asymmetric digital subscriber line)

Bell Atlantic is planning to use the ADSL approach—providing video-on-demand service over copper telephone lines—to serve up to 2,000 customers in another area.

ADSL, in its present state of develop-

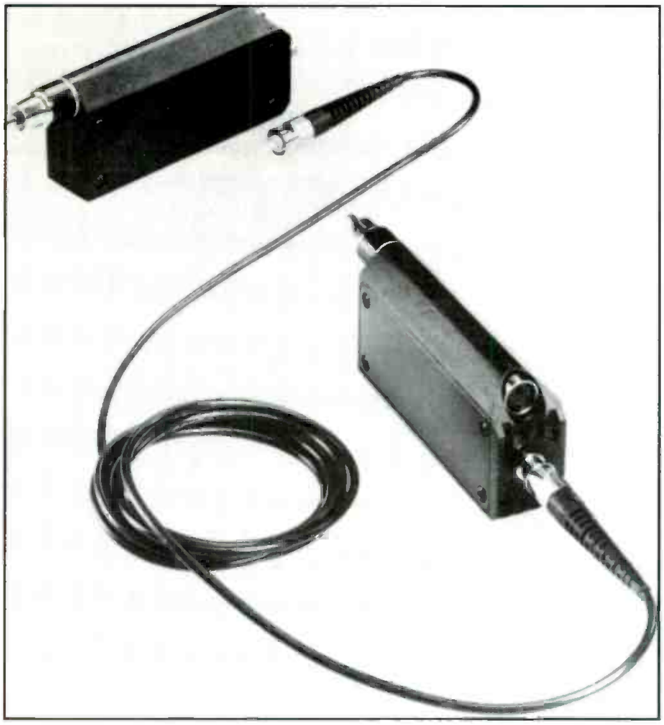
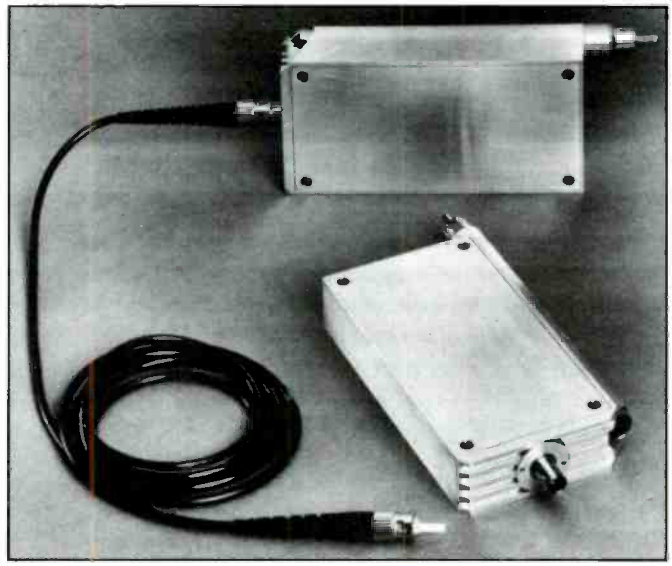


Figure 4. Fiber optic audio transmitters and receivers are designed to provide high dynamic range, as demanded by high fidelity audio equipment.

Figure 5. Fiber optic transmitters and receivers for video are designed to provide broad bandwidth, important for video signal transmission.



ment (Figure 3), permits the multiplexing and transmission of a one-way, 1.544 Mbps digital signal along with the POTS (Plain Old Telephone Service) or basic rate ISDN (Integrated Switched Digital Network) signal, and a two-way signaling channel on an integrated basis over a single non-loaded copper pair.

Advances in both ADSL technology and video decoding techniques will provide for real-time broadcast capability in 1995, at channel rates of 3 Mbps up to 6 Mbps over a single twisted copper pair. The ADSL central office unit works with an ADSL remote terminal located at the customer's premises.

The remote terminal separates the POTS or ISDN signal from the compressed video signal. The POTS signal is transported over standard customer premises wiring; the broadband signal is delivered via standard twisted pair copper facilities to a set top terminal. Video programming over the system must be pre-encoded, digitized, and stored on a video server.

Fiber, fiber everywhere

For years we've been hearing about fiber optics as a medium of signal transmission. Of course, some communications companies have been using it for years, but it's finally beginning to find its way into homes. Take, for example, the "Mongoose" fiber-optic cable system now offered by one company as a means of transmitting audio information.

Employing an innovative laser technology, a young Missouri company has developed the first fiber optic cable system for stereos, VCRs and other home audio and video equipment. The new system, which replaces conventional wire cables and uses analog optical signals, can convey information more than two miles, while eliminating the noise, interference and attenuation associated with wire cable.

"There is a measurable, observable improvement when fiber optic cable is used in place of wire," said Armando Martinez, founder and vice president of development for ASM Labs, Inc., based in Marionville, near Springfield. "Optical fiber is an ideal way to connect components. It is non-conductive, has no impedance, and neither causes nor is affected by electrical noise. Our innovation is that we have developed a way to send high fidelity analog audio and video signals over the fiber and created products that are plug compatible with conventional equipment."

All-analog format

"It's important to recognize that we are working in an all-analog format," Mr. Martinez said. "There are no digital conversions, so there is no loss of information, no jitter, and no need for error correction. The integrity of the original signal is uncompromised. The applications for this technology have tremendous practical benefits, as well as a strong appeal to purists and professionals."

According to Lewis Fleury, ASM president, Mongoose technology can also be used in professional and commercial audio-video systems, and they are developing an 8-channel system for this market.

Cable runs of 2.4 miles

The optical fiber cable system, now available for audio and video, incorporates a small electronic transmitter, which plugs directly into a component, such as a CD player, VCR or tape deck, and converts the output signal, an electrical signal, to an optical signal. It then sends the signal over the fiber cable.

At the end of the cable, which can carry the information as far as 2.4 miles (4km) in a single, uninterrupted run, a receiver converts the optical signal back to an electrical signal. The receiver, also small, plugs directly into the component via a standard RCA-type connection. The receivers and transmitters are powered by separate isolated, linear power supplies.

Specific products for audio and video

Martinez, an engineer who has worked for NASA's Jet Propulsion Laboratory on space-based electro-optic and laser communication systems, said that ASM Labs developed different products specifically for audio (Figure 4) and video (Figure 5).

"Our audio transmitters and receivers are designed to provide high dynamic range, as demanded by high fidelity audio equipment. The system for video is designed to provide broad bandwidth, important for video signal transmission." The audio and video systems use the same type of fiber-optic cable to carry the signal.

"Optical fiber cables consist of an optical fiber, which has a greater tensile strength than steel, jacketed in layers of polymer, kevlar fibers and other plastics," Martinez said. The finished cable has an outside diameter of three millimeters, less than an eighth of an inch, and is lighter and more flexible than wire cable (Fig. 6).

"It is suitable for any job where wire is now used. Installers can pull this cable as they would any piece of wire without worrying about damage. It's strong, it's tough, and it's durable. And you can run several pairs of optical fiber in the space needed for one pair of wire cables." As with wire cable, each channel of audio or video information requires its own optical cable.

The digital mirror device (DMD)

Texas Instruments has demonstrated a fully digital prototype of a high-definition display system based on its digital micromirror device (DMD) technology (HDTV Update, **ES&T** February 1994). This demonstration shows that TI's DMD technology has the potential to make quality projection television a reality—implementing either today's standards or the proposed high-definition standards that are expected to be implemented later this decade.

The display technology based on the DMD (Figure 7) is capable of showing an extremely bright, high-quality, large display that overcomes the performance limitations of current display technologies such as CRT and LCD based projection displays. DMD technology is expected to be viable over the long-term.

"It can improve the performance of today's large-screen projection TVs which employ NTSC display standards, and will be able to scale up to meet high-definition standards requirements," said Gary Feather, Digital Imaging Systems marketing manager for TI. "This technology has the capability of displaying large, high-definition images, and that is what we have demonstrated at the ARPA High Definition Systems Conference."

The DMD-based display was demonstrated at the fourth annual High-Definition Systems Conference sponsored by the Advanced Research Projects Agency (ARPA) of the U.S. Department of Defense earlier this month.

A display for multiple information sources

The digital design of the DMD display will also facilitate the convergence of computers and televisions. The digital design allows a DMD display to serve as an all-digital interface to multiple information systems. Today's display systems are unable to present information from multiple sources simultaneously.

"The fully digital design of a high-definition DMD-based system will be able to simultaneously display computer generated text, graphics and games, full-motion video and broadcast programs," Feather said. "As new networks emerge, the need to simultaneously receive and show information from multiple sources will become a user requirement."

System provides 1716 x 960 resolution

The progressive scan, high-definition, front-screen projection system that TI demonstrated at the ARPA conference (Figure 8) projects images at a distance of 11 to 22 feet onto a 5-foot to 12-foot screen (up to three meters) with a 16:9 aspect ratio. Cinema images are shown in a 16:9 aspect ratio. Aspect ratio describes the ratio of width to height of the screen.

Three high-resolution DMDs—one for each of the three colors that comprise an image—red, green and blue—project a 1716 x 960 (1,647,360 pixels) image. The projector provides a 256-level gray scale and uses eight bits of data per color. The projector has a metal halide light source.

Each high-definition DMD measures

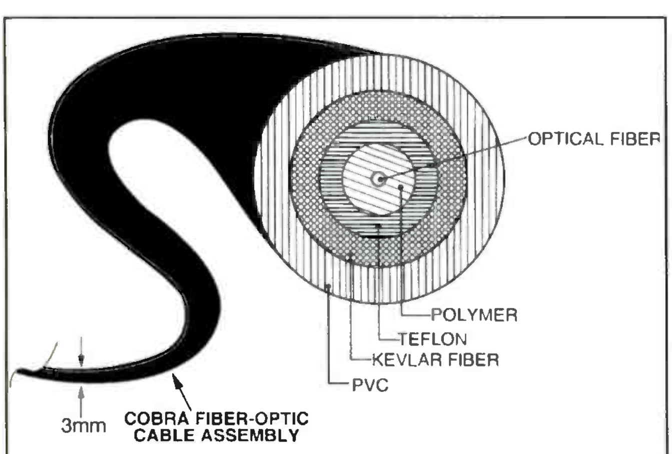


Figure 6. Optical fiber cables consist of an optical fiber, which has a greater tensile strength than steel, jacketed in layers of polymer, kevlar fibers and other plastics. The finished cable has an outside diameter of three millimeters, less than an one-eighth of an inch, and is lighter and more flexible than wire cable.

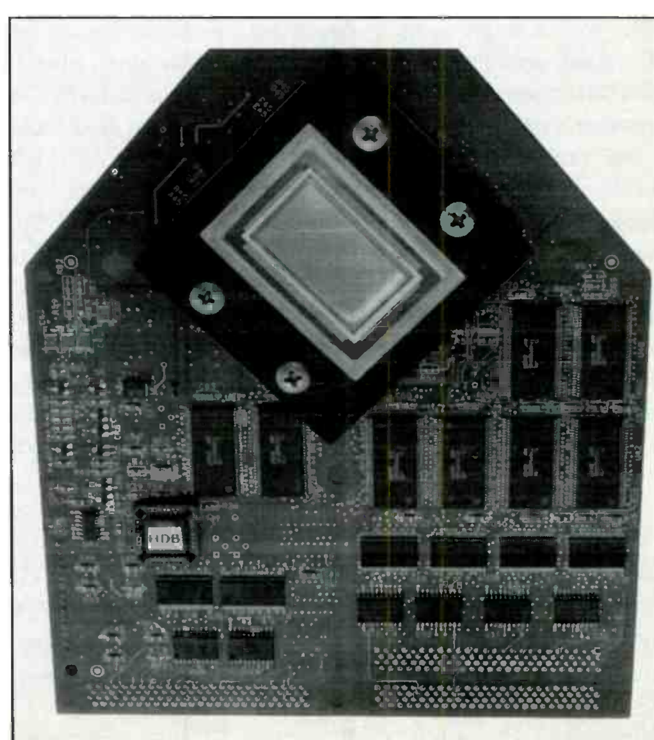


Figure 7. At the heart of Texas Instruments' high-definition digital micromirror display is this high-definition projection electronics board, containing a high-definition digital mirror device (DMD) and eight video RAMs. The DMD measures 37mm by 22mm and is configured as a 2048 by 1152 array and has more than 2.3 million mirrors.

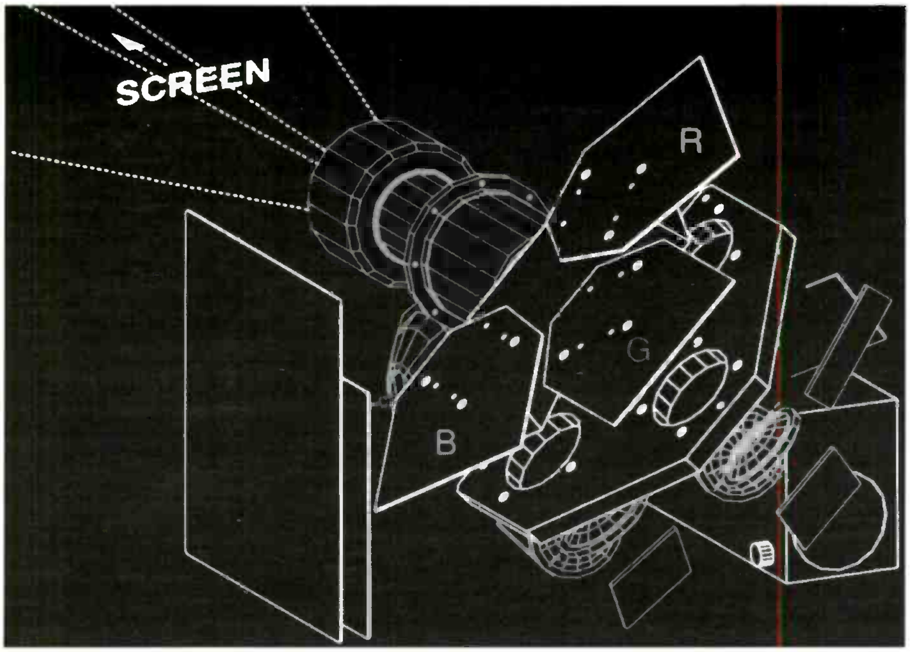


Figure 8. The fully digital prototype of TI's high-definition digital micromirror display based on the digital mirror device technology.

approximately $1^1/_2$ inches by $^3/_4$ inches and is configured as a 2048 x 1152 array. Each device has more than 2.3 million mirrors. The 16-micron square mirrors are fabricated on 17-micron centers. A resolution of 1716 x 960 was chosen for demonstration purposes due to the video input source.

With a 2048 x 1152 pixel format, the device is compatible with the proposed European high-definition standard (2048 x 1152) and takes full advantage of available manufacturing technology. The DMD also has the resolution capability to handle the proposed North American high-definition standard of 1920 x 1080.

A state-of-the-art picture

"The system we're demonstrating delivers a state-of-the-art picture with excellent resolution, brightness, contrast and color," said Jack Younse, TI program manager for the ARPA/Air Force High-Definition Display program. "We've made substantial progress compared to the projection display we demonstrated here 12 months ago, and look forward to the expected performance of the system at completion of the contract later this year."

"Our new high-definition projection system has over five times the pixel density for a given screen size as the standard NTSC DMD projector demonstrated at last year's conference. This is due to the larger sized DMD. By adjusting the magnification of the optics, we can obtain very high pixel density on small screens or standard pixel density on very large screens.

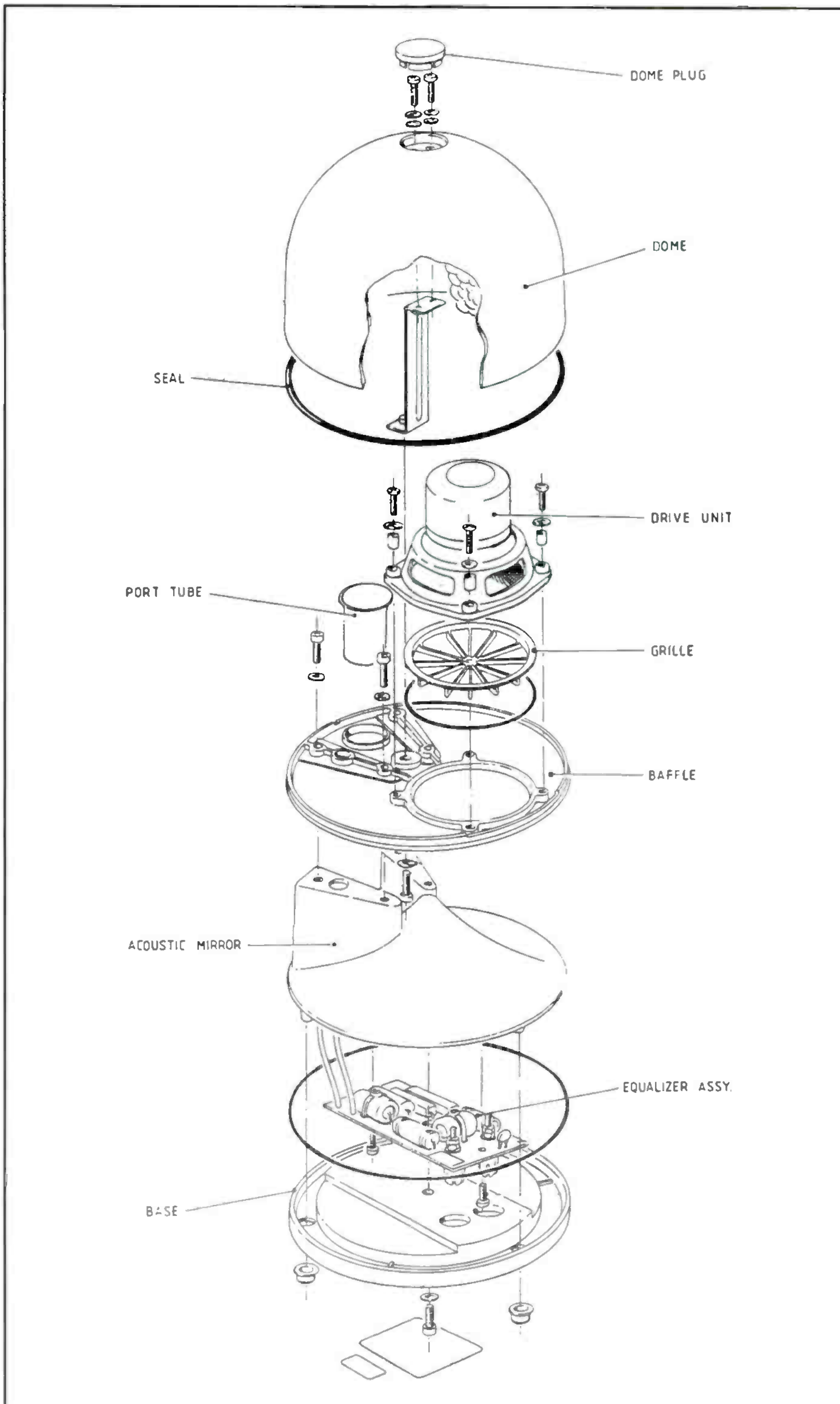


Figure 9. This speaker radiates sound into the listening area with wide dispersion and high accuracy. According to the manufacturer. There is no "right" or "left" speaker awareness, just stereo sound throughout the room.

This first prototype projector clearly shows the capability of high-resolution DMD spatial light modulators. This technology has the potential for world class, truly digital, high-definition displays at affordable prices in time to serve future emerging high-definition markets."

At the 1993 High-Definition Systems Conference, TI demonstrated a projection display system based on a single DMD chip using a sequential color operation. That system, used with a 60-inch diagonal screen that had a 4:3 aspect ratio, provided a contrast ratio of 55:1 and screen brightness of 220 lumens.

The 442,368-mirror DMD utilized

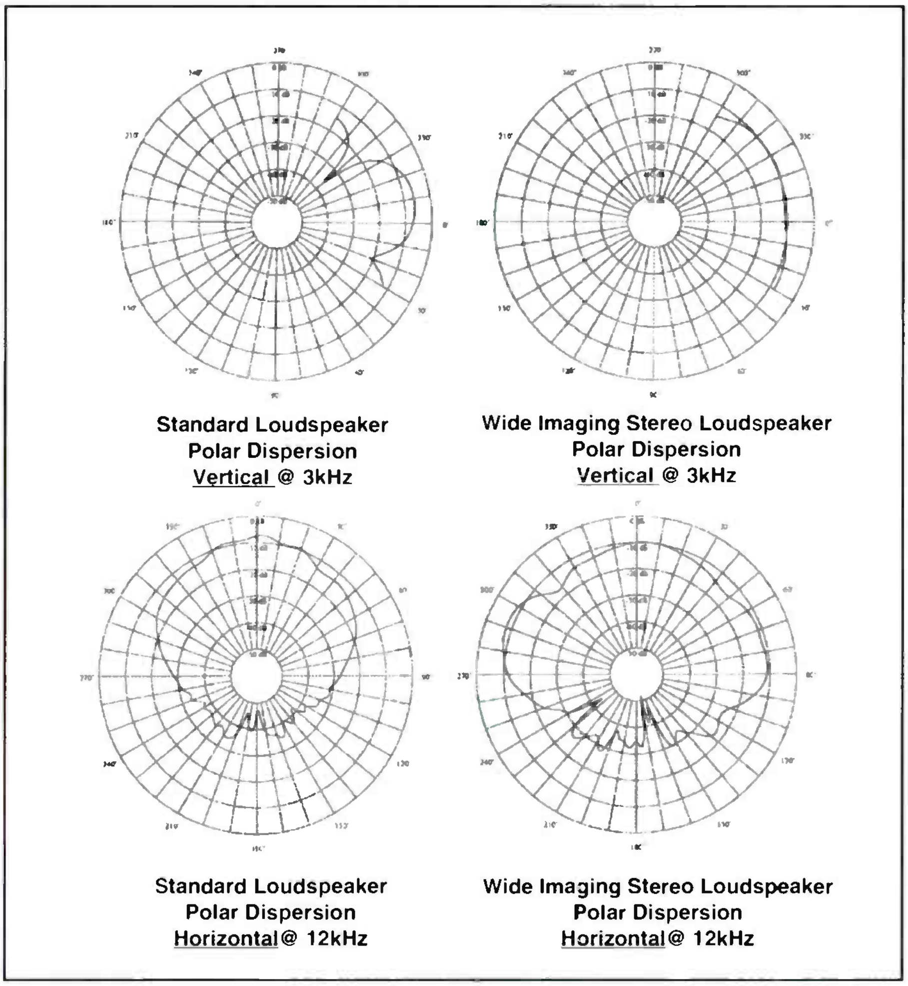


Figure 10. These patterns compare the dispersion of the new speaker with those of a conventional speaker.

307,200 mirrors to display a 640 x 480 NTSC image. The projector had a 1,000W xenon light source.

Wide imaging stereo

When stereophonic audio was introduced, it provided listeners with a greater degree of reality in the sounds produced by their audio equipment. With stereo, when it is well done, it is possible for listeners to sit between the speakers and hear what sounds like a "sound stage," where it is possible to hear different elements of the audio program at apparently different points in the room.

The problem with stereo is that at a point in front of and directly between the speakers there's a "sweet spot," where the stereo effect is greatest. As the listener moves to one side or the other, the stereo effect becomes gradually less pronounced, then almost nonexistent.

Acoustic mirror provides wide dispersion

A new type of speaker (Figure 9) radiates sound into the listening area with wide dispersion and high accuracy. According to the manufacturer, Canon U.S.A., there is no "right" or "left" speaker awareness, just stereo sound throughout the room with equal power and balance everywhere. See Figure 10 for a comparison of the dispersion patterns of this new speaker with those of a conventional speaker.

In this system, the sound is aimed at specially designed acoustic mirrors (Figure 11), which produces a stereo listening area six times as great as the area produced by conventional speakers.

Technology builds on technology

Every innovation in consumer electronics seems to encourage still further innovation. The introduction of television led eventually to the video cassette recorder, which led to camcorder technology and home theater. The computer has been brought into households as computers and as video games. Now such things as CD-ROM and CD-I (compact disk - interactive) are available.

Now we're seeing fiber optic delivery of communications signals, digital satellite television, and nothing less than a revolution in personal communications.

Consumer electronics servicing, which has changed and expanded in scope in recent years, will be continually challenged to keep pace with it all. ■

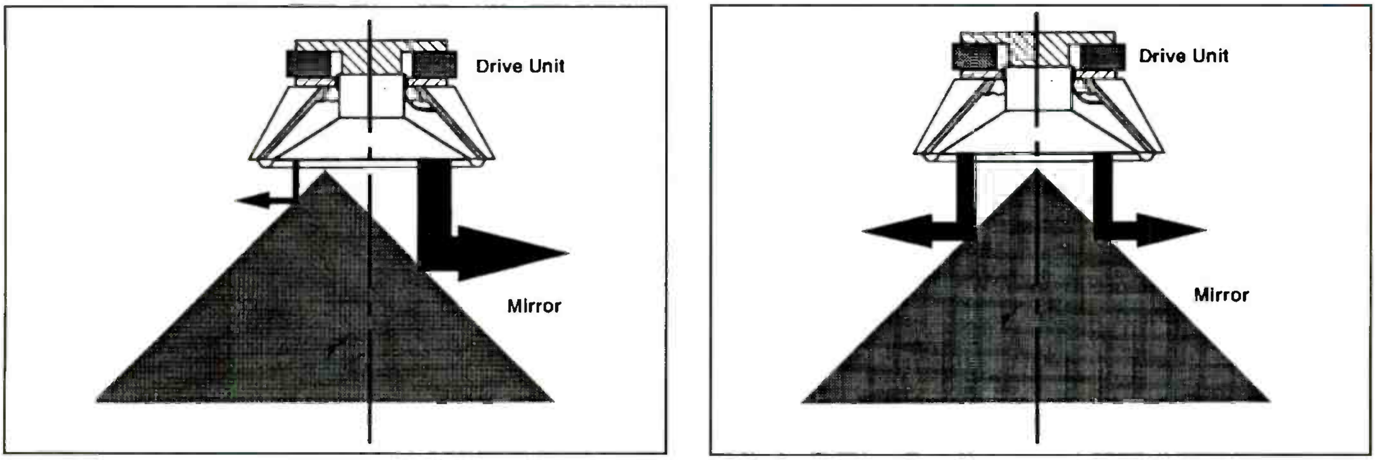


Figure 11. In this system, the sound is aimed at specially designed acoustic mirrors, which produces a stereo listening area greater than the area produced by conventional speakers.

VCR servo problems: The diagnostic device revisited—Part I

By Steve Babbert

An article, "Servicing VCR servo systems," by Stephen Miller, published in the October 1988 issue of this magazine, outlined a method of troubleshooting servo circuits by voltage substitution. The article included plans for building a diagnostic device that could supply a precisely adjustable voltage to substitute for the servo's motor control voltage.

The device uses two ten-turn potentiometers for coarse and fine voltage adjustment. A three-position switch enables the user to raise or lower the voltage for kick-start and stop without having to adjust the controls. See the schematic diagram for this device in Figure 1.

This article will show how voltage substitution helped to find the cause of an unusual problem in a recent model VCR. First, let's look at why servos are needed in a VCR, and how they work.

The helical scan system

Because of the high frequencies associated with the video signal, conventional, or "linear," recording techniques are not practical for video. In magnetic tape recording, as the frequencies increase, the head gap must become smaller or the tape speed must become greater, or both.

Physical limitations in manufacturing place restrictions on how small a head gap can be. High tape transport speeds translate to longer tapes requiring larger reels. This problem is eliminated by using the helical scan method of recording and playback for video.

In helical scan recording, the tape traverses a helical path around the drum containing the video heads. As the tape is

Babbert is an independent consumer electronics servicing technician.

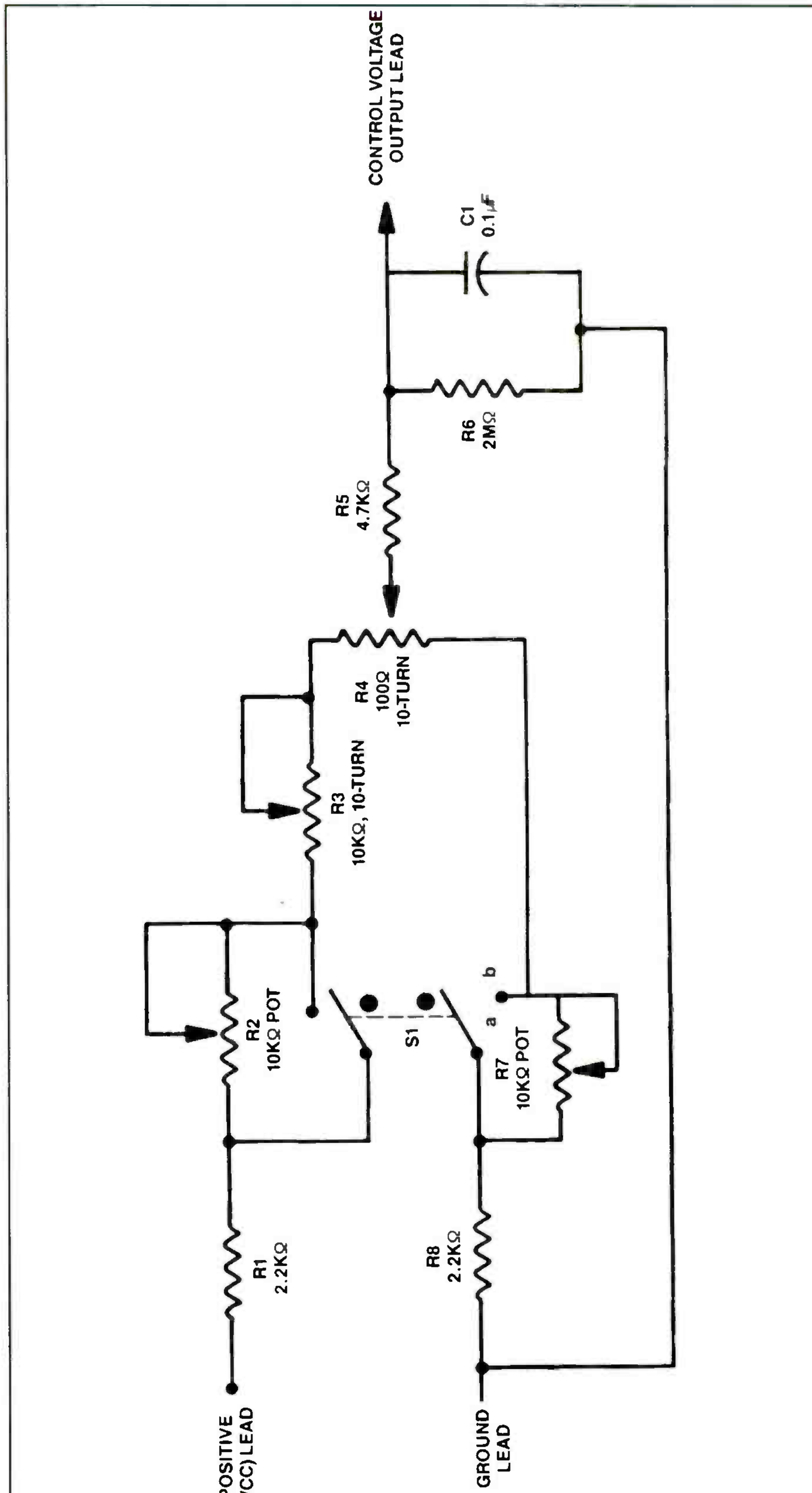


Figure 1. This is the schematic diagram for the VCR servo diagnostic device. R_3 provides coarse speed adjustment while R_4 allows fine speed adjustment. R_2 and R_7 provide adjustments of minimum and maximum voltage. S_1 is a DPDT center-off switch that provides three operation modes: kick-start, run and stop. R_1, R_5 and R_8 provide current limiting during kick-start operation. The network consisting of R_5, R_7 and C_1 forms a current limiting filter. →

Figure 2. The capstan motor speed/phase control line originates at the servo IC and ends at the capstan motor board after passing through the integrators. At the motor board this line is yellow, whereas all other lines are gray.

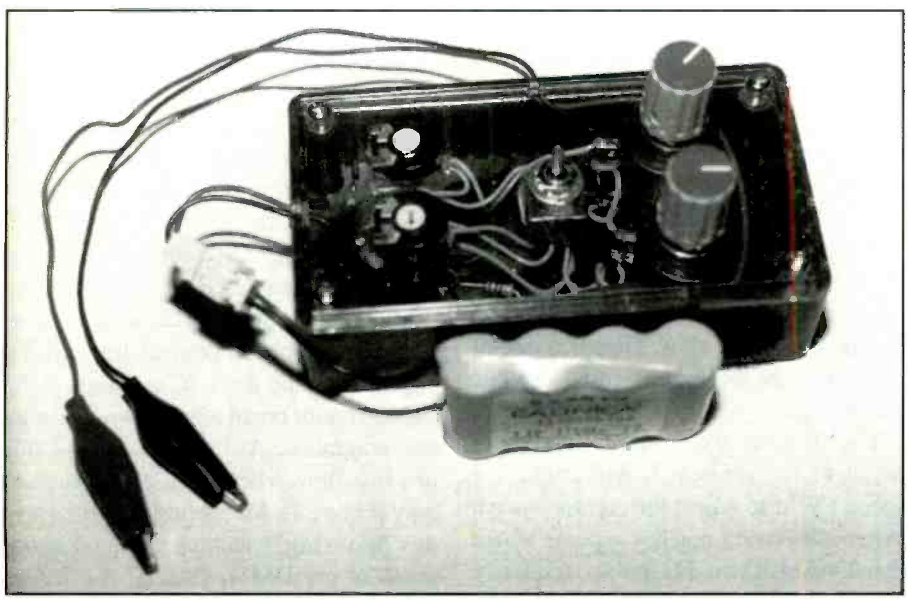


Figure 3. This is a photo of The diagnostic device I constructed. I used a 4.8V Ni-Cd cordless telephone battery to power it.

pulled around the rotating drum during recording, the head records on it diagonal tracks which are very closely spaced. Using this method of recording, a single inch of tape will contain the equivalent of many feet of video track information.

In the basic system, there are two video heads spaced 180 degrees apart on the drum. The azimuth of each head is shifted by a few degrees to prevent cross-talk in the event that one head overlaps an adjacent track. Narrow guard bands are inserted between tracks to help prevent this problem. For faithful reproduction during playback, a means must be provided whereby the video heads will remain on their respective tracks.

The servo system

In essence, servos are self-correcting feedback loops in which a system can monitor its own actions and provide any needed correction. The capstan servo, which controls tape movement, consists of two loops: speed and phase.

The speed control loop

The speed control loop, which can be considered to provide coarse speed correction, functions by comparing divided down FG (frequency generator) pulses to a stable reference frequency in an AFC (automatic frequency control) circuit. Though there are different systems in use, one common method uses 29.97Hz as the stable reference. It is derived through division of output of the 3.58MHz oscillator.

The FG pulse, which is induced in a stationary head coil during record by magnetic pole pieces in the capstan flywheel, has a frequency that is directly proportional to the motor's speed. In some machines, the FG head is replaced by a "Hall effect" device.

The FG pulse train is divided before being compared to the reference. This is necessary because the FG frequency is much higher than the reference frequency. Furthermore, since the FG frequency depends on the motor's speed, it also depends on the speed at which the tape was recorded (SP, LP, or EP).

One popular frequency generator design uses 240 magnetic pole pieces in the capstan flywheel. The FG frequencies are approximately 719.3Hz (SP), 359.7Hz (LP) and 239.8Hz (EP). These frequencies, which, incidentally, are all multiples of 29.97, will be divided as needed to obtain the correct comparison frequency. Nonstandard division rates may be used during special effects as directed by the system control.

Division takes place in a variable division block which is controlled by the auto speed select circuit (to be discussed shortly). Any difference between the frequency of the divided down FG pulses and the internal reference causes the speed PWM (pulse-width modulation) block to adjust its duty cycle (the ratio of on time to off time). Longer on times render higher average dc values.

The phase control loop

The phase control loop, which can be considered to provide fine speed, or angular position control, functions similarly to the speed control loop. Its purpose is to retard or advance the position of the tape with respect to the video heads by causing momentary increases or decreases in the motor's speed as needed. It compares the CTL (control) signal to a stable reference in the APC (automatic phase control) circuit.

The CTL pulse is read from the control track on the lower portion of the tape by a stationary head. The control track uti-

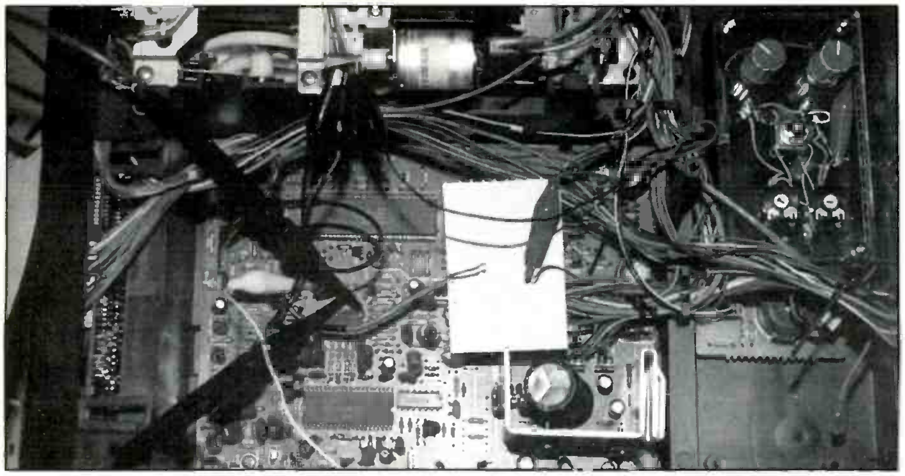


Figure 4. I opened the capstan motor control line and connected the device's positive lead to the motor side of the line and the negative lead to the VCR's ground.

lizes the linear recording method which is used in conventional audio recording. The tracking control provides an adjustable delay in the phase of the CTL pulse with respect to a reference.

The tracking system

The tracking system is used to compensate for mechanical variations between different machines. The same effect could be achieved by changing the physical position of the CTL head with respect to the head drum. Any difference in phase between the CTL pulse and the reference causes the phase PWM block to adjust its duty cycle.

The speed and phase PWM outputs are low-pass filtered, or "integrated," leaving only the average dc value, which is proportional to the duty cycle. These two voltages are then matrixed and amplified before being applied to the capstan motor drive circuit to control its speed and phase.

It's worth noting that this control voltage is not the motor supply voltage. The control voltage causes the motor drive circuit to supply the appropriate voltages to the motor windings.

Head drum speed and phase control

The head drum, or "cylinder," servo also uses a speed and a phase loop. It functions much the same as the capstan servo. The main difference is that both FG and PG (phase generator) heads, in conjunction with magnetic pole pieces in the rotating head drum, are used to provide the required feedback. The drum servos are simpler because the drum speed doesn't change for different tape speeds or special effects. A good source for more information on how servos work is Sencore's Tech Tip 176.

The auto speed select circuit

The auto speed select circuit is used to determine the speed at which the tape was recorded. The CTL pulse is the key to the operation of the auto speed select circuit.

During record, the CTL pulse is 29.97 Hz, regardless of the tape transport rate. During playback, the CTL frequency will only be correct if the tape speed is the same as it was during record. By measuring the CTL pulse, the auto speed select circuit can determine if the tape is traveling too fast or too slow. Then this circuit can cause the FG pulses to be divided accordingly.

The divided frequency, when compared to the reference, will cause the speed PWM to adjust the capstan speed. When this speed reaches a point where the divided down FG pulse frequency matches the reference, the AFC circuit will cause the PWM block to hold its present duty cycle. This will keep the motor at its correct speed.

Solving a capstan speed problem

A customer brought in a Sears Model 580.53295750 VCR that was exhibiting a capstan speed problem. The owner brought it to me for a second opinion after being told by another service center that the capstan motor was defective. Their estimate was too high to justify the repair.

When I ran a quick check to observe the problem at first hand, the capstan motor was wildly erratic in the play mode but not in the fast forward or reverse modes. Based on this, I was pretty sure that the problem was more likely in the servo circuits. A defective motor generally will not run properly in any mode. I gave the owner a lower estimate, based on my evaluation.

When the unit was placed in the play mode, the video and sound would speed up and then abruptly stop two or three times per second. A clear picture was always visible on the monitor but there were noise bars in the picture that are characteristic of the search modes. Occasionally the speed would become normal for about a second.

The speed at which the tape had been recorded made no difference. The symptom was also present when using a tape test jig. Since the test jig has no tape, there was no possibility that the symptom was caused by mechanical problems in the tape path.

An attempt with no schematic

I did not have a schematic for this model, so I looked for the pinouts of all ICs relating to servo operation in my cross references. Unfortunately, none of the ICs were listed. I was going to have to rely on my understanding of the circuit and whatever common test points I could find. Fortunately, the servo section boundaries were clearly marked on the PC board.

My first step was to check the capstan motor speed/phase control line, which originates at the servo IC and ends at the capstan motor board after passing through the integrators. At the motor board this line is yellow, whereas all other lines are gray (Figure 2). Measuring the voltage of this line while watching the analog bar graph of my DMM, showed that it was jumping erratically in step with the motor.

Knowing that this control voltage is derived from the combined outputs of both the speed and phase PWM blocks within the main servo IC, I attempted to backtrack. This unit uses just one 42 pin IC for both the capstan and drum servos. Two other 14 pin ICs, which were identical, were op amps (operational amplifiers).

I was able to trace the erratic control voltage back to pin 15 of the servo IC, which I assumed was either the capstan speed or phase PWM output. I could find no meaningful waveform at this pin with an oscilloscope.

Checking for a missing signal

I considered the possibility that one of

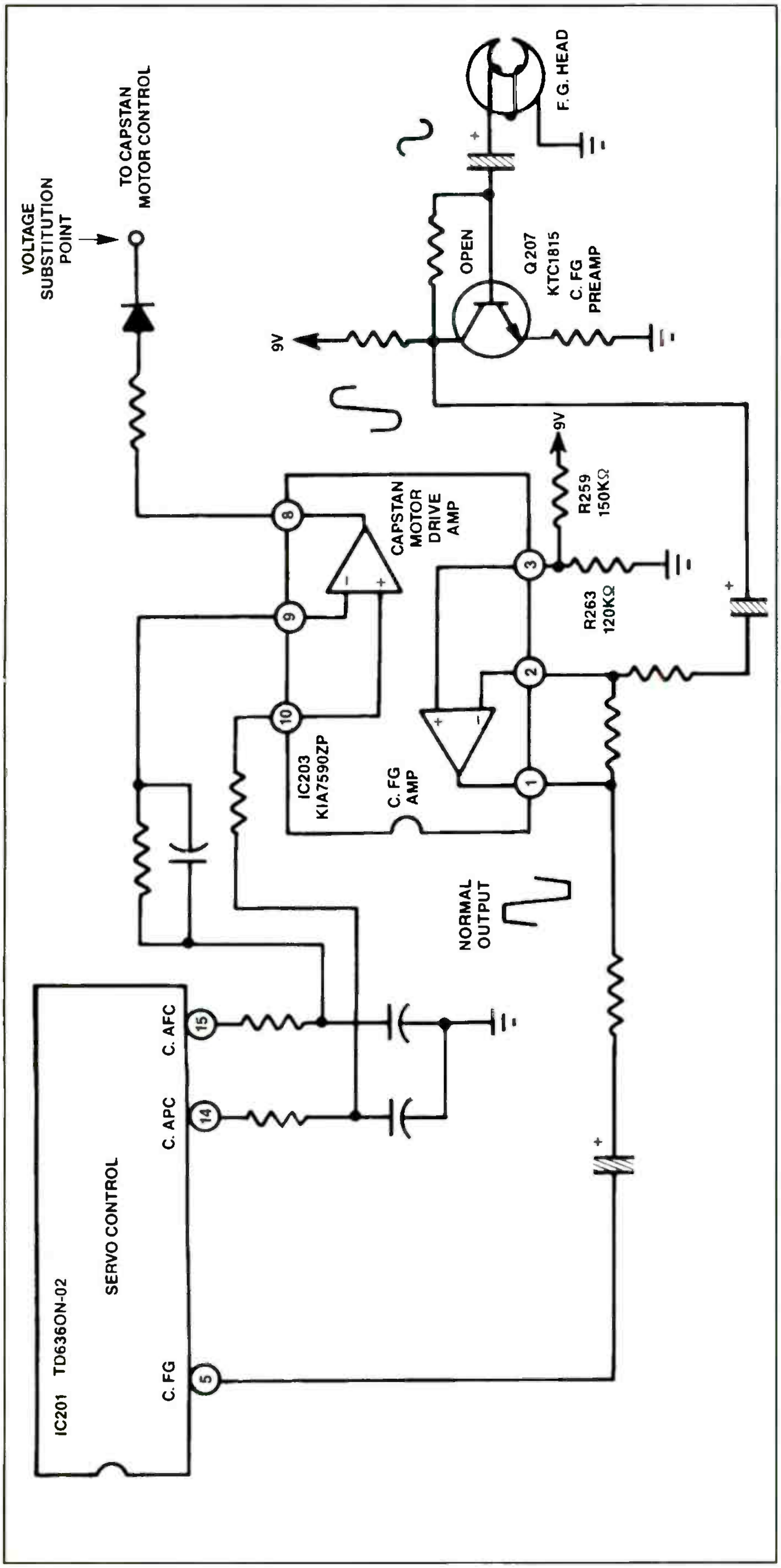


Figure 5. This diagram shows the capstan motor control segment of the VCR circuits. Note where I substituted the voltage from the diagnostic device.

the feedback signals or the 29.97Hz reference was missing or intermittent. Because the head drum appeared to be running normally, I ruled out the possibility that the 29.97Hz reference signal was missing. This signal is necessary for the proper operation of both the head drum and the capstan.

Just to be sure, I used the frequency counter function of my DMM and hunted for this signal. I found it at several pins on the op amps and one pin of the servo IC. I eliminated the possibility of a loss of CTL pulse from the control head, because the problem occurred even when using a cassette test jig. Again, because the test jig contains no tape there can be no CTL pulse.

I observed the capstan FG pulse at the FG head using the oscilloscope, but its amplitude and frequency were unstable because of the capstan speed variations. I was going to have to open one or more loops to isolate this problem. As in any loop system, a problem in one part of the loop will affect measurements in all other parts. The VCR diagnostic device would be helpful here.

Opening the loop

When I built the diagnostic device (Figure 3), instead of using voltage from the VCR for the supply, as was done in the original article, I decided to use a 4.8V Ni-Cd cordless telephone battery. This way, I would only have to make two connections to the VCR: one to the motor's drive control line and the other to ground. With the fine adjust control set to its center position, I adjusted the coarse adjust control for an output of about 2.3V. This is a common "run" voltage.

I traced the capstan motor control line to the component side of the main PC board, in order to gain access to it while the machine was right side up. I opened the line and connected the device's positive lead to the motor side of the line and the negative lead to the VCR's ground (Figure 4). I left the line that normally supplies the control voltage from the servo circuit unconnected.

Using a tape recorded in the SP mode, I placed the VCR into the play mode. When the tape was fully loaded around the head drum, I flipped the switch into the kick-start position and then quickly back to the run position. The capstan motor was now running at a constant speed but a little faster than normal.

I adjusted the fine adjust control until the sound seemed normal. The picture would alternate between clear video and snow as the video heads wandered into the guard bands and wrong azimuth tracks. This is normal for a properly working capstan motor when being manually controlled by an adjustable voltage source. Best results are obtained when using a tape recorded in the SP mode for this test. In other modes, the capstan motor runs so close to its stall point that it may need frequent restarting.

Examing the synchronizing pulses

Again I observed the FG pulses at the FG head. Their amplitude and frequency now were almost constant, but without the schematic I couldn't follow them through their conditioning circuits to the servo IC. What's more, I could find no pulse at any pin of the servo IC that had the characteristic trapezoidal appearance and frequency associated with the fully conditioned FG pulse.

However, I was able to find the drum FG and PG pulses, which looked normal. The FG pulse frequency was approximately 719.3Hz and the PG pulse frequency was 29.97Hz. To verify that these pulses were drum related, I loaded the drum motor by lightly pressing my finger against its upper surface. The frequencies of the two pulse trains changed.

Measurement showed that the line that normally provides the control voltage to the motor was stable when the motor was running at a constant speed. However, the voltage on that line would increase to about 7V when I lowered the motor speed to a certain point, and decrease to about 0.1V when I raised the speed.

The servo circuits were making some attempt to control the speed of the motor, but the control was far too loose. In any event, it looked as though the erratic FG pulses were somehow related to the erratic motor speed control.

Obtaining a schematic

At this point I decided that I was going to have to either obtain the schematic or resort to the "shotgun" method. Since shotgunning has no educational value, I opted to get a copy of the schematic. Understanding the exact cause of this problem was more important to me than trying to maximize profit.

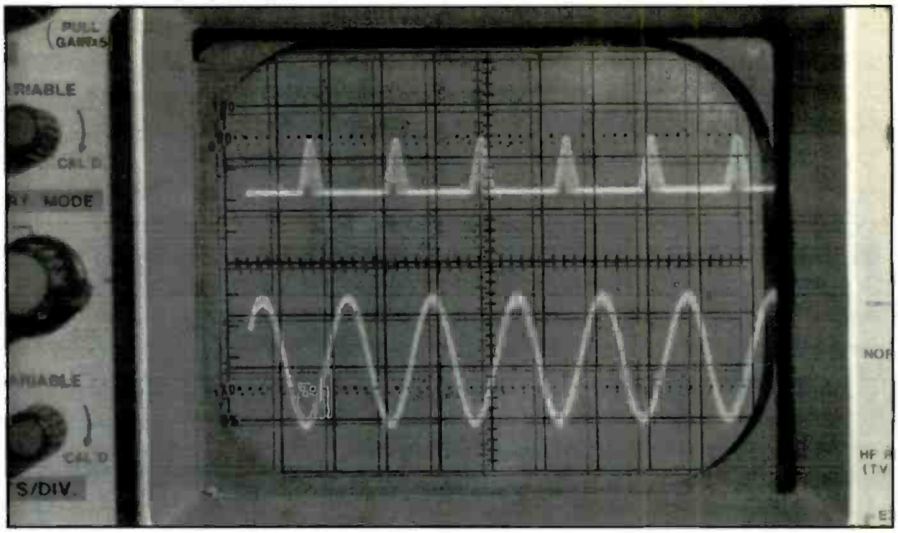


Figure 6. This oscilloscope photo shows the FG signal at pin 2 of IC203 (sinewave at bottom), a quad op amp. Pin 2 was the inverting input of the amp labeled "C.FG AMP". The spike at the top of the screen is the output of the op amp. The positive spike, present only when the motor was running well above its normal speed, occurred during the interval of the negative peak.

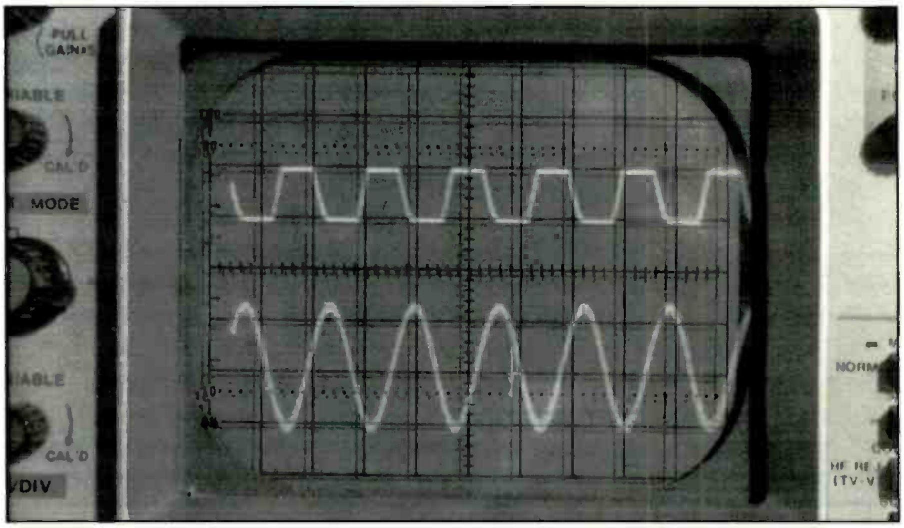


Figure 7. After replacing R259 I could see a clean trapezoidal wave (the correct signal) at the op amp's output regardless of the motor's speed.

When the schematic arrived (Figure 5), I focused my attention on the path from the FG head to the pin labeled "C.FG" on the TD6360N-02 servo control IC. The sine wave signal that was induced into the FG head by the rotating capstan magnets appeared normal. It was routed to the base of Q207, which was a preamp in a common emitter configuration.

I observed the signal at the base of that transistor with the diagnostic device connected and the VCR running at constant speed. I found the pulse amplitude to be $30mV_{pp}$. The signal at the collector was $700mV_{pp}$, showing that the stage provided considerable gain.

The signal was routed from the preamp to pin 2 of IC203, which was a KIA-75902P quad op amp. Pin 2 was the inverting input of the amp labeled "C.FG AMP". This amp is configured in such a way as to be driven alternately between saturation and cutoff by the input signal. This causes clipping of the top and bottom of the sine wave, creating a quasi-trapezoidal wave. Though the input to this amp looked normal, the output resembled a very narrow positive-going spike.

Solving the problem

Because IC203 also contained the properly working drum motor amp, I surmised that it was good, although it is not uncommon for a single amp in a multi-amp chip to fail. The non-inverting input (pin 3) of the capstan FG amp should be held at close to one-half of the 9V supply by the voltage divider consisting of R263 and R259. Measurement showed about 0.1V at this pin. A quick check of these resistors showed that R259 (150KΩ, 1/8W) was open. This caused the non-inverting input to be pulled close to ground by R263.

The output of an op amp swings high when the noninverting (+) input is more positive than the inverting (-) input and low when the situation is reversed. With the (+) input held at ground because of the open resistor and the (-) input above ground the op amp's output would always be low. When the amplitude of the sine wave became great enough, the negative peak would force the (-) input below the (+), which would drive the output high.

Scoping the input and the output of the op amp simultaneously showed that the positive spike occurred during the interval of the negative peak (Figure 6). The spike was only present when the motor was running well above its normal speed. After replacing R259 I could see a clean trapezoidal wave at the op amp's output regardless of the motor's speed (Figure 7). The amplitude of the wave was about $7.5V_{pp}$. I disconnected the diagnostic device and reconnected the motor control line. The machine ran perfectly. So exactly what had been happening?

The problem solved

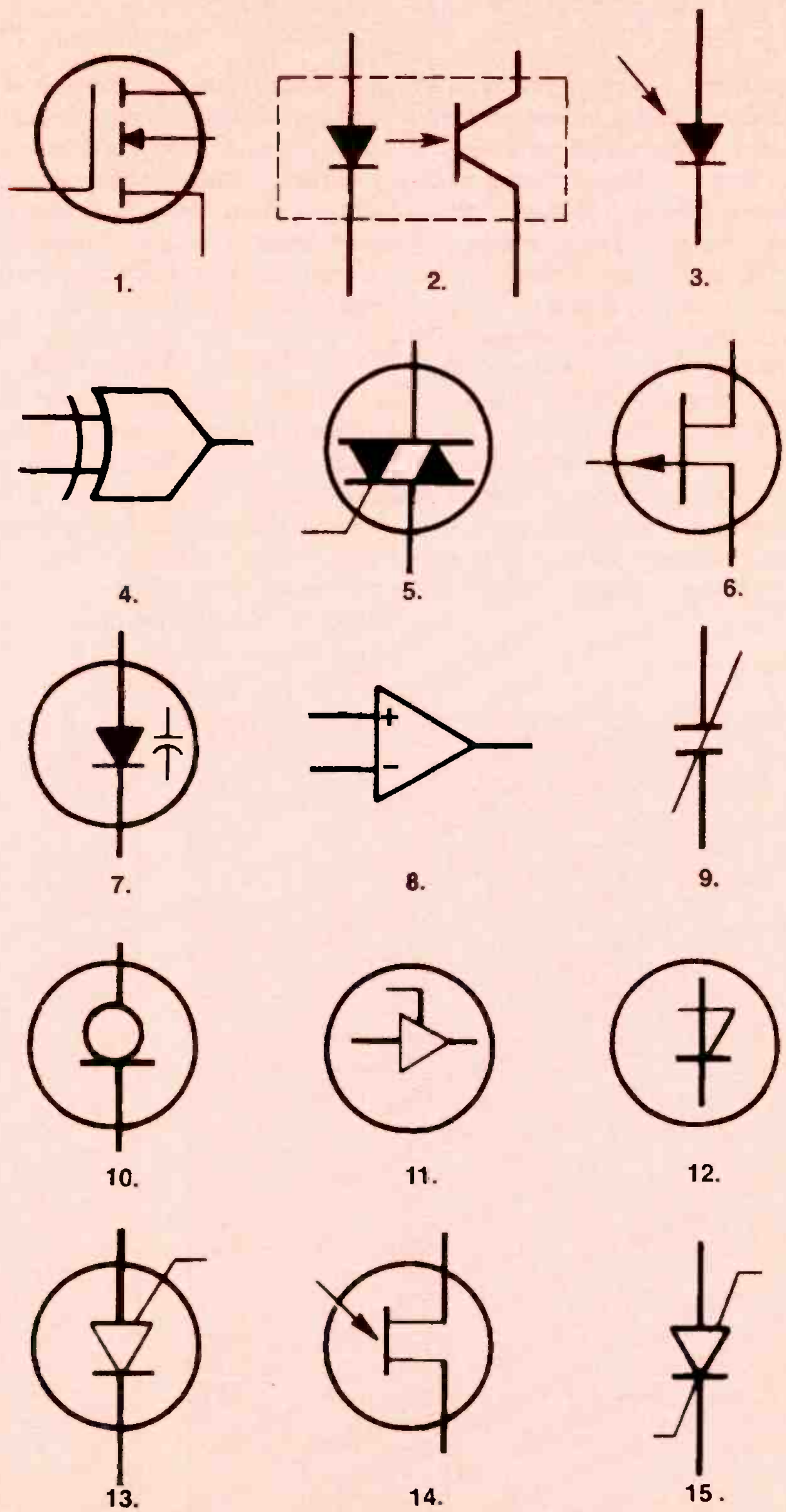
The AFC circuit within the speed control loop responded to the absence of the FG pulses by causing the motor speed to increase. This is understandable because an absence of pulses corresponds to the lowest possible speed (stop), which calls for the maximum correction. The fact that the motor was turning made no difference. Since the amplitude of the pulses induced in the FG head are proportional to the motor speed, the higher motor speed resulted in higher-amplitude pulses.

When the pulses reached a level where they could cause the improperly biased op amp to output a signal that was detectable by the AFC block, their frequency was too high. The servo circuits responded to this by instantly slowing the motor, which subsequently reduced the amplitude of the FG pulses below the level of detection. The result is the continuous changing of the motor's speed.

Servo circuits aren't difficult to repair if you have a good understanding of how they work and a basic knowledge of electronics. Using the diagnostic device, or another suitable voltage source, to open the loop would be extremely helpful in localizing the problem. Once this is done, normal troubleshooting procedures will lead you to the defective component. ■

Test Your Electronics Knowledge

Answers to the quiz *(from page 66)*



Multimeter update: Evaluating today's meters

By Conrad Persson

When Brattain, Bardeen and Shockley invented the transistor around forty years ago, they really started something. It wasn't long before consumer electronics products began to shrink in size, become lighter in weight and become more reliable. Oh, yes, they also began to increase in performance and features.

As electronics products changed, so did the test equipment used to troubleshoot them. The large, limited VTVM gave way to the handheld multimeter.

The evolution of the multimeter has gone so far today that we have available a large confusing assortment. An array of meters is available in sizes from shirt pocket to bench top, prices ranging anywhere from twenty to thousands of dollars, and measuring ability that extends from ac and dc voltage and current and resistance to other units that can measure not only those basics, but can also test semiconductor junctions, continuity, measure inductance, capacitance, frequency and temperature.

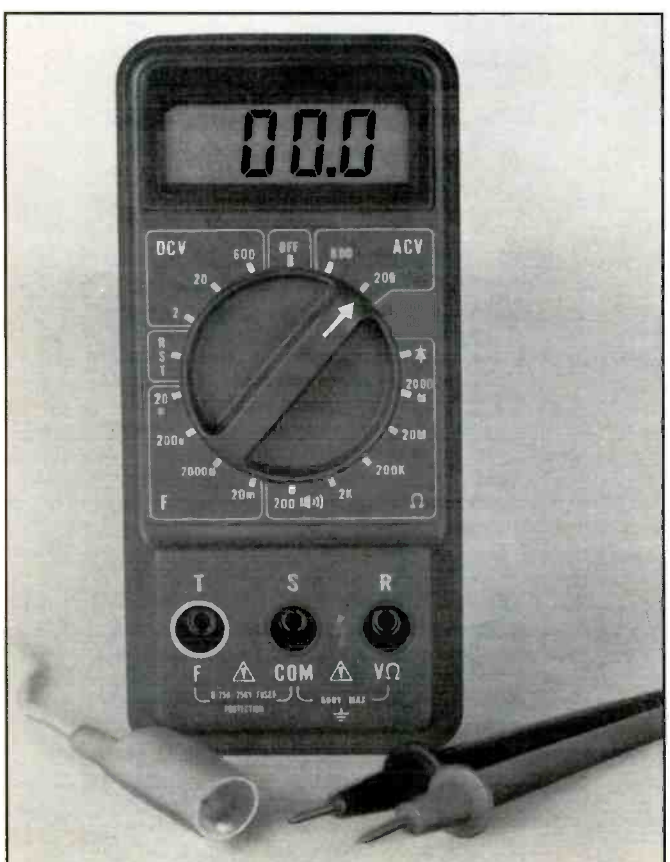
Persson is editor of ES&T.

Deciding what you need

With all of the meters and all of the features available today, the task of deciding what meter you should buy sometimes becomes a little like rolling dice; you know what the process is, but you're never sure what the outcome will be. You see a meter that sounds like it will do everything you need it to do, and it looks like a well made, professional meter. But will it, in fact, fill all your multimeter needs?

One good way to start in determining what you need in a meter is to write down, as much as possible, what you use currently available test equipment for. Keep a kind of log for several weeks, and at the end of that time see what you typically use a meter for, what other test equipment you have used during that period, the times when you have been unable to conduct testing as you would have liked to because the necessary test functions were not available.

As you evaluate your log, a pattern will emerge. You will probably find that you take a lot of dc voltage readings and a lot of resistance readings if you're like most service centers. You'll also probably find that you take occasional ac readings such as to find out if there's 120V available on the load side of a fuse or breaker. Not too



many consumer electronics service centers perform much current reading: that requires that you break the circuit and put the meter in the line.

Basic multimeter features

If the only things you use a multimeter for are to make voltage, current and resistance readings on the bench, then just about any good, solid, reliable multimeter will do. Your only concerns are whether it's accurate enough and reliable enough.

For most servicing and troubleshooting, meters don't have to be terribly accurate. For the most part when you're measuring voltages, you have to be able to confirm that they're there, and somewhere in the correct range.

However, to make sure that you're getting a meter that will stand up to the rigors of constant use by a professional, it's best to buy a meter that has a brand name that you can trust, and that tells you that the meter, as well as the probes and any other accessories, are of adequate quality. In other words, you don't want to be paying attention to the meter. You want to be paying attention to the work.

To underscore this point, I once had a cheap meter with a name most people would recognize, and I seldom used it. It was accurate enough, but every time I used it, I found that the probe, which was soldered to the lead wire, had broken off at the solder joint. I guess the lead wires were brittle, or otherwise not suited to the task. A professional can't afford that kind of hassle.

Other standard features

Technicians who troubleshoot down to the component level, as most consumer electronics servicing technicians do, need some method of confirming whether a component is faulty once it has been implicated as the cause of the problem and removed from the circuit.

Resistors can be checked with the ohmmeter. A shorted or open capacitor or an open inductor can frequently be detected with the ohmmeter. But the condition of semiconductor junctions frequently can't be determined without the proper diode test. For that reason, the diode test is a must for consumer electronics service.

Continuity measurements are sometimes a frustrating exercise with a DMM. If there's any capacitance in the circuit, the technician may watch the digits change, and never be quite sure what's going on.

If the multimeter has a continuity beeper, that ceases to be a problem. If you touch the probe to two points and the meter beeps, there's continuity between the two points. If the meter doesn't beep, no continuity.

You may need these features

Because microminiaturization has made it possible for multimeter designers to pack a lot of functionality into a small package, some handheld meters now offer inductance, capacitance and frequency measurement. And with some meters you can even measure temperature. However, each of these neat features that goes into the meter also raises the price tag. If you need these features, it's a pretty inexpensive way to get them. If you don't need them, however, it doesn't make sense to pay a premium price just in case you might one day need it.

What the specs mean

Most meter specification sheets list the measurement ranges for each of the meter's functions, measurement accuracy, and the number of digits or the number of counts, or both.

Measurement accuracy

Accuracy simply provides the buyer with a measure of how close the meter reading will be to the actual value of the parameter being measured. As an example, if a meter is specified to have an accuracy of ±0.5%, the reading on the meter display may be one half of one percent higher, or lower than the actual value. For example, if you're reading 100V at some point in the circuit, the actual value might be 99.5Vdc or 100.5Vdc. For most service work, then, 0.5% accuracy is more than adequate.

Number of display digits

You'll frequently see DMMs rated in terms of digits in the display. Usually this will be a number of digits, plus $^1/_2$. For example, a typical meter display is $3^1/_2$ digits. The $^1/_2$ digit simply means that in addition to the three seven-segment digits, which can assume any value from 0 to 9, including the numeral 8, which uses all seven of the segments, the most significant (leftmost) digit has two segments, and thus can only have a value of 1.

This "half" digit allows the designers to effectively double the value that can be displayed while only adding two display segments and enough circuitry to address those segments. For example, three digits can display 999, while $3^1/_2$ digits can display 1,999.

Number of display "counts"

The number of display counts is another method of specifying displays. A typical display specification is "2000" counts, which tells the prospective user that it can capably display 2000 different values, from 0 to 1999.

Making the purchase

All things considered, today's multimeters, in general, represent excellent value. They offer accuracy, versatility, reliability, ruggedness, and can tell a savvy technician a lot about the circuits he's probing. A little planning on the part of the technician can help to make sure that the meter selected will do everything he needs it to do. ■

NTSC Part III—RF Signals

By Arthur Flavell

This is the third in a series of three articles that describe the NTSC video signal and its applications in video equipment. Part I examined sync signals and their role in circuit control and timing. Part II looked at the other elements of the composite signal—luminance and chrominance. Part III discusses use of baseband video and audio signals to modulate an rf carrier for efficient signal distribution.

Baseband signals

Baseband video and audio signals may be used together to reproduce a complete program consisting of a color picture and sound. However, because of the range of frequencies in these signals, they are not well suited for wide-area distribution.

Figure 1 illustrates the frequency spectra of the various signals. Note that all four components occupy some of the same frequencies at the lower end of their ranges. A distribution method must be used which allows all four elements to be included, without losing critical information and without significant interference between the individual signals.

Why rf?

One of the primary objectives of the NTSC was to create a national broadcast standard which would allow widespread distribution of television programming. A scheme was developed which provided for the inclusion of all necessary signals in a single rf channel with a bandwidth of 6MHz.

Initially, distribution was the exclusive domain of the broadcasters, with direct transmission to the viewer via the airwaves. Since those early days, other methods of signal transfer have been devised, including cable, video tape, laser disc and satellite. Through all the developments thus far, the NTSC format for rf channelization has remained in effect.

Putting the pieces together

Part of the problem of getting several signals to peacefully coexist in a single rf channel has been solved by the production of composite video. (This was discussed in detail in Part II of this series.) In essence, video signals (Y and C) and sync signals (V and H) use the technique of time division multiplexing. That is, they take turns modulating the carrier, with video signals using one segment of time and sync signals using the next.

Sync signals are kept from interfering with the reproduced picture by blanking the video for brief periods and placing the sync pulses in the over-scanned area of the screen that is not visible to the viewer. Luminance and chrominance signals share the same frequency spectrum, even though the two bandwidths overlap.

This is accomplished by shifting the chrominance (chroma) information in frequency to a relatively unused segment of the luminance (luma) bandwidth. The chroma signal is used to modulate a 3.579545MHz subcarrier, producing sidebands which carry chroma information.

To prevent interference in the reproduced video, the chroma subcarrier itself

Flavell is owner of an independent consumer electronics service center in Alaska.

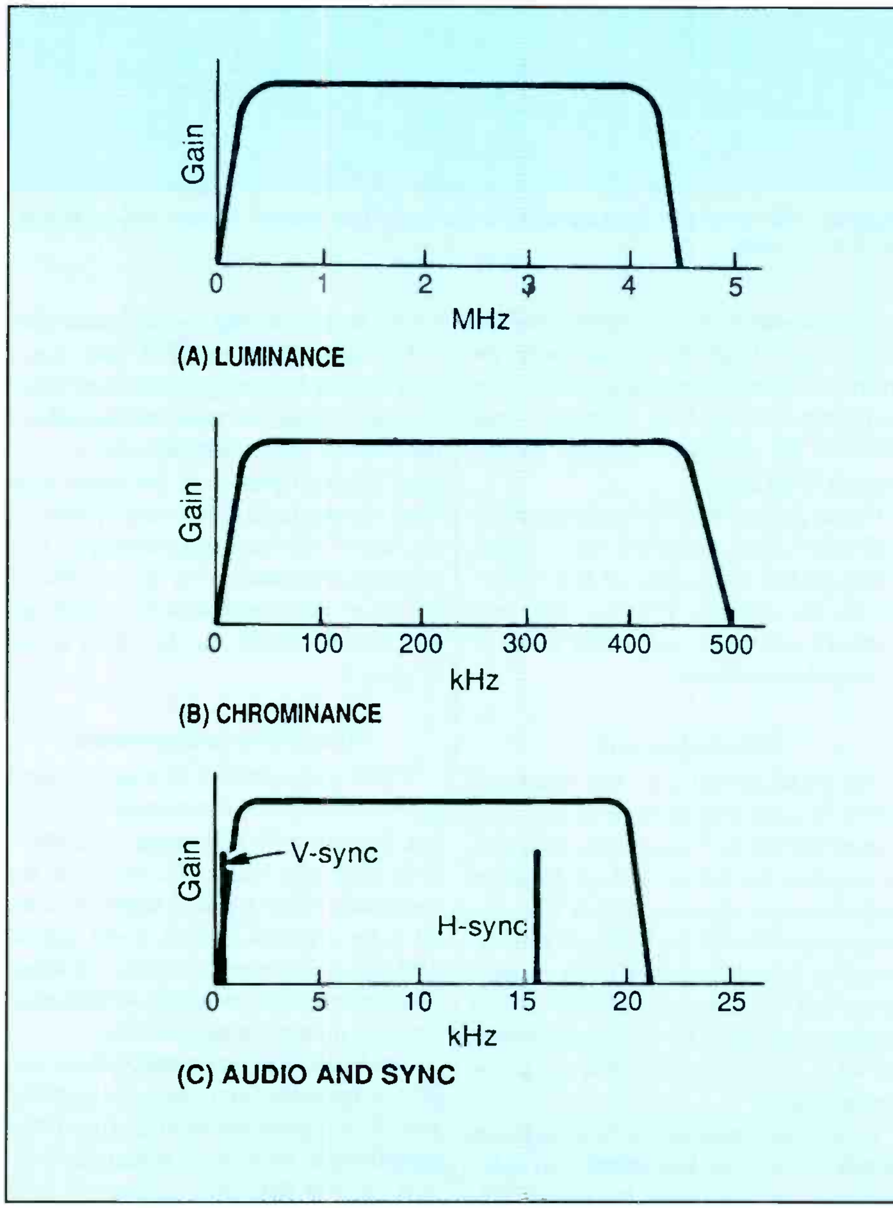


Figure 1. The frequency spectra of the various TV signals.

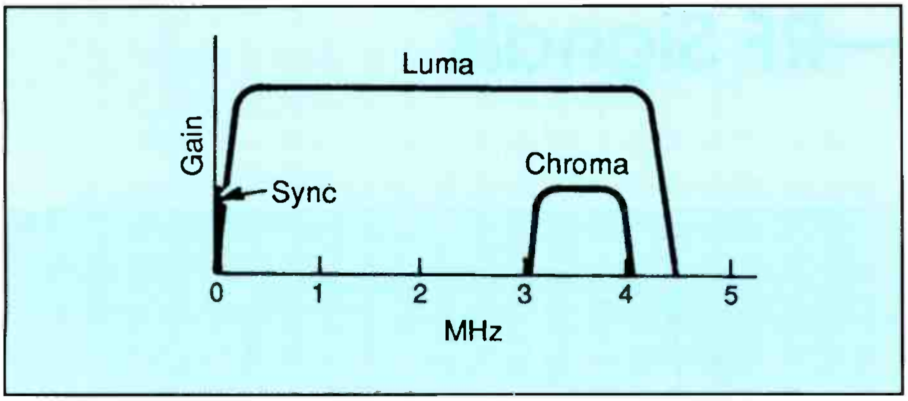


Figure 2. The composite video signal is the product of four different signals: V-sync, H-sync, luma and chroma.

is not transmitted. It is reinserted into the receiver by a local chroma oscillator. To ensure accurate color reproduction, the oscillator is locked in frequency and phase to the original subcarrier by the chroma burst signal.

Figure 2 illustrates the frequency characteristics of the composite video signal. Although it is the product of four different signals (V-Sync, H-Sync, luma and chroma), composite video still exists at baseband frequencies.

Conversion to rf

The NTSC system uses the composite video signal to amplitude modulate an rf carrier. The carrier frequency is chosen to be suitable for the desired propagation characteristics. Actual channel frequencies are specified by the Federal Communications Commission (FCC) in cooperation with international authorities. The sidebar contains frequency information for the rf channels in common use in the United States.

Amplitude modulation produces an output comprising the carrier and sidebands above and below the carrier frequency. The frequency spectrum occupied by a sideband is proportional to the frequency of the modulating signal. With composite video as the modulating signal, the upper sideband extends 4.2MHz above the carrier frequency and the lower sideband extends 4.2MHz below. The total bandwidth used is 8.4MHz.

The am detector in a receiver uses only one sideband to recover the transmitted information. Because of this, part (or all) of one sideband may be eliminated without sacrificing any program content. In addition, improved frequency spectrum utilization and transmission efficiency results from reducing overall bandwidth.

The video signal in NTSC uses a process known as "vestigial sideband transmission." A special bandpass filter allows the carrier, upper sideband and a "vestige" or small portion of the lower sideband to pass. In this case, only 750kHz of the lower sideband gets through. This segment, combined with the 4.2MHz of the upper sideband results in a total bandwidth of 4.95MHz for the video signal (Figure 3).

Modulation measurement

NTSC uses a system of negative modulation. That is, the more positive the signal, the lower the percentage of modulation, and vice versa. In terms of the composite video signal, a highly saturated color segment (which could exceed 100 IRE units) would produce minimum modulation. Sync pulses, at -40 IRE units, produce maximum modulation.

The levels of program material are usually set using the luminance and sync signals. Sync signals are set to produce 100% modulation. Maximum luminance signals (at 100 IRE units) produce 12.5% modulation. It is important to observe these limitations when adjusting rf systems. The audio subcarrier relies on some level of video carrier to beat against. If video carrier modulation is permitted to fall too low, a loud buzz is produced in the audio channel.

What about audio?

The audio program is used to modulate another subcarrier which is positioned 4.5MHz above the video carrier. This places it above the passband of the video upper sideband.

The audio subcarrier uses frequency modulation as opposed to the amplitude modulation used for the video carrier. The maximum modulation level is specified at ± 25 kHz for 100% modulation. For improved signal to noise performance, pre-emphasis is used at the transmit end and de-emphasis at the receive end, much as in broadcast FM.

FM transmissions are more immune to natural and man-made noise interference than AM systems. Because of this fact, acceptable signal-to-noise ratios may be realized with a lower transmit power than that used in the video circuits. The audio subcarrier is typically 13dB to 17dB lower than the video carrier.

The rf channel

Figure 3 illustrates the frequency spectrum of a typical rf channel. Channel 3 is shown as it is commonly used as the output channel of VCRs.

Note that the total bandwidth of the channel is 6MHz. The video carrier is positioned 1.25MHz above the lower edge of the channel allocation. The chroma subcarrier frequency is 3.579545MHz above the video carrier and the audio subcarrier is 4.5MHz above the video carrier. This frequency relationship holds true for every rf channel.

From the low-frequency end of the channel to the -3dB point of the lower sideband is a segment 500kHz wide that is not used. A similar unused segment 250kHz wide exists between the audio subcarrier and the upper channel edge.

These two segments combine to form a 750kHz guard band between channels. This separation is necessary to prevent the video carrier of one channel from interfering with the audio subcarrier of the channel below in adjacent channel systems.

Working with rf signals

Television rf signals are designed for use with a television receiver. The input to the receiver, whether from antenna, cable system or VCR, must be of adequate level and signal-to-noise ratio to produce good results. Low signal strength can produce a noisy, snowy picture. High signal strength can cause front end overload and AGC pulling. This typically appears as excessive contrast or a dark screen with loss of horizontal synchronization.

To ensure the proper input level to a receiver, a means of specifying and measuring signal strength is needed. The unit

These tables show the characteristics of the broadcast channels and cable channels currently available under NTSC (the National Television System Committee).

BROADCAST CHANNELS—VHF

CH NO.	VISUAL CARRIER	CHANNEL FREQUENCY
2	55.25	54 - 60
3	61.25	60 - 66
4	67.25	66 - 72
5	77.25	76 - 78
6	83.25	82 - 88
7	175.25	174 - 180
8	181.25	180 - 186
9	187.25	186 - 192
10	193.25	192 - 198
11	199.25	198 - 204
12	205.25	204 - 210
13	211.25	210 - 216

BROADCAST CHANNELS—UHF

CH NO.	VISUAL CARRIER	CHANNEL FREQUENCY
14	471.25	470 - 476
15	477.25	476 - 482
16	483.25	482 - 488
17	489.25	488 - 494
18	495.25	494 - 500
19	501.25	500 - 506
20	507.25	506 - 512
21	513.25	512 - 518
22	519.25	518 - 524
23	525.25	524 - 530
24	531.25	530 - 536
25	537.25	536 - 542
26	543.25	542 - 548
27	549.25	548 - 554
28	555.25	554 - 560
30	567.25	566 - 572
31	573.25	572 - 578
32	579.25	578 - 584
33	585.25	585 - 590
34	591.25	590 - 596
35	597.25	596 - 602
36	603.25	602 - 608
37	609.25	608 - 614
38	615.25	614 - 620
39	621.25	620 - 626
40	627.25	626 - 632
41	633.25	632 - 638
42	639.25	638 - 644
43	645.25	644 - 650
44	651.25	650 - 656
45	657.25	656 - 662
46	663.25	662 - 668
47	669.25	668 - 674
48	675.25	674 - 680
49	681.25	680 - 686
50	687.25	686 - 692
51	693.25	692 - 698
52	699.25	698 - 704
53	705.25	704 - 710
54	711.25	710 - 716
55	717.25	716 - 722
56	723.25	722 - 728
57	729.25	726 - 734
58	735.25	734 - 740
59	741.25	740 - 746
60	747.25	746 - 752
61	753.25	752 - 758
62	759.25	758 - 764
63	765.25	764 - 770
64	771.25	770 - 776
65	777.25	776 - 782
66	783.25	782 - 788
67	789.25	788 - 794
68	795.25	794 - 800
69	801.25	800 - 806

CABLE CHANNELS—MID BAND

STD DES	CH NO.	VISUAL CARRIER	CHANNEL FREQUENCY
A	14	121.25	120 - 126
B	15	127.25	126 - 132
C	16	133.25	132 - 138
D	17	139.25	138 - 144
E	18	145.25	144 - 150
F	19	151.25	150 - 156
G	20	157.25	156 - 162
H	21	163.25	162 - 168
I	22	169.25	168 - 174

CABLE CHANNELS—SUPER BAND

STD DES	CH NO.	VISUAL CARRIER	CHANNEL FREQUENCY
J	23	217.25	216 - 222
K	24	223.25	222 - 228
L	25	229.25	228 - 234
M	26	235.25	234 - 240
N	27	241.25	240 - 246
O	28	247.25	246 - 252
P	29	253.25	252 - 258
Q	30	259.25	258 - 264
R	31	265.25	264 - 270
S	32	271.25	270 - 276
T	33	277.25	276 - 282
U	34	283.25	282 - 288
V	35	289.25	288 - 294
W	36	295.25	294 - 300

CABLE CHANNELS—HYPER BAND

STD DES	CH NO.	VISUAL CARRIER	CHANNEL FREQUENCY
AA	37	301.25	300 - 306
BB	38	307.25	306 - 312
–			
–			
ZZ	62	451.25	450 - 456
AAA	63	457.25	456 - 462
–			
–			
XXX	86	595.25	594 - 600

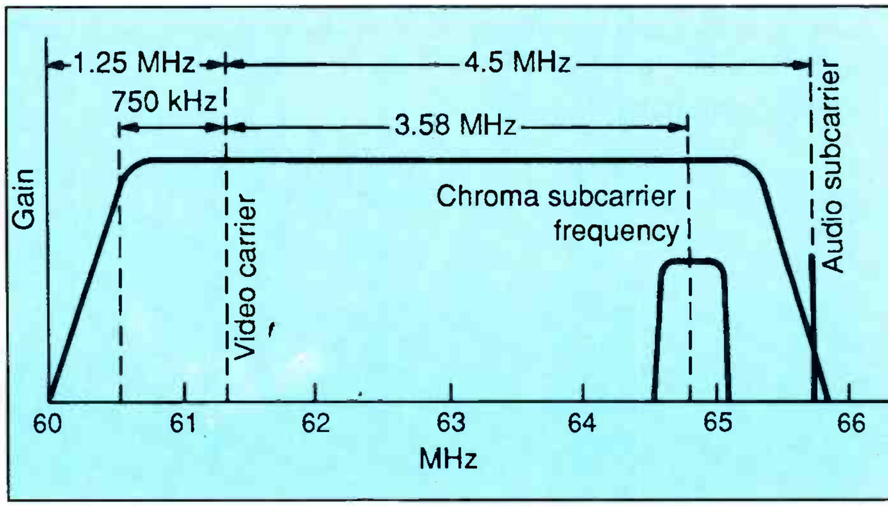


Figure 3. The frequency spectrum of a typical rf channel.

of measurement for rf signal levels is the dBmV. A level of 0dBmV is produced by a signal voltage of 1 millivolt across a 75Ω load. Levels are measured with an rf signal level meter.

Most television receivers are designed to work with a nominal input signal of 0dBmV. Although acceptable results may be obtained with lower levels, most industry professionals try to set levels between 0dBmV and +10dBmV at the set.

The signal level meter may be used to measure off-air signals from an antenna. It is particularly useful when installing an antenna system that feeds several outlets.

For example, assume you wish to place four antenna jacks in a home. A typical four-way splitter will cause a 7.5dB loss from the input to each of the outputs. If the signal strength from the antenna is +3dBmV, the level will be -4.5dBmV out of the splitter. There is also loss in the cable length from the splitter to each outlet to be considered.

The level at the set may be as low as -5dBmV or lower and poor picture quality could result. Knowing the signal level from the antenna (by using the meter) allows you to install an appropriate line amplifier upstream of the splitter and provide the customer with good quality results. Without the meter, it is a hit-or-miss proposition at best.

RF interference

The rf interference, or rfi, is always a concern when working with rf signals. VHF and UHF broadcast channels are designated for distribution via the airwaves. Cable channels, however, share spectrum with many other services, including aviation, business, public service and amateur users. The FCC imposes stringent signal leakage limits (and penalties for failure to comply) on cable operators. In some systems, cable channel frequencies are offset to further minimize interference problems. These channels are designated HRC (harmonically related carriers) and IRC (incrementally related carriers).

Consumer electronics technicians need to be conscious of the problem as well. Special care should be taken when making connections in rf systems. Use good quality cable and connectors. Use proper techniques when making connections.

Poor connections result in poor system performance, signal leakage and signal ingress. Signal ingress problems arise when a broadcast signal invades a cable system. This can cause co-channel interference when the cable system has programming on the same channel as the broadcast station. With two signals of the same channel being fed to the receiver, the results can range from annoying to downright frustrating.

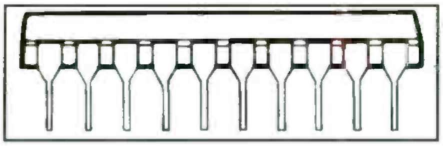
Where do we go from here?

Literally hundreds of rf distribution systems already exist. They range from homes with multiple antenna or cable outlets to schools, hotels and convention centers with MATV systems. Many of these systems are in dismal condition and in serious need of repair, upgrade or outright replacement. Acquiring a fundamental knowledge of the NTSC system and a moderate amount of test equipment can enable technicians to open up many new service markets. ■

New concept for IC wiring

Toshiba Corporation announces that its researchers have proposed a new concept for the basic architecture and interconnect wiring of future generations of integrated circuits. Computer simulation of the proposed architecture, quantum interconnection with cellular architecture (QIC), have confirmed its fundamental operation, indicating applicability to highly advanced quantum effect devices, such as dynamic random access memories with a capacity in excess of 1 terabit. (1 terabit = 1,000 gigabit, or one trillion bits)

Each new generation of highly integrated electronic devices depends on progress in microprocessing, including the ability to form extremely fine electrodes and their interconnect wiring. The wiring alone already accounts for more than 50% of the surface area of chips, and poses one of the greatest challenges to greater levels of integration. Further increases in the



number of electrodes on chips raises the danger of bottlenecks in the wiring, hurting performance. In addition, the physical limits of sub-micron microprocessing are drawing nearer, prompting interest in a new approach to chip design that does away with electrodes and hard wiring.

QIC proposes an architecture that operates at a sub-atomic level and which makes use of the quantum characteristics of electrons to form circuits. The basic structure consists of a series of closely-arranged cells. These cells use electron confinement phenomena to store two electrons on four or five quantum dots, which can be understood as tiny holes holding individual electrons. The electron tunnel effect is used to change and control the position of the electrons in the cell, while Coulomb interaction, the phenomenon governing the attraction and repulsion of electrons, is used to control electron attitude and allow signals to be transmitted through the circuit.

This proposed architecture enjoys numerous merits. An electronic device that has no need for electrodes or metal wiring would be much smaller, achieve much higher levels of integration, and offer very, very low power consumption. The basic design also has wide applicability: simulations laying out cells in a loop have demonstrated logic circuits, including inverter circuits and AND/OR circuits, all of which have shown stable operation.

The company plans to continue to develop the new architecture, with the goal of realizing future generations of commercial devices.

Computer modules and components

By David Presnell

In several previous articles I have discussed computer servicing in general. This article will take a look at the modules that make up a typical IBM compatible computer and the individual components that make up the modules. It will also discuss component level servicing versus module or card replacement. Future articles will look at making component level repairs on computer modules.

The basic building blocks

The computer is made up of various modules. Modules are the boards and boxes that contain the components (chips, resistors, capacitors, etc.). The modules of the computer include:

- the power supply
- the motherboard
- the case
- the monitor
- the video/printer I/O (input/output) card
- the keyboard
- the floppy disk drive(s)
- the hard disk drive
- the hard/floppy disk I/O controller card (may be two cards on some computers

Modern computers may also contain a fax/modem (internal card or external unit), a tape back-up drive and controller, a CD-ROM drive and controller, a game board, a mouse, a joystick, and a printer.

Repair or replace

It's often a coin toss for a technician to determine when to attempt component level repair or replace the module of a malfunctioning computer system. Cost has to be the deciding factor.

Let's assume you discover that an IC on a disk controller card is defective. The IC will cost you $8.00, and a new controller card will cost you $16.00 plus shipping. Which way would you proceed? What if the chip is a plug-in DIP? What if the chip is a 128-pin surface-mount device (SMD)? That brings up some interesting points.

First, take a look at the approximate wholesale prices of some of the replacement modules available for the IBM compatible, as shown in Table 1. These prices are for commonly available products with at least a one year warranty, purchased in single quantity.

The prices in Table 1 are by no means firm. In fact, when you call your supplier, you may find prices much lower than the lower limits I mentioned above. You

230W AT power supply	$39.00	to	$79.00
386 motherboard w/cpu	$65.00	to	$79.00
486 motherboards w/cpu	$189.00	to	$699.00
Case, baby AT w/hardware	$39.00	to	$99.00
Monitor 14-inch SVGA 0.28 DPI	$199.00	to	$399.00
Video/printer card, SVGA, 1MB	$59.00	to	$150.00
101-key enhanced keyboard	$16.00	to	$89.00
3-1/2 inch 1.44MB floppy disk drive	$39.00	to	$85.00
250MB IDE hard disk drive	$181.00	to	$245.00
IDE 2H/2F/2S/1P/1G controller	$11.00	to	$25.00

Table 1. Approximate wholesale prices of some of the replacement modules available for the IBM compatible.

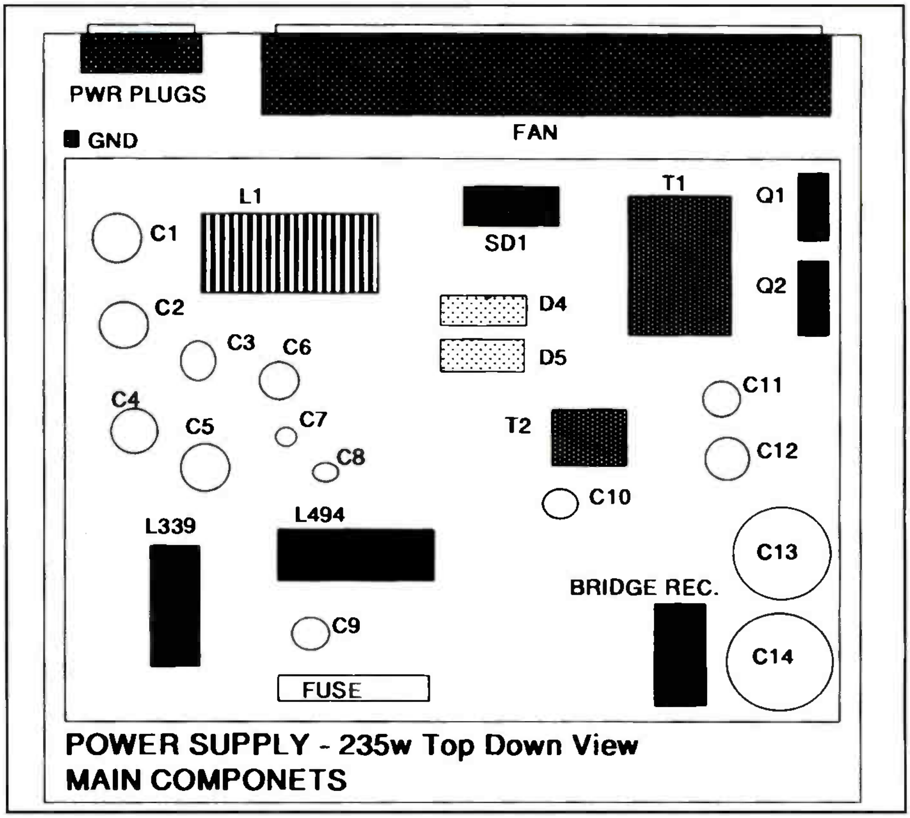


Figure 1. The primary components of a 235W power supply. The easily diagnosed and replaceable components include the power plugs and cords, fan, various common capacitors and resistors, input diodes and/or bridge rectifiers, L339, L494, and the fuse.

Presnell is owner of an independent computer servicing business and a freelance technical writer.

will pay the higher prices for name brand products. In many cases, you can increase the quantity to two or three and reduce the price significantly.

Note that the prices are for products available through mail-order suppliers. The IDE controller card mentioned in the table is a single card that provides connections for two IDE hard disks, two floppy disk drives (any size), two serial devices (such as a mouse or external modem), a parallel printer, and a game port for a joy stick.

Now, let's see if we can take some of the guesswork out of knowing when to attempt component level repair or to replace the module with a new one. The first stage of any repair is to locate the module (power supply, motherboard, etc.) that is causing the problem. Once you've isolated the defective module, then ask yourself a few questions.

Can I perform the component repair?

This may seem to be a simple question, but consider your situation for a moment. You've located a 40-pin DIP chip on the motherboard as the probable defective component. Can you desolder the defective chip and install and solder in a new chip without destroying the motherboard?

Many motherboards are multi-layered. Simply put, the circuit traces you see on the top and bottom of the board are not necessarily the only traces that exist. There may be traces hidden between layers. If an internal trace becomes damaged you can figure on replacing the board.

In fact, many service manuals discourage desoldering anything from a computer motherboard, even a resistor. These manuals will often instruct you to cut the leads close to the part and solder the new part (or socket) to these existing leads. Chips are replaced on motherboards regularly, including VLSI surface mount devices. If you plan to do so on a regular basis, you will need to purchase and use properly, some specialized equipment.

Can I perform the service quickly?

I try not to rush a computer service job, but time is money. You can be sure your customers will want their computers back up and running quickly. What is quickly? You will see ads for computer service turnarounds of 24 hours or less. Most of the companies that offer such quick service have a large 24-hour staff of highly-equipped technicians just waiting to sell you a new motherboard for your computer at a very nice price.

The quicker your turnaround, the higher the rate that you will charge. In my market area, two days seem to be tolerated by most of my customers.

I hear a lot about quick service, but when it comes to computers, you must take enough time to make sure you have a complete repair. Thorough testing after servicing can be just as important as diagnostics during servicing. If you rush through a service procedure only to receive the computer back the next day, you lose. Spending an extra ten minutes to assure that the service was performed completely and properly is a lot more profitable than wasting an hour with an upset customer trying to explain why you didn't correct the problem. Remember, working on returns keeps you from working on other profitable jobs.

With that said, I will open myself to criticism. My average bench service takes one hour and 15 minutes. My average single computer installation (including standard software) takes about two hours. About 89

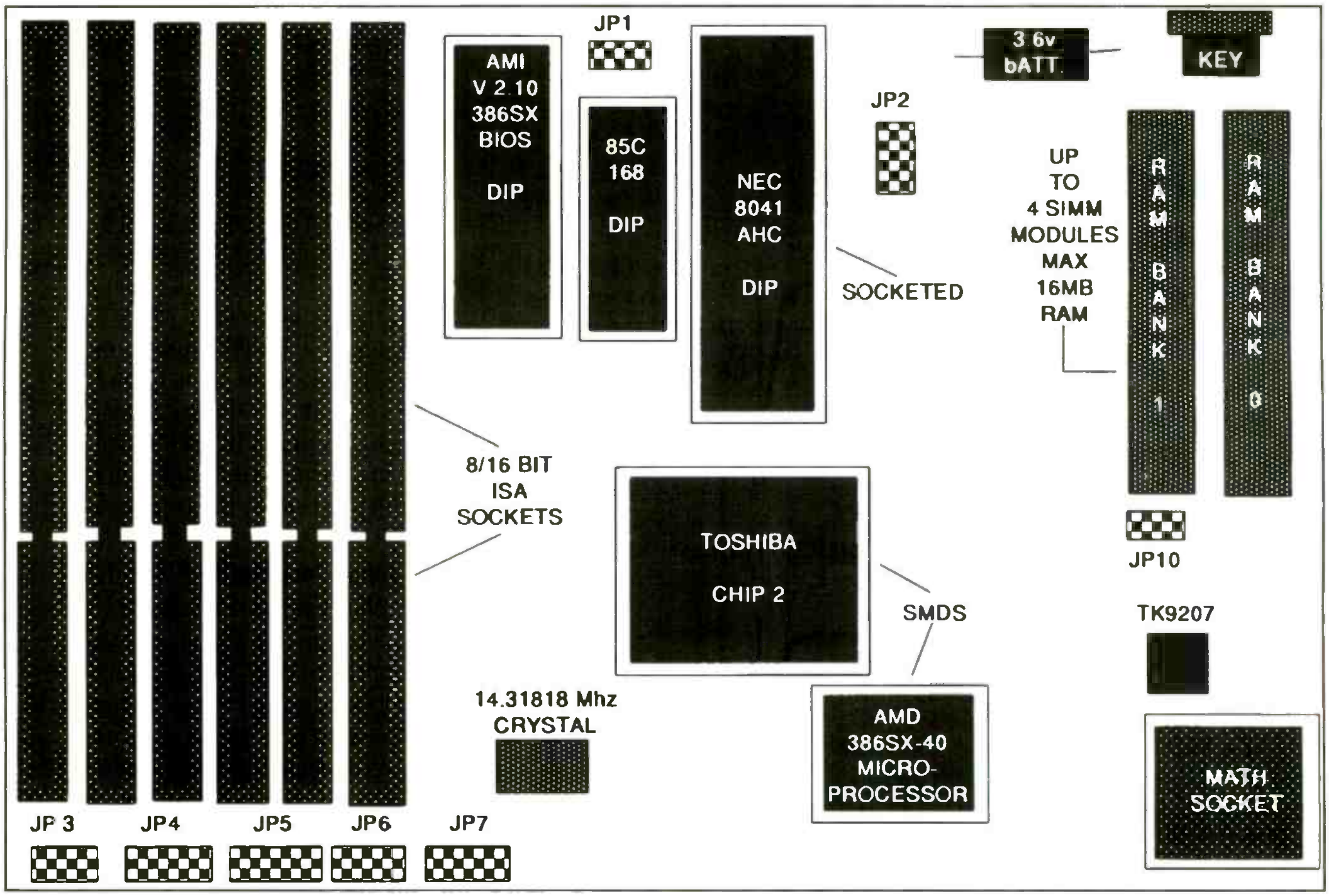


Figure 2. The primary components of a typical 386-SX-40Mhz motherboard. When the motherboard fails, always look first at the simple things. It may be nothing more than a loose jumper or connector. The only socketed chip on this motherboard is the 40-pin 8041 keyboard and I/O interface chip.

percent of the hardware related service I perform consists of module replacements, but the 11 percent of service in which I replace components is highly profitable.

Replace the module or the component?

If you've only located the defective module, you can spend a lot of time tracing the defect down to the component. As a general rule of thumb, if the module costs under $50.00, by all means replace it. This includes connector cables, plugs, and power cords, as well.

If the cost of the module was between $50.00 and $100.00, (power supplies, floppy disk drives), you could attempt component repair if you can locate and begin replacement of the defective component in less than 15 minutes. If you replace a bridge rectifier (or four input rectifier diodes) and a fuse (a common problem) in a $69.00 power supply, and it still doesn't work, install a new power supply. You might finish the repair later and sell it as a used supply, or scrap it for used parts.

With modules costing over $100.00, you must spend a little more time trying to pin down the specific defect. If a hard disk drive quits working as a result of mechanical problems, however, replace it. If it is so worn that it crashes, it needs replacing anyway.

There are a few companies that repair hard disk drives but the cost comes close to that of buying a new one. Monitors can usually be repaired, but don't spend three hours on a monochrome monitor that can be replaced for $89.00.

Can I perform component-level service cost effectively?

I've already discussed this question in the previous paragraphs, but I will add a few more comments. In today's fast-paced world, it's easy to forget the value of a good old penny. A good friend of mine (and master electronics technician), recently reminded me about drops of water falling into a bucket. Before long, the bucket will be full.

Pennies lost on your bench will quickly turn into lost dollars and lost profits. I think about cost effective repairs more than repair time. If you have the knowledge, skill, and equipment, then your repair time will be efficient and competitive.

Can you repair a module at a cost that will make your customer happy and give you a satisfactory profit? If you wish to test this theory, then just try to charge a customer $100 for repairing an 8-year-old monochrome monitor when they could have purchased a new one for $129.95.

Component list

Let's look at some of the primary components of the computer's various modules. Since there are so many different types of modules and thousands of various components, I will limit my discussion to the primary components and those that might be replaceable.

The computer case

Let's begin with a typical computer case: the mini AT desktop. From the manufacturer, a case should contain the following parts:

- 8Ω, 0.5W speaker,
- DPDT switch,

- mounting hardware package,
- hard disk LED,
- power LED,
- turbo LED,
- keylock & keys.

The speakers used in computers are commonly available, and do occasionally fail. The DPDT switch can become defective, and although a little harder to find, can be obtained from many electronics parts suppliers. The LED's will sometimes fail and require replacement.

Plug-in cards

Next, let's look at the many available plug-in cards for the IBM compatible computer. When a card doesn't work, first make sure it is plugged in correctly and seated enough to make good contact. Some have screws that allow adjustment when mounted. If a card such as a multi-I/O card fails, generally replace it. These cards cost less to replace than to repair. This would include most of the peripherals connected to the computer as discussed above.

The power supply

Figure 1 illustrates the primary components of a 235W power supply. The easily diagnosed and replaceable components include the power plugs and cords, fan, various common capacitors and resistors, input diodes and/or bridge rectifiers, L339 which is a linear IC quad comparator (cost, about 49 cents), L494, which is a linear IC controlled circuit pulse width modulator (cost about $1.50), and the fuse. The most common failures in the computer power supply will be a blown fuse and shorted input diodes, or a defective bridge rectifier.

The motherboard

Figure 2 shows the primary components of a typical 386-SX-40Mhz motherboard. When the motherboard fails, always look first at the simple things. It may be nothing more than a loose jumper or connector. The only socketed chip on this motherboard is the 40-pin 8041 keyboard and I/O interface chip. These are available for around $2.00, and if you suspect it you can easily try a replacement. These ICs rarely fail.

The smaller DIP, located in close proximity to the 8041, is an 85C168 (or more commonly a 146818) CMOS real-time clock and calendar. This chip contains a section (usually 64 bytes) of RAM memory that is preserved by the 3.6V back-up battery. This CMOS RAM holds configuration information for the computer. This chip is socketed on some computers, but not on the one in Figure 2.

This chip can be difficult to obtain, and unless socketed, difficult to replace. This motherboard contains a single AMD 386SX BIOS V2.10. This is usually a socketed chip, but not on this motherboard. Compatible BIOS replacement chips will run from around $18.00 to $80.00, and unless you have a replacement on hand, it will probably not be cost effective to replace.

It would not be cost effective to replace either the Toshiba CHIP 2 or the CPU on this motherboard. The CHIP 2 is a VLSI SMD that operates or controls the system data transfer functions, DMA, data bus functions, and many other functions. It is these chips that have integrated hundreds of what used to be separate DIP chip functions into one. The AMD 386 microprocessor in this computer is also surface mount and costs about $50.00 wholesale. It's not worth replacing.

This motherboard costs me $65.00 with the microprocessor, memory, and a one-year warranty. The 3.6V battery can be replaced simply by plugging an external battery pack into the external battery connection and changing the jumper to EXT (usually JP2). TK9207 is an 8-pin DIP that converts a 33MHz board for use with a 40MHz processor. This chip replaces jumpers JP8, JP9. The 14.31818 MHz crystal is commonly available at about $3.00.

Summary

It's easy to appear to be a board swapper in computer service, but as you move into computer service for the first time, you will find it cost effective and less time consuming to replace a module, rather than to attempt component level repair. This will not necessarily increase the cost to your customer.

Of course, for every computer, there's a monitor. Color monitor price ranges still allow cost effective component level servicing, and should continue to do so in the near future. You can be sure that with computers, change is inevitable, and those technicians who keep up with change (or at least attempt to) will continue to survive as electronics technicians. ■

TV video problems

By Homer L. Davidson

Symptoms such as excessive brightness, weak picture, no video, distorted and smeary picture, beats in the picture, retrace lines and intermittent video are generally caused by problems in the video circuits. Usually these video problems occur in the circuit after the if output or first video transistor or IC. Weak picture, absence of video or distorted and smeary picture may be caused by problems in the video input transistor or IC circuits. If the picture is too bright, of if you see retrace lines, check the brightness reference, the picture tube circuits, or the CRT (Figure 1).

Signal tracing is a good way to track down video problems. Start by connecting the oscilloscope to the output of the video if and work your way downstream until you locate a component or IC that has video input but no output, or a weak or distorted output. You can signal trace for a weak video picture or intermittent video using a broadcast signal, or using a color dot-bar or sine or square wave generator. Of course, if you have an rf-if video signal generator on the bench, use it.

By signal tracing the video circuits with the scope, a loss of signal waveform can be detected whether you're using a broadcast signal or a test generator as input. Most video waveforms found in Sams Photofacts are made with a color dot-bar generator that is connected to the TV antenna terminals.

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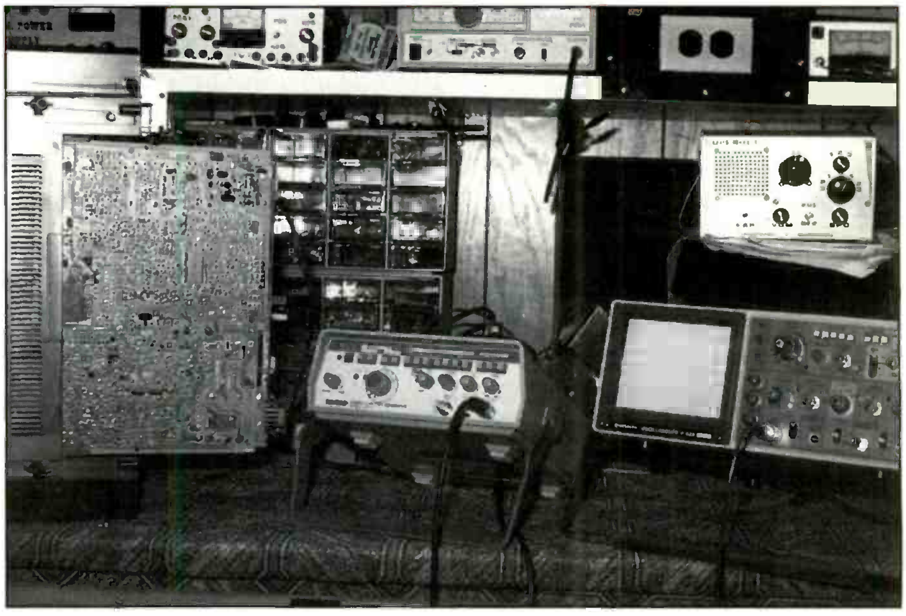

Figure 1. Video circuit problems can be diagnosed by signal tracing using a color dot-bar generator or a sine wave generator, with an oscilloscope as indicator.

When you're faced with an intermittent video problem, you can still use the broadcast signal or color dot-bar generator waveforms with the picture tube and oscilloscope as monitors. Monitor the video circuits with the scope at the different test points, or at the video if output, first video amp, delay line and chrominance/luminance IC.

Different symptoms, different components

A frequent cause of intermittent video problems is a poor soldered connection somewhere in the video circuits. Look for poor soldered connections around the leads of components such as transistors, ICs, coils, chokes, AGC modules, and delay line parts in the video circuits.

Wiggling components and prodding on terminals may cause the video to come and go. Tapping on modules, coils, delay lines and IC components may make the video picture return. Once you have located the intermittent section, take continuity, resistance and voltage measurements.

Soldering the various terminal connections may restore the picture. Keep in

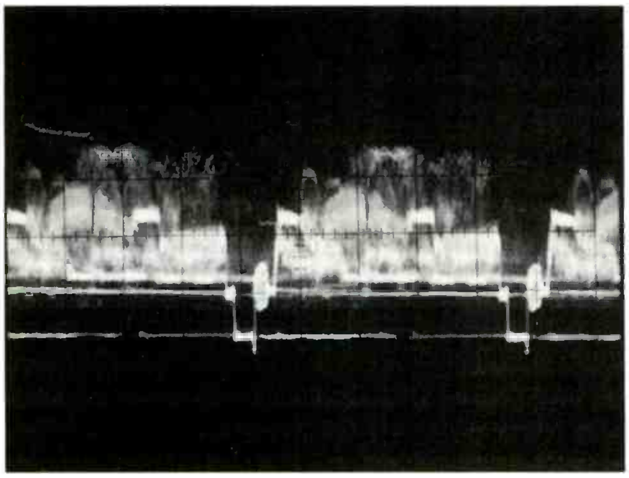

Figure 2. The waveform observed with a tuned broadcast station and signal tracing the video circuits with the oscilloscope.

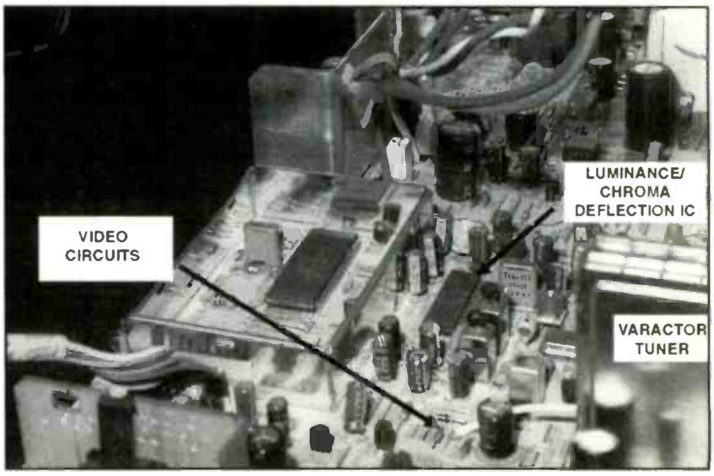

Figure 3. Usually the video circuits are near the luminance/chrominance IC, if and tuner components.

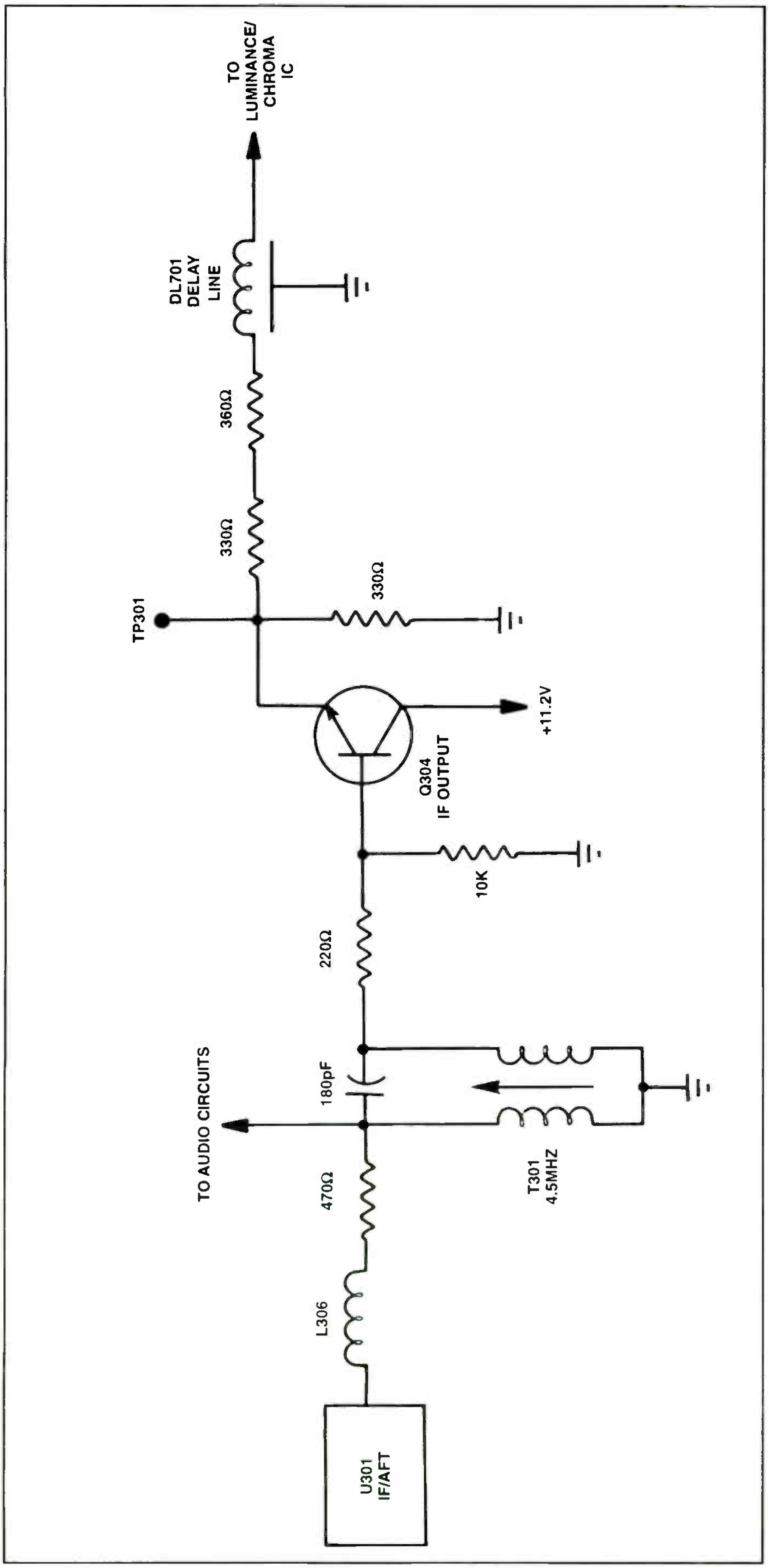

Figure 4. When the sound is normal and there is no picture, trace the signal from the if output or video transistor through to the luminance IC.

mind that a blob of solder at a component lead may have formed because the lead was not properly tinned, or there was contamination on the lead. A poor connection at that point may very well be the cause of the problem.

Touch up these areas with the soldering iron. Be careful not to create solder bridges. Going over the terminals with an iron may solve some video problems.

Weak video

The cause of a weak picture can be located by signal tracing with a broadcast signal or with the color dot-bar generator and sine wave generator (Figure 2). A weak video signal may be caused by a defective video transistor, SAW filter network, poor soldered connections around SAW filter components, AGC circuits, or if circuits and transistors. Suspect a defective SAW filter network or terminal leads that may produce a weak picture if you observe a beat in the picture. Do not overlook the possibility that the problem may be caused by a defective if IC.

Signal tracing

With a weak video or intermittent picture, signal tracing with the scope and screen of the TV set may help in locating the defective component. If a color dot-bar generator is not handy, check the signal from a local TV station. Tune in the correct channel and use the scope as indicator. Check the broadcast signal waveform at the if output or first video amp.

Although the broadcast signal is constantly varying, you can use it to trace through the various video stages until the weak stage is located. Because the broadcast signal is constantly varying, it's hard to know if a change of signal level was simply a change in the broadcast signal or a result of an intermittent circuit problem. Intermittent video circuits are, therefore, more difficult to locate with this type of signal.

If you have a color dot-bar generator, connect it to the TV antenna terminals and select channel 3 or 4. Start at the if output or the first video amp to check for an adequate signal. If you have a Sams Photofact schematic of the chassis, follow the video circuits and compare the output waveform that you observe at each video stage to the Sams waveform (Figure 3).

The video signal can be checked right up to the luminance/chrominance IC and to the color output transistors. When you locate a portion of the video circuit that has a weak or distorted output signal, check transistors, ICs and supply voltage sources in that video circuit.

Sine wave generator video

To use signal injection with a sine wave generator in diagnosing video problems, start at the if amp or first video amp transistor or IC after the if amplifier circuits to inject a sine wave into the video circuits. The sine wave and triangle waveforms seem to work best in the video circuits. Remember, the principle of operation of a video amp is similar to the principle of operation of the audio amp. The video amp, however, is designed to amplify a video signal.

Set the frequency range of the generator between 10kHz and 100kHz for the best dark horizontal bars on the TV raster. Short out the antenna terminals if a strong local broadcast station is present. The TV screen will serve as an indicator of the condition of the video circuits. You might want to do this sometime with a new TV chassis, and notice the gain and results of each stage so that you'll have something to compare to when you're servicing a set that has a problem.

Adjust the sine wave output so that the horizontal black bars are deep black and stationary. Excessive signal amplitude may overload the video circuits and turn the raster black and smeary looking. When you have reached a point in the circuit where the injected signal produces weak video on the screen, turn the gain control of the generator up. When you start at the if output transistor or IC, the signal should be greatest. As you proceed through the video circuits, the bars will become lighter and it will be necessary to increase the signal amplitude.

You will notice a slight loss of signal when the signal is injected into the emitter-follower video circuit. This is normal. After the delay line, the signal amplitude may be as little as one half of the signal amplitude found at the if output transistor (Figure 4). When a drastic change in video is noticed from transistor to transistor to the IC component, check the video circuits at that point.

You may want to start at the pin terminal where video enters the luminance /chrominance IC. Rotate the sine wave gain control wide open, or adjust for clean horizontal black bars. As you proceed toward the if output chip or detector circuits, the signal may have to be turned down on the generator. When you reach a stage where the black bars disappear or turn gray, you have located the weak video circuit.

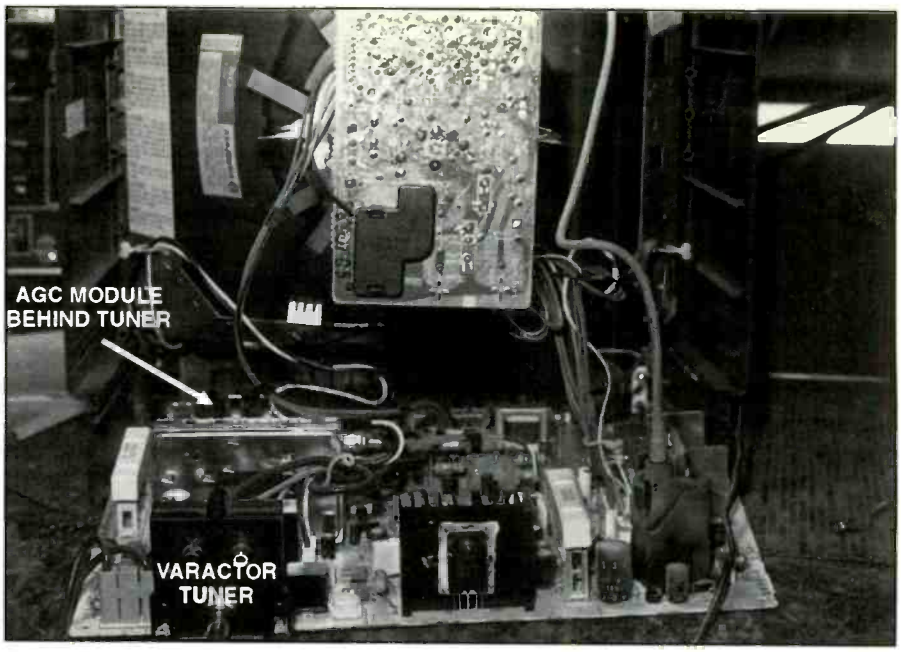

Figure 5. Tapping the AGC module in a Sony KV-139R portable, would cause the picture to pop in and out. At times the picture was a negative image.

Intermittent video

Intermittent video problems are more difficult to solve than most video problems and a lot of time may be involved. Monitoring the video circuits in several different areas may isolate the intermittent. Flashing and noisy lines in the picture may be caused by intermittent components, soldered joints and bad connections.

Poor lead terminals on video transistors and ICs may produce intermittent problems. Poor soldered connections on the delay line, if, or luminance IC may cause intermittent video. Tapping around on components within the video circuits may turn up a defective component or poor terminal connections.

Intermittent picture on a Sony KV-139R

The owner of this Sony portable complained that the picture would sometimes disappear abruptly, and then just as abruptly, reappear. Just moving the chassis would make the picture disappear. Sometimes the picture would resemble a negative image (Figure 5). Tapping around the tuner and AGC module would cause the picture to show white lines and then disappear. Further probing revealed that the AGC module protruding above the pc board behind the tuner assembly was intermittent.

After removing solder from the connections between the AGC module and the main pc board, I removed the AGC module and carefully inspected the pc wiring. I decided to resolder all of the solder joints on the module board. Sometimes wholesale resoldering of a pc board is the best way to correct intermittent problems. In this case, resoldering all board contacts eliminated the intermittent problem.

Fading video on an RCA CTC132 chassis

The owner of this RCA set complained that after the TV chassis operated for one or more hours, the video would fade out, leaving a black screen. The sound was normal, indicating that the problem was in the video circuits. On some occasions the picture would return spontaneously. I shut down the chassis to cool and connected the scope for monitoring the video circuits. It was my expectation that the defective component would either become leaky or open after becoming warm.

When the video disappeared the voltage output of the 11V source that supplies the video amp (Q311) and video buffer on PW-V10 board had dropped to zero. Rechecking the dc circuits, I found that the 11V and 5V regulated sources were fed from regulator transistors on the same board. I checked Q751, Q753 and Q754 in the circuit. They tested good (Figure 6).

I turned the set on again and waited until the picture disappeared. Voltage measurements at all of the terminals of all three transistors and the power switch (Q754) revealed that Q571 and Q574 had opened when they became warm. I replaced both faulty components, solving the problem of the fading picture.

No video

A common symptom of video problems is absence of a picture accompanied by normal sound and raster. Usually the no picture or video symptoms are easy to locate compared to the situation with weak or intermittent video. When I encountered a set with this symptom, I measured the high voltage at the CRT. High voltage was present at the CRT. Sometimes dots or fading in the raster was seen. In a case such as this, observe the waveforms in the video circuits with input from a broadcast station, dot-bar generator or sine wave generator to try to locate the dead video circuits.

Open video transistors, the if IC or the luminance/chrominance IC may cause the no-video problem. Check the SAW filter network and comb filter circuits for defective parts and bad connections. An open delay line, coils or resistors in the video circuits may produce a no-picture symptom. Check all video voltage supply sources. Check for low supply voltages on the if and luminance IC. Do not overlook on-screen-display (OSD) circuits when there is no video.

No video in a Goldstar CMT-9428 portable

A Goldstar color portable on the bench had no video, but normal sound. The screen was dark. I connected the color dot-bar generator to the antenna terminals and traced the video signal with the scope up to one side of the delay line, Z202 (Figure 7). There was no video on the output of the delay line. I replaced the open delay line with an exact replacement, part number 150-245D.

The video delay line component has caused problems in many color chassis. Intermittent video may be caused by a poor delay line coil or board connections. A flashing picture may be caused by an intermittent delay line.

Another symptom of delay line problems is a picture that disappears leaving only color on the screen. Poor soldered delay line terminals may result in a smeary distorted picture. When the brightness and contrast controls have no effect on the video or picture, suspect an open delay line.

Excessive brightness

When the control has no effect on the brightness, or when the picture is excessively bright, the problem is usually caused by something in the luminance or picture tube circuits. When you encounter excessive or uncontrollable brightness, check for a defective service switch, which is the cause of this problem in some chassis. Another possible cause of this symptom is a leaky reference drive transistor. In some sets, the picture tube may become extremely bright when the set is first turned on and then the chassis will shut down. Check for dust in the CRT spark gaps. This symptom may also be caused by a defective picture tube.

Excessive brightness with retrace lines may be caused by a defective picture tube, a leaky brightness transistor, a defective IHVT transformer or a leaky luminance/chrominance IC. Flashing dark lines on

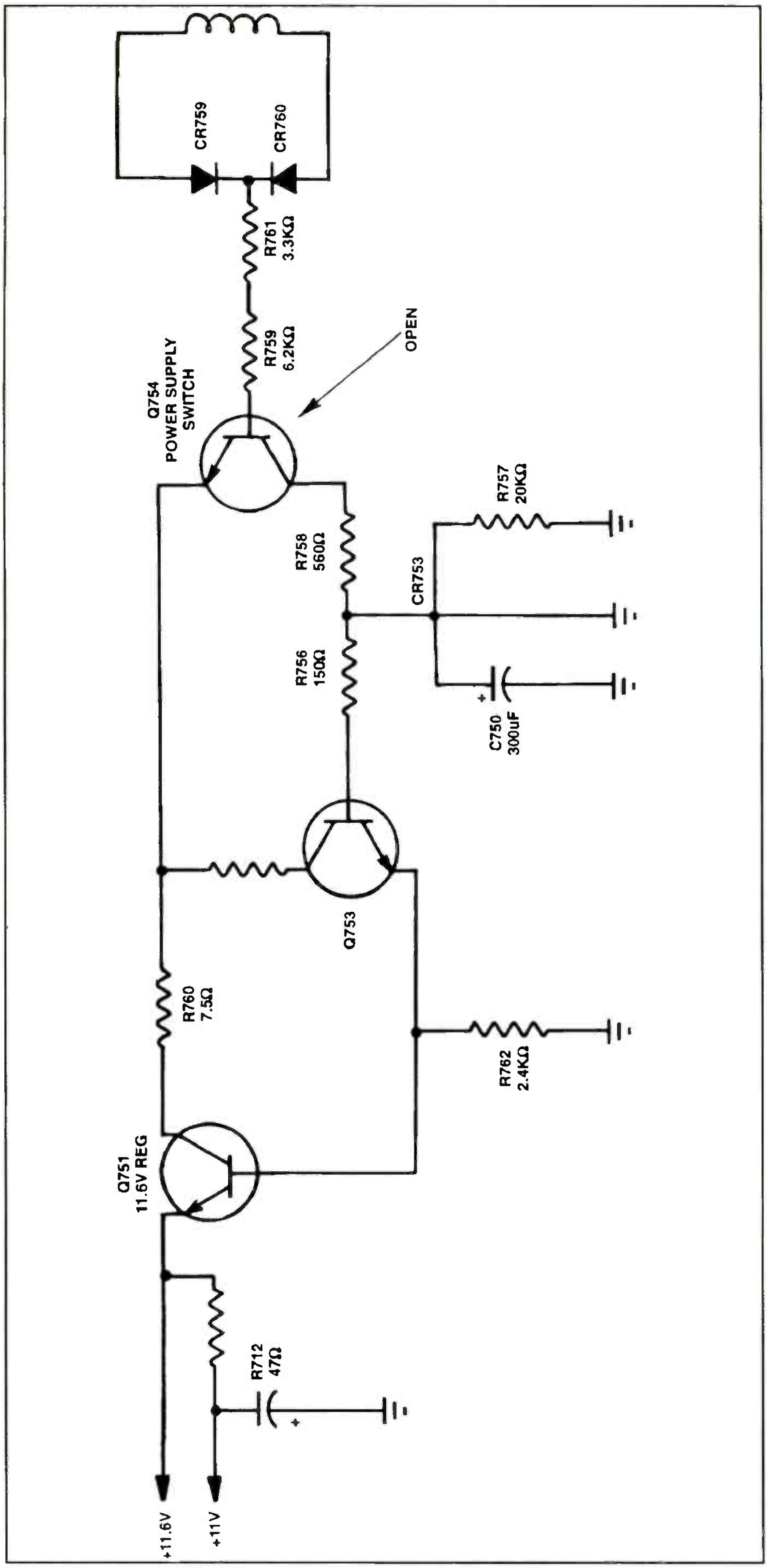

Figure 6. Fading out of the video in an RCA CTC132 chassis was caused by an open power supply switch transistor that removed the 11V source from the video circuits.

the screen may result from a defective luminance chip. A bright picture with pulling and retrace lines may be caused by a defective main filter capacitor. A grainy picture may be caused by a defective IC chip, while a washed out picture may be caused by a defective picture tube. Determine whether or not it's the CRT with a picture tube test.

Extremely high brightness in an RCA CTC121

In this RCA GJR2038P, the picture was excessively bright, and there were some retrace lines in the picture. I thought that the problem might be a bad picture tube. CRT tests were normal, however. Occasionally the picture would become brighter followed by shutdown of the set after operating for an hour or two.

I measured voltages at the luminance/chrominance processor. These voltages were normal. I checked the schematic for other luminance transistors and ICs, such as the luminance peaker (IC701), auto peak amp transistor (Q701) and luminance buffer transistor Q709 (Figure 8). When I checked the reference brightness transistor, Q703, it appeared to be leaky. I removed Q703 from the chassis and tested it again for leakage. I replaced both Q703 and CR708. Excessive brightness in several of these sets was solved by replacing the brightness reference transistor.

Conclusion

When signal tracing with the scope and color dot-bar generator, check the various test points in the video circuits. Usually the chassis has to be pulled out to gain access to these terminals from the top side of the chassis. Be careful not to accidentally short out the circuitry by careless use of test equipment probes in the video circuits. These probes may tend to slide off the contacts or component leads on the pc wiring side.

In some cases you may want to solder a loop of hookup wire in the video circuit on the pc wiring side to which to clip the scope probe, voltmeter or generator when monitoring the video circuits for intermittent problems. If you don't take the proper precautions, the scope or generator probe may come loose and short against the flyback circuits, damaging the test equipment. Make sure the generator probe has a 0.01μF or 0.047μF capacitor in series with the probe so not to damage the test equipment ■

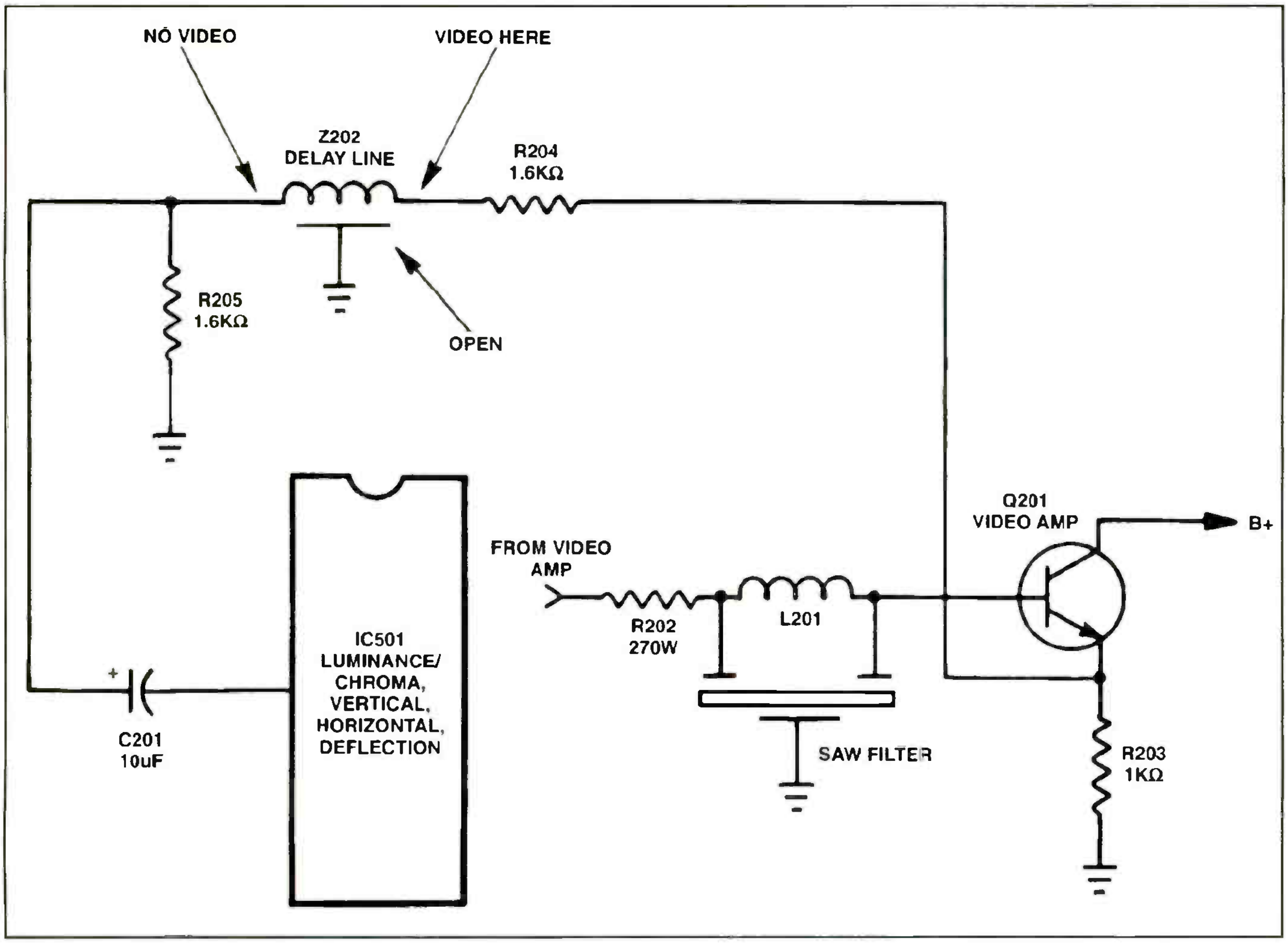

Figure 7. A Goldstar CMT-9428 portable set had no video. The cause of the problem was signal traced to an open delay line (Z202).

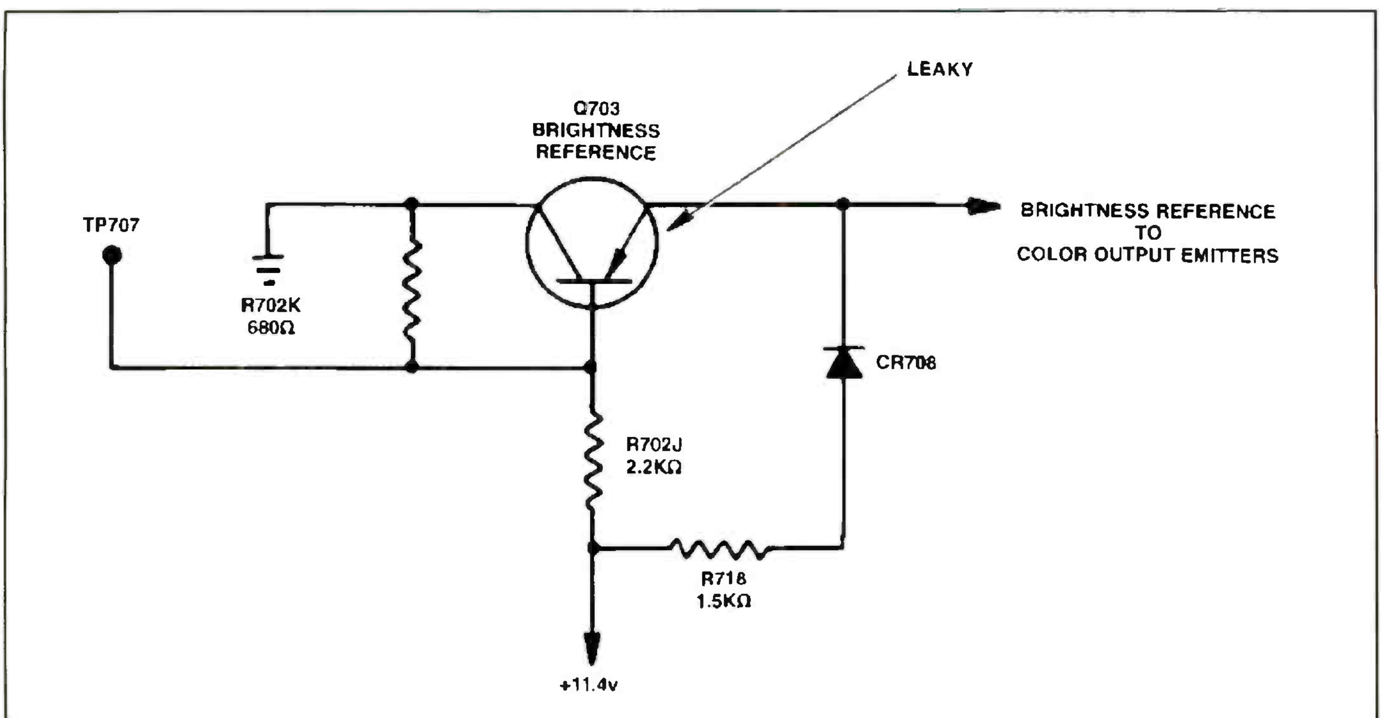

Figure 8. Excessive brightness in an RCA CTC121 chassis was caused by a leaky brightness reference transistor (Q703).

Electrostatic discharge damage

By The ES&T Staff

Static electricity is one of those phenomena that everyone is aware of, but generally takes little notice of. You know what I mean. In the winter, especially, evidence of static electricity is everywhere. For instance, when you run a comb through your hair and then move it away, your hair follows it, and every strand repels every other strand making grooming almost impossible. You wear those trousers made of a synthetic material, and the cuffs cling to your socks. Every time you take a few steps across the living room rug and touch the light switch or the faucet, a huge, and even a little painful, spark jumps between your finger and the grounded item.

Static electricity is subtle

Even though all that evidence is there, the effects of static electricity in daily life are so subtle, in contrast to all of the other more substantial things that we see and feel, that it's easy to forget that it's really almost everywhere, all the time. And, for the most part, that's not a problem. In most daily lives, static electricity, on the small scale (lightning is another story), doesn't hurt anyone or anything.

But when the individual who's experiencing the discharge is a technician handling semiconductor devices containing elements with thicknesses that are measured on a scale that makes a piece of paper seem thick by comparison, static electricity becomes a very serious problem. A static electric discharge that a human can't even feel is enough to destroy or irreparably damage electrostatic devices.

How static electricity is generated

Most of us are aware of how static electricity is generated, and we've had fun with it at one time or another. There's a party coming up, so you're blowing up balloons. Then you remember that if you rub a balloon on your shirt you can make the balloon stick to the wall. That's one way to generate static electricity. Or how about those times when it's really dry, and you pull a piece of cellophane tape off of the roll, only to find that it then acts like a snake charmer's snake when you try to apply it to the paper.

In general, anytime you bring two pieces of material together in close contact and then separate them again, static electricity is generated. Electrons from one piece of material are transferred to the other piece of material, leaving one with a net negative charge and the other with a net positive charge.

When one of those pieces of charged material is brought into contact with something that has a different charge, electrons may flow from one to the other: an electrostatic discharge. Depending on the difference in potential between the two, the voltage between the two objects when the discharge takes place, and the quantity of electrons that flow, will be greater or lesser.

Conductors (a screwdriver, wrench or pliers on the bench) contain a lot of "free" electrons, because in these materials, electrons are easily transferred between atoms of the material. When a charged object is brought near a conductor, there will usually be a discharge.

Objects made of insulators, such as plastic products, tend to hold a charge.

And, of course, everything depends on the ambient conditions. If the humidity is high, everything is slightly damp, so static electric charges may leak away as quickly as they build up. If the humidity is low, insulators that become charged may remain charged for a long time.

Some commonly encountered voltage values

The voltages that may build up on the human body during ordinary activities may amaze you. For example, walking across a synthetic carpet on a cold winter day when the air is desert dry may build up a static electric charge greater than 30,000V. Just sitting at the service bench and moving around, while wearing a synthetic shirt may generate voltages in excess of 5,000V.

ESD sensitivity of components

The U.S. Department of Defense has performed studies to evaluate the sensitivity of electronics components to electrostatic discharge. The results are revealing. Some components and ICs may be damaged by discharges that occur at voltages of less than 2,000V, a level of static voltage that human beings can't even feel. Some examples of these sensitive devices are: discrete MOSFET devices, surface acoustic wave (SAW) devices, charge coupled devices (CCDs), op amps, ICs.

In other words, if a technician is working on a consumer electronics product, he could easily be generating several times the voltage necessary to destroy many of the components in the product, and not even know it.

On the other end of the ESD voltage spectrum, if the static situation is such that you feel a painful spark when you touch the doorknob, or the electrical outlet on the bench, you could be generating between 4kV and 20kV, enough to damage such components as low power bipolar transistors, small signal diodes, LEDs, phototransistors and optocouplers.

The damage is real, and observable

Because, as we mentioned at the outset of this article, ESD is such an ethereal phenomenon, somehow it's just difficult to really believe that it really causes damage. But the U.S. Department of Defense has performed experiments under controlled conditions. They use a generator to generate a precise voltage of static electricity then discharge it through a component. Then they open up the component and look at it through a microscope.

We don't have photos of this phenomenon for this article, but the evidence gathered by this experimentation clearly shows that an electrostatic discharge through a sensitive component can cause some of the material to be melted or vaporized, totally destroying the component.

More evidence that shows ESD damage is real is provided by the notations on consumer electronics product schematic diagrams. The manufacturers are pointing out that certain devices are sensitive to ESD discharge. The manufacturers would not go to the expense of adding those notations to the schematics if the danger weren't real.

Damage may be worse than destruction

Electrostatic discharge is one area where a damaged component may be far worse than one that has been totally destroyed. If a component, such as a tran-

(Continued on page 66)

***Troubleshooting Electronic Devices*, By Joel Goldberg, Delmar Publishers Inc., 320 pages, $23.95 softcover.**

This step-by-step guide to troubleshooting develops the practical problem-solving skills needed to become efficient and effective troubleshooting technicians. This practical text provides useful, real-world coverage of the circuits used in communications devices, microcomputers and peripherals, and home entertainment devices. All of the explanations are based on and refer back to the fundamentals of Ohm's, Kirchhoff's, and Watt's Laws. A thorough description of the expert technician's thinking process during analysis and repair trains how to troubleshoot like the pros.

Learn how to sharpen troubleshooting skills with: practical examples of common repair problems, including modular electronic components and how to replace them, coverage of basic testing equipment that relates the concepts of testing to common electronic components, photographs and sketches of electronic circuits that add visual clarity and help explain troubleshooting skills and concepts.

Delmar Publishers Inc., Albany, NY 12212-5015

***The Novell Certification Handbook*, By John Bueller, CNE, and Robert A. Williams, CNE, CNI, TAB Books, 224 pages, 25 illus., $24.95 softcover, $40.00 hardcover.**

The Novell Certification Handbook is an all-in-one guide to acquiring and making the most of Novell credentials.

Certified NetWare Engineers John Mueller and Robert A. Williams have compiled a one-stop source of essential information for network administrators, engineers, and instructors who want to obtain Novell certification or, having already acquired it, use it to their best advantage in an increasingly competitive job market. They answer the most commonly asked questions: What are the certification requirements?, How do I register for the exam?, What should I look for on the test?, How can I speed up the certification paperwork?, What's the best way to present my certification to prospective employers or clients?, What are the continuing education requirements of CNEs, CNIs, and ECNEs?, How do I set up a consulting business once I've received certification?

Sample test questions and study tips help prepare CNA, CNE, CNI, and ECNE test takers for Novell exams.

TAB Books, McGraw-Hill, Inc., Blue Ridge Summit, PA 17294-0850

***The dBASE IV Professional Programmer's Reference*, By Richard A. Biegel and Sumant S. Pendharkar, Prentice Hall, 600 pages, $36.95 paperback.**

Prentice Hall/ PTR announces the publication of *The dBASE IV Professional Programmer's Reference* by Richard A. Biegel and Sumant S. Pendharkar.

As technical support specialists at Ashton-Tate and Borland International, Biegel and Pendharkar, spoke to thousands of professionals frustrated by the incomplete literature available on dBASE IV. The authors wrote this reference to help professionals solve a world of problems. Related language elements are arranged by chapter, making it easy to quickly locate the language element you need. The book includes chapters on data types, commands, functions, set commands, and system memory variables; includes multiple tables in each chapter that allow you to see at a glance all of the commands and functions that perform related operations such as input/output, string manipulation, mathematical, file management, and record management operations; provides a clear, unambiguous description of each language element, along with an explanation of why each element is important and in which programming contexts is most useful; includes programming examples for each language element, and pays special attention to the hardest to use language elements, includes additional detailed descriptions and many examples.

Prentice Hall, Simon & Schuster Education Group, Englewood Cliffs, NJ 07632

***Troubleshooting & Repairing PC Drives and Memory Systems*, By Stephen J. Bigelow, Windcrest, 368 pages, 288 illus., $22.95 paperback, $34.95 hardcover.**

Troubleshooting & Repairing PC Drives and Memory Systems is an invaluable reference for computer technicians, students, and hobbyists. Bigelow gives reliable, up-to-date troubleshooting and repair guidelines for all types of PC storage and memory devices. He shows how to repair or replace: hard drives, backup drives, RAM ICs, SRAM and DRAM chips, floppy drives, CD-ROMs, expansion SIMMS, and FLASH cards.

Readers learn how data storage and memory equipment operate and the importance of regular cleaning, maintenance, and alignment to the long, trouble-free life of drives and memory media. The book includes consolidated troubleshooting charts, vendor listings, glossary, and a schematic symbols chart.

Bigelow is an electrical engineer specializing in the design of computer subsystems. His articles appear regularly in electronics magazines.

Windcrest, TAB Books, Blue Ridge Summit, PA

***FDDI Handbook: High Speed Networking Using Fiber and Other Media*, by Raj Jain, Addison-Wesley Publishing Company, 560 pages, $49.50 hardcover.**

FDDI Handbook: High Speed Networking Using Fiber and Other Media by Raj Jain provides the fiber distributed data interface standard. It describes all of the components of FDDI and discusses the many issues relating to design, layout, purchase, and use.

The author has over 15 years' experience in the analysis and design of distributed systems. He has taught FDDI tutorials at numerous conferences, serves on the editorial advisory board of the *Journal of High Speed Networks*, and is Vice-Chair of ACM SIGCOMM.

FDDI Handbook provides an easy-to-understand explanation of key aspects of FDDI. It is designed to meet the needs of a wide audience. The initial overview of FDDI and individual chapter overviews can be read quickly by busy executives. Following details are appropriate for buyers, network managers, and designers. It covers such topics as: how applications run differently on FDDI, Ethernet, and Token Rings, how to install, manage, and troubleshoot and FDDI Network, what products to buy and where to buy them, what alternatives were considered in the development of the FDDI, and why does the standard work the way it does, and how to integrate different sizes and lengths of cable.

The book ends with a discussion of performance issues and error analysis.

Addison-Wesley Publishing Company, MA

Video electronics standards

Are you confused by computer monitor designations such as EGA, CGA, VGA and SVGA? This article is intended to give readers some background on the evolution of those standards, and describe the efforts of the Video Electronics Standards Association in bringing about standardization of computer graphics.

The Video Electronics Standards Association (VESA) was established in 1989 to set and support industry-wide video graphics and related standards for the benefit of people who use computers.

VESA was born out of the need to end the confusion and fragmentation in the high end of the PC graphics industry.

International in scope, VESA is a non-profit corporation located in San Jose, California, and headed by a board of directors representing a voting membership of more than 200 company and corporate members from throughout the United States and around the world.

VESA's standards for excellence are created and developed through its technical committees. Beginning with work groups addressing needs, the VESA committee structure ultimately creates proposals for standards which are then submitted to the entire VESA membership for review and ratification. Each VESA member (company or corporation) is given one vote.

VESA was born out of the need to end the confusion and fragmentation in the high end of the PC graphics industry. Before VESA, the industry lacked a common ground where companies could work together toward compatibility and ease of use. People using computers faced an assortment of incompatible graphics boards, monitors, and software. Once VESA was established it quickly became the industry's forum and voice for debating and resolving graphics issues.

Today, VESA standards make it possible for advanced video products from different companies to work together without modification. By standardizing the way software drivers, display boards, monitors, and applications work together, VESA makes it easier on the end user by ensuring that products from a wide variety of manufacturers are compatible.

Some early graphics formats

To understand the role of VESA in the computer industry, it helps to take a quick look back over the past decade.

IBM introduced the Monochrome Display Adapter (MDA) in August of 1981 with the release of its first personal computer. Green text on a single color, "black screen" was the display. The original IBM Color Graphics Adapter (CGA) was also introduced at the same time for those who wanted two color, 640 x 200 pixel, or four color, 320 x 200 pixel graphics systems, which opened up the door of computer graphics to the world.

Though all of this might seem primitive now, CGA's graphics were dazzling at the time. However, the text display on CGA systems was limited because of the comparatively low resolution (8 x 8 dots per character). By 1982, Hercules Corporation offered a card which offered MDA quality text display while still providing black and white graphics capabilities exceeding CGA resolution (and limitations).

It didn't take any time at all for VGA to become the de facto PC graphics standard . . . for awhile anyway.

IBM came up with a color solution in 1984 with the Enhanced Graphics Adapter (EGA). This brought color to Hercules quality graphics and an even higher resolution (640 x 350) with 16 colors for CGA. EGA was soon followed by the Professional Graphics Controller (PGC), which finally achieved a resolution of 640 x 480 and was capable of producing square pixels. Those square pixels significantly enhanced the ability of printers and plotters, resulting in "presentation quality" printouts which equalled the on-screen graphics.

PGC also brought with it analog color signals which expanded the choice in on-screen colors from 16 to 256. In monochrome mode it could produce 64 shades of gray.

The advancements continued and in 1987 IBM provided a new theshold in graphics capabilities with the Video Graphics Array (VGA). VGA displayed text at a highly legible 720 x 400 and square-pixel color graphics at 640 x 480 with up to 16 colors on-screen at once or 320 x 200 resolution with 256 on-screen colors. It didn't take any time at all for VGA to become the de facto PC graphics standard . . . for awhile anyway.

Today, VESA standards make it possible for advanced video products from different companies to work together without modification.

Super VGA—unrealized potential

After VGA became established, other graphics companies began looking for ways to take VGA graphics capabilities even further. They soon began making boards and monitors that became known as Super VGA (SVGA). These products were a superset of the VGA standard with resolutions as high as 800 x 600 (with 16 on-screen colors), which was the highest resolution possible on the low cost, multi-frequency monitors during the 1987-88 time frame.

Since that time, Super VGA has grown to include resolutions of 1024 x 1280 and 1280 x 1024 with color depths up to 24 bits per pixel, or 16.8 million colors. The only problem with Super VGA products was that they required customized software drivers for the advanced graphics modes, and that led to confusion and frustration on the part of non-technical users.

While the technology was readily available in Super VGA for stunning graphics, very few programs could actually take advantage of the Super VGA capabilities. The real problem was that certain Super VGA graphics boards wouldn't work with Super VGA monitors. The lack of specific standards and the resulting proliferation of non-compatible products in 1989 led to the formation of the Video Electronics Standards Association (VESA).

Working for compatible products

Once VESA was established, the membership wasted no time in setting their first standard known as "Mode 6Ah" which defined consistent initialization numbers for 800 x 600, 16-color Super VGA. This allowed programs to set that graphics mode on all Super VGA boards. While it was a small step technologically, Mode 6Ah was quite significant for anyone who worked with computers because it eliminated much of the confusion and frustration. The end user could now easily take advantage of Super VGA.

VESA has gone on to issue many other standards for compatibility. Because VESA's membership is global in scope, leading international manufacturers of systems, monitors, graphics boards, software drivers, and software applications now make many compatible products which not only work together, but get the end user to work on the computer quicker.

The committee structure

All VESA standards are created by its technical committees. The process for developing those standards begins with work groups which then hammer out proposals for standards. Those proposals are reviewed and then, when approved, submitted to the general membership for ratification where each member (company or corporation) is given one vote.

These are the technical committees:

Advanced Video Interface Committee. This committee was formed to define and standardize the interface between multimedia peripherals. The standard will follow the concept of the existing feature connector, and will also allow for new digital video applications. The interface defined by this committee will enable graphics and video subsystems to be developed independently by different manufacturers and to be integrated together seamlessly.

Local Bus Committee. This committee created and will continue to refine a standard interface for local bus products. Local bus technology dramatically increases the performance of graphics products and other products which tend to get "bottlenecked" by current bus designs.

Monitor Committee. This committee is responsible for setting all standards regarding monitor interfacing. Currently there are six technical workgroups functioning under the Monitor Committee: Discrete Monitor Timing, Display Communication Channel, Display Power Management, Video Image Area, Display Information Format, Measurement Standards, and Enhanced Video Connector.

Software Standards Committee. This committee creates software interface standards, handles the software coordination of the other committees, and assists with the test software and application notes that accompany each standard. ■

The perils of building a personal computer

By Sheldon A. Fingerman

When a friend recently asked me to get him a computer, little did I realize it would turn out to be far more difficult than I could imagine.

Usually I acquire computers preassembled, but because I wanted to keep the price obscenely low, and still make a buck, I had to assemble it myself. And why not? I am a qualified technician, I've worked on plenty of computers, so how hard could it be to build one from scratch? I was soon to find out.

It was easy enough finding all the components at extremely good prices. Unfortunately, my supplier failed to notify me as to when the items would be shipped, and the total cost. When UPS arrived I had no money. I had to run into town, get the cash, and drive all over the neighborhood chasing the UPS truck. This took about an hour out of my day. And this was only the beginning.

Operating in close quarters

I opened the first box like a child on Christmas morning. It was the mini tower case, which brings me to another subject. If IBM is called "Big Blue," why are all computers, monitors, and other assorted peripherals painted off-white?

There was a lot of stuff rattling around inside the case, so I opened it to find a bag of hardware, some "feet," and a power switch. The case had a hole in front for the switch, so I removed the switch from its plastic bag and stuck it in. Was that ever a mistake.

Installing the power switch, which was now virtually impossible to remove, left me little room to attach the wires from the power supply. And, the power supply had four wires to be attached to the switch. Which wire went where? The case and power supply came with no documentation. (Remember, I wanted to save money).

Luckily, I was able to remove the cover from another computer to find the proper connections. But as I said before, I had very little room to maneuver. It took some time, and using long needle-nose pliers I finally got it. What I should have done was pull the wires through the hole in the case first, attach them to the switch, *then* push the switch into the hole. I also discovered, later, that the proper connections were labeled on the power supply.

Dealing with sheetmetal

Next came another shock. You know those vertical, or in this case horizontal slots that are in the back of the case? Well, they were all covered, and I thought this was due to those "L" shaped slot covers. No such luck. The slots were only "scored" in the sheetmetal. I had to use pliers, and by bending the tabs back and forth break them out of the case. This was a lot of work, and consequently took a lot of time.

Installing the speaker would have been hopeless had I never seen the inside of a computer. It didn't screw in or bolt in. It slid into small clips stamped in the case. And there were two different spots for it.

One was directly under the cage that held the hard drive; there it would have faced up, directly against the drive. The other, and more logical place, was toward the front and bottom of the case, facing inward. There was no way to mount it facing toward the front, which I thought to be quite odd, but there were some strategically placed holes on the bottom of the case—I assumed to let the sound out.

As I tried to put together some kind of a plan at this point, I again benefitted from my experience. Since this was a tower case, I knew the location of the motherboard would make it difficult to get to some of the screws when installing the drives.

The disc drives

The floppy drives came hermetically sealed, meaning without documentation. Although each drive had about a zillion jumpers on it, I knew they usually came from the factory jumpered correctly. Usually. I knew I couldn't harm anything by installing them as is, but I wouldn't know if they worked properly until I fired up the computer, and it seemed I was quite a long way from that.

It was time to install the hard drive. It was a 3.5 inch Conner, again hermetically sealed, again without documentation. I assumed that since my supplier did most of their own assembly, they buy a lot of drives, but only have one set of instructions. Once again, I had to remind myself how much money I was saving.

Most IDE hard drives have jumpers, and this one was no exception. Of course, most hard drives come with documentation. The only pins jumpered were labeled "C/D." Well, the drive was going to be C or D, so what the heck. Even though an IDE drive has to be designated as a "slave," "master," or "only," experience told me that a sealed drive from the factory will usually install correctly if it is the only hard drive used.

The real problem here was that while most hard drives are now shipped with the drive parameters on the label, this one was not. Fortunately, experience paid off once again. It was about 8 p.m., and there was no way to get Conner technical support on the line. I called the Conner 24-hour bulletin board, and downloaded the entire manual for the drive. This took only minutes, but should have been unnecessary.

Over the years I've learned to check the length of the screws used for installing hard drives, especially the new 3.5 inch variety. In this instance I found that the screws were a bit too long, and would have damaged the drive's circuit board had I just gone ahead with the installation. A washer under each screw left me with an adequate margin of safety.

Thanks for the memory

Now for the memory. I've been in this business for quite a while, but to be honest I've never had to put SIMMs (single

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inline memory modules) on a new motherboard. I'd added SIMMs, I'd replaced SIMMs, but I'd never been faced with virgin memory banks. Which way do they go? Well, they're virtually impossible to put in backwards—easily. ICs on a SIMM face the direction in which you have to push the SIMM to clip it into place.

When handling static sensitive devices I always try to use some type of static control, usually a wrist strap that can be plugged into the ground of an ac socket. Otherwise I grab the nearest water pipe, try not to shuffle across the rug, and never remove my sweater too quickly.

Installing the motherboard

Installing the motherboard was a lesson in logic, and I had to be very careful here. The only way to match the mounting holes in the motherboard with the holes in the case was to actually place the motherboard into the case. This exposed the fragile bottom of the motherboard to bare metal. Not only is there danger of static shock, but the delicate traces on the board could be damaged as well.

One pattern became evident after a few tries. Surprisingly, very few of the supplied plastic standoffs were used, and only one screw was used to lock the board in place. To determine proper placement I lined up the keyboard socket with the hole in the back of the case, and used the multi I/O card to check that the "slots" were lined up properly.

Making connections

With the motherboard firmly in place, it was time to attach the two power supply plugs, P8 and P9, to the motherboard. Since this was a "virgin" motherboard, the sockets were not "keyed" to their respective plugs. It would have been quite easy to reverse the plugs at this point. I had gone this far, and I wasn't about to see my work go up in smoke.

I had replaced a lot of power supplies, and I knew that the three red wires on P9 face the front of the computer, and the orange wire on P8 faces the rear (toward the keyboard socket). Another fail-safe check is to confirm that the black wires on both plugs are adjacent.

The motherboard did come with documentation, so attaching all the wires from the LED indicators, the keylock, the speaker, and the reset button was a simple procedure. The motherboard was also well labeled. Using the documentation I was able to attach the black wire from each LED to each ground. Of course, since I didn't have any documentation for the case, I had to assume that the black wire was ground. Little harm can be done here. If an LED doesn't light, reversing the plug will solve the problem.

The video card and multi IDE/IO slipped easily into place. Glancing at my watch I realized that this was taking a lot longer than I had anticipated, but I was so close that the excitement was unbearable.

All I had to do now was attach the power supply and cables to the drives. Guess what? They sent me two floppy drive cables, which would have been fine had I also received a hard drive cable, but no such luck.

The smoke test

It was getting pretty late, and I new I could get a cable in the morning so I decided to give up. I turned on the "tube," and was just getting comfortable when I realized that a computer doesn't need a hard drive. In a fit of confidence I attached the keyboard, attached the monitor, grabbed a fire extinguisher, and flipped the switch. Bingo! It worked.

Of course I got a lot of error messages, but everything worked, the lights lit, and I didn't see any smoke. A quick trip to the setup routine eliminated error messages.

The next day I got an IDE cable and completed the project. Fortunately I had the Conner manual that I had downloaded, otherwise I would have had to call tech support to get the drive parameters.

A few afterthoughts

Some words on cables: Most kits come with "keyed" cables for the floppy and hard drives. In other words, it's virtually impossible to attach the cables improperly. In this situation there were no keys.

The ribbon cables used on drives have a colored line, usually red or blue, which designates pin number one. Pin one is usually labeled on the controller card. On a 5.25 inch drive, pin one is closest to the slot cut into the edge connector. On most 3.5 inch drives, and IDE hard drives, pin one is usually closest to the connector for the power supply. I emphasize "usually."

I have never damaged a drive by attaching a cable backwards; however, that doesn't mean it can't happen. Put on your glasses and look closely to see if pin one is labeled. If not, go by the guidelines above and don't be too concerned. If you are having problems accessing a drive, and everything else is in order, reversing the cable may do the trick.

In summary, the lack of documentation, videos, etc., made the job much more difficult than I anticipated, and I'm not sure if I would do this again, but I did learn a lot. Also, considering the amount of time it took, the money I saved was negligible.

However, if you have more time than money, don't get frustrated easily and enjoy a challenge, make some calls, get some prices, and have a stab at it.

I'm just glad I didn't have to assemble the monitor. ■

What Do You Know About Electronics?

Analyzing circuits

By Sam Wilson

In previous issues I have pointed out that students would find the study of electronics to be a lot simpler if we didn't have so much jargon in the subject. Another name for jargon is gobbledegook.

Resistor jargon

Take, for example, resistors. We have temperature stabilization resistors, surge-limiting resistors, load resistors, thick film resistors, emitter bias resistors, ballast resistors, bleeder resistors, and on and on. To a beginner it can look like there must be an infinite number of resistors and applications of resistors.

My point is that those terms lead us away from the idea that there are only three uses of resistors as listed below.

Even when you are an experienced technician it is a good idea to keep in mind that a resistor is only used for three basic purposes:

1. limit current,
2. introduce a voltage drop, and
3. generate heat.

Every time I say that, it reminds me of the guy in Denver who came up to me after a lecture and said resistors are also used for coil forms (as in peaking coils). Actually, that is not an electrical use, so, I don't count it.

I could make several complete articles about components and their uses compared with their names. However, I have done that before. So, let's move on to circuits. It is interesting to note that there is not an infinite number of circuits. If you put the circuits into categories it is much easier to analyze circuit behavior. Let's start with *coupled* circuits.

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

Coupled circuits

This is an extremely complicated category. If you get deep into the mathematics of coupled circuits you have to poke around with impedance matching, four-terminal networks, frequency input and output relationships, etc. Let's not open that can. For now, just consider the types of coupling circuits between amplifiers. Later we will go into each type in depth.

There are only four basic methods of coupling energy from one amplifier to another. As shown in Figure 1, they are:

- R-C coupling
- direct coupling,
- transformer coupling, and
- impedance coupling.

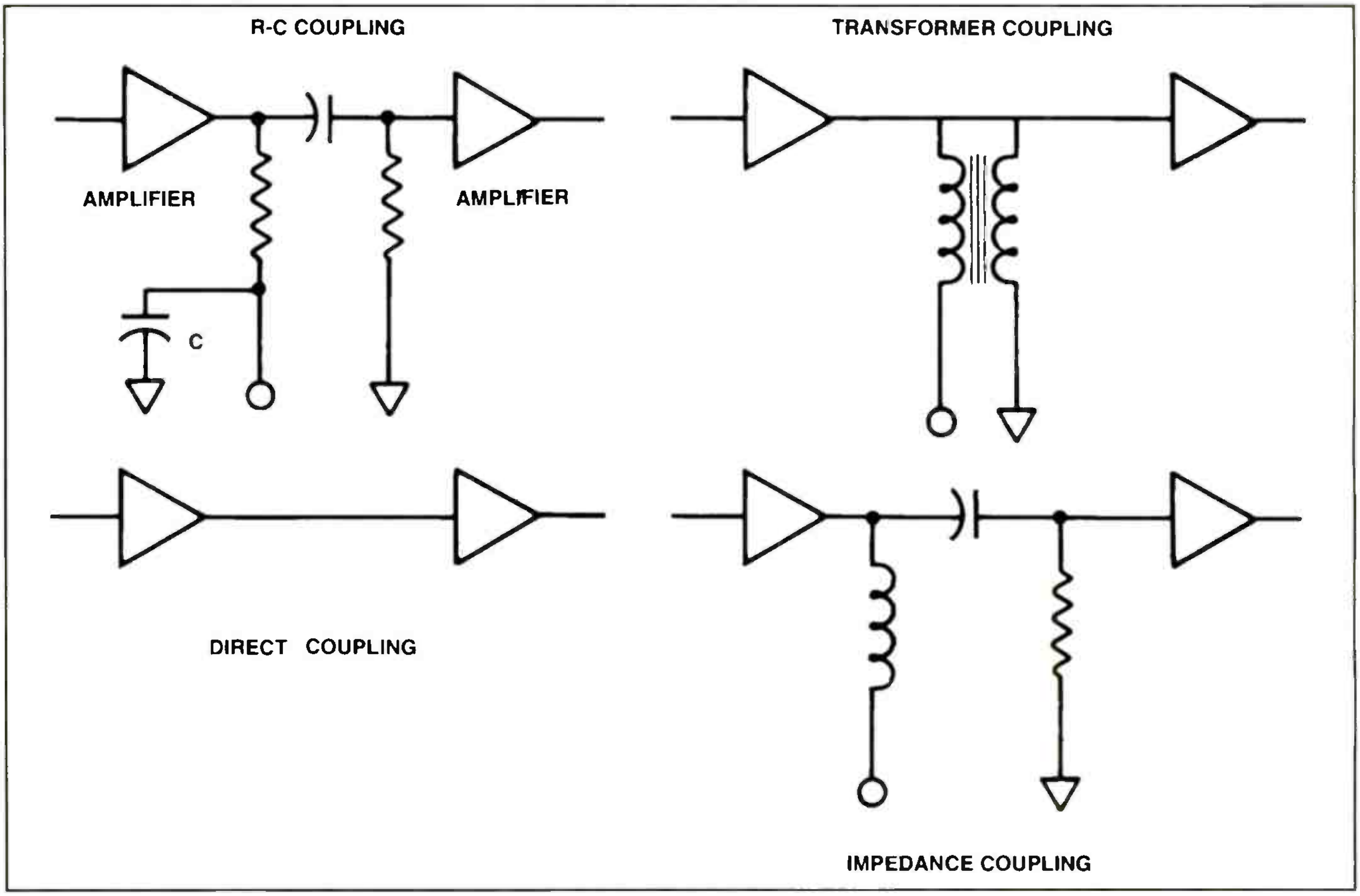


Figure 1. There are only four basic methods of coupling energy from one amplifier to another. R-C coupling, direct coupling, transformer coupling and impedance coupling.

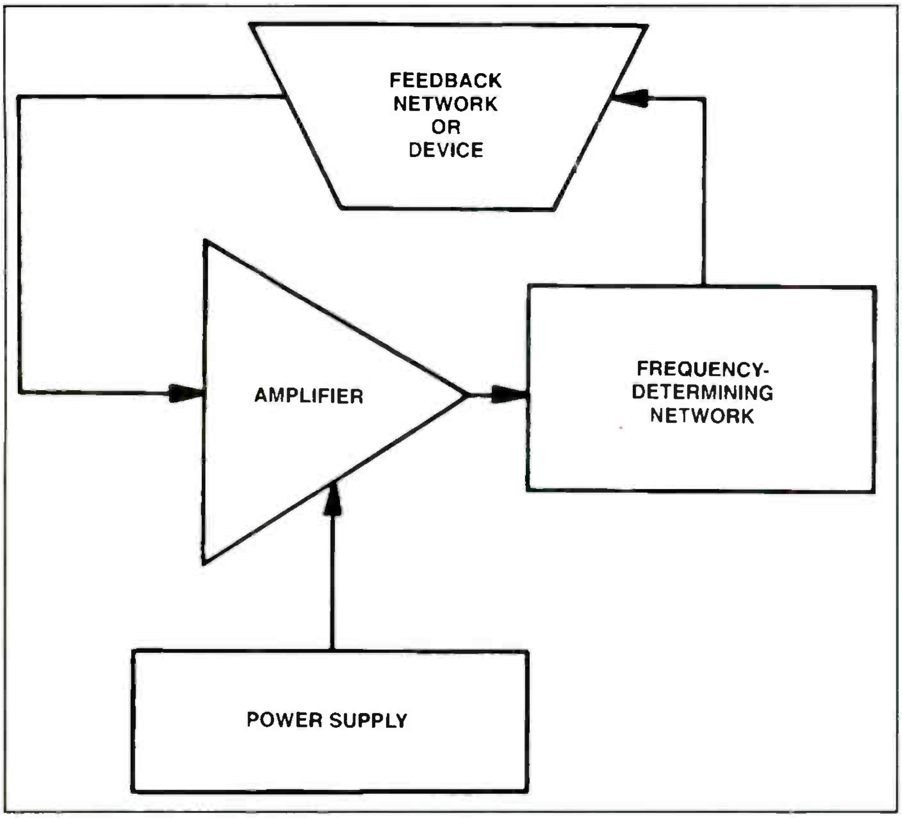


Figure 2. This block diagram is representative of all of the oscillator types, and is useful in troubleshooting any malfunctioning oscillators.

There are some important variations of those coupled circuits that we will discuss as we go along. At first we will stay in the audio amplifier applications. However, we will find the same basic methods used at all frequencies. They look different in microwave systems but they are simply variations of the same idea.

When you are looking at a system for the first time, knowing the type of coupling tells you a lot about what it is used for. For example, when you see direct coupling being used you know you are looking at a case where a wide band of frequencies is being passed from one amplifier to the next amplifier. That is really the only good reason for using direct coupling and putting up with the power supply problems associated with direct coupling.

RC coupling has an important advantage over the others—it is cheap. It also has a good frequency response except at the lowest frequencies.

Transformer coupling is expensive. Good audio transformers do not come cheap. If you want to compare two audio transformers you can tell a lot by weighing them. The better transformer will weigh more. That assumes both transformers are well designed.

In impedance coupling, capacitors and/or inductors are used to get specific bandwidth characteristics. For example, the impedance coupling circuit has an inductor to improve high-frequency response.

Servicing computer-designed circuits

I have been told by engineers that computer-designed coupled circuits defy any kind of analysis and the best thing to do when you're trying to service one is to start replacing parts until you get the right one. I find that type of "troubleshooting" repulsive, but, they are probably right. I guess the best rule would be to avoid time consuming analysis. Give it a good visual inspection and make sure the trouble is actually in the coupled circuit. With the right test equipment you can do that.

Sinewave oscillators

In some cases, analyzing a circuit can be greatly simplified by studying its block diagram. Take the example of the sinewave oscillator. You know that there are many types and many variations. However, they have only one purpose: change dc to ac. If the oscillator doesn't do that it is not much of an oscillator.

When you wade through the types of sinewave oscillators, you take a trip through history. They are often named after brilliant men who first brought the oscillator into being. So, you have Armstrong, Hartley, Colpitts, Pierce and Wein Bridge oscillators. That looks like a hefty collection of circuits to remember. The names don't really tell you anything about the oscillator circuit.

Keep in mind the fact that they all have one thing in common: their block diagram. Knowing that block diagram *does* tell you about the circuit.

Figure 2 is the block diagram that applies to all of the above oscillators. It is like a road map to troubleshooting one that doesn't work.

As with all circuits, the place to start troubleshooting is the power supply voltage. If you don't have that, there isn't any sense in going any further.

Before you go romping through the oscillator circuitry to solve a problem, make sure it *is* the problem. About the best way to do that is to defeat the amplifier.

Defeating the amplifier

All of the oscillators have an amplifer. Defeating the amplifier is easy to do if you remember that it is nothing more than an amplifier like the ones you've seen many times. The usual way to defeat the amplifier is to kill the amplifier bias. Then, use a sinewave generator to inject the voltage—at the proper frequency—at a point where the oscillator delivers its signal. If the system works with this injected signal, you know the oscillator isn't doing its job.

As mentioned before, all of the oscillators discussed here have an amplifier. You need that to replace energy lost in the tuned circuit due to resistance. The resistance generates heat and that, in turn, represents energy lost to the system. Lost energy has to be replaced. That is the reason all of the oscillators have an amplifier.

You know how amplifiers work and the dc voltages needed to get them into operation. Measuring the polarities of those dc voltages is one way to check an oscillator circuit. Remember, you are checking an amplifier. You are not checking an oscillator. The oscillator is the whole thing including the amplifier.

In the good old days, you could check the bias on the amplifier to see if the circuit was oscillating. Grid leak bias was used and if you lost oscillation you also lost the bias. Today an oscilloscope can be used for determining if there is oscillation. Another very good method is to use a grid dip meter (or the equivalent solid-state instrument).

The frequency-determing network

It isn't enough to just check to see if the oscillator is oscillating. You also need to make sure it is running at the required frequency. Both the scope and the dip meter can be used for that purpose.

There must be some kind of frequency-determining network in the oscillator circuit. That can be an LC circuit, a crystal, or an RC network. All three kinds are used in sinewave oscillators.

In most cases, the tuned circuit also acts as the regenerative feedback network. This way, you can check both at the same time.

If you are using a statistical approach to troubleshooting, keep in mind the fact that the frequency-determing network and the feedback circuit are the least-likely causes of trouble in an oscillator.

The principal is the same

To summarize, you should remember that a sinewave oscillator circuit always follows the block diagram of Figure 2. It doesn't matter if the amplifier is a tube, transistor, FET, MOSFET or op amp. It doesn't matter if the frequency-determining network is an LC or RC circuit or a crystal. It doesn't matter which circuit configuration is used to obtain regenerative feedback. As a technician you will recognize those variations but you will recognize that none of those variations will change the block diagram. We will go from here to schematics of the various sinewave oscillators and break them down to the block diagram.

Speaker protection

Here's a useful bit of information. You can protect an expensive loudspeaker with an ordinary fuse by using the equation given here:

$$I = 0.8\sqrt{P/Z}$$

where:

I is the fuse rating in amperes
P is the speaker power rating
Z is the speaker impedance

Never use a slow blow type of use for speaker protection!!! ■

Will Total Quality Management work for you?— Part 12

By John A Ross

TQM Point 12a

Remove barriers that rob hourly workers of their right to pride of workmanship. The responsibility of supervisors must be changed from mere numbers to quality.

TQM Point 12b

Remove barriers that rob people in management and engineering of their right to pride of workmanship. This means abolishment of annual review or merit ratings and management by objectives.

In the last article, point 11 of the TQM philosophy addressed worker evaluations, the reasons for focus on a quality process, and leadership. Past articles have illustrated obvious problems or barriers—such as fear, purchasing habits, and an over-emphasis on organizational values—that can appear in the workplace and damage morale. Point 12 builds on these earlier discussions by looking at other barriers that impede the quality process. Some of those barriers are micromanagement, an emphasis on hierarchical structure, and organizational culture.

The problem with micromanagement

Micromanagement is a common affliction that hits even the most progressive companies. Sometimes, the overemphasis on organizational values becomes apparent through certain danger signs. Often, when we strive for efficiency, effectiveness, and accountability, and attempt to please those in authority, it becomes easier to spread the blame to others. Job security rather than job satisfaction becomes a priority for everyone.

All this can result in poor workmanship and, in turn, customer complaints. As the pressure rises to produce more for less and employees begin to think that they work for an uncaring organization or uncaring managers, they often become less concerned about quality workmanship.

Unfortunately, when problems such as these arise, management often responds with micromanagement. As micromanagement becomes prevalent, the organization becomes even less efficient as managers abandon some responsibilities while concentrating on the smallest details of a subordinate's work day.

TQM entails a change in attitude

Any move toward TQM is a move toward not only organizational change but also toward a change in organizational attitude. From a production perspective, the early stages of organizational change may initially slow some processes.

From a human perspective, not all individuals cope well with change or readily accept new methods of performing their tasks. Others may feel that their job offers no future or no chances for satisfaction because of the new management style.

Every organization has individuals who still refuse to change because of political problems, higher expectations, or because they may need to learn something new. Some of those individuals may react to change by leaving or becoming disruptive influences.

It is extremely important to think about the organizational structure before moving toward TQM. An assessment of structure may show that the structure itself is a barrier to quality production. For instance, people may become so attached to their positions in the structure that they specialize in only one or two tasks. Further, structure sometimes allows informal power centers to develop that prevent deserving ideas from reaching fruition.

Finally, the strict adherence to structural rules may block some innovative person from having any input into the creative, decision-making processes. While some may acknowledge a person's ideas, those in charge may not listen because that particular individual does not have the position or credibility to successfully push the idea.

Organizational structures

Organizational structures can be summarized in two basic definitions. The centralized, functional structure has a clear vertical chain of authority for decision-making and communication. In addition, it has many explicit rules and specialized functions. Decisions are usually made from the top down with rewards tied to individual or group performance. Here, employees are valued because of their compliance and the goals revolve around giving customers the most for their money.

The decentralized, product-oriented

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

Test Your Electronics Knowledge

Symbols *(Answers on page 23)*

By Sam Wilson

Draw the symbols for the following electronic components and logic circuits:

1. N-Channel enhancement MOSFET
2. Optical coupler
3. LAD (light activated device)
4. Exclusive OR
5. TRIAC
6. P-Channel JFET (junction field-effect transistor)
7. Varactor
8. Operational amplifier
9. Normally-closed switch contacts (industrial symbol)
10. Constant-current diode
11. Tri-state buffer
12. Four-layer diode
13. PUT (programmable unijunction transistor)
14. UJT (unijunction transistor)
15. SCS (silicon controlled switch

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

Electrostatic *(from page 54)*

sistor, has been destroyed, you can measure the junction resistances and conclude that it's open or leaky and put in a component that tests good. But if the component has been damaged it may test good, but never perform properly, causing the product that it's in to perform below par. Then, somewhere down the road, it may fail.

If the failure of that damaged component is within the period of the warranty provided by the service center, the service center will have to eat a call back and soothe the ruffled feathers of the customer. If the failure occurs beyond the warranty period, it may still leave a bad impression on the customer, who may go elsewhere for service next time.

Preventing ESD damage

Electrostatic discharge damage can be prevented. Everyone in the facility where service is performed should be aware of the dangers of ESD, and invoke appropriate controls. These controls include grounding of the individual performing the service, isolation of static sensitive devices in their protective packaging until they are installed in the product, and neutralization of static electricity through the use of ionizers where necessary.

Another important aspect of prevention of ESD damage is elimination of sources of electrostatic discharge at the service bench. Check your pockets for plastic materials before you go to the bench. If that box of cough drops or pack of cigarettes has a plastic wrapper on it, get rid of the plastic. Don't use plastic or plastic foam cups for coffee or other drinks. And even keep the roll of cellophane tape on a desk in another area of the service center.

Don't relax your guard

As development continues in electronic device design and manufacturing, electronic components are likely to continue to become smaller, and ICs are likely to continue to cram more tiny devices into smaller and smaller packages. The consequence of these processes will be devices that are increasingly static sensitive. Unless the scientists and engineers are somehow able to eliminate the sensitivity of these devices to ESD, even as they make them smaller and smaller, it will be to the advantage of the manufacturers who use the devices in the products they make, and the service technicians who service the products to make every effort to prevent ESD damage to the devices they handle.

structure has a network of influence and communication, and few general rules. Decisions are made both from the top down and from the bottom up while employees are rewarded for creative teamwork. The organizational goals involve leadership and quality in the products and services provided. As you may suspect, the second structure is from a TQM-style, technology-oriented organization.

The organizational culture

The organizational culture is the set of collective values and beliefs of an organization's members that develops over a period of time and becomes passed on to new members. In some cases, the organizational culture is reflected in the symbols used by an organization, its rhetoric, and the actions of its members. Some organizations have cultures that radiate success and have a clear sense of mission; while others have rigid patterns of behavior or cultivate distrust among managers and workers.

As your organization moves towards the TQM philosophy, take the time to recognize and study the cultural values of your organization. Many times, the cultural values of an organization may be difficult to change because those values are historically acceptable.

Of all the management philosophies that exist, though, TQM may accomplish organizational change in the best way. Politically, TQM considers organizational culture by including everyone in the decision-making process and by considering the importance of participative management. The sense of equality, trust, and justice offered by participative management will go far toward changing the organization for the better.

Meeting the challenges of change

All the problems presented in this article pose challenges for those wanting to pursue the type of organizational changes given by TQM. As someone interested in quality and change, remember that the chances for failure are sometimes as great as the chances for success. However, the rewards for successful implementation of the TQM strategy will be tangible and long-lasting. Later articles in this series will show some methods for successfully implementing organizational change.

Photofacts

SEPTEMBER

Literature

(from page 7)

Application note for oscilloscope users

LeCroy announces the introduction of a new application note entitled "Probes and Probing."

After describing the problems most frequently encountered in probing electronic signals, the application note presents a discussion of choosing the right probe for various applications. Many engineers are using new logic families whose dynamic characteristics need to be matched with those of their probe. Logic families discussed include: TTL (standard, low power, and high speed), ECL (10kH, 100k, ECLinPS), and CMOS (BiCMOS, FACT, HCMOS).

Another tricky probing problem encountered by engineers is the need to look at signals on low-impedance transmission lines. Choosing the correct probing technique can make the difference between a 20% error in measuring a signal or a 0.1% error. It can also make the difference between having a product that works correctly or one that has undetected problems.

Circle (11) on Reply Card

Surge suppressor brochure

Information on the new line of Perma Power surge suppressors, applicable for all types of electronic equipment in the home or office, can now be found in a new brochure from Shape Electronics.

The brochure details the four grades of surge suppressor models. Premium-grade models protect PCs and workstations, and offer a lifetime product and equipment warranty. Heavy-duty, premium-grade units are applicable in test equipment, copy machines and laser printers. Computer-grade models protect personal computer systems, and standard-grade units provide surge and noise protection for home computers, home entertainment and appliance applications.

As the brochure explains, communication surge suppressors are designed to protect various electronic equipment, such as fax machines and electric phone systems, from damaging surges that travel through phone and data lines. The surge suppressors use advanced SIDAC surge protection with fast-switching time to eliminate spikes.

Circle (12) on Reply Card

Test and measuring instrument catalog

Brunelle Instruments Inc., has now released an updated instrumentation catalog. This new edition features many standard items along with many new models of test equipment. Products included are: oscilloscopes, function generators, frequency counters, power supplies, spectrum analyzers, multimeters, clamp-on ammeters, panel meters, stroboscopes, and more. A table of contents on the inside back cover makes for quick reference.

Circle (13) on Reply Card

Solder smoke extraction system

Weller announces the available central models of Fumex solder smoke extraction systems. These units can serve from 15 to 150 stations. Five different self-contained models are available and can be mounted on the wall, above a drop ceiling, roof mounted, or attached by other means. The Ambient Model is another new addition to the system. This self-contained, portable unit controls process odors where source capture is impossible. Its HEPA filter removes 99.97 percent of all airborne and nuisance particulate. The portable model is a self-contained unit for high-efficiency particulate removal; 99.97 percent efficient HEPA filter and activated carbon filter.

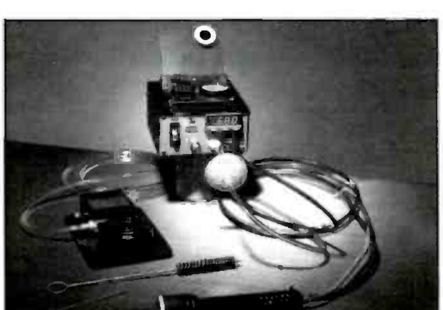
The four original self-contained models serve one to four work stations. Each is portable, includes a convenient carrying handle, and is impact resistant.

An adjustable tube is attached to each fume extractor soldering iron and postioned just above the soldering tip. As fumes rise from the heated solder, they are sucked into the tube and captured within the vacuum pump fitted with special filters.

Circle (70) on Reply Card

Digital desoldering system

A.P.E. introduces the EX-680 featuring Autotune temperature control. The unit is a digital desoldering system for high volume production touch-up and repair. Operates on in-house air supply filtered and regulated from 60 to 90 psi. This pneumatically-powered station converts shop air into high vacuum flow at 2.5 to 3.0 cfm. Continuous vacuum is achieved through a pneu-vac foot pedal activating a venturi system for an instant vacuum



force of 20-23 inches of Mercury. The integral modular LED control panel constantly monitors thermal loads to ensure safe removal of any solder joints—even multi-layer PCB's.

Standard design control features include digital closed-loop microprocessor-based PID for tight temperature control, selectable temperature, program security lock to prevent unauthorized changes for settings, and a high thermal mass low wattage static dissipative desoldering handpiece that allows the operator to work at safe temperatures reducing the possibility of PCB damage.

Circle (71) on Reply Card

EMF/ELF meter

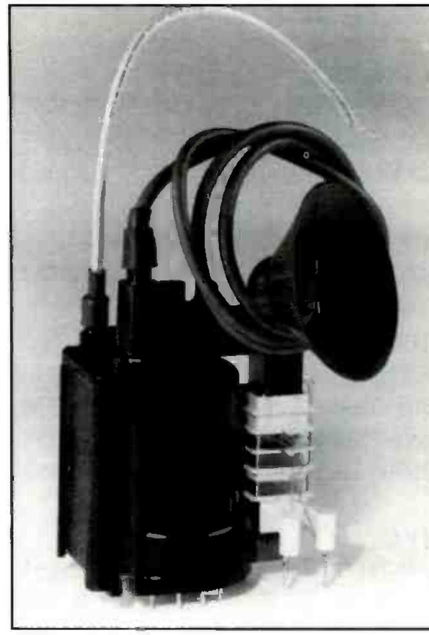
Extech Instruments introduces a single axis EMF/ELF meter used to measure electromagnetic radiation levels in the 0.1 to 199.9mG (milli-Gauss) range with an

ELF frequency bandwidth of 30Hz to 300Hz. The unit is accurate to 4% at 50Hz to 60Hz with a sampling rate of 2.5 conversions per second to ensure reliable readings. Offering a $3^1/_2$ digit 1.5 inch LCD readout with overrange indication, the EMF/ELF Meter monitors electromagnetic radiation levels from video terminals, fans, wiring, power lines, and numerous other sources.

Circle (72) on Reply Card

Flybacks and IFTs

Philips Service Company announces



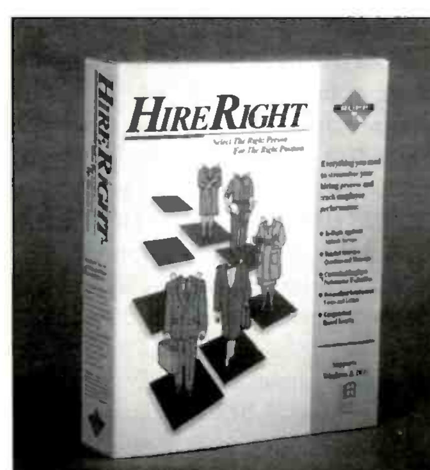
that the popular E34 Chassis/flyback transformer and IFTS for Philips 19C4; 25C1, C2, C4; and 25C5 chassis are again available to servicers.

For the E34 Chassis/flyback transformer the part number is 4825 140 67029; the 19C4 Chassis part number is 4835 148 87139 (replaces 361916-1,2,3); the 25C1, C2, C4 Chassis part number is 4835 148 87048 (replaces 361846-1, 3, 4, 5, 6 & 4835 148 87047); and the 25C5 Chassis part number is 4835 148 87054 (replaces 36169-1,2).

Circle (73) on Reply Card

Software for hiring

Rupp Technology Corporation is now shipping HireRight PC software, a Windows-compatible employment toolkit



that helps to streamline hiring, more effectively motivate staff members and accurately track employee evaluations.

Based on personality surveys designed by a leading human resource authority, the software brings the complete staffing process—from before the initial interview through promotion or termination—to the user's desktop.

Circle (74) on Reply Card

Digital multimeter

A.W. Sperry Instruments, Inc. introduces a new $3^1/_2$ digit, 20 range, 6 function digital multimeter.

This new pocket-sized autoranging DM-12 is ergonomically contoured for the hand, it has a 200-hour battery life, and recessed safety designed input terminals. Additional features include overload protection on all ranges, a diode test function, capacitance test function and auto power off.

Circle (75) on Reply Card

Shipping container for electronics

The shipping container line recently introduced by *Chicago Case* has added a newly designed model #SC191919. A shipping case for all 14-inch monitors, as well as for electronic devices, computer peripherals, medical electronics and other sensitive equipment.

This standard container is constructed of durable, light weight, heavy impact 0.250 inch to 0.310 inch polyethylene (HDPE). The entire line of standard cases is available in high visibility industrial blue color for quick, easy identification.

Construction includes heavy duty aluminum tongue and groove valance with

rubber gasket to seal out moisture and dust. Military style hardware with quarter turn butterfly twist locks, padlock eyelets for added security, and spring loaded handles are standard.

Circle (76) on Reply Card

Work vise

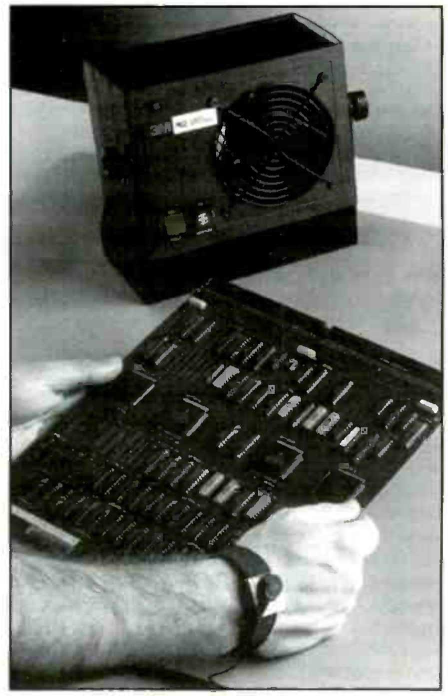
PanaVise Products Inc. announces the PV Jr., a versatile small vise that weighs 1lb 4oz. Developed for such projects as soldering; drilling; painting; assembling; fly-tying and light industrial use, its head positioning ranges can rotate and swivel 360 degrees, and pivot 210 degrees.

The jaws have a maximum opening of $2^7/_8$ inch and are made of fiber reinforced thermal plastic alloy. The base which fits all of the company's base mounts is made of die cast zinc, just like the other offerings in the product line.

Circle (77) on Reply Card

Air ionizer

The new 962 Ionized Air Blower from *3M* features three fan speeds for increased ionization effectiveness and a heater to help make the workstation environment more comfortable.



The ionizer is a self-contained, bipolar, intrinsically balanced ionized blower that neutralizes static charge on nonconductors such as insulative tapes, plastics, and circuit board substrates.

The unit blankets the workstation with an equal number of positive and negative ions to effectively neutralize charged objects. The proprietary self-balancing power supply will continue to deliver a balanced ion stream even if emitter points become dirty or corroded.

Circle (78) on Reply Card

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WANTED

Schematic for a 535A Tektronix Oscilloscope. Will copy and return. *Contact John Dirian, 4190 Bonway Dr., Pensacola, FL 32504, (904) 477-6736.*

Piston and cap used to raise arm of Dual Model 1229Q tone arm. *Contact Eric P. Smith, 1812 33rd St., Zion, IL 60099, (708) 872-5753 voice/fax.*

Service manual with schematic for Panasonic Model SE-3160, radio/phono/8 track tape player. Will buy original or copy plus pay expenses and postage. *Contact Gene Jones, (301) 946-5767.*

Hitachi VT-98A or RCA VLP900, VLP950HF, VLP970/MVR975 VCRs for parts. *Contact David Arnold, Arnold Electronics, 1303 Christy Ave., Lawrenceville, IL 62439, (618) 943-2287.*

Yoke for a Magnavox TV. Yoke #3618380001, Tube #25VGMP22. Yoke not available from Magnavox. Also, 1-XFmer #4-2512-17900. 1-LA4250 for fisher Audio System. Model MC-530. *Contact John Carr, John Repari Services, 142 Jackson St., Philadelphia, PA, 19148.*

Service manual and/or schematics for Shakespear 35 12-volt infinitely variable speed trolling motors with battery saver, electronic motor speed control. Send post card to *Ed Drake, 921 Liberty Rd., Roanoke, VA 24012.*

Servicing info and/or schematic for 1976 Chrysler Cordoba tachometer. *Contact H. D. Fogle, 35 Widlwood Rd., Katonah, NY 10536, (914) 232-4738.*

Will pay for schematic or copy of Cobra Cam 89, Cobra 28, and Royce 1612 CBs. *Contact Jack Gomez, 207 East 27th St., Kearney, NE 68847, (308) 237-4405 (hobbyist).*

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Antique RCA oscilloscope, Model WO-91C. Best offer. *Contact Jeff Moser, 111 Nuthush Ct., Hillsborough, NC 27278, (919) 732-0703.*

Eico Grid Dip Meter, M710, $15.00; Sencore Handy 75, RC146, resistor/cap. subber, $15.00; Castle Field Strength Meter, FSM-U, $15.00; Castle Tuner Subber, Mark IV, CUV, $15.00; Zenith System Analyzer, 852-257, mid 1980s, $15.00; Lectrotech Digital Color Bar Generator, BG10, $50.00, B&K Solid State Sweep/Marker Generator, Model 415, $350.00. Plus shipping, complete with manuals. *Contact Wallace W. Huffman, (219) 453-4811.*

Text books, service manuals, parts, tubes—90% off list price. Send large S.A.S.E. *Contact M. Seligsohn, 1455 55th St., Brooklyn, NY 11219.*

Tek Model 7904, 500 MHz main frame with two 7A26, one 7B53A, one 7B92, $750.00; Tek 561B, 10 MHz, $125.00; H.P. 1725A, 275 MHz, $600.00. *Contact Andy Bagatta, P.O. Box 1036, Marlboro, NY 12542, (914) 236-4773.*

Sencore TF-46 SuperCricket transistor tester, $165/00; Sencore LC-53 Z-meter, $375.00; Sencore power supply, $135.00. *Contact (703) 525-2382.*

Sencore VC93 All Format VCR Analyzer, brand new, never used, paid $2995.00, asking $2500.00. *Contact Mrs. Charles Singleton, (313) 841-5246.*

Sencore CVA 94–VR 940, $2,590.00; VC 93, $2,100.00 or package for $4,127.00. *Contact John, P.O. Box 458, Grabill, IN 46741, (219) 627-6456.*

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Parts Express	14	28	800/338-0531
Philips ECG	13	29,30	800/526-9354
Premium Parts +	69		800/558-9572
RNJ	26	31	800/645-5833
Satellite Dealers Association	14	32	317/653-4301
Sams, Howard & Company	17,51	33,34	800/428-7267
Sencore	IFC,55	49, 50	800/SENCORE
Serviceware	43	36	613-521-7391
Sperry Tech	72	37	800/228-4338
Wavetek	3	38	800/854-2708
Wholesale Electronics	72	39	800/351-2233

We'd like to see your company listed here too. Call Diane Klusner at 516/681-2922 to work out an advertising program tailored to suit your needs.

SALES OFFICE

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