

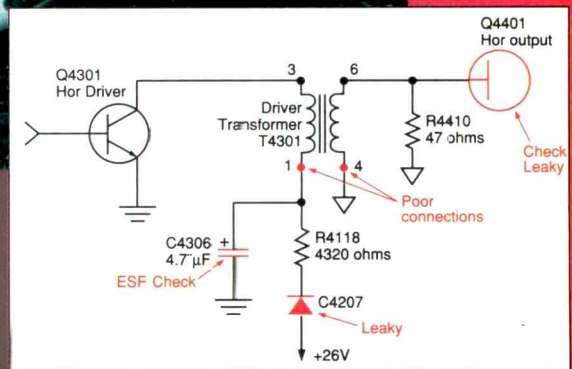
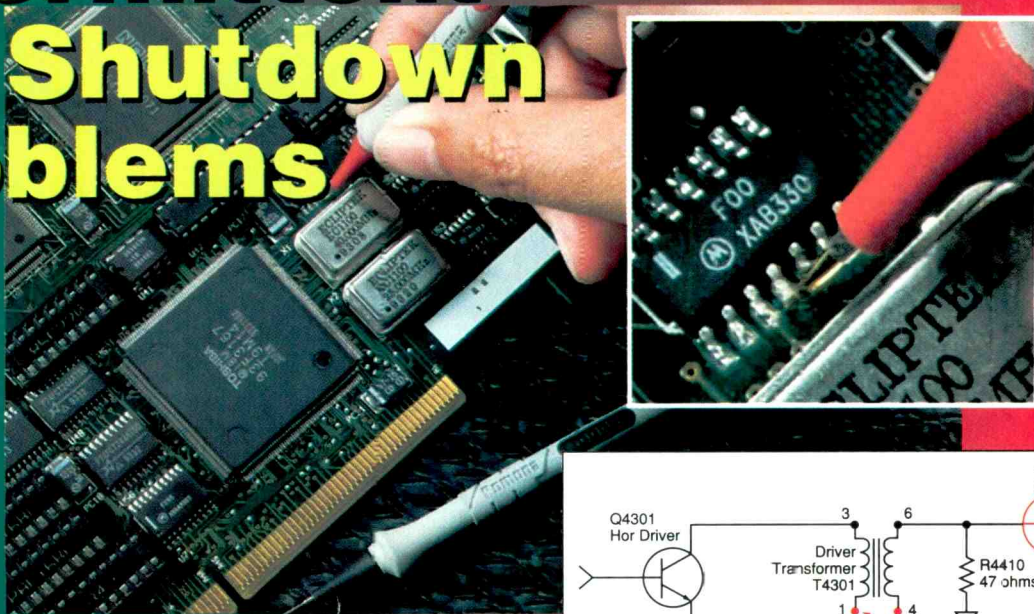
# ELECTRONIC<sup>TM</sup>

## Servicing & Technology

December 2000

### Test Equipment Showcase

# TROUBLESHOOTING TECHNIQUES: Intermittent TV Shutdown Problems



- **What's Inside Those HDTV Set-Top Boxes?**
- **Constant Voltage vs. Constant Impedance Sound Systems**
- **Consumer Electronics Show (CES) Preview**

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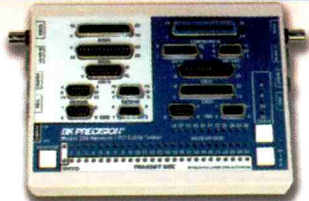
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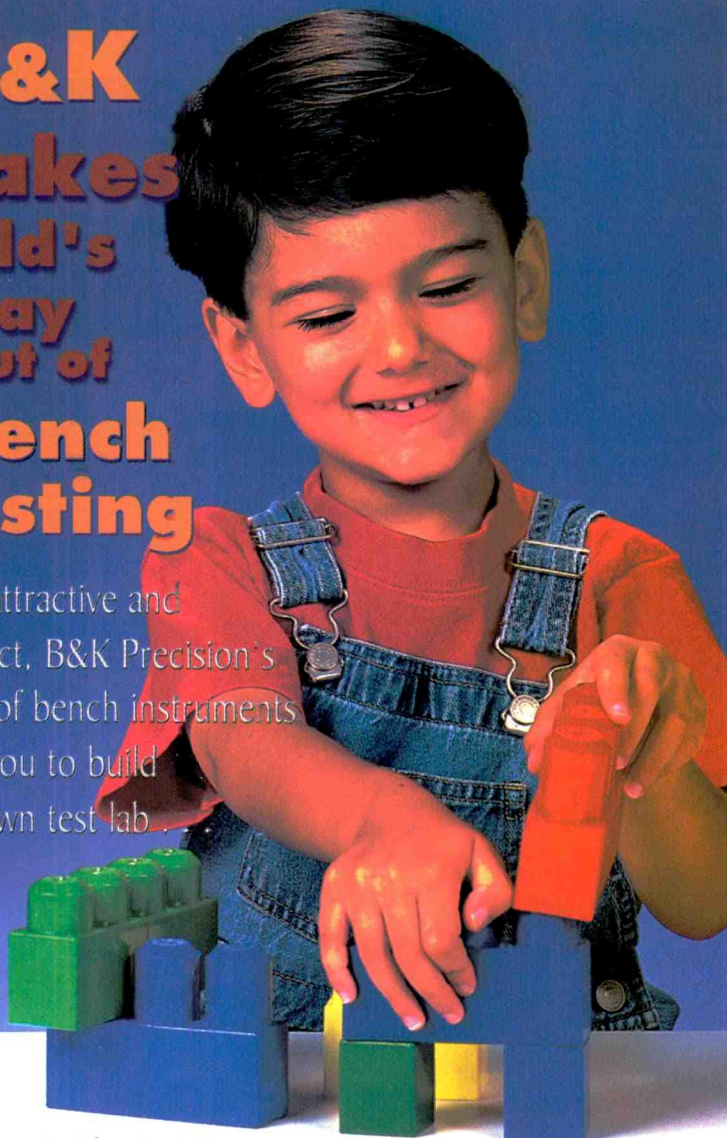
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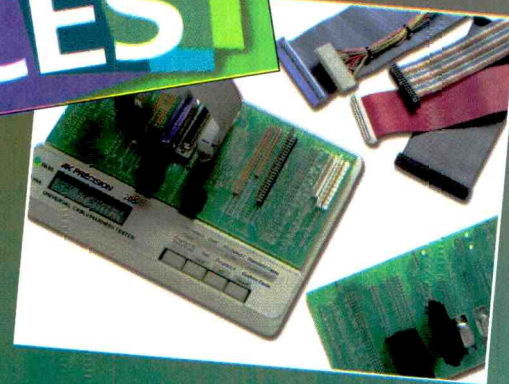
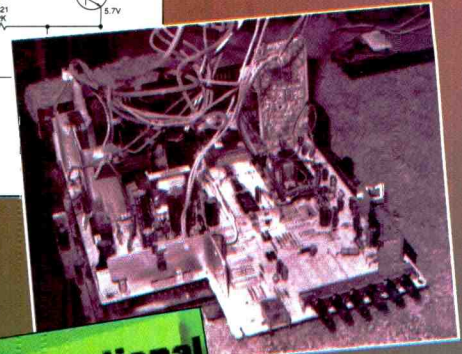
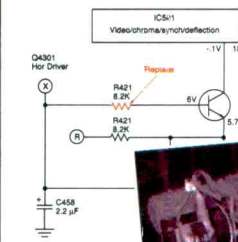
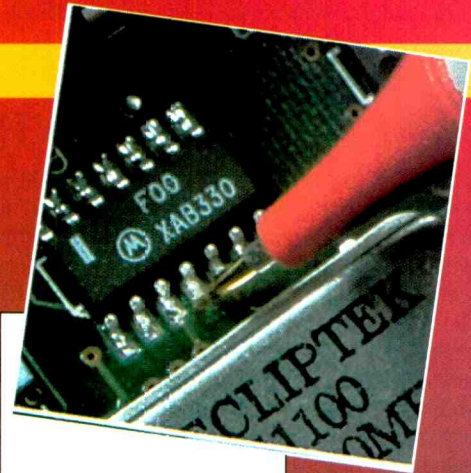
##### TEST EQUIPMENT SHOWCASE ...An Advertising Section **18**

Wherever there is a professional performing a diagnosis on a system that is malfunctioning, there is some type of test equipment being used. This advertising section provides vendors with an editorial opportunity to present their products, services and benefits to the professional servicer.

#### WHAT'S INSIDE THOSE HDTV SET-TOP

##### BOXES?...John A. Ross **33**

As digital TV continues to gain in popularity, many consumers have opted to purchase set-top boxes that provide tuning, MPEG audio and video decoding, data processing, filtering, digital-to-analog conversion and communications links. Here is a review of the compression scheme utilized and the circuitry used to tune and decode a HDTV signal.



Cover Photo Courtesy of Pomona Electronics.

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# Editorial

by Nils Conrad Persson

## WHAT'S IN A NAME?

In the Wall Street Journal of November 9, 2000, a technology column by Walter S. Mossberg, "Mossberg's Mailbox," in which the author answers questions from readers, this question was published: "What is the name of the class of set-top devices that record TV programs on hard drives for replay whenever the viewer wants."

The answer was interesting. "These products are new, so a universal name for their category hasn't emerged yet. Some call it 'Personal TV,' or PTV. Others call it DVR, for digital video recorder. Still others call it PVR, for personal video recorder."

Apparently the development of technology these days has been so incredibly rapid that our society doesn't get a chance to name one technology before another is introduced.

Moreover, and somewhat beside the point, so many new technologies seem to be emerging at one time: PTV, DVR, or PVR, home networking, wireless technology, global positioning systems, to name just a few, that there's less fanfare for some of the new technologies that come along. I remember when compact discs were introduced there was a great deal of hype and hoopla, and a great deal of interest among the technologically oriented public. The same with walkman type devices. This new class of recording device, I'll call it PTV, just seemed to show up in stores with little excitement.

But then, if you look at history, naming of new technology, has always presented problems. For example, when the automobile was first introduced, the early versions were called "horseless carriages." Actually, if you think about it, at that time that moniker probably fit. Some enterprising inventors had taken a gasoline (or electric, or steam) powered engine and fitted it to a carriage of the type that had been pulled by a horse, and made it go by itself, without the help of a horse.

Of course, the fact that the carriage could go by itself gave rise to the term automobile, meaning "self moving." Actually, that raises another point about our language: we often truncate terms so that what was once an adjective describing a noun is used as a noun to describe the concept. No doubt "automobile" was at one time used as an adjective, as in the term "automobile machine," or possible "automobile carriage," but then the noun was dropped and the device became known simply as the automobile.

Again to digress, we see the same thing at work on television hundreds of times a day now. When television was new and the program was interrupted for advertising, the announcer would intone, "we now interrupt this program for a commercial message." The word "commercial" was an adjective modifying the noun message. Nowadays we have completely eliminated the word "message," and "commercial" has become a noun with which we're perfectly comfortable.

History is rife with examples that show that coming up with an appropriate name for a product, concept, or technology is not a simple task, and sometimes engineers, and others have, in some cases, struggled to find a good name for a concept, and in other cases have been wonderfully inventive.

A good example of an interesting, although quite obscure, word coinage is the term "raster," which service technicians use every day. Care to venture a guess as to where that one came from? I'm not absolutely sure that I'm correct, but I'd give myself pretty good odds that the research that I did gave me the correct

derivation. Raster was probably derived from the Greek word "rastare," which means "rake." The idea is that if you could expand the picture on a TV screen you would see the lines formed by the electron beam as it sweeps across the face of the picture tube: lines that resemble the lines left by a rake as it is swept across the ground.

Here are a couple of other interesting coinages from the world of electrical engineering. In some technology that escapes me now, there's a waveform that consists of a brief vertical rise, followed by a somewhat longer horizontal segment, then the waveform rises in a curve that starts out steep and becomes less steep, then the waveform abruptly falls vertically to the point at which it started, and then this process repeats. Some clever engineer noticed that this waveform resembled the shape of one of those old fashioned cash registers (it probably wasn't old fashioned at the time) looked at from the side. The waveform became known as a "cash register" waveform.

In another technology, this time digital, a device was developed that consists of a number of regions that can store a charge. The information is stored into the device by introducing it to one of these regions, whereupon the charge is passed from region to region until it reaches the region where it is to be stored. What would you call such a device? Some clever character gave it the name "bucket brigade" device because the passing of the charge from region to region resembles the old idea of a line of people passing buckets full of water from the source of water to be poured onto, say, a burn-

ing house, to put the fire out.

Some terms are coined by a manufacturer, or an alliance of manufacturers. Sometimes they sound odd, or don't really convey the idea of what the product does, but then the ear of society adapts to accept the term and grasp its meaning. One of my favorites along those lines is "Walkman." The only thing about that name that conveys the concept of the product is the idea that a person (man) can walk with it. But that unfortunate term has found our way into our collective consciousness, and it's a perfectly adequate term, even being used to describe a whole class of devices.

Fortunately, the English language, in which so many of these terms are coined is a living, growing, flexible language. Even if many of the terms we use to describe technology are imperfect, or a long time in coming, we usually wind up with a term that fits somehow. There is a story that once the newspaper published at the Vatican, which is printed in Latin, referred to a motorcycle. Because there is no Latin word for motor (the language became dead before the concept was introduced) the best term the writer or editors could come up with was something like "two-wheeled chariot propelled by firewater."

No doubt one day soon, the companies that make the PTV, DVR, or PVR will come up with at least an adequate name for their class of products, and even if it isn't perfect, we'll eventually accept it as part of the language. Considering the rate at which technology is advancing, however, by that time we'll have a good handful of products that no one has a name for.

*Conrad Persson*



# ELECTRONIC

Servicing & Technology

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

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# News

## CEA Urges FCC to Spur Competitive Retail Market for Set-top Boxes

If the Federal Communications Commission (FCC) is serious about developing a robust commercial market for digital cable set-top navigation devices, the agency must immediately revise its rules and the market incentives available to cable operators, argued the Consumer Electronics Association (CEA) in comments filed earlier this week with the FCC. The comments were filed in response to the Commission's Further Notice of Proposed Rulemaking regarding the commercial availability of navigation devices (CS Docket No. 97-80).

In its filing, CEA argued that the current navigation devices rules have not fostered the intended development of a competitive commercial market in set-top navigation devices so that consumers can obtain these products from multiple sources. CEA noted that this goal is mandated by Section 629 of the Communications Act of 1934, as amended. CEA pointed its finger squarely at the cable industry for dragging its feet in providing the essential information and standards that would allow manufacturers to develop and market devices competitive with those provided by cable companies.

"Given the lack of technical specifications for a wide variety of services that are needed to support competition in the provision of navigation devices from independent manufacturers, CEA is convinced that the cable industry seems to have determined it has no responsibility to achieve a commercial market for navigation devices," said CEA. "The FCC improperly entrusted the cable industry with the responsibility to adopt standards that would facilitate competition and consumer choice. This responsibility is not being met. The ultimate loser here is the American consumer." CEA did note that the cable industry has made point-of-deployment modules available and has proceeded with the OpenCable process, allowing for the development of competitive devices, but added that the industry has pursued proprietary solutions for the delivery of digital cable services with much more "vigor and focus."

"The result," wrote CEA, "is that the deployment of proprietary, non-OpenCable

complaint set-top boxes has been accelerated, threatening to foreclose the market for navigation devices before any independently-supplied devices can be designed or manufactured." CEA urged the FCC to take three steps to spur the retail market for digital set-top devices. First, the Commission must take immediate action to open and expand the standards-setting process for navigation devices and make sure that the process produces meaningful results on a timely basis. As part of this effort, cable operators should disclose technical information for all new cable services so that all commercially available devices will be able to interoperate with these services. Second, the FCC should move up the date to end the distribution of devices with embedded security from 2005 to January 1, 2002. And third, the Commission must require the cable industry to remove the major barriers to the development of that commercial market—such as unfair and unreasonable licensing requirements— as soon as possible. "In order to ensure commercial availability of the full panoply of navigation devices," CEA said in conclusion, "the Commission should consider adopting rules, consistent with our suggestions, that will compel the cable industry to remove barriers to achieving a retail market."

## New High-Tech Career Training is Launched in Chicago

The Consortium for Electronic Systems Technician Training announced today the launch of its Electronic Systems Technician (EST) training program at Coyne American Institute in Chicago, Illinois. Area businesses and individuals will profit from this new opportunity to become skilled in the electronic systems business.

The Consortium is pleased with the number of students that have enrolled in Coyne's first EST class, which is part of the Institute's Electrical Maintenance program. There are 30 students enrolled in the evening class and 20 in the day class.

The Electronic Systems Technician curriculum is in addition to their Electrical Maintenance training.

The electronic systems industry is a sizable force with a bright future according to an employment survey which was conducted by the Consortium for Electronic



Systems Technician Training in 1998. Not only did the industry employ 630,000, its workforce of some 180,000 Electronic Systems Technicians (ESTs) earned \$6.3 billion in wages and benefits from Consortium member companies. Continued growth and competitive compensation are forecast through 2002.

"The need for Electronic Systems Technicians is incredible and the opportunity outstanding," said Richard Goldman, President of The Consortium for EST Training. "It's the career for those who want to use their brains but not be stuck behind a desk or workbench all day. You get to use cutting-edge technology and work in many different settings."

Other schools teaching the EST curriculum are Montgomery College in Rockville, Maryland and Sir Sanford Fleming College in Peterborough, Ontario. The Consortium continues to look for schools to adopt the Electronic Systems Technician curriculum.

## **Zenith and PTS Electronics Announce Referral Program**

PTS Electronics, one of the nation's largest independent electronics service companies, has been selected by Zenith Electronics Corporation as a preferred vendor to provide approximately 2,000 different types of television modules to Zenith Authorized Service Centers (ASCs). Under the agreement, Zenith will refer its 3,500 ASCs to PTS for product support on older modules that are no longer supported directly by Zenith. "This relationship with PTS Electronics concludes an extensive search for a strategic partner to improve service support for our customers and products" said Dave Phipps, Director of Parts Operations for Zenith. "PTS maintains the largest inventory available with a 24- to 48-hour turnaround time."

Phipps said other factors Zenith considered include PTS's more than 30 years of experience, its history and leadership in serving manufacturer clients, and its reputation in the electronic service industry.

PTS services a wide range of electronic products and sub-assemblies, including television tuners, mainboards, HDTV chassis and telecommunication products, such as cell phones and automotive products. The company's corporate headquarters are located in Bloomington, Ind., and has facilities in Tustin, Calif, and Arvada, Colo.

Zenith's Parts & Service operations are based in Huntsville, Ala. Zenith is a wholly owned subsidiary of LG Electronics.

## **Electronic Systems Driving Tomorrow's Automotive Technology**

Electronic innovations will shape the automotive industry in the coming decade, according to comments made in October at the Blue Ribbon Panel at Convergence 2000.

Donald L. Runkle, executive vice president and president, Dynamics & Propulsion Sector of Delphi Automotive Systems, joined four industry experts and moderator, William Powers, vice president of research for Ford Motor Company, to answer key questions about the future of automotive electronics.

Speaking specifically on electronics, Runkle told the panel: "I think we are in for a very exciting decade as we knock on the door of unlimited computing power, unlimited memory and unlimited bandwidth. By 2010, I expect advancements in elec-

tronics to propel the auto industry toward solving many of its remaining problems."

Runkle emphasized six major electronic/electrical changes on the horizon for the next decade:

**Electronic Cocoon** - This is a broad Delphi innovation where sensors and computers will be constantly on guard for things like rear-end and frontal collisions, broadside collisions and vehicle stability. "With the right kind of focus and developments, I think we can imagine cars that don't have accidents," Runkle said.

**Vehicle Stability Control** - Products such as Delphi's TRAXXAR™ and Brake-By-Wire Systems, provide major improvements in braking, handling, and overall vehicle stability. "I know the concept of accident-free driving will strike fear in the hearts of many, including airbag producers and some 'legal eagles,' but we can't stop progress," Runkle said.

**Electrical Intense Powertrains** - The challenges of providing both cleaner and more efficient vehicles are now met simultaneously. According to Runkle, since the practical application of electricity more than one hundred years ago, there has been a trend to replace mechanical and hydraulic devices with electrically driven motors and actuators. This has been true in virtually every mechanical system, including the automobile. This trend will continue what Runkle calls "electrical intense powertrains."

**Total Vehicle Energy Management** - "Future electrical systems will need to be thought of in the context of energy management systems," Runkle said. "One can see the day when engine control may be a subset of the energy management system." Load management and peak level shaving will be standard features to minimize system cost and optimize vehicle efficiency.

**Mobile Multimedia** - Consumers continue to demand more from their vehicles in their average 80-minute-per-day drive time. Delphi will meet that demand with the Communiport Mobile Multimedia System. "The information and entertainment features will relieve the tedium of the long commute," Runkle said.

**14/42-Volt Electrical Architecture** - According to Runkle, 42 volt will become an expected standard for most automakers in the future because consumers will demand more from their vehicles. "If we want to apply high power electrical loads such as valve train, then 42-volt makes sense," he said.

Members of the Convergence 2000 Blue Ribbon Panel, moderated by Ford's William Powers, were: Runkle, Francois Castaing of Castaing and Associates, Hans Gustavsson of Volvo Car Corporation, Norio Omori of DENSO Corporation and Franz Wressnigg of Siemens Automotive Corporation. More information on the Blue Ribbon Panel can be found at [www.convergence2000.org](http://www.convergence2000.org).

## **FCC Takes Steps to Allocate Additional Spectrum for New Wireless Services**

(This is an unofficial announcement of Commission action. Release of the full text of a Commission order constitutes official action.)

The Federal Communications Commission adopted a Notice of Proposed Rulemaking (Notice) that proposes to reallocate 27 megahertz of spectrum transferred from Federal Government use for non-Government services. The Notice proposes reallo-



cation of a number of small spectrum blocks transferred pursuant to the Omnibus Budget Reconciliation Act of 1993 and the Balanced Budget Act of 1997. These actions and proposals will benefit consumers by permitting and encouraging the introduction of new wireless technologies.

Specifically, the FCC proposes to allocate 27 megahertz of spectrum from the 216-220 MHz, 1390-1395 MHz, 1427-1429 MHz, 1429-1432 MHz, 1432-1435 MHz, 1670-1675 MHz, and 2385-2390 MHz bands transferred from Government to non-Government use. The transfer of these bands to non-Government use should enable the development of new technologies and services, provide additional spectrum relief for congested private land mobile frequencies, and fulfill the FCC's obligation as mandated by Congress to assign this spectrum for non-Government use.

The Notice also requests comment on procedures for the reimbursement of relocation costs incurred by incumbent Federal Government users as mandated by the National Defense Authorization Act of 1999. As with all matters involving spectrum allocated to government use, this proceeding has been the subject to coordination with the National Telecommunications and Information Administration of the U.S. Department of Commerce. This proceeding continues the implementation of the FCC's recent Spectrum Policy Statement, which, among other things, identified a preliminary allocation plan for this spectrum, and articulated a number of goals for efficient spectrum management. The Commission has received several suggestions for use of this spectrum including: (1) pairing some of the bands and assigning licenses to band managers through competitive bidding, while proposing traditional site-licensed approaches in other bands for use by industrial and public safety operations; (2) using a portion of this spectrum for satellite feeder links; (3) using a portion of this spectrum for utility telemetry to support automated meter reading; and (4) requests have also been made for using a portion of this spectrum for personal location services. This Notice examines these recommendations and identifies several other options for making use of these bands to provide valuable services to the public.

## **HAVi Network Architecture Status**

HAVi (Home Audio/Video interoperability entertainment) was founded by eight leading Consumer Electronics companies that jointly developed specifications for a home entertainment network, providing plug and enjoy convenience and interoperability to connected digital home entertainment devices. The HAVi founding members have worked together in a cooperative project over more than two years to develop the present standard. They are: Grundig AG, Hitachi, Ltd., Matsushita Electric Industrial Co., Ltd. (Panasonic), Royal Philips Electronics, Sharp Corp., Sony Corp., Thomson Multimedia and Toshiba Corp. A contribution has also been made to the specification by Victor Company of Japan, Ltd. (JVC) in co-operation with Matsushita.

HAVi is a multi-brand standard intended primarily for the networking of digital AV home entertainment products. Devices connected in a HAVi network can interoperate, which means that they can share each other's resources and functionality across the network. With a HAVi network, users are no longer faced

with the complex set-up and operation of many separate devices and remote controls. All they will have to do is enter the task they want to perform, and HAVi will do the rest. HAVi features easy 'plug-and-enjoy' functionality and uses an underlying IEEE 1394 digital interface (i.LINK™ or FireWire™).

Since the formation of the HAVi Organization in November 1999, more than thirty companies have become members. These companies include Digital Harmony Technologies, Hewlett Packard, Loewe, Kenwood, LG Electronics, Mitsubishi Electric, Pioneer, Samsung Electronics, Sanyo, Seiko Epson, Sun Microsystems, Tao Group, QNX Software Systems, Vivid Logic, Wind River Systems, Yaskawa Information Systems. Numerous other companies and organizations also have expressed their support for HAVi, or their intention to become a member.

The joint licensing process, enabling interested companies to develop products compliant with the HAVi home network architecture, has started. Licenses cover the use of the HAVi logo as well as patents defined by the HAVi specification, which are required for the production of compliant hardware and/or software products. Considerable interest is being shown in acquiring HAVi licenses by companies in a variety of industries, including consumer electronics, PCs, software, cable distribution and semiconductors.

The mission of the HAVi Organization is to promote the adoption of the HAVi architecture for consumer AV devices (digital TVs, set top boxes, etc.) and peripherals and to encourage the development of software applications and services to bring new convenience, flexibility and personalization to consumers. The Organization has also expressed interest in developing interconnecting "bridges" with other home networking standards such as Jini and Universal Plug and Play (UPnP).

The HAVi Organization held the first of its Fast Track Technical Seminars on April 20 in San Jose, California and July 28 in Tokyo. Similar technical seminars – focused on application development – will be offered for member companies only in US, Europe and Japan in the next few months.

The key characteristic of a HAVi network is that connected devices will be able to share each other's resources and functionality across the network. All HAVi-compliant devices will automatically declare the functionality they have available, and will make that functionality accessible to other devices over the network.

Users will no longer be faced with the complexity of setting-up and operating many separate devices and remote controls. All they will have to do is enter the task they want to perform, and HAVi will do the rest. That means they will no longer need to worry about where that function is located, and input commands to several different devices.

An important benefit of HAVi is that it is a multi-brand standard. This means that HAVi-compliant devices, regardless of brand, can be connected to a home network and will offer all the HAVi benefits together with the other connected equipment. A further benefit is the creation of an open and future-proof concept. New, compliant devices can be added to a system at a later time, which protects the user's initial investment in equipment.

Further information about HAVi can be obtained from the Organization's website: [www.havi.org](http://www.havi.org).



# Troubleshooting Techniques

## Intermittent TV Shutdown Problems

by Homer L. Davidson

When a television set is in shutdown it is difficult enough to locate the defective component. When the shutdown problem is intermittent, or the set is cycling off and on, the problem becomes even more difficult to correct. In most cases, intermittent TV shutdown conditions are caused by problems in the horizontal, low voltage power supply or system control circuits. When a set is experiencing an intermittent shutdown symptom, it might not turn on for several minutes, or it might stay on for only a few seconds and then shut down. It might cycle off and on, or it might pulse off and on and then go into complete shutdown (Figure 1).

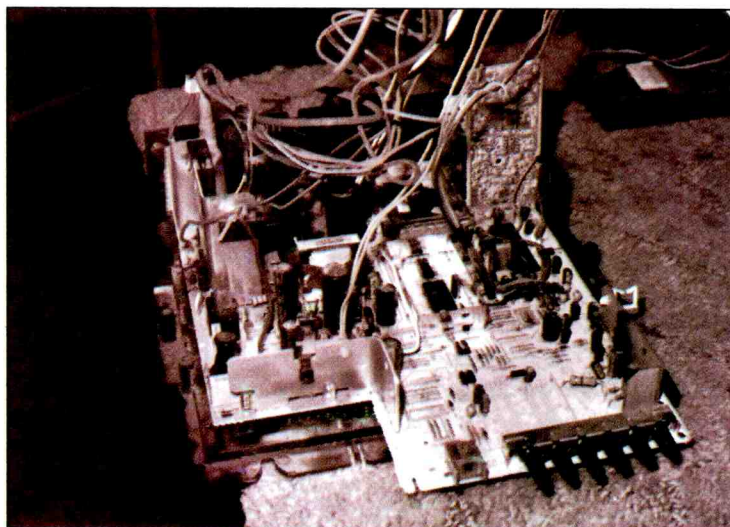
See Table 1 for a list of useful troubleshooting steps to follow when the problem is intermittent shutdown problems in a modern TV set.

One useful troubleshooting procedure in the case of a set that is in shutdown is to use a variac to lower the ac power line voltage to the set. This can make the chassis run, if only for a second or two. By observing the screen and noticing if the raster has improper width, insufficient vertical sweep or lines in the raster before shutdown, you may be able to get a clue as to what circuit caused the shutdown problem.

Sometimes by interpreting the condition of the TV screen, you can determine what section is breaking down. For instance, if only a white horizontal line is seen before shutdown, you can assume the defective component is in the vertical section, causing the shutdown. Go directly to this section to locate the intermittent component.

You might be able to induce the intermittent problem, while monitoring the horizontal drive signal to the output transistor with the oscilloscope, by raising or lowering the ac line voltage

with a variac or variable isolation transformer, thus gaining useful troubleshooting information. In addition to using the scope, monitor the various voltage sources while varying the ac voltage. In some cases, by applying coolant or heat on transistors, IC's, micro-processors and capacitors, you might be able to cause the intermittent breakdown problem to act up.



**Figure 1.** Intermittent shutdown symptoms are usually caused by defective components in the low voltage power supply and horizontal circuits of the RCA TC187 chassis.

Table 1

### TROUBLESHOOTING TECHNIQUES FOR INTERMITTENT SHUTDOWN PROBLEMS

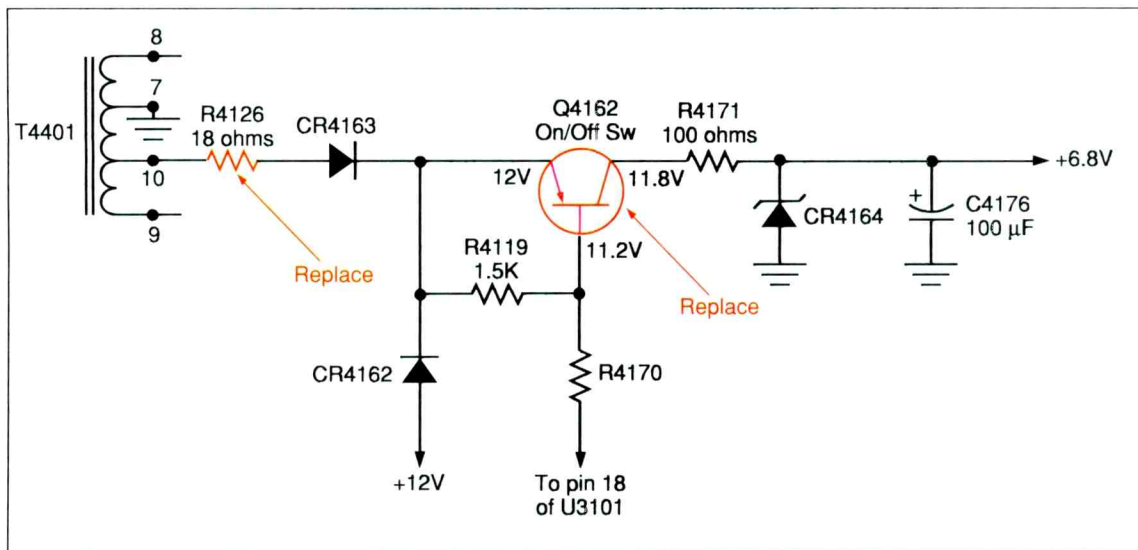
- Start set at reduced line voltage
- Interpret display screen appearance to determine section where faulty component is
- Induce fault by raising/lowering line voltage using a variable transformer
- Use coolant spray/heat to isolate faulty component
- Monitor power supply sources during intermittent
- Check for bad solder joints
- Check ESR of suspect electrolytic caps
- If shutdown is instantaneous on set turn on, check for defective flyback, leaky diodes, defective failsafe resistors, changes in resistance in failsafe circuits

### Power Supply Shutdown

The most common intermittent shutdown symptom is failure of a component in the low voltage power supply or the horizontal circuits. By checking and monitoring the different power supply sources, you can quickly determine if the intermittent component is in the power supply circuits. If the monitored voltage sources are normal during the intermittent shutdown symptom, the defective component might be located in the horizontal or other TV circuits. If the voltage level that you're monitoring changes significantly during the time the intermittent failure occurs, you can assume that the defective component is in the circuits that generate that voltage source.

Intermittent shutdown symptoms may be caused by a defective part in the power supply, such as intermittent transistors, IC's, silicon diodes, or a change in resistance of low ohm resistors.





**Figure 2.** Intermittent shutdown in this RCA CTC167 chassis was caused by R4120 (18ohms) and Q4162.

### An Intermittent RCA CTC167

The complaint on one RCA CTC167 chassis was that it might stay on for a few minutes, then it would lose horizontal sync and then shut down. Monitoring the different voltage sources revealed that the 6.8V source would drop to a few volts during the intermittent failure, and then return again when the set resumed operation (Figure 2).

Diodes CR4163, CR4162, CR4164 and transistor Q4162 in the 6.8V source were checked and tested normal. R4126 had increased in resistance (152ohms) and was replaced. Again the 6.8V source was measured during operation of the set. When the intermittent shutdown symptom occurred, this voltage again changed. A quick voltage test on the emitter terminal of transistor Q4162 indicated the 12V source had increased. No doubt this transistor (Q4162) had become open.

When the voltage test probe was applied to the collector terminal of the transistor, the chassis came alive and 6.9V was measured at C4176. Replacing Q4162 with a universal replacement solved the intermittent power supply shutdown problem.

### Runs at Lower AC Voltage

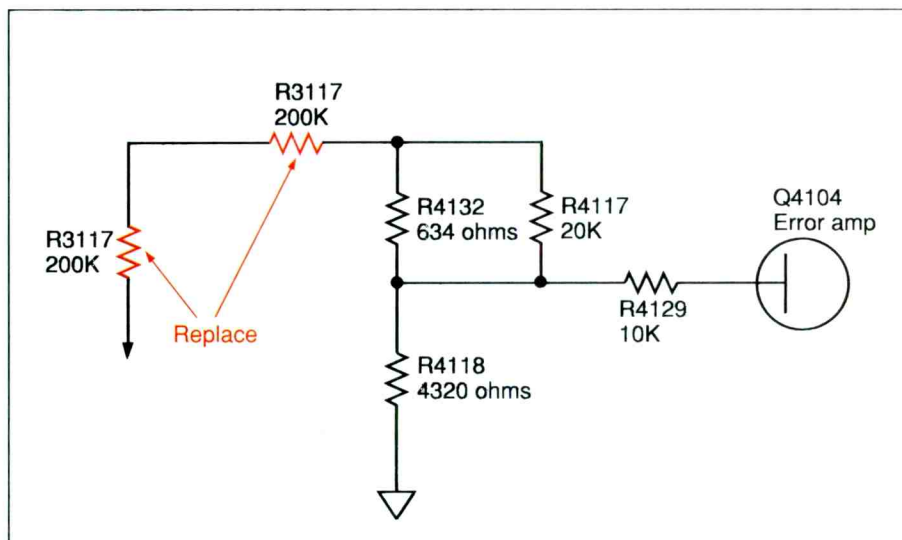
Sometimes the intermittent chassis will operate at a lower ac applied line voltage. To see if this is true of a set you're

servicing, simply lower the voltage using a variac or variable isolation transformer down around 90V. If the chassis operates at reduced voltage, suspect silicon diode breakdown, a bipolar transistor that is opening under load, zener diode shutdown or a change of resistance in the low voltage circuits. Sometimes more than one part may be defective.

The zener diode in the voltage regulator circuit might overheat and become leaky at normal power line voltage but will operate at a lower line voltage. In this case, the chassis will shut down at normal power line voltage but will show

age. The voltage at the base of the Error Amp (Q4104) in the low voltage circuits was 0V. At first, the Error Amp was suspected of being shorted or leaky, but it checked normal in the circuit. The voltage at the base of Q4104 comes from a +125V source, and is applied through R4175 and R4116 (Figure 3). We suspected that these resistors were opening when the normal voltage was applied to them. Replacement of both R4175 and R4116 (41.2Kohms) restored the set to normal operation.

In the same RCA CTC159 chassis, the TV would operate on and off, and then



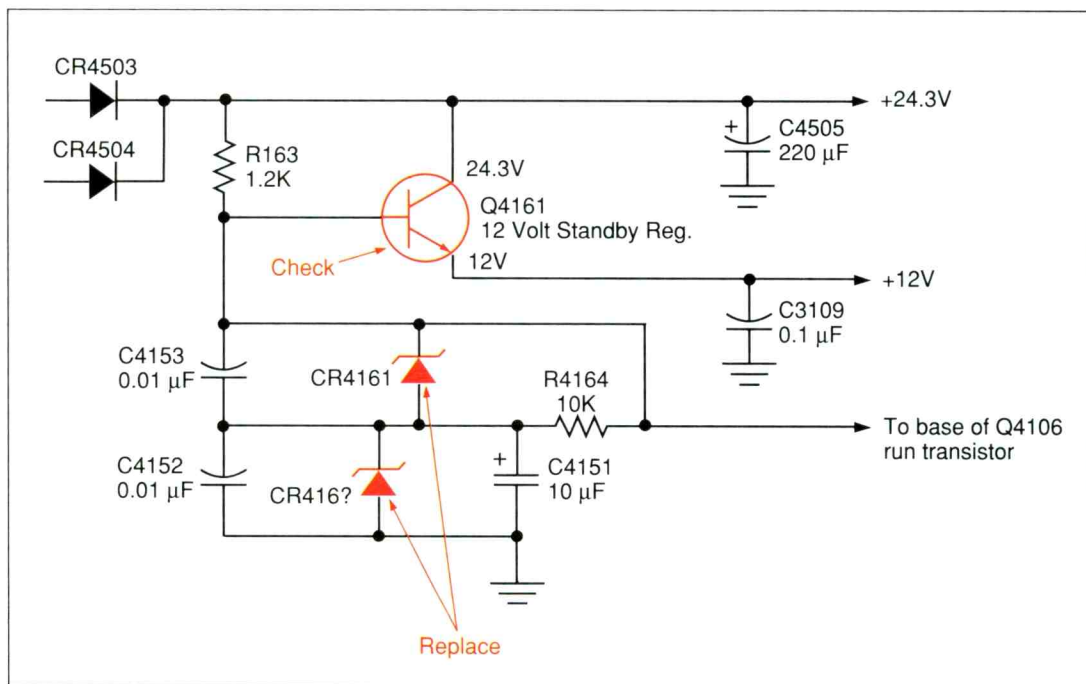
**Figure 3.** An RCA CTC159 chassis was shut down and was making a tick-tick noise. This failure was caused by bad resistors R4175 and R4116.

a picture with a reduced power line voltage. Likewise, a defective voltage regulator transistor might open up under load at regular line voltage and cause intermittent shut-down.

### An Intermittent RCA CTC159

The RCA CTC159 chassis came on, then went dead, making a tick-tick noise. The set would operate at a lower ac line voltage.





**Figure 4.** The cause of shutdown in this RCA CTC159 chassis was determined to be a leaky Q4161, 12V standby transistor, zener diodes CR4161 and CR4160.

shut down. Possible causes of a dead CTC159 chassis include an open F4001 (5 A) fuse, R4001 (27ohm/15W) resistor, defective SCR4101 regulator and a 33V zener diode (CR4101) in the 33V source. An intermittent squeal with shutdown may be caused by a leaky 6.2V zener diode in the Error Amp emitter circuit.

The on/off and shutdown symptom in this chassis was caused by defective zener diodes in the Standby 12V source. Sometimes the chassis would power up with the remote and at other times come up and shutdown. By monitoring the 12V standby source, the defective diodes were located in the 12V standby transistor regulator circuits.

CR4161 would go open and a horizontal squeal was heard, when the CTC159 chassis shut down. The shutdown symptom was created, when the 5.6V zener diode (CR4160) became leaky (Figure 4). Play it safe by replacing Q4164 (2SD2012) with part number 157627, CR4160 with part number (132616) with a universal NTE5071A, and CR4161 part number (176746) with a NTE5011A universal zener diode.

## Intermittent Horizontal Circuit Shutdown

The most common intermittent shutdown problems are caused by a defective component in the horizontal output transistor circuits. Intermittent shutdown can result from a leaky or shorted horizontal output transistor, low horizontal frequency, insufficient output drive voltage, poor driver transformer connections, defective sweep IC, or a defective flyback.

The intermittent shutdown in a CTC159 chassis occurred as a result of a deflection IC (U1001) and a leaky zener diode (CR4160). Because of the defective deflection IC, the horizontal output transformer would short intermittently. After CR4160 in the low voltage power supply was replaced, the voltage in the horizontal drive and output circuits

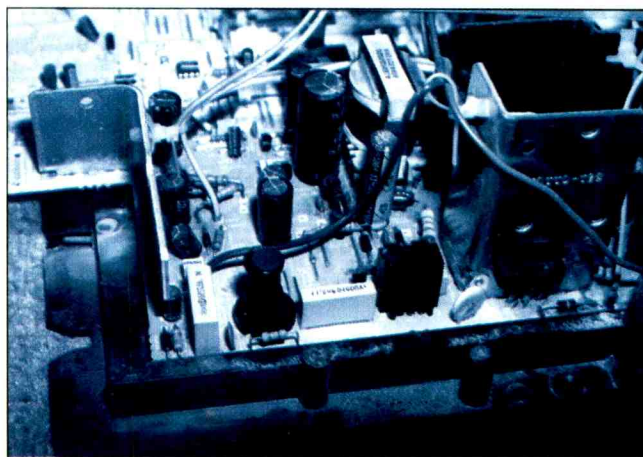
returned to normal.

Absence of drive voltage on the base terminal of the output driver transistor (Q4401) was caused by a deflection IC (U1001) (Figure 5). U1001 was replaced with the exact RCA replacement part number 150851, which restored the set to operation.

The most common intermittent shutdown symptom in one of these sets can be caused by poor soldered connections on the output driver transformer T4301. These poor contacts can cause many different output transistor problems. Intermittent or no drive voltage on the base terminal of the horizontal output transistor (Q4401) can

cause the transistor to run hot and become shorted between collector and emitter terminals.

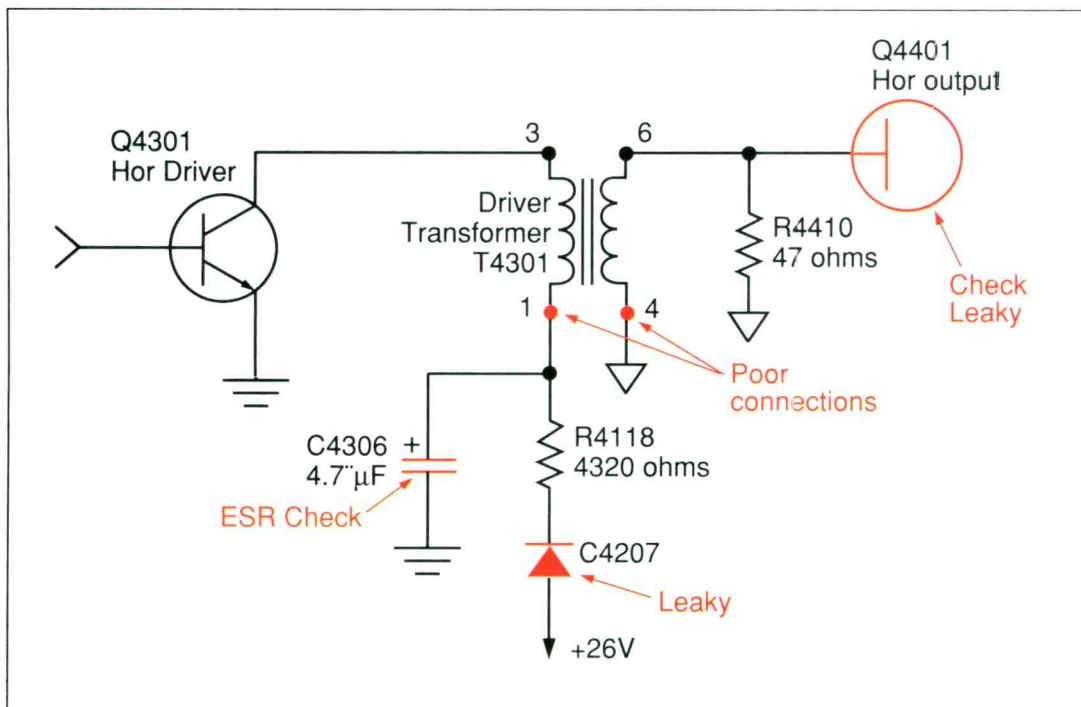
Also check for a change in resistance of R4305 (240 ohms) or poor soldered connections. Remove one end of R4305



**Figure 5.** Absence of drive voltage on output transistor (Q4401) was caused by a defective deflection IC (U1001).

for accurate resistance measurement. Check CR4707 for leaky or shorted conditions. Test C4306 (4.7uF) for ESR





**Figure 6.** A very common cause of a dead set and shutdown problems, or intermittent shutdown symptom is bad soldered joints of horizontal driver transformer (T4301).

problems with the ESR meter. If the ESR has become too low, it could cause the replacement output transistor to overheat, thus destroying it (Figure 6).

### Immediate Shutdown

If the TV turns on, then immediately

shuts down, most often the cause is a defective flyback, leaky diodes, fail safe resistors, or a change in resistance in the fail safe circuits. If you encounter a set that acts like this, monitor the high voltage to the horizontal output circuits and scope the horizontal output transistor. Try

to isolate the immediate shutdown symptom to either the horizontal output or power supply circuits.

Listen to see if the relay clicks, and check to see if voltage is applied to the input circuits of the power supply. You can quickly tell if the low voltage sources are functioning by monitoring the different voltage sources with the voltmeter or DMM. Suspect a silicon diode or regulator transistor in the secondary voltage sources of the flyback if the TV turns on and takes a little more time before shutdown.

Failure of the 12V source in the standby regulation circuits of a RCA CTC146 chassis was caused by zener diode CR3104. This zener diode is in the 12V standby of the voltage regulator transistor (Q3107), in the emitter circuit. Check CR3104 for leakage (Figure 7). Replace the 5.6V zener diode with a ECG5011A universal replacement. In another CTC146 chas-

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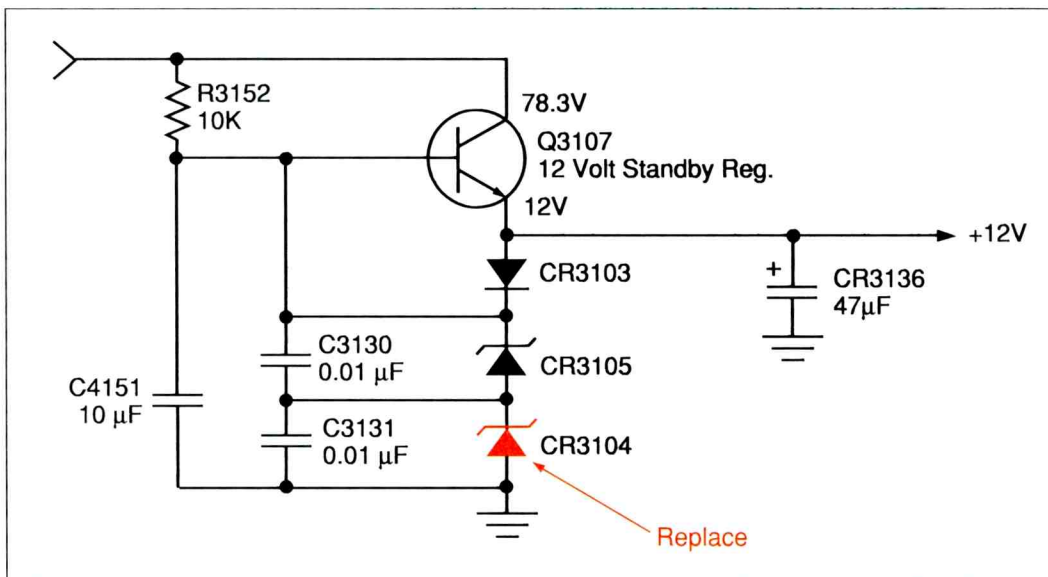
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**Figure 7.** Immediate shutdown was caused by CR3104 in an RCA CTC146 chassis.

change in resistance of a resistor to the base terminal of the holddown transistor (Q403). The holddown transistor in this set is located off of pin 18 of the Video/Chroma/Sync/ and deflection IC501. R422, a 100Kohm resistor had increased in resistance causing Q402 to shutdown the deflection IC501. Look outside the horizontal and low voltage power supply circuits for defective components in the high voltage shutdown circuits, when the horizontal and low voltage power supply circuits are normal (Figure 9).

sis, the TV turned on and then went into shutdown. Leaky CR4118, a silicon diode in the 12V source of the secondary winding of the flyback circuits was replaced.

### Set Cycles and Pulses Off and On

Go directly to the low voltage power supply circuits, when the chassis pulses off and on, then the set shuts down. Suspect that the resistors in the circuit of the 12V Run Regulator transistor have burned or otherwise changed value, that zener diodes in the On/Off Switching transistor circuits have become open circuited, or that resistors in the Saw Tooth Generator circuits of the RCA CTC159 chassis have become open. Check all diodes and transistors in the low voltage circuits with in-circuit tests of the DMM.

The pulsing off and on, then shutdown symptoms in a RCA CTC159 chassis was caused by an open 6.8V zener diode in the 6.8V source. The open zener diode can increase the output voltage of the Off/On switching transistor (Q4152) to over 12V, causing the chassis to cycle off and on. Suspect the On/Off switching transistor to become leaky, when pie crusting is found in the raster and the chassis immediately shuts down (Figure 8). Replacement of Q4152 and CR4164 with universal replacements restored

this set to operation.

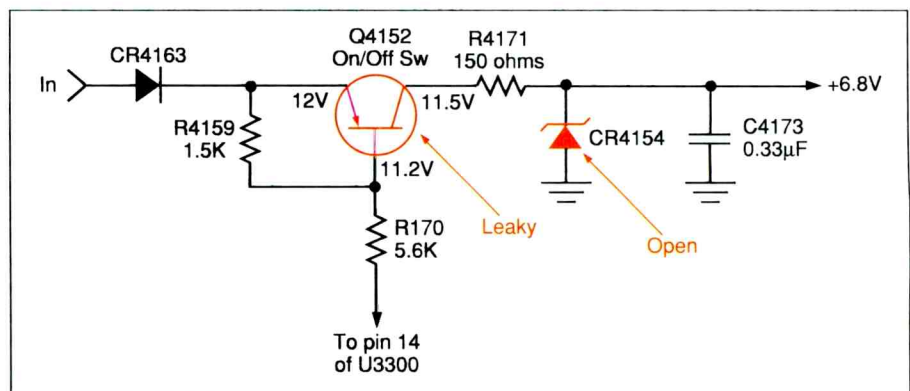
### Intermittent Hold Down Circuits

A defective component in the hold-down or fail-safe circuits can cause intermittent operation and chassis shutdown. Excessive high voltage can cause the chassis to shutdown, when the high voltage has reached a critical voltage setting. High voltage shutdown might be caused by improper adjustment of the B+ or low voltage source, or by a defective compo-

### Intermittent System Control Shutdown

Last but not least, if the power supply and horizontal circuits are okay, check out the main system control circuits. Some microprocessors have a shutdown circuit in the system control circuits. Test all diodes and resistors tied to the main control IC terminals. Take critical voltage measurements on each IC terminal.

Intermittent shutdown followed by a dead chassis was the symptom in a



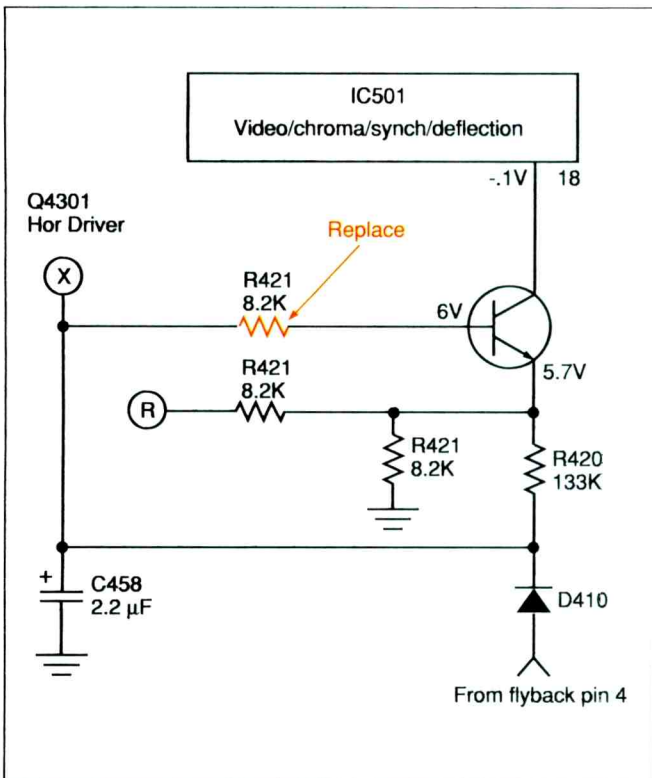
**Figure 8.** An RCA chassis that pulsed off and on was caused by open zener diode (CR4154) and (Q4152) on/off transistor.

nent in the hold down voltage circuits from the flyback. Scope the flyback waveform where it is tied to the input of the fail safe circuit.

Chassis shutdown occurred in a Samsung TC-2540S TV, caused by a

Samsung TC-2540S TV. D915 and D911 silicon diodes connected to terminals 13 and 23 of IC901 were checked and found to be leaky. If you encounter a similar problem, quickly check these diodes with in-circuit leakage tests with the diode test



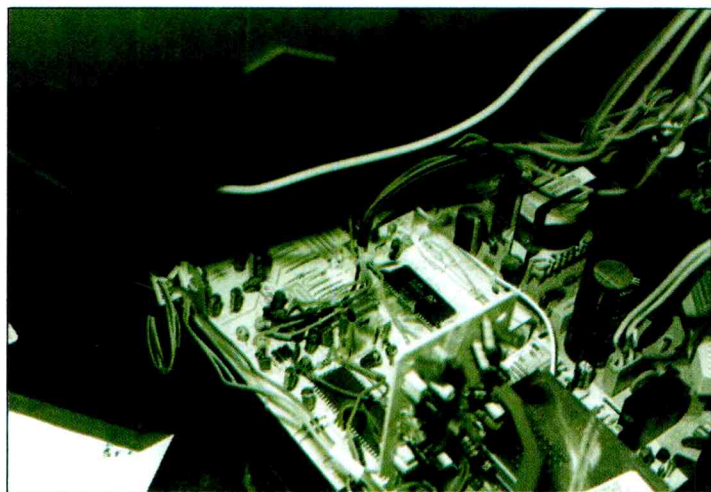


**Figure 9.** Intermittent chassis shutdown in a Samsung TC-2540S TV set can be caused by an increase in resistance of R422 (100K).

of the DMM. In rare cases, when one lead is disconnected, or when the diode is completely removed from the circuit for accurate out-of-circuit tests, the diode might test normal (Figure 10).

In an RCA CTC166 chassis, the chassis was intermittent and then went into shutdown. Since diode (CR4160) in the 12V standby power supply has been the culprit in sets exhibiting these same symptoms, we performed an in-circuit diode test on that component. In this case, however, the diode proved to be normal. The suspect diode, CR4160, was replaced nonetheless, but the symptom remained. All voltage sources and the horizontal circuits tested normal.

On checking the schematic, we noted that pin 16 on the Micro Control Processor IC (U3101) was labeled shutdown. A quick voltage test on terminal 16 indicated 0V instead of the 4.4V specified on the schematic. Since a 9V source was feeding the shutdown circuit, a voltage test on one side of R3117 was a little high, indicating the 9V source was present. Either U3101 was loading down the 9V source or R3118

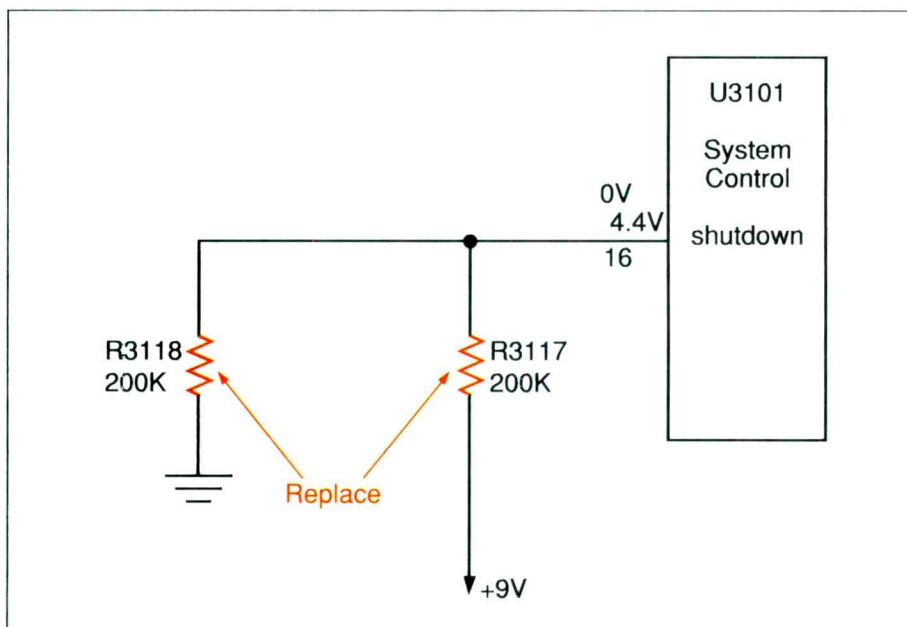


**Figure 10.** A defective system control microprocessor can cause shut-down problems in an RCA TV chassis.

and R3117 had changed resistance (Figure 11). Both 200K resistors were replaced as they had almost doubled in resistance. Replacing R3117 and R3118 solved the intermittent shutdown problem.

Although the defective components that cause most intermittent shutdown problems are located in the low voltage power supply and hori-

zontal circuits, do not overlook a bad tuner for the same symptoms. Poor grounds in the tuner section of RCA's CTC175, CTC177 and CTC187 chassis might cause intermittent or no vertical sweep, poor or no audio, intermittent snowy picture, shrinkage of raster, no tuner action, and can cause intermittent or no turn on or if on, the TV might shut-down. Of course, troubleshooting poor grounds and EEPROM symptoms in these RCA chassis, is another whole different ball game. ■



**Figure 11.** Do not overlook a change in resistance of R3117 and R3118 in the system control circuits of IC (U3101) when you're troubleshooting TV shutdown symptoms.



# Consumer Electronics Show (CES) Preview

by the ES&T Staff

The Consumer Electronics Show (CES) is slated for January 6 through January 9, 2001, in Las Vegas, NV. This annual event is a showcase for the latest in consumer electronics technology. It includes exhibits by manufacturers, conferences on technology, and seminars on the business aspects of consumer electronics. Following is a brief preview of what's on tap at CES.

## Technologies to Watch at CES

There will be a number of new or developing technologies that will be attracting the attention of attendees at CES. Here are a few that the CES people predict will be particularly interesting.

### Digital Radio

With the introduction of two new digital technologies in 2001, American consumers soon will have a multitude of digital audio choices available in their cars. Expect receivers for digital satellite radio and digital terrestrial radio to start trickling into the U.S. marketplace in 2001. And if the business plans of three companies come true, the analog radio sound that has been with us since Pittsburgh's KDKA was licensed in the 1920s will be just a fading, fizzing, popping dream.

But consumers cannot hear the crystal clear reception of local AM and FM radio and the varied content of national satellite radio with today's radios. Get set for the radio receiver market to heat up. The first generation of these receivers will debut at CES.

In the satellite arena, two companies obtained spectrum from the Federal Communications Commission (FCC) in 1997 to provide satellite digital audio radio service (SDARS). Sirius Satellite Radio and XM Satellite Radio expect to each beam 100 channels of digital music and talk formats from the stars by mid-year 2001 for coast to coast coverage. Meanwhile, iBiquity Digital is finalizing development on a technology that will allow earth bound stations the opportunity to go digital. The in-band, on-channel digital and analog signals on the same fre-



quency. Stations are expected to begin adding digital to their signals in 2001 pending the resolution of certain technological and regulatory hurdles

### Bluetooth

With immense support across disparate industries, Blue tooth is becoming one of the favored global wireless technology standards. While other wireless technology groups such as IDa and Home RF have fewer than 100 members each, the Bluetooth special interest group (SIG) is comprised of close to 1,400 companies. Seldom does anyone see such cooperation among competitors and across disparate industries. Today it's leadership Promoter Group has expanded beyond its initial founders; Ericsson, IBM, Intel, Nokia, and Toshiba to include 3com, Lucent Technologies, Microsoft, and Motorola. The SIG has become the leading force driving a rapid widespread acceptance of Bluetooth across a wide spectrum of telecommunications, computer hardware/software, automotive, military, medical and consumer electronics industries. The actual applications of Bluetooth enabled wireless technology signal a revolutionary global change in workstyles and lifestyles. It's at the core of the promise of a robust wireless internet., wireless electronic commerce devices, and 'gee whiz' devices yet to come. For further information on Bluetooth technology and its possible applications, check out Consumer Electronics Vision magazine's article by Susan Schreiner.

### Digital Imaging

If the old adage suggests a picture paints a thousand words, then the words evoked by the digital images being transmitted across computers today must number in the multi-billions, each personalized to the exact tenor and taste of their originator.

A new and powerful army of product suites are making their way into consumers' hands that empower users to capture, view, edit, save and send images in ways that were quite simply out of reach only a year or two ago. These digital cameras and camcorders, expanded editing software packages and other facilitating technologies are melding in a rainbow of applications, ranging from e-mailing photos of the kids to grandma to breathing new life into old home movies to creating and editing digital movies that can "screen" on a variety of formats.

According to the results of the Consumer Electronics Association's (CEA) "Digital Camera Owners Profile" survey, nearly 48 percent of owners claim the main reason for purchasing a digital camera was to post pictures to a website.

In addition to posting photos, digital camera owners also engage in a variety of other activities that enhance the sharing of experiences. Eighty percent of owners declared having e-mailed a photo taken with a digital camera, 82 percent have printed a photo, and 26 percent viewed a photo on their TV.

Ownership of a digital camera also correlates to an increase in photography. Fifty-eight percent of owners reported an increase in the total number of photos taken after the purchase of their digital camera. The typical owner takes approximately 37 pictures per month with their digital camera. Little difference was found to exist among gender, age or income segments when considering usage. CEA estimates that 2.7 million digital cameras will be sold in the United States this year, a 30 percent increase from 1999 sales.

### Home Networking

More people are equipping their houses



with a full range of networked systems that can control everything ranging from programming their alarm systems to setting up their heating and lighting to distributing television and Internet connections.

The home networking industry has come a long way since the first remote controls and timers came onto the market about twenty years ago, and the industry has grown in scope to reflect this coming of age.

Early home automatic systems aimed to simplify our lives by automatically taking care of the mundane aspects of running a home, like turning lights on and off or putting appliances on a schedule. Integrated home systems (IHS) sought to link independent systems and appliances so they could work together and be controlled from other sources, so arming the security systems could set back the thermostat for example. Home networking brings the power of distributed content to the home's automated and integrated systems. And the proliferation of digital technology in a multitude of devices promises to change the market even more dramatically. Just as the personal computer revolutionized the way we communicate, the home networking market could be the next phase of technology that changes how we live.

The Consumer Electronics Association (CEA) defines a home network as follows: a home network facilitates communication among the appliances, home systems, entertainment products and information devices in a home, so they can work cooperatively and share information. This allows user to get information about the home's condition and remotely control home systems and appliances, as well as provide access to information and entertainment resources outside the home. According to a CEA survey of 1000 consumers in April of this year, consumers share the industry's excitement about the future of networking digital products, as long as the information is immediately applicable to them. Entertainment content such as music and video are among the most popular types of content consumers would like to distributed around the house earning 59 and 47 percent respectively.

### **MP3 and Internet Audio**

Last year MP3 by storm. At the 2000 International CES, more than a dozen new MP3 players debuted. MP3 technology is going a new way to carry and receive free music off the Internet. MP3 technology is going to change the way music is sold and listened to forever. According to a Consumer Electronics Association (CEA) survey, 65 percent of multimedia PC households with Internet access have listened to a sound file from an Internet Web page and that number is growing daily. MP3 is an acronym for MPEG 3, which is itself an acronym for Motion Picture Expert Group-1., Audio Layer-3. MPEG defines digital video and audio data compression standards. Because they are open standards, nobody owns them, any they are available free or for a small fee. MP3 has become the commonly accepted term for downloading digital music files from the Internet. For example, MP3 can compress the size of a five-minute CD track from about 50 megabytes to five megabytes and download time to your computer's hard drive from about two hours to ten minutes.

CEA's Generation Y: Home Entertainment Market Overview found among the online segment of Gen Y (approximately 60 percent), 57 percent have played an MP3 music file. Although sound quality exceptions vary, the data suggests that the majority of Gen Y listening to the MP3 format rate its sound quality as comparable to a typical stereo. In addition, the study shows that Gen Y is moving away from the traditional stereo system for listening to music. Approximately 14 percent of respondents claimed to use their PC more than a traditional stereo for listening to music. Another one is four claimed to use both with approximately the same frequency; meaning that nearly 40 percent of Generation Y is using the PC as much or more than a stereo for listening to music.

### **Conferences and Sessions**

Following is a partial list of the sessions that will take place at CES. Potential attendees should be aware that attendance at some of these events comes at consid-

erable additional cost beyond the basic cost of attending the show.

### **Wireless Technology**

While CES' wireless conference track includes sessions designed to help attendees learn about the basics of wireless, the university for Mobility is the place to learn about the basics of wireless, why is it the "next big thing," and the realities of wireless voice and data capabilities today and into the near future. Business solutions examine how to stay ahead of the world in e-commerce with new strategies enhance consumer relationships, form online partnerships and market subscription services, as well as expert tips on showcasing convergence products, attracting the Generation Y consumer and selling digital products to analog customers.

### **GartnerGroup's Dataquest**

This conference track provides critical market data about technologies pegged as hot, emerging and on-track to grow: home networking, Internet appliances, broadband, Internet audio, mobile computing and more. This is a free conference track. Explains how content and the convergence of the entertainment, computer and communications industries are impacting the digital consumer marketplace.

### **Emerging Technologies**

In this conference track, attendees will hear what experts have to say about the relationship of content and services in the future, and how the latest platforms and user interfaces that will make using technology easier in the months and years ahead.

Highly advanced training sessions provide a valuable education in home networking, one of the fastest growing sectors of the consumer technology industry. This track features special sessions produced by CEDIA.

### **Home Entertainment**

This conference looks at where digital entertainment is today and how broadband delivery will affect the way music, video, voice, data and the Internet all find their ways into homes.





**Mobile**

This free conference track examines all aspects of automotive technology, including car navigation, vehicle security, on-board entertainment, as well as how to install, how to sell and how to build your business in the mobile electronics marketplace.

**Networking**

This conference track focuses on the business opportunities for retailers, manufacturers and service providers as more and more products can be connected together.

**Wireless**

In this conference track, attendees will find out the latest developments in wireless consumer products and take part in the new Wireless Retail Training Program. Retailers will get in-depth training on how to sell wireless products on the sales floor or online. ■

For more information on the Consumer Electronics Show:  
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 1:00pm-5:00pm NESDA STATE/LOCAL PRESIDENTS Skybox 212  
 5:00pm-6:00pm JOINT MEETING OF NESDA/ISCET Skybox 212

*BOARDS (Immediately Following Conclusion of IS CET Board and State Presidents Meeting)*

**THURSDAY, JAN. 11**

9:00am-4:00pm NESDA BOARD MEETS TO ASSIST COMMITTEES & RECEIVE REPORTS Skybox 206  
 4:00pm-5:00pm NESDA PROFESSIONAL SERVICES Skybox 206  
*ANNUAL BOARD OF DIRECTORS (NESDA Board Personnel)*

**FRIDAY, JAN. 12**

9:00am- NESDA BOARD OF DIRECTORS Skybox 206  
*CONCLUSION - GENERAL MEETING*

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# Constant Voltage vs. Constant Impedance Sound Systems

by Alvin G. Sydnor

The constant voltage distribution system is not new. It has been used widely by public utilities because of its inherent advantages for power distribution. Many years ago the audio field took its cue from the utilities and many in the field began to realize the many benefits CV offered in distributing audio signals throughout a large facility.

## The Constant Impedance Method

Many years ago output impedance matching in commercial sound system installations were using what was known as the "constant impedance method" which required the use of matching transformers. The constant impedance method was originally adopted because the direct voice-coil method was impractical, and the need for long lines, also because the need for a large number of loudspeakers to be connected within a system. The constant impedance method did provide a convenient means for connecting loudspeakers so that various speakers within the system could be operated at different power levels. This was especially useful when installing sound systems in large industrial and commercial facilities that had high noise levels as well as quiet areas.

When using the constant-impedance method the speaker lines were often referred to as "high-impedance lines" because they were usually connected to an amplifier providing a 250ohm or 500ohm output tap. This high-impedance line was connected to the individual loudspeaker voice coil through a line-matching transformer that had a secondary winding that matched the loudspeaker voice coil impedance. The primary winding of these line-matching transformers were connected by the installer to the proper primary impedance tap so as to control the amount of power that a particular loudspeaker would draw. Most line-matching transformers had four impedance taps, 4, 8, 250 and 500 ohms.

The constant-impedance method did work well in its day, but it had a number of very serious disadvantages. Among the

disadvantages were the complex and complicated computations that were required when installing a large sound system that required many loudspeakers. Another difficulty encountered was the need for large high-power amplifiers that frequently delivered in excess of 200V that was developed across the speaker lines. As you can imagine, this was a very serious matter due to the dangerous shock and fire hazards these voltages presented.

Another problem, as well as an inconvenience, was the situation in which a system had to be moved or enlarged it meant that it became necessary to re-adjust every transformer in the system. In some cases it was necessary to replace the transformers in order to provide the correct impedance. Today, the constant-impedance method is not being used, however you can still find these systems still in operation.

## The Constant Voltage Method

In order to correct the many disadvantages of the constant-impedance method, a system of impedance matching had to be developed. The new system became known as the "constant-voltage method" which has virtually superseded the constant-impedance method and is today a standard in most commercial sound system installations.

The constant-voltage system was developed by the Committee on Sound Systems of the Radio Electronic Television Manufacturers Association. In developing the constant-voltage system the committee complied with the recommendations of the Underwriters Laboratories, in regards to speaker line voltage selection for the rated output of the amplifier. The constant-voltage system, recommended by the committee was accepted and adopted by the industry and it hinges around a design voltage, rather than a design impedance. The European standard is 100V, while the American standard is 70.7V (often referred to as simply 70V). First, we must clarify what is meant by constant voltage. It does not mean that the speaker lines carry an audio voltage that is always 70V or 100V as the

case may be. During quiet signal spots, there is no voltage on the speaker line in the constant voltage system.

Today, most commercial sound system amplifiers provide a variety of output terminals thus providing versatility for the variety of applications. Most amplifiers today provide output impedance of 4ohm and 8ohm as well as 12.5V, 25V, 70V and 100V output taps. Most amplifiers provide 70V (actually 70.7V) and 25V taps at the multi-screw output terminal strip. It must be kept in mind that in the constant-voltage system the 12.5V the 70V, and the 25V volt or 100V nomenclatures represent the highest voltage the amplifier will develop and those voltages will appear only when the amplifier is operating at its full-rated power. The voltage will accordingly be less when the amplifier is operating at levels below the output as rated by the manufacturer.

What all this really means is that the available, or peak-signal voltage is regarded as a constant figure, at which value various currents, or wattages, may be drawn, for the determination of the relative power throughout the system. As an example, ten 5W speakers are connected to a 50W amplifier, correct matching will be achieved if the same "constant-voltage" design figure is used throughout the system. Thus, each speaker will receive one-tenth of the total power.

## Standards

Standardizing on the output voltage of an amplifier simplifies the computation of transformer taps required for varying sound levels of the loudspeakers. The line matching transformers for use in constant-voltage systems are available for operation with the two standard line voltages, 70V and 25V. The size of the transformer will depend on the power it is designed to handle. As a general rule, constant-voltage transformers have taps for matching loudspeakers with 4ohm, 8ohm, or 16ohm voice coils and they also have taps marked in watts. This makes it very convenient for the technician and installer to select the required transformer



wattage from the multi-wattage tap, thus providing the required sound level for each loudspeaker. The technician must take care to insure that the total power consumed by all loudspeakers in the system is equal to or less than the power output rating of the amplifier.

When dealing with large systems that require long transmission lines, the 70V tap is the choice because it reduces the power loss caused by using long transmission lines. Smaller systems that use shorter transmission lines are usually installed using the 25V line tap. A word of caution is necessary at this point, and that is that the general trend is to use the 25V tap because there are many local building codes that require the 70V transmission line be run in conduit or armored BX-type cables. You must always be aware of the local building code before starting an installation or upgrading any existing system.

In some cases constant-voltage transformers with taps marked in watts are not available, however, transformers designed for use in the constant-impedance system with taps marked in impedance can be used. In order to use a constant-impedance transformer you must first determine the wattage delivered by its marked impedance, for the 25V system the formula to use is  $Z = E / P$ . Here, Z equals the desired impedance tap, E is the voltage, and P is the power in watts. For the 70V system, the formula is:

$$Z = 625 / \text{desired power in watts.}$$

In constant-voltage sound systems, the amplifier is looked upon as a constant-voltage generator and the speaker feed lines are looked upon as a power lines. So it's no longer necessary to think in term of impedance. Instead, we will be thinking in terms of voltage and watts.

Assuming that the voltage across the line is 70V, it is now only necessary to determine the voltage level required at the voice coils of each speaker to consume a specified number of watts. If an 8ohm

speaker is to be driven at 12.5W, the voice coil signal should be 10V, since 10 is equal to the square root of impedance (8) times watts (12.5). This hook-up requires the use of a 7:1 voltage step-down transformer.

On occasion you will encounter transformers that may not have any taps but have a 7:1 turns ratio, or the transformer may have a tapped primary, or a tapped secondary, or it may be a tapped auto-

need for any changes or rewiring of the speakers. The fourth advantage is that after the system is installed and operational it may be necessary to make some individual loudspeakers louder or lower the volume on some which can be simply accomplished by changing the transformer tap on the loudspeaker so it will handle more or less power as required.

In the constant-voltage system, it is also possible to switch loudspeakers in and out of the system at will with no noticeable increase or decrease in volume of the remaining speakers. As pointed out earlier, this is not true in the constant-impedance system, because any change in the number of loudspeakers will affect the impedance match of the system.

### Horn-Loaded Systems

In horn-loaded systems, the low-frequency output of the horn is determined by the low-frequency cut-off characteristics of the horn. If frequencies below this theoretical cut-off point are fed to the driver (when dealing with horn type speakers the matching transformer is often referred to as a driver) the unit will find itself virtually unloaded for these below the cut-off-frequency point, and the diaphragm will have a tendency to rum wild and may suffer damage. One way of preventing such low-frequency over-load is to use either a capacitor in series with the driving unit, which will offer increasing reactance to the lower frequencies and prevent

them from being fed to the driver unit. Another alternate method is to shunt the voice coil with a choke coil that will bypass the very low frequencies around the voice coil. Essentially the secondary of the transformer in this unit bypasses the low-frequency energy from the voice coil and the diaphragm will not see an acoustic load, and thus providing over-load protection against excessive unused power.

**Figure 1**

### THE RELATIONSHIP OF SPEAKER VOLTAGE AND POWER CONSUMPTION

VOLTS*	Watts Consumed By Speaker		
	4-Ohm	8-Ohms	16-Ohms
1	0.25	0.125	0.063
2	1.0	0.5	0.25
3	2.25	.12	0.56
4	4.0	2.0	1.0
5	6.25	3.12	1.56
6	9.0	4.5	2.25
7	12.25	6.12	3.06
8	16	8	4.0
9	20	10	5.0
10	25	12.5	6.25
11	30	15	7.5
12	36	18	9.0
13		21	10.5
14		24	12
15		28	14
16		32	16
17			18
18			20
19			22
20			25
21			27
22			30

\*Voltage Across Speaker Voice Coil

transformer. To help in the proper selection, Figure 1 lists the relationship of speaker voltage and power consumption.

There are a number of obvious advantages in using the constant-voltage system over the constant-impedance system, first is the elimination of detailed mathematical calculations and the second is that when the system is expanded requiring additional power, higher power amplifiers can be substituted. Third, there is no



## Advantages of the 70.7V Constant-Voltage System

Often there is confusion as to how to set a constant-voltage amplifier when its full rated power is not being used. As an example, one may think its proper to turn down the gain of the amplifier which may be rated at 100W when only 35W is being drawn from it on the basis that the economy of amplifiers power will thereby be obtained, or that the speakers will be overdriven. Both of these propositions are incorrect. When you consider your home light and power system, if all your appliances were turned off, your wattmeter would stand still, but the line voltage would still remain at 120V.

The same analogy holds true in the constant-voltage system (audio 70.7V system) even though the gain control may be set to provide a maximum 70.7 output volts. If there is no load tied to the amplifier, then the amplifier will deliver no power, and take no power from the speaker line other than stand-by-power. The power it will take from the line, and the power it will deliver to the load will be completely dependent upon the actual load itself. As to the question of overdriving the speakers tied in the system, if the full power rating of the amplifier is not used, this is obviously impossible since it is the voltage that will overdrive a speaker that has a fixed impedance and not power; and since the voltage is maintained constant by the amplifier irrespective of load, then even a single speaker (set at 2.5W) may be put across a wide-open 100W system with complete safety. Turning down the gain of a constant-voltage amplifier will naturally reduce the power input to the speakers if one desires to do so, but that will be at the expense of upsetting the sound power distribution throughout the whole system.

If the system is set up after a legitimate sound survey has been made, and the power ratings of the individual speakers the system were set accordingly, there should be no reason to play with the gain controls of the amplifier. If variations are required in certain areas due to changes in ambient noise conditions, then these changes should be made by tapping at the transformer of the speaker located in that particular location to achieve the desired

sound output at that location without upsetting the rest of the installation.

We are now in a position to more fully understand the compound advantages of the 70.7V constant-voltage system over the constant-impedance system.

### Advantages in Six Areas

In addition to the obvious, it is important to point out six areas that offer advantages of the 70.7 constant-voltage system.

(1) In multi-speaker systems, impedance matching is completely eliminated. It is not necessary to arrange a network of speakers in any fancy series-parallel combinations to obtain the proper impedance match to a transformer. In the constant-voltage system, the impedance is meaningful only to the extent that it determines how much power will get into the speaker, and this is taken care of by the manufacturer of the transformer by fixing the wattage ratings on its terminals. This is accomplished by simply choosing the required power tap.

(2) Since the 70.7V line maintains a constant voltage irrespective of load, once an individual power adjustment on a speaker has been made, it continually receives the same amount of power even when other speakers are added or removed from the system. More constant and uniform coverage is the result of volume controls that have been re-adjusted.

(3) By being able to proportion individual speaker power to immediate local and specific needs without upsetting other local adjustments of the other components, more efficient utilization of available sound power is made

feasible.

(4) Maximum utilization of available audio power is made possible by the elimination of volume controls or attenuators which consume power to make a volume level change, in contrast to transformers which are essentially in this case non-power consuming devices.

(5) It becomes relatively easy to determine one's amplifier needs and to keep these needs to a minimum by simply counting up the actual speaker power requirements without the necessity of allowing for uncertain attenuation losses.

(6) More adequate overload protection is afforded each individual speaker transformer on the constant-voltage system. Should a transformer fail somewhere in a system, the speaker line voltage (70.7V) would still remain unaltered, so a transformer failure in one location does not start any chain reaction such as a rise in the 70.7V. ■



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# Accurate Testing Saves Time, Labor and Money

Wherever there's a professional performing a diagnosis on a system that's malfunctioning, there's some type of test equipment. Consider a physician trying to find out what's wrong with his patient. He uses a thermometer to check temperature, a sphygmomanometer to check blood pressure, a scale to measure the patient's weight. He takes a blood sample for a lab to perform a number of measurements including: blood gases, sugar level, cholesterol level, etc.

The mechanic working on a car might check engine compression, battery discharge capacity, resistances at a number of critical junctions and more.

The common link in these cases is that when there's a problem with any kind of complex mechanism, whether human, or human-made, a proper diagnosis requires the use of test equipment to record vital operational data.

The same, of course, is true of the consumer electronics service technician trying to perform a diagnosis on a TV, VCR, microwave oven, or other product. If the problem is at all complex, the technician may, in the course of his diagnosis, bring to bear an impressive array of test devices and accessories: DMM, oscilloscope, waveform analyzer, capacitor tester, variable transformer, bench power supply, or even more specialized equipment.

## The Test Equipment

Service centers have been forced to change and grow to keep up with changes in the test equipment they use, and to learn to operate new types of test equipment. The basic principles of electronics, however, will never change. Because of these con-



starts, much of the test equipment in use by service centers today will still be useful for years to come. The DMM and the oscilloscope, and other test instruments and accessories such as the variable transformer, the isolation transformer and the bench power supply are just as necessary as they ever were to the serious consumer electronics technician. Therefore, the test equipment required by the technician doesn't so much change, as grow.

But because the consumer equipment serviced by technicians becomes more complex and sophisticated, even as new test equipment is being introduced, the existing items of test equipment are evolving and being improved.

For example, while today's technicians require oscilloscopes and test meters and other old standbys just as much as they did 10 or 20 years ago, in many cases the test equipment they require has to be more sophisticated, perform more precise measurements, than before. The products that the technicians are required to service are so much more

sophisticated than they once were, and so the test equipment that the technicians use to analyze them must also be more sophisticated.

## What Makes Test Equipment Useful?

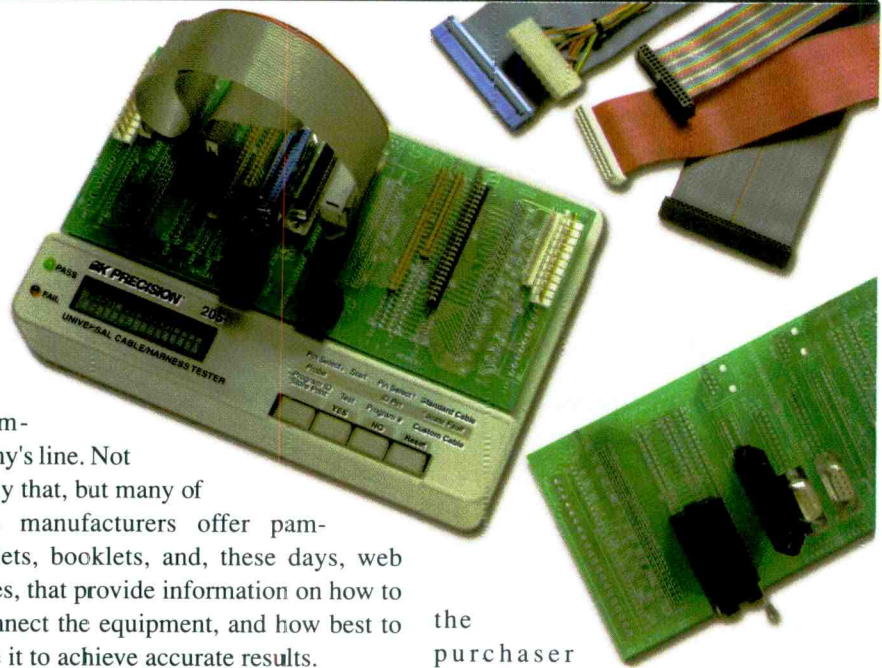
A piece of test equipment is only as valuable as its usefulness in assisting the technician in tracking down the cause of a problem to the fundamental cause so he can correct the problem. The factors that make a piece of test equipment valuable include these:

- Ease of use
- Capability
- Accuracy
- Support by the manufacturer
- Versatility

## Help in Deciding What Test Equipment to Buy

If a product offers a lot of features, and is based on sophisticated technology, it is a challenge for the potential purchaser to





compare features in order to know what product to buy. Fortunately, a consumer electronics service center has access to a number of resources that can help them chose from among the many test products offered by the many manufacturers. For example, the test equipment manufacturers offer catalogs and spec sheets. Most of these provide details of the features offered by each of the products in the

com-pany's line. Not only that, but many of the manufacturers offer pamphlets, booklets, and, these days, web sites, that provide information on how to connect the equipment, and how best to use it to achieve accurate results.

In some cases catalogs published by distributors and by companies that rent or lease test equipment list products from a number of manufacturers within each price level, and so makes comparison somewhat easier.

## THE CHECKLIST

Before a service center buys a piece of test equipment, it might be useful to check the candidates against a list such as this: (this specifically applies to scopes but the principals apply to most Test Equipment purchases)

- What products will this equipment be used to test (now and in the near future)?
- What bandwidth is needed?
- Single-channel, or multichannel?
- Is waveform storage needed?
- Will this be used at the bench only, or on site as well?
- Does this scope need to have on-screen readout of waveform parameters?
- Can this purchase be cost justified as a time and effort saver?
- Will the technicians need training to use this test equipment?
- Would something less expensive, less sophisticated do the job?
- Are the recommendations being made on facts or perceptions?

the purchaser was so bowled over by the impressive bells and whistles offered by a particular piece of test equipment by a particular manufacturer that the precious budget for test equipment was used up on a single piece of test equipment when it should have been used instead to purchase several pieces of less sophisticated, but more practical test equipment.

## Making the Decision

The purchase of a piece of test equipment, it would be best if the purchase should be considered in detail before the product is bought. Unfortunately, that doesn't always happen. For example, when it's decided that the service center needs a new oscilloscope, the service manager may perform some research on the products and prices, and then send out a purchase order for an oscilloscope.

Most purchases done in this manner turn out fine, but sometimes the organization learns too late that the unit isn't quite what they need. For example, it may not have the required features to service some new consumer product that they will soon begin servicing. In other cases the service center realizes that the expensive new piece of test equipment has far more features than they'll ever need, and the money tied up in it could be used elsewhere. You occasionally see some of those items listed in Readers' Exchange in this magazine.

The corollary to this is that sometimes

## Finding Out About the Suppliers

Not all car manufacturers, appliance manufacturers, or homebuilders are alike or equally competent. The same is true of test equipment manufacturers. making a wise decision in the purchase of a new piece of test equipment requires a fair amount of research on the part of the purchaser.

This special advertising section "Test Equipment Showcase," was conceived as a way to help bring more information about test equipment providers to readers. Every advertiser in this section has been given additional space to tell readers something about their company, or to help readers understand the value and use of that company's products.

We invite you to read what these companies that sell test equipment have to say about themselves and their products.



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**Electronic Design Specialists** makes test equipment designed to help servicing electronic technicians troubleshoot problems as quickly and accurately as possible. All test equipment is designed by David T. Miga, CET, who is an electronic engineer and a certified electronic technician.

The EDS corporation was started in 1986 when Dave designed a digital capacitor meter and a semiconductor analyzer to increase his own productivity as a contract technician. When other technicians saw what the EDS-52 capacitor meter and the EDS-59 semiconductor analyzer could do, Dave found himself being asked to build more of these prototypes for them. The production version of the semiconductor analyzer, the SemiAnalyzer 59C, was very successful and was sold from 1987 until 1997. Other unique test equipment followed, such as the Bus Line Tracer, the Micro-Analyzer, the Leak Seeker, and the very popular CapAnalyzer. Although designed for independent service technicians, regular users are the US military, most of the fortune 500 companies, NASA, the TV networks and cable companies, Panasonic, Pioneer and many trade schools and colleges.

Dave designs his test equipment with an entirely different perspective than most test equipment companies. All ideas start with interviewing thousands of

independent service technicians for their opinions and special needs. This approach is different from conventional test equipment manufactures, where equipment is designed by engineers that may have never picked up a soldering iron, who wouldn't be able to repair their own television, even with their own test instruments. Their idea of test equipment is to bombard the technician with numbers, to be expensive and to be difficult to use. This is overkill for a servicing technician; check out the "used test equipment" section in the classifieds of this magazine for these products.

For this reason, all EDS equipment is designed to give the technician the tools to tell whether a component is good, poor, or bad, in a circuit, as accurately as possible. A technician doesn't need to know what a capacitor's dissipation factor or dielectric constant is; just is it bad, can I move on? EDS test equipment is designed by technicians, is guaranteed accurate for in circuit tests, and is designed for easy use. Determining the quality of a component in questions done by the test instrument, not the technician.

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gramming the test equipment to make the decision, with Dave's 30-year experience as helpful input. Every CapAnalyzer 88A is still tested with the same actual good, poor, and bad electrolytics and tantalums used to design the original prototype, before releasing it to the customer.

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## Introducing Easy-to-Use Insulation Piercing Test Clips for a Variety of Field Applications

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needed to pierce the insulation of a wide range of wire types and sizes. The clips also feature a rotating banana jack that prevents the test lead from twisting.

Intended for making temporary connections in the field, the test clips feature a safety-rated shrouded banana jack that is compatible with virtually all industry-standard banana plugs,

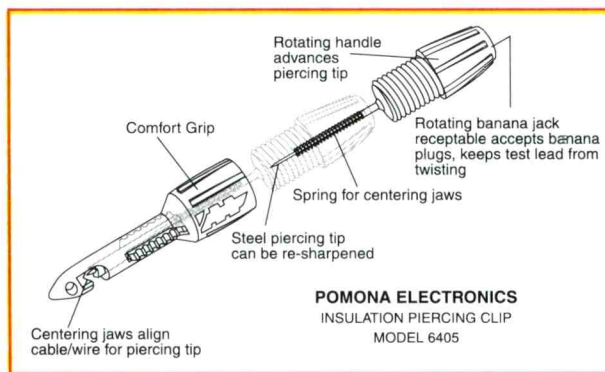
including digital multimeter plugs with or without safety shrouds. A retractable pin and a wire-centering mechanism secures insulated wires using a spring-loaded double-V clamp. Contact is made as the screw-in barrel drives the sharp piercing point through the insulation, allowing it to make contact with the conductor. The clip is small enough to access individual wires in large bundles and sturdy enough to last in severe service. With a variety of applications in mind, the clip is designed for use with a wide range of wire sizes from tiny 0.060-inch diameter (22AWG) to large .200-inch diameter (10AWG).

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Available from authorized Pomona distributors, the Insulation Piercing Test Clip sets are priced at \$30.00 per set (includes one black clip and one red clip). For more information or to order a free copy of Pomona's Test & Measurement Accessories Catalog, contact Pomona Electronics, Tel. (909) 469-2900; Fax (909) 629-3317, or visit the web site at [www.pomonaelectronics.com](http://www.pomonaelectronics.com).

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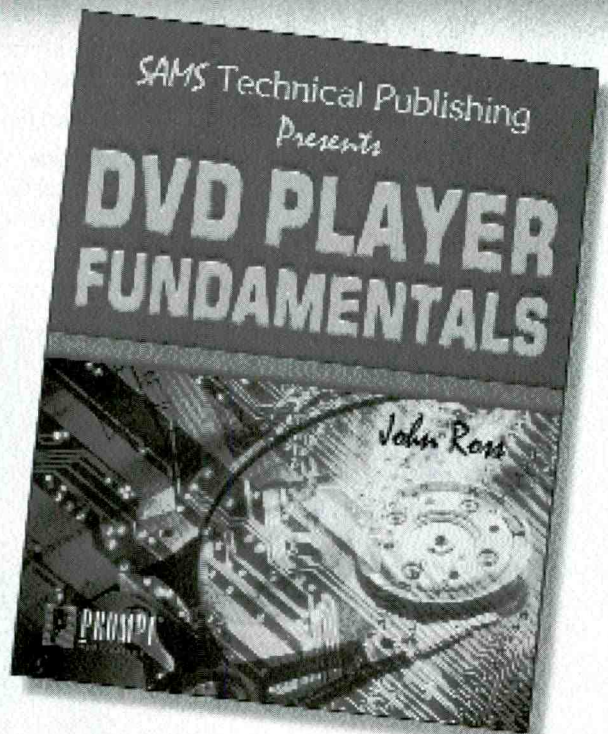
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by John Ross

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# What's Inside Those HDTV Set-Top Boxes?

by John A. Ross

## Introduction

Digital television has become one of the hot consumer electronics products for this holiday season. Much of the success enjoyed by digital television has occurred because of MPEG-2 audio, video and system standards. In turn, the MPEG-2 standards (a compression standard created by the Moving Picture Experts Group) create a framework for the creation, transmission and display of video, audio and data from the service provider to the end consumer.

As digital television continues to gain popularity, many consumers have opted to purchase set-top boxes that provide tuning, MPEG audio and video decoding, data processing, filtering, digital-to-analog conversion, and communications links. Most set-top box designs rely on RISC-based embedded microprocessors that provide scalability and have extensive third-party tool support (RISC stands for reduced instruction-set computer). Typical peripheral circuits in a set-top box include a UART (universal asynchronous receive/transmit), a Centronics port, an NTSC/PAL encoder, an audio Digital-to-Analog converter, and smart card interfaces.

This article will start with a description of the compression scheme used in HDTV to compress the video and audio data, and will then provide an overview of the circuitry that is contained in a set-top box and used to tune and decode an HDTV signal.

## MPEG-2 Video and Audio

The Motion Pictures Experts Group mission grew out of earlier standards work for digital compression of still pictures. MPEG defines the structure of the bitstream and the decoding process used to reconstruct bitstreams into frames of video and audio samples via a pre-defined rule base, or algorithm. By 1990, the MPEG committee had developed a data structure syntax for Source Input Format, or SIF, where video and compact disc audio utilized a combined data rate of 1.5

megabits per second. The MPEG-2 project expanded later to include HDTV and SDTV rate programs over many media such as disc, broadcast, and tape.

During operation, the MPEG compression process examines each frame of a moving picture and compares the contents of the frame on a pixel by pixel basis to the previous frame. If the pixel values in the new frame match the pixel values in the original frame, the MPEG compression processor ignores the new frame. In addition, the MPEG processor also examines a range of pixels for areas of identical color and tone.

When two frames match, the MPEG processor inserts a special small marker that instructs the MPEG decompression processor to restore the pixel. If frames have pixels with identical color and tone areas, the MPEG processor removes the duplicate areas and sends on only one pixel. An instruction accompanies the lone pixel and contains information needed to replicate the color and tone areas for a specific number of times.

Although the MPEG compression scheme cannot condense volumes of data to a low enough level, the lossy characteristics of MPEG take advantage of the ability of the brain and eyes to fill in any information gaps. As a result, the compression encoder can look for near matches rather than exact matches of data. Adjusting the nearness of the match also controls the amount of compression. However, compression of a file at a ratio higher than 3:1 will result in the averaging of intermediate tones and allows pixelation, or the placement of visible blocks in an image, to occur.

## MPEG-2 Video Encoding

During the first step of the encoding process, the encoder circuitry reduces the active area from the NTSC format of 704 x 480 down to 352 x 240. In addition, the circuitry translates the color information from the NTSC the RGB to the YUV format. While the translation compresses the color signal, the YUV format also

separates the color information into independent brightness and hue values. When the human eye views any color, the luminance, or brightness, information exists as the dominant component. Because hue is less significant than brightness in terms of color, the MPEG encoder eliminates 75% of the chrominance values.

During the compression process, any unneeded information is immediately discarded. As an example, the NTSC broadcast format uses only 480 out of the possible 525 scan lines to hold image information. The additional 45 scan lines contain information needed for the analog transmission of the signal but unnecessary for the digital transmission of the signal. Discarding the 75% of the chrominance values and the analog-only information allows the MPEG compression scheme to work with only 124 megabits of video data per second rather than the original 162 megabits of information.

With the data, flag, identifier, and error correction information, a data packet for the DBS system is 147 bytes long. The first two bytes of the packet contain the Service Channel Identification, a twelve-bit number that ranges from 0 to 4095 that identifies the channel for the packet. The third byte contains the four-bit long flag, an identifier for the encryption code while the next 127 bytes contain the video data. The final seventeen bytes are used for forward error correction.

The MPEG compression standard relies on discrete cosine transformation, or DCT, for the translation of 8 x 8 blocks of image pixels into sets of numbers. The DCT technique works by removing redundancies from the images. Rather than compress the image, the complex mathematical process of discrete cosine transformation changes the video signal into a form that can be easily compressed. During the process of compressing the NTSC signal, the video frame is divided into 8,100 small individual blocks or boxes. In comparison, the compression of a PAL or HDTV signal results in more



blocks. The process also groups the blocks together into five columns called macro blocks and then moves the blocks into an order that increases the efficiency of the compression.

At the beginning of the process, all information about the top left pixel in a specific block is stored in its complete form. In the next step of the process, only the difference between the next pixel and the base pixel is stored. For example, the transformation of a signal that represents only the blue sky, the difference between the first pixel and the next pixel would equal zero. The zero value for the difference would continue for all the pixels in the block and only the difference values would be stored.

If the televised scene includes white and gray clouds, the difference value would change. With the clouds in the lower half of the block, the bottom pixels might differ from the base pixel by changes equaling a negative one or a pos-

itive three. After the completion of the process, the values of each pixel in the block are weighted according to the specifications of the system.

Each set of pixels describes one level of detail with low detail images represented by many zero values and high detail images represented by fewer zero values. In essence, each value given through the discrete cosine transformation represents energy at a particular frequency. Rounding off the results of the transformation reduces the number of possible values and produces a better chance for identical values. Although transformation is not the same as compression, frames that feature lower detail can be compressed more than frames with higher levels of detail. Discrete transformation produces a frame called an I-frame, or intra frame.

### Spatial and Temporal Compression

MPEG-2 encoding uses spatial compression within each frame using block encoding techniques and temporal compression between nearby anchor frames within the video stream to eliminate redundant frame-to-frame information. While not used on all frames set for compression, the encoder uses motion estimation to determine the amount of needed compression. To remove redundancy, the system compares frames that incorporate motion estimation with previous frames, called predicted or P-frames, or with both previous and future frames,

called B-frames or bi-directionally predicted frames. A typical sequence of frames would include one I-frame every 15 frames and a P-frame every third frame except during the use of an I-frame.

During the compression process, the system approximates the amount of compression it needs for each block. To do this, the compression system looks for long strings of zeros in the data. Rather than storing the entire string such as 000000000000000, the system stores a phrase that means "15x0." Consequently, the more consecutive zeros contained within the data translates into saved space. Because long strings of zeros rarely occur in practice, the compression code tries to round off all values from negative one to positive one down to zero. If the data stream remains too large, the circuit will attempt to round off all values from positive two to negative two down to zero. This process continues until the proper amount of data compression results in the reproduction of only about 25 megabits per second of video information.

At this point, quantization has a major impact on the size of the final encoded video stream. Larger constants offer fewer possible values and increase the compression ratio. The increased density of compression allows the loss of information and the degradation of video signal quality. Quantization ensures that the video stream data rate never exceeds the throughput of the target output device. During operation, the encoder accesses quantized and transformed values from the lowest to the highest frequencies. As a result, the quantized data becomes strings of identical values that comprise a single token. In turn, each token indicates a value and the number of times that the value repeats.

Encoding the tokens involves the assignment of the most common tokens to symbols that have the shortest possible length. With this process, further compression of the data occurs through the distribution of token frequencies. The MPEG standard further increases the compression by eliminating any redundant data that appears on more than one frame. Throughout the encoding process,



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### REED-SOLOMON DECODING

A Reed-Solomon decoder processes each block of data and attempts to correct errors and recover the original data. The characteristics of the Reed-Solomon code dictate the number and type of correctable errors. With this method, 188 bytes out of every 204 bytes are received as data, and the remainder is used as parity bits to help correct any remaining errors.

These routines allow for the probability of a non-detected error to be less than 1 in  $10^{25}$ . In more physical terms, this means that there would be only one undetected error in 2 quadrillion discs. The error correction data alone requires 288 bytes for every 2,048 bytes of informational content on the disc. This allows for the correction of numerous bad bits, including bursts of bad data over 1,000 bits long.

Using linear block-based error correcting codes that have a wide range of applications in digital communications and storage, Reed-Solomon codes operate as a subset of BCH codes. Specified as RS(n,k) with s-bit symbols, the Reed-Solomon code uses k to represent data, n to represent a parity code, and s to represent a quantity. During encoding, the Reed-Solomon encoder takes k data symbols of s bits each and adds parity symbols to generate an n symbol codeword that has n-k parity symbols of s bits each. A Reed-Solomon decoder processes each block and attempts to correct errors and recover the original data. The characteristics of the Reed-Solomon code dictate the number and type of correctable errors.

The amount of processing required to encode and decode Reed-Solomon codes corresponds to the number of parity symbols per codeword. During decoding, a Reed-Solomon decoder can correct up to t symbols that contain errors in a codeword where  $2t = n - k$ . Given a large t value, the decoder can correct a large number of errors. However, the capability to correct a larger number of errors requires additional processing power.

the MPEG encoder has the capability to look ahead as many frames as desired to seek repetitive blocks. A pointer that references a single copy of the block replaces identical blocks of pixels common to two or more successive frames.

### Encoding MPEG-2 Audio

The MPEG-2 Audio Standard for low bit rate coding of multi-channel audio supplies up to full bandwidth left, right, center, and two surround sound channels plus an additional low frequency enhancement channel, and up to seven commentary/multilingual channels. Due to the need for compatibility, the MPEG-2 audio compression standard also extends the stereo and mono coding of the older MPEG-1 Audio Standard to half sampling-rates of 16kHz, 22.05kHz, and 24kHz for improved quality for bit rates at or below 64 kilobits per second per channel.

### Receiving Signals at the Set-top Box

Figure 1 is a generalized block diagram of a typical set-top box and illustrates many of the functions performed by circuitry within the device. As the diagram indicates, tuner circuitry tunes to the carrier frequency and converts the incoming signal to a baseband format. Sampling of the baseband signal creates a digital representation of the signal.

### Philips TDA10021 Single Chip DVB-C Channel Receiver

Take a look at the functional block diagram of Figure 2A and the circuit diagram of Figure 2B. The TDA10021 Single Chip DVB-C Channel Receiver operates with 4, 16, 32, 64, 128 and 256-QAM (quadrature amplitude modulation) modulated signals and interfaces directly to the IF signal. A 10-bit analog-to-digital converter samples the IF signal. Within the channel receiver, a digital down converter converts the bandpass input signal down into the two quadrature I and Q channels.

The I and Q signals pass through anti-alias filters and through a half Nyquist filter that has a fixed roll-off of 0.15 and gives a stop band attenuation of more than 40dB. After baseband conversion and Nyquist filtering, the signal feeds to an equalization filter for echo cancellation. Depending on the system requirements for optimization to network characteristics, the equalization filter may operate as either a T-spaced transversal equalizer or a decision feedback equalizer. A decision-directed algorithm ensures final equalization convergence.

The TDA10021 channel receiver utilizes a Forney convolutional deinterleaver of depth twelve blocks as specified in the Digital Video Broadcast, or DVB, standards and a Reed-Solomon decoder that corrects up to eight byte errors. A

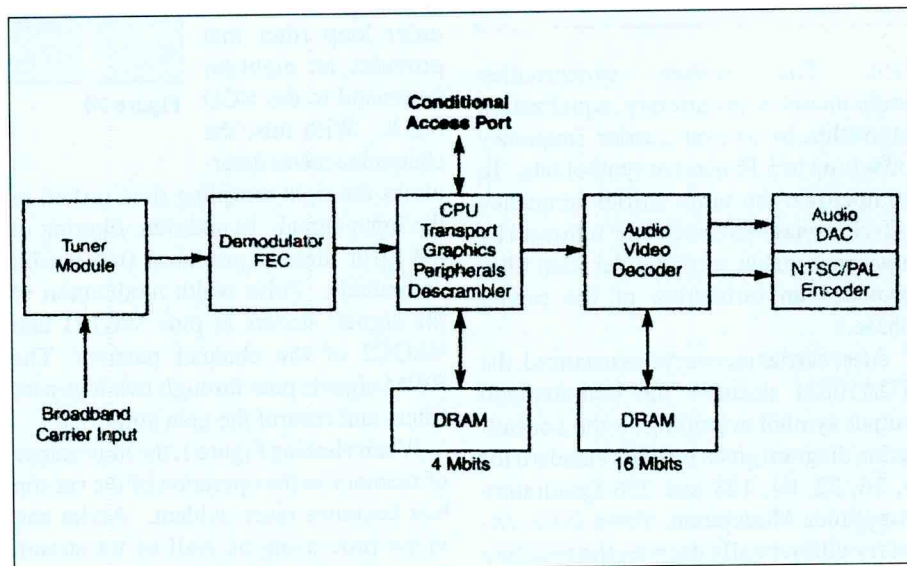


Figure 1. Simplified block diagram of an HDTV set-top box.



frame synchronization algorithm using the MPEG-2 sync byte automatically synchronizes the deinterleaver and the decoder. DVD-C standard descrambling also occurs at the Reed Solomon output.

Along with downconversion, filtering, deinterleaving, and decoding, the TDA10021 also performs clock and carrier recovery functions. Programmable digital loop filters for both clock and carrier recovery optimize the filter characteristics according to the current applica-

### PULSE-WIDTH MODULATION

Invented during 1939, pulse code modulation, or PCM, uses 0 and 1 pulse values to generate a 16-pulse train that indicates a sampled value. A linear PCM system encapsulates the following processes:

- Uniform sampling
- Uniform quantization
- Optimal dither
- Non-dynamic psychoacoustic noise shaping
- Transparent data compression

Adaptive Differential Pulse Code Modulation varies the number of bits that represent a difference between consecutive 16-bit samples according to the signal.

The carrier synchronizer implements a proprietary equalization algorithm to recover carrier frequency offsets up to  $\pm 18$  percent symbol rate. To compensate the input carrier frequency offset, a phase error detector followed by a programmable second order loop filter provides an estimation of the carrier phase.

After carrier recovery has occurred, the TDA10021 decodes the demodulated output symbol according to the constellation diagram given by DVB standard for 4, 16, 32, 64, 128 and 256 Quadrature Amplitude Modulation. From there, circuitry differentially decodes the resulting

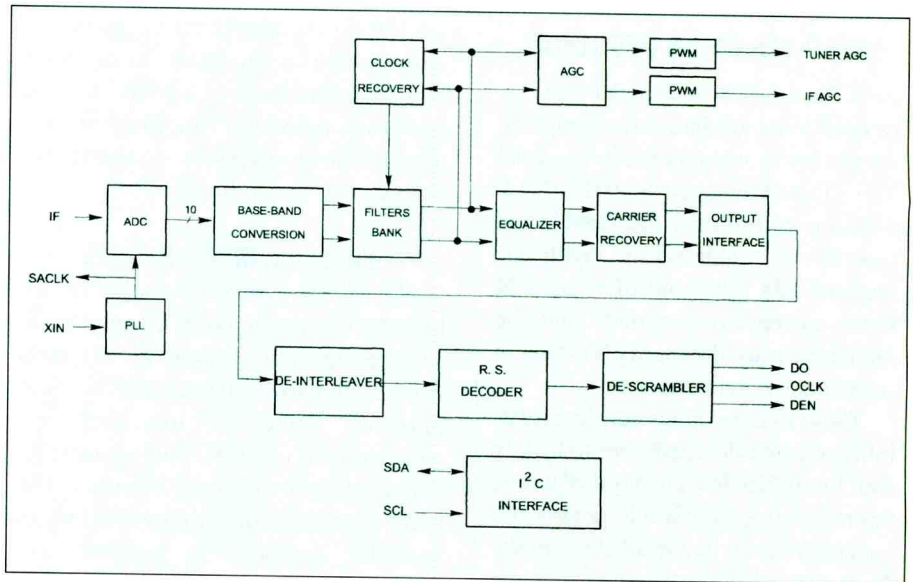


Figure 2. A is the functional block diagram of a TDA10021 single chip DVB-C Channel Receiver. B is the circuit diagram.

symbols into a DVB-compliant format and serially feeds the symbols to the Forward Error Correction portion of the channel receiver.

Digital clock recovery begins with a timing error detector implementing a Gardner algorithm. The resulting error signal is fed to a programmable second-order loop filter that provides an eight-bit command to the NCO block. With this, the channel receiver determines the right sampling time instant of the input signal. In addition, filtering of the error signals produces two ten-bit commands. Pulse-width modulation of the signals occurs at pins VAGC1 and VAGC2 of the channel receiver. The PWM signals pass through two low-pass filters and control the gain amplifier.

When viewing Figure 1, the importance of memory to the operation of the set-top box becomes more evident. Audio and video processing as well as bit stream transport, microprocessor operation, and

graphics processing require large blocks of random-access memory. Moving back to the analysis of the TDA10021 Channel Receiver, deinterleaving fills the memory associated with the deinterleaver. Once this occurs, the first deinterleaved bytes arrive at the input of the Reed-Solomon decoder.

From there, the Reed-Solomon decoder decodes the symbol stream from the de-interleaver according to the (204, 188) shortened Reed-Solomon code. During this operation, the Reed-

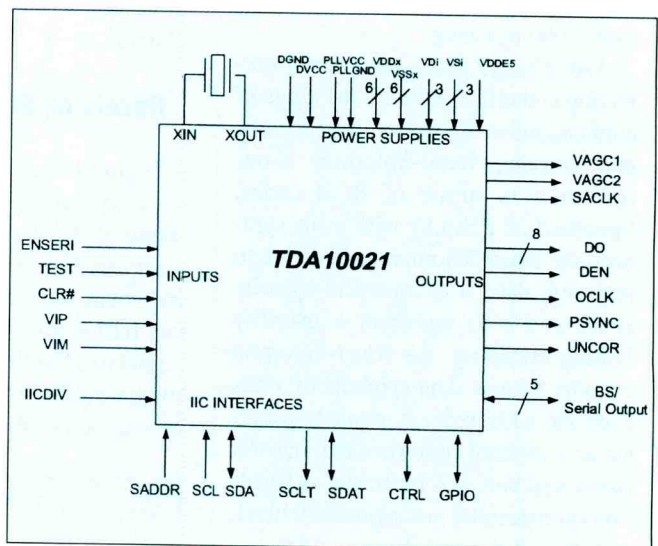


Figure 2B



Solomon decoder corrects up to eight erroneous symbols in each block. When the symbol stream exceeds the correction capability of the decoder, the block does not change. The resulting signal state sets the flag UNCOR and-as an error indicator—forces the most significant bit of the second byte in the MPEG2 frame to one.

### **Decoding MPEG-2 Video and Audio**

Decoder circuitry restores the deleted information so that the reproduced picture matches the original scene. A digital-to-analog converter translates the video signals from the digital format to the NTSC-standard analog format. Audio signals travel through MPEG decompression IC and then through another set of digital-to-analog converters for each stereo channel. The decoder must recover and maintain specific timing information and perform complex data processing during the decompression and decrypting of the video and audio information. In addition, the decoder processes the digital-to-analog conversions.

### **Processing MPEG-2 Signals at the Set-top Box**

Referring back to Figure 1, the graphics engine located within the host microprocessor processes and creates bitmaps that may overlay with video. In addition, the microprocessor programs the devices in the system and performs initialization and system maintenance functions like control, monitoring and interrupt handling of all components of the set-top box. The host microprocessor also provides the processing capabilities for graphic interfaces, electronic program guides and user interfaces.

### **Demodulation and Error Correction**

Again referring to the block diagram shown in Figure 1, the demodulator and error correction portions of the host processor recover a digital transport layer bitstream that consists of a stream of packets. An associated Packet Identifier, or PID, links each packet to a particular program or carrying service information.

The transport demultiplexer selects and depacketizes the audio and video packets of the program desired by the viewer. From there, the demultiplexer stores service related information for processing by the set-top box host microprocessor.

The transport demultiplexers examine the Packet ID of each incoming packet and discard packets that do not match any of the 32 PID values found in the processor registers. From there, the demultiplexer circuits depacketize the audio and video data of the selected program and send the data to the MPEG-2 audio and video decoders for reconstruction. Service information and private data undergo further processing before passing to the set-top host processor.

the PIDs, depacketize packets that contain private data and then examine the first few bytes of the private data to make a further decision about retaining the packet.

The process of examining the first few bytes of the contents of the private data defines private section filtering. Private section filtering operates by examining the private data and assigning a portion of the starting bytes as address bytes for the set-top boxes. Each unit connected to the network compares the address of the private data with the address held in the set-top box. Only messages addressed to the particular box remain stored for additional processing. Messages not addressed to the specific box become discarded.

## **EMBEDDED MICROPROCESSORS**

A microprocessor functions as the central processing unit for a computer system and processes system data; controls other devices within the system; and communicates with peripheral devices. Viewed as a device, a microprocessor contains a central processing unit, a small portion of random-access memory, a small portion of read-only memory, and input/output ports. Microprocessors control the logic of almost all digital devices and exist as the heart of personal computers and workstations.

An embedded microprocessor functions as a part of a larger device or system and includes instruction sets that initiate a particular task. The architecture of embedded microprocessor closely resembles the architecture of standard microprocessors. Further, these devices are generally driven by

real-time operating systems and do not contain on-board ROM.

Microprocessors differ in the amount of instructions executed; the number of bits processed within a single instruction; and the number of instructions that the processor can execute per second. Microprocessors employ either the complex instruction set computing, or CISC, architecture or the reduced instruction set computing, or RISC, architecture. Intel x86 and Pentium processors are prime examples of CISC technology. The limited command set and simpler architecture of RISC processors allows those devices to execute instructions three or more times faster than a CISC processor at any given clock speed. These advantages as well as their smaller physical size have made RISC processors the choice for embedded solutions.

### **Private Section Filtering**

Private section filtering schemes allow service providers to communicate with the set-top boxes in the network. In many networks, transport packets that contain private data travel to all of the set-top boxes in the network. From there, each set-top box must select packets based on

All this allows vendors to provide specific capabilities for networked consumers. As an example, the use of private section filtering assists with the implementation of message addressing—the assignment of a uniform network address for each set-top box. With message addressing in place, the vendor



attains an option for individually addressing each set-top box. Taking message addressing an additional step, vendors may also use Multi-user Addressing to address groups of set-top boxes or Broadcast Addressing to simultaneously address all set-top boxes.

first few bytes of the private data with values that were programmed in its registers by the set-top box host microprocessor. If the values match, the processor retains the private data additional processing and discards any data that has non-matching values. However, a full hardware-based

bility given through embedded software.

### The Philips SAA7219 Transport RISC Processor

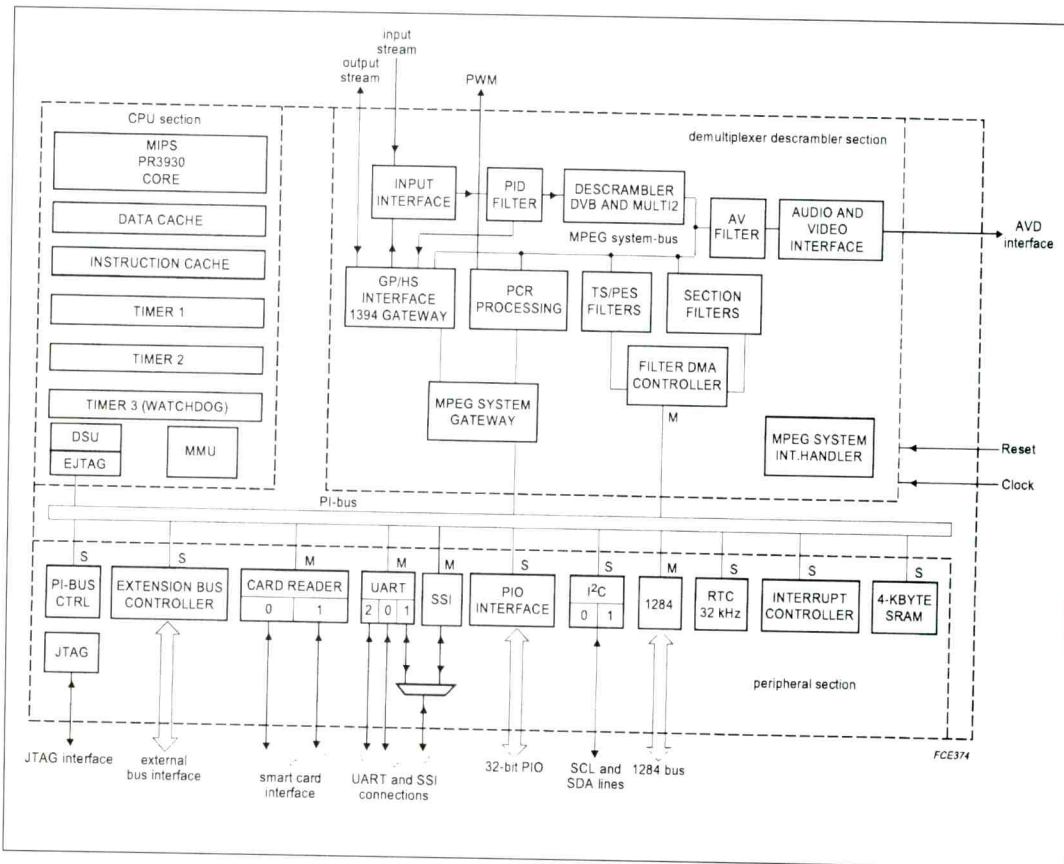
Referring to the block diagram shown in Figure 3, the Philips SAA7219 RISC processor works as part of a combination of devices that receive and decode MPEG-2 transport streams. Because the processor performs all controller tasks in the set-top box, it interfaces with peripheral devices such as UARTs, Centronics ports, and IEEE 1394 devices. During operation, the processor has the capability to receive byte-parallel and bit-serial data streams at a maximum rate of 108 Mbits/s.

With Figure 1 in mind, the data stream applies to an on-chip DVB descrambler. From there, the demultiplexer section removes Program Specific Information (PSI), Service Information, (SI), Conditional Access, (CA), messages, and private data. All the information is stored in external memory for additional processing.

Hardware-based private section filtering for the SAA7219 uses a maximum of 32 different Packet Identifiers. In addition, the processor incorporates a low-power sleep mode used for ensuring stand-by operation for the set-top box. The processor requires a 3.3Vdc voltage supply.

The Philips SAA7215 integrated MPEG AVGD decoder

Figure 4 is the block diagram of a Philips SAA7215 Integrated MPEG AVGD (Audio/Video/Graphics/Display) decoder. After leaving the host processor, the compressed audio and video bitstreams travel to the MPEG2 audio and video decoder for reconstruction. Decoded audio and video bitstreams flow



**Figure 3** the Philips SAA7219 RISC processor works as part of a combination of devices that receive and decode MPEG-2 transport streams. Because the processor performs all controller tasks in the set-top box, it interfaces with peripheral devices such as UARTs, Centronics ports, and IEEE 1394 devices.

The capability to address each set-top individually allows vendors to send reminders to consumers about subscription due dates. In comparison, Multi-user Addressing establishes a method for performing software upgrades or for downloading object code to specific network nodes. Broadcast Addressing allows vendors to change the descrambling keys for all set-top boxes connected to the network.

Manufacturers may implement private section filtering through hardware or software methods. If established through hardware, the transport demultiplexer in the system compares certain bits in the

private section filtering scheme may not cover all requirements.

If private section filtering relies on software, the host microprocessor manages the entire task of comparing the values in real-time. In comparison to hardware-based private section filtering, software-based private section filtering cannot protect against the loss of data. Because the host processor also handles other tasks, the processor may not handle enough successive private data packets within a given time period. As a result, most systems rely on hardware-based private section filtering schemes that include programma-



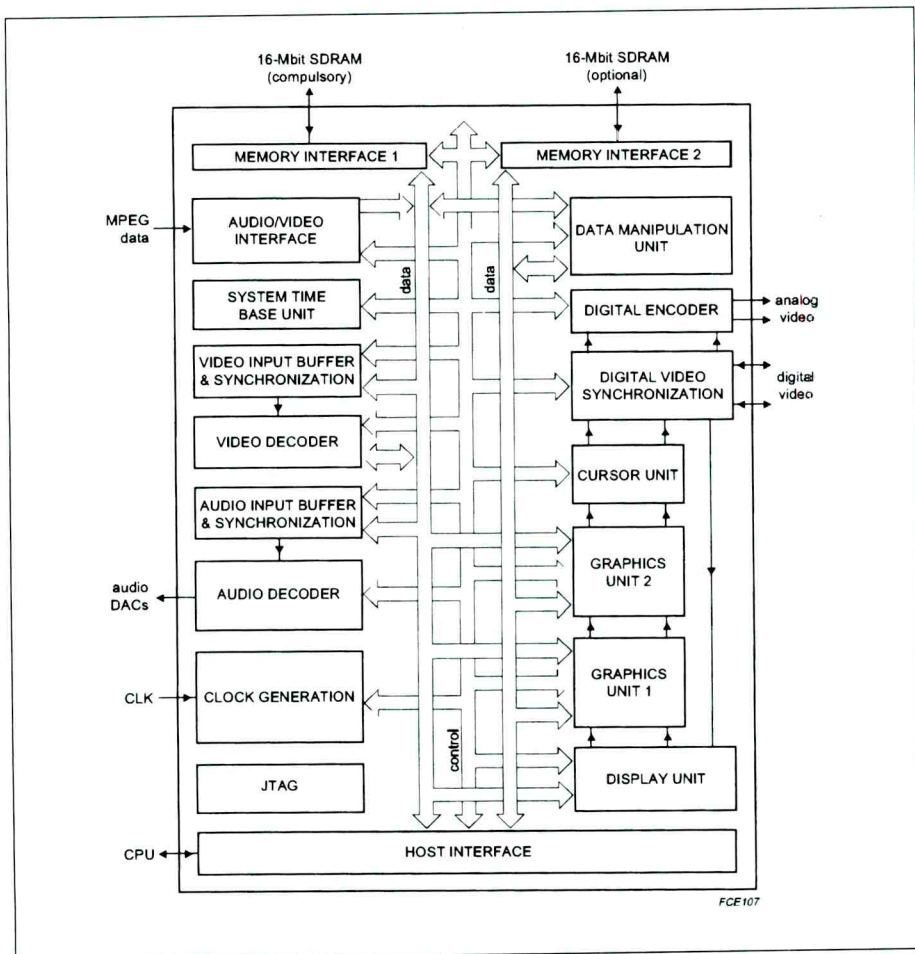


Figure 4 is the block diagram of a Philips SAA7215 Integrated MPEG AVGD (Audio/Video/Graphics/Display) decoder.

to the speakers and television monitor.

The enhanced graphics output from the device supports the RGB, SVideo, composite video, NTSC, PAL and SECAM video formats, background displays, and various on-screen displays such as program guides. On Screen Display resolutions range from SIF to CCIR601. Decoded audio and video bitstreams from the selected program feed to the speakers and the television set.

### Embedded Software

For the most part, an operating system controls the computer on which it runs by either providing or denying system resources to application software. As a result of this scheme, operating systems wield a large amount of control over the applications and resources used by the computer. However, the relationship

between operating systems and application software changes in dedicated environments such as embedded systems.

Much of this change is due to the type of applications used with embedded systems. While traditional operating systems serve as an interface between the user and the system along with functionality, embedded operating systems emphasize overall system functionality and, traditionally, provide little interaction between the user and the system. In brief, the operating systems allow the embedded system to perform a dedicated function.

Real-time operating systems work with applications that require a "real-time" capability or the capability to provide an immediate, predictable response to external events. For example, an embedded system that controls an anti-lock braking

system in an automobile must react to external events such as pressure on the brake pedal; the speed of the automobile; and road conditions within a fraction of a second. In addition, the RTOS enables the simultaneous decompression and synchronization of digital streams of audio and video information. Given these functions, real-time systems are used to enhance performance; reduce manufacturing costs; and enable product customization and differentiation.

Real-time operating systems may be loaded from some type of external media or may reside within a microprocessor as part of an embedded system. The RTOS seen with embedded systems complete requested functions within a consistent timeframe. As an example, a memory allocation either occurs correctly or yields an error condition if the allocation cannot occur within a specific time. To protect against error conditions, embedded sys-



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tems programmers write code that provides correction alternatives rather than shutdown routines. In addition, we can view an RTOS as a stripped-down operating system that sacrifices user and safety functions such as a GUI or memory management for speed. As a result, the RTOS runs extremely precise routines at high speeds. With this in mind, an RTOS runs on a reduced memory footprint. While desktop operating systems required anywhere from 4 to 32 megabytes of RAM, a minimally configured RTOS may run with 50 kilobytes of RAM.

An RTOS offers multitasking through either multithreading or multiprocessing capabilities. With multitasking, a programmer interleaves the operation of unrelated portions of application code and provides the illusion that the system is completing multiple, tasks simultaneously. Multiprocessing assigns distinct codes and data spaces and allows the operating

system to assume control of the application. With multiprocessing, the embedded application can support more complex operations. Multithreading—a traditional operation for embedded systems because of its simplicity—allows multiple threads of an operation during a single process. Each task in the multithreaded model shares code and data space with all other tasks in the system and no virtual to physical translation is necessary.

Along with speed, limited use of resources, and multitasking, an RTOS also provides peripheral, device driver, sub-system, and third-party support. While peripheral support involves the organization of the code that interfaces with peripheral devices, device driver support adds code to control devices. Sub-system support involves interfacing with communications packages or graphics libraries. With third-party support, RTOS developers provide the advantages

of speed, resource conservation, and systems support to third party embedded systems vendors

tion software from any hardware dependent actions. As a result, the time critical private data stream filtering occurs at a higher priority than a response to a channel change request from the viewer.

Embedded systems applications developers seek to use a fully integrated and open modular suite of software development tools and real-time operating systems to allow software development to occur concurrently with product development. Software tools used with set-top box designs have a basis on C++ and support the functionality of the RTOS. The Graphical-user Interface included with the software provides an easy-to-use interface that imitates the appearance and operation of a remote control device. Within this application, the GUI software gives the user the capability to switch channels, control the OSD menu, audio volume, fast forward, freeze, slow motion, and produce other functions. An integrated ethernet port in the set-top box provides the capability to download software upgrades or patches from manufacturer's web sites.

### Set-top Boxes are a Subset of the HDTV Receiving System

The idea of set top boxes was a concept that allowed manufacturers to make the transition from NTSC TV to HDTV smoothly, and economically for consumers. While HDTV is being introduced into major markets quickly, many smaller markets still have either no, or extremely limited HTDV programming. Consumers are reluctant to spend around \$1,000 to be able to capture programs that don't exist in their area. Moreover, the way in which the front end functions of HDTV are handled will undoubtedly evolve over the next few years.

Set top boxes allow consumers to buy a digital TV set but add the HDTV tuning system only after HDTV programming is available in their area, and with the most up to date units available. Service centers will no doubt be called upon to handle problems that may occur with these devices. It might be a good idea to begin learning about them now. ■

### Set-top Boxes and Real-time Operating Systems

The embedded processes seen with the devices found in a set-top box depend on functions provided by real-time operating systems software. As an example, private data stream filtering relies on the scheduling and timing given through the RTOS. The operating system schedules and prioritizes tasks performed by the processor and shields the applica-

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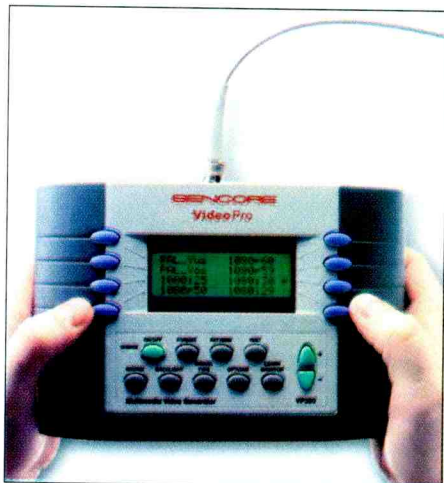
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# New Products

## Multimedia Video Generator

A new multimedia video generator, from Sencore delivers the HDTV, NTSC, and computer display video signals need-



ed by a service center for accurate alignment of front and rear projectors, monitors, direct view displays and video walls in all operating modes

Each home theater or high definition television installation requires signals for driving the display's HDTV, NTSC and Computer modes.

The VP300 "Video Pro" provides the patterns necessary for black level, white balance, focus and convergence alignment in all of the display's operating modes. The generator is portable, lightweight and battery operated (8 hours on one charge).

The unit features ATSC HDTV and standard definition formats (1080i, 720p...), 4:3 and 16:9 aspect ratios, component video (YPbPr) and RGB video output, composite and S-Video NTSC/PAL outputs, monitor output (SVGA, XGA...), setup and alignment test patterns.

The unit is a handheld, portable, battery operated product that can operate 8 hours on one charge.

Sencore Inc.  
Circle (18) on Reply Card

## Wireless Notebook Computer

Itronix Corp. announces the Itronix GoBook, a fast notebook PC for field-based mobile workforces. Designed for rugged indoor and outdoor use, the computer combines cutting-edge PC technol-

ogy with broad new wireless capabilities, placing them in one computing solution that helps mobile workers become more productive.

The unit is a fully-featured PC notebook computer, built to withstand the rigors and changing needs of remote field use. It sustains extremes for water, shock, drop, and temperature, including rainstorms and other harsh environments. To make the unit even more practical, Itronix has incorporated its new CRMA (Common Radio Module Architecture, pronounced "Karma") field-upgradeable wireless capability that allows users to easily upgrade radio modems or change networks in the field, thereby avoiding costly and time-consuming depot returns.

The product offers the latest in powerful PC laptop architecture. Standard specifications include an Intel Pentium III or Celeron CPU delivering 600+ Mhz of processing power, 256MB SDRAM, a 2.5" 6/10/20 GB hard drive, and 12.1" SVGA TFT color display with three-button touchpad navigation.

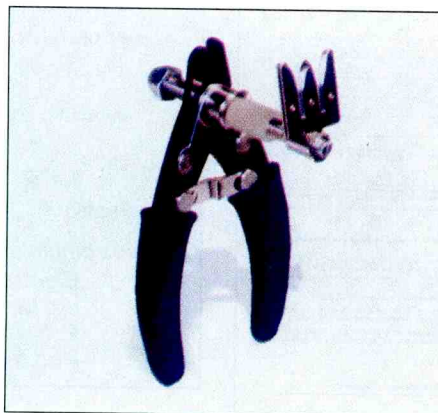
Instant wireless communications are available via a number of integrated radio options including American Mobile, BellSouth Wireless Data, CDPD, GSM, or Wireless LAN—all field-upgradeable.

Itronix Ltd.  
Circle (19) on Reply Card

## Wire Cut and Strip Tools

JDV Products Inc. has introduced the WS4473 Series for cutting and stripping combinations of wire gauges and variable strip-off lengths.

Two models are available: the WS4473 is furnished with combination blades for



22AWG to 26AWG wire and the WS4473C is furnished with combination and single blades for 22AWG to 30AWG wire. Blades are easily interchangeable. Blade post can be adjusted to change the strip-off length. Tools have rust resistant, oiled, black oxide coating and soft sponge-like grips.

JDV Products, Inc.  
Circle (20) on Reply Card

## Magnifier

Edroy Products announces that it has added a new product to its line of vision enhancers. Magni-Specs combine feather weight comfort with ophthalmic-grade magnification to provide a vision aid for medical practitioners, electrologists, assemblers, quality controllers, laboratory technicians, graphic artists, hobbyists



and others who require a clear magnified work field.

The magnifier provides a hard-coated prismatic acrylic magnifying lens held in place with an ABS plastic brow bar, nose piece and post. The product, which can be worn alone or over eyeglasses, weighs 1.2 ounces, providing optimal comfort for the user. Moreover, the lenses flip up and out of sight when not needed, and because they do not block ambient light, eye fatigue is reduced. A hard protective case is provided to ensure protection.

Edroy Products Co. Inc.  
Circle (21) on Reply Card

## Home Video/Audio Network System

The Leapfrog HomeNetwork system from Terk transmits video and stereo audio sources to a TV in any room in the home using existing phone lines. Because the product eliminates the need to install



# New Products

dedicated wiring and provides full two-way remote control operation from anywhere in the home, it offers possibilities for designing custom multi-room systems that were not possible before, says the manufacturer.

To use the system, all that is needed is a phone jack near each audio/video component. Simply connect the transmitter unit to an A/V source such as a satellite receiver or DVD player and a phone jack, and connect the receiver unit to the remote TV and a phone jack.

This product does not interfere with phone, fax or Internet connections in any way and can operate simultaneously with normal telephone service.

#### Features:

- Includes transmitter and remote receiver units
- Transmits video and/or stereo audio from TVs, VCRs, DVD players, CD players, cable TV boxes, satellite receivers and other A/V components
- Two-way infrared transmission capability allows the user to control the source component from the remote location
- Effective range of over 500 feet
- Twisted-pair home telephone wiring is an ideal carrier for audio and video signals
- Balanced circuitry eliminates noise
- Functions as a child monitor or part of a home security system when connected to a camcorder and TV
- Transmits and receives audio and video from computers (converter card required)
- Up to 4 more receiver units can be added to accommodate multiple TVs
- Included accessories: (3) A/V dubbing cables, (2) AC adapters, (2) phone cords, (1) infrared emitter

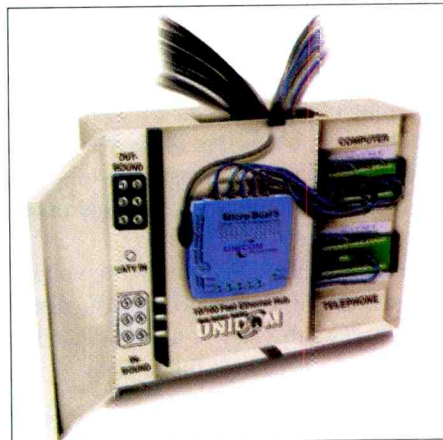
Terk

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## Home Network Box

The UniHome Network Box from Jensen Tools is a home wiring system that's designed to be in compliance with TIA-570-A residential wiring standards and the EIA-600 Consumer Electronics Bus (CE Bus). The box provides the user with a solution for centrally managing wiring and net-

work communications. Standard features include support for outside services such as Telco, satellite and cable television. In-house devices supported include telephone,



television, data devices, and internal video source distribution.

With its open architectural design and the installation of Category 5/5E twisted pair and RG-6 coaxial cable, the system can connect devices and appliances from a variety of different sources. It allows for the connection of outside peripherals such as computers, printers, telephones, fax machines, VCRs and security cameras. Since the product supports the transmission of broadband signals, current and future services can be used such as high-speed Internet access via cable modem, interactive television, HDTV, and digital satellite television. With an Ethernet hub installed, you can provide Internet access, file and print sharing, and run multimedia applications to all the networked computers throughout the home.

The unit includes a 6-port computer module for Fast Ethernet networks, a 1-port telephone module for telephone, a 1-port CATV input, an 8-port inbound/outbound video module, a mounting plate for hub or switch connection, five 1-foot Cat5E patch cords, one 7-foot telephone patch cord, and extra space for an additional module.

Jensen Tools Inc.  
Circle (23) on Reply Card

## Banana Jacks

Pomona Electronics offers new Panel Mount Banana Jacks, compatible with virtually all industry-standard banana plugs, including digital multimeter plugs,

with or without safety shrouds, providing convenient, hassle-free use. These new jacks are designed for custom test and measurement setups where safety-rated banana jacks are required, and install easily onto plastic or metal panels up to 1/2" thick.

The new Banana Jacks are designed to assemble into 1/2" diameter holes and are available in two styles. The press-in Banana Jack model 6388 features a straight-rib body and simple press-in mounting from the front side of the panel. The threaded body Banana Jack model 6387 fits both 1/2" diameter holes and 1/2" x 28" threaded holes. Featuring a hex bezel that can be gripped with a wrench from the front of the panel, the 6387 is also easily fastened from the backside of the panel with the supplied hex nut. An optional spacer raises the jack 1/2" out of the panel, allowing placement where there is limited space.

Both Banana Jack models are available with five different terminal options to accommodate virtually any manufacturing requirement. Terminal types include a solder cup which can also be used as a crimp terminal, a bifurcated cup for soldering, and a solder turret. Other available terminals include threaded studs in #6-32 and #8-32 sizes.

The jacks are suited for a wide range of applications, including building test and measurement instruments, testing fixtures, and for use in safety lockouts and factory controls. Compliant with an array of recent safety standards including UL-3111, IEC1010 and EN61010, the new jacks are available in ten colors with Tin, Nickel or Gold plating and feature 1000 volt CAT III ratings.

Pomona Electronics  
Circle (24) on Reply Card

## Powerline Network Controller

Inari announces the IPL0201, a fully integrated MAC/PHY 2 Mbps Powerline Network Controller targeted for use in broadband home networking applications. The IPL0201 combined with the IPL0202 analog frontend is designed for applications such as external USB to powerline network adapters, and embedded systems such as broadband gateways that distribute high-speed Internet access over



# New Products

a home's existing electrical wiring.

The IPL0201 supports simultaneous transmission of all information types including data, control, and isochronous communications. The controller also offers a very robust 4-channel communications processor that sends and receives rate-adaptive data at speeds up to 2 Mbps. The IPL0201 contains both a USB peripheral interface as well as a generic 8-bit interface.

The IPL0201 controller includes the firmware to run Inari's Powerline Exchange (PLX) network protocol. PLX supports network services such as security, authentication, channel redundancy, variable speeds, acknowledged responses and various addressing modes that are optimized for powerline-based systems. The protocol provides self-throttling, sequencing, packet retries, and a deterministic access engine required to support isochronous communication. The protocol is the first and only protocol developed to be scalable from simple "on-off" control, through data networking, and into distribution of real-time streaming on a home's existing electrical wiring.

**Inara**

Circle (25) on Reply Card

## Fume Extraction System

The Metcal® BVX-100 Fume Extraction System provides the power for effective extraction without the hassle of equipment installation. This truly portable, bench-top system is easy to set-up and relocate to perform efficient arm or plenum fume extraction for single users in today's fast-paced, flexible manufacturing. Compare the BVX-100 to larger, multi-user machines, and you'll see why it's the practical choice for fume extraction.

According to the manufacturer, features and benefits of the system include the following. It is a single-user system with multi-user power for thorough, effective fume extraction. No installation means easy set-up and relocation. Small footprint saves valuable bench top space. Efficient arm or plenum applications provide flexibility in fume extraction. Unique blower design provides quiet operation. Optional under-bench mounting bracket increases bench top.

**Metcal**

Circle (26) on Reply Card

## Non-contact Volt/Amp Probe

Amprobe announces the KWIK-I-E non-contact volt/amp probe. The unit is small in size, offers dual functions, a bar graph display, two ranges, and is UL & CE listed.

The unit allows the user to measure voltage and current without stripping or breaking of wires. Because the product is small, it can be carried in pocket or tool pouch. The probe measures volts and amps, and displays the readings on an easy to read display.

Specifications: Weight: 3 ozs; voltage ranges: 6V-60V and 60V-600V, Amps Ranges: 0.6A-6A and 6A-60A; Accuracy: +/- 15% of full scale.

**Amprobe**

Circle (27) on Reply Card

## Outdoor Antenna for Receiving Digital TV, Analog TV and FM Radio

Channel Master has announced its new outdoor multifunction antenna. The new Stealthenna, named for its sleek, low-profile appearance, provides excellent VHF, UHF, and FM reception from metropolitan to suburban areas for both digital and analog broadcast signals. In addition, the antenna can serve as an off-air companion antenna to a digital satellite receiving system, such as DIRECTV or Dish Network. The antenna is sold fully assembled for easy do-it-yourself or professional installation. For use in areas with difficult reception, an optional amplifier that fits neatly inside the antenna housing is also available.

According to the manufacturer, the Stealthenna delivers superior reception of local digital TV signals as well as conventional analog TV and radio broadcasts in its stated reception range.

The antenna is optimized for digital and analog signal reception, bi-directional reception VHF/FM and directional reception for UHF. Mast and coaxial cable are sold separately. For additional signal gain, the antenna can be equipped with an amplifier that fits inside the antenna housing. The amplifier, which uses separate circuitry for VHF and UHF signals, provides a signal gain of 15dB. The antenna has a span of 55 inches and its

housing measures 15 inches from front to rear.

The product meets the specifications set forth by the Consumer Electronics Association (CEA) Mapping Program for the large multi-directional antenna category. CEA has created a detailed map of every metropolitan area that shows, block by block, the type of antenna needed. Using the CEA coding system, the unit is recommended for the areas designated yellow, green and light green. Most retailers will have copies of maps available for consumer use.

**Channel Master**  
Circle (28) on Reply Card

## Loudspeaker Reconing Videotape

WVS offers a videotape on loudspeaker reconing. "Foundation of Understanding" the company says that this is a comprehensive education on loudspeaker rebuilding. This 1hr video contains all 3 segments listed below.

### A: Step by step reconing instruction

- Identify the Loudspeaker for ordering parts
- Proper cleaning of the speaker frame
- Proper placement of new parts - Cone, Coil, Spider...
- Centering the voice coil depth for maximum performance.
- Assembling the parts dry.
- Adhesive applications.
- Testing and evaluating performance after reconing.

### B: Step by step Refoaming

- Identify the Loudspeaker needing refoamed or re-edged.
- Proper cleaning of the speaker frame and cone for new foam.
- Centering the voice coil for success.
- Assembling the parts.
- Adhesive application.
- Testing and evaluating performance of the refoamed speaker.

### C: Compression Driver repair

- Identify the compression driver.
- Proper replacement of driver coil/diaphragm
- Tips and fanfare

**WVS**

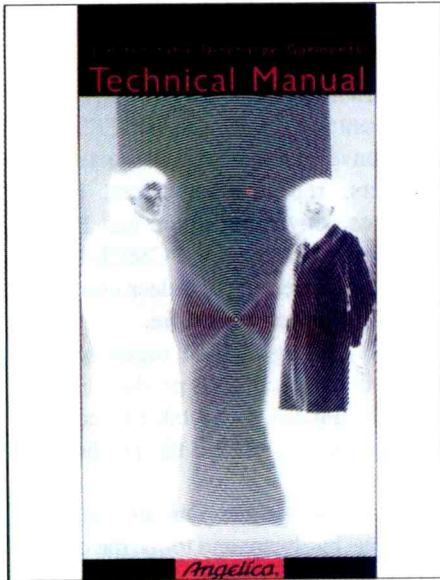
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# Literature

## ESD Manual

Angelica Image Apparel (AIA) recently released a manual to introduce and explain the various aspects of the company's Electrostatic Discharge (ESD) garments.



This is a comprehensive handbook for understanding static electricity, written in non-technical language. The document covers topics such as how static electricity is generated and how the company's garments can assist in ESD protection. Also included is a summary of the ESD Association's Standard (STM 2.1-1997) covering garment testing and a comprehensive glossary of commonly used technical terms.

The manual complements the company's new Tech-No-Charge garment line, which conforms to the ESD Association Garment Standard. These garments are constructed of fabric designed to prevent electrostatic buildup, which can damage or destroy sensitive electronic equipment.

Accompanying the manual will be an apparel brochure, flyers, fabric swatch cards and test results showcasing the company's technology-driven line of ESD garments.

Angelica Image Apparel  
Circle (30) on Reply Card

## Electronics Product Catalog

HMC offers their latest electronics product catalog. Products listed include ESD wrist straps, bags, runners and mats

for the production line, DMM's, power supplies and oscilloscopes for the engineer. Also featured are static control equipment and supplies from 3M and Desco, industrial cleaners and dusters from Chemtronics. This 136-page catalog contains listings of tools, test equipment and supplies needed by most consumer electronics service centers.

HMC  
Circle (31) on Reply Card

## HomeRF Web Site

The HomeRF website ([www.home-rf.com](http://www.home-rf.com)) features information that describes how consumers can experience the freedom of wireless Internet access and printer sharing in and around the home. With RF systems in the home, families can share a single Internet connection among multiple PCs. It is also possible to share files, drives, and printers without wires, listen to favorite MP3 music, enjoy cordless data and voice, and take full advantage of a broadband Internet connection.

The mission of the HomeRF Working Group is to enable the existence of a broad range of interoperable consumer devices, by establishing an open industry specification for unlicensed RF digital communications for PCs and consumer devices anywhere, in and around the home.

Featured at the site is a FAQ (frequently-asked questions) segment that helps the service center or consumer understand what this new technology is about. The following are general questions that people have asked, and their answers

QG1: What is Wireless Home Networking?

A: Wireless Home Networking uses radio frequency to transmit both data and voice information. In this respect, it is similar to a cordless phone that 'tunes in' to different signals on specific frequency bands and ignore others.

QG2: What are the benefits of Wireless Home Networking?

A: Wireless home networks allows multiple PCs users to share Internet access, printers, files and drives, and participate in multi-player games without wires; offering the consumer computing flexibility and mobility. Wireless solu-

tions offer convenient, economical, and fun network computing.

QG3: How should I evaluate wireless home networks?

A: A good wireless home network solution should be:

Powerful: You should be able to have all the capabilities of a typical office network such as simultaneous Internet access, file and drive sharing, and printer sharing.

Simple: Installation should take just a few minutes and using the network should be easy and intuitive. The setup software should require answers to only a few simple prompts or questions.

Economical: You should not have to pay much more than \$100 for each networked PC. For two PCs on a home network, this is about the same cost for a good quality home printer.

Secure: Your wireless home network should provide effective provisions to prevent unwanted access from neighbors or visitors to your neighborhood.

Based on Industry Standards: Products that comply to the same industry standard work together. Look for a wireless home network that is HomeRF Certified.

Also available on the web site are technical and business and standards questions and answers.

Home RF  
Circle (32) on Reply Card

## Electronic Parts and Accessories Catalog

Fox Electronics Warehouse offers its Fall/Winter 2000 electronic parts and accessories catalog. The catalog includes the company's broad line of products including antennas, audio/video accessories, batteries, cable and wire, camcorder accessories, capacitors, CATV accessories, chemicals, consumer products, DSS products, flybacks, picture tubes, remote controls, resistors, semiconductors, service components, service tools/aids, soldering equipment, speakers, telephone accessories and VCR parts.

The catalog contains black and white photos of many of the parts to help the user identify the product he needs. The catalog includes a quick reference guide in front, and a detailed index at the back.

Fox Electronics Warehouse  
Circle (33) on Reply Card



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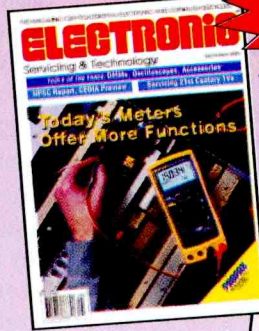
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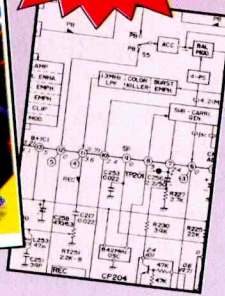
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Tel: 516.681.2922 Fax: 516.681.2926

## Literature

### Computer Communication Tools Catalog

B&B Electronics Manufacturing company offers their 2000/2001 catalog of computer communications and tools. Included is a selection of products that support RS-232, RS-422, RS-485, wireless, fiber optic and USB requirements. The catalog includes RS-232 to RS-422, main frame and TTL converters, RS-232 to current loop converters, RS232 to RS-485 converters, isolated converters and isolators, repeaters, boosters, marine interface converters, Serial and Parallel communications cards, PCMCIA cards, DIN rail converters, Wireless communication equipment and more.

The catalog is well organized and indexed, and includes a product index, a functional index, and a table of contents to help the user to find the product he's looking for.

In addition to the computer communications hardware and tools, the catalog includes a selection of computer communications software and reference books

B&B Electronics Manufacturing  
Circle (38) on Reply Card

## ES&T Help Line

*I need a service manual for a SAE receiver R-102. Do you know who bought this inventory and could you help me get this manual?*

Rejean Mathieu  
819-874-1049 between 2pm and 5pm  
Fax: 819-874-0704

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# Books

## Handbook of Microcontrollers

by Myke Predko  
ISBN: 0-07-913716-4  
859 pages

Price: \$54.95 US (softcover)

Microcontrollers can be found in just about everything electronic, from cars (suspension systems, anti-lock brakes, electronic seats, etc.) to kitchen appliances. The myriad of variables available in choosing a microcontroller can make choosing the "best" device for an application very difficult. It is also difficult to find good introductory information, both in the field of microcontrollers for beginners as well as the different devices available for use in an application. This book will provide a comprehensive introduction/reference for the five most popular 8-bit Microcontrollers used today, both in professional applications and in hobbyists' experiments.

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(1-800-262-4729)  
Fax: 1-614-759-3641

## Choosing, Maintaining, and Repairing Your Home Theater System

By Andrew Yoder  
ISBN: 0-07-076514-6

Format: Hardcover, 120 illus., 360p.

Pub date: June, 1998

Copyright: 1998

Price: \$39.95US

Selecting and setting up your ideal home theater can be fun, satisfying, and anxiety-free, whether or not you decide to spend major bucks. In this book, Andrew Yoder, one of America's favorite home electronics writers, tells novices, intermediates, and anyone who just needs a bit more information how to choose compatible equipment that will provide years of exciting, enjoyable home theater value. You'll learn how to select wisely from new technologies and enhancements, such as stereo VCRs, DVD players, computer integration, HDTV, CATV, interactive television, and satellite broadcasting. And how to shop for the best deal without getting ripped off. He even covers useful Internet resources, from

reviews to on-line discount stores.

CONTENTS: Principles of Video, Choosing a Video System, Installation, Speakers, Building and Buying, Amplifiers, Television Antennas, Building a Home Theater, Creating a Home Satellite Receiver System, Creating a Home Video Recording System, Maintenance.

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## The Illustrated Dictionary of Electronics

by Stan Gibilisco  
ISBN: 0-07-024186-4  
788 pages

Price: \$39.95 US (softcover)

Packed with definitions and illustrations, this reference is now revised to include the latest terminology and up-to-date artwork. It's an indispensable tool for anyone interested in electronics at any level-layman, novice, or seasoned professional. Reviewed to ensure complete accuracy by a distinguished editorial board, the seventh edition contains nearly 28,000 entries-definitions, abbreviations, and acronyms-including many new terms in the fields of robotics, artificial intelligence, and personal computing as they relate to electronics. Vividly illustrated with 1000 high-quality drawings, this impressive volume is extremely accessible and easy to use. Organized alphabetically, it includes a number of information-filled appendices.

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## Encyclopedia of Electronic Circuits, Volume 7

by Rudy F. Graf, William Sheets  
ISBN: 0-07-015116-4  
976 pages

Price: \$39.95 US (softcover)

This is the seventh volume in Graf's best-selling series of circuit encyclopedias.

Like its predecessors, this volume will contain over 1000 circuits from manufacturer applications notes developed during the last four years. All circuits will be organized by category (audio, RF, IC, etc.), and the all-inclusive index will reference all 7 volumes for ease of use.

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## Choosing, Maintaining, and Repairing Your Audio System

by Andrew Yoder  
ISBN: 0-07-065346-1  
Format: Hardcover, 120 illus., 381p.  
Pub date: September, 1997  
Copyright: 1998  
Price: \$39.95US

Shopping for a home entertainment system? Confused by all the choices? Aimed at novice/intermediate buyers, this true consumer's guide will help you purchase the best system for your needs and budget, from low-end to highly sophisticated. It explains the latest technologies - including stereo VCRs, CD players, and MiniDiscs - with an eye toward future enhancements. You'll learn how to choose the right mix of equipment; easily install and maintain it; troubleshoot basic problems; and much more.

CONTENTS: Principles of Sound, Choosing an Audio System, Choosing a Video System, Installation, Speakers, Building and Buying, Receivers and Amplifiers, Antennas, Maintenance, Basic Troubleshooting.

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## Telecommunication Circuits and Technology

September 2000  
ISBN: 0-7506-5045-1  
Paperback 400pp  
Price \$34.95

Telecommunication Circuits and Technology provides students with a



# Books

problem solving approach to understanding the fundamentals of telecommunications. The author covers the common telecommunication and data communication circuits that are currently taught at higher education level and also used in industry. Understanding is reinforced with frequent worked examples and problems for specific applications and industrial data sheets are also given.

This practical text will also be attractive to technical professionals wishing to update their skills or become familiar with new technology.

**CONTENTS:** Oscillators, Modulation systems, Filter applications, Tuned amplifier applications, Power amplifiers, Phase locked loops and synthesizers, Microwave devices and components.

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Woburn, MA 01801-2041  
781-904-2500  
Fax: 781-904-2620  
www.bh.com

## **Newnes Passive and Discrete Circuits Pocket Book**

September 2000  
ISBN: 0-7506-4192-4  
Hardback 400pp  
Price \$29.95

Newnes Passive and Discrete Circuits Pocket Book is aimed at all engineers, technicians, students and experimenters who can build a design directly from a circuit diagram. In a highly concise form Ray Marston presents a huge compendium of circuits that can be built as they appear, adapted or used as building blocks. The devices used have been carefully chosen for their ease of availability and reasonable price. The selection of devices has been thoroughly updated for the second edition, which has also been expanded to cover the latest ICs. The three sections of the book cover:

Modern passive components: relays, meters, motors, sensors and transducers

Design of attenuators, filters and bridge circuits

Discrete semiconductor devices: JFET, MOSFET, CMOS, VMOS, UJT, SCR, TRIAC, and various optoelectronic devices

The subjects are treated in an easy-to-

read, highly practical manner with a minimum of mathematics.

**CONTENTS:** Passive electrical component guide; Relays, meters and motors; Modern sensors and transducers; Passive attenuator circuits; Passive and active filter circuits; Modem bridge circuits; Basic diode circuits; Special diode circuits; Transistor principles; Transistor amplifier circuits; Transistor waveform generator circuits;

Miscellaneous transistor circuits; Optoelectronic circuits; FET basics; JFET circuits; MOSFET and CMOS circuits; VMOS circuits; SCR circuits; TRIAC circuits; Index.

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## **Electronic Servicing and Repairs**

September 2000  
ISBN: 0-7506-5053-2  
Paperback 264pp  
Price \$34.95

Electronic Servicing and Repairs is a new edition of the successful Electronics for Electricians and Service Engineers and completely updates the previous text.

Electronic Servicing and Repairs includes an expanded chapter on testing and fault diagnosis, incorporates PLCs and CAD software and introduces automatic test equipment (ATE). Communication and security systems are completely updated - the section on TV receivers, satellite TV, VCRs, CD players and cable TV has been expanded and a new chapter has been devoted to alarm systems.

**CONTENTS:** Health and safety, Electronic component recognition, Electronic circuit assembly techniques, Electronic semi-conductor devices, Electronic circuits in action, Testing electronic circuits, Digital electronics, Electrical circuit theory, Electronic systems, Communication systems, Security systems, Sensors and transducers.

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Editorial Contact:

Nils Conrad Persson

913-492-4857 [cpersedit@aol.com](mailto:cpersedit@aol.com).



# Books

## Basic AC Circuits, Second Edition by Clay Rawlins

September 2000  
ISBN: 0-7506-7173-4  
Paperback 541pp  
Price \$39.95

Basic AC Circuits, Second Edition is a step-by-step approach to AC circuit technology for the beginning student, hobbyist, technician, or engineer. The book is built into a series of self-paced, individualized learning goals covering electronics concepts, terms and the mathematics required to fully understand AC circuit problems, simple or complex. Each chapter includes learning objectives, fully illustrated examples, practice problems and quizzes providing teachers, trainers and students a complete AC technology resource. In the new edition the author has updated the book to reflect changes in technology, especially the test equipment available today.

CONTENTS: Introduction to

Alternating Current; AC and the Sine Wave; The Oscilloscope and Its Use; The Sine Wave and Phase; Resistive Circuits; Capacitance; RC Circuit Analysis; Inductance and Transformers; RL Circuit Analysis; RC and RL Time Constants; RLC Circuit Analysis; Phasor Algebra; Complex RLC Circuit Analysis; Resonance.

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## Introduction to Digital Signal Processing

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Introduction to Digital Signal Processing covers the basic theory and practice of digital signal processing (DSP) at an introduc-

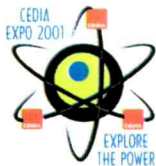
tory level. As with all volumes in the Essential Electronics Series, this book retains the unique formula of minimal mathematics and straightforward explanations. The author has included examples throughout of the standard software design package; MATLAB and screen dumps are used widely throughout to illustrate the text.

Ideal for students on degree and diploma level courses in electric and electronic engineering, Introduction to Digital Signal Processing contains numerous worked examples throughout as well as further problems with solutions to enable students to work both independently and in conjunction with their course.

CONTENTS: The basics, Discrete signals & systems, The z-plane, The design of IIR filters, The design of FIR filters.

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# Calendar of Events



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JANUARY 6 — 9, 2001  
Las Vegas Convention and Las Vegas Hilton  
Alexis Park and Riviera  
Las Vegas, NV  
Consumer Electronics Association  
2500 Wilson Boulevard  
Arlington, VA 22201-3834  
703-907-7605  
www.ce.org  
www.cesweb.org

**NATIONAL ALL SERVICE CONVENTION (NASC)**  
FEBRUARY 7 — 11, 2001  
Delta Resort  
Orlando, Florida  
Electronic Technicians Association (ETA)  
502 N. Jackson  
Greencastle, IN 46135  
800-288-3824  
www.eta-sda.com or  
Professional Service Association (PSA)  
71 Columbia Street  
Cohoes, NY 12047  
518-237-7777

**COMDEX/Chicago 2001**  
(Formerly COMDEX/Spring)  
APRIL 3 — 5, 2001  
McCormick Place, Chicago  
Key Media  
300 First Avenue  
Needham, MA 02494-2722  
731-433-1500  
www.comdex.com

**CABLE-TEC EXPO 2001**  
MAY 8 — 11, 2001  
Orlando, FL  
Society of Cable  
Telecommunications Eng.  
140 Phillips Road  
Exton, PA 19341  
610-363-6888  
www.EXPO2001info@scte.org

**ELECTRONIC DISTRIBUTION SHOW & CONFERENCE (EDS)**  
MAY 15 — 17, 2001  
Educational Programs  
May 14  
Las Vegas Hilton  
Las Vegas, NV  
Electronic Distribution Show Corp.  
222 South Riverside Plaza  
Suite 2160  
Chicago, IL 60606  
312-648-1140  
www.edsc.org

**NATIONAL PROFESSIONAL SERVICE CONFERENCE (NPSC)**  
JULY 30 — AUGUST 4, 2001  
Riviera Hotel  
Las Vegas, NV  
National Electronics Service Dealers Association (NESDA)  
2708 Berry Street  
Fort Worth, TX 76109  
817-921-9061  
www.nesda.com

**CUSTOM ELECTRONICS DESIGN AND INSTALLATION ASSOCIATION (CEDIA)**  
SEPTEMBER 5 — 9, 2001  
Indianapolis Convention Center  
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CEDIA Headquarters  
9802 N Meridian Street  
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Indianapolis, IN 46260  
800-669-5329  
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B&K PRECISION	IFC	9	(800) 462-9832	ELECTRONIX CORP.	50	35	(937) 878-9878
COMPONENTS DEPOT	9	7	(800) 999-2188	"ESCALERA, STAIRCLIMBER"	50	36	(800) 622-1359
CUSTOM DATA ASSOCIATES	17	8	(800) 451-0137	HERMAN ELECTRONICS	50	34	(800) 938-4376
ELECTRO HORIZONS:				ISCET	39	15	(817) 921-9101
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CD-ROM LIBRARY	51	37	(800) 462-4659	SAMS TECHNICAL PUBLISHING	23	12	(800) 428-SAMS
ELECTRONIC DESIGN SPECIALISTS	21	10	(561) 487-6103	SENCORE	24	13	(800) SENCORE
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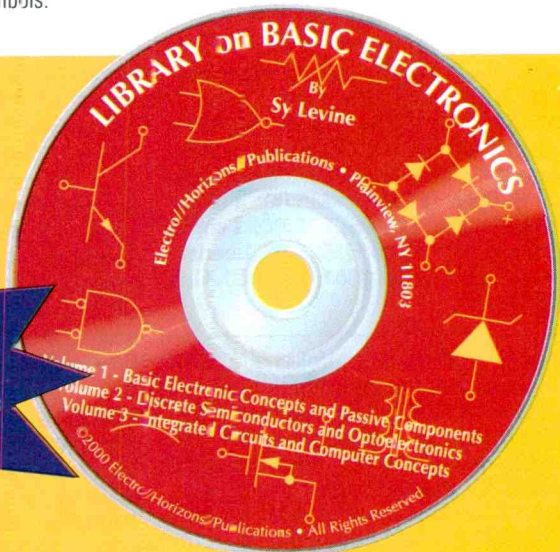
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# ES&T Readers Speakout

## READER OPINION SURVEY/COMMENTS

### The September issue Reader Opinion Card asked our readers to:

- Indicate key business or technology topics ES&T should cover, or continue to cover.
- Share thoughts about market happenings, events, directions, difficulties and/or opportunities you believe we should address.
- And, make comments on this first issue published by Mainly Marketing.

### Responses not previously printed.

I am new to the TV repair Business. I need catalogs to find services for repair parts.

B.A. - Weaverville, NC

View point has it right. I use ES&T as a reference library.

L.R. - Mt. Solon, VA

I have seen dozens of reference books on semiconductors, ICs, and other spare parts. I would be very happy to see a cross reference book on Flyback Transformers. Please send me information on buying same. P.S. Yokes, too.

J.A. - Charlestown, West Indies

Topics on: Public Address Systems, Commercial Sound Systems, Sound Reinforced Systems. Your first issues of ES&T are all very well edited.

S.T.V.S. - Costa Rica, Central America

Audio, Audio, Audio! I like the announcements and information on industry manufacturers and educational institutions offering service-oriented workshops, especially for CD's and DVD's. Thanks.

G.G. - San Francisco, CA

### October Issue comments regarding Profax: White or Yellow Background? Glossy or Dull Coated Paper?

The old Profax on yellow insert.

E.J.S. - N. Brookfield, MA

I would prefer you to return to the traditional white paper with blue print. Do you remember the editions from the 60's?

"Anon."

Pages 6-14 of the October issue seem needlessly long. I would rather see real service articles on TV, VCR combos, DVD and CD. What happened to the Annual Profax Special?

B.W. - Ithaca, MI

What happened to the Profax Special issues? Sections on repair remedies, fixes.

M.T. - Frackville, PA

Leave the Profax the way it used to be!!! This magazine should be all troubleshooting articles - nothing else!!!

G.V.E. - Ypsilanti, MI

Would like information on printers - theory and basic maintenance.

Manufacturers' manuals do not give any maintenance information. Need information on auto computers also!

A.P. - Parlin, NJ

No more VCR's! Too cheap to replace. (Ex: Combo units).

C.W. - Pine Knot, KY

Please leave the Profax the way they used to be. Give us more articles on repairing electronics and less on products and business.

N.S. - Ecourse, MI

The recent Profax on white has greatly improved readability. The tan previously used was scarcely readable.

O.E. - Reno, NV

More trouble-shooting articles on TV/VCR repair.

S.R.C. - Mentone, CA

Need schematic on Sharp VCR power supply, model VC-H75U

Bact, MD

Good Luck

C.A.L. - Marietta, GA

More tips on TVs, microwave ovens, VCRs and stereos. Thank You.

P.M. - Avondale, LA

Parts and components numbers would make Profax excellent! Block diagrams on Profax too!! IC pinouts on Profax also!

T.V.F. - Virginia Beach, VA

I am not interested in this, but why not put it in PDF format on your website = save \$.

M.L.S. - Portland, OR

Printing on schematics is too small. Cannot view!

J.S. - St Petersburg, FL

Need more letters and bulletin board questions from readers. 56 pages is

not enough. Profax has been reduced in value. I'm going to let my subscription run out in protest. Your fax number did not work. Content of this magazine is shrinking. Why should I continue?

L.G. - Los Angeles, CA

No automobile, computer or business articles! More "tax folders" in each issue. More TV trouble-shooting articles in each issue. See RCA comment on page 54 in last issue, except on VCR stuff. Also see M.E. comment on page 54 could have said it better.

R.R. - La Combe, LA

Would like to see some articles on AC/DC TV/VCR combinations such as Magnavox and Symphonic.

R.R. - Nutley, NJ

Fine print - can't read.

R.M. - Hialeah, FL

Articles on digital TV's would be helpful. Go through an actual chassis and explain circuits. May take a few issues to do it.

T.T.W. - Midland, TX

More good trouble-shooting articles on: TV, TV/VCR, Audio, Projection TV, DVD and CD. Also, computer and monitor trouble-shooting.

R.R. - Coleman, MI

I have every schematic from the very beginning and lately have found some of them without the power supply schematic or tuner included.

D.S. - Milwaukee, WI

I would like to see an article on automotive test equipment. Is there a repair opportunity in servicing for local repair shops (auto) that have problems with their test equipment?

G.N. - West Hurley, NY

Would like to see more schematics from manufactures such as Symphonic, Shintom, Funai, etc.

R.L.S. - Shelby, OH

### Other Letters.

Can you edit in CD format circuits vertical/horizon audio video for the last 10 years in different brands? Some time ago I read vertical systems in one edition. Could be a powerful tool for service. Thanks. Subscriber for over 30 years.

R.P.

Thank You for years of providing very useful up to date information and education that so aids in the service industry. When I talk to someone that doesn't subscribe I am amazed, and then they subscribe to your magazine. Thanks again.

K.H. - Palestine, Texas

I have been a subscriber to this magazine for many years now, and every so often I write and request, suggest, beg or whatever... for a searchable index by keyword, to all the wonderful and helpful articles in the magazine. In the early 90's I suggested a CD-Rom, now it could be on the Internet... The fact of the matter is that all this data is for nothing if it is not readily available. In the past, there have been articles on various subjects that have either made us money or helped us save time on a particular repair. Or in some cases we have used your magazine for training our tech's. If we could just have a database searchable by keyword, I think that would be great value-added service, or perhaps a new source of Revenue for this magazine. I beg you to give serious consideration to this. You have a wealth of knowledge at your fingertips and you've already paid for it! Thank you for your time and consideration.

W.V. - Seattle, WA

I wanted you to know that ES&T is now on the right track. I feel the following changes are necessary to keep up with the times. -A section dedicated to PC and Computer Monitor Repair and Upgrading. Electronics Service has focus on repairing TV and VCR and has neglected the fast growing PC market. Distance learning courses. Grantham College and Cook College offer distance learning courses to attain a Bachelor degree in Electronic Engineering Technology.

S.B

**OOPS! In Last month's column a reader asked about NPSC. The telephone number for NESDA is not "??-??-???" It is 817-921-9061.**

ES&T

Send your comments, questions, suggestions, complaints and kudos to:

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dallen@mainlymarketing.com  
Fax: 516-883-2162



## Still Learning, Still Living!

There is an ad we often hear on the radio suggesting that most people quit learning new words, cease to increase their vocabulary after the ripe old age of 20, or so. We hope not, and we hope that we never lose our ability to look at "the new" with the awe and acceptance we see within our grandchildren.

This month Editor Conrad Persson talks about the origination and development of words describing our fast-moving industry. He is right, of course when he comments that we are developing technology faster than we can name its products!

Before acquiring ES&T, we were involved in publishing magazines and newspaper — to, and for, the computer/electronics OEM industry. (As a matter of fact, we still do some work for computer-based publications.)

In the OEM market we see a strong sense of amazement and excitement as each technological development arrives, resulting in another new product to be grabbed up by businesses and consumers alike. Each of these products offer the buyer a perceived advantage, benefit or status over their business or residential neighbor.

We were caught a little off guard then, when we ventured into the ES&T market and found the spark — the excitement — of new ventures, new technologies and new opportunities wasn't as prevalent as we expected.

Whether due to a past lack of cooperation and participation by the OEMs, or the influx of too many new products over the past several years, or simply just because of information overload, we cannot answer. But, we can work to understand and possibly present another perspective.

Every professional servicer simply cannot learn, and know, everything about servicing the plethora of new products invading our conscience (especially during this holiday season). However, we certainly want to stay alert to the opportunities offered. Maybe we need to pick our targets. After all, no one seems to be an expert on all aspects of the computer, let alone the technology.

Maybe we need to form small organizations of professionals from several parts of our business — Audio, Digital TV, monitors, printers, servers, surveillance, personal electronics, white goods, etc. — and market "one stop maintenance and repair facilities". Doctors have found this to be a marvelous way of sharing facilities and patients without each having to be experts in multiple disciplines.

Age 65 was the common age for retirement for a pretty simple reason - we were not expected to live much beyond that milestone. Today, we expect to live well into our 70's, 80's and even 90's. We shouldn't be looking at becoming non-productive or unaware for 20 or more years.

Let's get excited again! CES is being held in Las Vegas in January with more new products, technologies and opportunities than ever. Need more? The video game business is now valued at more than \$6 Billion per year...virtually the same as the entire movie industry! According to news reports as we write this column, some 30% of the new PS2 playstations sold this holiday season are expected to have technical difficulties. Warranties and guarantees notwithstanding, how many will come into your shop in January?

*Mark Marcellino*

*Paul Allen*



# 2001 EDITORIAL SCHEDULE



Watch for these Features, Special Reports, Technical Updates and other articles designed to help Consumer Electronics Service and Maintenance Professionals stay current and grow.

ISSUE	SPECIALS	COMPUTERS/ NETWORKING/ AUTOMOBILE ELECTRONICS	CONSUMER ELECTRONICS	TOOLS/ EQUIPMENT COMPONENTS	HOME THEATER	50TH ANNIVERSARY	SHOWS/ CONFERENCES
<b>JAN</b>	CES SHOW ISSUE NASC PREVIEW	2000 ANNUAL INDEX OF ARTICLES AND PROFAX SCHEMATICS	DVD Playstations	Materials Handling: ESD to Moving Equipment		50th Anniversary – History Part 1	CONSUMER ELECTRONICS SHOW (CES) 2001 January 6-9, Las Vegas Convention Center, Alexis Park & Riviera, Las Vegas NV
<b>FEB</b>	NASC SHOW ISSUE	REFERENCE ISSUE on Service Tips: CD's, Webs and OEM contacts	Scanners	VCR/TV Combos	Service Management Software	Phone Systems	Service Center Management Trends
<b>MAR</b>	COMDEX PREVIEW NASC REVIEW	TOOLS AND TOOLCASE SHOWCASE and Review	Printers	VCRs	Test Equipment Update	Designing Your Showcase Site	Circuit Board Rework Opportunities, Solutions
<b>APR</b>	COMDEX SHOW ISSUE EDS PREVIEW	DISTRIBUTION SHOWCASE and Review	Rewritable Disk Systems	CCTV	Test Probes/ Accessories Update	Antennas/ Top Boxes for HDTV	50th Anniversary – History Part 2
<b>MAY</b>	COMDEX REVIEW, CABLE-TEC SHOW ISSUE, EDS SHOW ISSUE, NETWORKD+INTEROP SHOW ISSUE	15th ANNUAL WEB and BUYER'S GUIDE. Includes multiple manufacturer/ distributor listings in the Product Directory and a Company Contact Directory, including Web and Email addresses	Monitors	Marine Electronics	Electronic Servicing Supplies	Audio/Sound Installation and Maintenance	Cost of Service Today
<b>JUN</b>	EDS, COMDEX, CABLE-TEC & NETWORKD REVIEWS		GPS/Auto, Marine, etc.	Camcorders	Soldering Desoldering	Network Installation and Maintenance	Learning Programs
<b>JUL</b>	NPSC PREVIEW		Auto Computer Systems	Microwave Ovens	Oscilloscope Update	Servers	50th Anniversary – History Part 3
<b>AUG</b>	NPSC SHOW ISSUE CEDIA PREVIEW	REPLACEMENT PARTS SHOWCASE and Review	Firewire	Digital TV	Multimeter Update	Lighting	Complying with Environmental Considerations
<b>SEP</b>	CEDIA SHOW, NETWORKD+INTEROP SHOW ISSUE	HOME THEATRE SHOWCASE and Review	Telecom Test Equipment	HDTV	Transformers	Power Management	Home Theatre Opportunities
<b>OCT</b>	CEDIA, NETWORKD REVIEW, COMDEX PREVIEW	MANUFACTURERS PRODUCT BRAND Directory	PC Testing Tips	Keyboards/ Organs	SMD	Servicing \$10,000+ TVs	50th Anniversary – History Part 4
<b>NOV</b>	COMDEX SHOW ISSUE		Computer Software Diagnostics	Cassette Mechanisms	Power Supplies	Rear Projection	Servicing TVs Today
<b>DEC</b>	COMDEX REVIEW	TEST EQUIPMENT SHOWCASE and Review	Internet Access	CD Players	MPU's	Security	New Technology Update

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Sencore Technical training tape no. TV 300, Understanding Horizontal Stages, with workbook in binder (used one time) \$30 plus freight, The Servicer's Advantage by Sencore Tech Tips no. 101 through 230 in binder \$30 plus freight. Also, ES&T magazines years 1983 through 1992 (120 issues) and years 1994 thru 1999 (49

issues, 11 missing) \$50 plus freight. Will send everything for \$100 plus freight. T.T. Walton, 3403 Crestmont Dr., Midland, TX 79707, Phone 915-520-6553.

Sencore VC93 Video Analyzer, like new, all probes, manual, video tapes, \$825.00. Contact James Wajid 914-831-5981.

Radio Shack 3-Meter CB Tester \$15. NRI Signal Tracer \$25. Fluke 806DA True RMS Multimeter \$200. Microwave Oven Leakage Tester \$40. Contact Leonard Duschenchuk 561-871-5831.

Sencore SC 3100 Waveform Analyzer \$2,300.00. Sencore VC93 VCR Analyzer \$1,100.00. Both in mint condition. Please contact Steve Berry at 734-586-4137 or email sberry5401@aol.com.

## WANTED

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Schematics for Bogen Amplifier model# MX30A (not MX30 covered in Sams 491-5) and Rauland model 4160C. John J. Trimble 72 Holly Drive New Holland, PA 17557 Phone (717) 355-6724

Yoke for Curtis Mathes Color TV model# A2647 RC Chassis C87-7 part # 48007215. Need price and availability. Phone (701)225-4996 Fax (701) 225-4996

Mitsubishi 35" TV model #CS-3504R - need front door part #702C757030. Contact Todd in Felton, PA at 717-993-5164.

SCREAN for Lap-Top, Toshiba Satellite 335 CDT or 330. 718-477-1385, email jkmny@aol.com.

Marantz FC #LC-6554-4151 or Marantz AMP Model IA2232SB. For parts, Mackenzie TV Service, 1800 N. Scottsdale Rd., Scottsdale, AZ 85257. Phone: 480-946-7270. Fax: 480-946-2549. Email: marjmac@home.com.

CRT's for NEC 6PG+ or 9PG+ Projectors PT#

E8508A - RP, GP, BP or copy of service manual. Fax: 562-924-9626.

Need service manual, Schematic, for a NEC-Model CD-510-CD player. Will copy and return or buy. Murray's Repair Service 561-966-8862.

## IN MEMORIUM

On November 7, 2000, the service industry suffered a staggering loss. Ken Hull, an industry icon, suffered a fatal heart attack while attending Church. While we knew that Ken suffered from heart problems, this was unexpected. The world is a lesser place.

Those who knew Ken or dealt with him know the love he had for our profession, and how he relished being a vital part of it. We were endlessly amazed by his devotion to the tips program that he founded, and endlessly amazed at the number of hours he spent helping everybody that he could. Ken will be missed by many, many folks who benefited greatly from his service and attention.

Few in our industry ever accomplish more than creating a job for themselves and perhaps a few others. That KDTV Software lives on after Ken's passing is a true testimony to the greatness that he achieved during his lifetime.

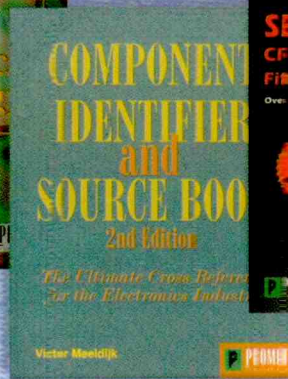
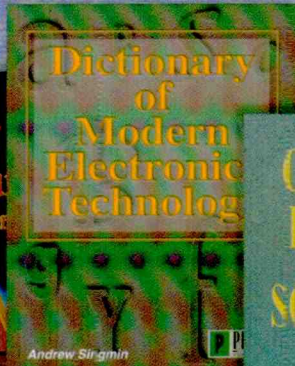
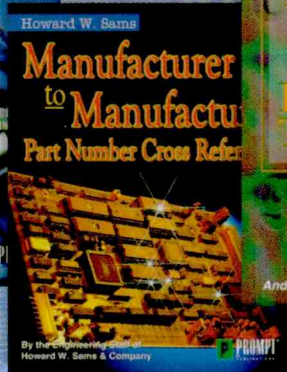
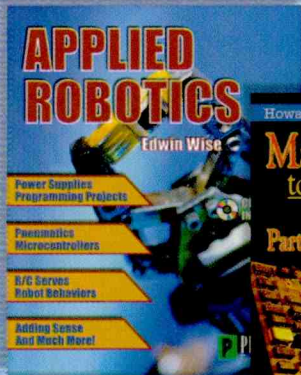
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