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ELECTRONIC Servicing & Technology

Volume 17, No. 9 September 1997

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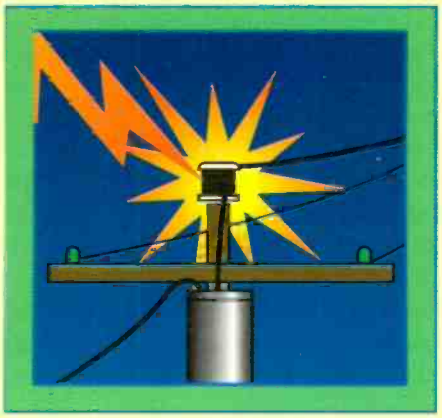

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ON THE COVER

The oscilloscope is arguably the most fundamental instrument for use in observing/measuring varying signals. Although the concept of the oscilloscope is quite simple, all of the bells and whistles of modern scopes may make them seem complex. An occasional refresher in oscilloscope operation may make them more easily understood. (Photo courtesy LG Precision)

HDTV: The digital revolution continues

As the article "The state of new consumer electronics technology" in this issue points out, there is a great deal of change on the horizon for people who are involved in consumer electronics in any way, largely as a result of the advent of high-definition television (HDTV). The change will have a major impact on the individuals who service this new technology. It boggles the mind to consider what the new technology truly means, and no doubt many of its implications are still not clear, even to the companies and individuals in the forefront of the technology, but will begin to unfold as HDTV systems are put in place.

As an example of the things yet to be made clear, consider the statement in the article itself: "In addition to all of this, you can carry immense amounts of data over the channel, either by dedicating some portion of the channel capacity, or by using the channel opportunistically. The Grand Alliance did an experiment with a BMW commercial produced in HDTV. When the car swooshes across the countryside, it takes most of the channel to reproduce top-quality HDTV pictures, but when the BMW logo is shown for a few seconds, much of the channel capacity is available for data. Over the course of this 51-second commercial, 60Mbytes of data (40 floppy diskettes worth!) was transferred through the channel, simultaneously with the delivery of a high-quality HDTV commercial. Thus, the challenge for using the DTV transmission capability for information services is not in squeezing data through, but it is a marketing challenge to figure out which data applications consumers will desire."

Yikes! I was going to try to make some kind of comment about that tremendous data capacity here, but until I've had a chance to think about it a great deal I'm just left speechless. Imagine, all that data in about one minute. Multiply that by 60, then by 24, and that gives you an idea of how much data *might* be transmitted in a single day. On one channel.

But how about this thought? Web TV is a reality. I see those set-top boxes and keyboards in the stores even now. No doubt many people who have not seen fit to buy a computer are buying them. In the future, when HDTV sets are available, no doubt it will become a purchasing decision whether or not to buy one with or without the circuitry that will allow the owners to access the internet.

And will sets come with a remote keyboard instead of the type of remote control available now? And a floppy disk drive or a zip drive or some other totally new type of recording device? After all, if TV stations will be capable of transmitting all that data in addition to the programming, wouldn't it be necessary to have some type of recording device?

And since TV receivers will be able to access the Internet, will TV programming be available on the net? At the moment, the answer might seem to be "no," because of the limited data capacity of the telephone lines that most of us use to connect to the Internet, but there are other ways to connect to the Internet.

For example, telephone companies are now offering connections for computers using the integrated services digital network (ISDN). It costs several hundred dollars to set up, and the monthly charges are considerably more than for the average telephone line, but the connection allows computer users to transfer data much faster than they can over a standard telephone line, and carry on a telephone conversation and/or send a fax at the same time as data transfer is going on.

And cable companies will no doubt get into the act. That TV cable that comes into your home works both ways. And it has a broad bandwidth. In Lawrence, KS, for example, there's a cable company that is providing data communications on an experimental basis for some of its customers. According to a report on the performance of the system, when a customer accesses a site on the Internet she doesn't experience that delay and slow painting of the page on the monitor screen that those of us who use a telephone line experience. Once contact is made with the site, the page virtually jumps onto the screen instantaneously. With coaxial cable between a customer and her internet provider, why wouldn't it be possible to transmit video programming via the net?

And as long as we're dreaming, how about this? With TV sets becoming increasingly digital, why wouldn't we one day have "virtual" TVs. That is, TV sets that are so "programmable," or perhaps a better term would be versatile, that the type of signal that it would accept could be determined by changing the software on which the set operates. And, hey, we could change the software programming in the set by downloading it from the local TV station, cable provider, DSS system, Internet TV program provider, or who knows what program originator in the future.

If this were to come to pass, then it would no longer be necessary for an entire industry to gear up for a major change such as we're now doing for HDTV. If a program originator developed some new type of signal that provided better picture or sound quality, he could just reprogram your set on the fly to display it. That would then give that program originator a competitive advantage.

Ok, maybe now I've gone to far. But the possibilities for the future of TV and other information delivery for the future do seem to be almost limitless. It's certainly fun to think about. Let's not spoil it by thinking about all the work service centers are going to have to do to gear up for servicing it.

Nils Conrad Persen

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NEWS

The New York State Forum & Expo

The New York State Forum & Expo, "Planning Together for the Digital Age," is scheduled for Tuesday Evening and Wednesday, October 14 and 15 at the Holiday Inn, Plainview, NY. This event, sponsored by the Greater NY Electronics Service Dealers Association (Greater NY ESDA), Western NY Electronics Guild (WNYEG) and the New York State Electronic Service Dealers Association (NYS-ESDA), is an opportunity for attendees to meet with distributors, computer hardware and software companies, and manufacturers. Exhibitors will be showing their individual product lines and providing free catalogs, as well as other information for attendees.

This event will provide a chance for service dealers, manufacturers, third-party administrators and distributors to meet in an open forum to begin planning together for the digital age. The mission of the event is to help to determine what is required to continue servicing consumer electronics products in the future.

The evening of Tuesday October 14 is scheduled for the New York State Electronic Service Dealers Annual Meeting and Election of Officers. This meeting is open to all attendees.

On the morning of Wednesday, October 15, 1997, there will be a Forum in which attendees will be invited to discuss subjects of interest with manufacturers, third-party warranty administrators and parts distributors. Subjects will include warranty, parts availability, service literature, CD ROM training, DVD and high definition television.

During the afternoon of October 15 there will be a Manufacturers and Service Dealers Roundtable that will feature several 20 to 30-minute time segments with a moderator and manufacturer's representatives with whom attendees will be able to discuss their own problems in the areas of warranties and parts.

Also in the afternoon there will be a lecture by Randy Whitehead of NESDA, based on a full day seminar on Certified Service Management that is given annually at the National Professional Servicers Convention.

An Expo and Trade Show will be held in the evening, where distributors and manufacturers will have booths in which to exhibit information and materials of interest to all service centers.

For more information, write to New York State Forum & Expo, Mrs. Pat Viscardi, Chairman, 3995 David Place, Seaford, NY 11783, or call Mrs. Viscardi at 516-221-6403.

Digital set makers summit marks historic gathering

Television set manufacturers gathered in June in Arlington, Virginia for the first ever Consumer Electronics Manufacturers Association (CEMA) summit focusing on television engineering and marketing issues raised by the shift to digital television (DTV). The program offered attendees an opportunity to learn about several engineering and marketing issues affecting the industry as the country prepares for regular broadcasts of digital television signals.

At a joint session, CEMA President Gary Shapiro called the gathering a first for CEMA and the industry because it "allowed us to talk about opportunities and issues as our era fully shifts to digital technology."

"We all know that the next 18 months will be extremely difficult for the television industry, but the summit laid out the myriad of common challenges we face through an open dialog among set manufacturers. There was candid give-and-take with the participants. They questioned long held assumptions, discussed current needs and debated the next steps required to launch DTV. Numerous issues still remain, including what efforts CEMA can undertake to support stronger analog set sales," added Shapiro.

Attendees also urged CEMA to keep promoting analog television and to not shy away from discussing its capabilities and value. Other topics included CEMA managing and administering an Advanced Television Systems Committee (ATSC) TV Set Certification Program, standardizing definitions to ensure consumer understanding, HDTV programming opportunities during the 1998 Winter CES, retailer education initiatives, channel numbering and navigation,

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cable ready DTV sets, converter boxes, and antenna and reception systems. While no program decisions were finalized, several companies volunteered to begin reviewing options to ensure that consumers understand that today's analog TV set is a terrific value which will provide several years of use. Future initiatives also are planned to help educate the retail community about digital television and its capabilities. Consumer DTV promotions will not be planned until at least next year.

More than 100 people from 27 companies attended the all day sessions that included a luncheon address by CEMA Senior Economist Todd Thibodeaux, who provided attendees with a glimpse of market expectations for DTV.

According to Thibodeaux, "We're faced with a CE market vastly changed and infinitely more diverse then when color TV was introduced. Marketing to early adopters is much more complicated but open to much more opportunity. We now have entire pockets of consumers who early adopt wireless technologies, groups who early adopt computer technologies, and of course we still have those on the lookout for new stereo and video products. By my own count, some 30 million U.S. households are early adopters of at least one consumer electronics category, including video games, telephones, autosound, and accessories."

He went on to recommend marketers look closely at who their early customers are and be prepared to deliver more targeted messages than what are traditionally expected from our industry.

"Selling DTV to an early adopter who owns a computer and a DSS is going to be a different task from selling DTV to someone who owns a cellular phone, a 19" TV, and a VCR, even if they are identical in a demographic sense they come to the market with different expectations for the technology and value in home entertainment. If we as marketers try to lump all the different product constituencies together under the single umbrella of early adopter, we're likely to miss some opportunities to exploit the true potential of DTV. And, we're likely to create a generic message which reaches no one."

Cordless phones continue torrid sales pace fax machines also strong in 1Q

Following a record-setting 1996 in which more than 20 million cordless telephones were sold to dealers, cordless sales continued to climb in the first quarter of 1997. According to statistics released by the Consumer Electronics Manufacturers Association (CEMA), over five and a half million cordless phones were shipped to dealers from January to March, representing a 32 percent increase from last year.

Thanks to rapidly growing consumer demand for 900MHz models, dollar sales shot up 43 percent to $342 million. The 900 MHz category constituted $135 million of that total — a whopping 107 percent increase.

Despite the fact that 96 percent of U.S. households already own at least one corded telephone, the corded market remains steady. Manufacturers shipped over five million corded models to dealers in the first quarter, amounting to $120 million in sales — down one percent.

Unit sales of telephone answering devices (TADs) were up slightly from last year, but price erosion led to a 10 percent decline in TAD dollar sales, to $186 million. Cordless combination models showed the most success, ringing up $118 million.

Consumer fax machines sold particularly well in the first quarter, jumping 39 percent. With high-end models showing strength, dollar volume shot up 62 percent to $328 million.

VCR, camcorder sales continue to expand; led by large-screen models, color TV posts may gains

VCRs and camcorders ran neck-and-neck in the May sales sweepstakes, with color television finishing strong as well, as reported by the Consumer Electronics Manufacturers Association (CEMA). Sales of VCR decks and camcorders each grew 14 percent last month, and on a year-to-date basis each is up 16 percent relative to the first five months of 1996. Of the 1.2 million VCRs sold to dealers in May, more than 500,000 were stereo-equipped, a 22 percent improvement over the same month a year ago. Year-to-date sales of VCRs exceed 5.6 million.

Like VCRs, the camcorder category experienced its best May ever, reporting unit sales of nearly 300,000 as consumers gear up for graduations, summer weddings and vacations.

Through May, 1.39 million camcorders have been sold to U.S. dealers. Color TV receivers grew a modest yet resilient two percent last month, due mainly to a 16 percent jump in sales of large-screen sets (defined by CEMA as direct-view models measuring 25 inches and above). More than 1.4 million color TVs were sold to dealers in May, and on a year-to-date basis, TV sales are almost precisely what they were during the first five months of 1996 — some 7.3 million units. The total number of video hardware units shipped last month rose seven percent as compared with May 1996, with the year-to-date increase also at seven percent.

Projection television and color TV/VCR combinations encountered some softness in May. Projection TV declined five percent last month, yet on sales of 264,000 units is running fractionally ahead of last year's pace. TV/VCR combinations, despite a seven percent drop in May, continue to outperform last year's totals by a wide margin. For the first five months, 817,000 TV/VCR combinations were sold to dealers, a 25 percent surge over the 652,000 sold at a comparable point last year.

On the digital side, more than 27,000 DVD players were shipped to dealers last month, bringing this product's total to 96,000 units for the year. By contrast, May sales of laserdisc players plummeted 81 percent to some 1,800 units.

Rising eight percent in April, systems outperform other audio sales

Amounting to $111 million, April sales of audio systems were led by compact systems, which surged 34 percent to $72 million, according to data gathered and analyzed by the Consumer Electronics Manufacturers Association (CEMA). For the first four months of the year, $473 million worth of audio systems were shipped

(Continued on page 59)

The state of new consumer electronics technology

Based on information provided by the Consumer Electronics Manufacturers' Association (CEMA) and the Advanced Television Standards Committee (ATSC)

This is an interesting time to be alive. It's possible (well, almost) for a person to speak to anyone else anywhere on earth, (and actually, some who may be orbiting above it). Anyone with a few thousand bucks to spare can have a theater in his/her own home. Anyone with a computer and a modem can access information from thousands of other computers throughout the world, thus tapping a virtually limitless information resource. In a few years, individuals in this country will be watching high definition television, from broadcast antennas, cable, satellites, or possibly some other signal source.

Since so much is happening in consumer electronics, on such a number of fronts, this seemed to be an opportune time to recap some of what has been happening, and present some information from the industry that's making it happen.

Keep in mind that the dates noted here were those projected at the time this article was written. Some may change and some may have already changed.

Digital HDTV background

The ATSC (Advanced Television Standards Committee) Digital Television Standard adopted by the FCC was based on a system built by the Grand Alliance, a consortium of digital television (DTV) system proponents who were finalists in the first round of testing under the FCC Advisory Committee on Advanced Television Systems (ACATS).

ACATS (composed of representatives of the computer, broadcasting, telecommunications, manufacturing, cable television, and motion picture industries) worked with the Grand Alliance to review the design of the proposed system, and gave its approval to final specifications for system modules: audio, transport, format, compression and transmission. The ATSC documented the system as a standard and ACATS adopted the Grand Alliance system in its recommendation to the FCC on November 28, 1995.

On July 25, 1996, the FCC proposed policies for developing the initial DTV allotments and procedures for assigning DTV frequencies to broadcasters. Under the proposed plan, all DTV service would eventually be located in a core region of spectrum currently allocated for broadcast television, namely the spectrum existing at channels 7 through 51. This plan is intended to allow early recovery of the spectrum outside the core region: channels 60 through 69.

On November 27, 1996, members of the broadcasting, consumer electronics manufacturing, and computer industries reached agreement on which elements of the standard should be mandated by the FCC. At the request of these industries, the FCC on December 31, 1996 formally adopted every aspect of the ATSC standard except for the video formats. While not adopted by the FCC, the video formats will remain a part of the ATSC standard, and are expected to be used by broadcasters into the foreseeable future.

On April 3, 1997, the Commission allocated digital spectrum to broadcasters. Network affiliated broadcasters are required to transmit digital broadcasts in the top 10 markets within 24 months of this ruling. In each of the top 10 markets, at least one broadcaster, and more often more than one, has promised to send digital broadcasts within 18 months. Television manufacturers have indicated that they will be marketing digital television receivers by late 1998.

NTSC and digital TV sets in the U.S.

Currently there are nearly 250 million television sets in use in the U.S., with annual sales averaging 23 million to 25 million sets a year for the past five years. While initially HDTV television sets will be expensive, the gradual move to digital HDTV will not make current National Television Standards Committee (NTSC) televisions obsolete. Inexpensive converter boxes will enable consumers to receive digital programming on their current NTSC sets as broadcasters convert to digital programming.

What is the Advanced Television Standard Committee (ATSC) digital television standard?

These are the highlights of the ATSC digital television standard.

- Video compression is based on the international MPEG-2 (Motion Pictures Experts Group) Standard. Video formats include standard (STV) and high definition (HDTV), in both progressive and interlace scan.
- Audio compression is based on Dolby AC-3 technology offering digital surround sound.
- A packetized data transport system that allows the transmission virtually any combination of video, audio, and data services. The combination of services can be changed dynamically by the broadcaster offering new business possibilities.

As an example, a broadcaster might transmit multiple channels of standard definition television (SDTV) during the day and high definition television (HDTV) during prime time. New data services can accompany both of these transmissions.

- An extensively tested and proven modulation technology, 8-VSB (vestigial sideband), which provides robust and reliable terrestrial transmission. The 8-VSB modulation system assures a broad digital television coverage area, reduces interference with existing analog broadcasts and provides immunity from interference into the digital signal.

Technical questions and answers for digital television

Here are some answers to questions that people have had about HDTV.

Q: *What is the agreed upon definition for high-definition TV?*

A: There is a generally agreed upon definition of HDTV: approximately twice the vertical and twice the horizontal resolution of an NTSC TV. Because HDTV also has a wider screen, HDTV pictures contain about five times as much picture information (picture elements or "pixels") as conventional TV: twice as much vertically, twice as much horizontally, and then a bit more to fill the wider screen.

HDTV usually also includes multiple channels of digital surround sound as well. In the case of the ATSC DTV Standard based on the Grand Alliance HDTV system, the standard offers CD-quality surround sound.

To many people, high-definition means 1,000 vertical scan lines in the picture, but things aren't quite that simple. For the same number of lines, a progressively scanned picture offers a higher effective resolution than a picture using interlaced scanning where only half of the lines are shown at a time. Thus, there are two fundamental HDTV formats in the ATSC DTV Standard: 1080 lines x 1920 pixels/line; and 720 x 1280 pixels per line. These two fundamental pixel arrays are used at three different frame rates: 60 frames per second for live video, and 24 and 30 frames per second for material originally produced in film.

Thus, there are six HDTV formats in the standard. All of them use progressive scan except one, the 1080 x 1920 at 60 frames per second. This particular format requires the most bits, and the only way that this format can be fit into a 6MHz terrestrial broadcast channel is to use interlaced scanning, which is essentially a further compression technique which reduces the bit rate by only reproducing half of the picture at a time.

Here is a summary of HDTV formats (P indicates progressive scan, and I indicates interlace scan).

- 1080 x 1920 24P, 30P, 60I
- 720 x 1280 24P, 30P, 60P

Although knowledgeable people often refer to the 1080 interlaced format as providing the highest level of resolution, in fact, it's more complicated than that: 720 progressive is roughly comparable in effective vertical resolution to 1080 interlace, although the 1080 x 1920 format will offer greater horizontal resolution. And of course the 1080 x 1920 progressive formats will provide the highest spatial resolution, but at lower frame rates, i.e., at lower temporal resolution.

Everything about digital TV is a tradeoff between various factors. Here, you can get higher spatial resolution at the expense of lower temporal resolution. Different types of programming would cause you to choose different tradeoffs, thus the inclusion of multiple formats to choose from in the Standard.

Q: *What is the difference between digital television (DTV) and high-definition TV (HDTV)? Can the terms be used interchangeably?*

A: Digital Television (DTV) is a broad term encompassing all types of digital

Video and computer industry facts

Consumers are already spending $45 billion annually on video entertainment products and computers and software

- $17 billion Video
- $28 billion Computer

Consumers spend $29 billion a year on televisions and computers alone.

- $10 billion TV
- $19 billion on home PCs

60% of the people who own a big screen TV also own a computer, while more than 80% of the people who own a computer also own a big screen TV.

Consumers are spending $40 billion annually for video programming, video software, computer software, and subscriptions to on-line services.

Television manufacturer brand names are known for entertainment among consumers.

There are 250 million TVs being used in U.S. households every month and 44 million personal computers.

The inventory of TVs turns over about every 8 years.

60% of multimedia computer owners use their systems to listen to audio CDs.

50% of computers owners consider their systems more as entertainment products than work tools.

Computer display monitors are made by household TV manufacturer names like Sony, RCA, Philips and Zenith.

70% of families who set-up a home theater spend more time together.

16 million households in the U.S. have a complete home theater system.

A color TV which cost $500 in 1955 would cost $2,500 in today's dollars, but instead, the average price of a color TV is just about $325 (35% lower than in 1955) with dramatically better picture and sound quality.

Consumers are already spending more than $2.4 billion annually on color televisions (about 25% of all TV sales) with price points $1,300 and above.

When HDTV is introduced we could expect, based on historical trends in consumer electronics prices, for the price to drop by more than 50% within 10 years.

At least 18 million U.S. households identify themselves as early adopters of new technologies, which at a minimum could mean 1 in 5 households with an HDTV within 8 years.

Consumers spend nearly $25 billion annually on consumer electronics products priced at $750 and above.

On average, U.S. households annually spend $800 on consumer electronics products.

88% of teenagers would prefer a computer over a video game if they could only have one to play games with.

68% of teenagers prefer a computer for playing games even when they already own a state-of-the-art video game system.

Senior citizens (50 and over) owning a computer spend an average of 11 hours per week working on their computer and about 18 hours a week watching TV.

Currently only about 1 in 5 computer owners are interested in having the capability to watch TV through their computer.

The typical adult consumer watches about 20 hours a TV a week.

On average, consumers interested in a TV/PC would prefer a screen about 30 inches. 42% would prefer a screen 30 inches or larger.

47% of consumers interested in a TV/PC would expect to pay at least $3,000.

Consumers interested in a TV/PC would have the following uses: % likely

77% Watch TV programming
73% Watch prerecorded videos
63% Record TV programming
59% Word Processing
50% Browse the Internet
43% Send and receive email

36% of consumers are interested in a flat panel 16 x 9 color TV.

Sound and picture quality are two of the top three reasons

10 million people have purchased a digital satellite system.

So far this year about 40% of computer sales have gone into first time homes.

Source: Consumer Electronics Manufacturers Association (CEMA). Based upon recent consumer surveys and other original research.

transmission. HDTV is a subset of DTV indicating greater than 1000 lines of horizontal resolution.

Another type of DTV is Standard Definition Television (SDTV) which has picture quality equivalent to (or slightly better than) a good analog picture. Since it requires less data to generate a SDTV picture, a broadcaster will be able to transmit multiple channels of SDTV within its 6MHz digital channel.

What broadcasters can send in a 6MHz channel is frequently misunderstood and misstated. It depends entirely on the type of program material that is being sent. For the toughest live video, i.e., fast-action sports like basketball, it does require most of the channel to send a single HDTV program. However, for more typical video like game shows, you could usually send one HDTV and one SDTV program concurrently over the channel.

For film-based material (all movies and 70% to 80% of prime time programming), you can send two high definition TV programs simultaneously.

Here's a summary of what you can send concurrently over the channel:

- Sports/Action Video — 1 high definition, or 2 to 3 SD
- Typical Video — 1 high definition plus 1 SD, or 4 SD
- Movies/Slow video — 2 HD, or 6 SD

In addition to all of this, you can carry immense amounts of data over the channel, either by dedicating some portion of the channel capacity, or by using the channel opportunistically. The Grand Alliance did an experiment with a BMW commercial produced in HDTV. When the car swooshes across the countryside, it takes most of the channel to reproduce top-

quality HDTV pictures, but when the BMW logo is shown for a few seconds, much of the channel capacity is available for data. Over the course of this 51-second commercial, 60Mbytes of data (40 floppy diskettes worth!) was transferred through the channel, simultaneously with the delivery of a high-quality HDTV commercial. Thus, the challenge for using the DTV transmission capability for information services is not in squeezing data through, but it is a marketing challenge to figure out which data applications consumers will desire.

Q: *Does high-definition only mean interlaced, or could it also mean 1080 lines of progressive scan?*

A: The term "high definition" could apply to 1080 lines of progressive scan. While the technology does not yet exist to allow broadcasters to transmit 1080 lines of progressive scan in the digital channel, such technology should be available in the future.

High-definition most definitely does not only mean interlaced. Indeed, five of the six ATSC HDTV formats are progressive. One of the most exciting things about the standard is that film-based material, including all movies and 70% to 80% of prime time programming (like ER, etc.) can be shown in 1080 x 1920 progressive scan (at 24 frames per second or "Hz"). And by the way, all film material will be automatically transmitted using progressive scan formats. It would be inefficient and more difficult to use interlaced scanning for the transmission of film-based material. Thus from day one, most digital TV programming will be transmitted in progressive scan.

As noted, ATSC cannot yet fit 1080 x 1920 progressive at 60Hz into a 6MHz channel, and it's not even close right now. ATSC has just started work on a layered coding approach to enable them to do this in a backwards compatible way, but additional invention is required. It's hard to say when this might be possible, but it's very unlikely in the immediate future.

Q: *What are the intentions of broadcasters to use both progressive scan and interlaced formats?*

A: It's a complicated issue for broadcasters to decide which formats to use, but it's virtually certain that they will use a variety of formats for different purposes. CBS has spoken out clearly in favor of 1080, interlace, for video, progressive for film. NBC has stated clearly that they will offer substantial amounts of HDTV, but they have not clearly indicated whether they'll use 1080, 720 or a mix of both. ABC has said they'll offer HDTV, and they have shown a preference for progressive scan, i.e. 720 progressive, but that could change. Fox originally spoke in favor of SDTV to the exclusion of HDTV, but last year Rupert Murdoch seemed to indicate that a quick look at the business case for multiple SDTV had rekindled Fox's interest in HDTV. There is no pivotal cost issue on progressive vs. interlace. You will see both progressive and interlace, in both HDTV and SDTV.

Q: *Why would anyone buy a regular NTSC TV set now with HDTV coming?*

A: These sets will work forever with everything but broadcast. For broadcast signals they will work until 2006 and then low cost converters are available. Even if the broadcast analog signal is ended in 2006, a $1,000 set bought in 1997 would cost about three cents a minute of average use for the next ten years.

Q: *What short term effect will DTV have on the sales of standard TV sets?*

A: If the manufacturers do their jobs and explain the situation carefully, it should not have an impact. Standard broadcast television signals will work until the year 2006, and well beyond. Also, televisions will continue to work with cable, DSS and VCRs. Furthermore, they expect low cost (under $150) converters to be available when digital signals replace analog, so viewers will be able to receive the DTV broadcast.

Q: *When the analog signal stops in 2005, will people throw out obsolete sets?*

A: Not likely. First, the TV sets will work with cable, home satellite, VCRs, DVD and other products. Second, for broadcast television, manufacturers expect low cost (under $150) converters to be available when digital signals replace analog signals.

Once the transition to Digital Television begins, inexpensive converter boxes will be available that will allow the consumer to view DTV broadcasts. That means the television that a consumer buys today will receive both analog/standard broadcasts and DTV broadcasts.

Q: *What does the year 2006 termination really mean?*

A: 2006 is a "target." In Washington, Democrats and Republicans want to balance the federal budget by the year 2004. Auctioning the analog spectrum has become a mantra for politicians in order to recoup revenues as one method to help offset a portion of the budget deficits. In reality few people believe that DTV penetration by 2005 will allow the shutting-down of the analog signals by 2006.

Even though the budget is a politically explosive issue, broadcasters are committed to making huge investments to protect their existing franchises.

Q: *How much will HDTV sets cost?*

A: The first HDTV sets in 1998 will be limited in quantity and very expensive ($2,000 - $5,000). As mass production occurs, prices will drop rapidly.

The Advanced Television Systems Committee (ATSC)

The Advanced Television Systems Committee (ATSC), established in 1982, is an international organization developing voluntary technical standards for the entire spectrum of advanced television systems. There are approximately eighty ATSC member companies and organizations, which represent the many facets of the television, computer, telephone, and motion picture industries.

On December 24, 1996, the Federal Communications Commission (FCC) of the United States adopted major elements of the ATSC Digital Television Standard (Doc. A/53) in the FCC's Fourth Report and Order. Under this decision, the video and audio compression, the packetized data transport structure, and the modulation and transmission system specified in the ATSC standard are mandated by the Commission for use by terrestrial broadcasters, while the specific video formats to be used for digital broadcast television will be the subject of voluntary industry standards.

Standards for ATSC television sets

The Advanced Television Systems Committee (ATSC) announced in April, 1977 that it will be creating a program to certify television sets, computers and other consumer video devices which are capable of receiving all ATSC video formats for the new digital era.

"Consumers will need to know that what they buy will work no matter which ATSC format is used by programmers," said Robert Graves, Chairman, ATSC. "This certification program will be simple and will indicate that a consumer video receiver will work with all of the video formats in the ATSC Digital Television Standard."

This certification program is aimed at avoiding consumer confusion as the new digital TVs come to the marketplace. "While this program will provide information to indicate whether a television will receive all of the ATSC video formats, it will leave the choice of the display type such as progressive or interlace scan, high-definition or standard-definition, to the consumer," said Mark Richer, Executive Director, ATSC. The ATSC may also consider certification of other types of devices that serve different or limited functions. ATSC members including representatives of the computer, consumer electronics, broadcast, telephone, satellite and cable industries will finalize the technical details of certification at future ATSC meetings.

"This program will help consumers make informed choices when purchasing new products; it should reduce marketplace confusion," said Linda Golodner, President, National Consumers League.

Home automation

The increasing sophistication and ever decreasing size of electronic circuitry made it inevitable that one day electronics would be used to control functions in the home. Today, home automation technology has begun to result in real-world products and services, and has the potential to become an important part of the U.S. consumer electronics industry.

Functional and Flexible

Using home systems and products and one or more of the 5 industry standards (CEBus, LonWorks, NEST, SMART-HOUSE, X-10), consumers are now able to perform a wide variety of home automation tasks. For example, homeowners can electronically check their security systems before retiring for the night, turn off the lights, close the shades, adjust the thermostat, turn off the TV and set it to wake them up in the morning, simply by touching the bedside controls or clicking the mouse of a PC.

From a remote location, the homeowner can regulate the temperature or turn the lights on or off by telephoning the house and punching in the appropriate codes. For those fortunate enough to own a getaway house at the beach or the mountains, a quick call from the car phone will ensure that the home is both comfortable and well-illuminated upon arrival.

For those concerned about an elderly relative, motion detectors have the ability to sense when the person is unusually still, and if a query doesn't receive a response, can automatically telephone a pre-designated number for help.

Becoming a reality

While often associated with custom built luxury homes, home control systems are becoming more common in planned communities, tract housing, and other developments of affordable housing.

For example, it's possible for windows to be closed automatically when it rains, for lights to be controlled automatically, and more.

Utilities

Many utility companies across the country are utilizing home automation standards, such as CEBus or LonWorks, for consumer energy management programs. In the future, these programs may become standard, as users determine their energy needs and spending habits based on real time pricing information.

One utility company is now involved in a trial program that includes 1,000 homes. Utilizing the LonWorks standard, the utility places an LCD unit in the customer's kitchen, and the customer can input changes to the energy management system. Messages received on the LCD are product or service oriented; for example, high cost warnings, utility messages (tree trimming day, etc.) warnings of low voltage periods, restoration of services, load management, itemized billing — both estimated (this month's bill) and actual (last month's bill). Users can compare usage to the previous year, and can break down bills by appliance. Meter reading, both water and gas, is also accomplished remotely.

Meters are individually addressable; that is, they can send and receive messages to and from a particular source/home. Meters can be set for a certain number of hours each month — an "energy goal" — and the meter will issue a warning when that number is approaching. Later in the program, the company hopes to tie in to other outlets and conduct all programming via television or PC.

Industry standards in home automation technology

Thanks to years of work in product development labs, committee rooms, and the field, manufacturers and contractors now have a number of choices in enabling technologies and standards they can put

What the industries are saying about digital HDTV

"We at PBS are determined to give our fellow citizens more choices and more reasons to choose the services we provide. And so, we look forward to the rise of Advanced Digital Television."

—Ervin Duggan
President and Chief Executive Officer, Public Broadcasting Service

"The full ATSC standard will be the vehicle for the most powerful and productive era broadcasting has ever seen. It will serve the needs of all in the television industry - in video, audio, and data. It provides the choices we need to compete in the marketplace and maximize local and network services in our communities."

—Eddie Fritts
President and Chief Executive Officer, National Association of Broadcasters

"ABC is committed to digital television, and is poised to be a leader in bringing free TV into the digital age. ... we are deeply dedicated to the task and look forward to being among the first to bring this exciting new service to the public."

—Robert Iger
President, ABC, Inc.

"Today, ATSC digital and widescreen high definition will escalate "Broadcast Quality" to a plateau never before imagined, and through this technology, we at CBS are determined to take our broadcasts and services to this new quality plateau."

—Michael Jordan
Chairman and Chief Executive Officer, Westinghouse/CBS Inc.

"Digital HDTV offers consumers the choice of crisp, clear, digital quality video and audio. Our industries are dedicated to bringing Digital HDTV to the American public as rapidly as possible."

—Gary Shapiro
President, Consumer Electronics Manufacturers Association

"The HDTV process we began a decade ago is now a reality, and the American public, which broadcasters serve with free and universal service, will be the beneficiaries."

—Margita White
President, Association for Maximum Television Service

"Moving quickly and decisively to implement the ATSC Digital Television Standard is important to our success as a network, as stations, and as producers. That is why NBC has committed to an aggressive buildout of its owned and operated stations and why we have prepared ourselves to provide regular and special high resolution programming to our affiliates in the latter part of 1998 when new TV sets will be available."

—Robert Wright
President and Chief Executive Officer, NBC Television Network

to use to make systems integration and automation happen in the home. Among the most pervasive and high profile are the following:

CEBus

The CEBus standard gives manufacturers from multiple industries a uniform way to link household products. Home LANs (local area networks) treat the home's electronic devices and equipment as nodes on the LAN. Products attached to the home LAN put messages on and take messages off the home LAN. The CEBus standard tells manufacturers what their products must do to send and receive CEBus compliant messages on a home LAN. The CEBus standard also defines how the home's wiring can be used to transport messages between CEBus compliant products throughout the house.

Options include: the home's powerline wiring, telephone wire (4 pair), video wire (dual coax), and wireless transmission options such as radio frequency (RF) and infrared (IR) signals.

Manufacturers using CEBus to develop products for home LANs can give their products CEBus compliant features during the manufacturing process. They also have the option of creating an add-on module that gives their product the ability to send and receive CEBus compliant messages via the home LAN.

Features:

- CEBus, which allows for five different mediums of transmission, can handle a great many more commands per second than standards utilizing power lines.
- CEBus makes high bandwidth data channels available, and can assign them to appliances facilitating use.
- The CEBus system provides for 2-way communication.
- The CEBus standard is a consensus specification developed for industry, by industry and remains controlled by industry — unlike proprietary standards.
- The CEBus standard provides uniform speed on all media. The signaling speed for control channel messages is the same on the powerline, twisted pair, coaxial wire, radio frequency and infrared. No buffers are required.
- A home with a CEBus automation system is "future-proof," that is, ready for the technological advancements of tomorrow.

LonWorks

In a LonWorks network, no central control or master-slave architecture is needed. Intelligent control devices, called nodes, communicate with one another using a common protocol. Each node in the network contains embedded intelligence that implements the protocol and performs control functions. In addition, each node includes a physical interface that couples the node microcontroller with the communications medium.

LonWorks is an "open" technology and is accessible to all. The Neuron chip, which is the enabling technology for, and the core component of every LonWorks node is manufactured and sold worldwide by both Motorola and Toshiba.

Features:

- The technology can work with existing power lines.
- Small control components consume little power and are ready to be designed into home products.
- Increasing volume is rapidly lowering the cost of the Neuron Chip.
- Any product with a LonMark can work as part of a system, regardless of who made the part.

SMART HOUSE

Molex created the SMART HOUSE home automation system, unifying cables for power and signal distribution and making available a wide selection of "intelligent" outlets and switches. Cables direct all communication functions into the system controller, providing a pathway through which the system infrastructure is accessed.

Features:

- Easy to install.
- Easily upgraded.
- Has no contention problems.
- Provides benefits of client-server networks to the system.
- Provides secure off-site access and programmable notification.
- Has three primary options for interfacing with the network.
- Enables closed loop power control.
- Has hardware and software development tools available.
- Has local control default in the event of network failure.
- Has built-in diagnostics.

The two leading manufacturers of SMART HOUSE System Integration and Control Technology are AMP Inc. and Molex Inc.

X-10

The X-10 Group designs, develops, manufactures and markets a wide variety of home automation and security products that work by sending signals over existing power line wiring. These home automation products are called "power line carrier" (PLC) devices. X-10 also manufactures compatible PLC products which are installed in commercial buildings and private homes by professional contractors and electricians. The commercial applications are primarily for energy management. The residential products are often installed by builders who want to offer home automation as an additional selling feature.

The home automation line consists of "controllers" that automatically send signals over existing electric power wiring to receiver "modules", which in turn control lights, appliances, heating and air conditioning units, etc.

Features:

- X-10's PLC technology saves labor and wire, since the ability to send control signals from point A to point B does not require additional wiring.
- The necessary controllers and modules are considerably less expensive than hardwired models and do not require the initial expense of a server or a node.
- X-10 systems require less than 20 percent the time needed to install a hardwired system; add-ons and modifications are simple to implement.
- To make a home X-10 compatible, just replace a home's wall switches, dimmers and receptacles with X-10 components.
- X-10 manufactures their own products and they own the patents.
- X-10 is more readily available and cost effective. A consumer can walk into a nearby electronics store, such as Best Buy, Home Depot, Incredible Universe and Lowe's, and purchase all of the necessary equipment to automate his or her home with the X-10 standard. ■

Test Your Electronics Knowledge
Power calculations and miscellaneous

By J.A. Sam Wilson

Sam Wilson is currently busy with other urgent projects, and was therefore unable to prepare What Do You Know About Electronics/Test Your Electronics Knowledge *for this issue. This is a reprise of articles that appeared in a previous issue.*

1. A certain power amplifier increases the input power by 3dB. If the input power is 5.2W, what is the output power?

2. A certain transmission line introduces a 3dB loss to input power. If the input power is 9.8W, what is the power output from the transmission line?

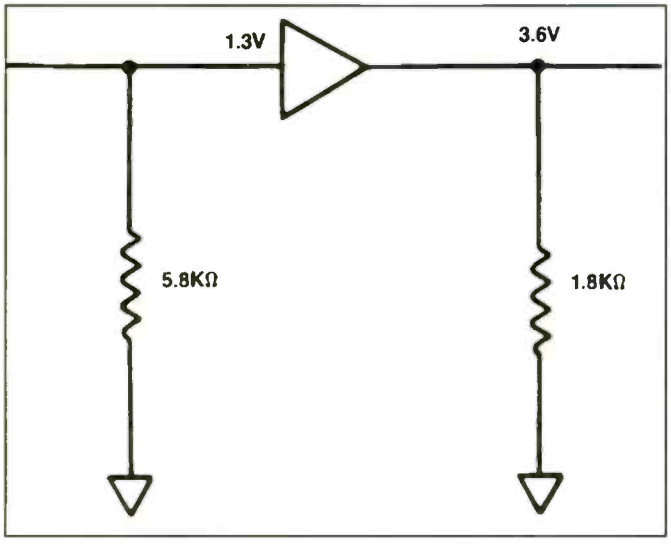

Figure 1. What is the dB gain of this amplifier?

3. Figure 1 shows an amplifier with a signal voltage input of 1.3V and an output signal voltage of 3.6V. What is the dB gain of the amplifier?

4. What is a stroboscope used for?

5. What does VCO stand for in a phase-locked loop?

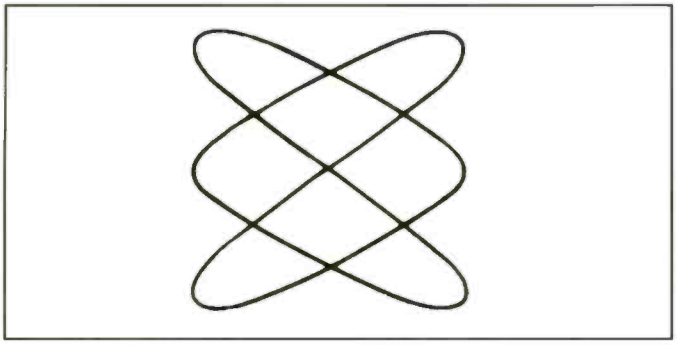

Figure 2. In this Lissajous pattern, the horizontal sinewave frequency is 450Hz. What is the vertical frequency?

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

6. Consider the Lissajous pattern of Figure 2. The horizontal sinewave frequency is known to be 450Hz. What is the vertical frequency?

7. What is the impedance of four 4Ω speakers in parallel?

8. Is the following statement correct: Partition noise does not occur in a MOSFET.
A. correct
B. not correct

9. Is the following statement correct: Decreasing the gain of an amplifier will automatically increase its bandwidth.
A. correct
B. not correct

10. Is the following statement correct: The drain voltage of an enhancement MOSFET is never greater than 36V.
A. correct
B. not correct

(Answers on page 60)

Multimeter safety

Based on information provided by Fluke

Engineers who analyze multimeter safety often discover that units failed because they were subjected to a much higher voltage than the user thought he was measuring. There are occasional accidents when the meter, rated for low voltage (1,000V or less), was inadvertantly used to measure medium voltage, such as 4160V. In other cases, the damage to the meter had nothing to do with misuse; it was a momentary high-voltage spike or transient that hit the multimeter input without warning (Figure 1).

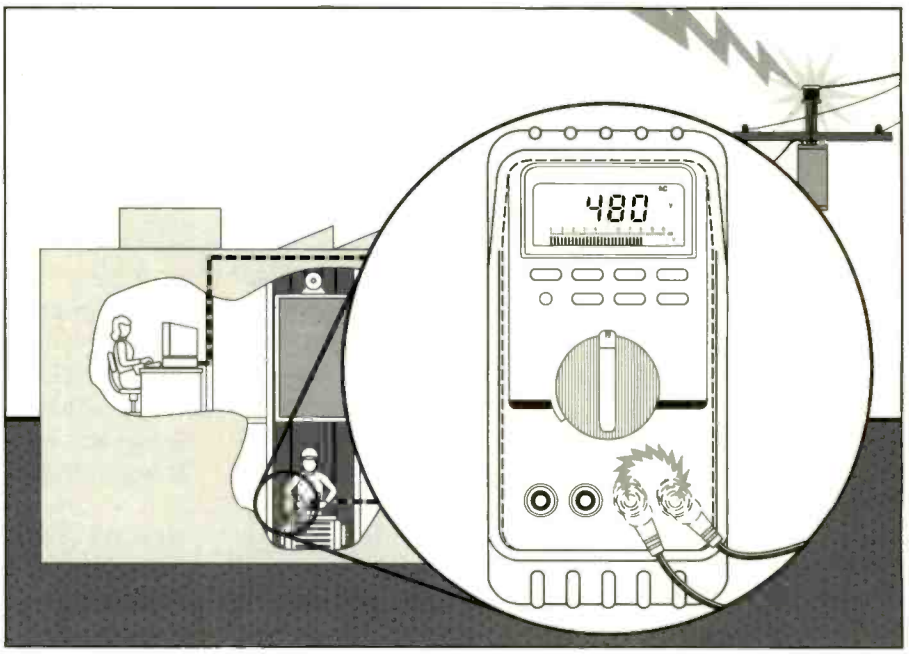

Figure 1. When a technician is making measurements on live electrical circuitry, a high-voltage spike on the system can damage or destroy the meter.

Voltage spikes: an unavoidable hazard

As distribution systems and loads become more complex, the possibilities of transient overvoltages increase. Motors, capacitors and power conversion equipment such as variable speed drives can be prime generators of spikes. Lightning strikes on outdoor transmission lines also cause extremely hazardous high-energy transients.

If you're taking measurements on electrical systems, these transients are "invisible" and largely unavoidable hazards. They occur regularly on low-voltage power circuits, and can reach peak values in the many thousands of volts. In these cases, you're dependent for protection on the safety margin already built into your meter. The voltage rating alone will not tell you how well that meter was designed to survive high transient impulses.

Early clues about the safety hazards posed by spikes came from applications involving measurements on the supply bus of electric commuter railroads. The nominal bus voltage was only 600V, but multimeters rated at 1000V lasted only a few minutes when taking measurements while the train was operating. A close look revealed that the train stopping and starting generated 10,000V spikes. These transients had no mercy on early multimeter input circuits. The lessons learned through this investigation led to significant improvements in multimeter input protection circuits.

New safety standards

To protect the user against transients, safety must be built into the test equipment. What performance specification should you look for, especially if you know that you could be working on high-energy circuits? The task of defining a new specification for test equipment was recently addressed by the IEC (International Electrotechnical Commission). This orga-

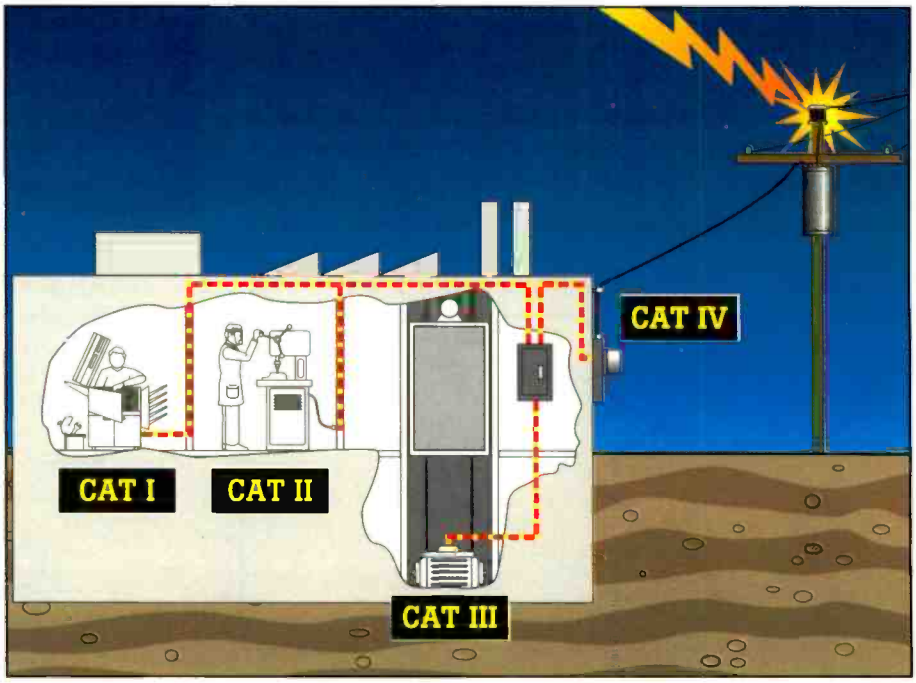

Figure 2. Power distribution systems are divided into categories that describe the power that might be available at that point during a high-energy transient such as a lightning strike.

organization develops international safety standards for electrical test equipment.

For a number of years, the industry standard was IEC348. That standard has been replaced by IEC1010. While well-designed IEC348 meters have been used for years by technicians and electricians, the fact is that meters designed to the new IEC1010 standard offer a significantly higher level of safety. Let's see how this is accomplished.

Transient protection

The real issue for multimeter circuit protection is not just the maximum steady state voltage, but a combination of both steady state and transient overvoltage withstand capability. Transient protection is vital. When transients ride on high-energy circuits, they tend to be more dangerous because these circuits can deliver large currents. If a transient causes an arc-over, the high current can sustain the arc, producing a plasma breakdown or explosion, which occurs when the surrounding air becomes ionized and conductive. The result is an arc blast, a disastrous event which causes more electrical injuries every year than the better known hazard of electric shock.

Overvoltage installation categories

The single most important concept to understand about the new standards is the overvoltage installation category. The new standard defines categories I through IV, often abbreviated as CAT I, CAT II, etc. (Figure 2/Table 1). The division of a power distribution system into categories is based on the fact that a dangerous high-energy transient such as a lightning strike, will be attenuated, or dampened, as it travels through the impedance (ac resistance) of the system. A higher CAT number refers to an electrical environment with high power available and higher-energy transients. Thus a multimeter designed to a CAT III standard is resistant to much higher energy transients than one designed to CAT II standards.

Within a category, a higher voltage rating denotes a higher transient withstand rating: e.g., a CAT III 1000V meter has superior protection compared to a CAT III 600V rated meter. The real misunderstanding occurs if someone selects a CAT

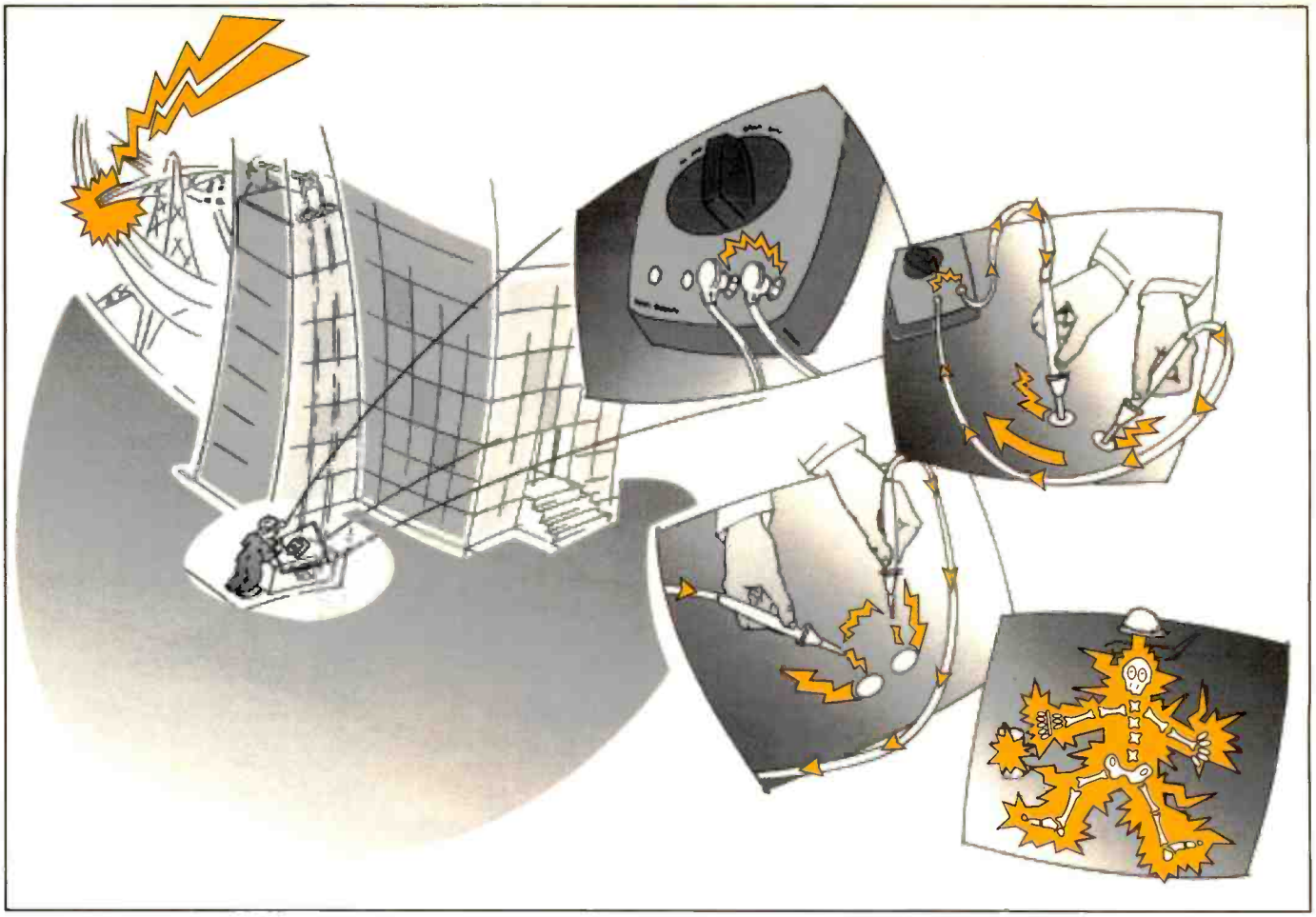

Figure 3. If a high-energy transient should happen to strike the power line while a technician is taking measurements, the result could be a high fault current that might cause damage to the meter or serious injury to the technician.

II 1000V rated meter, thinking that it is superior to a CAT III 600V meter.

It's not just the voltage level

In Figure 2, a technician working on office equipment in a CAT I location could actually encounter dc voltages much higher than the power line ac voltages measured by the motor electrician in the CAT III location. Yet transients in CAT I electronic circuitry, whatever the voltage, are clearly a lesser threat, because the energy available to an arc is very much limited.

This does not mean that there is no electrical hazard present in CAT I or CAT II equipment. The primary hazard is electric shock, not transients and arc blast. Shocks, which will be discussed later, can be every bit as lethal as arc blast.

To cite another example, an overhead line run from a house to a detached workshed might be only 120V or 240V, but it's still technically CAT IV. Why? Any outdoor conductor is subject to very high-

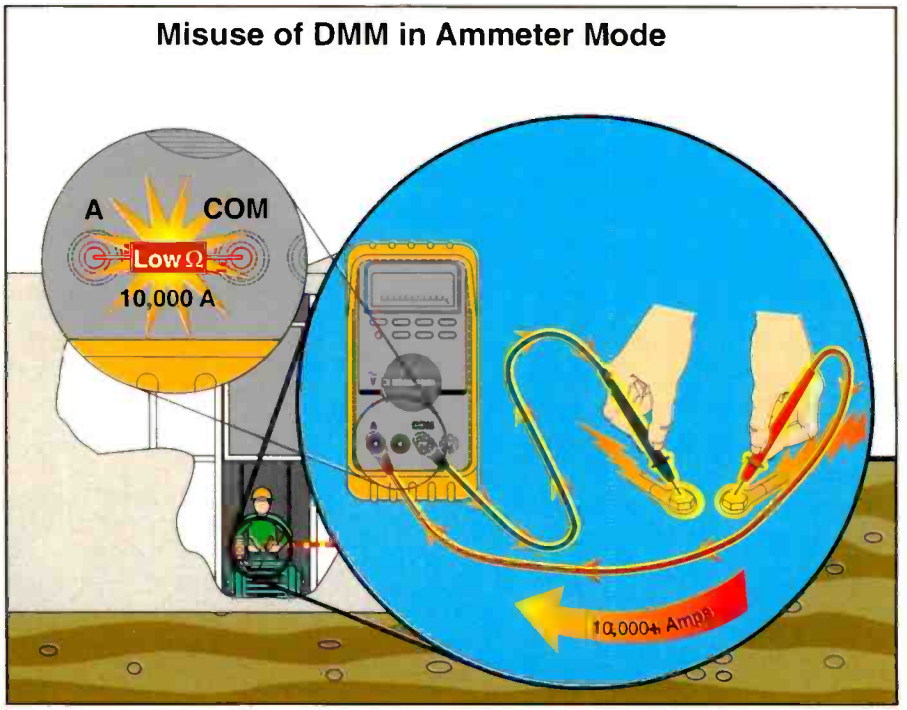

Figure 4. Inadvertently measuring voltages with the meter in ammeter mode is essentially placing a short circuit across the points being measured. It's wise to use a multimeter protected with high-energy fuses and replace a blown fuse only with the high-energy fuses specified by the manufacturer.

energy lightning-related transients. Even conductors buried underground are CAT IV, because although they will not be directly struck by lightning, a lightning strike nearby can induce a transient because the lightning generates powerful electromagnetic fields.

When it comes to overvoltage installation categories, the rules of real estate apply: it's location, location, location.

Transients, the hidden danger

Let's take a look at a worst-case scenario in which a technician is performing measurements on a live three-phase motor control circuit, using a meter without the necessary precautions (Figure 3). Here's what could happen:

1. A lightning strike causes a transient on the power line, which in turn strikes an arc between the input terminals inside the meter. The circuits and components to prevent this event have just failed or were missing. Perhaps it was not a CAT III rated meter. The result is a direct short between two measurement terminals through the meter and the test leads.

2. A high-fault current, possibly several thousands of amps flows in the short circuit just created. This happens in thousandths of a second. When the arc forms inside the meter, a very high pressure shock wave can cause a loud bang, very much like a gunshot or the backfire from a car. At the same instant, the technician sees bright blue arc flashes at the test lead tips, the fault currents superheat the probe tips, which start to burn away, drawing an arc from the contact point to the probe.

3. The natural reaction is to pull back, in order to break contact with the hot circuit. But as the technician's hands are pulled back, an arc is drawn from the motor terminal to each probe. If these two arcs join to form a single arc, there is now another direct phase-to-phase short, this time between the motor terminals.

4. This arc can have a temperature approaching 6,000C (10,000F) which is higher than the temperature of an oxy-acetylene cutting torch. As the arc grows, fed by available short-circuit current, it superheats the surrounding air. Both a shock blast and a plasma fireball are created. If the technician is lucky, the shock blast blows him from the proximity of the arc. Though the technician would be

Overvoltage Category	In Brief	Examples
CAT IV	Three-phase at utility connection, any outdoors conductors	• Refers to the "origin of installation", i.e., where low-voltage connection is made to utility power. • Electricity meters, primary overcurrent protection equipment. • Outside and service entrance, service drop from pole to building, underground line to well pump.
CAT III	Three-phase distribution, including single-phase commercial lighting	• Equipment in fixed installations, such as switchgear and polyphase motors. • Bus and feeder in industrial plants. • Feeders and short branch circuits, distribution panel devices. • Lighting systems in larger buildings. • Appliance outlets with short connections to service entrance.
CAT II	Single-phase receptacle connected loads	• Appliance, portable tools, and other household and similar loads. • Outlet and long branch circuits. • Outlets at more than 10 meters (30 feet) from CAT III source. • Outlets at more than 20 meters (60 feet) from CAT IV source.
CAT I	Electronic	• Protected electronic equipment. • Equipment connected to (source) circuits in which measures are taken to limit transient overvoltages to an appropriately low level. • Any high-voltage, low-energy source derived from a high-winding resistance transformer, such as the high-voltage section of a copier.

Table 1. IEC Standard 1010 describes four categories of electrical installation, based on the degree to which a high-energy transient generated by an event such as a lightning strike on a power line will pass through to the installation.

injured, he would be alive. In the worst case, the victim is subjected to fatal burn injuries from the fierce heat of the arc or plasma blast.

In addition to using a multimeter rated for the appropriate overvoltage installation category, anyone working on live power circuits should be protected with flame resistant clothing, should wear safety glasses, or, better yet, a safety face shield, and should wear insulated gloves (Figure 4).

The dangers of misusing test equipment

Transients aren't the only source of possible short circuits and arc blast hazard. One of the most common misuses of handheld multimeters can cause a similar chain of events.

Let's say a user is making current measurements of signal circuits. The procedure is to select the amps function, insert the leads in the mA or amps input terminal, open the circuit and take a series of measurements. In a series circuit, current is the same everywhere. The input impedance of the amps circuit must be low enough so that it doesn't affect the series circuit's current. The input impedance on the 10A terminal of one meter is 0.01Ω. Compare this with the input impedance on the voltage terminals of 10MΩ (10,000,000Ω).

Independent testing

To be sure that a meter meets a specification, look for a symbol and listing number of an independent testing lab such as UL, CSA, TUV or other recognized testing organization. Beware of wording such as "Designed to meet specification...." Designers' plans are never a substitute for an actual independent test.

How can you tell if you're getting a genuine CAT III or CAT II meter? Unfortunately, it's not always easy. It is possible for a manufacturer to self-certify that its meter is CAT II or CAT III without any independent verification. The IEC (International Electrotechnical Commission) develops and proposes standards, but it is not responsible for enforcing the standards.

Look for the symbol and listing number of an independent testing lab, such as UL, CSA, TUV or other recognized approval agencies. That symbol can only be used if the product successfully completed testing to the agency's standard, which is based on national international standards. Standard UL3111, for example, is based on IEC1010. In an imperfect world, that is the closest you can come to ensuring that the multimeter you chose was actually tested for safety.

What does the CE symbol indicate?

A product is marked CE (Conformite Europeenne), to indicate its conformance to certain essential requirements concerning health, safety, environment and consumer protection established by the European Commission and mandated through the use of "directives." There are directives affecting many product types, and products from outside the European Union can not be imported and sold there if they do not comply with applicable directives. Compliance with the directive can be achieved by proving conformance to a relevant technical standard, such as IEC101 for low-voltage products. Manufacturers are permitted to self-certify that they have met the standards, issue their own Declaration of Conformity, and mark the product "CE." The CE mark is not a guarantee of independent testing.

If the test leads are left in the amps terminals and then accidentally connected across a voltage source, the low input impedance becomes a short circuit (Figure 5). It doesn't matter if the selector dial is turned to the volts position, the leads are still physically connected to a low-impedance circuit. That's why the

Figure 5. Technicians making measurements on live electrical circuits should take precautions against injury that might be caused by high-energy transients.

Figure 6. Look for category and voltage ratings of test leads and multimeters.

amps terminals must be protected by fuses. Those fuses are the only thing standing between an inconvenience and a potential disaster.

Use only a multimeter with amps inputs protected by high-energy fuses. Never replace a blown fuse with the wrong fuse. Use only high-energy fuses specified by the manufacturer. These fuses are rated at a voltage and with a short circuit interrupting capacity designed for the safety of the user.

Overload protection

Fuses protect against overcurrent. The high input impedance of the volts/ohms ensures that an overcurrent condition is unlikely, so fuses aren't necessary. Overvoltage protection, on the other hand is required. It is provided by a circuit that clamps high voltages to an acceptable level. In addition, a thermal protection circuit detects an overvoltage condition, protects the meter until the condition is removed, and then automatically returns to normal operation. The most common benefit is to protect the multimeter from overloads when it is in ohms mode. In this way, overload protection with automatic recovery is provided for all measurement functions as long as the leads are in the voltage input terminals.

Applying categories to your work

Here are some quick ways to apply the concept of categories:

• The rule of thumb is that the closer you are to the power source, the higher the category number, and the greater the potential danger from transients.

• It also follows that the greater the short circuit current available at a particular point, the higher the CAT number.

• Another way of saying the same thing is the greater the source impedance, the lower the CAT number. Source impedance is simply the total impedance, including the impedance of the wiring, between the point where you are measuring and the power source. This impedance is what dampens transients.

• Finally, if you have any experience with the application of TVSS (transient voltage surge suppression) devices, you understand that a TVSS device installed at a panel must have a higher energy-handling capacity than one installed right at the computer, TV set or other sensitive device. In CAT terminology, the panelboard TVSS is a CAT III application, and the electronic device is a receptacle connected load, and therefore CAT II.

As you can see, the concept of categories is not new and exotic. It is simply an extension of the same common-sense concepts that people who work with electricity professionally apply every day.

Multiple categories

There's one scenario that sometimes confuses people trying to apply categories to real-world applications. In a single piece of equipment there is often more than one category. For example, in office equipment, from the 120V/240V side of the power supply back to the receptacle is considered a CAT II. The electronic circuitry, on the other hand, is CAT I. In building control systems, such as lighting control panels, or industrial control equipment such as programmable controllers, it is common to find electronic circuits (CAT I) and power circuits (CAT III) existing in close proximity.

What do you do in these situations? As in all real-world situations, use common sense. In this case, that means using the meter with the higher category rating. In fact, it's not unrealistic to expect people to be going through the category defining process all the time. What is realistic, and highly recommended, is to select a multimeter that is rated to the highest category in which it could possibly be used. In other words, err on the side of safety.

Understanding voltage withstand ratings

IEC1010 test procedures take into account three main criteria: steady-state voltage, peak impulse transient voltage and source impedance. These three criteria together will tell you a multimeter's true voltage withstand value.

When is 600V more than 1000V

Table 2 can help understand an instrument's true voltage withstand rating.

• Within a category, a higher "working voltage" (steady-state voltage) is associated with a higher transient, as would be expected. For example, a CAT III-600V meter is tested with 6000V transients,

Electric shock

While most people are aware of the danger from electric shock, few realize how little current and how low a voltage are required for a fatal shock. Current flows as low as 30mA can be fatal. Lets look at the effects of current flow through a "typical" 150 pound man.

- At about 10mA, muscular paralysis of the arms occurs, so that he cannot release his grip on the conductor.
- At about 30mA, respiratory paralysis occurs. His breathing stops and the results are often fatal.
- At about 75mA to 250mA, for exposure exceeding five seconds, ventricular fibrillation occurs, causing discoordination of the heart muscles; the heart can no longer function. Higher currents cause fibrillation at less than five seconds. The results are often fatal.

Now let's calculate the threshold for hazardous voltage. The approximate skin resistance from hand to hand across the body is 1000Ω under dry conditions. A voltage of only 30V across 1000Ω will cause a current of 30mA. Under wet conditions, or if there is a cut in the skin, resistance drops radically. The threshold of hazardous voltage is cut in half.

For multimeter manufacturers and users, the objective is to prevent accidental contact with live circuits at all cost. Look for these characteristics:

- Meters and test leads with double insulation on them.
- Meters with recessed input jacks and test leads with shrouded input connectors.
- Test leads with finger guards and a non-slip surface.
- Meter and leads made of high-quality, durable, non-conductive materials.

Work safely

No tool by itself can guarantee your safety. It's the combination of the right tools and safe work practices that gives you maximum protection. Here are a few tips to help you in your work. While some of the tips may be more applicable to electricians working on wiring systems, we thought that the list might be useful for anyone working with electricity.

- Work on de-energized circuits whenever possible. Use proper lock-out/tagout procedures. If these procedures are not in place or not enforced, assume that the circuit is live.
- On live circuits, use protective gear:
  - insulated tools
  - safety glasses or a face shield
  - insulated gloves
  - remove watches or other jewelry
  - stand on an insulated mat
  - flame retardant clothing.
- When making measurements in live circuits, use this procedure:
  - Connect the ground clip first, then make contact with the hot lead. Remove the hot lead first, the ground lead last.
  - Hang or rest the meter if possible. Try to avoid holding the meter in your hands to minimize personal exposure to the effects of transients.
  - Use the three-point test method, especially when checking to see if a circuit is dead. First, test a known live circuit. Second, test the target circuit. Third, test the live circuit again. This verifies that your meter worked properly before and after the measurement.
  - Use the old electricians' trick of keeping one hand in your pocket. This lessens the chance of a closed circuit across your chest and through your heart.

Overvoltage Installation Category	Working Voltage (dc or ac-rms to ground)	Peak Impulse Transient (20 repetitions)	Test Source (Ω = V/A)
CAT I	600V	2500V	30 Ohm source
CAT I	1000V	4000V	30 Ohm source
CAT II	600V	4000V	12 Ohm source
CAT II	1000V	6000V	12 Ohm source
CAT III	600V	6000V	2 Ohm source
CAT III	1000V	8000V	2 Ohm source

Table 2. These are the tests that are applied to meters for the various category and working voltage combinations. A meter tested to a higher category may provide a higher degree of protection than a meter that is tested to a higher voltage within a lower category.

while a CAT III-1000V meter is tested with 8000V transients. So far, so good.

• What is not as obvious is the difference between the 6000V transient for CAT III-600V and the 6000V transient for CAT II-1000V. They are not the same. This is where the source impedance comes in. Ohm's law (resistance = voltage/current) tells us that the 2Ω test source for CAT III has six times the current of the 12Ω test source for CAT II. Since power is proportional to the square of the current, the CAT III source has 36 times the power of the CAT II source.

The CAT III-600V meter offers greater transient protection than does the CAT II-1000V meter, even though its so-called "voltage rating" could be perceived as being lower. It is the combination of the steady-state voltage (working voltage) and the category that determines the total voltage withstand rating of the test instrument, including the all-important transient voltage withstand rating.

A note on CAT IV: test values and design standards for Category IV are not presently addressed in IEC1010, but are under consideration for the second edition. Therefore the highest-rated meters currently available are CAT III-1000V.

Creepage and clearance

In addition to being tested to an actual overvoltage transient value, multimeters are required by IEC1010 to have minimum "creepage" and "clearance" distances between internal components and circuit nodes. Creepage measures distance across a surface. Clearance measures distances through the air. The higher the category and working voltage level, the greater the internal spacing requirements. One of the main differences between the old IEC348 and IEC1010 is the increased spacing in the latter.

The bottom line

If you are faced with the task of replacing your multimeter, do one simple task before you start shopping: analyze the worst case scenario of your job, and determine what category your use or application fits into.

First, choose a meter rated for the highest category you could be working in. Then, look for a multimeter with a voltage rating for that category matching your needs (Figure 6). While you're at it, don't forget the test leads. IEC1010 applies to test leads too: they should be certified to a category and voltage as high, or higher than, the meter. When it comes to safety, don't let test leads be the weak link. ■

Oscilloscope update: The fundamentals

By The ES&T Staff

The oscilloscope is one of the fundamental pieces of test equipment for any measurement purpose. Just about any signal that is either electrical in nature, or can be converted into an electrical signal by means of some kind of transducer can be displayed, observed and analyzed on the screen of an oscilloscope.

For example, a technician can connect the probes of an oscilloscope to any point in a TV set and compare the signal observed to the signal that the manufacturer says should be there, and thereby learn something about the nature of the problem that the set may be exhibiting. A doctor can place sensors on the skin of a patient in the vicinity of the heart and monitor its electrical activity, thus determining if it is operating properly or malfunctioning. An automotive engineer can place a transducer on an engine block and monitor the output of the transducer, which is the electrical analog of the engine's vibration.

The analytical capabilities of the oscilloscope are limited only by the availability of transducers to convert any kind of phenomenon into an electrical equivalent, and the imagination of the individual using the oscilloscope.

Understanding the fundamentals

According to legend, and possibly to fact, at the beginning of each new season, the then coach of the Green Bay Packers, Vince Lombardi, began his coaching at the first team meeting, with the statement, "gentlemen, this is a football," then proceeded from there through the rest of the fundamentals, including the objective of the game of football, through the method of achieving that objective. Mr. Lombardi was a very successful coach.

Unfortunately, in consumer electronics servicing, as in most pursuits, there's little time to sit back and give or receive coaching in the fundamentals. There's so much work to be done, and there are so many *new* things to learn. Still, if we don't review the fundamentals once in a while we may lose sight of our objective. So, gentlemen, this is an oscilloscope.

What's going on in there?

The following may be obvious, but just in case it's not, we'll address the idea of a "waveform." We use the term loosely, but what does it actually mean? What constitutes a wave?

In the case of a radio signal, or a TV signal, broadcast from an antenna, the term is apt. The signal is actually moving outward from the antenna into space. Like a wave. If we could halt the movement instantaneously and make measurements of the amplitude of that signal at various distances from the antenna, they would vary depending upon the distance.

That is not really what's going on within a television set, for instance. If we measure an ac signal at some point of interest in the set, we would see that it is simply increasing and decreasing continuously. As an analogy, consider the output of a dc power supply. Connect a voltmeter to it and crank the control clockwise and counterclockwise. The needle would swing, or the digits would count up and down (Figure 1). That's a low frequency ac voltage.

Now do that up and down smoothly sixty times per second around a zero reference voltage and you've got 60Hz ac. There are two problems with that: one,

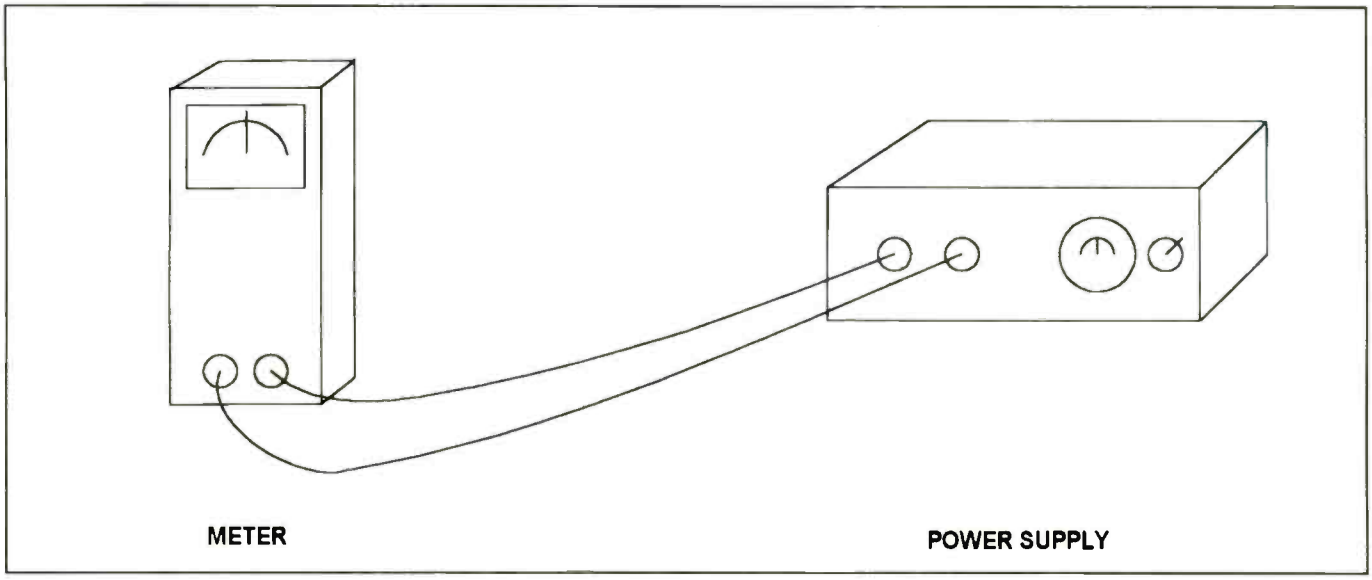

Figure 1. If you connect a meter to the output of a dc power supply and vary the voltage, you'll see the meter pointer move up and down, or the numbers on a DMM change up and down.

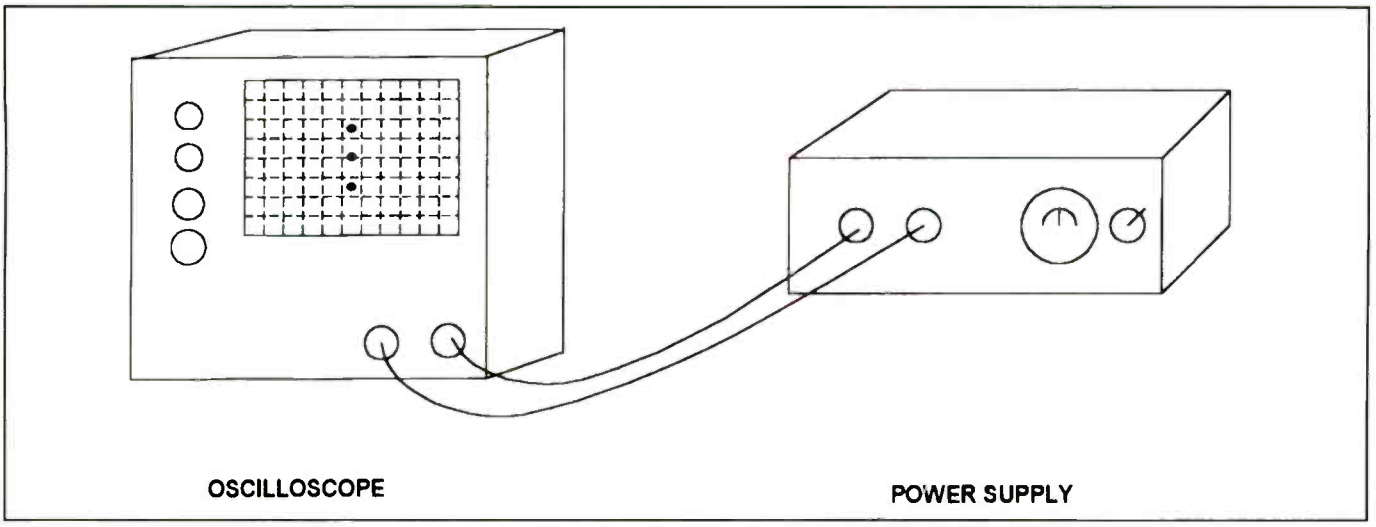

Figure 2. If you connect an oscilloscope (with "Sweep" off) to the output of a dc power supply and vary the supply output voltage manually, you will simply see a dot move up and down vertically in the center of the screen.

you cannot twist the knob that fast and, two, the meter display wouldn't be able to keep up with it.

Ok, to take care of one part of that problem, let's just pretend that you *can* twist the knob as fast as you want. And to take care of the second part of the problem, let's substitute an oscilloscope. And let's start with the sweep off.

Connect the scope to the supply and start twisting the knob. As you twist in a clockwise direction, you'll see the little dot on the screen move upward (Figure 2). As you turn the knob counterclockwise you'll see the little dot move downward. As you turn the knob faster and faster, at some point the movement of the dot will be so fast that you won't be able to see the dot moving anymore. You'll just have a vertical line on the screen (Figure 3). What to do?

The way to overcome this problem is to apply a varying voltage to the horizontal deflection plates that are arranged on either side of the neck of the oscilloscope's cathode ray tube (Figure 4). Start out with the voltage set up so that it's pos-

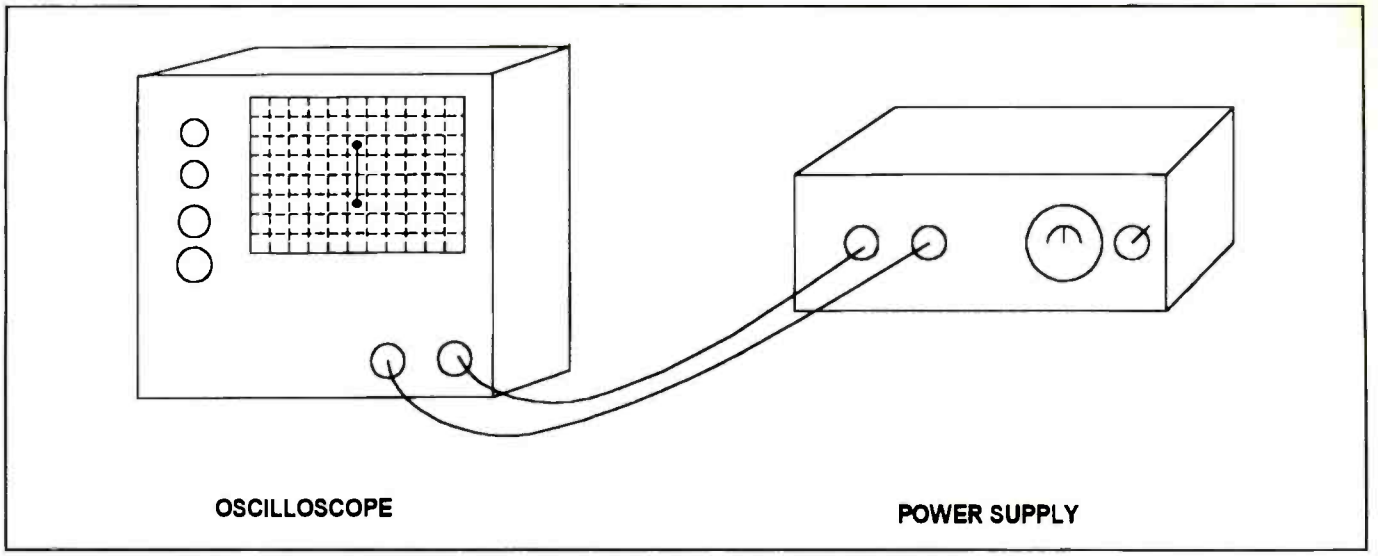

Figure 3. If the voltage varies fast enough, you will see a vertical line on the face of the oscilloscope.

itive in the direction of the left side of the screen as you view it, then gradually decrease the voltage until it is zero (at this point the dot will be in the middle of the screen), then increase it in the opposite direction until the dot has reached the farthest right position, then instantaneously reverse the voltage and start again.

As you increase the voltage output of the dc power supply, causing the dot to move upward on the screen, the varying voltage between the horizontal plates is moving it to the right. The effect is a "waveform" on the scope face that shows you how the supply voltage is varying. It is a representation in space (the width of the oscilloscope face) of what is happening in time (Figure 5).

Definitions

The foregoing has created definitions of some of the common terms we use in relation to oscilloscopes. Let's assume for the sake of the rest of this discussion that the amount of time between positive swings of the supply voltage are equal, and that the variation occurs smoothly, that this is a regular periodic "waveform" (Figure 6). For starters, the values to which we increase and decrease the voltage is the "amplitude" of the "signal" we've created. The highest positive value of the voltage is the "peak" value. The difference between the greatest negative value and the greatest positive value is the "peak-to-peak" value.

The time between positive peaks, or negative peaks is the "period". The number of times this happens in a given amount of time is the "frequency."

The point in time at which we start the horizontal voltage swing to synchronize with the voltage swing of the varying supply voltage so we can display one period of the "waveform," is the "trigger" point. In this case we triggered the horizontal "sweep" manually, but oscilloscopes are designed so that they can be triggered automatically at various points in the waveform, depending on what the user wants to see (Figure 7).

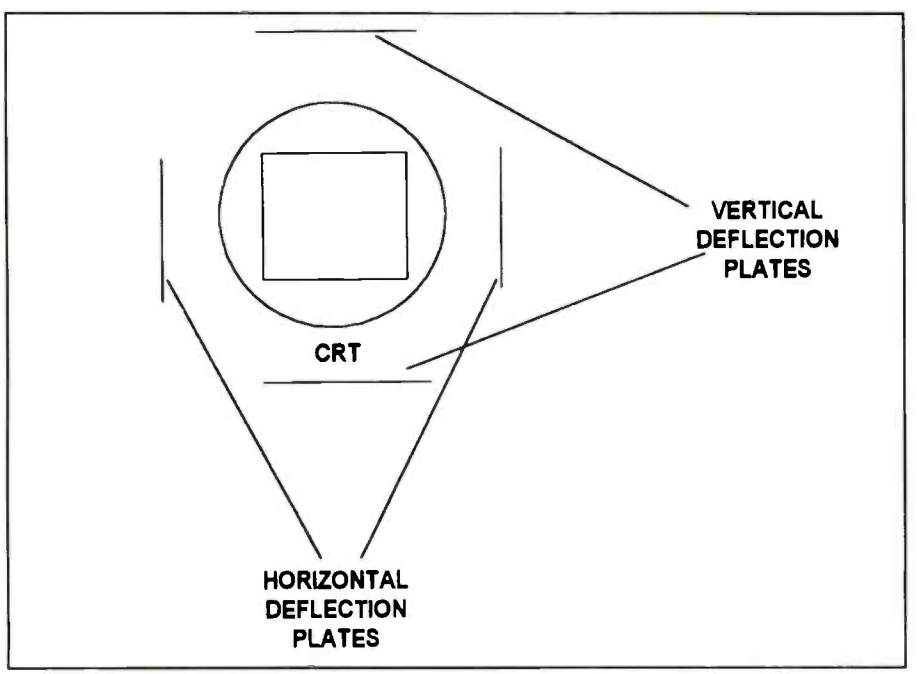

Figure 4. By applying a varying voltage to the horizontal plates on the oscilloscope, you will be able to see the varying voltage output of the power supply, even if it's so fast that the trace would otherwise be a vertical line.

Bandwidth

We know that we can display a dc value on the oscilloscope. A dc voltage simply displaces the dot (or the horizontal line if the sweep is turned on) by a vertical distance proportional to the voltage of the source. We also know that an oscilloscope is designed to display voltage variations over time. What is the fastest voltage variation (highest frequency) that an oscilloscope can display? That depends on the design of the particular oscilloscope. Some oscilloscopes can't usefully display signals that are higher in frequency than 20MHz. Others can display signals with

(Continued on page 39)

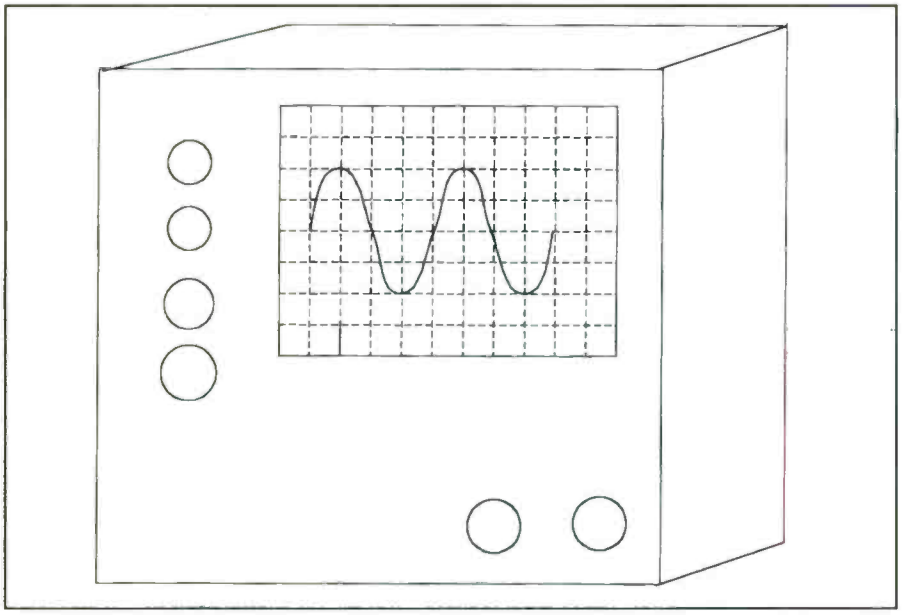

Figure 5. The "waveform" on the scope face is a representation in space (the width of the oscilloscope face) of what is happening in time.

frequencies up to several hundred or even several thousand MHz.

But the display of the oscilloscope doesn't just stop showing displays of waveforms above the designed upper end of the bandwidth. At that upper end of the bandwidth the amplitude of the displayed waveform is reduced to 70.7% of the actual amplitude (the -3db point). This is a definition of the bandwidth.

As the operator tries to observe waveforms above that frequency, the amplitude of the displayed waveform becomes still smaller, compared to the amplitude of the actual waveform. It's important to keep in mind as you're observing signals whose frequencies are approaching or above the bandwidth of the oscilloscope, that they'll appear on the screen to be smaller in amplitude than the actual waveform. They may be distorted, as well.

Rise time

The term "rise time" is another measure of the useful frequency range of an oscilloscope. The rise time of any signal is the amount of time it takes for it to increase from 10% of its value to 90% of its value. An oscilloscope cannot accurately display pulses with rise times that are faster than the specified rise time of the oscilloscope

Bandwidth and rise time are related by the following formula.

$$\text{Bandwidth} = 0.35/\text{Tr}.$$

Time to use the oscilloscope

To many technicians, the oscilloscope

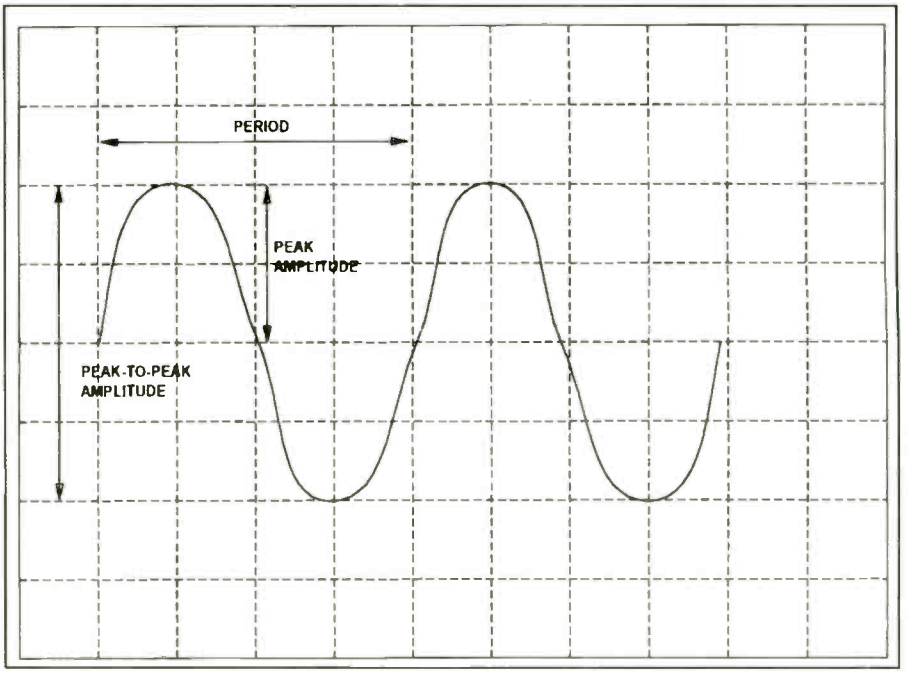

Figure 6. A regular periodic waveform has several characteristics, including amplitude, frequency and period. The frequency of the signal is 1/period.

is the second instrument of choice. The DMM is frequently the first choice, since it's smaller, more portable and easier to use. In many cases the DMM is all that's needed to determine what's wrong with a product. But when the problem doesn't yield easily to voltage and resistance measurements, it's usually time to bring out the oscilloscope. By using the scope's ability to provide a kind of "window" into the operation of the product being serviced, the technician can frequently solve a service problem as he/she can with no other piece of test equipment. ■

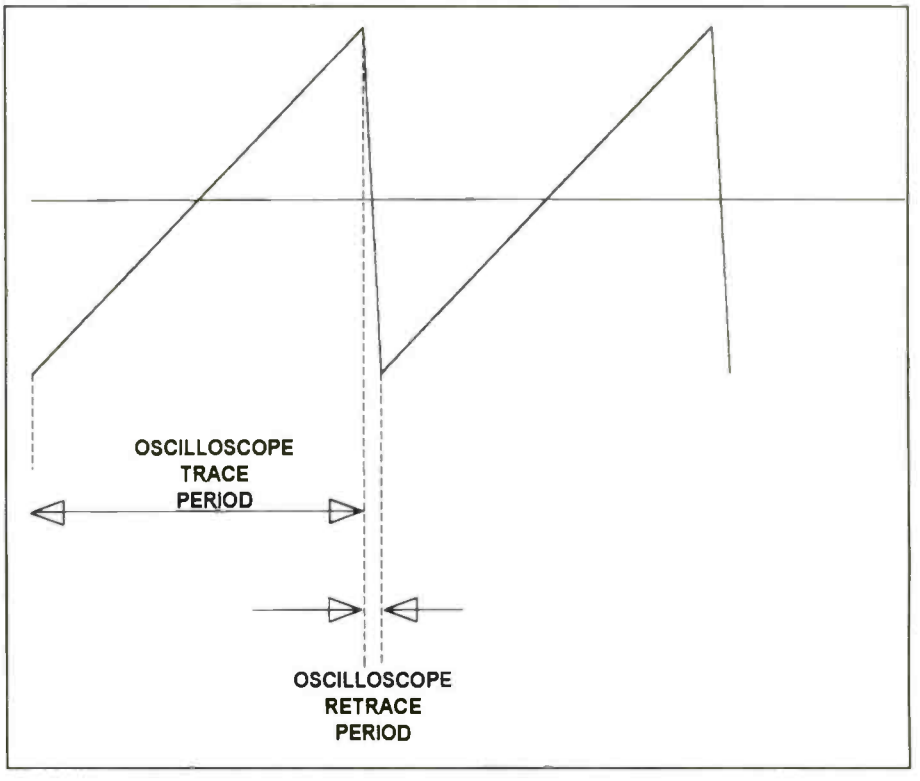

Figure 7. Applying a sawtooth waveform of specified amplitude and known frequency to the horizontal plates of the oscilloscope, results in a waveform that fills the scope screen horizontally, and from which attributes such as frequency and period can be ascertained.

PHOTOFACTS

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SCC-H81B-A 3879
SCC-H81C-A 3879
SCC-H82A-A 3879
SCC-H82B-A 3879
SCC-H83A-A 3879
SCC-J71E-A 3874

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Servicing RCA's CTC166 power supply circuits

By Homer L. Davidson

The low voltage power supply circuits in any TV chassis are critical to the operation of the set. If the power supply or portions of it do not operate perfectly, the chassis might appear dead, cycle off and on, cause intermittent operation, or produce an overloaded circuit, causing the chassis to shut down. Both the low voltage and secondary power supplies have produced some common as well as some unusual service problems in RCA CTC166 sets.

One of the most unusual service problems is the cycle on and off symptom. One technician might describe the symptom as "cycling off and on," while another refers to it as "pulsing off and on." The nature of this symptom might suggest that the cause of the problem is in another section of the TV chassis, even though the problem is in fact in the low voltage sources.

A dead set, or one that is in shutdown, is usually caused by the horizontal and low voltage power supply circuits.

If the symptom is one that suggests that its cause is in the power supply circuits, you can locate the low voltage power supply circuits with the help of the main board parts placement layout chart (Figure 1). If the schematic diagram is not handy, a good way to find the power supply is to look for the four silicon diodes in the full-wave bridge rectifier, and large filter capacitor C4007 (680uF-200V), with the low voltage components nearby. To quickly service the low voltage power supply and to take critical voltage measurements, the schematic is a must item.

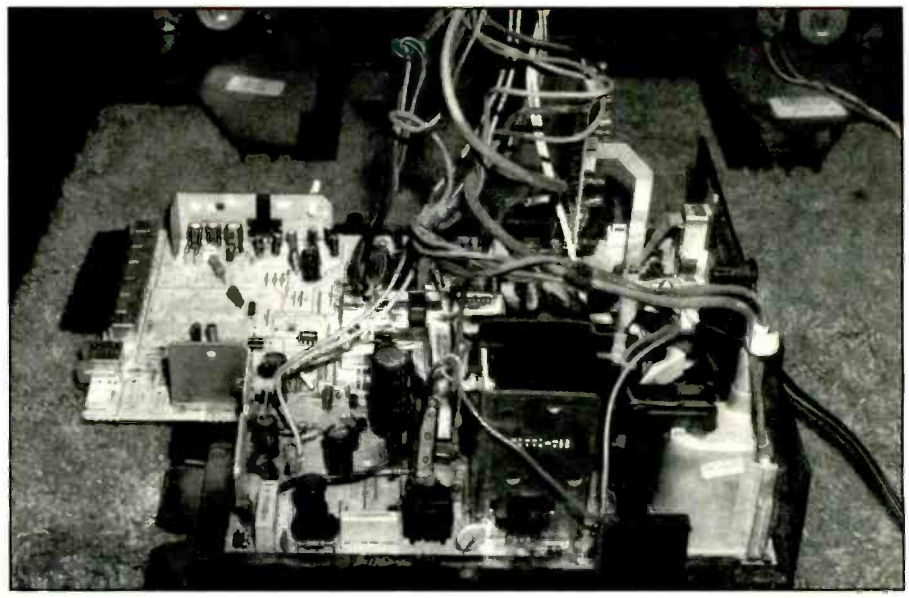


Figure 1. Examine the TV set to locate the various voltage sources.

Dead chassis - shutdown

One of the most common symptoms encountered in TV servicing is a dead set, or a set that shuts down abruptly. In the RCA CTC166, a frequent cause of a dead set is an open fuse, a faulty resistor, R4001 (2.7Ω), faulty silicon diodes in the bridge circuits, and problems in the horizontal output circuits. A leaky or shorted horizontal output transistor (Q4401) can cause a dead set symptom. Improper horizontal sweep from the deflection IC or horizontal driver transistor can produce a dead set or shutdown.

The components in the horizontal sweep section that are most likely to become defective are the horizontal output transistor and the driver transformer. If you encounter a set that is dead, fails to start up, or one that shuts down after operating, resolder the driver transformer terminals. Notice that the common components in the primary winding circuit are at ground potential, while the secondary winding parts have a common hot chassis (Figure 2). When troubleshooting in the secondary circuits of transformer

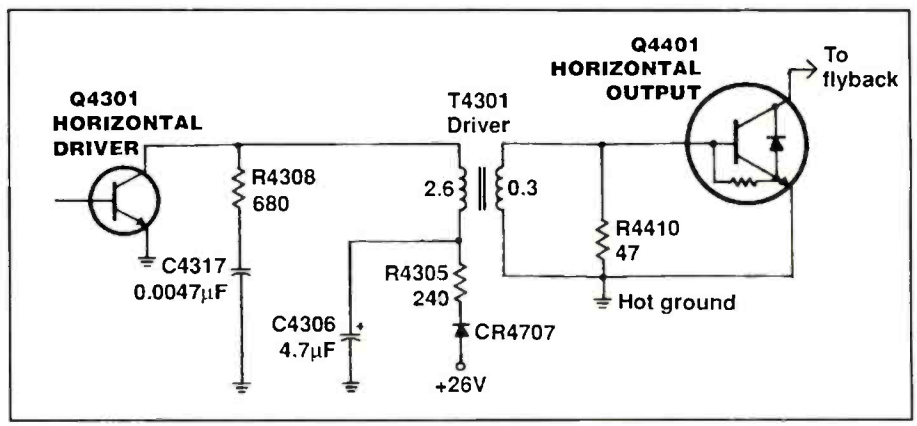


Figure 2. The most likely component to cause the set to fail to start up, or to shut down, are a faulty driver transformer or poor driver transformer terminal connections.

Davidson is a TV servicing consultant for ES&T.

T4301, measure all voltages, and observe all scope waveforms and voltages with reference to the hot chassis or your observations will be misleading.

If the set remains dead, or shuts down after you have soldered all four terminal connections, inspect the driver transformer for burned marks. Measure the resistance of the primary winding to see if it is as specified. The Sams Photofact for this set lists the primary winding resistance as 2.6Ω. This resistance is very low and should be measured with an accurate DMM. Often, a burned primary winding can cause a dead set or shutdown.

If you replace the horizontal output transistor, Q4401, and the set operates, but Q4401 runs hot, check capacitor C4306 (4.7uF) by placing a known-good capacitor in parallel with it. Check R4305 for burned areas or a change in resistance. In some cases, you may find that CR4707 is shorted or leaky.

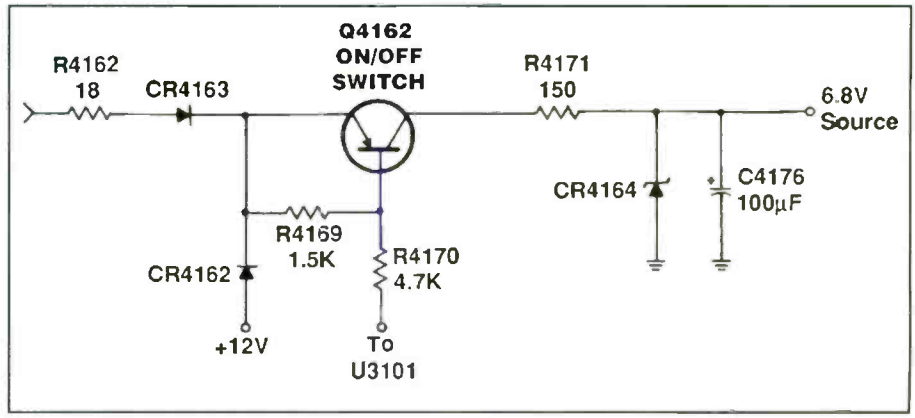


Figure 3. If you encounter an RCA CTC166 that operates intermittently, check Q4162, on/off switch, CR4162, and CR4164 for intermittent operation.

Dead chassis - standby

Another possible cause of a dead set is a defective component in the +12V or +5V standby voltage supply circuits. A separate power transformer (T4601) provides low ac voltage (21.4Vac) to the bridge rectifiers. This transformer is energized all the time when the power cord is plugged in the ac receptacle. The standby 12V and 5V sources from the standby regulator circuits feed to the control microprocessor (U3101) for standby operation.

A voltage measurement at the emitter terminals of Q4161 and Q4160 can determine if the standby circuits are normal. Check Q4161 and Q4160 to see if they are open. If either of these components is open, the set will have no 12V or 5V. Remove one end of each diode for accurate leakage measurement.

Check R4164 and R4163 to see if the resistance of each of them is as specified. Resistor R4163 (1.2Ω) has been known to increase in resistance causing a dead set. Remove one end of R4163 to make sure

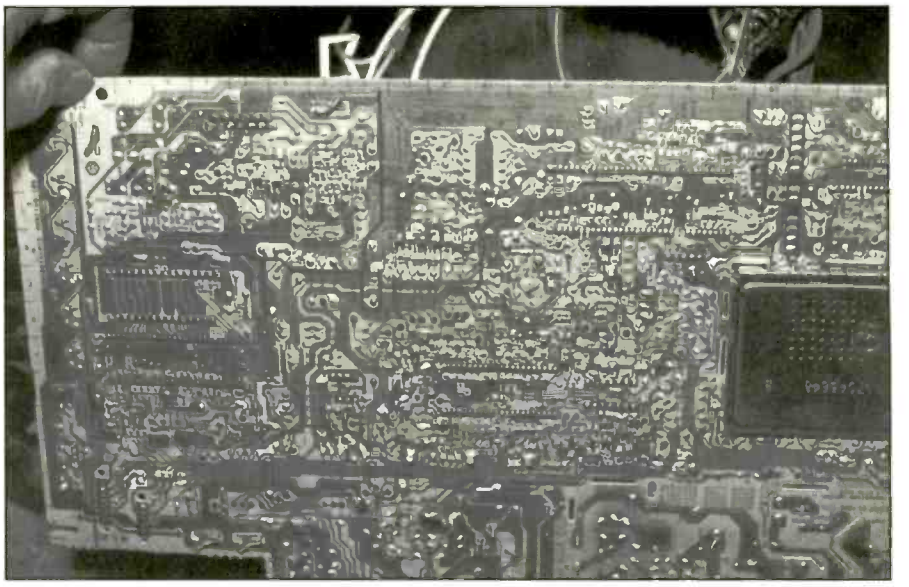


Figure 4. Check and resolder all transistor terminals in the regulator circuits if the set cycles off and on.

that you're measuring only the resistance of the resistor and not some other component that might be in parallel with it as well. Do not overlook an open filter capacitor C4605 (220uF) and C4160 (1500uF) as possible causes of the problem.

An overloaded component in another connecting circuit can load down the 12V or 5V sources, so look for possible problems in adjacent circuits. A leaky filter capacitor, control microprocessor U3101, transistors, and zener diodes in either the 12V or 5V sources can cause a reduced dc source voltage. Remember the standby voltages are fed to the horizontal driver stage, control microprocessor U3101, and off/on switch circuits.

Intermittent shutdown

Other than a defective driver transformer, other possible causes of intermittent shutdown are R4163 and CR4160 in the standby power supply. Test R4163 (1.2kΩ) for an increase in resistance and CR4160 for intermittent operation. When in doubt, simply replace both components.

Defective diodes, both rectifying and zener, seem to cause a variety of different symptoms in the low voltage power supply. A leaky sawtooth generator transistor (Q4103) and zener diode (CR4120) have been known to cause shutdown problems. An open Q4103 transistor can cause shutdown. Also check silicon diodes CR4101 and CR4103 in the sawtooth generator circuits as possible causes of set shutdown.

The on/off transistor switch (Q4162) has caused intermittent operation in the flyback secondary voltage circuits (Figure 3). Replace Q4162 with the manufacturer's exact replacement part num-

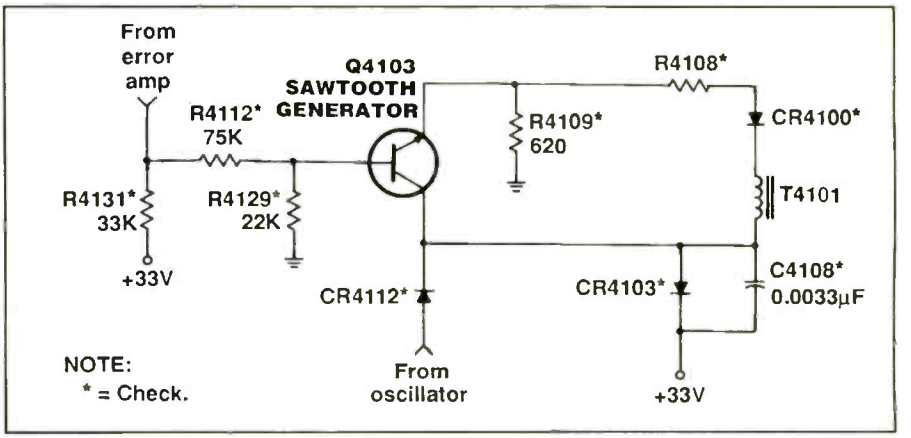


Figure 5. Check the following components for pulsing off and on problems: CR4100, CR4103, C4108 (0.0033uF) and C4118 (0.001uF).

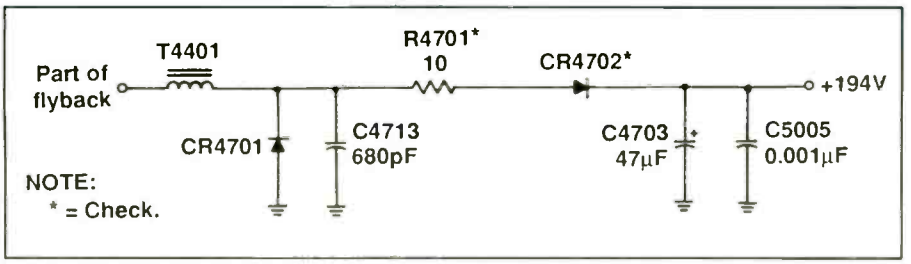


Figure 6. If the screen is dark, or if there is no color, check to see if R4701 is open, or if CR4702 has developed leakage.

ber 146850, or a universal replacement.

While in the off/on switch circuits, check diode CR4162 and zener diode CR4164 for lower voltage that feeds the horizontal deflection integrated circuit and Q4302 horizontal buffer transistor. When any transistor or diode in the low-voltage power supply is suspected, it is best to replace it at once.

Pulses or cycles off and on

While a leaky or open zener diode or silicon rectifier in the low voltage power supply might produce shutdown, it could possibly cause a pulse off and on symptom as well. Sometimes the chassis might cycle off and on several times before the set shuts down. A change in resistance of critical resistors in the regulated circuits can cause a pulse on and off symptom. Check all transistor leads for poor soldered connections in the case of intermittent cycling problems (Figure 4).

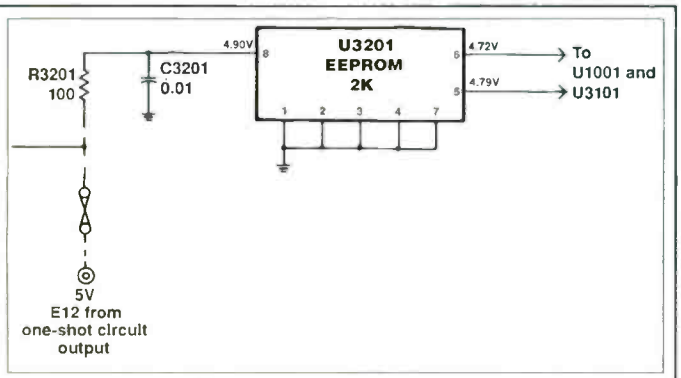
A change in resistance of R4175 (41.2kΩ), R4116 (41.2kΩ), R4132 (619Ω), and R4118 (4220Ω) resistors in the regulated B+ adjustment might cause a pulsing off and on symptom. These critical resistors should be checked with an accurate digital multimeter (DMM) and replaced with the original part number if their resistance is not as specified.

Replace with metal film resistors: R4175 (176500), R4116 (17650), R4132 (195725), and R4118 (195724). Also check the resistance of R4129 (22kΩ) and R4109 (820Ω) for cycling off and on.

Diodes CR4160 and CR4161 have been known to cause cycle off and on symptoms in several RCA sets. Often, the standby voltages should be somewhat higher than the 12V and 5V sources. If the +5V source is extremely low, check C4160 (1500uF).

Poor connections at the terminals of the sawtooth generator transistor (Q4103) might cause cycling and shutdown problems. Replace diodes CR4100 and CR4103 if they appear to be leaky and the set pulses on and off. Check corresponding bypass capacitors C4108 (0.0033uF) and C4118 (0.001uF) as well when the symptom is intermittent operation or cycling (Figure 5).

A defective CR4104 zener diode can cause cycling problems in the 33V source. This 33V source provides supply voltage to the various components in the error amp and sawtooth generator circuits. If the set pulses off and on, suspect



RCA CTC 175 color TV

A RCA color TV with a CTC 175 chassis was brought in for repair. The set was dead. There were no signs of start-up, or clicking of degauss relay, etc. I checked the fuses, all of them were operating properly. The +5V source was OK. I decided to check the EEPROM, U3201, which plays an important part in the operation of this TV set. Pin 8 had the 4.9V as shown on the diagram. I checked pins 5 and 6. Both pins checked much lower than what was needed, and there was no change when the power was turned on and off or other buttons were pressed. After replacing U3201 the TV would turn on with sound, raster, present, but the horizontal frequency was way off. There are no controls for adjusting horizontal frequency, vertical frequency, etc. After examining the label inside of the back cover, I found the information for reprogramming the EEPROM. I went through the procedure and reset the horizontal frequency and performed all of the other adjustments that were required. After doing this, the TV was again up and operating.

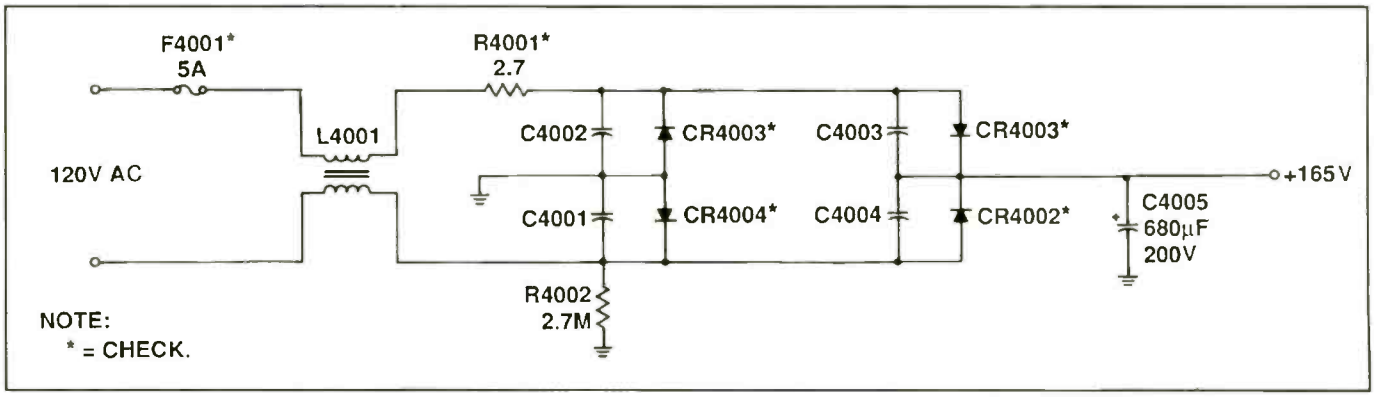


Figure 7. If a set has been hit by lightning, check the components that are connected to the power line and replace any components that have been damaged.

higher than normal voltages in the various low voltage power supply circuits. Notice that all voltage measurements at the terminals of transistors and components in the regulator circuits should be with reference to hot ground.

Service problems in the secondary circuits

The horizontal circuits must operate before any voltages are produced in the secondary windings of the flyback. Check to see if resistor R4125 (3.9Ω) is open or has increased in resistance if the set pulses off and on, then shuts down. Inspect resistor R4172 (22Ω) for open or burned areas if the +9V regulator transistor (Q4107) has developed leakage. If the screen is dark, or if there is no color output voltage (194V), suspect that resistor R4701 (10Ω) is open (Figure 6). Some technicians perform a quick in-cir-

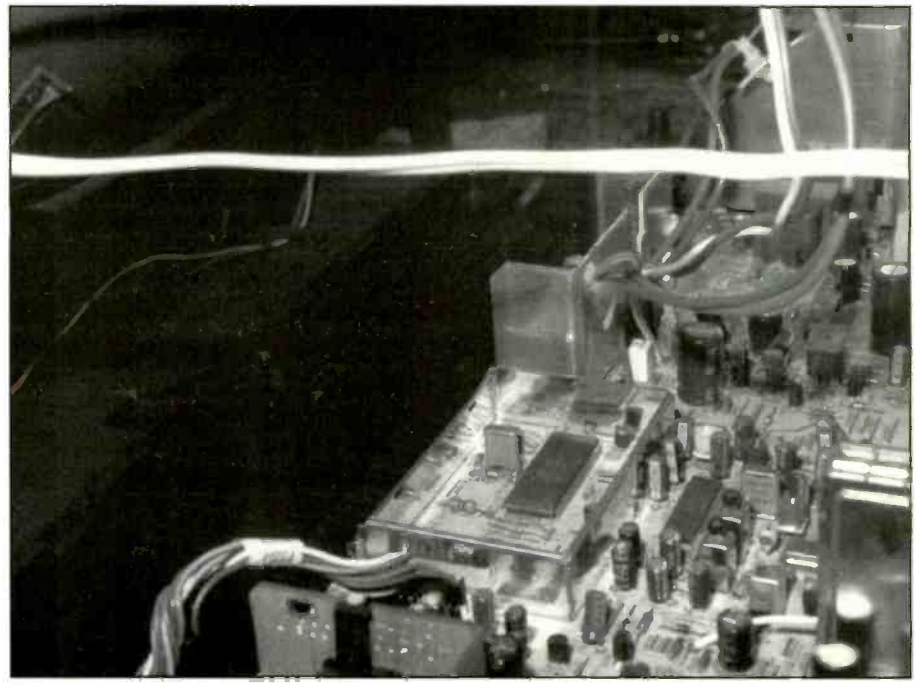


Figure 8. Locate the silicon diodes, transistor regulator and standby components to the left of the flyback transformer.

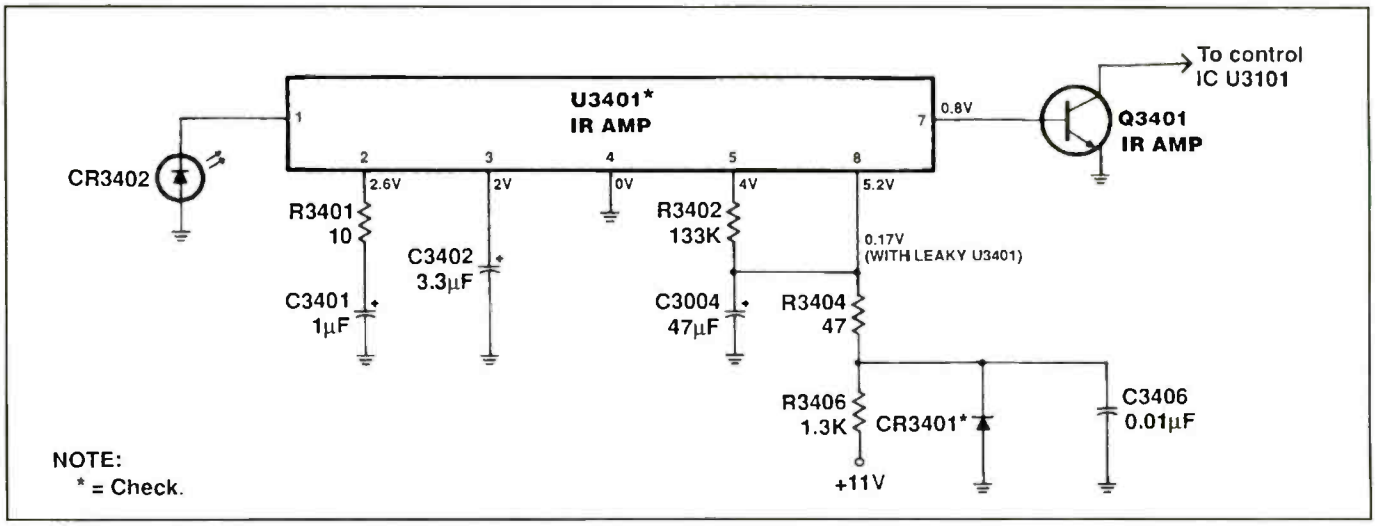


Figure 9. Measure the voltage at pin 8 of the IC to determine if U3401 IR preamp or zener diode CR3001 in the remote control receiver circuits are defective.

cuit test of all transistors and diodes in the secondary circuits of the set to locate a defective component.

Another possible cause of intermittent shutdown, is the on/off switch transistor (Q4162) if it has become open or developed leakage. If transistor Q4162 has become open, the voltage at its collector will be much lower than the specified voltage. This 9V source feeds the horizontal sweep, video and sound output circuits. Double check CR4165 and CR4168 before installing a new regulator transistor.

Lightning damage

Extensive damage can occur in the low-voltage power supply circuits when lightning strikes the home or if the power line is struck. Usually, only the fuse, isolation resistor R4001 (2.7Ω) and silicon diodes are damaged when there is a surge or spike on the power line. If lightning strikes, say, a block away, the same components may be damaged, or the fuse may be the only thing that is damaged. If lightning strikes the house, or the power line entering the home, sometimes the whole TV set is extensively damaged and must be considered a total loss.

You may have to replace F4001, R4001, CR4001 and CR4004 in the low voltage power supply before you can even begin to determine how much damage has been done (Figure 7). If you find that some of the printed circuit traces on the power supply circuit boards have been damaged by overvoltage and overcurrent to the set, check the power cord. It may have been damaged enough that it must be replaced. If the damage to circuit traces does not seem to be excessive, use hookup wire to replace any printed circuit traces that have been destroyed.

If the raw power (+165V) across the filter capacitor C4007 (680uF) is within specification, but the regulated +129V supply to the horizontal output transistor measures 0V, suspect a damaged component in the regulator circuits. Test transistors Q4104, Q4103, and Q4101 using in-circuit tests.

Determine if a standby voltage is present at the collector terminal of Q4161 and filter capacitor C4605 (220uF). If not, suspect an open primary winding of T4601 or damaged silicon rectifiers. Quickly, test Q4161, Q4160, CR4161, and CR4160 with in-circuit tests. Of course, if you find that pc traces on printed circuit boards in other circuits have been damaged by the overvoltage/overcurrent, consider the set a total loss.

Unusual symptom - no control

On one CTC166 set, the remote control transmitter unit would not control the set. When a remote control transmitter unit from another set was substituted, it didn't control the set either. I referred to the service literature and inspected the set and quickly located the remote receiver and standby voltage power supply (Figure 8).

Voltage at the supply pin, pin 8, of the IR preamp IC (U3401) measured very low. The run voltage was traced back to an +11V source from the +12V run regulator transistor. Here the voltage was normal (+13V). I located filter capacitor C1815 (1000uF) and measured the voltage there. This voltage was +10.9V.

Since I have found that the 5V zener diode regulator (CR3401) had caused remote control problems in the past, in another set, I disconnected one end of this diode and tested it. It was normal. The diode showed no signs of overheating. Resistor R3406 (1.3K) was found to be running a little warm. The resistance to common ground at pin 8 was lower than the specified resistance. The conclusion drawn was that the infrared preamp IC (U4301) was leaky (Figure 9).

After disconnecting pin 8 from the pc wiring, another voltage measurement was made at the end of R3406. The voltage increased to 5.1V, confirming that the preamp IC had developed leakage. The IC, U3401, was removed and replaced with the manufacturer's exact replacement part, number (195885). This corrected the problem. The leaky IR IC had loaded down the 11V source.

Conclusion

Shorted components, or components that have developed leakage, that are in circuits connected to the various voltage sources, can cause low voltage or shutdown. Notice when the set is energized what section is dead, for only a few seconds, that might be causing the set to shutdown. Check that circuit for a possible defective component. Look for leaky transistors, ICs, diodes, and electrolytic capacitors in the overloaded circuits. ■

What Do You Know About Electronics?

The "Toss it" syndrome

By J.A. Sam Wilson

Sam Wilson is currently busy with other urgent projects, and was therefore unable to prepare What Do You Know About Electronics/Test Your Electroncis Knowledge *for this issue. This is a reprise of articles that appeared in a previous issue.*

For years, the United States has been gradually painted into a corner; and, unless you start to do something about it, you're going to have your outdoors picnics on a mountain of garbage.

How many times have you heard statements such as these?

"If it costs less than $100.00, it is cheaper to throw it away than it is to fix it."

"It's not worth fixing. You can get a new one for about $60.00."

"Even if I wanted to fix it, I couldn't get parts for it."

"I'll tell you what, I'll give you $5.00 for it on a trade in."

So, an AM/FM receiver goes to the landfill because it needs a two-cent resistor. A small black and white TV receiver goes to the landfill because it needs a five-cent capacitor. A clothes dryer goes to the landfill because it has a broken wire. And on and on and.....

Used electrical equipment is fighting for space in a landfill already clogged with "disposable" diapers, hamburger wrappers and containers for household cleaners that will last 500 years without deteriorating in the least.

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

In the next few years this country is going to be hit with a problem that many people are blissfully unaware of. Landfills are going to start closing down because there is no place to make new landfills. There just isn't that much land available. Add to that the NIMBY (not in my backyard) attitude, and the problem is very serious indeed.

If you are an electronics technician, service center owner, manufacturer or consumer, you are in a position to solve this problem, as well as the new baby's mom next door. If we're going to survive, we are going to have to stop throwing stuff away and start fixing things. Furthermore, you need to stop encouraging people to throw things away. This is a problem that must be addressed.

Now think about this: when you throw that AM/FM radio away, you are not only hogging up the scenery and using up rapidly diminishing landfill space, you are also helping to use up one of our most important reserves: energy. It takes energy to build a new radio. Furthermore, it takes metals and chemicals. I know that this is going to be a big surprise to many people; but, we do not have an endless supply of these materials.

Is anyone listening?

I remember when tantalum capacitors first hit the market. There was some concern about the fact that the tantalum might cause a problem with the environment. A brave parts supplier in my area made a valiant effort to solve the problem. He put a barrel in the corner of his showroom with a sign asking technicians to throw their discarded parts into the barrel whenever they came to buy parts. There was a special emphasis on the tantalum capacitors, paper capacitors and transformers.

Within one week the barrel was half full of cigarette and cigar stubs, and wrappers from anything you could imagine.

Is that funny? Where do you suppose all the parts that were supposed to be in that recycling barrel went? How do you recycle cigarette stubs?

Let's switch over to the way manufacturers are contributing to the landfill problem. My friend Frank, owner of a service business in Arizona, once told me that the greatest contribution I could make to the consumer servicing industry was to solve the parts problem. The shop owners couldn't do it. The technicians couldn't do it, and the manufacturers couldn't do it. So I guessed I'd better jump in. But I couldn't solve it either.

What does that have to do with the landfill problem? Here is a set that has been waiting six weeks for a part. The customer is irate. Solution: sell the customer a new set. Give a good trade-in allowance. Then send the old set to diaper heaven.

Some electronic equipment that should be relatively easy to service is being sold in sealed containers. They are not repairable only because they are sealed

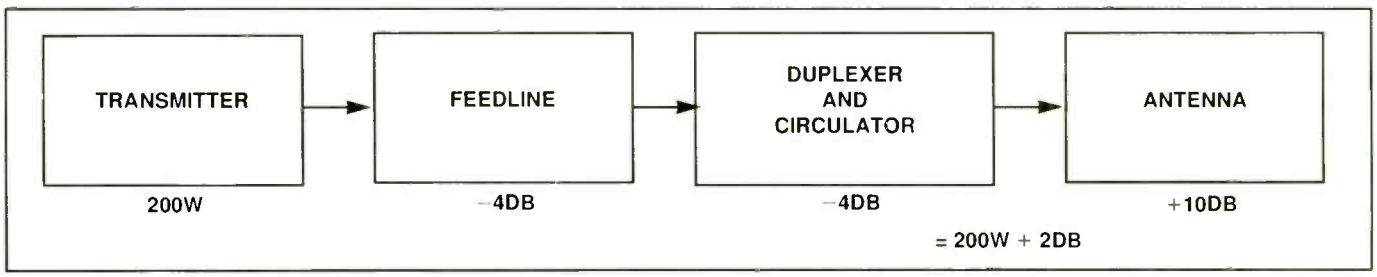


Figure 1. A system consists of a transmitter that has a power output of 200W, a feedlinewith 4dB loss, a duplexer and circulator with 4dB loss, and an antenna with 10dB gain. What will be the effective radiated power of this system?

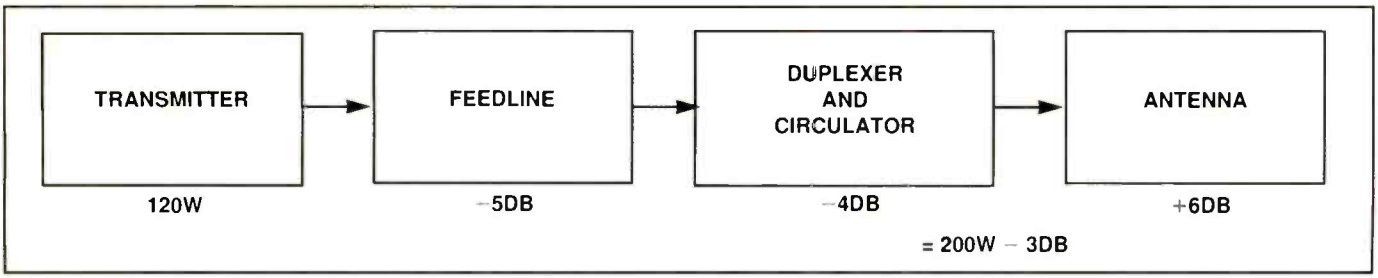


Figure 2. A transmission system consists of a transmitter that has a power output of 120W, a feedline with 5dB loss, a duplexer and circulator with 4dB loss and an antenna with 6dB gain. What will be the effective radiated power of this transmission system?

and there is no service literature available. More landfill fodder.

Some equipment is being made with absolutely no servicing information available; not even a schematic. If you don't believe that, try to get a switching regulator schematic for a certain popular computer. That subassembly has been deemed by the manufacturer as not repairable. Now I am talking about profit and landfill fodder.

Is there any way out of this mess? Some companies make laundry products that have been selling refills for their bottles. That means that someone knows about the problem besides us. Is there anything you can suggest? Let me know. We're all in this together.

FCC test problems about radiated power

Let me introduce you to Phronsie Dwitrong. When he graduated from high school he took a job inspecting buggy whip holders. He also dabbled in radio service, so he started thinking about himself as an electronics technician. He even read some stuff about it in a library book.

After four years he started to look around for another job. An ad in the help wanted section of the paper got his attention. They were looking to hire electronics technicians.

When he applied, Phronsie was told he would need a FCC license and he would also do well to try for a CET rating.

The FCC publishes all of the questions and answers for the GROL (General Radio Operator License). So, Phronsie borrowed a copy from his former high school shop teacher and spent about two hours looking through the pages. He was sure he was ready, so he took the test. He wasn't ready. Here is an example of a question he couldn't answer.

"What is the effective radiated power of a repeater with 200W transmitter

power output, 4dB feedline loss, 4dB circulator and duplexer loss, and 10dB antenna gain."

Phronsie took a wild guess and missed the answer by a mile.

The solution

(Note: in the FCC problems, the effective radiated power is referenced to a standard dipole antenna.)

It's too bad that Phronsie didn't subscribe to **ES&T**. By reading this column he would know how easy it is to solve that kind of problem.

Every time the power is increased by 1dB, the power is multiplied by 1.259.

As shown in Figure 1, in the system described in the problem there is an overall gain of:

-4dB + (-4dB) + 10dB = 2dB.

So the power will increase to:

(200 x 1.259) x 1.259 = 317W.

Just remember to multiply the power by the factor 1.259 as many times as there are 1dB increases.

All of the FCC problems involve a value of power that is raised or lowered by an even number of dB, so this simple method can be used for every FCC problem that involves raising or lowering the power by a number of dB.

When the value of dB is negative, it means that there is a lower output power compared to the input power. In this case, every time the power is decreased by 1dB, the power is divided by 1.259. That rule is demonstrated in the next problem from the FCC pool of questions for GROL examinations.

"What is the effective radiated power of a repeater with 120W transmitter output power, 5dB feedline loss, 4dB duplexer and circulator loss and 6dB antenna gain? Refer to Figure 2.

Solution to the problem

The overall gain is -3dB. In other words, there is a 3dB loss. Therefore, the power is divided by 1.259 three times:

120W/1.259 = 95.3W

95.3W/1.259 = 75.7W

75.7W/1.259 = 60.6W

The FCC answer is 60W.

This should come as no surprise to experienced technicians. It is a well-known rule that reducing power by 3dB cuts the power in half. Also, raising power by 3dB doubles the power.

If you use the better value of 1.2589 in the above calculations, you get 60.1, and that is significantly closer to the actual one-half power mark.

Using logarithms to solve the first problem

If you are a technician who prefers the solution from a more formal stance, here is how it goes. The equation is:

$dB = 10\log(P_A/P_B)$

If there is a dB gain, let P_B be the starting power and P_A be the new (increased) power. If there is a dB loss, let P_A be the initial value of power and P_B be the new reduced power.

In the first problem discussed earlier, there is a dB gain, so P_B is the starting power (200W) and P_A is the new power.

Then:

$2dB - 10\log(P_A/P_B)$

Divide both sides of the equation by 10:

$0.2 = \log(P_A/200)$

Take the antilog ($\log^{-1}$) of both sides of the equation:

$\log^{-1}(0.2) = \log^{-1}[\log(P_A/200)]$

$1.584893192 = P_A/200$

$P_A = 1.584893192 \times 200 = 316.97$.

Rounded off the three places that becomes 317W.

Using logs to solve the second problem

In the second problem, there is a 3dB loss. So P_A is the starting power (120W) and P_B is the new power.

$3dB = 10\log(120/P_B)$

Divide both sides by 10

$0.3 = \log(120/P_B)$

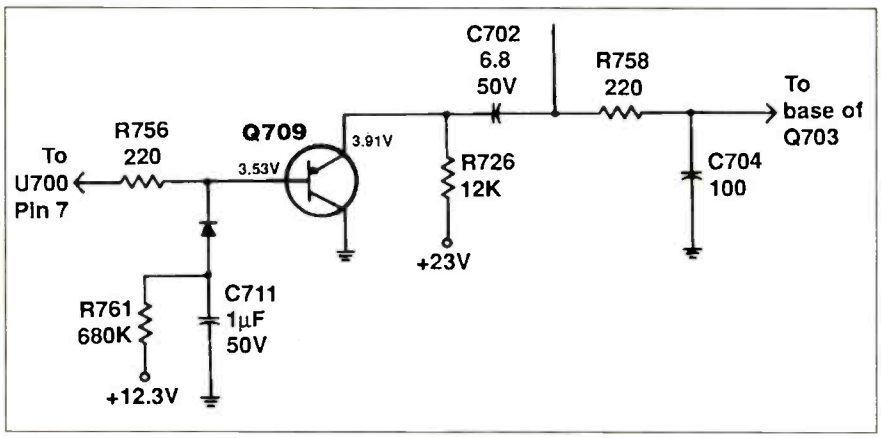
Take the antilog of both sides

$1.995 = 120/P_B$

Rearrange to get P_B alone on one side of the equation.

$P_B = 120/1.995 = 60$ (approximately)

The truth is that decreasing a power by 3dB does not exactly divide the power by 2. Likewise, increasing the power by 3dB does not exactly double the power. Those rules give a good approximation and they are used by the FCC to get answers to their problems. ■



RCA CTC 101A color TV

A RCA color TV using a CTC 101A chassis was brought into the service center for some repairs. The customer said that the picture was bad. I checked it and found that there was very little video. I warmed up my oscilloscope and started tracing the video signal. The video out of the U700 luminance processor was normal, pin 7 and a 4V p-p video signal feeding the base of Q709 second video emitter follower, but there was no video present on the emitter. I checked the Q709 in circuit and it checked out allright. I then checked the voltages on Q709. The emitter voltage was near zero. It should be 3.91V. I removed R726, a 12K 1/4W resistor to get a reliable check on it. R726 was totally open. After replacing R726, normal operation of the TV was restored. This was not a difficult problem to locate, but it proves how systematic troubleshooting, the use of an oscilloscope, and the use of voltage and resistance measurements can locate a defective component quickly and easily.

BOOKS

***Linear Integrated Circuits*, By Joe Carr, Newnes, 352 pages, paperback $37.95**

The linear IC market is large and growing as is the demand for well trained technicians and engineers who understand how these devices work and how to apply them. *Linear Integrated Circuits* provides in-depth coverage of the devices and their operation, but not at the expense of practical applications in which linear devices figure prominently. This book will attract a wide readership from FE and first degree students, to electronics hobbyists and professionals.

Chapter 1 offers a general introduction that will provide students with the foundations of linear IC technology. From chapter 2 onwards there is thorough coverage of the operational amplifier - perhaps the most common of all linear IC devices. The book continues to develop the theme of op-amps over several chapters and then switches to non-op-amp forms. Finally, because microwave linear IC devices (MMIC chips) are becoming increasingly important, a chapter is devoted to high-frequency devices VHF and up). All of this is clearly presented with useful examples.

The book contains an Introduction to linear integrated circuit devices; The IC operational amplifier; Inverting and non-inverting operational amplifier configurations; Dealing with practical operational amplifiers; Instrumentation amplifiers; Isolation amplifiers; Non-operational IC linear amplifiers; High frequency, VHF, UHF and microwave linear IC devices; IC waveform generators and waveshaping circuits; DC power supplies for linear IC circuits; and the Index.

Newnes, 313 Washington Street, Newton, MA 02158-1626

***Newnes Digital Logic IC Pocket Book*, By RM Marston, Newnes, 256 pages, hardcover $24.95**

This reference guide to modern '74'-series and '4000'-series digital ICs presents 620 useful and carefully selected circuits, diagrams, graphs and tables, supported by informative test and captions. Detailed descriptions of and practical applications information on more than 185 TTL and CMOS ICs are provided.

This wealth of information is clearly and logically arranged so that specific information can be quickly and easily located. Fifteen chapters cover from IC basics and TTL and CMOS principles, to the practical circuitry of logic ICs, waveform generators and multiplexers. While aimed at practical design engineering and technicians, this pocket book will also be of use to amateurs and students of electronics. The subject is dealt with in a readable and essentially non-mathematical manner, with the emphasis on practical 'user' information and circuitry.

Newnes, 313 Washington Street, Newton, MA 02158-1626

***Understand Electronic Filters*, By Owen Bishop, Newnes, 180 pages, paperback $24.95**

This book covers a field of electronics which is very mathematical and presents difficulties to electronics students at all levels. It aims to provide the reader with enough math to really understand what electronic filters are, how they work and how to use them. The book assumes a knowledge of mathematics at about GCSE level, and a minimum of electrical and electronic theory.

It proceeds by easy stages to describe the structure, action and uses of filters, introducing and explaining the necessary additional math at each stage. The discussion is backed up by descriptions of practical working filters of all types. All the filter circuits contained within the book are simulated on computer, and this provides a wealth of computer-generated diagrams and accurate graphs, many in 3-D, to illustrate the text. To ensure the reader is confident with what they learn, short sets of questions are included periodically throughout the text under the heading "Keeping Up?". At the end of each chapter there is a more demanding set of "Test Yourself" questions, designed to reinforce the understanding acquired by reading each chapter. Answers are given at the end of the book.

Newnes, 313 Washington Street, Newton, MA 02158-1626

***Introduction to Fiber Optics; A straightforward guide*, By John Crisp, Newnes, 240 pages, paperback $28.95**

This book provides a thoroughly readable introduction to fiber optics, assuming the reader has no previous knowledge of the subject, nor technical or mathematical background. It is suitable for engineers, technicians, students, hobbyists and installers, and covers the full range of fiber types.

The books contents include: Introduction; The physics of light refraction and reflection; Propagation of light along the fiber; Decibels; Some losses on an optic fiber; Real cables; principles and problems in joining optic fibers: Fusion splicing; Mechanical splices; Connectors; Couplers; Light sources and detectors; Testing systems; Designing systems; Introduction to transmission systems: Next steps; Glossary; Answers to problems and the Index.

Newnes, 313 Washington Street, Newton, MA 02158-1626

LITERATURE

Test equipment, tools and supplies catalog update

A 64-page update from Contact East comes with hundreds of 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.

New product highlights include: DMMs and accessories, oscilloscopes, scopemeters, soldering tools, clamp meters, custom and "create-your-own" tool kits, power supplies, milliammeters, and graphical multimeters. Also included are communication test equipment, datacom tools and testers, adhesives, measuring tools, precision hand tools, soldering/desoldering systems, static protection, ozone-safe cleaners, magnifiers, inspection equipment, tool cases, workbenches and chairs, and more.

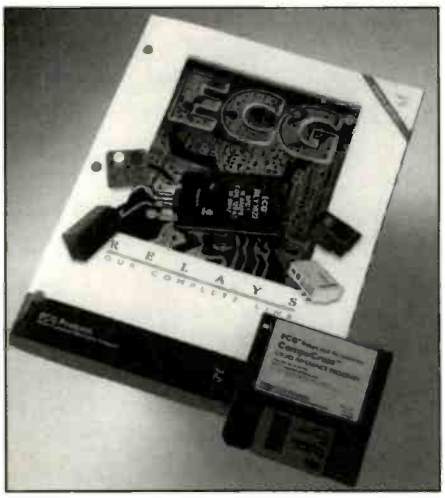
Circle (24) on Reply Card

Relay and accessory guide

Philips ECG products has introduced a new, easier to use, version of their popular *Relay and Accessory Guide*. The 8th Edition Guide has expanded to 772 types and includes over 60,000 industry part numbers covering 218 brand names.

The guide now contains 98 individual series of parts including: electromechanical, solid state, reed type, PC mountable, high current, latching, and more.

The following new series are added for the first time: photoelectric sensors, surface mount relays, phase monitoring relays, alternating relays.



Also included are the company's lines of: proximity switches, circuit breakers, time delay relays, I/O modules, cube timers, and contactors.

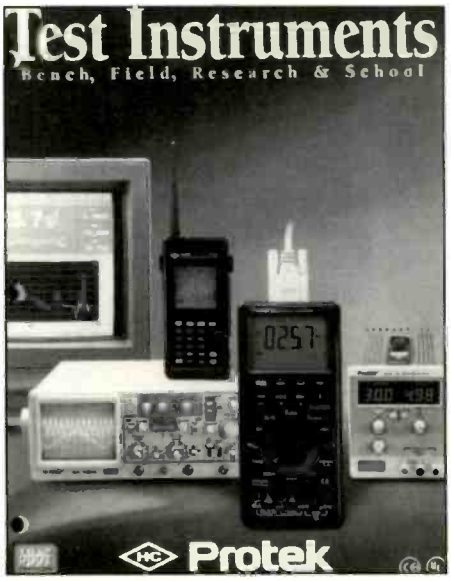
The cross-reference section is available on 3.5" HD diskette for Windows or DOS. The relay Insta-Cross Program quickly identifies the correct ECG relay for any listed industry part number.

Circle (25) on Reply Card

Test instrument catalog

A series of newly developed test instruments, including RF generators, ac millivoltmeters, portable power supplies, digital multimeters and analog meters are among the products featured in the latest HC Protek, Inc. catalog.

This 52-page publication details more than 75 instruments and incorporates quick reference guides for selecting digital and analog products, including digital storage scopes, portable and bench type scopes, state-of-the-art DMMs and other instruments.



The catalog also provides comprehensive specifications data for all products along with cross-reference indexing for easy identification.

Circle (26) on Reply Card

Online product selection and ordering system

Jameco Electronics has made available its offering of more than 5,000 electronic components and computer products for purchase via the World Wide Web at www.jameco.com.

The new electronic catalog allows Internet users to quickly search for a part by number or keyword. Customers can then add the item to a virtual shopping cart and continue adding products or place their order securely using purchase order, credit card or C.O.D. payment.

Realizing the customer's need for speed and ease of use, the electronic catalog was optimized for quick downloads. Product listings include only a textual description and current pricing for fast downloading. State-of-the-art equipment, high-speed connectivity and powerful databases provide for fast searches and reliable data transmission

The web site also offers special promotions, an automated catalog request form, technical support, company information, an e-mail directory and links to product manufacturer web sites. A link to the company's FTP site on the technical support page provides access to drivers, device lists, utilities and hundreds of pages of data sheets and manuals.

Circle (27) on Reply Card

25th anniversary catalog

Elenco Electronics introduces the 25th anniversary issue of their full-line 48-page color catalog.

Featured are trainers, tool kits, tools, educational kits, solder kits, oscilloscopes, power supplies, counters, generators, breadboard aids, multimeters, etc.

Circle (28) on Reply Card

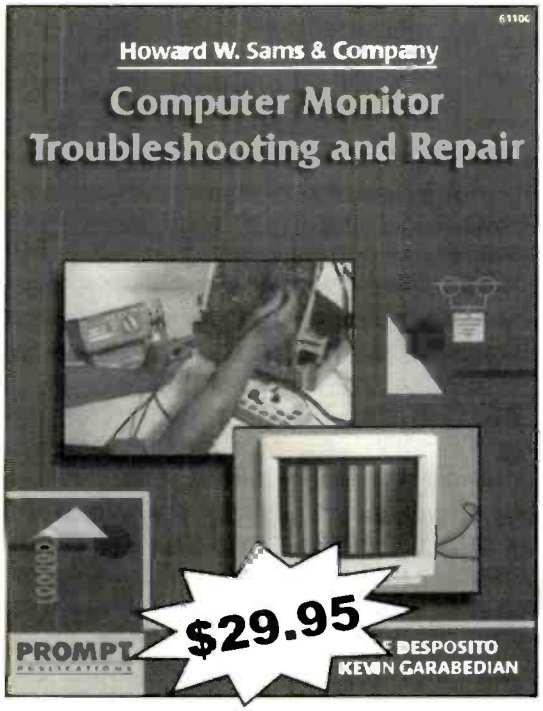
Now There's a Book To Help You Fix Computer Monitors

PROMPT PUBLICATIONS

Howard W. Sams & Company

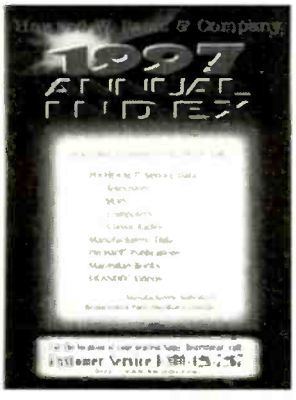
Computer Monitor Troubleshooting & Repair

This book can save you the money and hassle of computer monitor repair by showing you how to fix it yourself.



There is an ever increasing number of computer systems in homes, offices, and schools. An integral part of that system is the computer monitor. Its job is to process electronic signals and present them to the user in an intelligible way. When a computer monitor fails at this task, it is up to a technician to find out what is wrong and repair the problem. In light of this, the demand for computer monitor repair information has exploded, and manufacturers' service data is nearly impossible to find.

Computer Monitor Troubleshooting and Repair makes it easier for any technician, hobbyist, or computer owner to successfully repair dysfunctional monitors. Learn the basics of computer monitors with chapters on tools and test equipment, monitor types, special safety procedures, how to find a problem and how to repair faults in the CRT.



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1-800-428-7267

Laser printer tester

A microprocessor-controlled laser tester, LaserTest SX30 from *Laser Wizard* provides the service technician with a variety of features needed to troubleshoot laser printers. The technician can now disconnect the laser printer from the computer, remove all the covers, the toner cartridge, paper trays, have the top open, even remove the system board and still be able to operate the printer. This permits the technician to look for mechanical problems during printing, pinpoint board failures and power supply problems as well as distinguish between toner cartridge or printer problems. The tester utilizes the power of the printer it is testing to operate. LaserTest is designed to operate on all laser printers that utilize the Canon SX engine.

The tester was also designed to be expandable. By use of add-on modules like the NX60 a variety of laser printers can be serviced. The NX60 piggybacks onto the LaserTest SX30 host unit and can test all Canon NX engine-based laser printers. The connection can be made in a few simple steps.

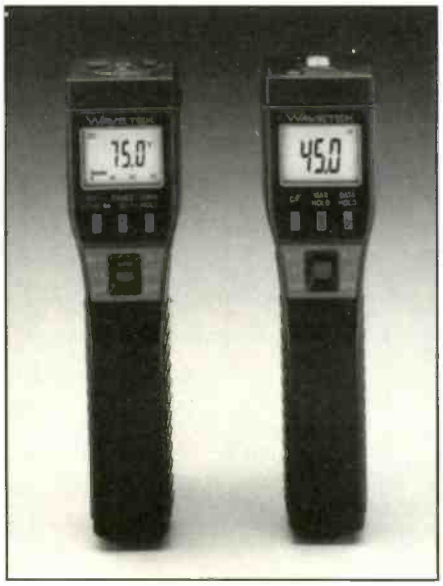
Circle (30) on Reply Card

"Mini-Stick" meters

Wavetek introduces an innovation in hand-held meter design with the ST75 and the TM45. Traditional handheld DMMs require the user to perform the cumbersome and awkward tasks of setting down the meter and concentrating on holding and placement of test leads, all while trying to read the meter's display. These meters allow the operator to safely read the meter's display while test leads are in contact - using two hands and without having to set down the meter.

For added convenience, the small thin style of the meters allows for better fit in tool belts and less space in tool boxes. They are convenient in applications such as tight spaces, quick trace on wiring panels and circuits, blower and motor circuit troubleshooting, etc..

The ST75 measures dc and ac voltage to 600V and resistance to 32Ω. Key measuring features include digital and analog



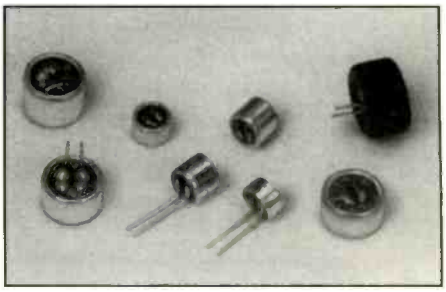
bargraph display, high resolution of 3200 count, autoranging, data hold, quick continuity checking and diode testing.

The TM45 is a digital thermometer with a range up to 2000°F/1300°C. Features include switchable °F/°C, Type K thermocouple compatible, data and max display hold and selectable 0.1°F/°C temperature resolution.

Circle (31) on Reply Card

Microphones

A new series of electret condenser microphones, designed for a wide range of applications including the latest multimedia and voice modems, is now available from the *Intervox* Division of International Components Corporation.



The new series includes omnidirectional, unidirectional, and noise canceling types, in pin or pad configurations. Dimensions range in size from as little as 6.0mm diameter by 3.0mm high to 9.7mm diameter by 10.0mm high.

Frequency range is wide: 20Hz to 16000Hz for omnidirectional types, 100Hz to 16000Hz for unidirectional and noise canceling types. Tolerance is ±3dB for omnidirectional types, and ±4dB for unidirectional and noise canceling types. Signal to noise ratio is >35dB, >38dB, or >40dB. Standard operating voltages include 1.5, 2.0, 3.0, or 4.5V.

Circle (32) on Reply Card

Function generator

Developed to satisfy the needs of general purpose experimentation both for R&D labs and the technical education market, the LG 1301 function generator from *Leader Instruments*.

The LG 1301 provides versatile control over waveshape, output level and dc offset. Wide frequency range and modulation capabilities as well as linear and log sweep complete this instrument.

Frequency range covers 0.002Hz to 2MHz while the output can be set for sine, square, triangle, pulse and ramp with control over symmetry where applicable. The basic oscillator is voltage controlled, permitting both internal and external control of frequency. Rear panel jacks output the

generator control voltage (GCV) and accept external control voltage (VGC). The unit provides a 50Ω output with 0dB to 70dB attenuators and dc offset control. A fused output provides protection against overload.

Circle (33) on Reply Card

Handheld DMM

B&K Precision's Model 5390 high accuracy, high resolution handheld DMM offers 0.025% dcV basic accuracy.

The meter measures the true rms values of complex signals via ac or (ac + dc) coupling at frequencies to 100kHz, and is autoranging on all functions including capacitance and dB. Other features include min/max/avg, resistive power measurement, a 34-segment bar graph, frequency counting to 500kHz, and extensive pule measurement capability.

Calibration is performed via a serial interface without opening the unit, and optional Lab Windows software. The calibration parameters, including full ISO 9000 documentation, can be output to a PC or printer.

Circle (34) on Reply Card

Desoldering braid dispenser

A hand-held desoldering braid dispenser that lets users dispense, position, and cut off braid using one hand, while

holding a soldering iron in the other, is available from *Xuron Corp.*

The Wickgun Desoldering Braid Dispenser eliminates the handling of braid, burned fingers, and manual cutting, and speeds desoldering operations by three to five times and cuts braid waste by up to 50%, claims the firm.

Featuring replaceable cassettes, preloaded with 15 ft. of pure copper braid, impregnated with water clean flux, the dispenser advances/retracts braid using a thumbwheel. Squeezing the trigger cuts off used braid.

Circle (35) on Reply Card

Multimeter with adjustable display

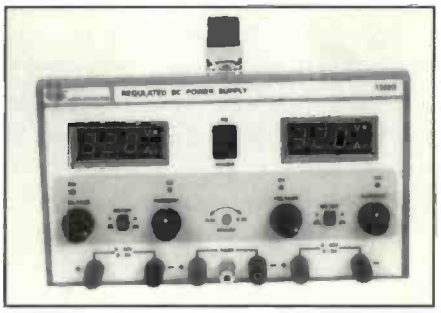
Extech's new multimeter with adjustable display measures dcV to 1000V with an accuracy of ±0.5%, acV to 750V, ac and dc current, resistance, capacitance, and temperature in selectable F or C. Readings appear in a large 0.98" (25mm), 3-1/2 digit, LCD display. Features include diode and transistor

tests, audible continuity, color coded input terminals, and auto power off. Complete with test leads, temperature probe, rugged heavy duty drop proof case, and 9V battery.

Circle (36) on Reply Card

Digital CC/CV triple-output dc supply

The *Global Specialties* new triple output CC/CV dc power supply offers 3 outputs, 2 each of 0Vdc to 32Vdc at 2A and 1 output variable from 4.5Vdc to 5.5Vdc at 5A. Each of the two 0Vdc to 32Vdc at 0A to 2A outputs offer adjustment controls for voltage and current, series and parallel operation, allowing the operator the option of two additional outputs 0Vdc to 64Vdc at 2A for 0Vdc to 32Vdc at 0A



to 4A. Additional features include a floating ground feature that allows for outputs of either full negative or positive output potential from the two outputs separately, constant curent/voltage mode LED indicators, easy-to-read eye-pleasing green digital LEDs, voltage and current indicators in the digital viewing area, and heavy-duty transformers with isolated design and short circuit protection.

Applications for the supply include experimental set-ups, circuit design and development, production line testing and repair, battery charging, incoming, electronic inspection and vocational-technical schools and universities.

Circle (37) on Reply Card

Hand-held frequency counters

Elenco Electronics introduces two new hand-held frequency counters, Models F-2800 and F-2850.

Both counters offer wide input ranges. The F-2800 displays frequencies from 1MHz to 2.8GHz and the F-2850 range is 10MHz to 2.8GHz.

ES&T Calendar

Internationale Funkausstellung/
USA Pavillion
August 30-September 7, 1997
Berlin, Germany
540-372-1414

PSC 97 (Pers. Communications Industry Association)
September 10-12, 1997
Dallas, TX
703-739-0300

CTIA Breakaway '97
September 18-20, 1997
San Diego, CA
702-268-1818 ext. 310

CES Mexico
October 8-10, 1997
Mexico City Mexico
Sponsored by EIA/CEMA
703-907-7620

ASEA (AZ) Annual State Convention
October 10-12, 1997
Casa Grande, AZ
602-937-3241
e-mail: Lunncet@aol.com

NASM 42nd Educational Congress
October 12-16, 1997
Dallas, TX
847-310-9930

NY State Forum & Expo
October 14-15, 1997
Plainview, NY
516-221-6403

Networks Expo Dallas/Windows World
October 29-31, 1997
Dallas, TX
201-346-1400, ext. 145

TeleCon XVII (ABC/Applied Business teleCommunications)
November 5-7, 1997
510-606-5150

'98 International Consumer Electronics Show
January 8-11, 1998
Las Vegas, NV
703-907-7600

The Consumer Electronics Future
January 12-14, 1998
Las Vegas, NV
703-907-7660

Home Automation Show & Conference
February 25-27, 1998
Orlando, FL
203-840-5482

NESDA 48th/ISCET 28th/NIAS 6th Annual
August 10-15, 1998
Kissimmee, FL
817-921-9061

PCS 98
September 23-25, 1998
Orlando, FL
703-739-0300

Personal Computer & Electronics Expo
October 15-18, 1998
Uniondale, NY
800-886-8000
516-889-6000

PCS 99
September 22-24, 1999
New Orleans, LA
703-739-0300

Each unit has a 250MHz direct count range for high resolution. The F-2850 also reads period and has auto triggering. Both units have data hold and 16-segment signal strength bargraph.

Circle (38) on Reply Card

Software for oscilloscope products

Fluke has introduced a new Windows software package that extends the documenting capabilities of its popular line of ScopeMeter test tools. The new FlukeView (version 2.0) for ScopeMeter software supports both the ScopeMeter 90 Series and the new industrial ScopeMeter 123 test tools.

Designed to run on Windows 3.1 and Windows 95, the software offers all the capabilities and ease of use of previous software, while adding the ability to read both graphical and numerical data simultaneously from the test tool's display. Utilizing a new proprietary format, the software can save multiple screens, waveform data, and logged readings in a single data file.

This software also enables users to export graphical images as separate files in .BMP and .PCX formats and to add descriptions to the images to help identify data in the future. In addition, numerical waveform and logging data can be saved separately using ASCII format files (.CSV and .TXT), making it easy to import information into standard computer spreadsheet programs.

Circle (39) on Reply Card

Duster

CRC Industries announces CRC Duster. The cleaner is formulated to remove contaminants such as dirt, dust and lint from electrical and electronic equipment, without damaging sensitive components or surface finishes.

According to the company, spraying the product in the direction of undesirable surface contaminants will effectively clean the area.

The product cleans with the powerful propellant blast that evaporates instantly, there is no need for wiping or dusting.

The product is non-abrasive, non-flammable and plastic-safe.

Circle (40) on Reply Card

to dealers, a healthy 14 percent improvement over January-April 1996.

Despite impressive gains by the systems category, factory sales of all consumer audio products slipped six percent in April. The dollar volume of manufacturers' sales to dealers totaled $503 million in April, down from $536 million posted during the same month last year. On a year-to-date basis, the audio equipment sector reported $2.08 million in factory sales, a three percent dip relative to the same period for 1996.

Components continued to show the most slippage, dropping 17 percent in April with sales of $103 million. Surround sound speaker packages, which rose five percent for the month, were the only subcategory to enjoy an increase. On a year-to-date basis, component sales now stand at $451 million, 16 percent below last year's pace.

In aftermarket autosound, April sales to dealers had a combined value of $157 million, down 11 percent from $175 million during April 1996. For the first four months, sales of in-dash CD players jumped 24 percent but were unable to lift the overall category into positive territory. April sales declined 11 percent to $157 million, and on a cumulative basis autosound sales now stand at $620 million.

As for portable audio, sales dipped fractionally in April to $132 million, and for the first four months are running seven percent below their 1996 pace. Within this category, however, home radios grew 11 percent, radio/tape boomboxes nearly 20 percent and CD boomboxes — the largest portable category in terms of dollar volume — by one percentage point.

CEMA and SBCA announce satellite education partnership at '98 Winter CES

The Consumer Electronics Manufacturers Association (CEMA) and the Satellite Broadcasting and Communications Association (SBCA) announced that they have agreed to jointly sponsor the satellite education and conference programming at the 1998 International Winter Consumer Electronics Show® (WCES). Under an agreement announced today by the two organizations, SBCA will be responsible for coordinating and developing the content for the sessions held at the WCES January 8-11, 1998, in Las Vegas, Nevada.

"The joining of these two organizations represents a turning point in the satellite industry efforts to broaden its impact on the consumer marketplace," said Gary Shapiro, CEMA's president. "We respect the SBCA and our pooling of resources will strengthen our mutual interest in providing dealers with the best possible information. SBCA's sponsorship instantly enhances the depth and value of the satellite conference program at the Winter CES. These sessions will provide manufacturers, retailers and press an opportunity to learn about the latest developments the industry has to offer."

SBCA will be responsible for selecting and coordinating moderators and panelists for 12 marketing and business sessions targeted to the satellite retailer. Each session will be 90 minutes in duration and in the Las Vegas Convention Center.

"This partnership will be a cost-effective educational forum for attendees and exhibitors," exclaimed Charles Hewitt, SBCA's president. "It is another way to provide opportunities for our mutual constituencies and our members. Winter CES is the most recognized trade show in the consumer electronics industry and will naturally complement our National Show in Nashville. We're confident this partnership will help grow our members' businesses as they continue to identify new ways to communicate with one another."

CEMA is a sector of the Electronic Industries Association (EIA), the 73-year-old Arlington, Virginia-based trade association representing all facets of electronics manufacturing. CEMA represents U.S. manufacturers of audio, video, accessories, mobile electronics, communication equipment information products and multimedia products. The SBCA is the national trade organization representing all segments of the home satellite television industry. It is committed to expanding the utilization of satellite technology for the broadcast delivery of entertainment, news, information, and education programming. SBCA is composed of satellite manufacturers, retailers, distributors, DBS companies, mass merchandisers, encryption vendors and programmers.

9th Annual Digital Engineering Conference set for Las Vegas in 1998

The Digital Audio & Video Workshop, produced annually by the Consumer Electronics Manufacturers Association (CEMA) and co-sponsored by the IEEE Consumer Electronics Society, has a new name and location.

First produced in 1988, the Workshop is now renamed the Digital Engineering Conference — the Consumer Electronics Future, and will be held in conjunction with the International Winter Consumer Electronics Show® (CES®) in Las Vegas, NV. For 1998, the Conference moves to January 12-14 at the Las Vegas Hilton.

Geared toward engineers and product development managers, attendees will gain powerful technical insight on trends, changes and advancements in digital audio, video, computer and access technologies, plus be able to enhance professional contacts and cross engineering disciplines.

The Conference opens with a discussion of digital television (DTV) and digital versatile disc (DVD) in a session chaired by David Naranjo of Panasonic and Mike Isnardi of Sarnoff Research Center. Designs must progress for all digital receivers while consumer standards for parts of the DTV product such as channel numbering are still being developed.

Attendees will hear a panel of experts give their opinions on "The DTV Challenge", as moderated by Electronic Engineering Times consumer electronics journalist Junko Yoshida.

Following the DTV and DVD discussions, IEEE Spectrum Magazine will lead a future-oriented discussion on the trends that are emerging from the changing nature of consumer electronics. New challenges abound such as copy management, high speed residential networks, increased capabilities of the Internet

Test Your Electronics Knowledge

Answers to the quiz *(from page 13)*

1. The output power is approximately twice the input power, or 10.4W. (See WDYKAE? in this issue.)

2. The output power is approximately one-half the input power, or 4.9W. (See WDYKAE? in this issue.)

3. 13.9. If you tried to calculate the gain using the equation:
$dB = 20\log(V_2/V_1)$,
you got the wrong answer. That equation only works if the input and output impedances are the same. Calculate the input and output powers using:
$P=V^2/R$.
Then use the equation:
$dB=10\log(P_2/P_1)$.

4. It is used for measuring RPM (revolutions per minute).

5. Voltage controlled oscillator.

6. See Figure 3. Note that horizontal and vertical lines are drawn against the curve. The number of times the curve touches the vertical line divided by the number of times it touches the horizontal line is equal to the horizontal frequency divided by the vertical frequency. In this case 3:2 = 450:f_V Therefore, $f_V=(450 \times 2)/3 = 300Hz$.

7. 1Ω. It is calculated the same way as four 4Ω resistors in parallel.

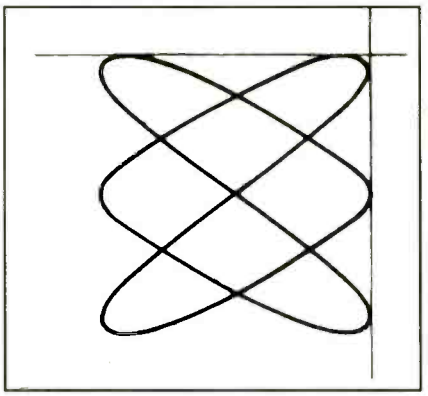
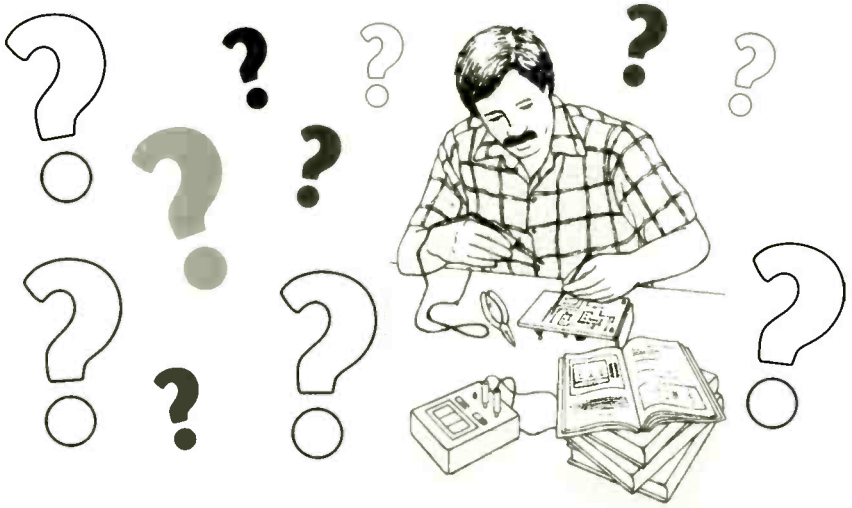


Figure 3. To solve TYEK question number six, draw horizontal and vertical lines against the curve as shown here. The number of times the curve touches the vertical line divided by the number of times it touches the horizontal line is equal to the horizontal frequency divided by the vertical frequency. In this case 3:2 = 450:fV. Therefore, fV = (450 x 2)/3 - 300Hz.

8. The correct answer is A. Partition noise occurs when a few of the charge carriers go (randomly) to the signal input electrode rather than the output electrode. That cannot happen in a MOSFET because the gate is insulated from the channel.

9. The answer is A. Gain and bandwidth are tradeoffs in an amplifier.

10. The answer is B. The voltage on the drain can be over 600V with respect to the source.



along with higher bandwidth. This session will focus on what's next in consumer electronics.

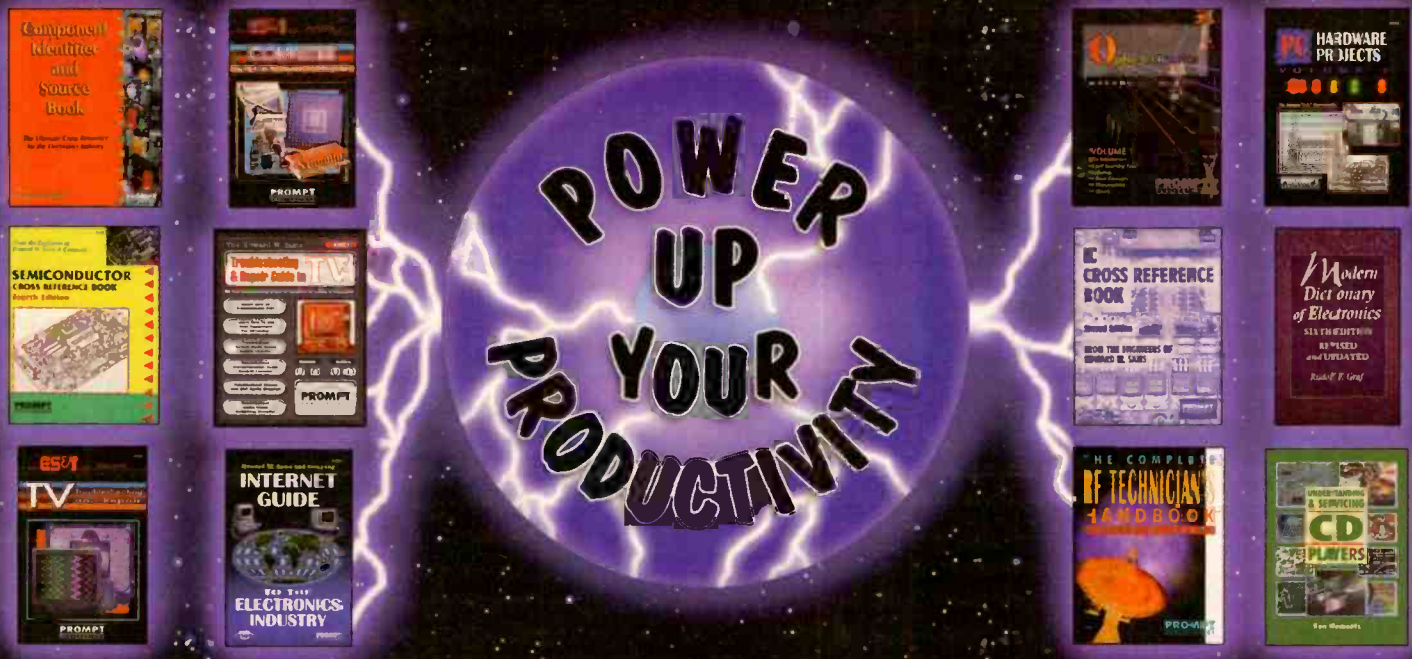
On January 13th, Steve Church of Telos Systems chairs a discussion regarding digital audio on the Internet. Industry experts will overview the technology today and where it is heading, and will describe systems used for netcasting along with the limitations of the Internet. Issues to be discussed include: bandwidth and compression challenges, TCP/IP protocol, RTP and RSVP protocols, netcasting, compression technologies, encoding systems, software coders, real-time coders, servers and client software. The latest in bit rate reduction compression (MPEG and others) will be considered in the context of applications such as digital radio and television broadcasting, computer audio and music distribution.

That afternoon John Mailhot of Lucent Technologies and Jeff Hamilton, formerly of General Instruments, will look at advances in provider technology. More than ever a good understanding of the providers' systems is needed by the manufacturers in order to offer consumers competitive products that will best optimize the data that is offered. Find out which services are commercially available, are being field tested and are in the prototype lab.

On the last day of the Conference, Galina Neumeier of Iterated Systems tackles the issue of computer convergence with digital audio and video. Recent product introductions such as the RCA/Compaq PC Theater and Web TV herald the long predicted convergence of computers with other consumer electronics. Although television receivers have incorporated DSP and computing capability for many years, these new products are the first in which both the computer and the TV function are readily available to the user either separately or in combination to form an entirely new device.

This session will focus on the new directions for such products, including presentations on interfaces, the relevance of standards and the impact of these kinds of products on new digital services. ■

ES&T Book Shop



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297802, for Sears Kenmore electric clothes dryer, Model 6508934. *Contact: 10443 Fairway Lane, Carmel, CA 93923, or call 408-620-1969 (days), 408-620-1940 (eve).*

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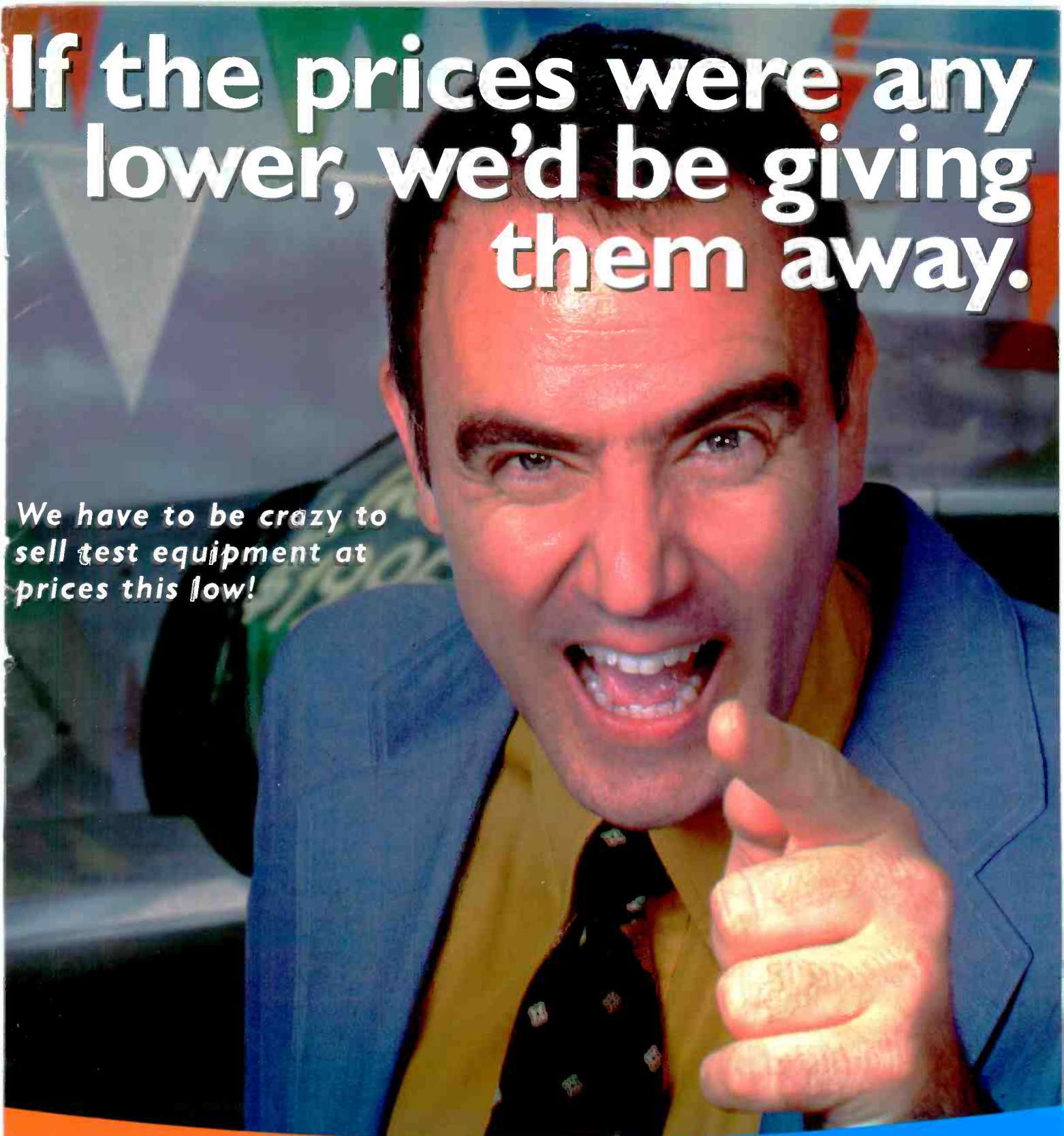

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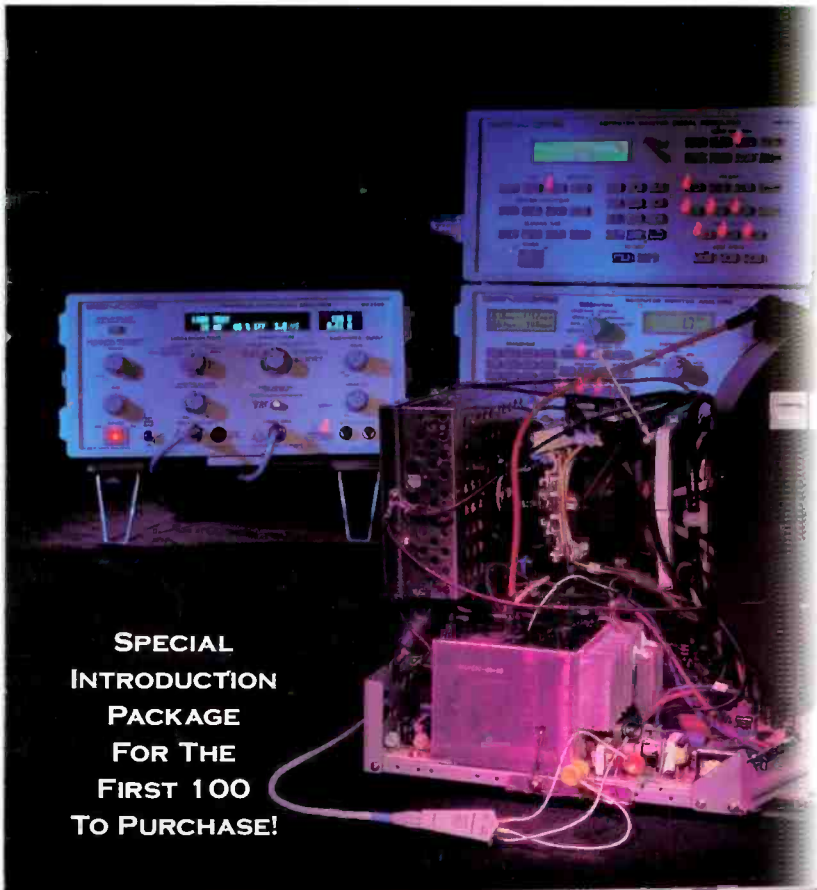

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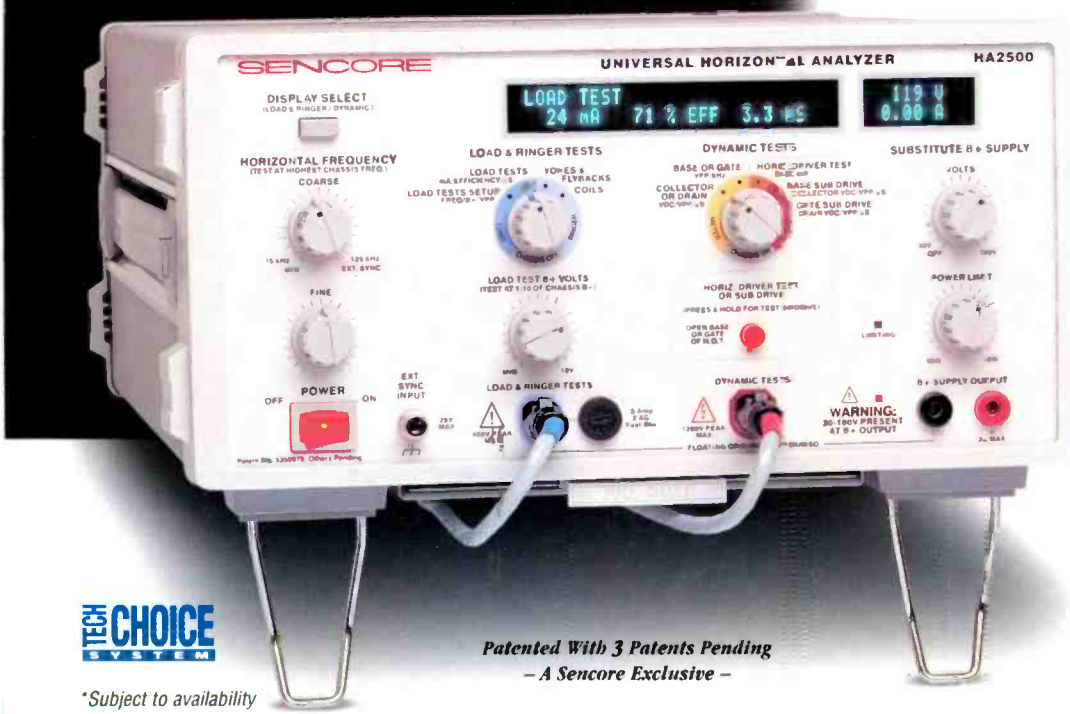

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