

THE PROFESSIONAL MAGAZINE FOR ELECTRONICS AND COMPUTER SERVICING

# ELECTRONIC<sup>TM</sup>

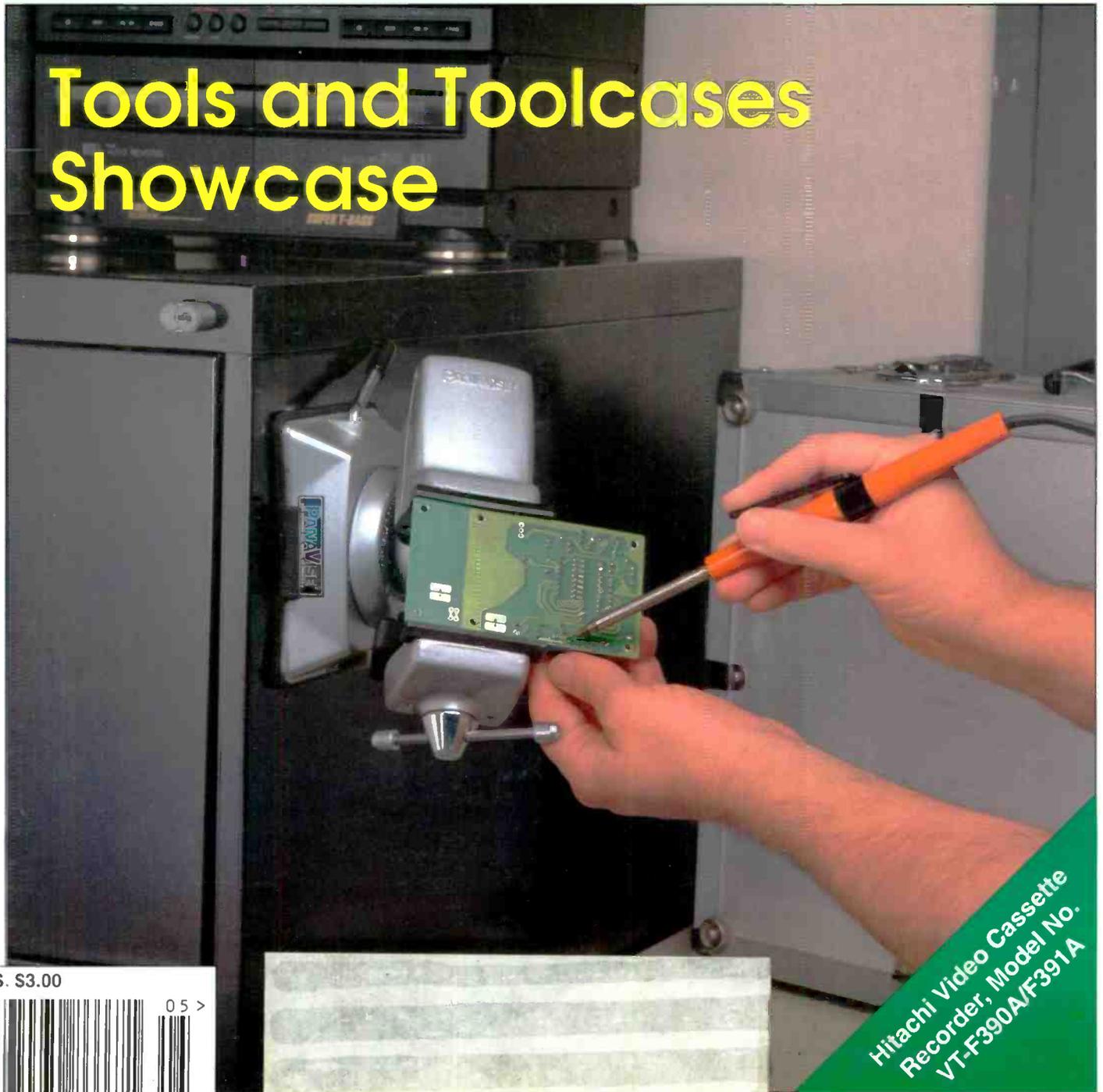
Servicing & Technology

May 1997

Camcorder servicing

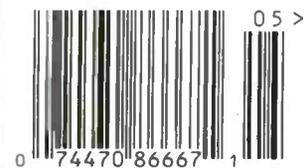
Troubleshooting tips on the web

## Tools and Toolcases Showcase



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# ELECTRONIC

Servicing & Technology

Volume 17, No. 5 May 1997

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*By Homer Davidson*

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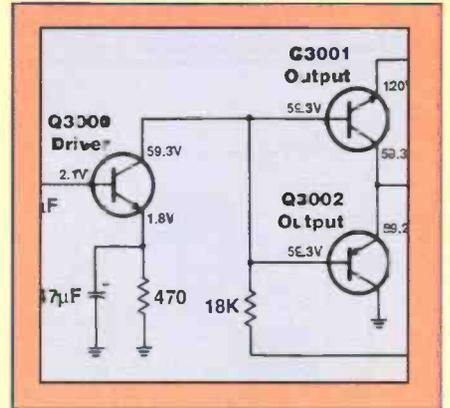
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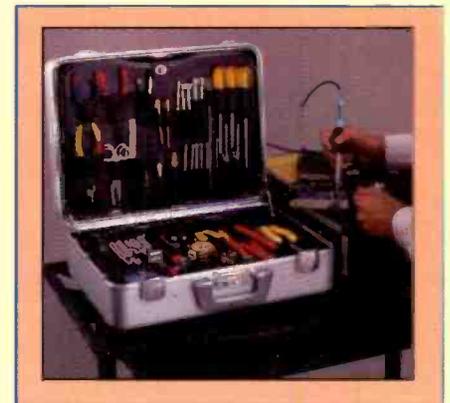
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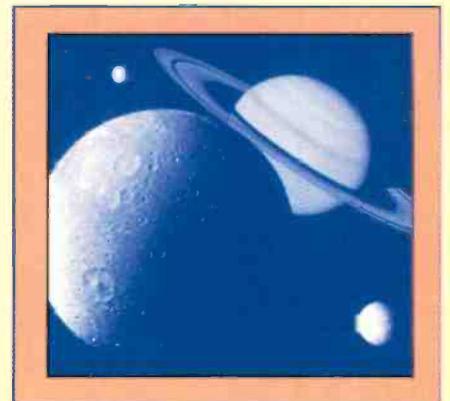
In order to perform their job, a technician must begin by getting the right tools and the right toolcases to carry them in. This showcase gives our readers the chance to see from the advertisers what the latest tools and toolcases are on the market.



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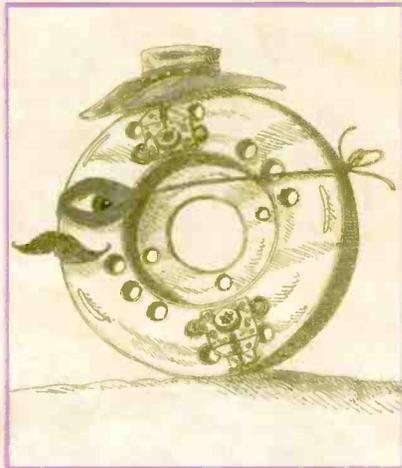
### ON THE COVER

Every profession, skill, or trade requires its own special tools. The best place to buy those tools is from a company that understands the special needs of the professionals to whom they sell, and who stock the tools they need. This Tools and Toolcases Showcase provides readers with some information on the capabilities of providers of tools to electronics technicians. (Photo courtesy Panavise)

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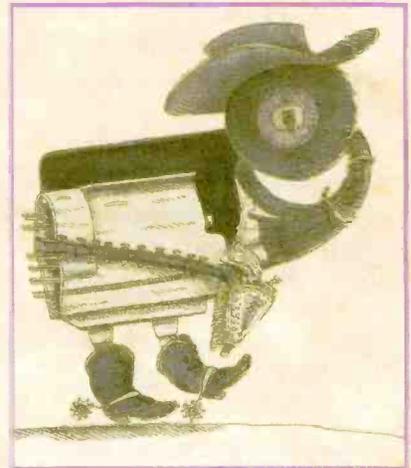
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# Creativity in servicing

If asked if they were creative, most consumer electronics servicing technicians and service managers would probably respond with a negative answer. They simply manage a service business, or service consumer electronics products. Nothing creative there, right?

Well, maybe. But on the other hand, they just might be very creative. And just possibly, if they recognized their creativity, they might possibly become even more creative and improve their service techniques, or make their business even more efficient and profitable.

For example, operating a business can be a very creative pursuit. In these difficult times, of people throwing away a VCR because they can buy a new one for under \$200, of increasingly complex consumer electronics products, or extreme competition for the services of electronics technicians from the local high-tech manufacturers, most managers of consumer electronics businesses have to be creative just to stay in business.

And creativity applies to the servicing technicians, as well. In fact, the pages of this magazine often reflect the creativity of the technicians who write articles for it. As an example, an article that was published a few years ago described how one technician had devised a way to use simple-to-construct transformers to solve the problem of short circuits between the heater and the cathode of a CRT, thus saving many picture tubes that would otherwise have been thrown away.

Another creative solution presented in this magazine described construction of a device using an infrared detector and assorted other components to easily test the infrared remote control transmitters used in TVs, VCRs and audio equipment.

## Troubleshooting is creative too

The mere act of troubleshooting is a creative act. The technician has data in the form of manufacturers' literature and his own knowledge of electronics theory.

When he encounters a problem in a given product, the technician compares the symptoms with what information he has available and, based on that, arrives at a tentative determination of what the problem might be. Then he tests his theory and sees if that solves the problem. If it does, he has completed the troubleshooting process. If not, he considers the problem again, and again comes up with a theory as to what the problem might be. He continues along in that vein until the corrective action he applies eliminates the problem. This entire process may be considered to be a very creative one.

Another example of creativity on the part of some technicians is evident in some of the diagnostic procedures and aids that some technicians have devised. For example, you have all heard of, and probably used the 100W lightbulb trick. When the problem in a TV set is such that the line fuse blows instantly, insertion of a lightbulb in the power line limits the current into the set, and the brightness of the bulb provides an indication of the amount of current drawn. Whoever came up with that idea was creative indeed.

And another technician came up with the idea of isolating a circuit and using an outside power supply and a signal generator to substitute for a signal input that would ordinarily come from another circuit. Thus isolated, if the circuit provided a normal output, the technician knew that something in the set other than this circuit was the cause of the problem. If the isolated circuit did not operate properly, it was the cause of the problem.

## Becoming more creative

If creativity is an important ingredient in running a servicing business, and servicing technicians and managers recognize that it is, they would be able to use certain techniques to increase their productivity. One technique that has been described by an expert on the subject, Edward de Bono, is called "lateral thinking."

De Bono has authored several books on the subject of creativity, including "Lateral Thinking," and "Serious Creativity."

Rather than try to summarize the idea of lateral thinking, I will paraphrase it. At least part of the idea is to generate a number of alternate avenues to achieve a desired objective. Let's take the example of the light bulb trick. Several ways to attempt to capitalize on this idea would be to throw out a number of ideas/questions. For example:

- Are there other ways to limit the current and get an indication of current draw while troubleshooting a TV that keeps blowing fuses?
- Is there a different approach to this problem that might work even better?
- Can a technique similar to this be devised that would work for other difficult servicing problems?

It's important during the phase of creativity during which you're generating ideas not to evaluate them. For example, you might come up with a good idea, but decide that it wasn't safe, or it would be too expensive. If you immediately kill this idea for that reason, you put a damper on the whole process, and kill any other ideas that might have sprung from the idea you squelched.

What you should do instead is to just generate ideas without evaluating them in any way, then evaluate, cull and discard ideas in another part of the process.

## Creativity works anywhere

Creativity can work in any phase of the business, from dealing with customers to generating more business, to servicing the product more efficiently. If nothing else, attempts at being creative will help you focus on your business, rethink what it is that your business is all about, and give you some fresh insights.

*Nile Conrad Penner*

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Developed specifically for the electronics production and service industries, the LS 1020 is equipped with features typically found only on higher bandwidth scopes. It is ideal for use on the audio bench, and can be used as a second scope for video troubleshooting as well. The unit is equipped with TV-V and TV-H coupling, has a 5 mV/div sensitivity (0.5 mV/div with X10 on), and includes both CHOP and ALT vertical mode functions. Rugged and reliable, the LS 1020 provides service professionals with an affordable choice without compromising features or quality.

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**January video product sales advance in most categories; larger screen sizes continue to show strength**

Beginning the new year on a positive note, January sales of video products posted gains virtually across the board, the Consumer Electronics Manufacturers Association (CEMA) reported today. Video cassette recorder (VCR) decks, camcorders and color TV/VCR combinations all registered unit sale increases in the 20-percent range, as compared with the same month a year ago.

Projection TV sales to dealers also continued to expand at a robust rate, rising 8 percent in January. And while sales of direct-view color TV receivers grew only fractionally last month, the larger screen sizes again enjoyed strong double-digit expansion. Sales of color television sets measuring 25 inches and above increased 13 percent, and sales of those 30 inches and larger jumped 26 percent.

William J. Sims, President of Zenith Sales Company, said, "Taken together, the solid industry growth numbers for large screen, direct-view receivers and projection TVs confirm our belief that consumers continue to embrace home theater, which has become a dominant force in today's video marketplace."

Coming off an all-time record year in 1996, during which some 14.6 million were sold, VCR deck sales last month totaled nearly 984,000 units, a 20.4 percent improvement over January a year ago. Color TV/VCR combinations reported healthy growth as well, rising 19.4 percent to more than 141,000 units, although within that category the results were mixed. Combination sets with TV screen sizes 20 inches and smaller surged 35 percent and accounted for 93 percent of sales, while those with larger screens tumbled 51 percent.

Camcorders, another record-setting category last year, enjoyed strong growth in January. More than 213,000 camcorders were shipped to dealers last month, up nearly 21 percent relative to January 1996's 177,000 units.

In the industry's flagship category, direct-view color television unit sales to U.S. dealers totaled nearly 1,174,000 last

month, a 0.6 percent improvement over January 1996. In addition to vigorous growth in the large and very large screen sizes, the 19- and 20-inch market showed welcome signs of stabilizing. Sales of these mid-sized receivers, which have been soft in recent months, increased a modest but significant one percent in January on volume of 393,000 units.

Dealer purchases of laserdisc players continued to decline, dropping 42 percent in January to some 7,600 units.

**Small office/home office use to increase over the next few years, CEMA survey reveals**

Many home office users plan to spend more time in their home offices in the next two to three years - according to a survey released today by the Arlington, Virginia-based Consumer Electronics Manufacturers Association (CEMA). Forty-five percent said they will spend "a lot" or "somewhat" more time in their home offices, while 41 percent indicated "the same amount of time".

"As exciting new computing and communication technologies open the doors to a full range of business opportunities at home, and online banking and shopping proliferate, we see home offices continuing to find their way into more and more American households," said Gary Shapiro, CEMA president. "The Internet,

*(Continued on page 61)*

**CORRECTION**

**April's Distributor Showcase contained the wrong telephone number for Thomson Consumer Electronics.**

**For more information on Thomson OEM parts and SK Series Universal parts please call 1-800-336-1900**

**ELECTRONIC**

Servicing & Technology

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

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## Spring 1997 catalog test equipment, tools, and supplies

This 56-page catalog supplement from Contact East features test instruments and tools for engineers, managers, technicians, and hobbyists, for testing, repairing, and assembling electronic equipment. Product highlights include DMMs and accessories, soldering tools, custom tool kits, EPROM programmers, power supplies, "create your own" tool kits, ELF meters, milliammeters, megohmmeters, wavemeters, breadboards and reference books. Also included are communication test equipment, scopemeters, datacom tools and testers, adhesives, measuring tools, precision hand tools, portable and bench top digital storage scopes, solder-

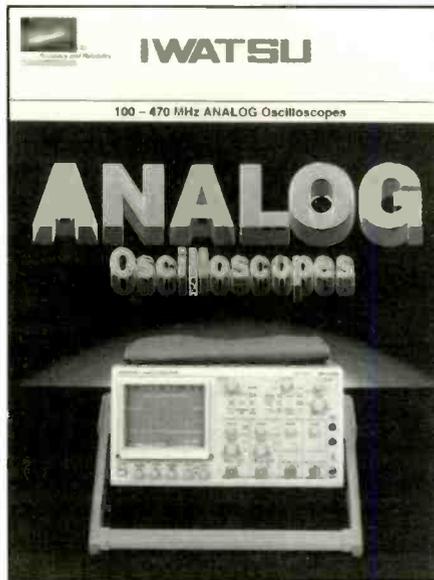


ing/desoldering systems, static protection, ozone-safe cleaners, magnifiers, inspection equipment, tool bags, workbenches, cases and more.

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### Oscilloscope catalog

A new multi-colored, 16-page catalog from Iwatsu incorporates detailed call-outs of key features to clearly delineate the operating potential of the company's oscilloscopes. The units include the Model 7840H, 470MHz, 4-CH, 10 trace scope; the Model 7840, 400MHz, 4-CH, 10 trace scope; the Model 7821, 200MHz, 3-CH, 8 trace scope; and the Model 7811, 100MHz, 3-CH, 8 trace instrument. Key characteristics include: TV triggering,



frequency counter operations, cursor measurements, high-speed automatic setup, unique box lens CRT, DC offset function, TV pedestal clamping, input event triggering, multi-function control, and FET probe power and probe offset.

The publication utilizes actual CRT signal pattern readouts to illustrate applications ranging from: video head frequency modulation signal observation; "eye-pattern" observations used in the development and manufacture of optical discs and telecom ATM switches; wide bandwidth noise on magneto-optical discs; and observation of radar burst.

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### Torx tool catalog

Wiha Tools has published a new, four-color catalog featuring their extensive line of Torx tools. This 12 page catalog details the company complete line of over 250 Torx tools in 23 different styles all designed for Torx fasteners. These tools are ergonomically designed and manufactured of hardened CVM tool steel.

Sizes of these tools range from T5 to T60. Also available are screwdrivers and bits for tamper resistant Torx.

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### Supplemental catalog

The latest 72-page, full-color Jensen supplemental catalog is now available. It joins the company's comprehensive master catalog in listing tool kits and cases.



Among the new items featured are several economy tool kits available for a number of industrial applications, including: service and repair of electronic and electrical equipment; telecom installation; PC service, repair and upgrades; standard field service; and for general purpose equipment work. A wide range of test instruments is also offered.

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### Repair capabilities manual

Galco Industrial Electronics has released a new Repair Capabilities Manual, a detailed listing of over 34,000 different products from more than 2,000 manufacturers of circuit boards and electronic controls that can be repaired or retrofitted by the company. A list repair price is given, as well as detailed listings of instrument calibration capabilities that are traceable to NIST standards, and a listing of available remanufactured controls that are kept on hand to assist customers in getting out of a "down" situation quickly.

Repair capabilities featured in the manual include ac and dc variable speed drives, counters and timers, CNC controls, encoder devices, power supplies, printed circuit boards, programmable logic controllers, servo and spindle drive systems, temperature controllers, test equipment and video display monitors.

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# ES&T Calendar

EIF '97

Electronic Industries Forum of  
New England  
May 6-8, 1997  
World Trade Exhibition Center  
Boston MA  
800-322-9332  
e-mail: summitexh@aol.com

Electronic Distribution Show  
May 13-15, 1997  
Las Vegas NV  
Sponsored by EIA/CG  
(Components Group)  
703-907-7547

Support Systems Expo  
May 14-15, 1997  
Boston, MA  
207-846-0600

Spring Comdex/CES Orlando  
May 23-25, 1997  
Orlando, FL  
703-907-7600

Spring CES '97 co-located with  
COMDEX/Spring WINDOWS  
WORLD  
June 2-5, 1997  
Atlanta, GA  
703-907-7674

VPEA (VA) Annual State Convention/  
Mid-Atlantic Assoc. Conference  
June 6-8, 1997  
Williamsburg, VA  
804-874-8818

T-E-A (TX)/G-SPEC Convention  
June 12-15, 1997  
San Antonio, TX  
512-476-3551

CES Habitech '97 - The Home  
Systems Trade & Training Show  
June 24-26, 1997  
Dallas, TX  
703-907-7674

CEMA Manufacturer/Retailer Summit  
June 25-27, 1997  
Bermuda  
703-907-7674

NESDA 47th/ISCET 27th/ and NIAS  
5th Annual National Professional  
Service Convention and Trade Show  
August 4-9, 1997  
Las Vegas, NV  
817-921-9061

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

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

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

CES Mexico  
October 8-10, 1997  
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# Servicing television directly coupled circuits

By Homer Davidson

**D**irect coupling is a method by which one circuit is connected to another to transfer the signal without benefit of a coupling capacitor or transformer. In early TV sets, transformer coupling was used in the tube circuits. Capacitors are used to couple circuits together while keeping dc voltages in one circuit from affecting the circuit to which it is coupled. Today, direct-coupling of circuits is found in transistor and IC circuits.

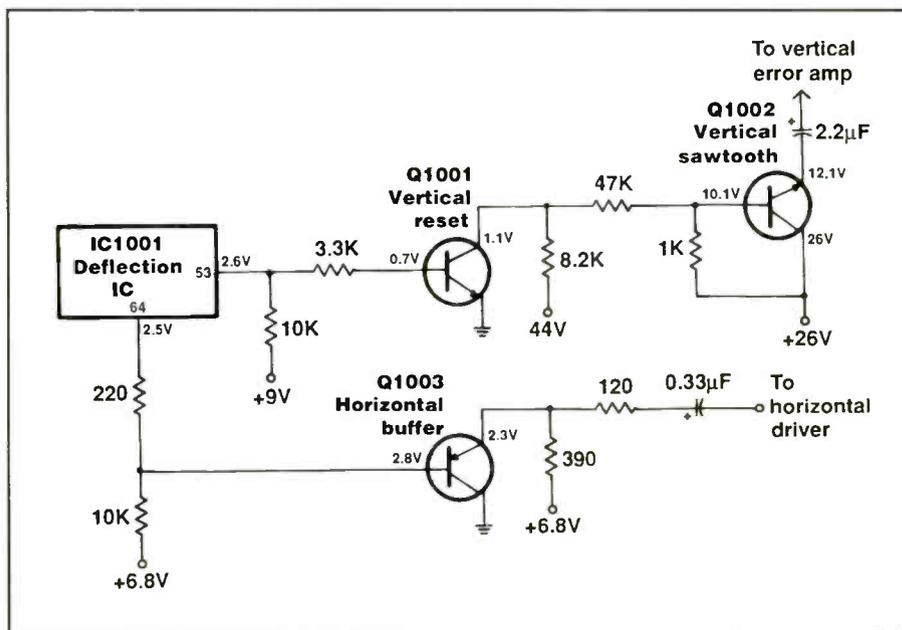
Direct circuit coupling is a different and economical method of connecting circuits together. Directly coupled circuits are found in the vertical, horizontal, luma, chroma, color output, power supply, and audio output circuits of the TV chassis. In directly coupled transistor circuits, dc voltages found on the collector terminal may be applied to the base terminal of the next transistor stage. Directly coupled circuits tend to be more difficult to service as a defective transistor might cause changes in voltages in the circuits to which it is coupled.

## Directly coupled circuits

Many types of circuits transfer signals besides those that are directly coupled. Frequently capacitors are used to couple two stages together. Capacitor coupling transfers ac energy between two different circuits, while blocking any dc. For example, a capacitor may be used to couple two audio stages together so that the audio signal will be transferred, but dc voltages will be blocked.

Electrolytic capacitance coupling is found between the audio output IC and the speaker. Capacitor coupling is used in many stages of the audio, video, horizontal, vertical and CRT circuits.

Transformer coupling uses electromagnetic induction to transfer electrical energy from one circuit to another. In-



**Figure 1.** In this set, the horizontal and vertical deflection circuits are directly driven from terminals of the deflection IC.

terstage and output transformers were used in the early audio stages between the af or driver transistors and from the output transistor to the speaker to transfer the audio signal. Transformer coupling is found between the horizontal driver and horizontal output transistor in the horizontal circuits of the TV chassis.

Inductive coupling is sometimes used in radio and TV if transformer circuits. Transformer coupling is much more expensive than direct coupling of circuits. "Link coupling" uses a low impedance coil that couples RF circuits together. The impedance-coupled amplifier uses a coupling capacitor and single-wound transformer for output load coupling.

## Horizontal and vertical directly coupled circuits

In early TV sets, transistors were used throughout the vertical circuits, and in some horizontal circuits as well. Today's deflection IC provides both vertical and horizontal drive signals. Two or three

transistors were found in the early vertical output circuits.

Present-day vertical circuits may consist of a vertical deflection IC with direct coupling between the vertical reset and sawtooth transistors (Figure 1). In this circuit, the vertical sawtooth waveform is coupled with a 2.2µF capacitor to the error amp and output circuits.

When either of the transistors in this directly-coupled circuit becomes open or develops leakage, voltages on both transistors will be affected. If Q1001 becomes leaky, higher voltages will appear on its base and emitter terminals. In most cases, a transistor that has developed leakage will have nearly the same voltage on all three terminals.

Notice the voltage measurements during normal operation of the vertical sawtooth transistor (Q1002). When leakage occurs between the collector and emitter terminals, higher voltages are found on all three elements of Q1002. The higher base voltage of Q1002 is applied through

the 47 $\Omega$  resistor to the collector terminal of transistor Q1001.

When transistor Q1002 appears open, the voltage at the emitter terminal will be very low, possibly 0V, while the voltages at the collector and base terminals will be higher than normal. Again a higher collector voltage is found on Q1001.

A leaky vertical reset transistor, Q1001, will reduce the voltage on the collector terminal with the 8.2 $\Omega$  resistor operating quite warm. When Q1001 becomes open, higher dc voltage will be found on the collector terminal. Naturally, when either transistor becomes defective, the vertical sweep signal at the vertical output IC will be weak or totally absent, resulting in improper vertical sweep, or, in extreme cases, horizontal white line in the center of the screen.

### Service the directly-coupled transistor vertical circuit

To quickly service the vertical directly coupled transistor circuits, observe the waveform at pin 53 and at the input terminal of the output IC. Scope each stage to locate the defective component. If the vertical deflection waveform is normal at pin 53 and not normal at the input terminal of the output IC, measure the voltages on each transistor.

Suspect a leaky transistor if the voltages are lower than specified and quite close to the same on all three elements. Check for an open transistor if the voltages on the base and collector terminals are higher than specified, and the voltage at the emitter terminal is very low. If there is any doubt, test each transistor out of the circuit.

In the circuit of Figure 2, the horizontal waveform on pin 64 of the deflection IC drives the horizontal buffer, driver and output transistors. The buffer base terminal is directly tied to pin 64 through a 220 $\Omega$  resistor. If Q1003 became shorted between collector and emitter, the 6.8V would be applied across the 390 $\Omega$  resistor. This voltage at the emitter terminal would be very low, which would cause a different voltage on the base terminal and at pin 64 of IC1001.

A quick forward bias voltage measurement between emitter and base will indicate a leaky transistor. If the voltage difference between these two elements is not 0.5V, suspect that Q1003 has developed

leakage. If Q1003 becomes open, the voltage at the emitter will be 6.8V.

In deflection circuits where the supply voltage (Vcc), for the deflection IC is derived from the flyback source, if the horizontal circuitry is defective, the flyback voltage source will be dead, thus there will be no supply source from the flyback circuits. In such a case, an external voltage must be supplied to the IC so that you can check the vertical and horizontal output waveforms with the scope. Horizontal and vertical drive circuits are more easily serviced when the supply voltage is supplied by the low voltage power supply circuit.

### Direct coupled luma amp circuits

A black screen or insufficient brightness can result from the luma amp circuits (Figure 2). In this circuit, three different transistors are used as luma (brightness) amplifiers. Transistors Q1501 and Q1503 are directly coupled with a delay line and an 820 $\Omega$  resistor between the collector of Q1501 and the base terminal of Q1503. Transistor Q1504 is directly coupled from the base terminal to the collector of Q1501. Switch Q1502 is controlled by a logic signal from the system control IC (U3101).

If any of the luma transistors become shorted or develop leakage, the voltages will change on all of the transistors. Leakage between the collector and emitter of Q1504 will cause the emitter and base voltages to increase. If Q1504 opens internally, the voltage at the emitter terminal will be very low. Check the forward bias voltage between the emitter and base terminals to confirm whether or not the transistor is defective.

If luma amp Q1501 develops leakage, its collector and emitter voltages will increase. Moreover, the base voltage on Q1504 will slightly rise in voltage. If Q1501 opens between collector and emitter, the voltage at the emitter terminal will be very low and the collector voltage will be just about equal to the supply voltage (11.4V). Scope the luma circuits for correct waveforms. Check and test each transistor with the greatest change in voltage on all three terminals. Compare your findings to the schematic.

### Directly coupled chroma circuits

Often, one or two transistors can be

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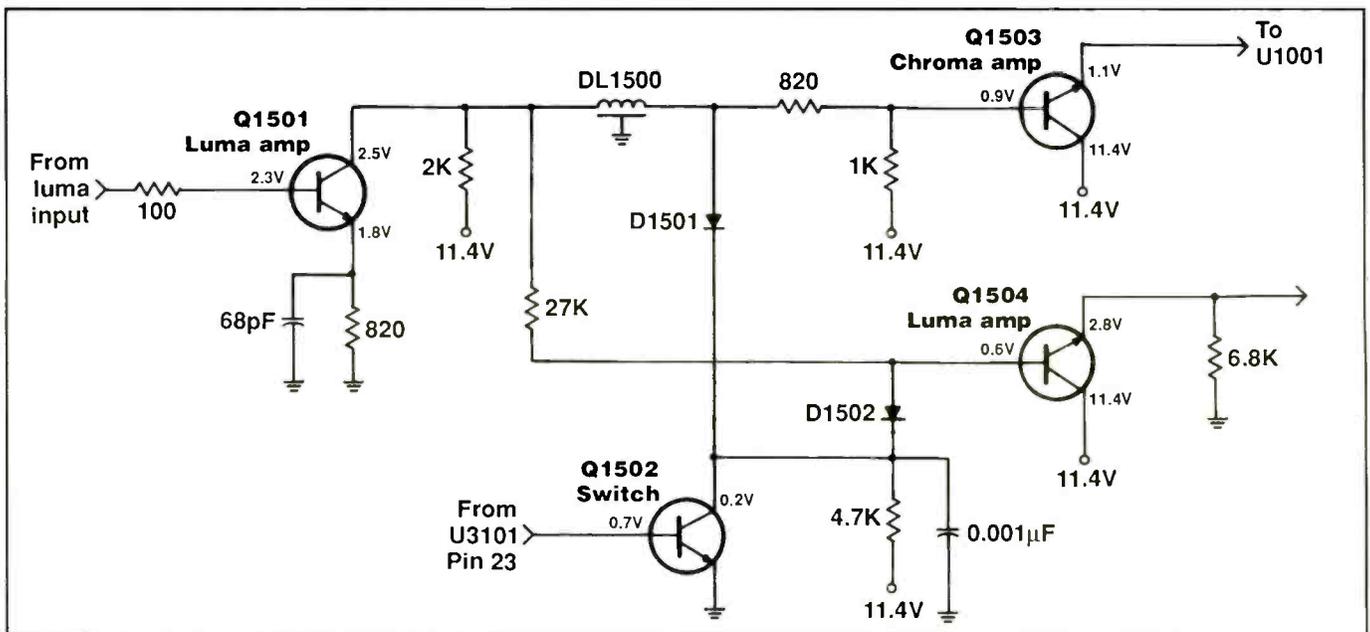


Figure 2. Directly-coupled transistor circuits may be used in the luma (brightness) circuits.

found in the chroma circuits of the present day TV chassis. In the circuit of Figure 3, chroma amps Q750 and Q751 operate in a directly coupled color circuit from the emitter of Q750 to the base of Q751. The 270Ω resistor connects the two chroma amps together. Both chroma transistors are connected in the emitter-follower configuration with the collector terminals tied to the supply source which has a voltage level of 11.2V.

Notice that Q750 has a forward bias of only 0.2V between base and emitter, while Q751 has a 0.7V bias voltage. If leakage occurs between the collector and emitter of Q750, the bias voltage on Q751 would increase. Furthermore, both base and emitter voltages on Q750 would increase and the voltages on all three elements would be very nearly equal. In most

cases, when a transistor develops a leakage or a short circuit, it occurs between collector and emitter terminals.

If Q751 develops leakage between its emitter and collector terminals, the voltage will rise on both emitter and base terminals. In such an event, the emitter voltage will be higher than the base voltage. Higher voltage will be applied across the 10Ω emitter resistor. In most cases, careful measurement of voltages on the transistor elements, measurement of the forward bias voltage, and in-circuit transistor checks can locate a defective transistor. If in doubt, replace both transistors.

### CRT directly coupled circuits

The red, blue and green color drive transistor circuits connect to the respec-

tive cathodes in the picture tube and work in a directly driven circuit. The red drive transistor (Q560) in, drives the red color output transistor (Q561) with Q562 as the red bias transistor. The collector terminal of Q560 connects directly to the base terminal of output transistors Q561 and Q562. All three transistors operate at higher voltages than do most transistors in the TV chassis.

When the red color output transistor becomes leaky, higher dc voltage is found on the base and emitter terminals of both Q561 and Q562. The voltage at the collector terminal of the red bias transistor will also increase. Since the collector of Q560 is connected directly to the base terminal of Q561, the voltage on Q560 will increase (Figure 4). In such a case, you will find an increase in voltage on pin 8 of the picture tube.

Since the color output transistor may break down if its dc operating voltage becomes excessive, test Q561. Perform this test out of the circuit, as Q561 and Q562 base and emitter terminals are in parallel, which might produce an erroneous in-circuit reading. Test Q560 and Q562 with in-circuit tests while Q561 is out of the CRT board.

Do not overlook a leaky or open drive and bias transistor that may destroy the color output transistor. Overheated collector resistors may change in value with a shorted output transistor.

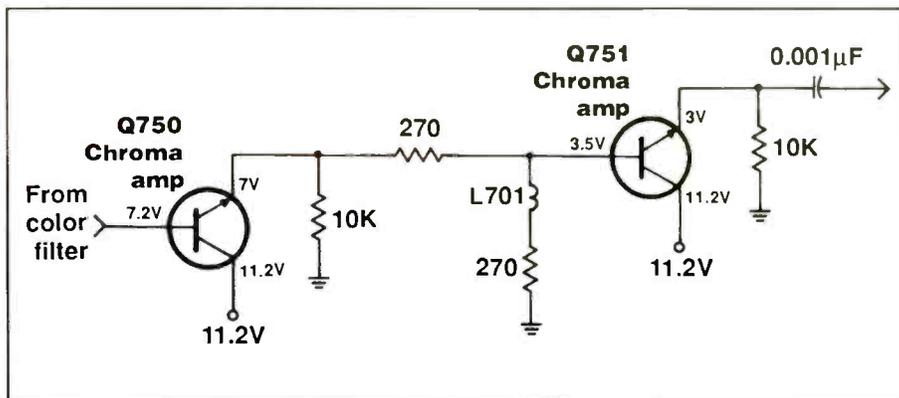


Figure 3. In many cases in today's TV sets, one or two directly coupled transistors are found in the chroma (color) circuits.

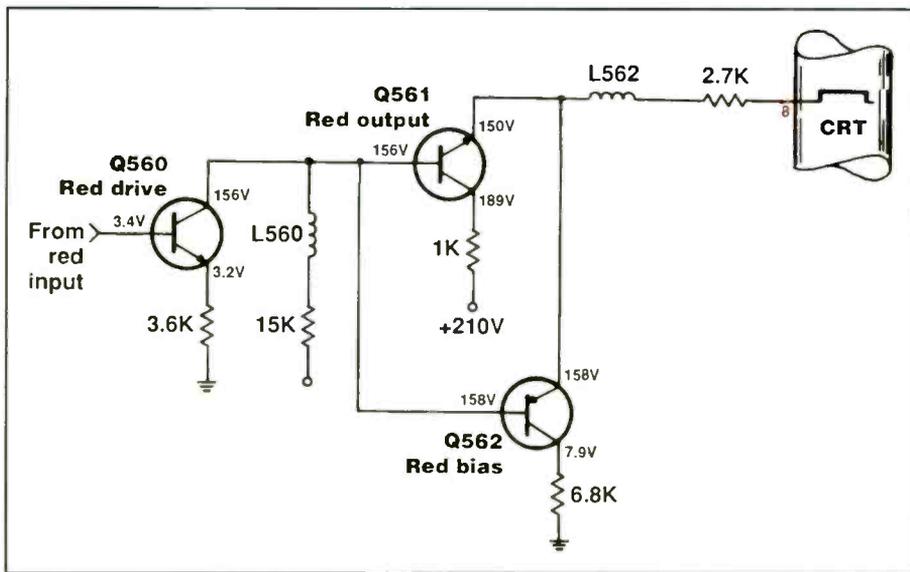


Figure 4. The color output transistors operate in directly coupled circuits.

### Directly connected audio output circuits

Today in inexpensive television sets you may find directly coupled transistors in the vertical and audio output circuits. When one or more transistors in such a configuration become leaky or shorted, the sound will be weak and distorted. Distortion may be heard when one of the output transistors in a push-pull configuration opens up. It is best to replace both output transistors when one is found leaky or open. Sometimes one transistor is found open and the other is found leaky.

In the circuit of Figure 5, if audio output transistor Q3001 becomes leaky, the supply voltage may lower, and you may measure higher than normal voltages on the base and emitter terminals of Q3001. The emitter and bias voltages on Q3002 will rise. Since the collector terminal of

Q3000 is directly coupled to Q3001, voltages will rise on transistor Q3000. If Q3001 becomes open between emitter and collector, the voltage at the emitter terminals of Q3001 and Q3002 will be very low. Besides weak and distorted audio, a leaky audio driver transistor (Q3000) can cause lower than normal dc voltages on the base terminals of both Q3001 and Q3002.

Notice that the supply voltage is very high in this audio circuit. Transistors Q3001 and Q3002 can easily break down under higher voltages. Remember to replace any one of these transistors with a higher operating voltage transistor. Test the other two transistors while one is out of the circuit. Remember in this circuit, there is a speaker coupling transformer, which supplies voltage to the base terminals of Q3002. Q3001, and the collector voltage to Q3000, from a 120V supply. ■

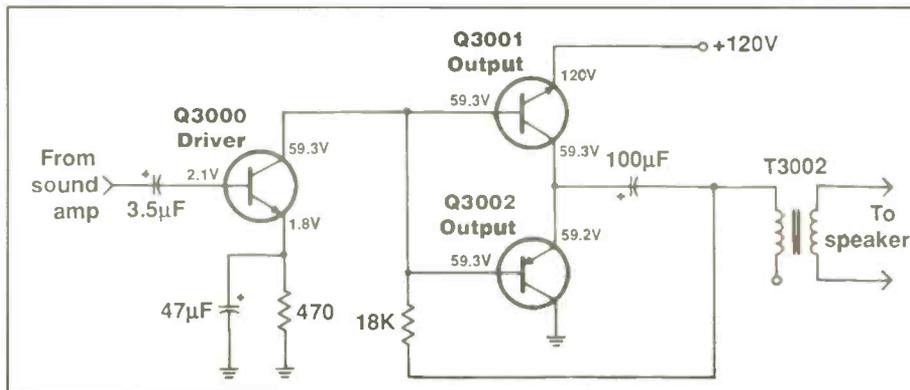


Figure 5. Transistor Q3000 provides directly coupling of the audio to the Q3001 and Q3002 audio output transistors.

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# Camcorder Servicing: Understanding chroma and burst preemphasis and deemphasis

By The ES&T Staff

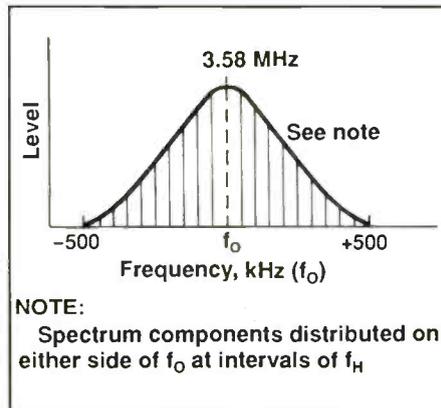
Camcorders are incredibly complex devices. They consist of not only a fully operational VCR, but a complex optical system and a great deal of signal correction circuitry. Because of this complexity, it's very easy to completely skip over some of the more unfamiliar circuit functions in trying to understand them enough to service them. This article will consider the need for chroma and burst preemphasis and deemphasis, and describe their operation. We hope this information proves useful to readers who may sometime in the future encounter a problem in these circuits.

## Preemphasis

Every electronic circuit generates some amount of noise that obscures the desired signal that is being processed by that circuit. If the amplitude of the desired signal is large by comparison with that of the noise, there is no problem. If, on the other hand, the desired signal is small in comparison to the noise, the signal will be obscured by the noise. In the worst case, the desired signal will be drowned out by noise. Anyone who has ever tried to carry on a conversation while a loud band or orchestra is playing nearby will understand the principle at work here.

In cases where noise is a problem because it's amplitude is large with respect to that of the desired signal, one way to improve the situation is to increase the level of the desired signal before it is introduced into the (relatively) noisy circuitry. The result of this amplification, if properly done, is that when the signal exits the circuitry, the noise will be small relative to the desired signal.

The process of increasing the level of the desired signal so that it will not be obscured by noise is commonly known as "preemphasis."



**Figure 1.** The chroma signal spectrum has its center frequency at 3.58MHz, and extends 500kHz above and below that frequency. The amplitude of the portion of the signal is relatively high, but the amplitude of the signal as the signal approaches the extreme frequencies falls off to zero. Noise is, therefore, a problem.

## Deemphasis

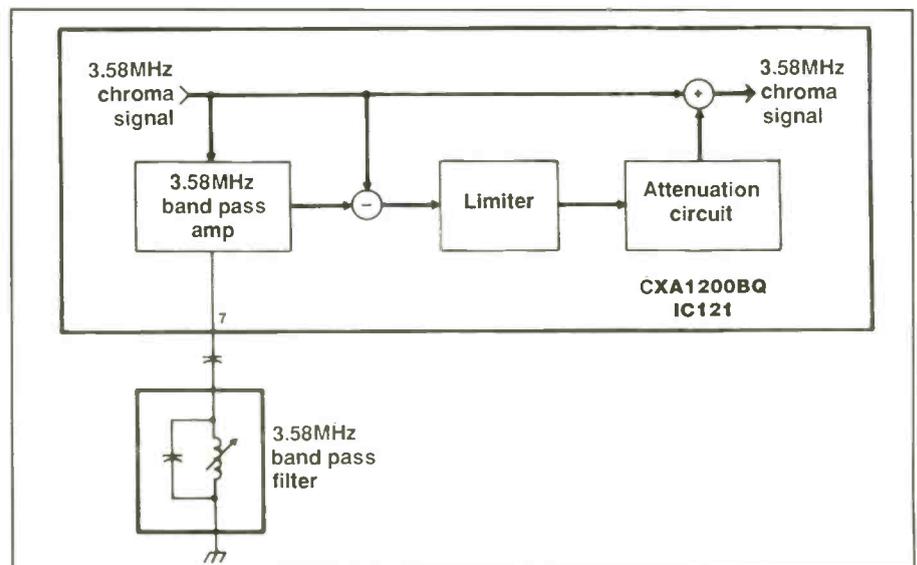
Preemphasis does a nice job of keeping the desired signal intact in spite of noise

in the circuits. It also, however, introduces another problem. When the signal that has been preemphasized reaches the circuits where it is to be converted to some useful output, or to operate with or on some other signal component, it's amplitude is now not in proportion to those of the other signals.

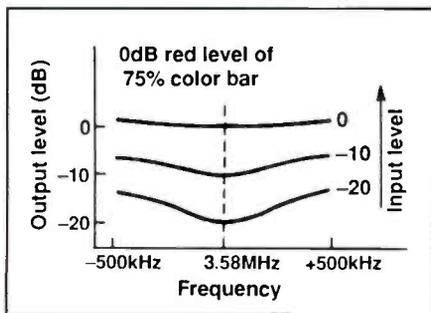
The solution to this problem is to reduce the amplitude of the signal by the same factor by which it was increased. This process is known as "deemphasis."

## Chroma emphasis

In a camcorder, the chroma, or color signal generated by the video camera section, consists of a range of frequencies of  $\pm 500$ kHz, with its center at the chroma signal frequency of 3.58MHz (Figure 1). The frequency spectrum components nearest to the 3.58MHz center frequency are relatively large in amplitude. As the frequencies in the chroma signal spectrum range above and below 3.58MHz,



**Figure 2.** A chroma emphasis circuit increases the amplitude of the chroma signal nonlinearly. The frequencies near the center get little emphasis, while the frequencies at the upper and lower extremes are emphasized significantly.



**Figure 3.** This chart shows the characteristics of the chroma emphasis circuit.

their amplitudes decrease, until at 500kHz above 3.58MHz and 500kHz below 3.58MHz, the amplitudes are zero.

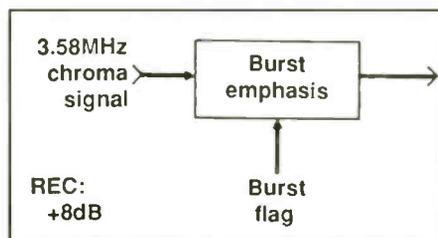
Because the chroma signal, especially at the upper and lower ends of the band, are susceptible to deterioration by noise because of their low amplitudes, the engineers who design camcorders have designed circuits (Figure 2) that increase the amplitude of the chroma signal to improve its signal-to-noise ratio.

In the circuit of Figure 2, the frequency components near the center frequency receive little emphasis because their amplitudes are relatively high, while the amount of emphasis increases as the frequencies move away from the center.

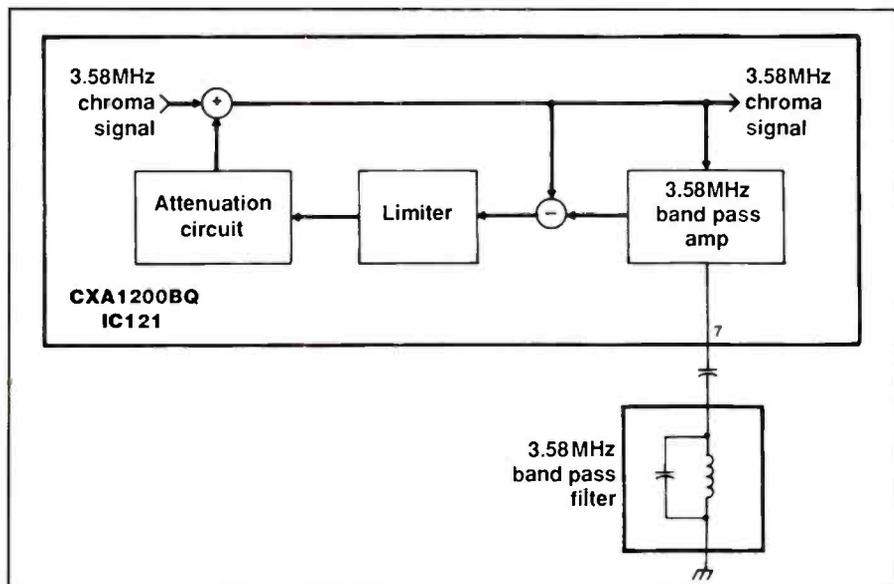
### Operation of the chroma preemphasis circuit

In the chroma preemphasis circuit (Figure 2), the 3.58MHz chroma signal follows a path that has several branches. At the first branch, the signal continues straight toward the summing point (+), but also branches to the 3.58MHz band-pass amplifier. The output of the band-pass amplifier is only the 3.58MHz center frequency signal.

The 3.58MHz signal is fed to the subtracter (-) where it is subtracted from the chroma signal spectrum, leaving only the sideband components. The sideband



**Figure 4.** The burst signal must also be pre-emphasized, by an amplifier that increases in gain during the period of the burst signal.



**Figure 5.** The chroma deemphasis circuit has an effect on the chroma signal that is equal to and opposite that of the emphasis circuit.

components are then fed to the limiter, then to the attenuator, and finally to the summing circuit where they are added to the original signal. The emphasis that results is shown in Figure 3.

### Burst emphasis

Noise that might have a deleterious effect on the burst signal is compensated for by boosting the level of the burst signal by using the burst flag to key the amplifier, increasing its gain during the burst period (Figure 4).

### Chroma deemphasis

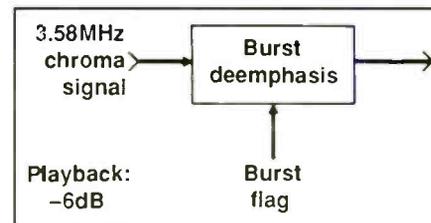
The chroma signal is restored to its original level by a chroma deemphasis circuit (Figure 5), which has an effect that is equal and opposite on the chroma signal to that of the emphasis circuit.

### Burst deemphasis

The burst deemphasis circuit (Figure 6) has an effect on the burst signal that is equal and opposite to that of the preemphasis circuit. This circuit lowers the level of the burst relative to the rest of the chroma signal by reducing the gain of the amplifier during the burst signal period.

### Chroma problems

Any problems in the color of the picture produced by a tape made on a camcorder, such as color distortion, should raise the suspicion that the cause may be



**Figure 6.** The burst deemphasis circuit decreases the gain of the amplifier during the period of the burst signal to a degree that is equal to the increase during preemphasis.

in the preemphasis or deemphasis circuits. Standard waveform and resistance checks in these circuits should reveal the component(s) that are the cause.

For example, excessive color saturation on a tape from a camcorder may be a result of improper operation of the chroma deemphasis circuit while the preemphasis circuit is operating properly.

### Theory can help troubleshooting

If a technician is unfamiliar with the theory of operation of a complex circuit such as a camcorder, he will have to rely to a great extent on guesswork and troubleshooting tips generated by the manufacturer or other technicians. The greater the knowledge of theory possessed by a technician, on the other hand, the easier it is to relate symptoms to specific circuits, and thus be able to troubleshoot without guesswork and only a limited reliance on troubleshooting tips. ■

# Troubleshooting tips on the web

By Victor Meeldijk

There is information of just about every kind on the Internet. Want to know what the weather is in just about any city? Check the net. Want to find out more about comet Hale-Bopp? Internet. Want tips on how to invest what's left of your hard earned money after you've paid your bills. Net.

It should come as no surprise, then, that you can also find tips on how to troubleshoot problems in consumer electronics products on the net. This brief article presents the URLs (universal resource locators) for several websites where you can find information on servicing of consumer electronics products.

## Elmswood

<http://elmswood.guernsey.net/>

Tips and hints on repairing VCRs and TVs. Users can submit tips or request help on a particular problem by contacting [pad@guernsey.net](mailto:pad@guernsey.net).

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

File's home page, Main Table of Contents Page 1

## Greetings

Welcome to Fil's World Wide Web Page. Each highlighted phrase (in color or underlined) is a hyper-link to another document or information resource here or elsewhere on the internet.

[Document Version: 3.02] [Last Updated: 11/7/96]

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JEM: private space

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This article was written by [filipg@paranoia.com](mailto:filipg@paranoia.com) [Feedback Form] [mailto]. The most recent version is available on the WWW server <http://www.paranoia.com/~filipg/> [Copyright] [Disclaimer]

Figure 1. When you access the electronics servicing page of the Paranoia website <http://www.paranoia.com/~filipg/>, you will see this page. Clicking on any of the highlighted (underlined here) items will allow you to access any of those pages.

Sci.Electronics.Repair.FAQ: Table of Contents (ToC) Page 1

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Please note that I'm back in college... and while I wouldn't call my self dumb, I'm not a genius... and I forgot all my previous Calc which I'm expected to know for my Differential Equations class... so don't expect any major changes until, oh, May. Minor updates and fixes will be attempted, when required. Thanks, Fil.

---

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"Other Information"

Figure 2. Clicking on the item "Sci.Electronics.Repair FAQ" on the first page of the electronics servicing page of the Paranoia website brings up this page on which you may make choices.

## Paranoia

<http://www.paranoia.com/~filipg/> (Figure 1)

VCR Repairs and troubleshooting tips by Sci.Electronics (Figure 2). This site is a complete VCR troubleshooting book written by Samuel M. Goldwasser. It includes SONY VCR error codes. See the older site: [http://fip.unina.it:80/pub/electronics/REPAIR/F\\_vcr\\_repair7.html](http://fip.unina.it:80/pub/electronics/REPAIR/F_vcr_repair7.html).

## Ndirect

<http://www.ndirect.co.uk/~nsmith/index.html> (Figure 3) (formerly <http://www.users.dircon.co.uk>), then select N, then nsmith:uk Television, VCR & Electronics Service Guide. It is A Direct Connection Member Web page that contains the "Television, VCR & Electronics Service Guide". It is written



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I am trying to provide, a database of common, and not so common, faults on UK televisions and video cassette recorders, with perhaps Audio and Satellite receivers in the future. Included will be information on parts suppliers, latest service information, briefs from all the manufacturers, and much more. You can help by sending any faults with their remedies, together with any articles that you may have authored. This site is what you make it, so please keep the information coming.

If anyone thinks computer monitors should be added then please email me with suggestions on what makes would be best added.

## TV & VCR FAULT INDEX

### TELEVISIONS

Akura	Alba	Amstrad	R & O
Bush/Rank	Contec	Ferguson/Thomson	Fidelity
Finlux	Goldstar	Goodmans	Grundig
Hitachi	ITT	JVC	Saisho
Salora	Samsung	Sony	Fatung/Decca
Matsui	Mitsubishi	Network (NEI)	Panasonic
Philips	Pye	Toshiba	Wahnam

### VIDEO CASSETTE RECORDERS

Akai	Alba	Amstrad	Akura
Baird	Ferguson	Goldstar	Goodmans
Grundig	Hitachi	Hitachi	JVC
Matsui	Samsung	Sharp	Sony

Have you tried the internet version of the UK Yellow Pages



**CAUTION:** Servicing of electronic equipment can be dangerous! All servicing should be performed by a trained electronic professional only. Lethal voltages and hazardous materials exist in most electronic equipment. A person who is unfamiliar with these hazards and safe service procedures risks serious injury to himself and others.

## Useful FAQ's

### FAQ for Professionals

Questions and Answers posed by electronic professionals active in electronic repair.

### FAQ for Users

Questions and Answers posed by consumers, electronic hobbyists and students.

My Telephone Number is (44) 01279 466574, this also being the FAX number.

Please Fax or email any information or Fault listings



Snailmail address:  
83 Plawburgh Close  
EASTONIA CROSSROADS  
Herts  
MK23 5UL

May I suggest the following for spares:

Willow Vale Electronics Limited  
11 Arkwright Road  
READING  
Berks  
RG2 0SU

Sales: Tel. 0118 9876444  
Sales Fax: Fax. 0118 9867180  
Accounts Dept: Tel. 0118 9860159

Willow Vale have a reputation for being fast, efficient and courteous. They have an online computer ordering system which they call "COPS" which works relatively well. The company can supply a CD ROM with all the spares and current prices together with many illustrations. The "Cuplink" software supplied, will allow you to store orders and upload via a file transfer system making for a fast efficient means of ordering.

SEME Limited  
Head Office and Despatch  
Unit 2  
Sandy Road Industrial Estate  
WELTON, NORTHAMPTON  
LEICESTERSHIRE  
LE13 1BB

Tel: 01664 45352  
Fax: 01664 63976



Seme now have a computer ordering system, entitled TUSK. Their web site is still young and progress seems

Figure 3. When you access the website at <http://www.ndirect.co.uk/~nsmith/index.html>, this page comes up.

The editors of **ES&T** have discovered a couple of other sites where you may or may not be able to find information on troubleshooting of consumer electronics equipment. Both sites are forums where someone can list a problem they have and if someone has a solution, they send it in. Anyone visiting the site may have access to the problem statements, as well as any answers that may have been provided. And, of course, visitors may list their own problems for solution.

### Newsgroup sci.electronics.repair

One of these sites is a "Newsgroup." It is called "The Repair of Electronics," and is located at sci.electronics.repair. Once you have accessed this newsgroup, you can scan a list of problems that have been posted to the newsgroup, and any replies that the posting has prompted. If there's nothing there that's applicable to any of the problems you have in your service center, you can post any of the problems you do have and check back from time to time to see if anyone has answered you.

For example, one problem read this:

"Zenith 25" TV, Don't have model number available.

"Symptom: Purplish raster; even with all drives at minimum. Voltages and signals at drive transistors on CRT board are identical. What should I normally see at the RGB transistor outputs? Every now and then when switching channels I'll see a quick bright green screen with bright retrace lines. But only for a split second.

"This set is a little over a year old, so I doubt a CRT malfunction is the cause. Any suggestions will be appreciated."

Two people provided suggestions. Sam Goldwasser, who has written for **ES&T** suggested the following.

"It isn't the drives but the bias/background you should be adjusting for dark/ shadow areas of the picture. The voltages should be nearly identical, but not necessarily exactly.

"You should see over 100V on the cathodes if the picture is totally black, possibly higher during retrace for blanking.

"For the bright green screen, a CRT malfunction (intermittent green cathode to heater short) is one of the possibilities. You would have to catch it in the act and do the tests suggested in the FAQ (a list of answers to frequently asked questions) or isolate the filament and see if the malfunction still happens."

Another person responded thus.

Hitachi tv fault listing Page 1

## Hitachi TV Fault Listing

Hitachi Sales (UK) Limited  
 Hitachi House  
 Station Road  
 Hayes  
 Middlesex  
 UB3 4DB  
 Telephone: 0181 569 1975  
 Fax: 0181 569 1441  
 For spares, contact Chas. Hyde & Son Limited

Notes regarding Hitachi

Hitachi are another company who only offer technical backup to engineers holding an account. I personally deprecate this attitude. It accomplishes little and suggests that they care little if their sets are kept working or not.

<b>C14P216</b>	
<p>Power Dead - stuck in standby  <i>Misc</i> Bright raster with flyback lines   No on screen display</p>	<p>Check R902/3 (82k ohms)          C711 or dry jointed          Check R008 (470k ohms)</p>
<b>C14P218</b>	
<p>Power Dead - stuck in standby  <i>Sound</i> Distorted sound  <i>Video</i> Brightness increases then set trips   No on screen display</p>	<p>Check R902/3 (82k ohms)          IC201 (TA8691N)          C711 (47uf)          Check R008 (470k ohm)</p>
<b>C21P819</b>	
<p><i>Sound</i> No sound   Low sound, no Nicam</p>	<p>R4063 o/c          IC1501 (T900477-021)</p>
<b>C2118</b>	
<p>Power Dead - 112V H1 reads high   Dead - tripping</p>	<p>Dry joint on R716          Check R909 for high resistance</p>
<b>C2514F</b>	
<p>Power Dead - except for a bright raster displayed for a few seconds at switch on <span style="float: right;">(Q80)</span></p>	
<b>CAP162E</b>	

Figure 4. Clicking on the name of one of the products on the first page of the N. Smith UK site brings up a page that provides the UK address of the manufacturer and a list of troubleshooting tips such as this.

The Electronic Repair Center Page 1



## Welcome to Electronic Repair Center

You will find here.....

- Answers to Electronic Repair Questions
- Lists of Electronic Repair Shops
- Electronic Repair FAQ
- Electronic Repair Bookstore
- Articles on Electronic Repair Subjects
- Classified Ads for Electronic Equipment, Parts and Data
- Monitor and Terminal Repair Software NEW RELEASE UPDATED 3/12/97!
- Sources for Electronic Parts and Components
- FAQ for Radio and Television Broadcast Professionals

---

Click on the Yer-Net logo to visit the Yoshi Electronics and Research site featuring information and data on electronics in English and Japanese.



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Figure 5. When you access the AnaTek website, this is the first page that comes up on your screen.

"I've replaced many Zenith CRTs within the two-year manufacturer's warranty period. And from your description it sounds like the CRT because the purple background that you have tells me that the green gun may be weak, as does the moment of bright green raster with retrace lines. Very typical of your description.

"You may want to contact Zenith or have an authorized service center take a look at it. If it's a little over a year old, you should still be under the manufacturer's warranty."

### Consumer Electronics on AOL

Another site is one that's available only to subscribers to AOL. To access this site, a member clicks on the category "Life, styles & interests." There are many choices within the category, including "Consumer Electronics." This category contains more than servicing information, including the opinions of other subscribers on a host of subjects within consumer electronics.

Clicking on Consumer Electronics, several subcategories become available: Video & Home Theater (V&HT), Cellular Technologies/Paging, etc. Clicking on V&HT gets the sub-

scriber to "Satellite," "DBS," and more. Within each sub-sub-category are message boards which contain the questions of subscribers and answers of other subscribers, including questions on problems and solutions in servicing of consumer electronics products.

Access to any of these sites may or may not get you the information you need for servicing, but whether it's of any value to a service center in terms of servicing, it might provide service centers a forum through which to educate consumers about consumer electronics service.

### Some other sites

There are other sites on which you may find troubleshooting information, some that offer free troubleshooting information, and some that will cost you a monthly fee. Here are two additional sites that we know of. If any readers know of other sites that offer similar information, please let us know about them.

Electronix Corp: <http://www.electronix.com>

LaserImpact: <http://www.laserimpact.com>

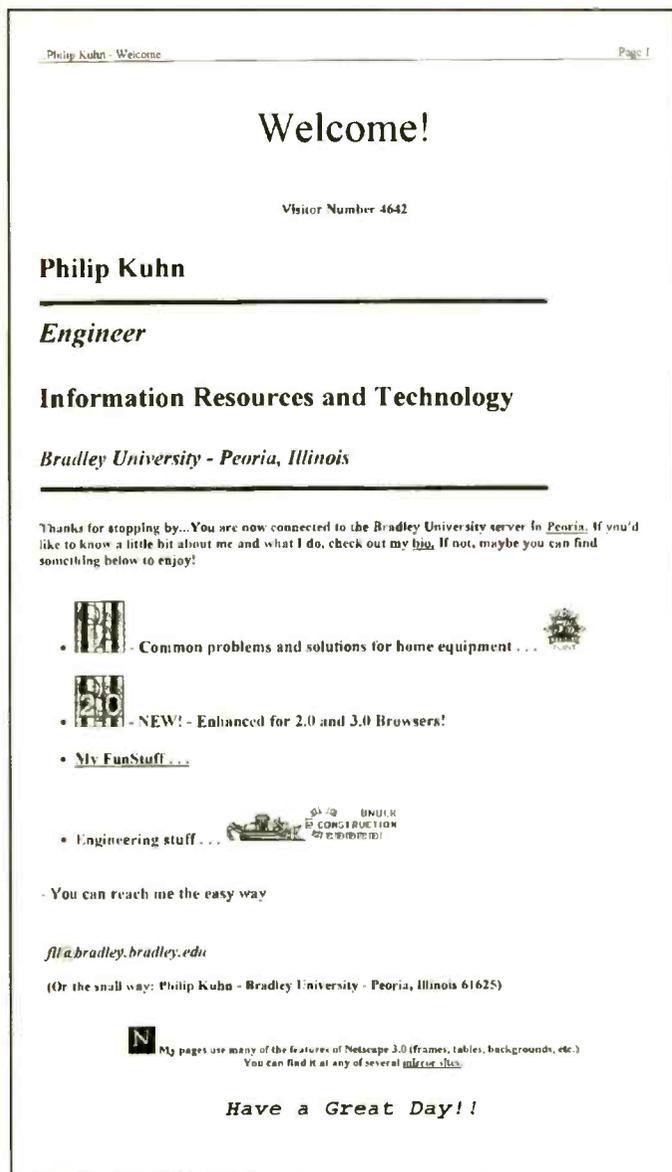


Figure 6. When you access the Bradley University website, this is the opening screen that you will see.

by Nigel Smith (nsmith@dircon.co.uk). (Note, this is a web page originating from England). It has listings by manufacturer and model numbers (Figure 4) and contains tips on TV/VCRs not found in the US (i.e., Salora, Amstrad, Fidelity, Ferguson, Goodmans, etc.). It also has repair articles that have appeared in magazines.

#### AnaTek

<http://www.anatekcorp.com> (Figure 5)

This is a Repair Tips and Procedures database for many consumer electronics products, with over 24,000 repair procedures. You can search through the database by manufacturer and model numbers.

#### Bradley University

<http://bradley.bradley.edu/~fil/> (Figure 6)

Bradley University, Peoria, IL has a Question and Answer

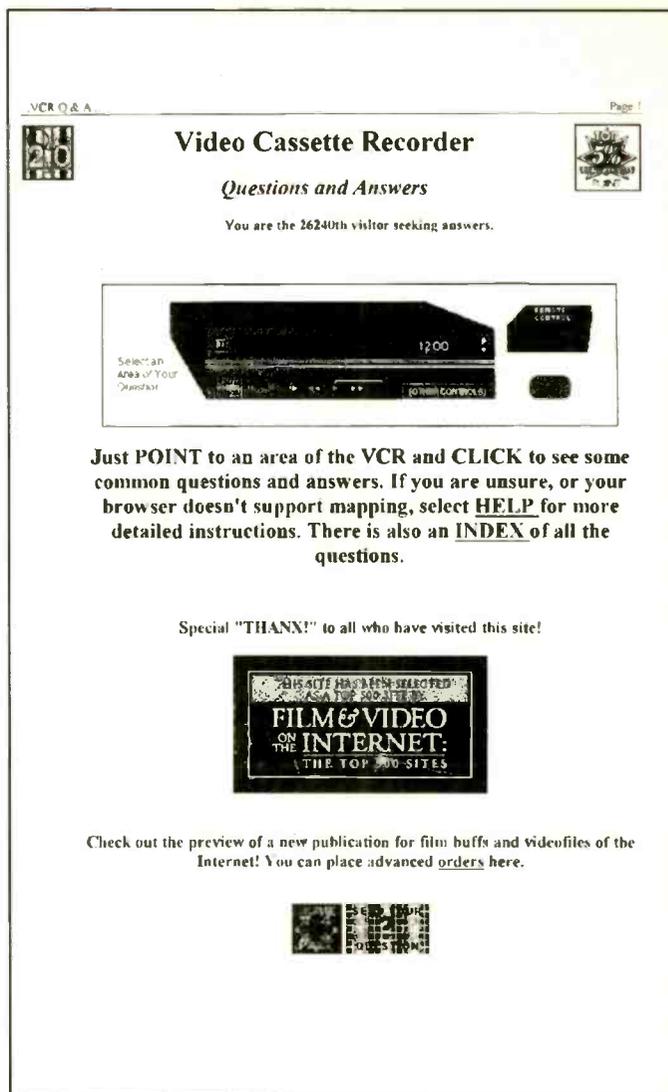


Figure 7. Clicking on the button marked "Common problems and solutions for home equipment" on the opening screen of the Bradley University website brings up this page. Clicking on an area of the VCR on this page provides tips on dealing with problems in that area.

Site on common problems and solutions for home equipment. A useful site for your customers to access as it explains in common language what problems such as "What does it mean when I hear squealing noises in rewind?" (Figure 7) This site is by Philip Kuhn (fil@bradley.bradley.edu)

#### The evanescence of web sites

Web sites may be relatively permanent, or they may be as fleeting as a summer's day. It's not uncommon that a website is set up and then not maintained, and eventually disappears. On the other hand, some web sites are carefully thought out, well constructed, and assiduously maintained. Please keep that in mind when you try to access any of these sites. There is a chance that they might not be there.

Similarly, the Internet is a somewhat flaky place. It's possible that today you will not be able to access a web site, and tomorrow it will be there and accessible in all its glory. ■

# Test Your Electronics Knowledge

## Numbers and math and stuff

By Sam Wilson

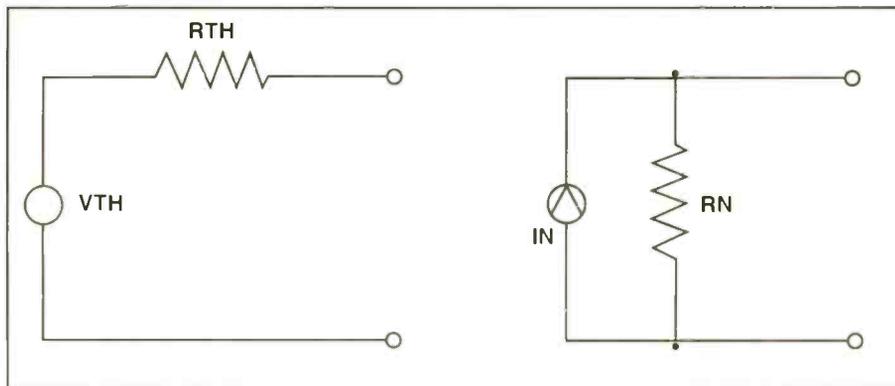


Figure 1. Any linear two-terminal network can be represented by a voltage source in series with a resistor (Thevenin's theorem) or by a current source in parallel with a resistor (Norton's theorem).

1. Write the number  $37_{10}$  as a binary number.

2. Convert  $100101_2$  to a decimal number.

3. "Unwanted disturbances superimposed upon a useful signal that tend to obscure its information content." That is the definition of \_\_\_\_\_

4. It is a good idea to know all of the rules of Boolean algebra. Here are four of the rules. Write the value of each:

- A.  $(A)(1) = \underline{\hspace{2cm}}$
- B.  $A + 0 = \underline{\hspace{2cm}}$
- C.  $(A)(A) = \underline{\hspace{2cm}}$
- D.  $A + A = \underline{\hspace{2cm}}$

5. Write the equation for converting the Thevenin Resistance of a circuit to the

Norton Resistance of the same circuit.

$$R_{TH} =$$

6. What kind of detector is needed for a suppressed carrier transmission?

7. How long (in seconds) does it take a  $0.01\mu\text{F}$  capacitor to charge through a  $500\text{k}\Omega$  resistor to 2 time constants?

8. Is the following statement correct? A toggle flip flop changes state every two input cycles.

- A. Correct
- B. Not correct

9. The time constant for  $500\mu\text{sec}$  inductor and a  $500\Omega$  resistor is \_\_\_\_\_ seconds.

10. The gain of an amplifier is 5dB. If the input power is 2.5W, what is the output power?

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# Is it the hardware, or is it the software?

By John Kull

**A**s technicians in the 90's, we are faced with many new challenges. When working with computers, one challenge we often face is deciding whether a problem is hardware or software related. Before you break out the tool case and grab the screwdriver, you need to make sure the problem isn't software related. A recent experience with a monitor problem drove this point home for me.

## A video compatibility problem

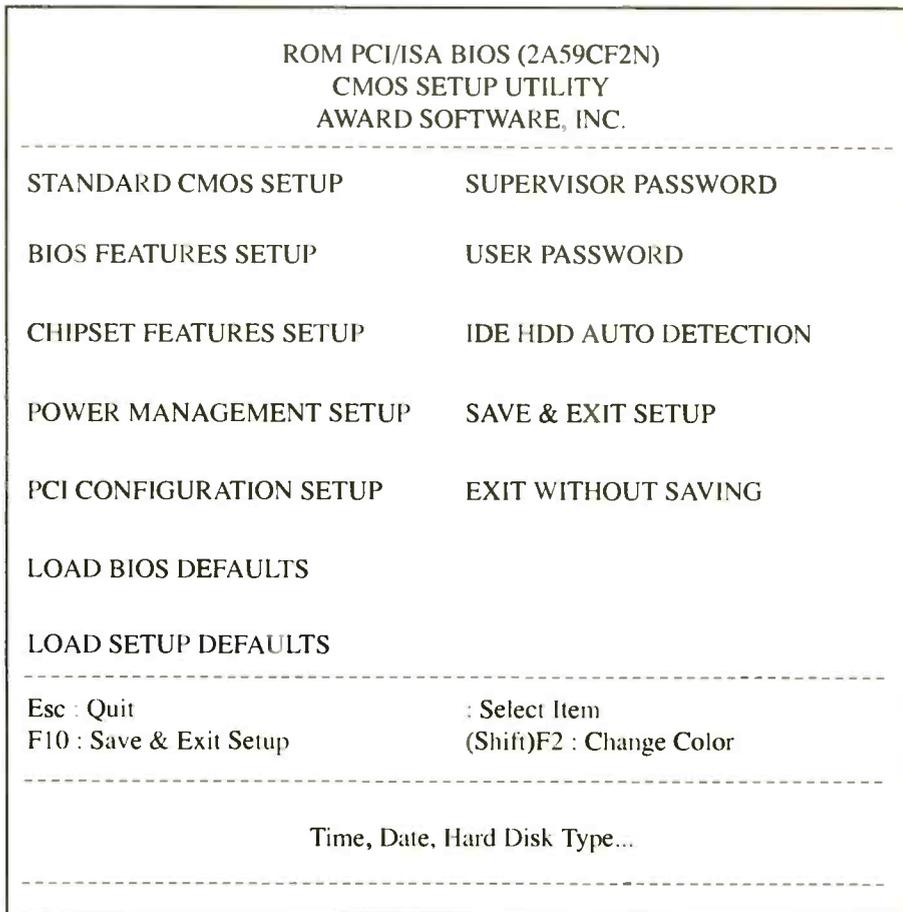
I received a call from a customer who had just installed a color VGA monitor. He was having problems getting the company's primary software to run in color. He explained that the system originally had a monochrome monitor and he wanted to use a color monitor to make the program easier to view. I began to ask him questions. "Did you install a VGA video board?" "No, I just plugged the new monitor in!" he answered. I was beginning to worry. VGA monitors use a 15-pin high density "D Sub" connector, while the older monochrome monitors used a 9 pin standard "D Sub" connector. The connector size and gender is the same, but the pin spacing is different. I was afraid he had possibly forced the connector on and had gotten lucky enough to get a picture.

He went on to tell me that the start up logo on his network software was displayed in color, but all software run after that was in black and white. At this point my curiosity was aroused. Most motherboards have a "color/mono" jumper that must be set in order for the video card to operate properly. I asked him if he had changed this jumper. "No," he replied "but I tried to change the monitor setting in the CMOS setup." I soon realized this was not a problem that was going to be solved over the telephone.

## A video compatibility problem

I arrived at his office and examined the

Kull is a Biomedical Technician and a frequent contributor to ES&T.



**Figure 1.** When you need to update the CMOS memory, you use a setup program from the system BIOS and enter or verify the proper information. You activate this program by pressing the delete key when prompted at bootup, or by entering a special keystroke sequence.

system. The monitor and video card were both high density D-Sub connectors. The original monochrome monitor used a high density D-Sub connector as well, - something I had never seen before. Upon booting up the system, a "display type mismatch error" was occurring. This is a common error when the video card is changed and the CMOS setup has not been changed.

The CMOS memory is a battery backed RAM memory that holds the information on the hardware configuration, such as hard drive parameters, floppy drive type, amount of installed memory and monitor type. When the computer boots up it executes a startup program contained in the

motherboard BIOS ROM called the POST (Power On Self Test.) A part of the POST routine reads the information in the CMOS memory to properly set up the hardware. If a parameter does not match the hardware that is installed, it generates a CMOS "type mismatch error." (The actual message displayed on the monitor will vary depending on the manufacture of the system BIOS.)

When a value needs to be updated in the CMOS memory, a special setup program is run from the system BIOS and the proper information is entered or verified (Figure 1). The setup program is activated by pressing the delete key when prompted at bootup, or by entering a spe-

cial keystroke sequence. From the main menu, the "Standard CMOS Setup" is selected. This menu is used to modify the hardware parameters (Figure 2). After the changes are made, the Standard CMOS Setup menu is exited and the option of "Save and Exit Setup" is selected from the main menu.

Many people make the mistake of not saving the changes after they have made them. After a change is made you must select the option that allows you to save the changes. If you exit the setup program without saving, you will continue to get the error. Some setup software will automatically select the proper monitor type, but it is up to you to save the changes.

### Saving the changes to the CMOS memory

In this case the customer had entered the CMOS setup, but had not saved the changes. I selected "Save changes and exit" from the CMOS setup menu. The error went away, but my problem did not. The program still refused to run in color.

Next I turned my attention to the motherboard. I began to look for the "color/mono" jumper. I found one two-pin jumper, but it had no labeling, and of course my customer had no documentation on the system. Left to trial and error, I switched the jumper and rebooted the system. There was no change.

I scratched my head and forged on. Since he told me he had not changed the video card, I decided to pull it out and check for configuration jumpers or switches. The card had a set of DIP switches for selecting the various video modes. On the card was a silk screen legend detailing the switch configuration. According to the legend, the card was already set for color operation. The card had several color modes of operation. One at a time I tried them. One at a time the problem returned.

### Was it the video card?

I was beginning to suspect the video card. Although the monitor displayed color briefly while his network software loaded, I wondered if all the modes of the card were working properly. Since it was a multi-mode card, the network software may have activated one mode while his software was using another mode that did

not function. Not having a spare video card with me, I installed the suspect card in another system to determine if the card was at fault. The card worked fine running the same program. Well, it wasn't the video card. Could it be the software?

### Was it the software?

Often times a program will require a "switch" in the command line to enable monochrome operation. For example, the command "dosshell/bw" enables the dos-shell program to run in monochrome mode. He said the command to start the program on the computer was just "hecs3" with no switches. OK, I thought, but often a program will be executed from a batch file. A batch file is a special file used to execute a set of DOS commands, frequently containing commands or switches to enable or disable certain features. Batch files are identified by the three character extension, "bat," on the filename. Reviewing the directory in which the program was located did not turn up any batch file named "hecs3.bat."

### It was the AUTOEXEC.BAT file

Every IBM PC or compatible makes use of one batch file upon startup, called AUTOEXEC.BAT. This file is executed at bootup and contains a series of commands to automate the startup process, by starting other programs or configuring a piece of hardware. I remembered there was a DOS command called "mode" that is used to set up default parameters for different hardware items such as input/output ports and monitor types. I pulled up the DOS help system on the mode command and reviewed its syntax. (By typing the command and then "/" in DOS 5, or "help" and then the command in DOS 6 and above, you can pull up an on-line help system. The help system can be an invaluable tool when troubleshooting configuration problems.)

I decided to add the command "MODE CO80" to the AUTOEXEC.BAT file to force the system in the color 80 column mode. I reviewed the AUTOEXEC.BAT file for the system and quickly found my problem: The AUTOEXEC.BAT file contained a line that read "MODE BW." The system was being forced to monochrome display by the "MODE" command. I didn't need to ADD the "MODE CO80," command, I needed to *remove* the

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# ★ ★ ★ SHOWCASE OF TOOLS & TOOLCASES ★ ★ ★

The right tool helps a craftsman get the job done properly, whether it's a mason laying up a brick wall, or a shoemaker putting a new sole on a worn shoe. The same thing is true of a consumer electronics service technician putting a new video head drum in a VCR, or replacing the EEPROM in a 27-inch television set.

Here is an example of a situation where using the right tool can make a big difference. You have to remove a pc board from some product; say a VCR. You look in your tool box and find that somehow, your nutdriver set isn't there. Perhaps you left it on the bench when you left the service center, or at the site of your last job.

There are some other tools that might get the job done. You might be able to get a small adjustable wrench on the nut, but that can become tedious because you are only able to turn it a half inch at a time because of obstructions. So you turn the nut, and turn it, and turn it, in small increments until you're sure it's been loosened enough to be "hand tight".

But, what seemed like only hand tight is a little tighter than the finger strength you can muster in those tight quarters. So you get the wrench back out and turn the nut a few more times. Finally it comes free. But what should have taken less than a minute, if you had the right tool, has taken several minutes, and there are still three more identical nuts holding the board in place that you have to remove.

This is not an uncommon occurrence, and this doesn't even fall under the label of "high tech". All you're trying to do is remove a few nuts so you can get a pc board out of the chassis. If the task was removing a multileaded pc, the problem really becomes difficult, and you had better have the right equipment if you're going to avoid damaging the circuit traces on the board, or overheating and ruining the replacement IC.

## Selecting a vendor

Tools can be purchased almost everywhere, from the hardware store to the do-it-yourself store. You can buy screwdrivers, nutdrivers, pliers, wrenches,



soldering and desoldering products and more. But the exacting work performed technicians frequently requires specialized tools, the kinds of tools you're unlikely to find in the general-line hardware store, or the hardware department of a department store.

As a general rule, therefore, it makes more sense for a technician to purchase most if not all of his tools from a vendor who specializes in tools for the electrical and electronic skills.

## The showcase

This Tool and Toolcase Showcase is designed to provide readers with a little more information than is ordinarily available about tool vendors. Each advertiser in this showcase has been given an additional amount of space to tell readers about their company in the hope that it will help in the process of determining who is most likely able to carry the kinds of tools most targeted to

consumer electronics service, and to provide technicians with assistance in tool and toolcase selection.

As you read the descriptions of these companies, written in their own words, you might want to keep these important questions in mind:

- How long has the company been in business?
- How often are they able to fill orders from stock?
- What payment options does the company offer—open order account, credit card, cash?
- How soon after receipt of an order to they ship?
- Do they add a shipping surcharge?
- Do they have a toll free number?
- What ordering options do they offer?
- What is their return policy?
- Do they offer a warranty?
- Is there a minimum order amount?
- What shipping options do they offer?
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MCM publishes two full-sized catalogs annually. The latest issue boasts over 6500 new products, and features over 100 pages devoted solely to semiconductors, repair parts and accessories. In all, MCM stocks over 35,000 items essential to the service industry.

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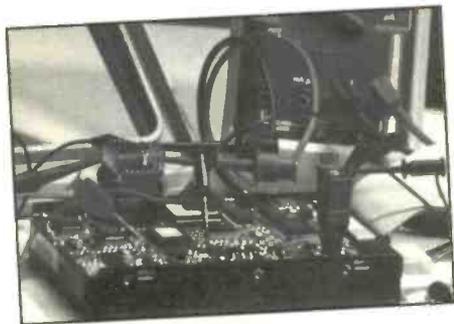
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The Model 6091 Ultra-Thin Micrograbber® is the newest addition to ITT Pomona's Grabber® series of testing tools which also includes other Micrograbber®, Minigrabber®, and SMD Grabber® test clips with plunger-type action and comfortable, finger grip operations.

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For more information and a free copy of the 1997 Test & Measurement Accessories Catalog, contact ITT Pomona Electronics at 1500 East Ninth St., Pomona, CA 91766-3835. For technical assistance call 1-800-241-2060, fax (909) 629-3317, or look up our web site, <http://www.ittpomona.com>.



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## PanaVise Products, Inc.

**7540 Colbert Drive  
Reno, NV 89511  
Phone: 702-850-2900  
Fax: 702-850-2929**

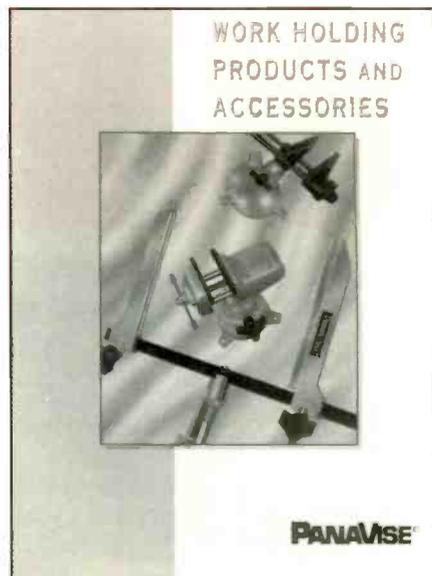
The PanaVise tradition of innovative quality began over 40 years ago with tool and die maker Otto Colbert. Otto was looking for a way to make his job easier: he wanted a vise head that could move easily without the need to continuously remove and reposition his work. After some time at the drafting table, he invented the now famous "split ball," an ingenious device that allows a vise head to "tilt, turn and rotate," then lock into position with a single control knob. The PanaVise product line began with this simple, yet very useful, invention.

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of heads, bases, base mounts and accessories. Create your own vise combination, or simply select a ready-to-go vise which best meets your workbench needs.

PanaVise is currently distributed throughout the world and represents superior quality in design, materials and workmanship. In late 1996, we completed and moved into a new 58,000 square foot facility which has allowed us to continue to expand our product line. From simple beginnings over 40 years ago, we've become the solid leader in work holding devices.

If you would like more information, see your local PanaVise distributor and ask for our 24-page, full color catalog which includes plenty of technical information. You may also send us \$1 and request the



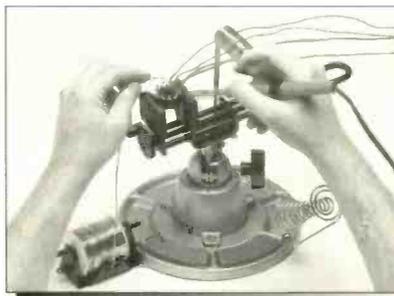
catalog from PanaVise Products, Inc., 7540 Colbert Drive, Reno, NV 89511, Tel: 702-850-2900, Fax: 702-850-2929, or visit our website at [www.panavise.com](http://www.panavise.com).

For all your service and repair workbench needs, remember PanaVise.... ask for it by name! ■

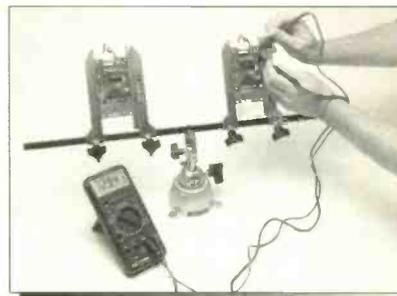
### PanaVise makes your repair jobs easier!

From small pagers to large circuit boards, a PanaVise can make your job easier. Full "tilt, turn and rotate" in every vise means you can position your work where you need it and lock it into position with a single control knob. Demand the best. Demand PanaVise.

Ask for it by name!



*Repair work is quick and easy with the right combination of PanaVise heads, bases and base mounts! Your PanaVise dealer has more information.*



*We added an extra pair of circuit board arms to a Model 372 so we could easily test two boards at once. PanaVise holders make it easy to work on circuit boards from 1/8" to 12" wide.*

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**Interchangeable heads** are available for all 300 series bases! Add versatility to your current vise by selecting another head. Your PanaVise dealer has the details.



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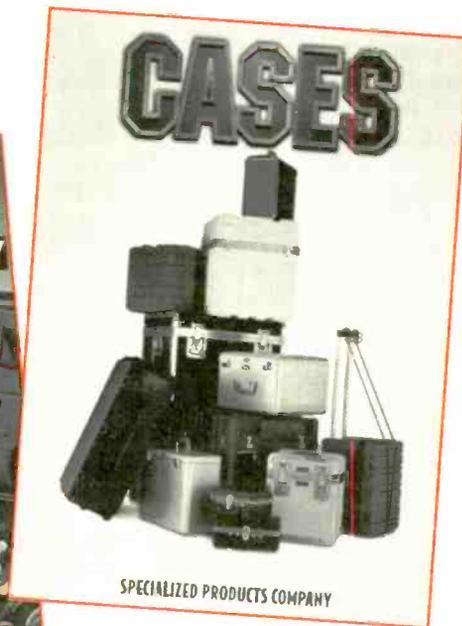
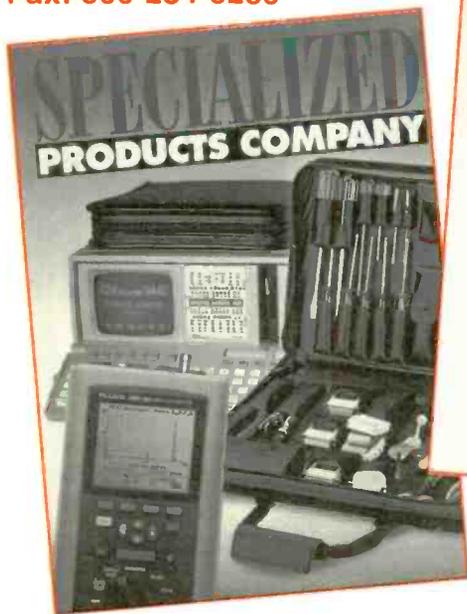
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7540 Colbert Drive • Reno, NV 89511  
Tel: 702.850.2900 Fax: 702.850.2929  
[www.panavise.com](http://www.panavise.com)

# ★ ★ ★ SHOWCASE OF TOOLS & TOOLCASES ★ ★ ★

## Specialized Products

3131 Premier Drive  
Irving, TX 75063  
Phone: 800-866-5353  
Fax: 800-234-8286



Specialized Products Company, an international supplier of tool kits and test equipment, has released its new comprehensive Case Catalog. The 32-page collection features a multitude of cases designed for virtually every application in every service-related field. SPC offers the largest selection available of high-density, reusable shipping containers in over 100 configurations plus styles for many other uses. Choose from cases for carrying, storing, protecting and shipping tools, instruments, laptop and notebook computers, sensitive and expensive equipment, circuit boards, catalogs and more.

Some cases have watertight hard shells while others are soft-sided padded styles. Others are specially designed to prevent dust contamination in cleanroom environments. For added versatility, you will find stackable styles for space-saving storage plus reversed versions for more storage space in the lid than in the base. Many containers give you a choice between 2-inch foam lining for a uniform interior cushion and 2-inch layers of full foam to create a custom fit for your contents. For easily pushing and pulling heavy loads, choose the convenience of rolling tool chests, cases with wheels or luggage carts. This impressive collection of cases ranges from

economical to top-of-the-line models for virtually every need and budget.

Case selection is easy with this new user-friendly catalog. Complete product descriptions are enhanced by large color photographs of both case exteriors and interiors with the main features clearly indicated. Detailed charts list sizes, weights, interior options and prices to simplify model comparison. Use the Order Form included in the catalog for easy mail ordering. For fastest service, place your order by toll-free telephone or FAX. All cases are shipped surface freight only because of their price-to-weight ratio. Entire case inventory is off-the-shelf for immediate delivery!

With over 30 years of sales experience, SPC is one of the nation's largest and best-known suppliers of tools, customized tool kits, cases and test equipment. A wide range of over 5000 specialized products includes everything needed for basic cable installation to board level component repair. Customers include electronic, computer and telecom technicians, engineers and managers plus virtually anyone else involved in the installation and/or repair of any type of technology. To receive your free copy of Specialized Products Company's Case Catalog, call (800) 866-5353 or FAX (800) 234-8286 toll free. ■

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**Immediate Delivery!**



**Specialized Products**

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Fax: 937-937-4644**

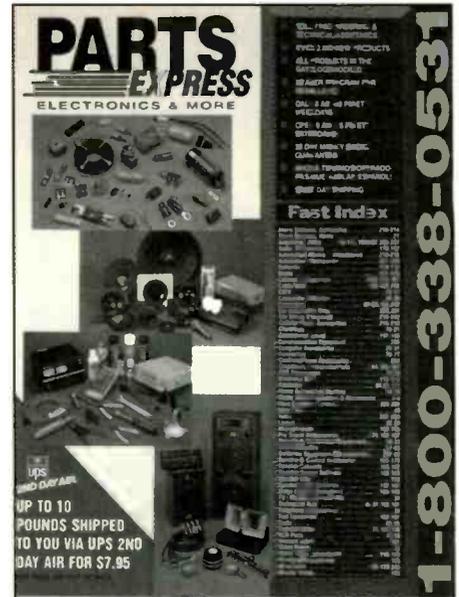
Parts Express is a full line distributor of electronic parts, tools, test equipment, and accessories geared toward the consumer electronics industry and the technical hobbyist. In business since 1986, Parts Express has quickly established itself as a leader in the industry by consistently providing quality products, first rate customer service, low prices, and toll-free technical support.

Parts Express stocks an impressive array of CATV and VCR repair parts, tools, semi-conductors, test equipment, chemicals, computer accessories, adhesives, telephone products, educational materials, pro sound equipment, raw loudspeaker drivers for home, car, and home theater applications, crossover parts, specialized connectors, batteries, cellular accessories, and a huge selection of wire and cable. Parts Express stocks over 15,000 items and

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Each year Parts Express produces a full line catalog, showcasing the complete



product offering plus detailed descriptions and specifications. This catalog is supplemented with numerous sales flyers during the year, offering special bargains and hot deals. For more information or to request a free 244 page full line catalog, please call 1-800-338-0531.

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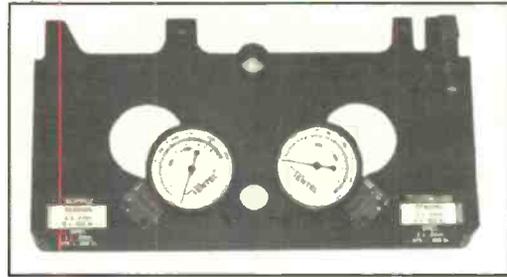
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Tentel manufactures the only univer-



sal test tools to provide fast, accurate measurement of these mechanical tests. Elimination of guessing provides better repairs without costly and embarrassing call backs, while actually cutting down the time spent on VCR service.

Tentel has been providing test tools to the video repair and maintenance

marketplace for over 24 years, and is recognized throughout the world as the leader in supplying easy to use powerful test tools for the mechanical measurements on video transports. Over 70,000 TENTEL test tools are currently in use for testing and repairing video transports. ■

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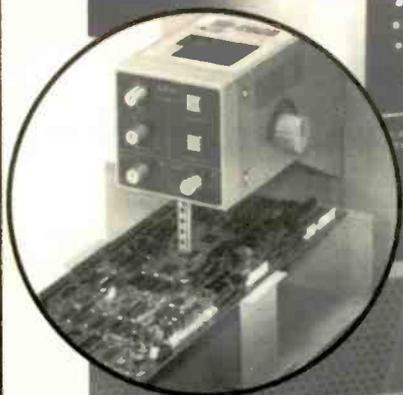
DEN-ON INSTRUMENTS first introduced into the U.S. market in 1988 the SC-5000 desoldering tool which generated a quite loyal and devoted following. Since then, there has been two model upgrades and nothing but praise for the quality and efficiency of the improved tools. The newest generation of the high performance desoldering

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Committed to making the highest quality products, *the DEN-ON Difference is Dependability*. Maximizing efficiency and life expectancy and minimizing down time is paramount to us. By staying on the leading edge of technology and innovation, DEN-ON has developed the **SD-3000 SMD Rework Station**. The SD-3000 can remove and replace any type and size of SMD up to 50mm sq. with a single revolving hot air nozzle. Simple X and Y axis knob controls configure and adjust the movement of the nozzle to trace over the leads or soldered points of the component, thus also making it possible to rework connectors, PLCC sockets, BGA, PGA, etc. without ever changing the nozzle or any hot attachments. Microprocessor controlled, built-in timer and temperature control for job repeatability and SMD/PCB damage prevention. This truly versatile and compact rework station comes complete and has a suggested list price of \$6000.00. ■

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## Jensen Tools

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Fax: 800-366-9662

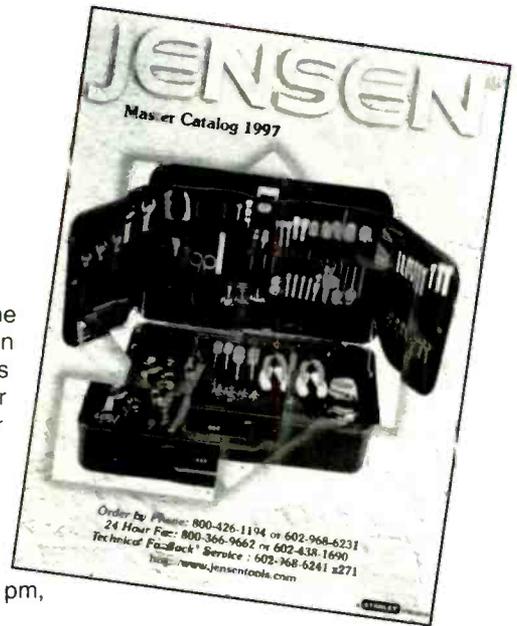
Jensen Tools Inc., major worldwide supplier of tool kits, specialty tools, test instruments, diagnostics, and other related equipment to the electronics industry, announces the operation of their 24-hour, 7-days a week FaxBack® system as a service for inquiries who need information about products in Jensen catalogs.

According to John Tucker, Jensen Technical Support Specialist, "FaxBack provides the latest catalog pages, detailed technical specifications and special promotions around-the-clock. We are constantly expanding and updating the information available to benefit our customers."

To access Jensen's FaxBack 24 hours a day, 7 days a week, phone 602-968-6241, ext. 271. An easy-to-follow voice

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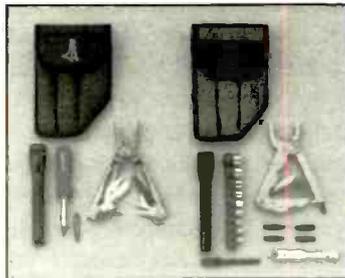
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## BOOKS

**Newnes Data Communications Pocket Book, Third Edition, by Mike Tooley, Newnes, 256 pages, hardcover \$24.95**

Written by the Dean of Technology at Brooksland College in Surrey, England, this new edition of the Pocket Book is for technicians and engineers involved with the installation and maintenance of data communications equipment.

This latest edition of the *Newnes Data Communications Pocket Book* has been substantially updated to keep abreast with the rapid developments in data communications technology. New topics have been introduced—data compression, the Internet and World-Wide Web, HyperText Mark-up Language and existing material has been updated—and expanded.

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

**Encyclopedia of Electronic Circuits on CD-ROM, By Rudolf Graf and William Sheets, McGraw Hill, \$99.00**

Adapted from the best-selling five-volume reference by Rudolf Graf and William Sheets, McGraw-Hill announces the release of the *Encyclopedia of Electronic Circuits on CD-ROM*. Containing 1,000 circuit designs from industry leaders such as Motorola, Texas Instruments, General Electric, RCA, National Semiconductor, and others, this tool lets users locate specific circuits, review them on PC, and print them on a laser printer.

The user can quickly find circuit designs by category, or alphabetically. There are 142 circuit categories that include audio circuits, display circuits, measurement circuits, power supplies, radio circuits, signal-generation circuits, and others. Once a topic is found, a text description of the circuit is provided, and the user can view the circuit diagram using a built-in schematic viewer, as well as print it out. Many schematics also include mechanical details of parts and IC packages, and waveform diagrams.

Additionally, users may call an 800 number for access to four locked CAD products available on the CD-ROM: *SuperCAD* (a full-featured schematic editor), *SuperSIM* (a digital simulator), *SuperSPICE* (an analog simulator), and *SuperPCB* (creates printed circuit

boards). Free demo software is included for both SuperCAD and SuperPCB.

McGraw Hill, 11 West 19th Street, New York, NY 10011

**Developing Java Entertainment Applets, By John Withers, John Wiley & Sons, Inc., 448 pages, \$29.95 US, \$41.95 Canada**

*Developing Java Entertainment Applets* by professional games designer John Withers arms readers with all the know-how needed to develop interactive multimedia Java applets complete with 2D and 3D graphics, animation, sound effects, and music. This book also provides readers with: An introduction to Java programming fundamentals and more advanced techniques; A comprehensive breakdown of design elements as illustrated in seven popular games; and The tools needed to design and implement a card game in Java.

John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012

**High Performance Audio Power Amplifiers, By Ben Duncan, Newnes, 288 pages, hardcover \$56.95**

Power amplifiers and their performance lie at the heart of audio engineering and provide some challenging problems for the engineer. Ben Duncan's experience, as an audio consultant, analog electronics designer and author, give him an unique insight into this difficult but rewarding field. This handbook is the distillation of the state of the art, says the publisher.

The contents of the book include: Introduction; Overview of requirements; The input port; The power stage, Topologies, classes and modes; The power supply; Audio specification and test; Real world testing - rationale and procedures; Choice, application, installation and setup; Maintenance and surgery; The future; Index.

Since 1977, Ben Duncan has been involved in the design of over 70 innovative, high-end audio products used by recording and broadcast studios, on stages, in clubs and by the most critical domestic listeners - as well as creating bespoke equipment for top musicians.

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

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6227	(sim to)VCR-285	CT-31G20UT	3825	20G-M100	3798	SY1953Y	3795
				20G-M100R	3798	SY1953YM	3795
<b>JVC</b>		<b>RCA</b>		20G-M120	3798	SY2549S	3791
AV-27750	3797	CTC175C2	3819	20G-M120R	3798	SY2053S	3820
AV-27710	3827	CTC185AA	3823	20H-M100	3798	SY2053SM	3820
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Circle (73) on Reply Card

# Correcting a tape backup problem

By Sheldon Fingerman

**B**acking up the data on a computer is extremely important, so when a tape backup system fails the owner will probably call in somewhat of a panic. The other day I received a call about a Jumbo 250 drive breaking tapes. A quick look at the backup tape confirmed what the customer had told me. They had also purchased some new tapes, which promptly broke as well.

As it turns out, this is a fairly common problem with many popular tape backup systems that use mini data cartridges. Although the tapes appear to be broken—actually pulled off the spool—they are fine. This is a perfect example of a situation in which it's important to not merely treat the obvious symptoms, but to get to the root of the problem.

## A look at the cartridge

First, let's take a close look at a mini data cartridge. Although it resembles a video or audio tape, the only things it has in common with them are the fact that it uses magnetic tape and has two spools. The similarity ends there.

Both reels on standard audio and video cassettes are exposed. This allows the transport to directly turn the reels. The tapes are attached to the reels, and the transport must be able to turn the reels at different speeds as the amount of tape changes from one side of the tape to the other. When a tape breaks you solve the problem that caused it to break, replace the tape, and usually do a good cleaning.

Remedies to problems with backup tape cartridges aren't quite that obvious. A quick glance at the cartridge will reveal two reels, but take a good look at the bottom of the cartridge.

There is no way for the transport to access either reel. Somehow, both reels are being controlled from the front of the cartridge.

## Construction of the cartridge

Using a mini data cartridge that contains no useful data for experimentation, carefully take the cover off by removing the screws on the bottom of the cartridge. Even with the screws removed it will take a bit of effort to remove the cover, so be sure to keep the cartridge right-side-up, or you could find yourself searching for parts all over your bench and the floor.

Once the cartridge is opened (Figure 1), the first thing you will notice is a strange band—that at first looks like part of the tape. It's this band that allows both reels to rotate in sync, regardless of the amount of tape on either reel. Rotating either reel shows how ingenious this assembly really is, and you should probably take a few notes just in case the components of the assembly decide to part ways.

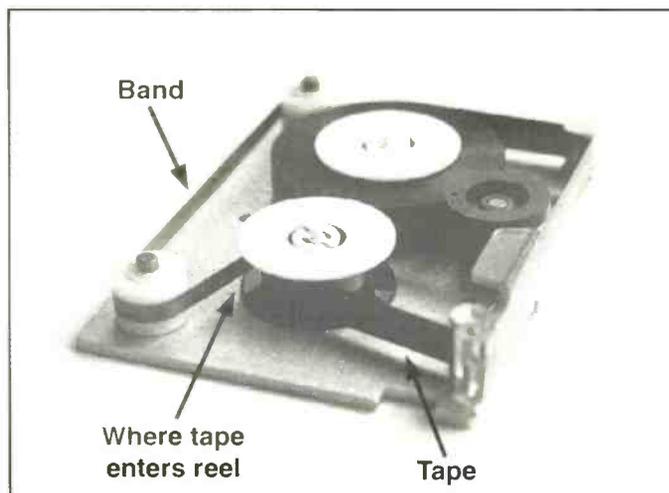
If you continue to explore the cartridge you will also notice something else that's very interesting: The only thing holding the tape to the reels is the tension of that strange band and overlapping layers of tape. When the end of the tape is pulled off the reel it may appear broken, but rarely is. Now, why would the tape come off the end of the reel? Or better yet, what the heck is supposed to stop the tape before it gets to the end?

If you look closely at the cover you just removed, you will notice a small mirror angled at 45 degrees. This mirror sits just behind the tape, and there is a small cutout in the cartridge just below it. Further examination will reveal very small holes in the tape at both ends (Figure 2). Be careful when looking for these holes not to pull the tape off the reel. Actually, as you'll soon discover, this is no big deal. Obviously, the holes in the tape, along with the mirror, have something to do with an end-of-tape sensor.

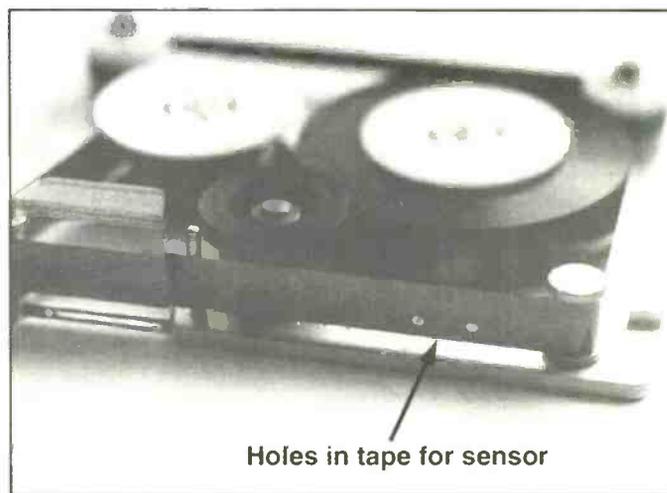
---

Fingerman is an electronics and computer consultant and servicing technician.

---



**Figure 1.** When you take apart a backup tape cartridge, you will note that it's constructed differently from an audio tape or video tape.



**Figure 2.** Light shining through small holes in the backup tape provide an end-of-tape signal for the tape drive.

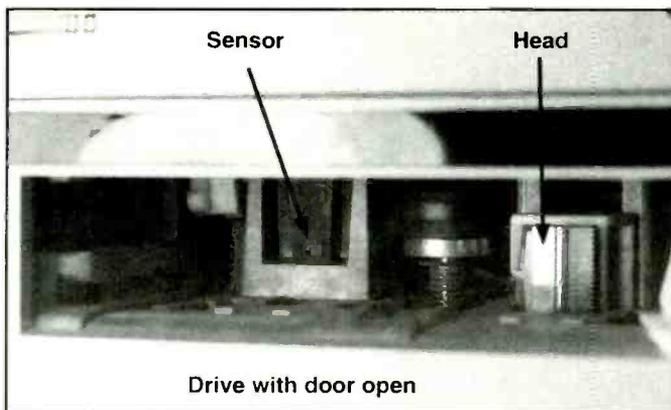


Figure 3. If the end of tape sensor is fouled by dust and dirt, the tape will continue to run and pull off of the reel.

### Examining the drive

Now let's take a look at the drive itself. You need not remove the drive, simply hold the door out of the way and grab a flashlight (Figure 3). To the left of the rubber drive wheel there's a sensor. You can easily spot a very small hole straight in (part of the sensor), and the mate to this assembly is below it. If you haven't figured it out by now, a beam of light is reflected off the mirror completing the circuit thus telling the drive the tape has reached the end of its travel.

Only three things can possibly interrupt this process: there are no holes in the tape, the beam is not functioning, or the sensor is blocked by dust or dirt. Since the first is virtually impossible, and the second is highly unlikely, it's a pretty good bet that the problem is dust and dirt. Clean a backup tape drive the way you would any similar device. Use a cotton swab and alcohol, compressed air, and if it's really dirty in there use a small vacuum. It is rarely necessary to remove the drive; just work right through the door.

Now, how about that "broken" tape? You will need to get the end of the tape back on the reel. It must be placed under the band and wound up on the reel a bit. Getting the tape started on the reel is the tough part. You'll find a little "spit" goes a long way here. Wet the end of the tape with your finger, then "stick" it to the reel and begin winding. Be sure to wind it past the holes in the tape, and there may be two or three sets of holes (obviously, if you don't do this it will pull off the reel again). Any slack in the tape can easily be taken out by turning the reels in opposite directions—gently.

That should do it. You've repaired the drive, and also fixed the "broken" tape. If you've done this for a customer you've made a few bucks and become a hero by saving them the cost of new tapes. You've even saved the data on the, er, broken tape. If the problem is on your own computer the entire process can often be done in the time it would take to go out and buy a new tape—which, as we've discovered, isn't the problem.

Keep in mind not all tape backup systems are alike, but this repair covers an awful lot of them. Remember, there are still a lot of Colorado Memory Jumbo 125/250 tape drives out there. I'd love to have a buck for every "bad" tape and backup system that's been thrown away.

This is an easy repair with an almost 100% guaranteed success rate, and a definite service call charge. ■

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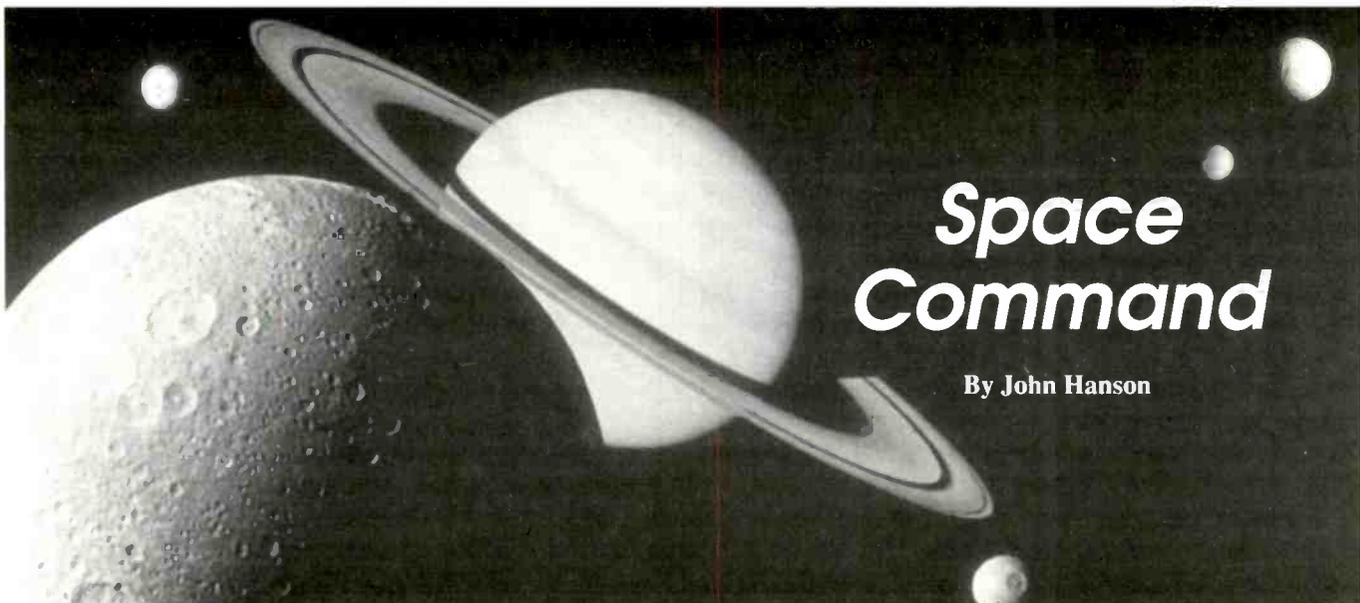
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Circle (81) on Reply Card



# Space Command

By John Hanson

Something from Star Wars? No, Space Command is what Zenith called its first wireless TV remote back in 1957. Zenith ran to the patent office and received five patents for Bob Adler's (Zenith's Chief Engineer) invention.

The idea of remotely controlling radios and TVs was old hat, going back to the 1930s, but without wires: that was something new. The genius in the concept was the simplicity of the hand unit. It was entirely mechanical. Adler used ultrasound for the carrier, and generated four commands: on-off, channel up, channel down, and sound mute, by changing the sound frequency. Four aluminum rods, different in length, were struck by a spring-loaded hammer to emit a tone to "Space Command" the function pressed. This device, clever and unique, catapulted Zenith to the position of leader in TV remote controls.

## Marketing strategy

As with every innovation in consumer electronics, the competition waited to see what marketing approach Zenith would use. The decision to limit the feature to the top-of-the-line models and to charge up to \$100 extra for the feature limited market penetration. Ignoring Zenith's patents, competition moved swiftly to circumvent the patents and a proliferation of me-too ideas hit the market. Most of the competing remote controls used an rf car-

rier and a complicated remote control that required a battery. Their immediate advantage was that they could offer more functions, such as volume up/down.

Both Zenith and its competitors began experiencing interference problems from a myriad of sources. Phantom commands plagued the industry for years. TVs would turn on mysteriously, and channels would change without a command. In the search for a better system, infrared light surfaced to become the carrier of choice. No patents were issued, so the entire industry moved in the same direction.

## The codes

What is interesting, and a bit unusual, all manufacturers submitted their own unique serial codes to the EIA for registration. As a result, dealers could demonstrate any model and make of TV on their sales floor without a cross-talk problem from another product.

Thanks to the listing of registered codes, universal remotes became a possibility. A single remote could be programmed to operate a TV, VCR and cable box. Conversely, remotes provided by the cable company to operate their box could be programmed to operate the TV.

## The remote control rf signal

Here's how a universal remote works. Each manufacturer has its own registered code for each product category. The customer looks up the two-digit or three-digit code in the remote's instruction guide,

and enters the code. The code is retrieved from the remote's memory and entered as the operating code. Figure 1, the rf signal code for a Sony remote control, is typical of manufacturers' codes.

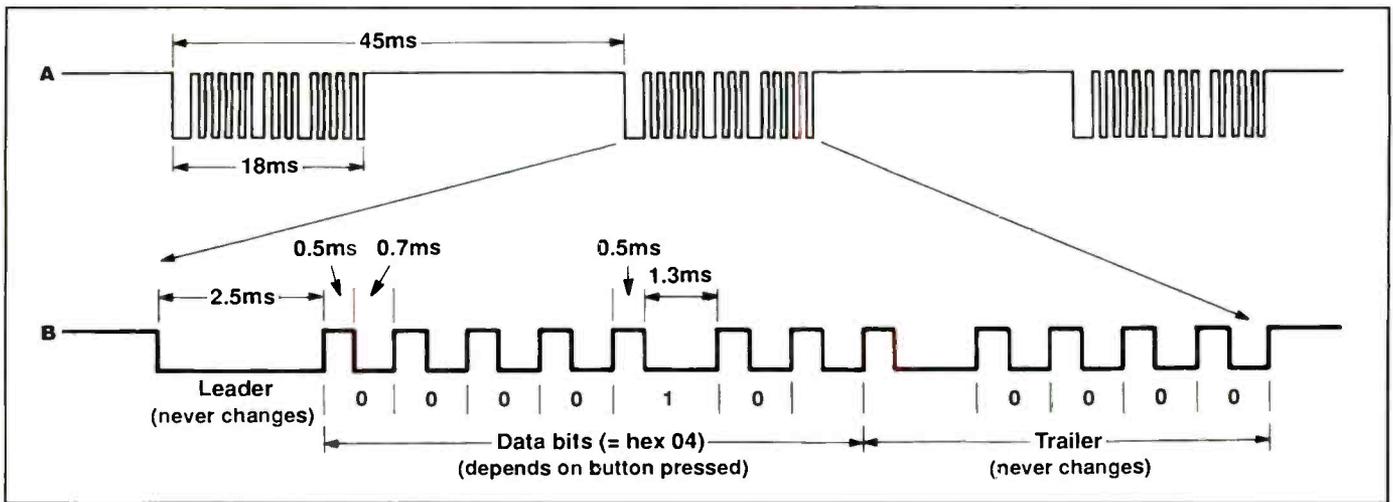
In this code, the low levels represent the presence of light from the remote control's IR light, and the high levels, no light. With each customer command, a light code burst is a series of long and short light pulses that define the binary bits. In this example, a 0.5µsec high level followed by a 0.7µsec high level equals a zero. This followed by a 0.5µsec high level followed by a 1.3µsec pulse defines a 1, or a hexadecimal 4.

## Remote control hand-held units can be repaired

IR remotes are well known as cost-effective, reliable, systems offering up to a year of average battery life. But they're not perfect. Channel surfers place a heavy burden on the button contacts. New, switch-mode fluorescent light fixtures compete with the light carrier frequency of the remotes, and can reduce sensitivity of the remote control.

In spite of the availability of low-cost replacements, remote controls can be repaired profitably. Repair of a remote is similar to cleaning tuner contacts, once you're beyond the mundane task of cleaning battery contacts and replacing the battery, it's possible to restore the contacts on the PC board using a type of liquid silver available at your parts distributor.

Hanson is an independent servicing technician and a retired service engineer from a major consumer electronics manufacturer.



**Figure 1.** The IR signal code for a Sony remote control, shown here, is typical of manufacturers' codes. In this code, the low levels represent the presence of light from the remote control's IR light, and the high levels, no light. With each customer command, a light code burst is a series of long and short light pulses that define the binary bits.

The fluorescent light cross talk problem may be resolved by applying a one-inch square of black plastic tape with a pin hole in the center, directly over the IR sensor on the product the customer is controlling. This reduces the acceptance angle of the sensor to the IR light. All the customer needs to do is accurately point

the remote at the product. There's a good chance that this solution will work. Another approach, of course, is to simply replace the lamp in the room that's causing the problem with a three-way lamp.

#### The future

What's in the future for remotes? Prob-

ably a voice recognition system. As for any consumer electronics product, the criterion is cost. This is the same argument we've heard for years on the CRT. No doubt the next century will bring us a flat display and a new remote control system, but for its time, Zenith's Space Command was a big breakthrough. ■

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Circle (69) on Reply Card

# What Do You Know About Electronics?

## Conversions

By Sam Wilson

**B**ased upon the premise that a little bit of review is always a good thing I will quickly go through the method of converting a binary number to a decimal number. I will also give a quick review of converting a decimal number to a binary number.

You might argue with the premise. For example, you might say: "If the bathtub is overflowing it is not a good thing to be reviewing digital basics."

OK—I'll grant you that. According to the rules of formal logic I can say: "I offer this premise 'a priori'." That is pronounced ah pree or ee. It means "This is my premise for the following and if you don't like it, spend the rest of the time counting the number of bricks in a wall."

### Converting binary numbers

First review: Convert 1010110 to a decimal. It is like learning to ride a bicycle. First you watch someone do it so you get a good idea of what the pedals are for.

So, you write the binary number that represents all of the locations of the number you are going to convert. Then, multiply each number by the binary equivalent for the location of the number:

$$\begin{array}{ccccccc} 2^6 & 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \\ 1 & 0 & 1 & 0 & 1 & 1 & 0 \end{array}$$

Starting from the right side and moving to the left you get:

$$(0 \times 2^0 = 0) (1 \times 2^1 = 2) (1 \times 2^2 = 4) (0 \times 2^3 = 0) (1 \times 2^4 = 16) (0 \times 2^5 = 0) \text{ and } (1 \times 2^6 = 64)$$

Then, you add all of the underlined numbers and you get:

$$2 + 4 + 16 + 64 = 86$$

Using the conventional method of writing it:  $1010110_2 = 86_{10}$

Now, let's go the other way - convert 86 to a binary number. The trick is to divide by two and divide the remainder until you run out of numbers. For example, when you divide 86 by two the

remainder is 0. The remainder for each step is over the top of the division.

$$\begin{array}{cccc} & 0 & & 1 & & 1 \\ (86^2 = 43) & & (43^2 = 21) & & (21^2 = 10) & \\ & 0 & & 1 & & 0 & & 1 \\ (10^2 = 5) & & (5^2 = 2) & & (2^2 = 1) & & (1^2 = 0) & \end{array}$$

Now, you write the remainders as a binary number starting from the right and going to the left:

$$86_{10} = 1010110_2$$

I said this was a review. If you go through the above steps it should remind you of the procedure and you can go it alone from there.

Now that we have reviewed the procedures I would like someone (anyone) some place (any place) to write and tell me how they use this in their job. I correspond with a number of technicians who are good at what they do, but I never get answers to that question.

Now, think about that. Every book I reviewed shows you how to convert decimal to binary and binary to decimal. I am sure that every reader can do it (but some of us need a little review).

If it is in the books, magazine articles, lectures, etc. why is there no place that provides us with examples of where we can use it? I will not go so far as to say it is useless. What I am saying is that I haven't received any information on how to use it on the job.

### What about ohm's law?

I am always amazed when a technician says, "I learned a lot of math when I was studying to be a technician, but I never have been able to use it".

The real truth is that the technician was never told how mathematics relates to the job, so I'll do it now.

In the mathematics of electronics courses you learned about Ohm's law, you did 207, or so, problems in Ohm's law and after you got out of school you never needed to do another problem.

Now, think about this. You measure the

voltage across a resistor (R) and you measure 10V when you should measure 2V. What are the possibilities?

- The resistor has changed value. That is very rare and you usually discard that possibility, but reserve it for later. You also discard the possibility that you have the wrong information. However, you might just want to double check your source of information.

- You know that there are two possibilities (disregarding the possibility of a bad meter or a bad measurement): either the current is wrong or the resistance is wrong. Statistically, your best choice is that the current is wrong.

You go through the possibilities much faster than you can read about them here. How do you arrive at the current so quickly? You know that the voltage across the resistor (V) is:  $V = IR$

So, there are only two real choices if you discard (automatically) the other possible choices we have listed.

You know it is the wrong current or the wrong resistance. You pick the current. Statistically, current is the best choice. You don't waste time on measuring the resistance of the resistor unless the current proves to be OK.

Having worked those 207, or so, problems you got it locked in your mind. You know what determines the voltage.

You can add it up this way: the mathematics is like a quick way to learn the relationships between the parameters. If you had to memorize those relationships in words a basic electronics course would have been a ten year course.

OK, so we know at least one reason for studying math in our basic electronics course. But, how about decimal-to-binary and binary-to-decimal conversions?

I'm waiting to hear from you guys and gals. You too. Phrone Sledge!

### Bad example

I was talking to a well-known and brilliant author about something he wrote in his book: A coulomb is the total electric

charge of  $6.28 \times 10^{18}$  electrons (or something like that).

I said: "You know that 6.28 is actually  $2\pi$  and it doesn't have anything to do with the value of a coulomb. However, you didn't correct it in the next edition of your book. Why, didn't you?"

His answer: "So many authors have copied that from me I was sure that if I put the real value in I would be accused of being wrong."

I put that story in here because I know I will get at least one letter saying "Why, then, did you put binary-decimal and decimal-binary conversions in your book?" (See above story.) In other words, if I didn't put it in my book people would say the book is not good. By the way, the real value of a coulomb is the sum of the charges of  $6.24 \times 10^{18}$  electrons. It can also be calculated to be  $6.25 \times 10^{18}$  which is a number you will sometimes see.

### Baffle job

I'm going to start by telling you a true story. When very sophisticated scientists and engineers—those who carry briefcases—go to a convention, they expect to attend lectures that they don't really understand. They list the names of the lectures in order to justify their expenses (paid by the company).

Some of those lectures are the result of a "call for papers" issued by the people who organize the conventions.

As a joke, two smart aleck engineers sent a proposal for a lecture using very advanced terminology. It was accepted before someone told them the whole thing was about a resistor.

As I remember reading about it, the "joke" was considered to be in very bad taste. Not funny McGee!

### How is it done?

There is a decoder going around that allows you to give a lofty title to your writing or lecture, or thesis, or dissertation. I provide you with the following decoder. The first word is usually an adverb. It modifies the adjective. The second word is an adjective that modifies the noun. The third word is the noun.

Here's the procedure: Think of a number with three digits. Select the word in the table that corresponds with the three digits you have chosen, and that is your title or subject or whatever. CONVENTION ORGANIZERS BEWARE! ■

### FIRST WORD

- 0 Alternative
- 1 Increasingly
- 2 Theoretically
- 3 Developmentally
- 4 Tentatively
- 5 Mathematically
- 6 Largely
- 7 Patently
- 8 Differentially
- 9 Integrally

\_\_\_\_\_\*  
 \_\_\_\_\_\*  
 \_\_\_\_\_\*  
 \_\_\_\_\_\*

\* Your choices

### SECOND WORD

- 0 Exponential
- 1 Distributive
- 2 Manipulative
- 3 Fourier
- 4 Mechanical
- 5 Technological
- 6 Industrial
- 7 Cooperative
- 8 Interactive
- 9 Thrusted

\_\_\_\_\_\*  
 \_\_\_\_\_\*  
 \_\_\_\_\_\*  
 \_\_\_\_\_\*

### THIRD WORD

- 0 Transformations
- 1 Pixels
- 2 Generations
- 3 Tautology
- 4 Torques
- 5 Thrusts
- 6 Cybernetics
- 7 Parcels
- 8 Declinations
- 9 Spoilers

\_\_\_\_\_\*  
 \_\_\_\_\_\*  
 \_\_\_\_\_\*  
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Example 473 - Tentatively Cooperative Transformations

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### Portable butane heat tool

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The product allows anti static soldering and is ideal for service technicians in industries including electronics, avionics, cellular communications, alarm systems, marine and automotive.

The tool features a rugged stainless-steel body and provides up to 125W of power. Temperature is fully adjustable up to 1,076F and the tool will run for up to two hours on a single refill.

Circle (24) on Reply Card

### Frequency counters

Two new frequency counters from Leader extend high resolution readings down 0.1Hz and offer operating versatility in the form of rpm and totalizer functions, deviation readings from a preset reference, and LO-GO-HI indicators that work from preset references to simplify judgment calls in production operations. The LF 826 covers the range 0.1Hz to 550MHz and the LF827 covers 0.1Hz to 1.3GHz. Time base accuracy is  $\pm 3$  ppm.



A large, bright 8-digit LED display has been selected for both units. Both feature reciprocal counting at frequencies below 10MHz to produce fast, high-resolution frequency readings at very low frequencies and direct counting from 10 to 100-MHz (Input A.). The prescaler method is used above 80MHz for Input B. Sensitivity is 15mV and 10mV rms for Inputs A and B respectively. An auto-trigger mode optimizes trigger level to minimize the effects of noise and hysteresis errors and a switchable low-pass filter removes RF to protect triggering on low frequency signal measurements.

Circle (25) on Reply Card



### Phone line for product design and testing

Viking Electronics, Hudson, WI introduces the DLE-200B phone line simulator. The unit eliminates the need to install phone lines for telephone testing. The user can connect two phone devices, modems, faxes, etc. to the simulator, and as soon as one of the attached devices goes off-hook, it will ring the other attached device. The device will transmit voice or high-speed data between the two devices.

Circle (26) on Reply Card

### Heat shrinkable tubing and sleeving selector guide

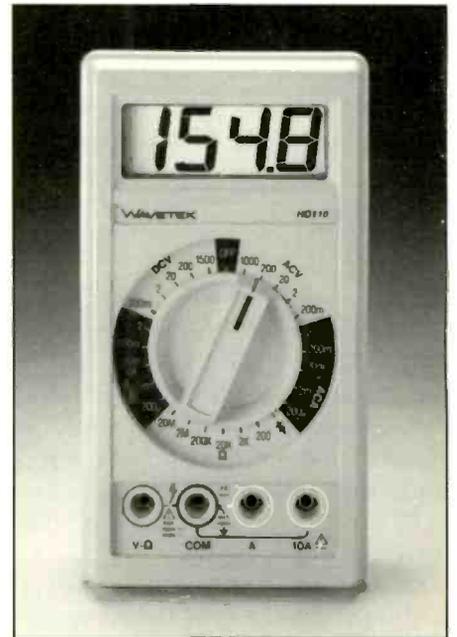
A new heat shrinkable tubing and sleeving selector guide supplied with a variety of evaluation samples is being offered by INSULTAB.

The Heat Shrinkable Tubing and Sleeving Selector Guide lists 36 standard products including PVC, thin wall polyolefin, multiple wall, special property, PTFE and FEP, and medical and non-

toxic heat shrinkable tubings. Also listed are PVC and PTFE sleeveings and spiral cut cable wrap.

The guide lists each material, its product name, specification, minimum shrink temperature, operating temperature, and flammability code ratings. Samples include various materials and colors.

Circle (27) on Reply Card



### DMM for rugged use

Wavetek's newly-enhanced Model HD110 is drop-proof, withstanding drops of up to ten feet onto concrete surfaces without damage. It's water/splash proof; use it outdoors anytime, anywhere. Battery life is 1,500 hours.

Functions include measuring range of 1500Vdc 1000Vac and ac/dc current to 10A. It measures resistance to 20M $\Omega$ , in addition to diode and continuity testing. Transient overload protection is 6kv.

Accuracy is 0.1%. The oversized display features 0.8 inch high characters.

Circle (28) on Reply Card

### Presaturated, lint-free wipes

These 8"x5", precut handwipes are manufactured in a choice of four solvents. ProClean flux remover, a mil-spec approved isopropyl based cleaner which will not affect soft plastic components; MultiClean, a general purpose cleaner

highly effective on water soluble contaminants, fluxes and pastes; Axarel 2200, a heavy duty cleaner which removes oils, grease, some inks and coatings, dries quickly with low aroma; and VeriClean, a new versatile and powerful cleaner which dries almost instantly, has no aroma and is 93% VOC exempt. None of the ingredients used are known or suspected to contain carcinogens.

Suited for use on SMT stencils and stencil printers, the wipes are also applicable for wiping connectors on PCBs, cleaning cables and harnesses and polishing assemblies such as optics, cabinets and equipment housings.

Circle (29) on Reply Card

### Magnifier

WASSCO announces Luxo's WAVE+ Plus magnifier. The primary lens is increased to 3.5 diopter, new brighter bulbs to increase light output by 33% and up to 85% when using the easily installed



accessory lenses of 4,8, or 10 diopter. The large viewing area, focused light source (the light does not leak out the side, causing discomfort to the viewer), and optional anti-reflective lenses help to prevent user burnout, fatigue, and eyestrain.

Circle (30) on Reply Card

### Programmable digital storage oscilloscope

Model 5150, a new four channel, 150-MHz Digital Storage Oscilloscope featuring a 50 GS/s sampling rate for repetitive waveforms and a 200 MS/s sampling

rate for non-repetitive waveforms, has been introduced by *B&K Precision*. Sampling repetitive signals at over 100 times the bandwidth of the oscilloscope greatly reduces the probability of aliasing.

These sampling rates complement standard features that include: automatic set-up of timebase, vertical sensitivity and trigger parameters; 40K of internal memory and a built-in PCMCIA slot that provides an additional 1 MB of memory per card; up to 16 automatic measurements; and full programming via built-in RS232 and IEEE488 interfaces. This oscilloscope also features Lab VIEW compatibility and a color VGA output.

Stored signals can be compared, manipulated, displayed and transmitted in a variety of formats. In addition, selected portions of measured waveforms can be compared directly with reference waveforms stored in memory. Trigger facilities include peak-to-peak, window and event counting.

Circle (31) on Reply Card

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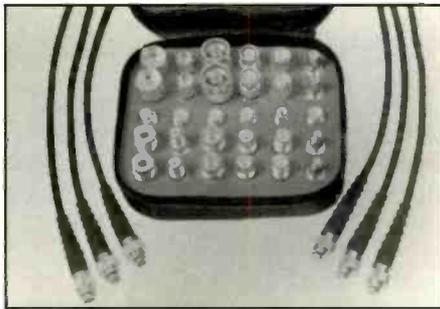


#### DMM with computer interface

B&K Precision announces the new Model 2880 DMM. The RS-232 interface allows the user to record measurements on a computer, and to print the results. The interval between measurements is selectable from one per second to one every .999 seconds. Measurements may also be graphed to show trends, or where to scrutinize the data more closely due to unusual or unexpected readings.

The meter has a "triple display" LCD with 4000 count resolution and a fast update analog bargraph. The triple display allows Min, Max, and Present readings to be displayed simultaneously. The user can change the mode to display Min, Max, and Average simultaneously. The triple display is also useful in the Compare mode where high and low limits may be set and displayed while the main display indicates PASS or FAIL when measurements are compared to the preset limits. Dual display can be used to measure ac voltage and frequency simultaneously. Other features include autoranging or manual ranging and Relative mode. The meter measures dc to 1000V at 0.3% accuracy, ac voltage to 750V and frequency to 20kHz. ac and dc current on 4 ranges to 10A. Ohms on six ranges to 40M $\Omega$  at 0.5% accuracy, continuity, diode test, frequency, and capacitance.

Circle (32) on Reply Card



#### Universal coax adapter kit

Time Motion Tools offers the Unidapt Kit, designed for the engineer technician. Users can mix or match any male or female UHF, N, BNC, TNC, Mini-UHF or SMA; optionally fitting F or RCA type with any other connector to create the adapter needed. Connectors are silver plated, machined brass, with gold plated contacts and Teflon dielectrics and come in an attractive padded and zippered case.

Circle (33) on Reply Card

#### Electronic CAD software

NTE Electronics, Inc., announces the availability of two new economical versions of WinDraft schematic design and WinBoard PCB layout CAD software programs developed by IVEX Design International of Beaverton, OR.

A lower cost set of WinDraft and WinBoard programs, with 200-pin capacity (upgradeable to higher pin capacities), was introduced earlier this year by NTE and has been extremely well received by professional engineers.

The new versions were developed to improve and simplify engineering and design of printed circuit boards. Both programs feature a 360-pin capacity (upgradeable to higher pin capacity), work with Windows-95, Windows 3.1, and Windows/NT, and come packaged in shrink-wrap boxes with a 75-page "getting started tutorial."

The user-friendly WinDraft can generate schematic designs within minutes of installation and provides everything needed for wiring, drawing, printing, and finishing the design. The WinBoard PCB layout software delivers sophisticated interactive routing capability. It has all the power necessary to accommodate complex board designs and the tools to

maneuver high-speed circuits, analog designs, and dense SMT boards. A library of over 700 module footprints (including over 350 SMT footprints); on-line editing of pad stacks; quick and easy placement of multiple copper pours; and reshaping of copper zones are all included.

Circle (34) on Reply Card

#### DMM with waveform display

Tektronix has added to its TekTools family a graphical DMM with waveform display, the THM 420 TekWaveMeter. This tool can be used in troubleshooting, maintenance, installation, calibration and repair of industrial, electronic, production and medical equipment.

The unit is a 3 3/4 digit, 4000 count DMM with true RMS for increased accuracy. It has auto power off, a backlight and continuity check beeper for ease-of-use. As a DMM, it can perform resistance, frequency, and diode tests. In waveform mode, the 5MHz, 16MS/s autoranging scope displays a graphic picture of the measurement to show characteristics like noise, glitches and intermittent failures. Additionally, the DMM can position, scale and trigger on a waveform.

Circle (35) on Reply Card



# NEWS

(from page 8)

in particular, is enabling people to accomplish their business and personal goals while in the comfort of their homes."

A large majority (76 percent) of survey respondents said they use their home office for "organizing household finances," while 45 percent indicated "home entertainment" and 43 percent said they used their home office to complete work that is brought home.

Why do people decide to set aside space for a home office in the first place? Thirty-three percent of the respondents say they invested in a home office to establish a small business while avoiding business rent payments. The rationale for 16 percent of respondents was handling "household and personal finances."

The CEMA survey also shows that home offices have become mainstays in the home, as 57 percent of respondents said they designated a separate room specifically for the office. However, only 39 percent indicated that their home office has a dedicated phone line.

Which products do they choose to stock their home office? Seventy-two percent of home offices use an answering device, followed by desktop computer (67 percent), printer (66 percent), and cellular telephone (48 percent). Telephone features are also important in any home office, with 50 percent utilizing call waiting and 21 percent using caller ID.

"State of the art" equipment is on the wish lists of one-fourth of home office households, but almost half (46 percent) said they "want just enough home office equipment to get work done".

The nationwide telephone survey of 500 households with a home office was conducted during the month of November 1996. The results have a margin of error of  $\pm$ four percentage points.

The Consumer Electronics Manufacturers Association (CEMA) is a sector of the Electronic Industries Association (EIA), the Arlington, Virginia-based trade association representing all facets of electronics manufacturing since 1924. CEMA represents U.S. manufacturers of audio, video, consumer information, accessories, mobile electronics and multimedia products. ■

## Test Your Electronics Knowledge

Answers to test (from page 23)

1. 
$$\begin{matrix} 1 & & 0 & & 1 \\ (37^2 = 18) & (18^2 = 9) & (9^2 = 4) \end{matrix}$$

$$\begin{matrix} 0 & & 0 & & 1 \\ (4^2 = 2) & (2^2 = 1) & (1^2 = 0) \end{matrix}$$

Answer:  $37_{10} = 100101_2$

2. 
$$\begin{matrix} 2^5 & 2^4 & 2^3 & 2^2 & 2^1 & 2^0 \\ 1 & 0 & 0 & 1 & 0 & 1 \end{matrix}$$
  
 $32 + 0 + 0 + 4 + 0 + 1 = 32 + 4 + 1 = 37$

Answer:  $100101_2 = 37_{10}$

3. noise

4. A. - A      C. - A  
    B. - A      D. - A

5.  $R_{TH} = R_N$  The resistances are the same, and they can be computed the same way. Thevenin and Norton equivalent circuits are shown in Figure 1. Either can be Figure 1 substituted for a linear 2-terminal circuit.

6. A product detector. If you said BFO it is not the answer. That is an oscillator it is not a type of detector. The product detector reinserts the missing carrier.

7. One time constant:  
 $= 0.01 \times 10^{-6} \times 500 \times 10^3$   
 $= 0.005$  seconds  
Two time constants =  $2 \times 0.005$   
 $= 0.01$  seconds (answer)

8. B - It changes once every input cycle.

9.  $T = \frac{L}{R} = \frac{500 \times 10^{-6}}{500} = 1 \mu\text{sec}$

10.  $5\text{dB} = 10 \log \frac{P_{OUT}}{P_{IN}}$

$0.5 = \log \frac{P_{OUT}}{P_{IN}}$

$\log^{-1}(0.5) = (\log^{-1}) \log \frac{P_{OUT}}{2.5}$

$\frac{P_{OUT}}{2.5} = 3.16$

$P_{OUT} = 7.9\text{W}$  (answer)

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**FURTHER PRICE REDUCTION.** Diehl Mark III \$49, Diehl Mark V Horizontal circuit tester \$169. New. Conductive coating for remote control keypads \$9.99 ppd. **WEEC**, 2411 Nob Hill Road, Madison, WI 53713. 608-238-4629, 608-273-8585.

**SENCORE, TEKTRONICS, HEWLETT PACKARD** (all models). We **BUY, SELL, & TRADE**. Please call "**CHOICE ELECTRONICS**" for all of your test equipment needs. Complete financing options available. Call 1-800-609-0677, ask for Lance Tople.

**Steps to troubleshooting electronics problems in circuits**, mail \$25.00. Steps to setting up your own TV store, send \$100.00. Certified checks or money orders ONLY. **Arnold Burns**, 425 East 51st Street, Brooklyn, NY 11203.

**Radio - New in original packages:** Rider Radio Manuals no. 6-7-8-10-11-15, no. 1 out of package, In box John Frider vol XIV Perpetual Troubleshoot Man, National Union by JF Rider, Sams Radio Photofacts 1-110, RCA Service Data 1-8, United Motor Service Inc., Home Radio Bulletin 1935-83. **TV - Rider TV Manuals** 1-3(2)-5-6(2)-7(2), RCA CTC 15-1156, Sams Photofacts folders 149-1992, \$500.00 each. **Seybert's Electronics**, 1331 Main Street, Anderson, IN 46016. 765-644-1252, Fax 765-642-1122.

**NAP Tuner 340309** RCA Tuner TCHRIA or TCCRIA. Snowy picture? Will repair for \$25.00, Free Shipping. **Tip Top TV & VCR**, 18441 Sherman Way, Reseda, CA 91335, 818-345-1974.

**CRT ADAPTER KIT** - Hooks your CRT tester to ALL picture tubes. Win the "socket war". Obsolete proof! \$59.00. **DANDY** 2323 Gibson, Muskogee, OK 74403. 918-682-4286.

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Sencore model SC61. Oscilloscope and a Sencore AC "Powerite" model PR57. \$1500.00 for the pair. **Contact: 407-671-2780.**

Sencore SC3100-\$2488.00, CVA94-\$2108.48, VR940-\$489.28, TF46-\$225.00, Kenwood DSO CS8010-\$1000.00, Fluke 45-\$300.00, B&K 520B-\$175.00, Hewlett Packard 3311A-\$125.00, and much more. **Contact: Rick, 210-519-3655**

Sencore VG91 and TVA92 TV video analyzers, in as new condition, hardly used. Complete with spare HOT for the TVA92, manuals, leads and original boxes. Will only sell as a pair - \$3000.00 plus shipping. **Contact: Clyde 613-546-1880, e-mail halfouel@sympatico.ca.**

Sencore SG80 (new never used) and PA81 (like new). Both complete with manuals, accessories and original boxes. \$3600.00 OBO. **Contact: Mamtronix, 913-467-8431 or 913-467-3921**

VCR service manuals for AIWA model HV70 AMNU, Zenith model VR2000, Realistic model 16-505. **Contact: Ernie Sharron, 68 Grove Street #2, North Brookfield, MA 01535, 508-867-7929.**

Eyecomm double-sided lighted sign. It reads "Electronic Servicing" with atom graphic on it. Large 8ft x 2ft, black with yellow letters. A real eye catcher. Paid \$1500.00, asking \$500.00. Like new. Photos available. **Contact: Chris, The VCR Shop, 757-238-2299.**

RCA color TV model 10J106, test jig and adapters, \$90.00. RCA voltomyst WV98C, \$60.00 working order. R.E.M. picture tube rejuvenator, \$35.00. Sam Photofact folders \$1.00 each in quantity. Muntz console TV from early 1950's-70's, you pick up. Edison diamond disc records \$5.00 each. All plus shipping. **Contact: Maurer Television, 29 South Street, Lebanon, PA 17042.**

Sencore VA62A video analyzer system. \$1200.00 includes VC63, NT64, ST65, EX231, TP212, cables, adapters, manuals and original boxes. B&K model 1249 NTSC generator, like new \$150.00, includes manuals and original box. **Contact: 414-498-8630.**

Hitachi V069 (new), B&K 1400, 530. Sencore SG165, SR68. CCR lightbox with slides. Sony CCR jigs, torque, gauges, test tapes. First reasonable offer takes. **Contact: Ed, 209-686-0168.**

Complete TV chassis test jig, \$950.00 OBO. **Contact: Doug, 904-259-5219, Rt. 2 Box 1868, Glen St. Mary, FL 32040.**

Hitachi VCR model VT-76AY, need schematic. No longer available from Hitachi or any other supplier. Will pay for copy and postage or will copy and return. **Contact: John Rypski, Pacer Electronics, 1074 Roselawn Drive, Paxton, IL 60957-1833.**

Service tips on Delco AM/FM CD auto radios. Information wanted on the Panasonic CD transport used in these units. Will pay or exchange. **Contact: John, 25 Pringbriar Lane, Kings Park, NY 11754, 516-544-6004.**

Akai VCR model VS303U, D-LED part ED-358056. Akai model VS-555um motor block. **Contact: Daniel, 250-338-6575.**

Compaq Desk-Pro model 2551, need schematic for power supply. Also transistor Q1 BUW 13A-S, and Q3 650-119. And Opto. CNY65-G8639 or cross references. **Contact: White's TV Service, 622 N. 5th Street, Hollis, OK 73550, 405-688-2612.**

Manuals and schematics for RCA CR11 WT-333A and Hameg HM 203-S. **Contact: Jim, PO Box 474 Methon, WA 98834.**

Sencore test equipment. Hickok or Precise 111M tube tester, tube limiters and amplifiers. **Contact: 612-869-4963.**

Need schematics for Crown CTV-L13, CTV-TW13, and for IMA 13-CTV. Pay for Copies. **Contact: Vergin TV, PO Box 220, Rockford, MN 55373, 612-477-4211, Fax 612-477-6578.**

## WANTED

NEC color TV model CT3000S, part no. 47105304 flyback transformer. Schematic for Zenith model R98 (Royal) Boombox AM/FM cassette radio. **Contact: Maynard Fischer, Route 1 Box 204A, Pulaski, WI 54162, 414-822-5458 (home), 414-497-8324 (work).**

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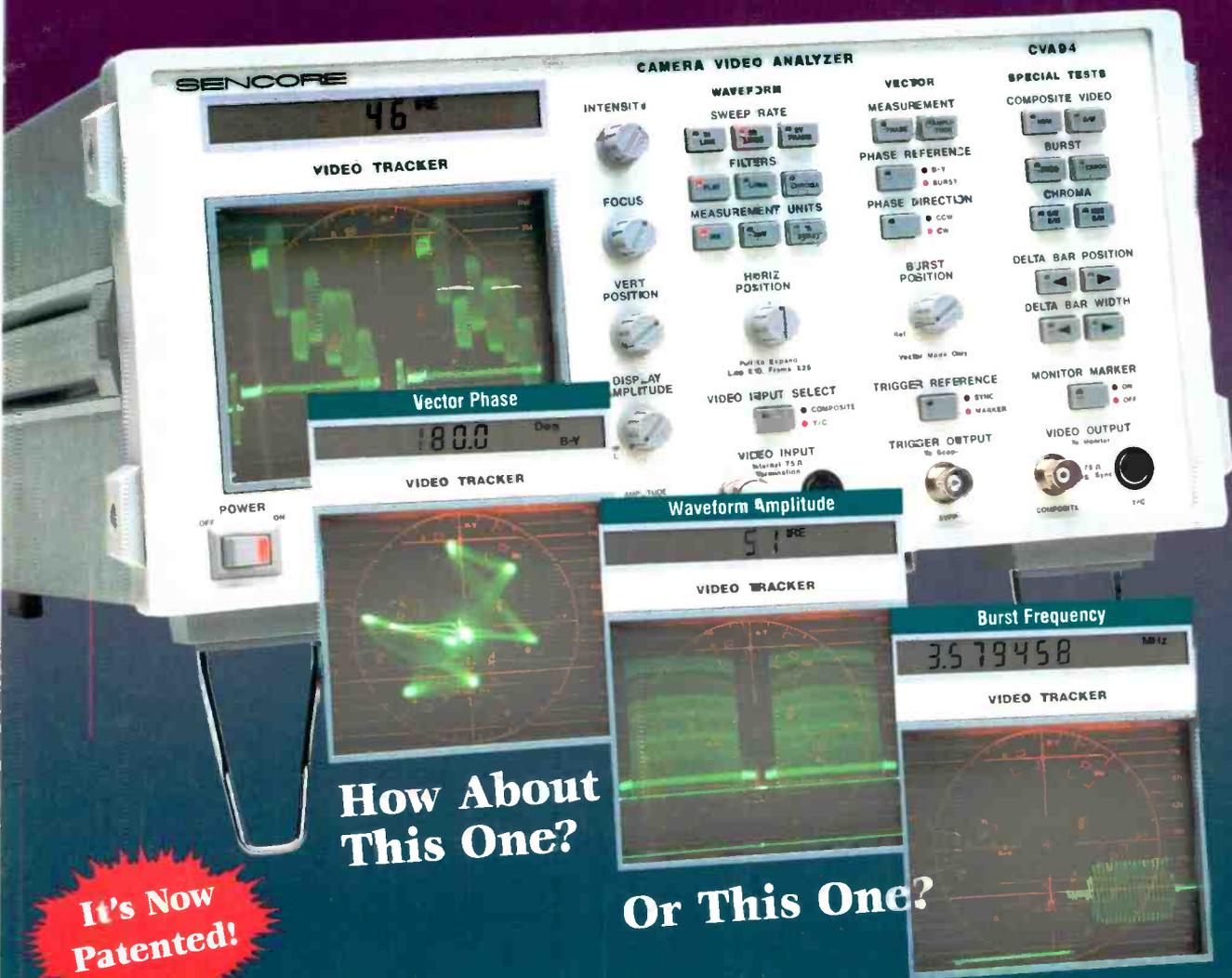
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