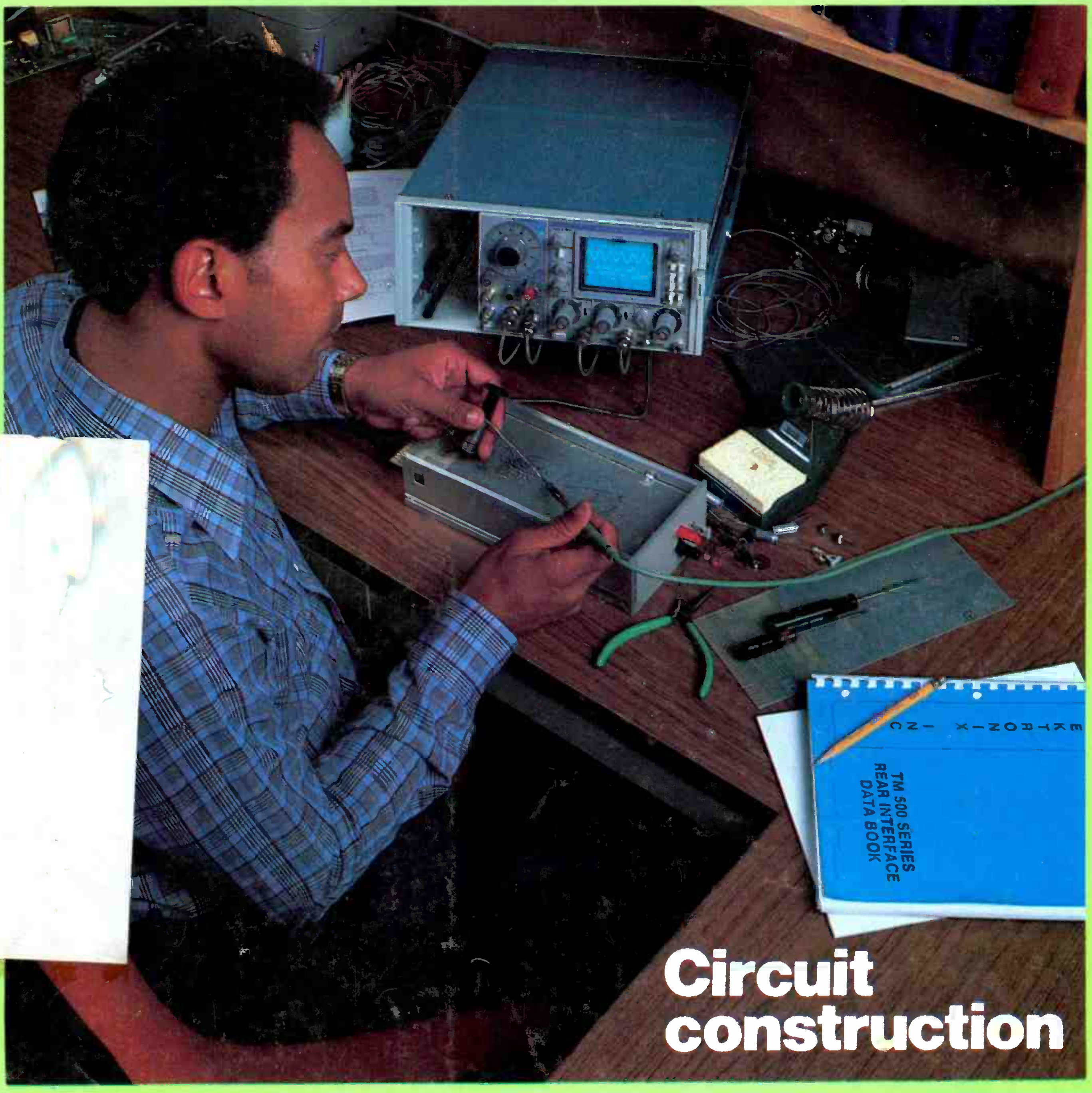
ELECTRONIC Servicing & Technology

OCTOBER 1984/$2.25

RCA CTC 131/132 chassis • Audio servicing test equipment

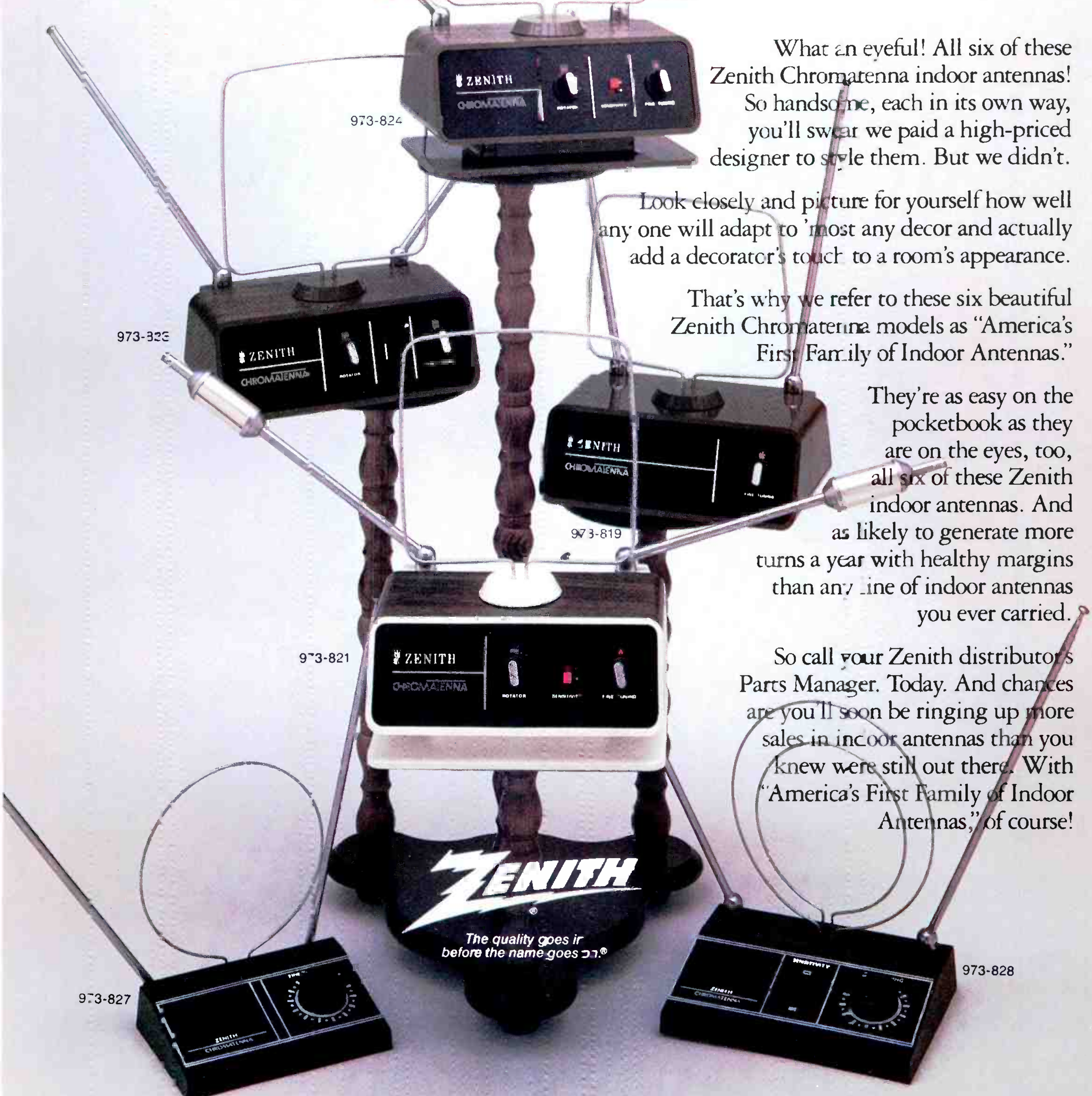
Using desoldering braid as a tool • VHS servo operation



Circuit construction

The best-looking ways to help keep TVs performing up to par may be right here before your eyes!

CHROMATENNA T.M. Antennas



What an eyeful! All six of these Zenith Chromatenna indoor antennas! So handsome, each in its own way, you'll swear we paid a high-priced designer to style them. But we didn't.

Look closely and picture for yourself how well any one will adapt to 'most any decor and actually add a decorator's touch to a room's appearance.

That's why we refer to these six beautiful Zenith Chromatenna models as "America's First Family of Indoor Antennas."

They're as easy on the pocketbook as they are on the eyes, too, all six of these Zenith indoor antennas. And as likely to generate more turns a year with healthy margins than any line of indoor antennas you ever carried.

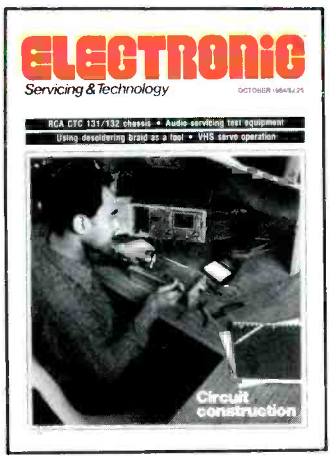
So call your Zenith distributor's Parts Manager. Today. And chances are you'll soon be ringing up more sales in indoor antennas than you knew were still out there. With "America's First Family of Indoor Antennas," of course!

Zenith Sales Company/Service, Parts & Accessories Division/11000 Seymour Avenue/Franklin Park, Illinois 60131

The how-to magazine of electronics...

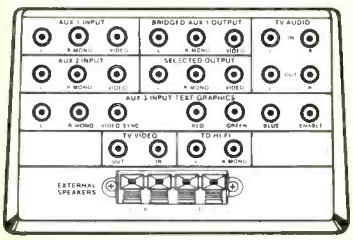
ELECTRONIC Servicing & Technology

OCTOBER 1984
Volume 4, No. 10



Constructing electronic circuits is an interesting and rewarding hobby in itself. As the article, *Build this speaker protector circuit* (page 20) shows, however, many homebrew circuits are also valuable in diagnosing and servicing equipment failures. (Photo courtesy Du Pont magazine)

Page 8



29-Connection ColorTrak 2000 Maxi Monitor Rear Patch Panel

Page 10

Page 54

Departments

Coming Next month...

RCA CTC 97 chassis—Every TV manufacturer produces sets that feature unique or unusual circuits. Effective troubleshooting techniques require an understanding of such circuits. The November issue will feature an article that describes some typical problems on some circuits peculiar to the RCA CTC 97 chassis, including start-up and shutdown problems.

A good source of information

I get a lot of phone calls and letters from readers looking for information of many different kinds:

- Where can I find a schematic for a model xyz TV set?
- Where can I get replacement parts for a Thermopolis quadra-tune TV?

Recently **ES&T** received two inquiries in one month about safety while servicing a television. One asked if it is still considered necessary to wear protective gear such as goggles and gloves while handling a picture tube, in view of the high degree of ruggedness and reliability of today's picture tube. Another caller asked about the danger of exposure to x-radiation of an individual working where color TV sets are operated out of their cabinets for servicing purposes.

We welcome letters and phone calls such as these, and in each of the cases mentioned above, we did some research and found the answers. To wit–yes, it's still necessary to wear protective equipment in case of a picture tube explosion, and no, if proper precautions are observed, there is no x-radiation danger from color TV servicing.

There is, however, an organization that is eminently qualified to answer such questions, from servicers and consumers alike; and, in fact, it has published many pamphlets, books, films and videotapes that provide the answers to these and many other questions about consumer electronics equipment. The organization is the Electronics Industries Association Consumer Electronics Group (EIA/CEG). The members of this organization are the companies that manufacture televisions, stereo equipment, video games, recorders and more.

CEG has a number of functions including setting of performance and safety standards for consumer electronic equipment, for example. One function on which they spend a great deal of time and money is the development and distribution of informational resources, such as mentioned earlier, for both technicians and consumers. Here are a few examples:

- Replacement parts sourcebook (a listing of whom to contact to obtain repair parts)
- Safety guidelines
- How to buy a phone
- How to buy a home computer

The organization also has several films and videotapes available, ranging on subjects from a discussion of the effects of electronics on modern society to a description of proper techniques for unsoldering and soldering chip components.

A few of these pamphlets, such as *How to Buy a Telephone* or *Safety*, are free if you ask for just one. Some of the other materials were quite costly to produce and cost money. In some other cases, EIA may ask you to pay the postage.

This information available from EIA represents a valuable resource. We suggest you contact them.

EIA
Consumer Electronics Group
2001 Eye St., NW
Washington, DC 20006
(202) 457-8700

Please enclose a self-addressed envelope to help defray postage and handling costs.

Nils Conrad Persson

ELECTRONIC Servicing & Technology

Editorial, advertising and circulation correspondence should be addressed to: P.O. Box 12901, Overland Park, KS 66212-9981 (a suburb of Kansas City, MO); (913) 888-4664.

Member, Audit Bureau of Circulation

Member, American Business Press

ELECTRONIC SERVICING & TECHNOLOGY (USPS 462-050) (with which is combined Electronic Technician/Dealer) is published monthly by Intertec Publishing Corp., 9221 Quivira Road, P.O. Box 12901, Overland Park, KS 66212-9981. Second Class Postage paid at Shawnee Mission, KS 66201. **Send Form 3579 to P.O. Box 12952, Overland Park, KS 66212-9981.**

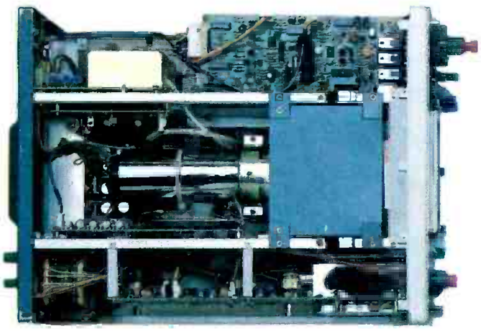
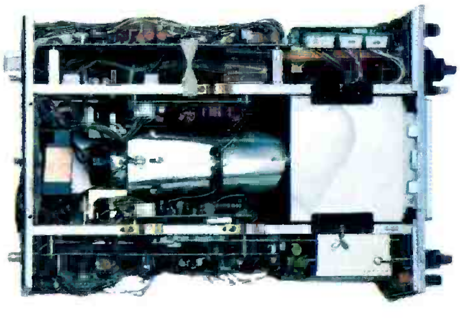
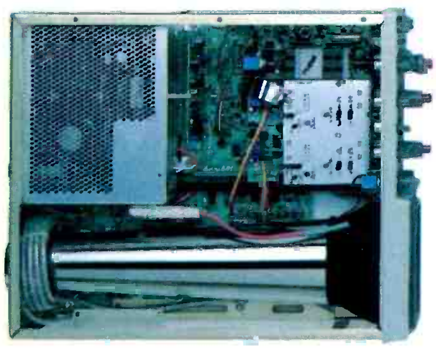
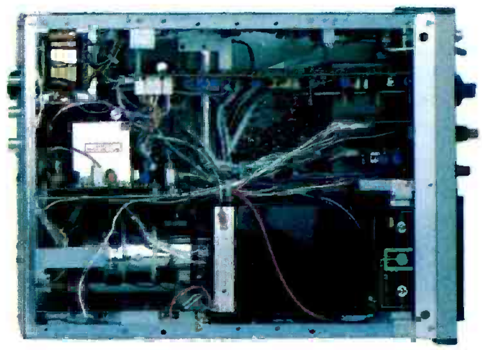
ELECTRONIC SERVICING & TECHNOLOGY is the "how-to" magazine of electronics. It is edited for electronic professionals and enthusiasts who are interested in buying, building, installing and repairing home-entertainment electronic equipment (audio, video, microcomputers, electronic games, etc.).

SUBSCRIPTION PRICES: one year $18, two years $30, three years $38 in the USA and its possessions. Foreign countries: one year $22, two years $34, three years $44. Single copy price $2.25; back copies $3.00. Adjustment necessitated by subscription termination to single copy rate. Allow 6 to 8 weeks delivery for change of address. Allow 6 to 8 weeks for new subscriptions.

ISSN 0278-9922 $2.00 + 0.00

INTERTEC PUBLISHING CORP.

You can't judge a scope by its cover.

When you look at our simplified, practical internal design, you see why the Tek 2200 Series delivers unparalleled high performance and reliability in the field. You get quality that's unmistakably Tektronix in scopes so advanced, they cost you less to buy and own.

Through an innovative new concept in scope design we reduced the number of mechanical parts by 65%. Reduced cabling by 90%. Virtually eliminated board electrical connectors. And eliminated the need for a cooling fan.

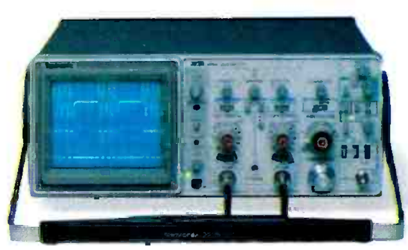
The result: a scope with designed-in simplicity that increases reliability as it cuts downtime and repair costs. All of which means outstanding value in a compact, lightweight package that your service technicians will appreciate.

Plus, you get a selection of performance to precisely match your needs. There are the 60 MHz single time base delay 2213A at $1200* and the 60 MHz dual time base 2215A at $1450.* And at 100 MHz, the dual time base 2235 at $1650* and the 2236 with an integrated counter/timer/multimeter at $2650.*

The industry's first three-year warranty† is testimony to 2200 Series dependability. Adding value to value are a variety of optional service plans that can economically extend this coverage to five years.

Consider what you're paying now in downtime, in service, in back-up scopes. On the bottom line, a Tek 2200 Series scope will save you money, time and trouble now and in the years to come.

Contact your Tek Sales Engineer for a demo today. Or call 1-800-426-2200, Ext. 201. In Oregon, call collect: (503) 627-9000, Ext. 201.



Tektronix
COMMITTED TO EXCELLENCE

*Prices F.O.B. Beaverton, Oregon
†3-year warranty includes CRT and applies to 2200 family oscilloscopes purchased after 1/1/83. Scopes are UL listed, CSA and VDE approved.

Technology

Taking the heat off projection TV

Sylvania audio/video has introduced two new liquid-cooled projection TV models. These models feature an advanced method of cooling the red, blue and green tubes in TV sets that typically generate high levels of heat during operation.

Sylvania's new projection sets offer better resolution and sharper pictures than ever before, according to Ron R. Stoltenberg, vice president and general manager, Sylvania. Through the technological innovation of liquid cooling, the tubes in these sets can also accept more current, which increases the tubes' light output. This advancement, along with new tube and lens optical coatings, results in greatly improved picture brightness and contrast ratio.

The new Sylvania 40-inch diagonal rear-projection system (PSC410PE) features a black matrix screen, a 17-button infrared remote control, which provides 125-channel capability, random-access digital tuning, favorite station scan and alternate channel. Also, this model is stereo adaptable, and an RF switcher is provided.

Home robot walks, talks, computes

What will the Smiths and Joneses be vying for during the remainder of the 1980s? Some predict they will be comparing who has the best home robot. In fact, Future Computing, a market research firm, predicts $2 billion worth of home robots will be sold by 1990.

Hubotics of Carlsbad, CA, has introduced Hubot, one of the first robots intended to be primarily used in the home, rather than by the hobbyist or in the schools. The basic 44-inch-tall model, with a suggested retail price of $3495, includes a complete mobile workstation, entertainment package and robotic functions.

As a workststation, Hubot includes a personal computer. Hubot's proprietary computer, the SysCon, has two parts. One is the personal computer, the other controls all the robotic functions. The workstation features a monitor, detachable keyboard, optional printer, 5¼-inch floppy disk drive and even a space for owners to put their toes as they work at Hubot. The personal computer includes the operating system, CPM and a variety of applications software is available.

The basic model has synthesized speech with a 1200-word vocabulary, and Hubot's face moves as he speaks. With the optional voice command module, Hubot speaks in a real voice and has an unlimited vocabulary in any language. This option also enables owners to command Hubot verbally and includes a microphone.

More traditional entertainment items include a 12-inch black-and-white television, an AM/FM stereo cassette player and an Atari 2600 video game set. Hubot also has a digital clock, displaying the time and temperature.

Due to the other side of his SysCon brain, Hubot moves by following programmed paths or through the use of a joystick. Once taught a path, his master can simply push one button to have him follow it again, or verbally command him if Hubot is equipped with the voice command module. His rotating OSP (Obstacle Sensing Processor) collar alerts him to stop when he encounters an obstacle.

Other options that will be made available include a burglar and fire alarm, vacuuming, an arm and hand, a drink tray and the ability to program Hubot's paths through graphics on the monitor.

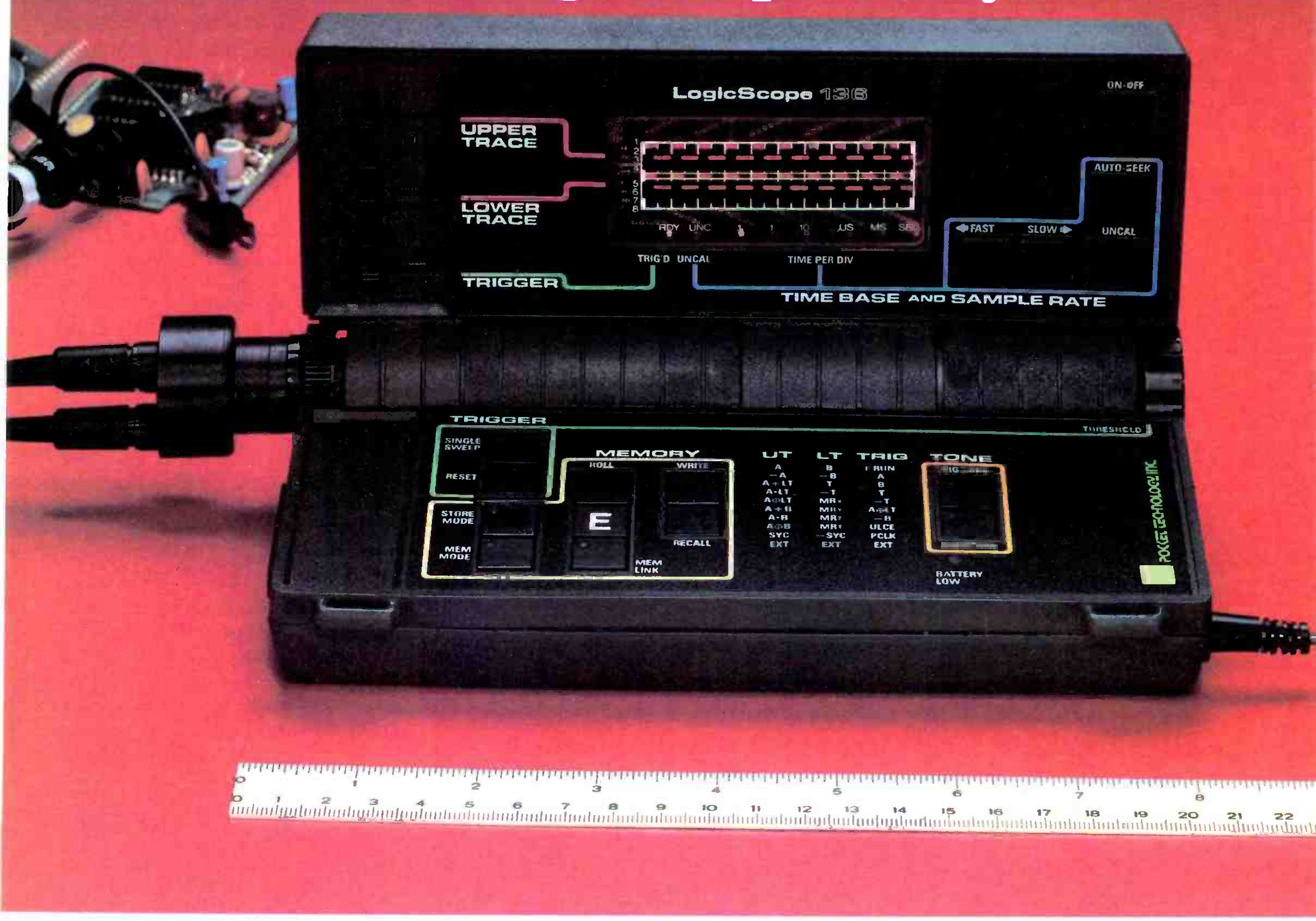
Hubot's Hu-Body is constructed of a single mold of polyethylene plastic, making Hubot almost indestructible. His plastic cannot be scratched or broken by even the blow of a hammer. Even the monitor has double protection to avoid breakage.

Aesthetically, Hubot was designed to be a warm and friendly addition to the home. He has only rounded corners, and human and machine characteristics are combined in the Hu-Body.

To recharge Hubot's battery, he is simply plugged into a wall socket. Another option will enable Hubot to detect when his battery is low and then automatically go to a wall unit to recharge himself.

ES&T

Meet Our New LogicScope 136. . . . A True Dual Trace 10 MHz Digital Storage Scope. Only $495.



True Dual Trace • 10 MHz Real Time Bandwidth • 3 Input Channels • I/O Port
Digital Waveform Storage • Boolean Waveform Operations • Audio Functions
8.25 (L) x 4.5 (D) x 1.75 (H) Inches • 1.25 Pounds • 9 Volt Battery/AC Operation

Consider the LogicScope 136

■ The LogicScope 136 is the next logical step in test instrumentation for you. It combines many of the features and capabilities of sophisticated logic analyzers and oscilloscopes . . . and it fits in your hand. Never before has so much technology been available in so small an instrument, at such a low price.

■ The pocket-sized LogicScope 136 is made possible by a patented breakthrough in display technology. The conventional cathode ray tube has been replaced by a unique array of 400 LED's that permits simultaneous display of two digital waveforms.

■ The 136 can be used for viewing single shot events, or repetitive waveforms. It can be operated in real time mode, or in memory mode which permits acquisition and storage of up to 24 128-bit waveforms. These can be recalled, logically compared (AND, OR, EXCLUSIVE OR) to other stored/input waveforms, or output to an external device via an RS 232 port.

■ Its very low cost, convenience and ease-of-use make the LogicScope the ideal instrument, for designing, troubleshooting or repairing digital systems.

Consider its Engineering & Field Service Applications:

■ On microprocessor-based systems, check the timing relationship of various parameters relative to the system clock and other key events. Its storage capability allows visual and logical comparison of non-repetitive waveforms to known reference signals. Output in the start-up of the digital device can be compared to reference signals to determine the operating state of the device. Questionable waveforms can be stored for analysis.

■ Its light weight and small size make the LogicScope convenient to take on every service call. The 136 provides much more information for trouble shooting a digital system or peripheral than a logic probe or digital multimeter, without having to lug an oscilloscope or logic analyzer along.

Contact us for the name of your local distributor

POCKET TECHNOLOGY, INC.
7320 Parkway Drive, Hanover, MD 21076
301-796-3300

Circle (6) on Reply Card

See us at WESCON '84 Booths 1566 & 1568

A technical overview

The new RCA CTC 131/132 TV chassis

Figure 1. This 25-inch console is one of 18 models in RCA's ColorTrak 2000 line that includes a built-in broadcast stereo sound system capable of receiving BTSC stereo TV broadcasts (when available).

Adapted from *The RCA Communicator* (an Electronics Technicians' Newsletter published by RCA Consumer Electronics.)

The CTC 131 and CTC 132 color chassis are the newest additions to the RCA unitized chassis family. The CTC 131 chassis is used in all 1985 (K-line) RCA ColorTrak 2000 25-inch *monitor-receivers.* A variation of the CTC 131 chassis, the CTC 132, is used in RCA's K-line projection TV models.

The Color Trak 2000 monitor-receivers give full spectrum audio/video performance and have either a 6- or 29-connection back *patch* panel for direct hookup of stereo and video devices. Also, all ColorTrak 2000 monitor-receivers come equipped for broadcast stereo and with the Digital Command Center infrared remote.

CTC 131/132 chassis have several new circuits. Among these are *Chroma/Luminance Wide I Processing, Automatic Kine Bias, Broadcast Stereo Audio System with Dynamic Noise Reduction (DNR* – trademark of National Semiconductor), *Chopper Power Supply, Video Noise Reduction* and *Video/Audio Switching Circuits.*

Full resolution color

The unique characteristics of human vision make certain colors more perceptible at low light levels. These colors center on orange and cyan (blue-green). Less perceptible colors are those centering on magenta and yellow-green. The NTSC color system accommodates these characteristics by transmitting the orange/cyan (or *I*) spectrum with a higher resolution than the magenta/yellow-green (or *Q*) colors. However, the *I* signal, because of its wide bandwidth, has the potential to mix with luminance (detail) information during processing. This causes picture detail interference. To avoid this, conventional color

Editor's note: For the signal schematic for this chassis, see the *Profax* schematic section in this issue.

televisions process only a fraction of the available *I* color signal.

K-line ColorTrak 2000 monitor-receivers and projection televisions now include full resolution color circuits that process 100 percent of the NTSC broadcast signal. These sets process the *entire luminance bandwidth,* for full detail performance; the *entire Q bandwidth,* for more brilliant colors; and the *entire I bandwidth,* for reproduction of more subtle color detail. RCA's charge coupled device (CCD) comb filter (or detail processor) virtually eliminates any interference caused by luminance and color mixing. And, the new chroma/luminance integrated circuit performs the complex task of converting the *I* and *Q* signals into the basic red, blue and green colors that drive the picture tube.

Video noise reduction

The new video noise reduction circuit minimizes snow and graininess in the dark picture areas, where these noise-related symptoms are most noticeable. It does this by automatically reducing the degree of peaking (sharpness) in the darker picture areas. At the same time, sufficient peaking is maintained in brighter areas, where detail is important but where noise is not as apparent. Also, because the video noise reduction sytem is *dynamic,* it senses and selectively adjusts the peaking to match brightness.

Automatic kine bias

The emissions of the three guns in a picture tube must be optimally balanced to produce correct whites. If picture tube setup is improper, loss of color fidelity occurs, and can cause an overall red, green or blue tint in extreme cases. With conventional color televisions, picture tube setup tends to drift during the time it takes the set to fully warm up (typically, about six minutes). Tube setup also deteriorates as a television ages.

The new automatic kine bias (or color balance) system dynamically senses color imbalance during picture tube warm-up, and automatically maintains true color tracking. A bias circuit samples the current from each picture tube gun 60 times per second. This current is compared to a stable reference, and when errors are detected, they are instantly corrected. Warm-up and aging drift are eliminated (along with the need for low-light setup screen controls.).

Broadcast stereo audio system

All CTC 131/132 chassis are equipped for stereo TV broadcast reception. Each set provides full-performance stereo sound from stereo TV broadcasts without the need for set modifications or special equipment. A built-in dbx decoding system reduces noise from specially encoded broadcasts. An LED indicator on the set lights during stereo programming, and a stereo/mono selector switch can be used to turn off the television's stereo processing circuitry in fringe areas where the stereo signal may not be strong enough for quality reception.

Alternate audio channel reception

ColorTrak 2000 monitor-receivers can also receive the alternate audio channel many TV stations may transmit for bilingual programming or other applications. A switch labeled *Audio B* can be set for automatic selection of the alternate audio channel when it is transmitted. Separate LEDs signal when Audio B programming is available and when the Audio B switch is set for alternate channel processing. The digital command center also includes an Audio A/B switch, allowing remote activation of the Audio B circuit.

Stereo from external component

ColorTrak 2000 monitor-receivers (CTC 131/132 chassis) can provide 2-channel sound when a stereo VCR or other stereo audio source is connected to the monitor-receiver's audio input jacks. The Dynamic Noise Reduction (DNR) system automatically reduces background noise and audio hiss on all program sources – off-air or VCR – without affecting the audio. The DNR system is activated by a front panel control. An LED indicator lights when the DNR circuit is active.

Audio quality

High-compliance speakers are an integral part of the audio system in all K-line ColorTrak 2000 models. These speakers provide excellent reproduction and high efficiency, even at higher-than-average volume levels. The speakers are driven by separate left and right amplifiers, for channel separation during stereo programming. Separate bass and treble controls permit TV audio to be tailored to accommodate room acoustics. Also, when volume is lowered, a built-in loudness contour circuit automatically boosts both bass and treble so that highs and lows are not lost as the sound level decreases.

Monitor-receiver panel (*Maxi* monitor)

The 29-connection back panel permits direct hookup of up to three stereo video peripherals (including compatible digital R/G/B devices), plus numerous audio/video output applications. A 6-connection back panel (not shown) is used on standard (or *mini*) ColorTrak 2000 monitor-receivers.

TV broadcast stereo overview

CTC 131/132 chassis incorporate the new TV broadcast stereo/Audio B multichannel receiver circuit. With this new stereo receiver, the TV viewer now can enjoy off-the-air stereo audio reception and select a transmitted secondary audio channel (Audio B) containing bilingual information or background music to accompany the video portion of the program.

The TV broadcast stereo/Audio B audio transmission is comprised of a wideband *composite audio signal* with several subcarriers. They are the conventional *monophonic* $L+R$ channel, the *stereo difference* information $L-R$ (left minus right audio), and the Audio B channel program. The stereo subcarrier is twice the horizontal scanning frequency, and is AM modulated with suppressed carrier. The Audio B program channel is an FM signal centered at five times the horizontal frequency. Both the stereo difference channel (L – R) and the Audio B channel signal are compressed at the trans-

"I'll tell you what it takes to succeed in VTR repair service."

"It takes know-how, and the right equipment to do the job. You obviously have the know-how, or you wouldn't be reading this magazine. The equipment? The same brand that factories use to build and test sets on production lines... LEADER!"

You need professional test equipment for a professional repair job.

Leader gives you test signal sources for every conceivable video and audio application–reliable and easy-to-use instrumentation that keeps you right on track. Audio sine/square wave generators cover 10 Hz to 1 MHz with low distortion.

To see what you're getting, Leader's LBO-517 50 MHz dual-trace oscilloscope is a natural. Put the input to a circuit on one trace, the output on the other, and actually see where distortion occurs, how much, and when it's corrected! You'll find more features on this oscilloscope than on many others regardless of price or manufacturer's claims. Or choose from a dozen other models.

The Leader frequency counter–in a rugged metal housing–can be used to adjust chroma frequency and vertical or horizontal synch circuits. Leader's large, bright fluorescent displays are easy to read. To round out your test bench, you'll need a wow and flutter meter, mirror-backed scale ac voltmeter, and a good quality field strength meter...all from Leader.

With Leader, you've got what it takes...

...to do the job right and build a reputation as the person to see when problems develop. With Leader on your test bench, there's no limit to the jobs you can tackle, the service you offer...or the extent of your potential income.

Two-year warranty. Evaluation units.

A history of high reliability permits Leader to provide a generous two-year warranty... backed by factory service depots on the East and West Coasts. A free, trial use of Leader instruments is available to all qualified companies.

Call toll-free (800) 645-5104 to request: an evaluation unit, our full-line catalog, the name of your nearest "select" distributor and additional information about how you can succeed in VTR Service.

For VTR professionals who know the difference.

LEADER Instruments Corporation

380 Oser Avenue
Hauppauge, N.Y. 11788 (516) 231-6900
Regional Offices:
Chicago, Los Angeles, Dallas.

Photograph of test bench taken at Orien-Tech, Inc. a factory authorized service center.

For Information Circle (8) on Reply Card
For Demonstration Circle (9) on Reply Card

mitter in accordance with the dbx TV noise reduction system. A pilot CW signal transmitted at the horizontal scanning frequency indicates the presence of stereophonic programming.

TV stereo broadcast audio generation

The simplified block diagram shows how the broadcasting station generates the composite audio signal. The left and right audio signals are added together to form the L + R (monophonic) signal. This signal is rolled off at 10kHz and passed to the input of the adder circuit along with a variety of other signals required to develop the composite audio signal. To generate the L – R audio channel, the right channel signal is inverted and added to the noninverted left channel. The L – R signal is processed by a dbx compander circuit (encoder) to dynamically pre-emphasize the signal characteristics. This companded audio information then is applied to an AM modulator with suppressed carrier output. The carrier frequency for this modulator is 31.468kHz (two times horizontal). The AM modulated signal is applied along with the L + R signal to the output adder circuit and combined with the 15.734kHz pilot signal and the Audio B information.

The Audio B signal source is amplified and applied to the input of an identical dbx compandor. The companded Audio B signal then is applied to the input of an FM modulator circuit, whose center frequency is 78.67kHz (five times horizontal). This FM modulated signal source is applied to the output adder circuit and combined with the previously developed signals, forming the composite audio signal. The bandwidth of the composite audio signal extends from 50HZ to 94.404kHz.

The various carrier frequencies and the pilot signal in the composite audio signal are derived from a reference system that is phase locked to the video horizontal sync. This minimizes problems that might cause spurious radiation and beats.

The composite audio signal then is passed to a conventional video/audio modulator, which generates the RF signal that is transmitted to the receiver. The receiver, in turn, must tune the proper channel, recover the RF signal, convert it back to baseband audio, individually demodulate the various subcarriers and switch the appropriate audio source to the audio processing system in the receiver.

TV stereo sound system (Figure 1)

The complete sound system for the CTC 131/132 chassis is contained on one separate subassembly. (The CTC 131/132 chassis contains *no* audio processing circuits.) The audio processing assembly consists of three circuit boards. These are the PWSB (sound IF, demodulators and matrix), the PWEXP (dbx expander), and the PWSS (audio volume/tone control, audio output).

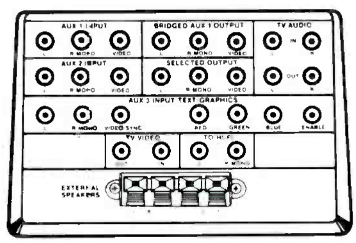


Figure 2. Connection ColorTrak 2000 maxi monitor rear patch panel.

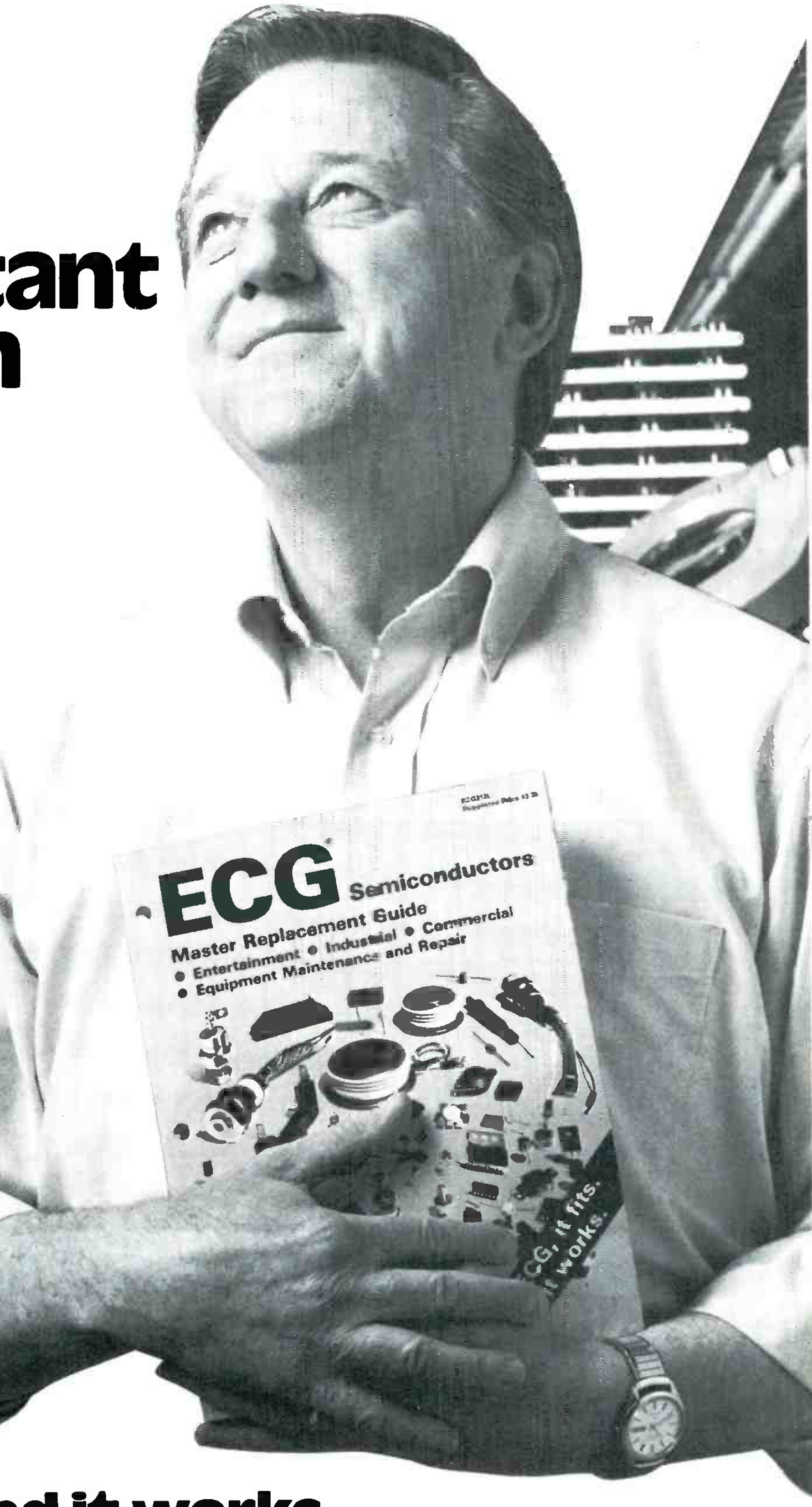
Because of the wide baseband audio, the sound IF signal cannot be processed by the pix IF circuit as it is in a conventional TV receiver. Instead, the IF signal output from the tuner assembly is routed to two separate circuits: the pix IF circuit, and the new sound IF system.

The pix IF output from the tuner is routed through the IF link cable to the CTC 131 chassis board. Next to the IF jack on the chassis board is an additional IF jack through which the IF signal is routed to the receiver audio subassembly. The 45MHz IF signal is applied to the first IF amplifier and detector network, which operates at the same frqeuency as the pix IF system (45MHz). The detector circuit in the first sound IF stage generates a difference frequency between the pix and the sound carrier, developing a 4.5MHz sound IF signal.

The 4.5MHz sound signal is applied to the second sound IF amplifier and demodulator circuit, which consists of a wideband 4.5MHz IF and demodulator. The 4.5MHz signal is demodulated, and the recovered baseband composite audio contains the monophonic audio. L – R stereo information, and Audio B signals. The composite audio is then routed to the Stereo/Audio B decoder circuit, which recovers the L – R, the Audio B and L + R information. The L – R and the Audio B information is applied to a switch circuit that selects either the Audio B signal source of the stereo broadcast information.

Because the broadcast transmitter performs only dbx companding of the L – R and the Audio B signals, the receiver must expand only these two signals and *not* the characteristics of the L + R signal. Therefore, the L – R or Audio B signal from the signal switch is applied to the input of the expander circuit on the expander board. The appropriate signal is then dbx expanded to its normal audio spectrum characteristics. The L + R also is routed to the expander board and passed through an audio delay circuit, to maintain the proper phase between it and the L – R or Audio B signals. The delay must precisely match the expander board circuit delay of the L – R or Audio B signals. This is necessary to optimize the channel separation in the stereo mode. The L + R and L – R/Audio B signals are routed back to the matrix amplifier on the PWSB board. The matrixed output signals then are passed to the PWSS board assembly. The signal is applied to a dynamic noise reduction (DNR) amplifier, which reduces background noise in the audio during low-amplitude, high-frequency conditions. The output of the dynamic noise reduction amplifier then is passed to the volume/bass/treble control circuit. The audio then is sent to the audio output circuit on the PWSS board, to drive the internal speakers in the TV receiver of external speakers.

Probably the second most important book you can turn to for guidance.



Electronics dealers and repair experts know they can depend on Philips ECG® Replacement Semis to fit and to work—reliably.

And they know they can depend on the new ECG Semiconductor Master Replacement Guide to save them time, money and aggravation when ordering the parts they need.

545 pages. 3,100 ECG Semiconductor types. More than 700 new products including transient voltage suppressors, microprocessor ICs, thermal cutoffs, solid state relays and more.

It's the only book of its kind you'll ever need this year, and you can get it from your nearest ECG distributor. Just call **1-800-225-8326** toll-free for his name and phone number (in Massachusetts, call 1-617-890-6107).

If it's ECG, it fits. And it works.

PhilipsECG

A North American Philips Company

On/off control operation (Figure 2)

The CTC 131/132 TV chassis uses an electronic latching-type of power on/off control system. The tuner control module (MSC) controls the on/off condition of the chopper regulator power supply. An on/off instruction from either the IR hand unit or the manual on/off switch activates a latch within the tuner control module microcomputer, pulling the control line to the chopper regulator to logic *Lo*. The chopper regulator then produces a variety of B+ power sources, two of which power the horizontal deflection system. The deflection system develops a variety of scan-derived B+'s, one of which, the +30V, is routed back to a sensing circuit in the MSC module. This causes the MSC module to latch the control line in the logic *Lo* state, keeping the power supply turned on.

If a problem exists in the chopper regulator supply or in the deflection system, the +30V from the output of the IHVT will not be present, and the latch system within the tuner control module will not keep the control line at a logic *Lo*. As a result, the control line will immediately go logic *Hi*, turning off the power supply. This operation takes only a few hundred milliseconds.

Also notice in the block diagram that the horizontal deflection system produces a shutdown signal that is applied to the chopper regulator circuit. If excessive high voltage exists, the shutdown command is applied back to the chopper regulator circuit, turning off the output of the regulator. When the output of the regulator is turned off, the B+ to the deflection system drops to zero, turning off the deflection system. At this time, the power supply again turns on, applying power to the chassis. If excessive high voltage continues to exist, the chopper power supply will be toggled off and on until the problem is resolved.

The chopper regulator should never be forced into an *on* state by defeating the protective feedback loop between the IHVT, MSC and chopper power supply.

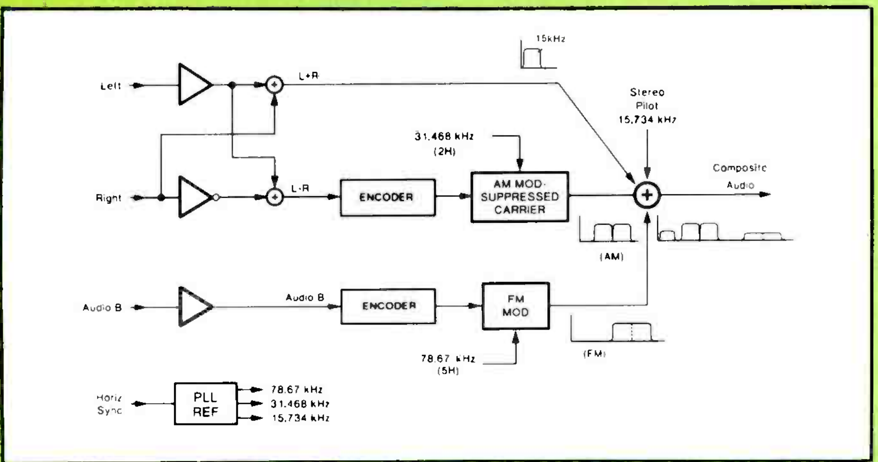


Figure 3. TV stereo broadcast composite—audio generation.

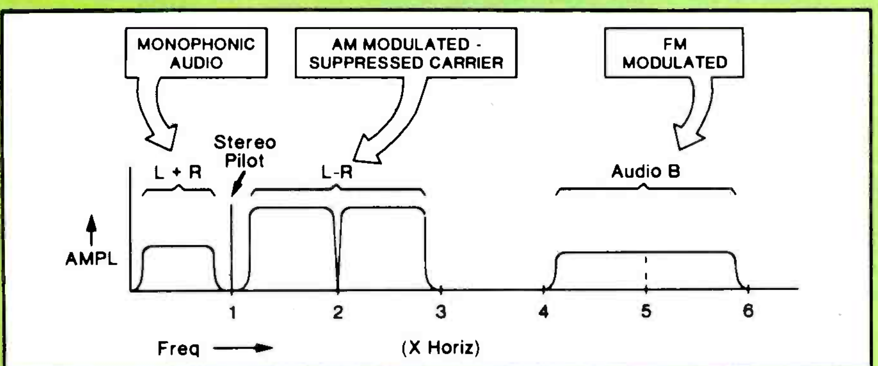


Figure 4. TV broadcast stereo—composite audio.

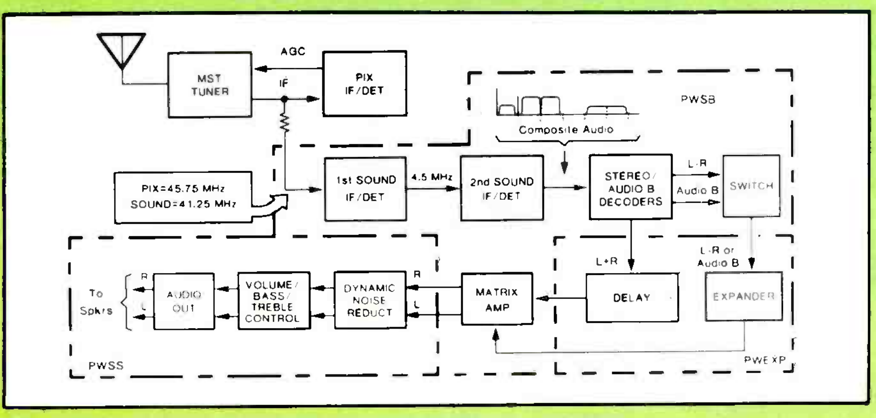


Figure 5. Stereo sound system block diagram.

Automatic kine bias (AKB)

The CTC 131/132 automatic kine bias (AKB) system (Figure 3) eliminates color temperature drift problems that occur in conventional receivers as a result of picture tube warmup and aging. A dynamic circuit in the CTC 131/132 monitors the emission of the three guns in the picture tube and corrects the dc bias of the video driver stage to maintain proper gray scale (color balance). See the simplified block diagram.

The AKB circuit monitors various gating signals within the video driver circuit during a test period called the *AKB process period*. This period occurs during the seven horizontal scan lines just after vertical blanking. (By reducing the vertical height of the receiver, the AKB period can easily be seen at the top of the screen.) The AKB process circuit requires vertical and horizontal pulses from the countdown integrated circuit to properly time its operations.

During the AKB process period,

the automatic kine bias circuit generates a variety of control pulses to set the video output stage to a known state. A grid *setup* pulse is applied to the picture tube grid from transistor Q5007. At the same time, the AKB pulse and AKB gate are applied to the luminance/chrominance process circuit and to the luminance/-chrominance interface board (PWLCI), respectively. These pulses from the AKB process circuit set up the inputs of the video driver stage during the AKB process period, thereby controlling the emission of the picture tube guns. Again, this AKB period occurs only during seven horizontal lines at the beginning of vertical scan. Otherwise, the luma/chroma process, luma/chroma interface (PWLCI circuit board) and video drivers operate normally. The AKB circuit eliminates the need for three separate screen controls. In the CTC 131, one screen control (AKB) is used to simultaneously adjust the screen potential to all three guns.

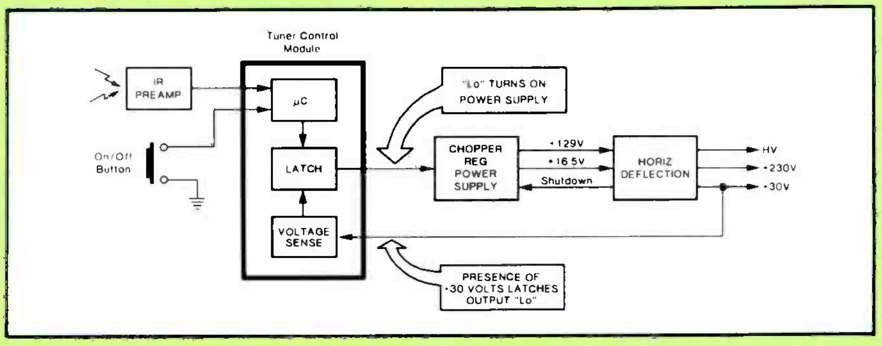


Figure 6. CTC 131 PWM chopper power supply on/off control operation.

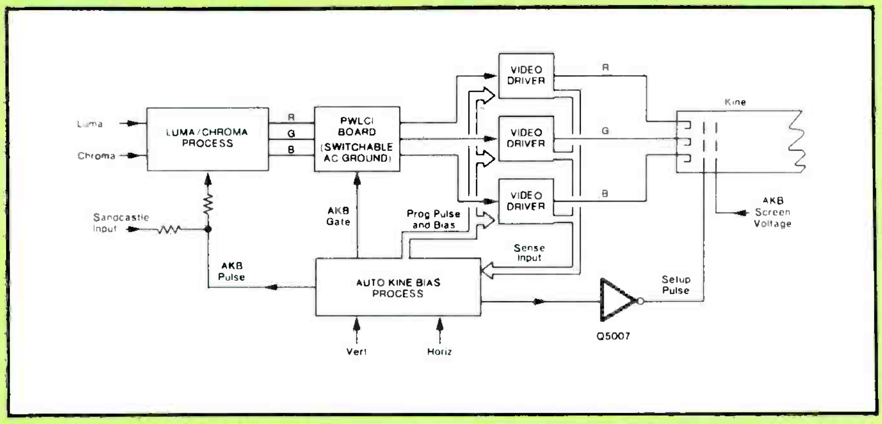


Figure 7. Automatic kine bias (AKB) simplified block diagram.

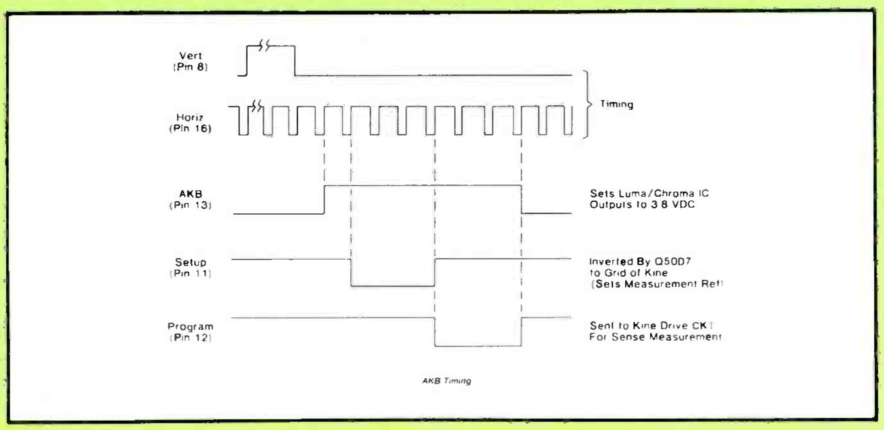


Figure 8. AKB timing.

AKB setup

To properly set up the receiver gray scale, place the setup switch (on the kine drive board) in the setup position and adjust the AKB control (on the rear of the IHVT transformer) until one color just barely becomes visible on the screen. Then, place the setup switch in the normal position. The AKB circuit now takes over and continuously adjusts the drive bias to the video driver stages so that the relative conduction of the picture tube guns maintain proper gray scale. This correction is updated 60 times a second (or every vertical field).

AKB timing (Figure 4)

As stated previously, the AKB processing period is the seven horizontal lines at the beginning of vertical scan. The vertical and horizontal pulses from the deflection countdown IC are used to time the operation of the AKB process system. As shown in the timing chart, at the end of vertical blanking, pin 13 of the AKB IC develops a positive pulse that lasts throughout the complete AKB period. This output pulse is passed to the chroma/luma IC, instructing the IC to *fix the R/G/B outputs at a 38Vdc level* during the AKB period. By using an oscilloscope *synchronzied* at the *vertical rate,* a technician can observe this AKB pulse and its effect on the R/G/B/ outputs of the chroma/luma IC.

The setup pulse from pin 11 of the AKB IC occurs one horizontal line after the start of the AKB period. The setup pulse is passed to transistor Q5007, is inverted, and then is applied to the grid of the kine gun. This pulse sets the *reference point* used during the AKB period to make the proper measurement. The program pulse from pin 12 of the AKB circuit is developed approximately *four horizontal lines* after the start of the AKB period, or at the end of the setup period. The program pulse, referred to as the *sense period,* has a duration of three horizontal lines. During this period, the pulse is sent to the kine drive circuit, and a measurement is taken to determine the conduction state of the three guns.

CONIFER IS ABSOLUTELY THE BEST MESH ANTENNA

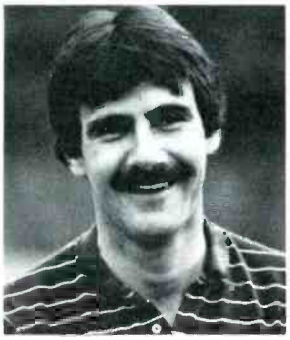
When Wayne Marong, owner of Harbour Audio/Video in Camden, Maine, saw the Conifer satellite dish for the first time he became immediately attached to it. He knew Conifer's quality and ease of installation was just what he had been looking for.

WHAT IMPRESSED YOU ABOUT CONIFER'S ANTENNA?

"I had been looking at some other types of mesh antennas and Conifer's impressed me as an easier package to get out into the field and install. Of all the mesh antennas it is the best."

WHAT DO YOU LIKE ABOUT THE COLOR AND THE MESH CONSTRUCTION?

"In this market area people like an antenna that blends into the scenery. If the black antenna is backed up against the woods it almost disappears. We also get a lot of high winds and Conifer's antenna holds up well."



Wayne Marong
Owner — Harbour Audio/Video
Camden, Maine

WHAT ABOUT WEATHER PROTECTION?

"We're right on the ocean and we have installed several Conifer antennas close to the shore. One is located on the roof of a house and is exposed to salt spray off the ocean. The Polymer coating and the stainless steel nuts and bolts protect it from rust and corrosion."

WHAT ABOUT DURABILITY?

"Conifer's antenna has held up well. I installed one system about 15 miles from the coast. We had a severe ice storm that deposited two inches of ice on the antenna and mount. It was severely iced. There were icicles hanging off the back. Yet, it made it through without coming down or falling apart."

IS THE CONIFER ANTENNA EASY TO INSTALL?

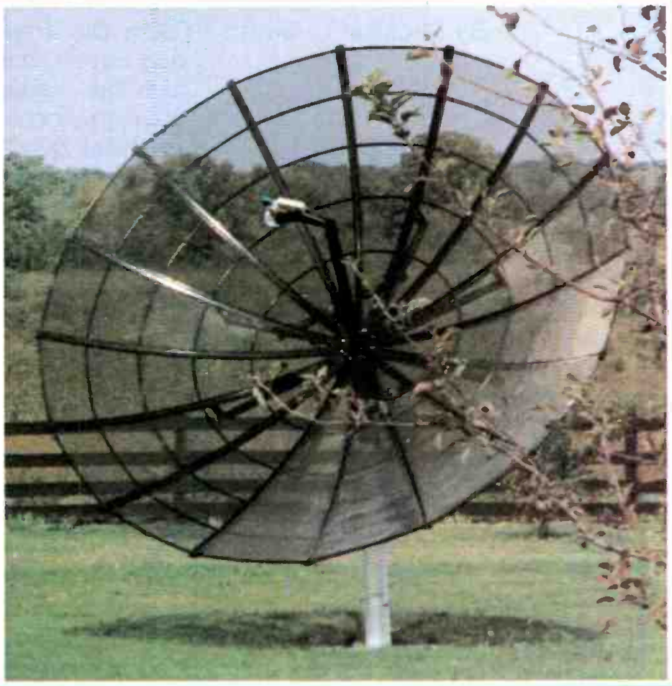
"The ease of installation is what I like best about the Conifer antenna. We actually custom build a mount and install the antenna on a roof. You can't do that with competitive dishes. We can assemble the Conifer antenna in a couple of hours."

WHAT DO YOU THINK OF CONIFER?

"The Conifer people are terrific. They have helped us with all the problems we've had and they are a good company to do business with."

WHAT KIND OF HELP DOES CONIFER OFFER?

"Conifer's new brochure <u>77 Ways To Succeed In The Home Satellite TV Business</u> can be a helpful tool. And it's FREE too!"



Conifer's DE-2001 "complete dealer ready TVRO system" includes: AN-1200C 12 ft. coated antenna (white, black, tan or green), Polarotor I™ Feed horn, 100K LNA, 36VDC Motor Drive, 100 ft. 13 conductor cable, RC-2001 deluxe receiver with convenient built-in features — motor drive control • polarity control • modulator. It all ships in a 6' x 3' x 2.5' box that weighs 300 lbs. and can fit in a family station wagon or van. Full one year warranty.

FREE! Fill out this coupon or send your business card and receive Conifer's "77 Ways To Succeed In The Home Satellite TV Business"

Mail to: Conifer Corp., Box 1025, Burlington, Iowa 52601

Name ______________________

Company ______________________

Business Address ______________________

City ______________ State ________ Zip ________

Phone Number (________) ______________________

FOR QUICKER RESPONSE, CALL OUR TOLL FREE NUMBER 1-800-358-3058
In Iowa Call (319) 752-3607

CONIFER

CONIFER CORPORATION • 1400 N. Roosevelt • Burlington, IA 52601 • 319-752-3607 (Iowa Calls) • 800-358-3058

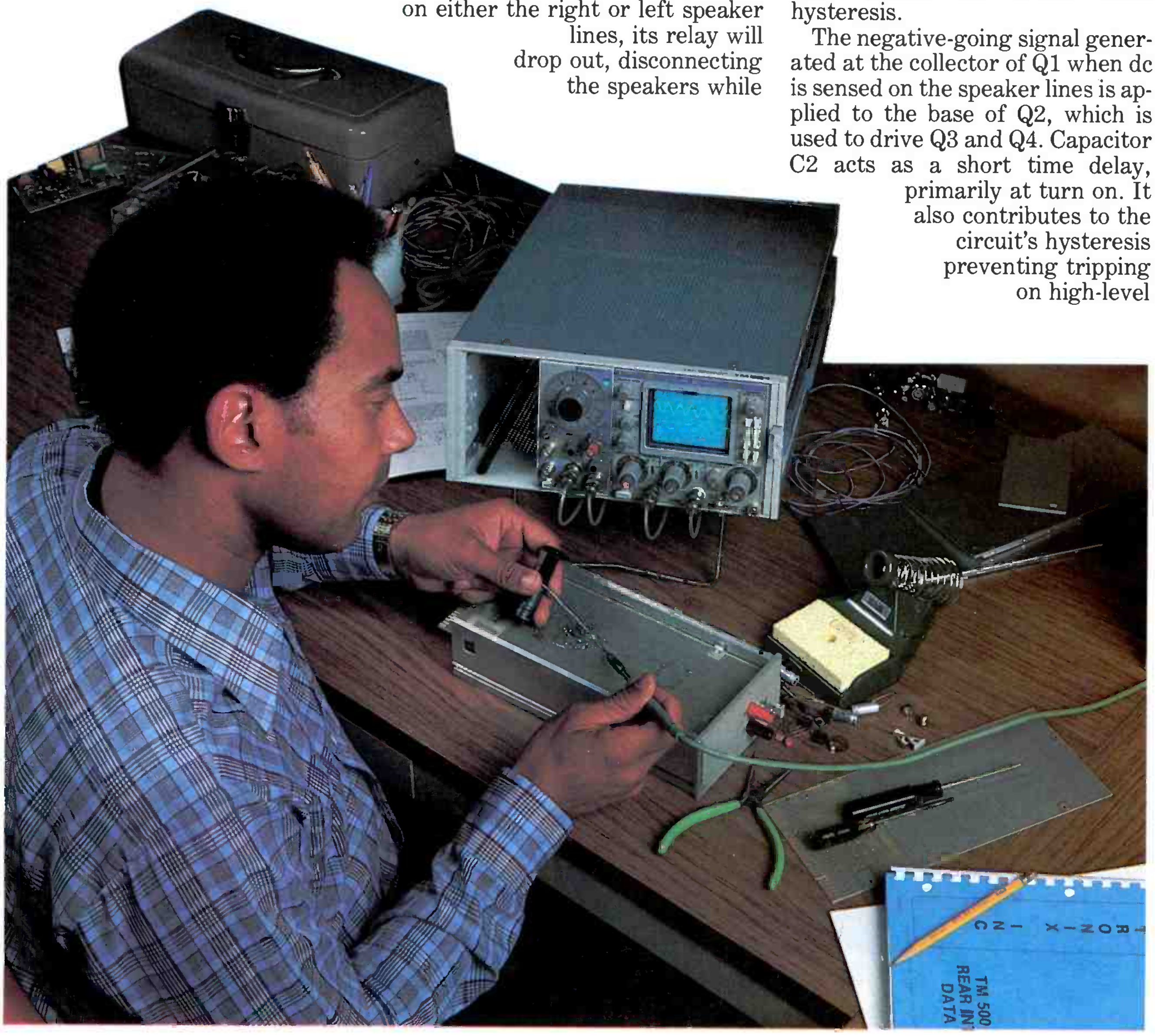
Circle (28) on Reply Card

Build this speaker protector circuit

By Michael L. Smith

Test bench speakers take a lot of abuse. They are often overdriven and fed dc from sick amplifiers at levels that would curl the toes of Frankenstein's monster. Those problem amplifiers are the reason for the circuit described here. Its design is not difficult, but it has the potential of saving loudspeakers.

The Speaker Protector monitors the speaker lines, watching for a positive or negative dc voltage to appear at the speaker terminals. (Sure the amplifier has a protection circuit, but does it try to protect the speakers or itself, and does it protect anything when the amplifier fails?) When this protector senses approximately 2V to 3V or more of positive or negative dc on either the right or left speaker lines, its relay will drop out, disconnecting the speakers while the bipolar LED changes from the safety indication of green to the danger indication of red to warn you there is a problem on the speaker line. The Protector will also mute turn-on transients that many lower priced amplifiers send down the line when power is first applied.



Description

Let's trace through the schematic Figure 1, and see what is happening in the circuit. The amplifier outputs are fed through isolation resistors to a diode bridge used to steer any dc on the line to forward bias Q1. Capacitor C1 bypasses the normal audio signals while holding any dc voltage for a time, giving the circuit some hysteresis.

The negative-going signal generated at the collector of Q1 when dc is sensed on the speaker lines is applied to the base of Q2, which is used to drive Q3 and Q4. Capacitor C2 acts as a short time delay, primarily at turn on. It also contributes to the circuit's hysteresis preventing tripping on high-level

THE ALL NEW MARK IV

SUPER TECH
DIAGNOSTIC COMPUTER

WILL DIAGNOSE ANY TYPE OF START UP, SHUT DOWN, DEAD SET, REGULATED LV POWER SUPPLY, HORIZ OSC / DRIVER, FLYBACK, HI-VOLTAGE OR SCAN DERIVED B + PROBLEM

IN LESS THAN 30 SECONDS WITH 100% ACCURACY !

- ★ **NO TEST POINTS TO LOCATE**
- ★ **NO PROBE WORK WHATEVER**
- ★ **NO SCHEMATIC REQUIRED**

Any technician can become totally familiar with the operation of a Super Tech Computer in about two hours. No programming is required, simply remove the horiz output transistor, plug in your Super Tech, then press four buttons. In the time it takes you to press four buttons, the display lights on your Super Tech will tell you exactly which stage has failed. Super Tech will then power the set up (in spite of its defects) and allow you to troubleshoot the now isolated defective stage. With Super Tech all start up / shut down problems are easy.

Super Tech computers are distributed by the very people who are using them ... independent shop owners. You're invited to either call or "drop in" on any of the following dealers. (Take your stopwatch with you)!

Statham TV & Communications, 1603 Center Point Rd., Birmingham, AL 35215	Bill Statham	(205) 853-4530
Daugherty TV, 1050 Broadway, Hamilton, IL 62341	Melvin George	(217) 847-3348
Taylor TV & Elect., 127 E. Williams St., Kendallville, IN 46755	Ray Taylor	(219) 347-0509
Brady's TV, 13920 Uplander St. N.W., Spring Lake Park, MN 55303	Pat Brady	(612) 786-5353
Electracraft, 23 Main St., Otisville, NY 10963	Paul Famiglietti	(914) 386-1213
Paul's TV, 1571 Easton Rd., Roslyn, PA 19001	Paul Williams	(215) 576-1696
Smokey's TV, 7227 Antoine, Houston, TX 77088	Smokey Wells	(713) 447-0500

DIEHL ENGINEERING • 6004 ESTACADO • AMARILLO, TX 79109
PHONE (806) 359-1824 CIRCLE (11) FOR FREE BROCHURE

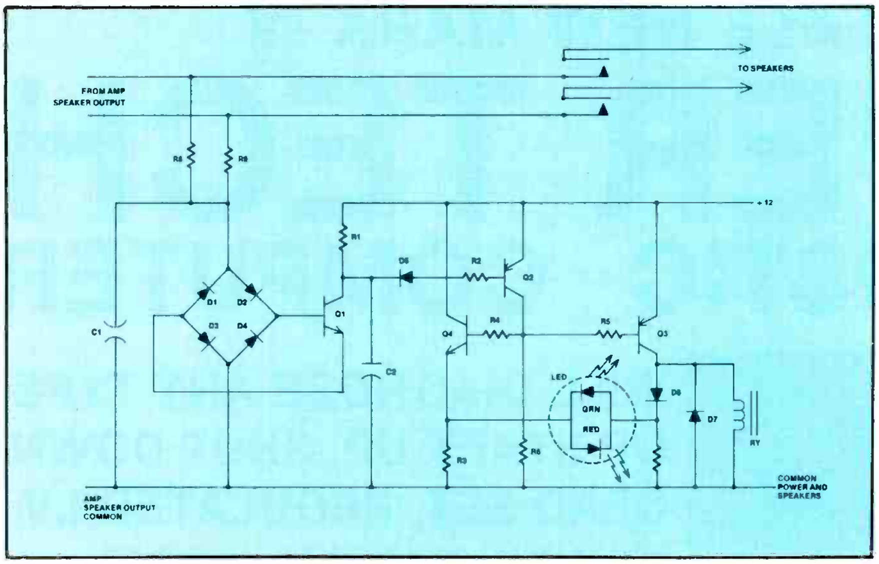


Figure 1. A relay in this speaker protector circuit disconnects the speakers if dc appears at amplifier output terminals.

signal transients. Diode D5 is more protection against false tripping on high-current music peaks by increasing slightly the needed negative-going voltage swing at the collector of Q1 to cause Q2 to conduct.

Transistor Q3 serves a dual purpose here. Most importantly, of course, it drives the relay, but it is also one half of a flip-flop used to reverse polarity of the voltage across the bipolar LED. With no dc present on the input, Q1 will be off, keeping Q2 off. This puts a low on the bases of Q3 and Q4, turning Q3 and Q4 off. Current flow through the LED at this time is from common through R3, the LED, D6, and Q3 to the supply. At this time, current will also be flowing from common through the relay and Q3 to the supply, activating the relay and closing the audio circuit to the speakers.

When the Protector trips due to a dc voltage at the input, Q3 and Q4 swap states. That is, Q3 now turns off, allowing the relay to drop out disconnecting the speakers, and Q4 turns on. Current flow through the LED is now from common through R7, the LED, and Q4 to the supply. Diode D6 blocks the dc path through the relay in this mode. LED is a two lead LED package with two LED junctions connected in parallel and inversely. One is green and one is red, producing a different color depending on the polarity of the applied voltage.

Note that transistor Q3 is a small current device rated at only 100mA. The relay specified operates at only 75mA (while the contacts are rated at 10A) which is no

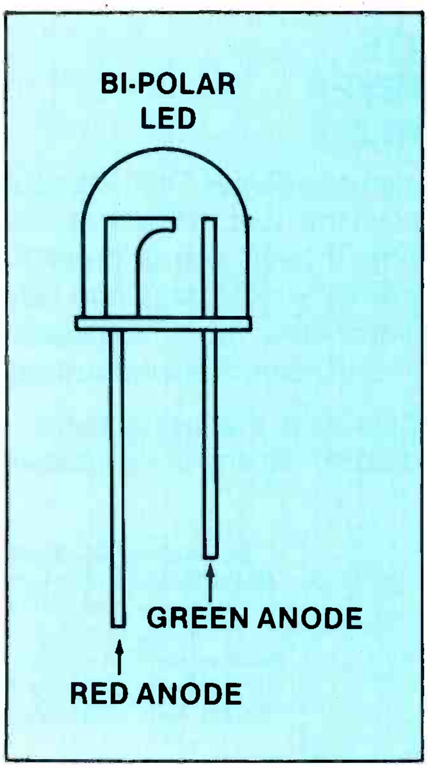


Figure 2. Bipolar LED glows green when speakers are connected via the relay, and changes to red when circuit conditions cause the speaker relay to open.

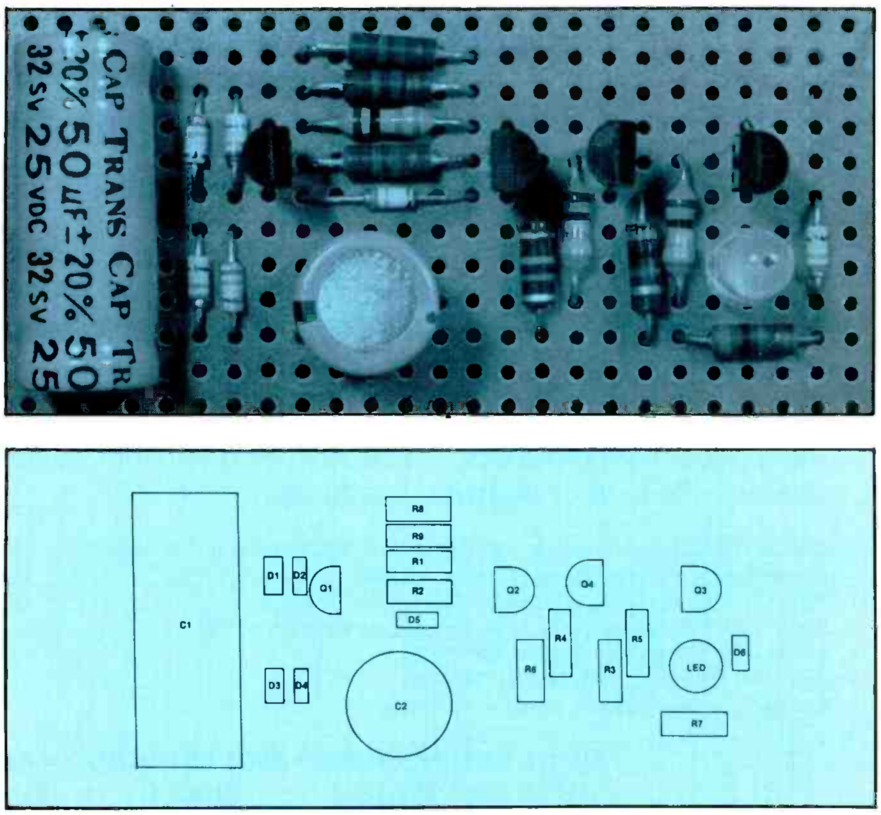


Figure 3. The mockup of the prototype layout of the Speaker Protector looks like this. Drawing identifies components.

problem for the 2N3906. If you use a relay with a larger current draw, you will need to change Q3 to a transistor capable of handling more current. Substituting the ECG replacement for the 2N3906, the ECG 159, will give the capability of supplying 1A according to the specifications in the ECG replacement guide. Of course, the power supply will also have to be changed to provide the additional current required by the relay.

Construction

Construction is really very straightforward. There are no critical circuits requiring special care. Check to be sure the diodes are installed correctly and if the LED lights the wrong color, just reverse its connections. As illustrated in Figure 2, the long lead of the LED is the anode of the red LED junction. Point-to-point wiring on perfboard works fine for the Protector. Figure 3A shows a mock-up of the prototype layout with the components labeled in Figure 3B. Remember that the wiring to and from the relay contacts will be carrying the audio to the speakers and should be of sufficient size to handle the power. I would recommend a minimum size of #18 gauge wire. If you will be using the Protector to pass large amounts of power on to the speakers, use larger wire for that part of the circuit to and from the relay contacts. The rest of the circuit can be wired with #22 gauge hookup wire, wiring pencil or whatever your favorite method may be.

If you want to use LEDs that you may have lying around in the

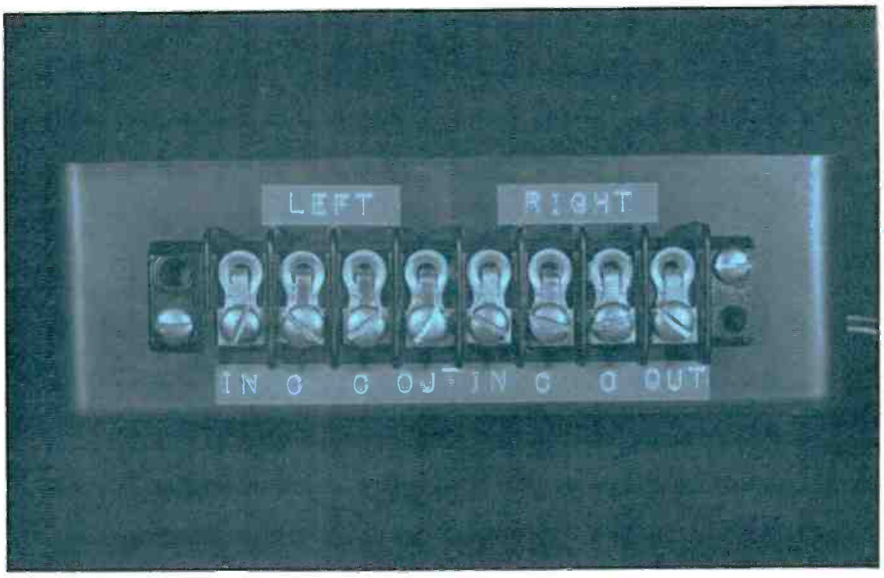


Figure 4. A screw terminal strip can be used to connect protector to speaker.

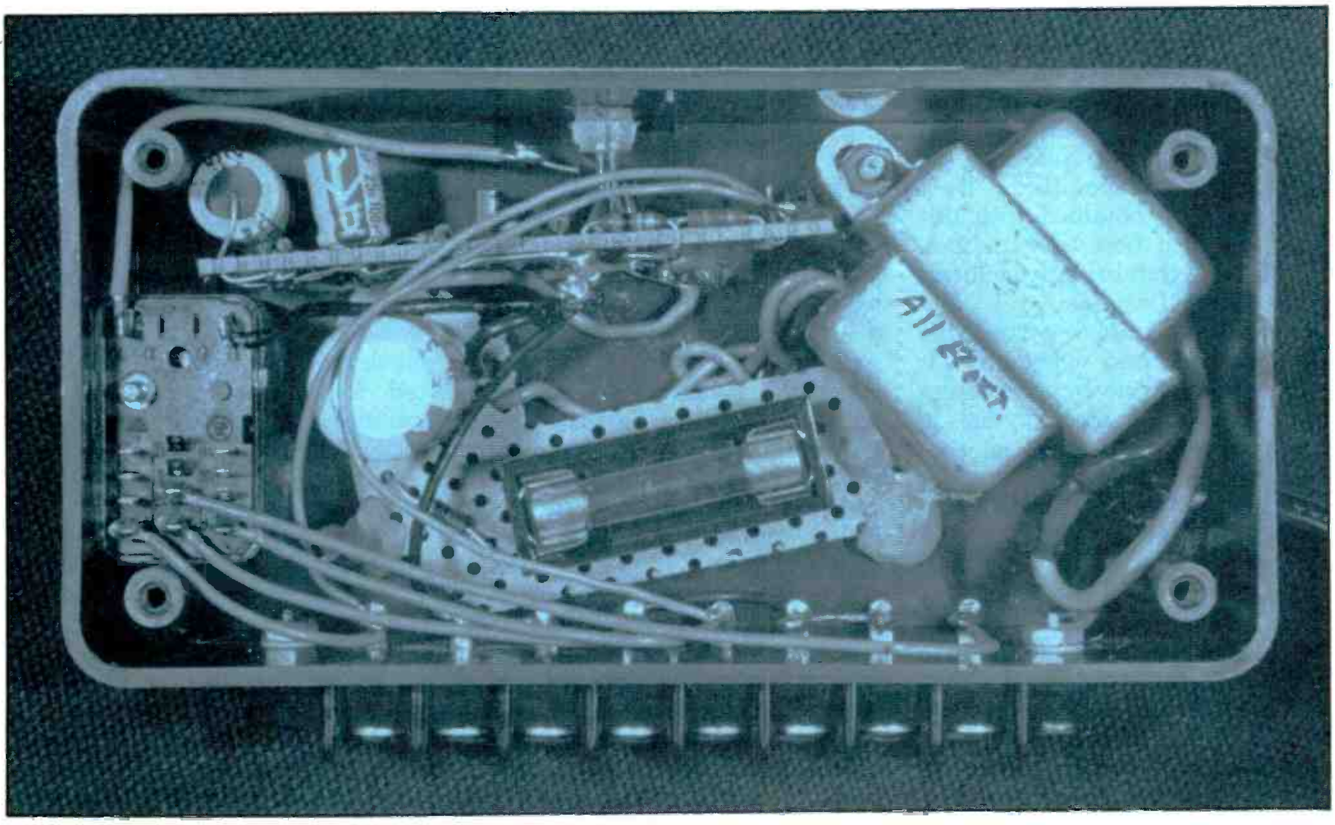


Figure 5. The author's prototype had a power supply built in. A preferred method of construction is to build or buy the power supply separately to remove line voltage from the enclosure and to simplify construction.

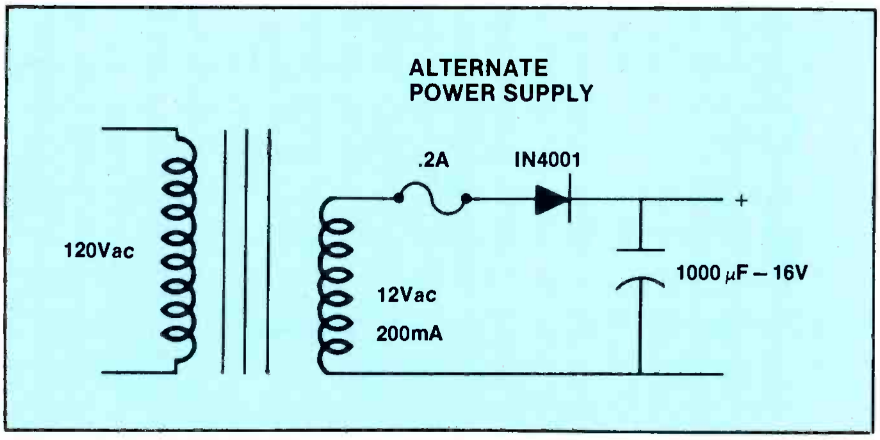


Figure 6. A power supply provides operating voltage for speaker protection circuit.

spare parts box, you can use two different colors, wire them together in inverse parallel, and put that combination in place of the bipolar LED specified. Best results will be obtained with this method if you first test the candidates to match brightness levels of the two LEDs used.

If you have trouble getting the 47µf non-polarized capacitor C1, you can make one by connecting two 100µf 25V electrolytics in series back-to-back, that is, connect their negative leads together using the two positive leads as the leads of the newly created capacitor.

The circuit can be housed in a small utility box such as those found at most electronics parts houses. My favorites are the five-sided plastic boxes with aluminum or plastic lids. They come in a variety of sizes and are easy to work with, making them ideal when the shielding of a metal box is not needed. A screw terminal barrier strip, Figure 4, makes a convenient way to connect the protector to the speaker lines. The prototype had the power supply built into the same box (see Figure 5), but a dc adapter supply would be better, in order to remove line voltage from the enclosure and to simplify the construction somewhat. Some of those power supplies have polarity reversal switches, so be sure to double check the polarity of the supply with a meter if necessary before powering it up. If the supply you choose has that reversal switch, you may want to set it and then lock it with a drop of glue to prevent accidents.

If you want to build your own power supply, Figure 6 illustrates a suitable supply using a transformer with a 200 mA 12V secondary, a single-diode halfwave rectifier, and a 1000µf 16V filter capacitor. The protector circuit is tolerant of supply ripple and can function fine with as much as 0.75 volts of ripple on the 12V supply. Remember to fuse the supply for safety and pay close attention to insulating all wiring and connections in and around the line voltage area.

Operation

There is no calibration or special instruction necessary to operate the Speaker Protector. Be sure to note which are the audio input lines and which are the output lines when hooking up the Protector, as proper protection does depend on the amplifier and speakers being connected on their respective sides of the relay.

Knowing what the Speaker Protector is doing will help in the understanding of why it behaves as it does under particular conditions. When power is first applied, there is a delay of a few seconds before it will connect the speakers to the amplifier. If the Protector is powered from the same switch as the amplifier, this will protect the speakers from turn-on transients produced on the amplifier output. If those transients do exist, or if the amplifier puts dc on the line at turn on, the Protector will see that voltage and keep the speakers off the line until the voltage drops to below the threshold level of the circuit. The Protector operates in an active-on mode, whereby it must apply power to the relay to allow signal through to the speakers. This method provides some protection to the speakers in the event that the Protector fails. Remember, too, that there is an indication at turn on that the Protector is working. When power is first applied, the LED should always glow red for a few seconds before switching to green and the relay is energized.

Conclusions

There are still many lower-priced amplifiers and receivers out there that have no protection circuitry at all, and many not so low-priced units that only attempt to protect themselves from a short on the speaker lines. In any case, any amplifier that needs repair is suspect. This inexpensive device can save tears and grief, not to mention money, when that amplifier sitting on your bench decides to spit up.

Speaker Protector Parts List

R1,R4,R5	10kΩ
R2,R8,R9	5.6kΩ (All resistors – ¼W carbon composition)
R3,R7	1kΩ
R6	4.7kΩ
C1	47µf non-polarized 25V (All Electronics #NP-10 or MCM Electronics #31-660)
C2	100µf 16V
D1-D6	1N4148 75V signal diode
D7	1N4001 50V 1A general purpose
Q1,Q4	2N3904
Q2,Q3	2N3906
LED	Bi-polar LED (All Electronics #LED-6 or Radio Shack 276-035)
RY	12V low current coil, DPST 10A contact rating (All Electronics #RLY-122 or Radio Shack 275-218 or equivalent)
Power Supply	12V 300mA dc (MCM Electronics #28-053 or All Electronics #MOA-500 or Radio Shack 273-1562 or equivalent)
Miscellaneous	Enclosure, 8-position screw terminal strip, perf board, LED holder

Alternate power supply parts list

T1	12V 200mA secondary (All Electronics #TX-1202 or Radio Shack #273-1385)
D1	1N4001
C1	1000µf 16V
F1	0.2A fuse
Miscellaneous	Fuse holder, perf board, line cord, screws and nuts

ES&T

Desoldering today's circuit components

By Carolyn Watson
Product Manager,
Solder Removal Company

Techniques of removing unwanted solder from electronic circuits have ranged from melting the solder and then banging circuit boards against the workbench, to using sophisticated desoldering systems that melt the solder and remove it by vacuum. For today's electronic circuits, with their miniature, heat-sensitive components, copper desoldering braid provides one way to do the job efficiently.

One characteristic of solder braid is its capability of meeting the heat and space limitations of the circuit. The copper conducts and retains heat efficiently. In practice, the braided copper is touched to the solder to be removed, and the soldering iron is brought into contact with the soldering braid above the solder. The soldering iron does not touch the solder, which is dangerously close to the component traces and the circuit board, all of which can be damaged by excess heat.

The copper wire quickly conducts the heat to the solder, which melts from the heat. The braid's capillary action draws the molten solder into the openings of the braid until it is completely removed. Two factors keep the heat from migrating to other areas: The copper acts as a heat sink, and the heated solder is removed as soon as it becomes molten. Because the solder is naturally removed the instant that it turns molten, the chance of a human operator applying the heat too long is remote. The bright copper-colored wick turns silver from the extracted solder. When each component is removed, the silver portion of the braid can quickly be cut off with an ordinary pair of wire cutters.

Desoldering braid may also be used to remove solder *bridges* that short traces or leads, or *icicles* that can come into contact with another surface in the cramped electronic assembly.

Getting the right braid for the job

Desoldering braid is manufactured in a number of widths appropriate for the area to be freed of solder, neatly extracting the excess solder without affecting the adjoining surfaces. Sizes of *Soder-Wick,* for example, range from 0.035 to 0.220 inches. Here is a table of widths by type of job:

- 0.035 inch – micro circuits
- 0.060 inch – small pads
- 0.075 inch – medium pads
- 0.110 inch – large pads
- 0.155 inch – terminals
- 0.220 inch – large lugs and wire connections

The proper size of braid will have a width equal to, or slightly larger than, the connection being desoldered. Wicks that are too narrow may not hold the volume of solder necessary for complete solder removal in one application. Wicks that are too broad may soak up too much heat from the iron and restrict heat transfer to the soldered connection.

Because only the braid comes into contact with the solder, the selection of an iron tip width need not be as critical as selection of the braid width. The tip should be at least as wide as the braid in order to get uniform heating of the braid, but it can be quite a bit wider without affecting the quality or speed of the desoldering job.

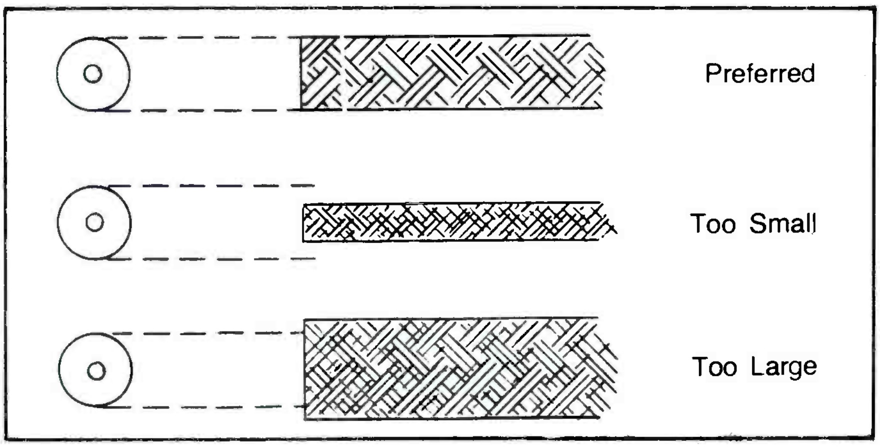
Desoldering braid works well for removing excess solder from circuit board through-holes. Molten solder will not flow easily from these holes because the narrow space between the lead and hole creates strong capillary action. However, the capillary action of the soldering wick will extract it.

Cruder alternatives have a probability of damaging the board or components. Some technicians heat the solder and bang it against a hard surface to force solder out of the hole. Others melt the solder while the board is upside down. Because the technician must work from the bottom up, the soldering iron tip can easily be misdirected to a nearby component. Others soften the solder just enough to remove the component and then poke out the solder with a pointed pick. This, too, can be harmful to the board.

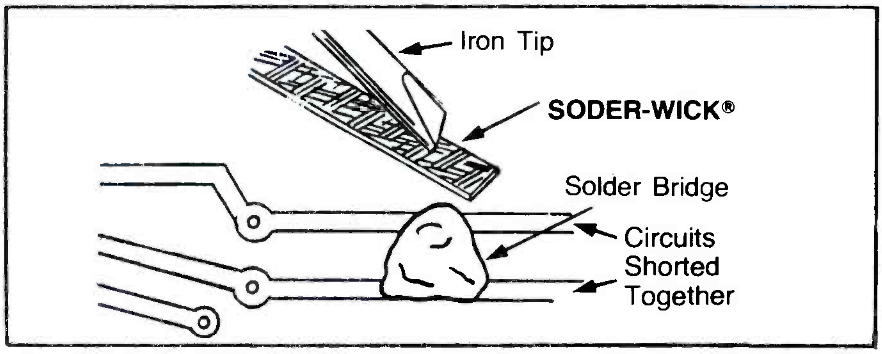
For the same reasons, desoldering braid is superior for removing excess solder from the etched numbers that identify printed circuit boards.

Another advantage of desoldering braid is its low cost. No investment in equipment is required. A spindle of desoldering wick as short as 2½ feet is the only purchase required, assuming that the technician already has a soldering iron. Cost per desoldered connection is less than half a cent. Cleanup of minor splotches of solder costs even less.

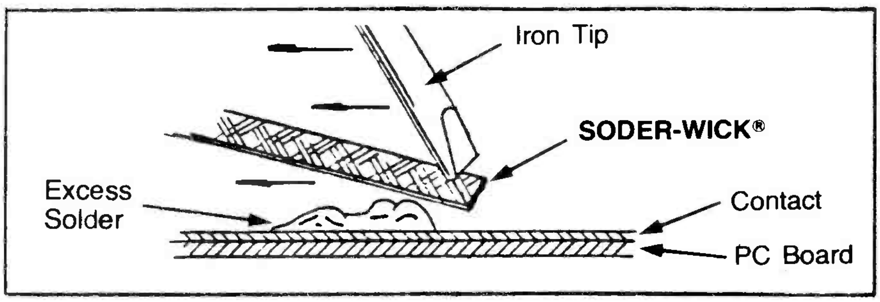
When removing solder from double-sided or multilayer boards, remove the solder from the compo-



Select desoldering braid of same width as area to be desoldered.

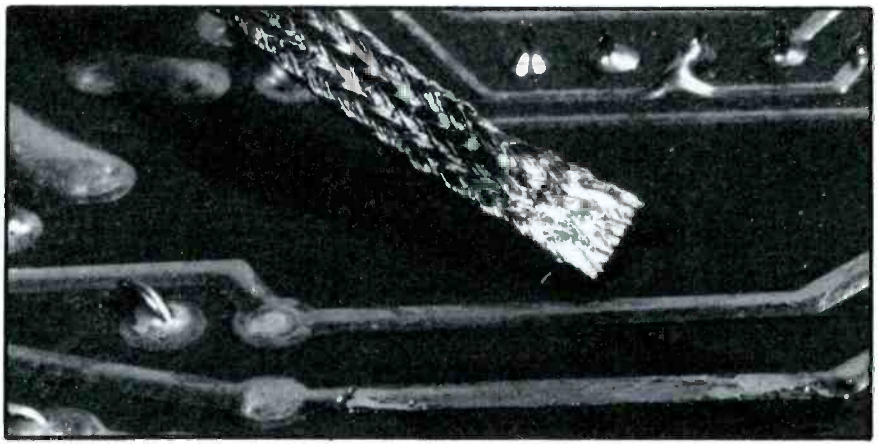


To remove *bridges*, touch desoldering braid to side of bridge.

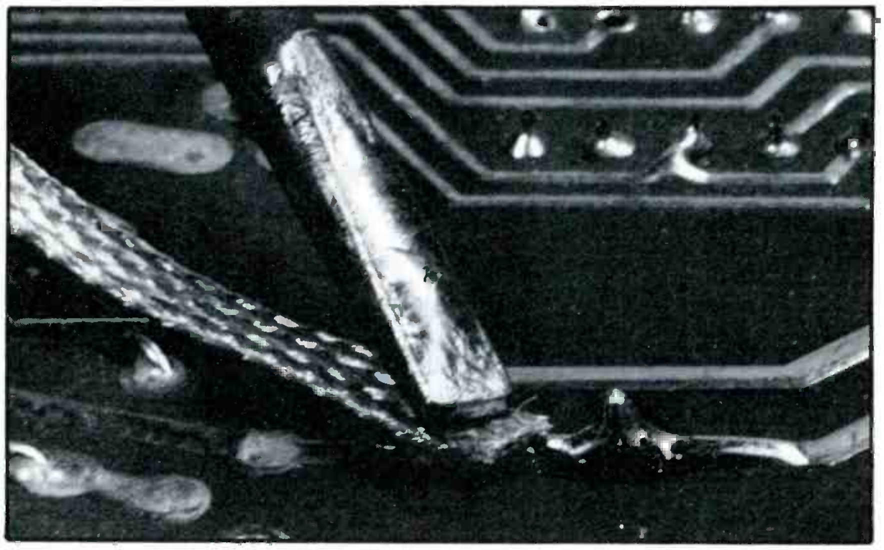


To remove large globs of solder, drag braid and soldering iron across the solder, away from the end of the contact.

Desoldering today's circuit components



Copper desoldering braid turns silver as it attracts molten solder.



Close-up photo shows correct way to remove icicles and other excess solder. Place braid atop icicle and heated soldering iron on braid, above the solder. When solder is removed, lift braid and iron together.

nent side of the board first with the desoldering braid and then remove the solder from the other side.

Removal of solder from thick multilayer boards with copper ground planes may call for an additional step because of the strong capillary attraction of the through-hole. Melting a small amount of solder where the soldering iron tip touches the top of the braid can start the wicking action, similar to *pump priming.*

Liquid flux also may prime the wicking action. If these steps do not work, applying heat on the other side of the board from a second soldering iron should do the job.

Fluxes

Because fluxes are used with desoldering braid, just as with solder, the available options should be mentioned. The primary purpose of flux is to prevent oxidation of the copper braid wire. Copper oxidizes easily in the air, and the oxidation coating retards soldering or desoldering. Flux can be added to the solder alloy, or, in the case of the pure copper desoldering braid, can coat the wire. *Soder-Wick* is coated with pure white rosin, which meets military specifications aimed at protecting the circuit against chemical contaminants.

Some companies prefer using water-soluble flux with unfluxed desoldering braid. By adding their own water-soluble flux to the braid, the flux residue can be more easily cleaned up with water and the unfluxed product costs less. (Unfluxed braid costs about 25 percent less than braid with rosin flux.)

Multilead components also can be desoldered with the use of desoldering braid. Leads must be desoldered one at a time, but because the desoldering braid doesn't just melt the solder, it removes it, there is no need for a component removal tool to separate the leads from the pad.

It's good practice to skip around the board area instead of going from one lead to the adjacent one. This prevents overheating of the board area between the pads.

When desoldering a connection to a terminal, it is necessary to distribute the heat throughout the connection. This can be done by placing the soldering iron tip and braid against the largest portion of the connection because it requires the most heat. Heat characteristically rises in a material such as a terminal, so the heat should be applied as low as possible on the connection. ES&T

Photofact

These Photofact folders for TV receivers and other equipment have been released by Howard W. Sams & Co. since the last report in ES&T.

CAPEHART
2920AR 2275-1

GENERAL ELECTRIC
Chassis 25EM-H 2272-1

MAGNAVOX
D8120/17 2271-3

RADIO SHACK
16-235 2277-1

RCA
AXR120W,Y/121W/191W,
CXR120W,Y/121W/191W 2276-3
AXR122S,Y128W,
CXR122S,Y/128W 2276-4

SANYO
Chassis A2K-43500 2273-1
Chassis A2F-550A00/55000 2274-1
Chassis A2G-42500 2275-2

SEARS
564.42260350 2276-1
564.42105350 2277-2

SHARP
19H78 2271-1
19H84 2272-2

WARDS
GGV17523A/7633B/7643B 2276-2

WELLS GARDNER
19K4625/626/675/676/677 2277-3

ZENITH
Z1318W 2271-2
Z1920W/990W/994W 2273-2
SZ1319W,W7 2274-2
Chassis 12YB4X 2275-3

For free sample guidelines on submitting Troubleshooting Tips and Symcures for publication, write to:
Troubleshooting Tips/Symcures
Electronic Servicing and Technology
P.O. Box 12901
Overland Park, KS 66212

WHAT DO YOU KNOW ABOUT COMPONENTS?

Inductors and transformers

By Sam Wilson

I know of at least a dozen places around town where I can buy a 47kΩ, ½W resistor or a 0.1μF 200V capacitor. But, if I wanted to buy a 0.1mH coil that can handle a current of 150mA, I might have to get it by mail.

That has been a problem with coils. When you are repairing electronic equipment, you have little trouble replacing the transistors, capacitors and resistors. But, if you want to replace a transformer or coil, you will likely have to order it from the manufacturer or a mail order catalog.

You ordinarily can't look at a coil or transformer and tell much about it. In a few cases, there may be a color code such as the one shown in Figure 1. But, in many cases, the coil is only identified by a part number. The same is true for transformers.

A coil, or inductor, is a component that stores energy in the form of an electromagnetic field. A good model for analyzing coil circuits is to consider them to be components that oppose any change in current through them. The word *change* is important. The most important applications of inductors are: storing energy, filtering, tuning and introducing an ac voltage drop.

Transformers are used for coupling energy between circuits, passing an ac signal but not dc and for changing the voltage, current or impedance of a circuit.

Inductance, measured in Henries, is a reading of how much energy an inductor can store. The amount of energy a coil can store depends upon the number of turns, the core material and the shape of the core.

Of these factors, the shape of the coil is the factor most likely to prevent you from winding a replacement coil. (This assumes that you are able to use the core material from the defective coil.) The spacing between the windings affects the length of the coil; and, for a given number of turns, the greater the length, the lower the inductance value. Furthermore, fat coils (those with a large radius) have more inductance than skinny ones, if they have the same number of turns. The wire diameter can affect the length of the coil, so it may indirectly affect its inductance. Also, you can get more turns per inch with a small-diameter wire.

If you do decide to try winding your own, get one of the relatively inexpensive bridges that measure inductance. That way you can tell if your handiwork is anyway near the value called out on the schematic. Also, if you have such a bridge, you may want to consider the idea of setting the inductance of a variable inductor and using it for a replacement part.

Some questions that are often missed regarding coils and transformers

When I was involved in the preparation of CET tests, I made a list of questions that were most often

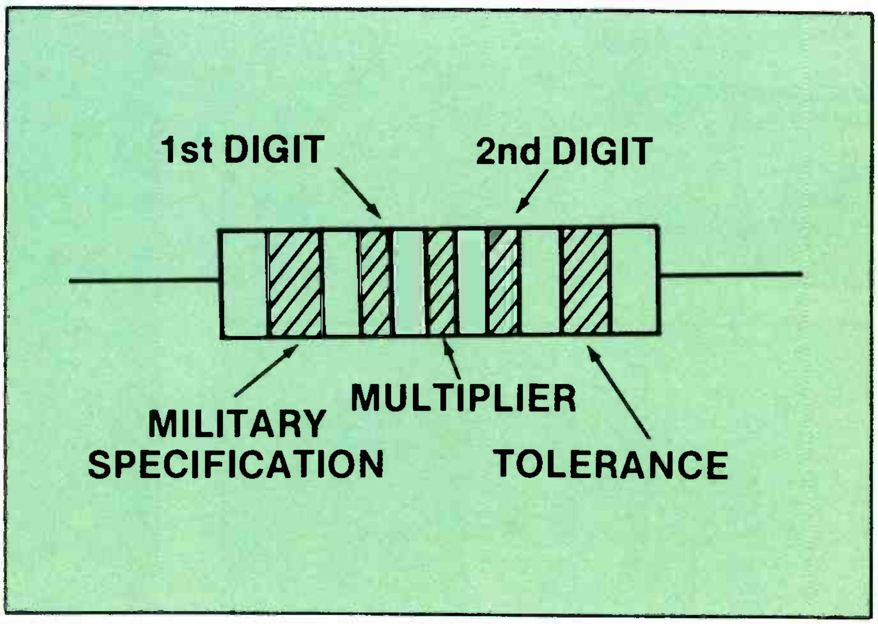


Figure 1. In some cases, transformers or coils may be identified with color coding. but more often there will only be a part numbers.

troublesome to technicians. The questions reviewed here deal with both transformers and coils. Remember that all of the test questions in the CET test are multiple choice but other types of questions are used in this review.

Question: What is the time constant of the L-R circuit in Figure 2?
Answer: The time constant equation relating inductance and resistance is:

T = L/R
For the combination in Figure 2,
$T = 0.1 \times 10^{-3}/27$
T = 3.7ms

Question: What do the dots on the transformer symbol in Figure 3 represent?

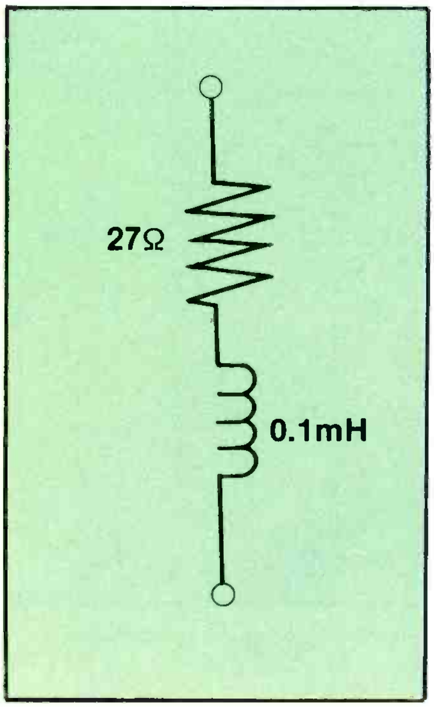


Figure 2. What is the time constant of this circuit?

Answer: They show the points where the transformer primary and secondary signals are in phase. In a few cases, this is important information when replacing a transformer in a circuit. An oscillator circuit is an example. Reversing one of the leads on the replacement causes the feedback to be degenerative rather than regenerative as required for an oscillator circuit.

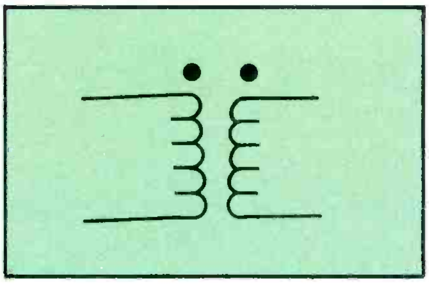


Figure 3. The dots on this transformer symbol provide some important information. Do you know what it is?

Question: The turns ratio (secondary turns to primary turns) of a certain transformer is four to one; often written as 4:1. What is the secondary impedance if the primary impedance is 25Ω?
Answer: The impedance of the primary and secondary are related by the *square* of the turns ratio.

$Z_2 = (N_2/N_1)^2 \times Z_1$
$(4/1)^2 \times 25$
$Z_2 = 400\Omega$ (answer)

$\left(\frac{N_2}{N_1}\right)^2 = \frac{Z_2}{Z_1}$

Most technicians can answer questions about voltage ratios and current ratios in transformers, but for some reason they have trouble with questions on impedance ratios.

The relationship between turns ratio and impedance ratio can be expressed in different ways:

$Z_1/Z_2 = (N_1/N_2)^2$
and
$N_1/N_2 = Z_1/Z_2$

Question: Inductive reactance is measured in
(A) Henries
(B) Ohms
(C) Farads
(D) Darafs

Answer: A surprising number of people have answered this simple question incorrectly. The problem seems to be that they read the question too quickly and answer (A). The correct answer, of course, is choice (B).

Question: What are the losses in an iron core transformer, and what methods are used to reduce these losses?

Answer: *Copper loss* is due to the resistance of the wires and connections in the transformers.

Eddy currents are caused by the moving magnetic fields cutting through the conducting iron core. According to Faraday's law, any time a magnetic field cuts a conductor, there is a voltage generated. That generated voltage sets up circulating (eddy) currents in the core material. Heat is produced by these currents, and the heat represents a loss of power.

Eddy currents are reduced by slicing or laminating the iron core. At higher frequencies, powdered iron or ferrite materials accomplish the same thing.

Hysteresis loss is caused by the fact that some energy is expended on each half cycle to remove magnetism that was established on the previous half cycle. This type of loss is reduced by the proper selection of core materials.

I once had an instructor in a trade school tell me he could tell which of two audio transformers is better, simply by weighing them. He demonstrated his conviction by comparing two transformers by weight. Then, he supported his choice by conducting a number of tests. His theory is based upon the idea that there is less chance of saturation (and resulting distortion) when there is more iron used in the construction of the transformer. Well, anyway, it worked in the examples he used.

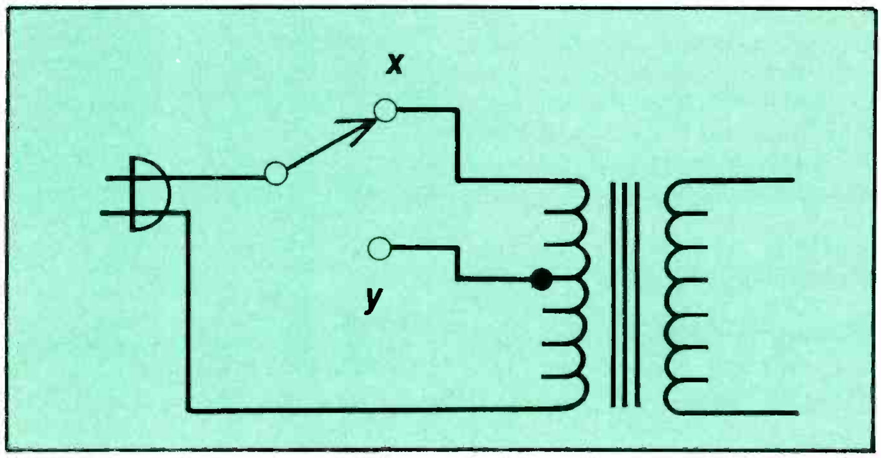


Figure 4. What will happen to the secondary voltage when the switch is changed from position x to position y?

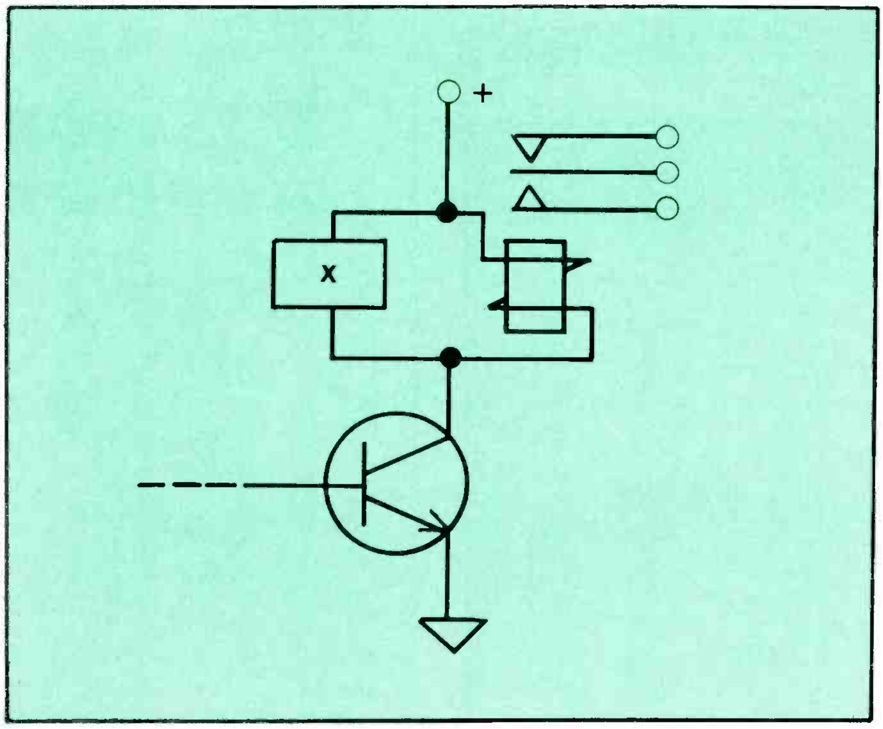


Figure 5. What components might be used in position x to protect the transistor from inductive kickback?

Question: For the power transformer shown in Figure 4, which setting of the switch (x or y) will result in a higher secondary voltage?

Answer: Setting y is the answer because it results in a higher turns ratio. This question also shows why shorted turns in the primary winding cause a higher secondary voltage.

Question: Name two components used in position x of Figure 5 to protect the transistor from inductive kickback.

Answer: Varistors and diodes.

VCR Basics

VHS servo operation

By Steven R. Bowden

Part 4

Corrections of rotational speed and position (phase) of the direct-drive (DD) cylinder and the capstan are performed by the servo system in VHS videocassette recorders (VCRs). Frequency and phase of the *standard* (or reference) signal are compared with the rotational frequency and phase of the cylinder (and its video heads), then the servo varies the rotation speed until a perfect match is obtained and sustained during operation. Different *standard* signals are used for recording and playing (briefly, sync from the incoming video is the *standard* during recording, while a signal divided from a crystal oscillator is the *standard* during playing).

Of course, these condensed descriptions cover a multitude of details in an actual machine.

Reference signal for recording

A large percentage of the VHS servo system is used for both recording and playing, with the necessary differences supplied by numerous switches. Most of this switching is performed inside various ICs. A single schematic could be used for recording and playing, but it is easier to understand when separated into specialized recording or playing.

Figure 1 is a block diagram showing how composite sync is separated from the incoming composite video before filtering removes the horizontal sync. It leaves the vertical sync, which is sent to TP201 and where it becomes the input signal for a buffer-oscillator. The buffer-oscillator operates as a buffer when vertical sync is present to trigger it, but it becomes a 58Hz oscillator if the vertical-sync is missing. Therefore, one of the two possible signals is recorded on the control track during recording, and this prevents the servo from malfunctioning (as it would without a control-track signal).

Output of the buffer-oscillator at TP202 is sent to trigger two flip-flops (FFs in IC201) that divide the 60Hz input. Output of one flip-flop is the 30Hz signal that is recorded along the tape's edge (for use during playback) by the control head. The 30Hz output of the other flip-flop is sent to the *trapezoid generator,* where these square waves are filtered to form a voltage-charging ramp (or sawtooth) on each leading edge, and a voltage-discharging ramp on each falling edge. These ramps are not very linear, because linearity is not essential, but they are *reference sawteeth* that are sent to the *cylinder-phase sampling gate* where they are phase compared with pulses derived from a signal that comes from rotation of the head cylinder (details later). These pulses are the *feedback signal.*

Remember that these sampling gates are basically similar to the

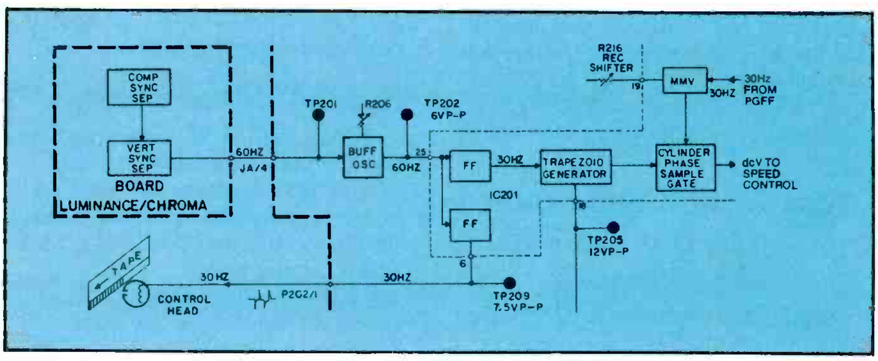


Figure 1. Recording cylinder-phase control

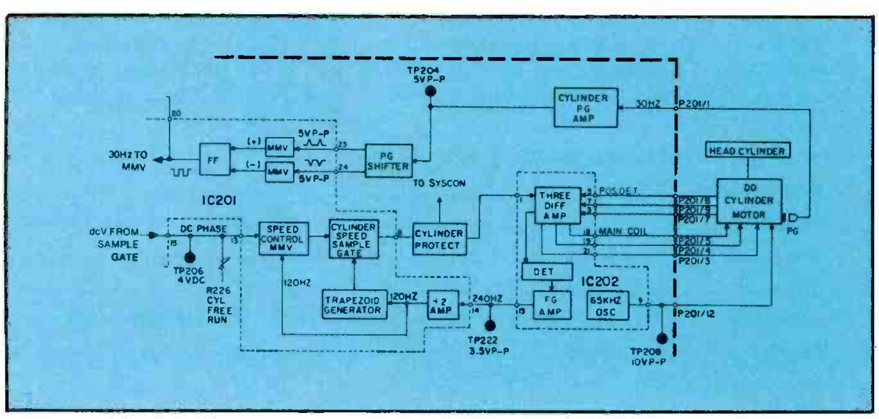


Figure 2. Recording cylinder-speed control

horizontal phase-detector circuits in color TV receivers. A sawtooth signal is generated from some horizontal-sweep pulses (*feedback* signal from the controlled circuit) while a pulse signal is filtered from the horizontal sync (separated from the *standard* or *reference* incoming video signal). Frequency and phase differences between *feedback* and *standard* signals produce an error-control dc voltage that pulls the horizontal-sweep frequency into proper phase lock, where it is maintained steadily.

Cylinder phase during recording

Two permanent magnets are attached to the outer rotating shaft of the direct drive (DD) cylinder motor (Figure 2). Magnetic fields from these magnets induce positive and negative voltage pulses in a pulse-generator (PG) coil mounted on the motor's side. Because the motor rotates the head cylinder and its shaft at 1800RPM, the PG coil signal pulses have a repetition rate of 30Hz. The positive and negative pulses (after processing) will identify positions of the video heads accurately. The pulses are separated and applied to monostable multivibrators (MMV's). Positive- and negative-going pulses from the MMV's trigger a flip-flop having precise 50 percent/50 percent duty-cycle square waves whose edges are accurately related to positions of the video heads. These high-accuracy square waves are applied to the input of another MMV (shown in Figure 1). Output of the MMV is differentiated to produce pulses that are the *feedback* signal at one input of the cylinder-phase sampling gate (Figure 1).

The other input of the cylinder-phase sampling gate is the so-called *trapezoidal* ramp signal from the standard signal mentioned previously and shown in Figure 1. Amplitude of the ramp is sampled by the feedback pulse, and the dc level *at the sampling point* is stored and held until updated (30 updates per second). Any shift of phase between the ramp and pulse will sample the ramp at a higher or lower dc voltage level, changing the stored voltage at TP206 and restoring the phase lock. During recording, the dc-phase voltage at TP206 is adjustable to +4Vdc by the cylinder free-run control R226.

Control of the video head *phase* is the purpose of the circuitry previously described. At this point, the phase circuitry joins the DD cylinder-motor *speed* circuitry.

Cylinder speed during recording

A varying dc voltage from the phase sampling gate is applied to one input of the speed-control MMV (Figure 2). Square waves of 120Hz rep rate are applied to the other speed-control MMV input. These pulses originate from the DD cylinder-motor position-indicator coils, which provide a 65kHz signal that is modulated with 250Hz. Detection of the 65kHz signal from the *three-differential-amplifier* circuit yields the 240Hz sine wave, which is amplified (FG amplifier) and changed to square waves before it is divided by two and applied to the speed-control MMV and the trapezoidal generator.

Rep-rate pulses measuring 120Hz from the speed-control MMV are one input signal for the cylinder speed-sampling gate, while 120Hz rep-rate non-linear ramps from the trapezoid generator are the other input signal for the sampling gate. Amplitude of the ramps at the time of the pulses is sampled and stored until updated. Any shift of frequency or phase between the pulses and ramps changes the gate's output dc voltage, which is amplified and used to control the 3-phase motor drive circuit in IC1202.

Output of the cylinder-speed sampling gate is used to detect whether or not the DD cylinder is rotating properly. The output voltage is sent to the cylinder-protection circuit, which senses the speed and sends a signal to the system-control circuit, and which shuts down the play or recording mode after five seconds of incorrect speed.

Dc voltage from the speed-sampling gate is amplified sufficiently by the *three diff amplifiers* circuit to power the 3-phase dc cylinder motor.

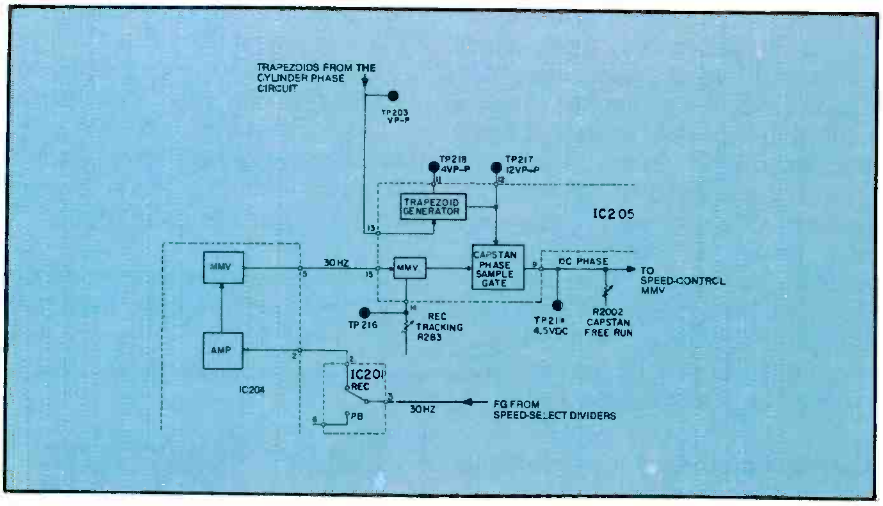


Figure 3. Recording capstan-phase control

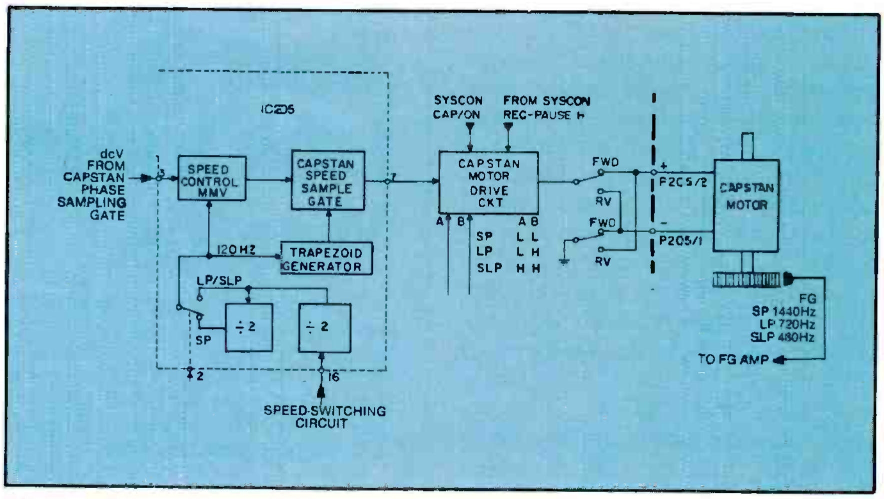


Figure 4. Recording capstan-speed control

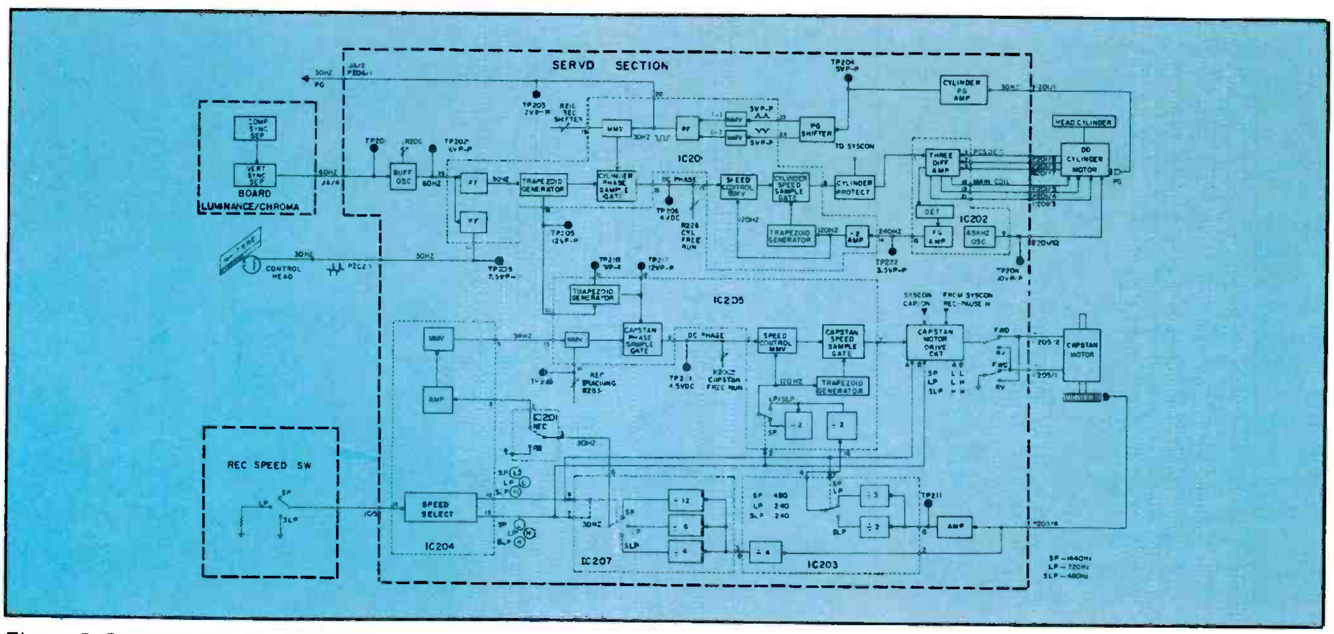


Figure 5. Servo circuit for recording

During recording, therefore, the head-cylinder servo varies the rotational speed and phase of the video heads to match and repetitional frequency and phase of vertical sync from the incoming video. Any deviation from perfect lock ruins the recording.

Capstan phase during recording

A trapezoidal waveform is taken from the output of the cylinder-phase trapezoid generator (at TP205) for use by the capstan-phase trapezoidal generator (Figure 3). Trapezoids from the capstan generator become the *standard* signal of the capstan-phase sampling gate. The other input signal *(feedback)* must be pulses, and they come from a MMV that has been triggered by the capstan FG signal, after it has passed through switches and dividers of the speed-selection circuits. Output from the capstan-phase sampling gate is a varying dc voltage that is combined with an adjustable voltage from the R2002 capstan free-run control before the sum is applied to the speed-control MMV (Figure 4).

Capstan speed during recording

A second input for the speed-control MMV consists of 120Hz square waves from the speed-switching and divider circuit. Output from the MMV is a pulse waveform that is applied to one input of the capstan-speed sampling gate. This is the *standard* or *reference* signal. The same 120Hz square waves from the FG and speed-switching circuits also are integrated (to form rounded ramps on both edges) in a trapezoid generator, which in turn supplies these trapezoids to the second input of the speed sampling gate (Figure 4). This is the *feedback* signal that reveals how well the capstan speed corresponds with the standard.

Output of the capstan-speed sampling gate (IC205 pin 7) is a dc voltage that varies as needed to correct the capstan motor speed. The dc voltage controls the *capstan motor-drive circuit* that powers the capstan motor and regulates its rotational speed.

Notice the forward/reverse

switch that inverts the polarity of the motor's dc voltage. Direction of the capstan motor's rotation is reversed for a short rewind for *record-pause transitional editing,* which will be discussed with the system-control section later in the series.

Look at the complete recording block diagram in Figure 5. Capstan FG frequencies at the motor (and at TP211 following amplification by IC203) are 1440Hz for SP mode, 720Hz for LP and 480Hz for SLP mode. IC203 divides these to 360Hz for SP, 180Hz for LP and 120Hz. The square waves go to IC207 pin 3 where an internal electronic switch selects division by 12 for SP, division by 6 for LP or division by 4 for SLP. In all cases, the output at pin 6 is 30Hz, which is sent to the IC201 record/playback switch, an amplifier, two MMVs and finally to the capstan-phase sampling gate as shown in Figure 3. That completes one path.

From TP211, the FG signal is divided either by three or two inside IC203 and divided by either two or four inside IC205. Therefore, the FG repetitive frequency applied to the speed control MMV and the capstan speed trapezoid generator always is 120Hz. This completes the FG path to the capstan-speed sampling gate.

The speed-select manually operated switch on the front panel is used by the VCR operator to select the SP, LP or SLP speed mode during recording. Rotation of the video heads is not changed, so the same number of diagonal video tracks are recorded on the tape each second. However, the faster tape travel of the SP mode allows some space between diagonal tracks (as an extra guard against interference), while the slower LP speed overlaps adjacent tracks somewhat, and the very slow SLP speed produces considerable overlapping of adjacent diagonal video tracks.

As shown in Figure 5 lower left corner, the manual speed-adjust switch activates the speed-select circuit in IC204, causing various combinations of digital highs and lows at pins 15 and 16 that are sent

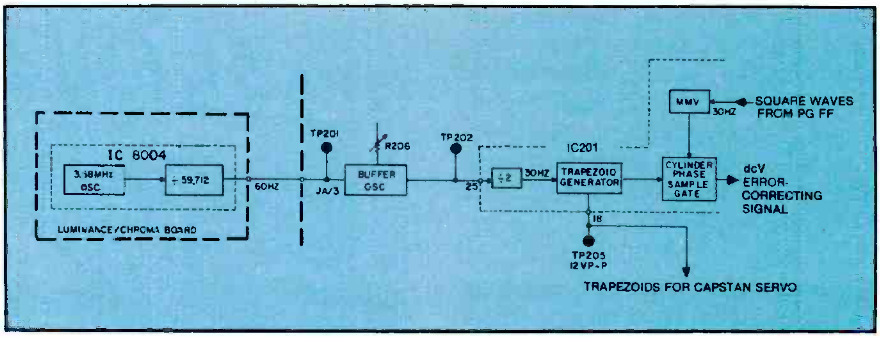


Figure 6. Playback cylinder-phase control

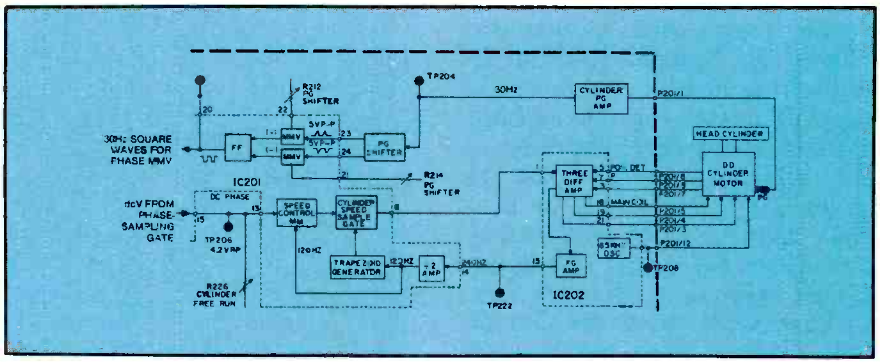


Figure 7. Playback cylinder-speed control

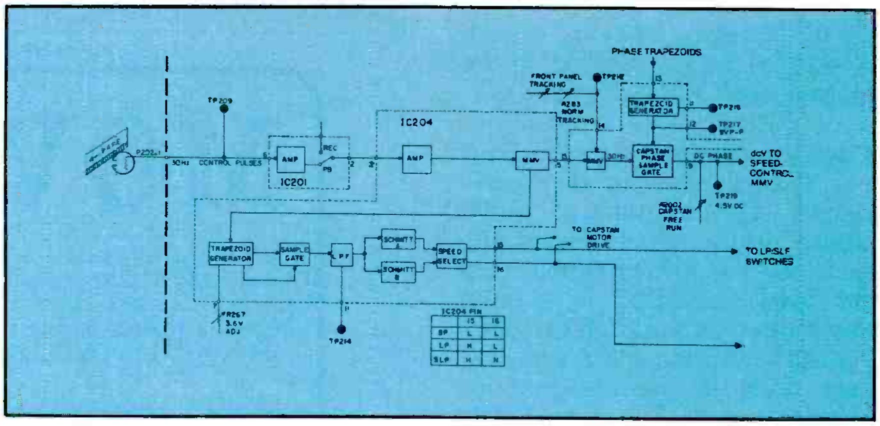


Figure 8. Playback capstan-phase control

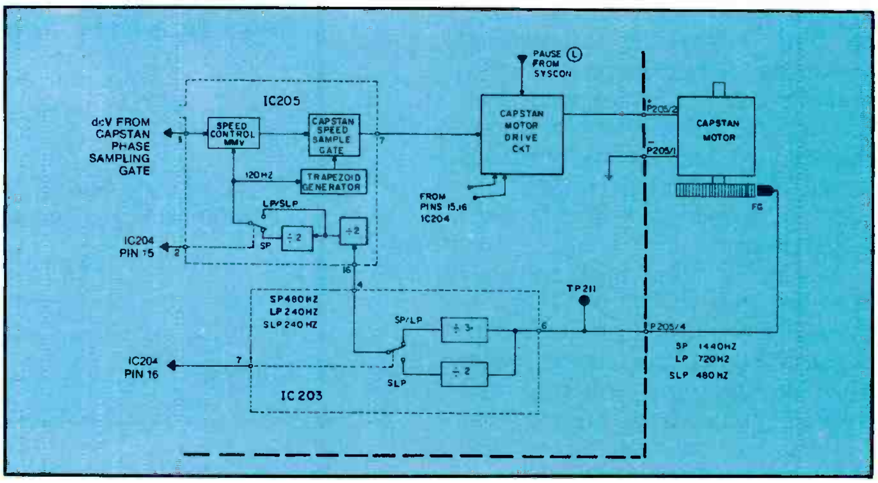


Figure 9. Playback capstan-speed control

to the capstan motor-drive circuit A and B inputs and to dividers inside IC207.

Cylinder-phase circuit for playing

The same servo circuitry is used for the play function as was previously described for the recording function. However, a different *reference* (or standard) signal is used and the dividers are arranged differently. The tape speed must be kept perfectly synchronized with the control pulses (previously placed on the tape during recording) while the head cylinder rotates at a constant speed.

Starting point of the cylinder-phase circuit is a 3.58MHz crystal-controlled oscillator that functions as the stable reference signal (Figure 6). This frequency is divided by 59,712, producing 60Hz that is applied to the buffer/oscillator. (The buffer/oscillator operates as a buffer amplifier when it has a 60Hz input, or it changes to a 58Hz oscillator in the absence of an input signal. Therefore, a signal always is produced.)

The remainder of the cylinder-phase circuitry is identical to that previously described for the recording function.

Cylinder-speed circuit for playing

Figure 7 shows the playback cylinder-speed-control circuitry. Notice it is identical to the recording circuitry and operation except a *PG shifter* variable control has been added to each PG-path MMV. Therefore, no detailed explanation of the circuit operation will be given.

Capstan-phase circuit for playing

The playback capstan-phase circuit does not use 30Hz square waves produced by dividing the capstan-motor FG signal. Instead, the 30Hz pulses previously recorded on the control track are amplified (Figure 8) and are used to trigger a MMV inside IC204. From that point onward to the motor, the phase-control (Figure 8) and speed-control (Figure 9) circuit operations are identical to those described previously for the recorded mode. There is one important exception: A front-panel-mounted tracking control is connected to the capstan-phase MMV at IC205 pin 14. This tracking control allows the VCR operator to momentarily move the tape slightly ahead or retard it until the heads track the proper video tracks, thus providing optimum stability. The normal-tracking R283 control is adjusted so the operation is correct when the tracking control is left at its detented position.

One additional circuit change is necessary to accommodate the electronic switching inside IC203 and IC205. A second output signal is taken from the IC204 MMV. These square waves are integrated by a trapezoid generator, which gives two outputs to a sampling gate. The dc output of a gate is filtered and used to control the speed-select circuit, which provides digital lows and highs at pins 15 and 16. For example, the outputs for SP speed are 15 low and 16 low. For LP they are 15 high and 16 low, or for SLP they are 15 high and 16 high. Pin 15 is connected to IC205 pin 2, and pin 16 is connected to IC205 pin 7 where they control the FG dividers. Pins 15 and 16 also are connected to the capstan motor-drive circuit. Figure 10 shows the entire servo block diagram when switched for playback mode.

Cylinder-motor drive

A unique design that allows minimal vibration and extremely quiet operation is used for the motor that directly drives the video-head cylinder assembly. The motor is a brushless dc type using electronic commutation to switch current in the three principal coils.

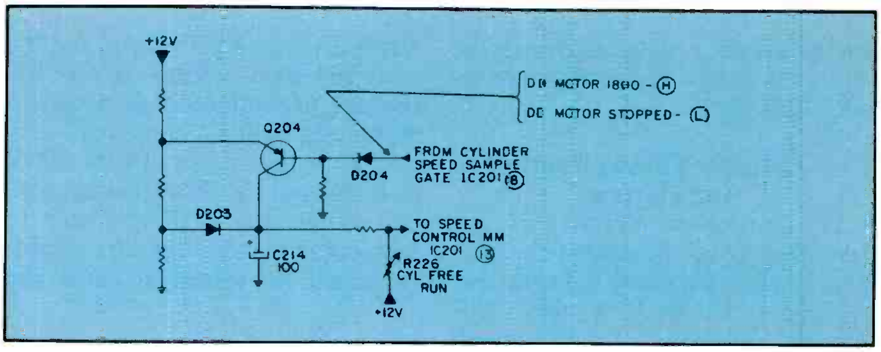


Figure 11. DD motor-start circuit

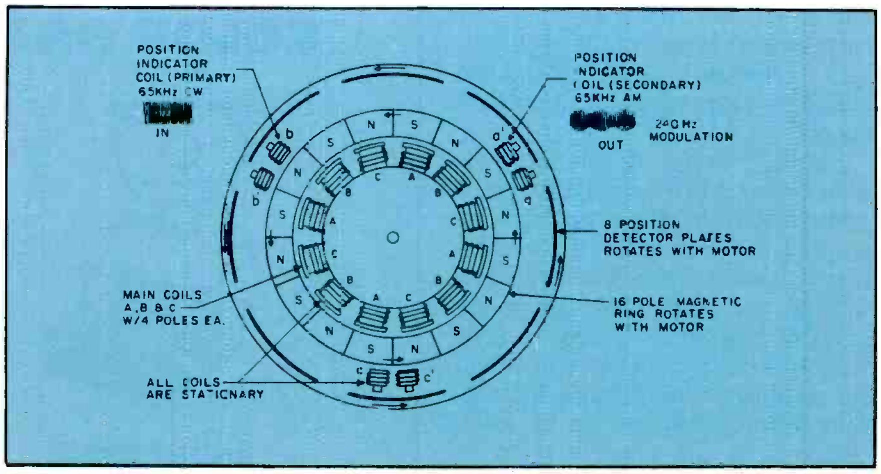


Figure 12. Direct-drive motor design

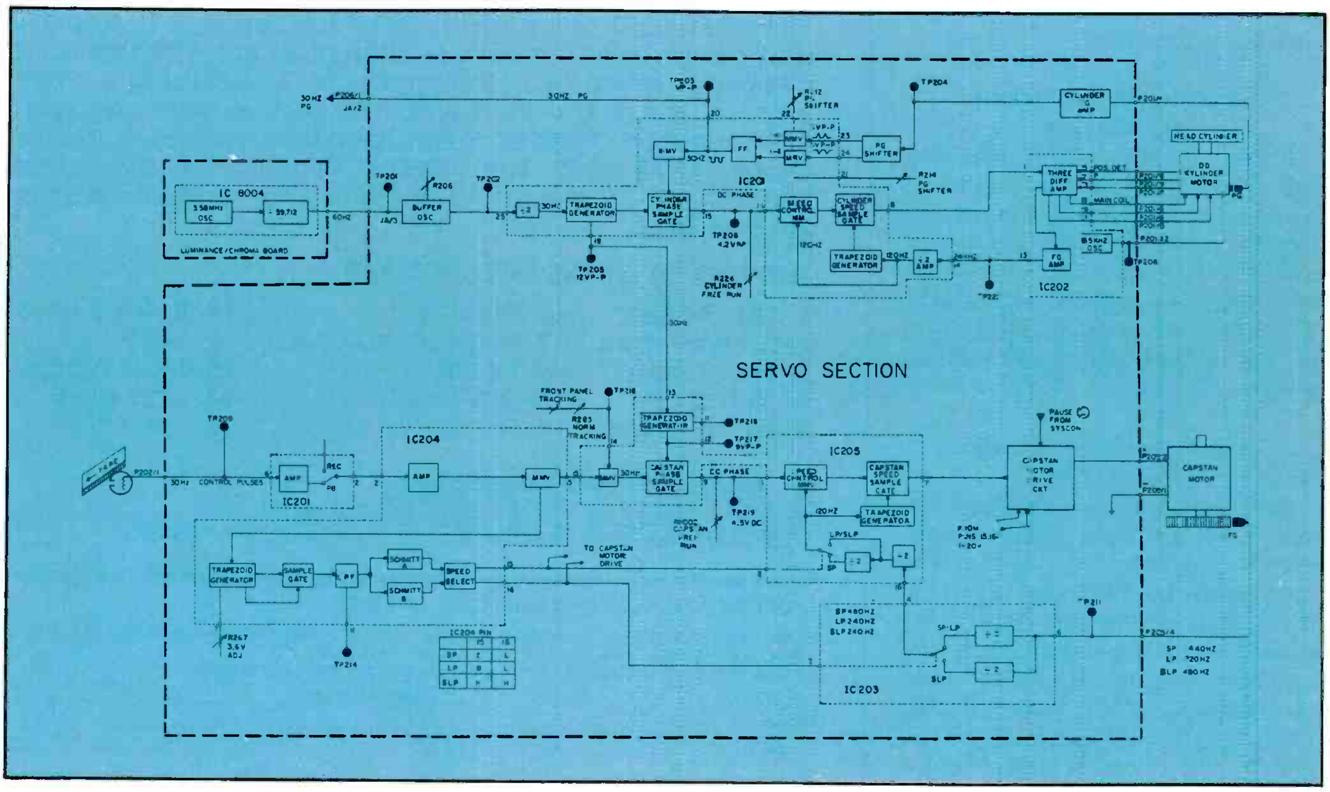


Figure 10. Servo Circuit for playback

To start the DD cylinder motor and have it accelerate to full speed within about 1.5 seconds, a dc voltage is applied to the speed-control MM at IC201 pin 13. Transistor Q204 (Figure 11) supplies this initial voltage while the motor is accelerating. Then the voltage is cut-off when the cylinder speed-sampling gate begins to supply voltage to the 3-phase motor drive. Without Q204, the voltage for pin 13 rises slowly as C214 charges from the +12V source through the resistors. During start-up, however, the Q204 conduction shorts across those charging resistors so the pin 13 voltage rises rapidly and forces the motor to accelerate more quickly.

Figure 12 shows a drawing of the motor that consists of a large 16-pole circular magnet, 12 driving coils (that make up three phases, each with four coils), eight position-detecting plates and three pairs of position-indicator coils. The magnetic ring and the position-detector plates rotate with the motor shaft, while none of the coils rotate. Torque for rotation is developed between the ring's permanent magnets and the magnetic fields produced by the main coils. Counterclockwise rotation of the magnetic ring (and the motor's shaft) is accomplished by application of the proper currents through the main coils at the correct times. Of course, this must be done by electronic circuits.

Before proper current at the correct time can be applied to the coils, the position of the magnetic ring must be known. This position is revealed by the position-indicator coils and the eight position-detecting plates. Remember that the position-detecting plates rotate with the magnetic ring, so the plates' positions are indications of the magnetic-ring positions. Three pairs of position-indicator coils are supplied, designated a, a^1; b, b^1; and c, c^1. A 65kHz unmodulated carrier is applied to the primary position coils a, b and c. When a detecting plate is between the core of a primary coil and the core of its secondary coil, the 65kHz from the primary coil is induced into the secondary coil, but when motor rotation moves the plate so it no longer is between these two coils, there is little 65kHz signal induced in the secondary coil.

When the motor rotates at correct speed, the signal at a^1 secondary coil, for example, is a 65kHz carrier with amplitude modulation of 240Hz. Motor rotational speed is 1800RPM divided by 60 (to RPS) equal 30Hz times eight detecting plates equals 240Hz. The same waveform appears at b^1 and c^1 coils, but these three modulations are 120° different in phase. Amplitude at each secondary coil is directly proportional to the rotational position of the detecting plates and the magnetic ring. A timing chart is shown in Figure 13.

The 65kHz carrier from each secondary coil is detected and these 240kHz sine waves used to drive Q1, Q2 and Q3 (Figure 14).

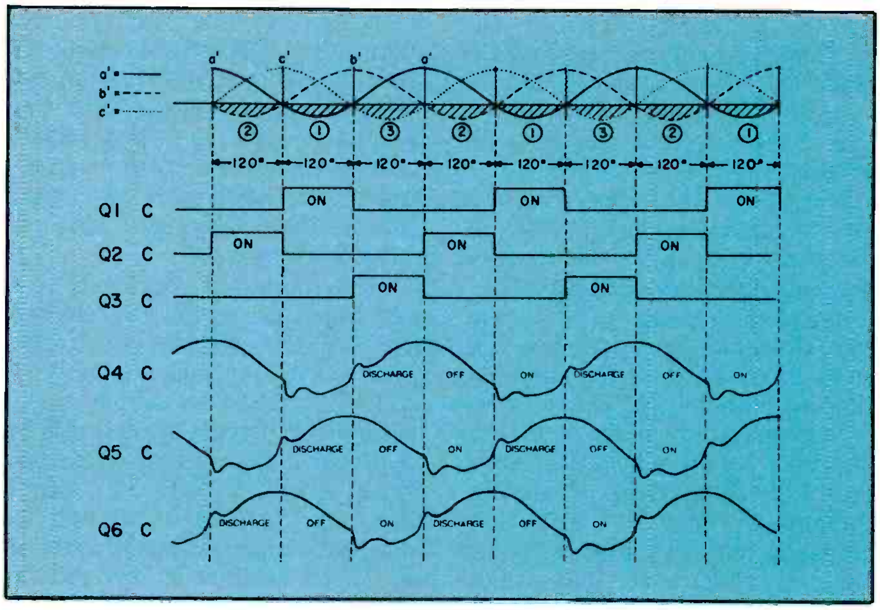


Figure 13. Direct-drive motor timing chart and waveforms

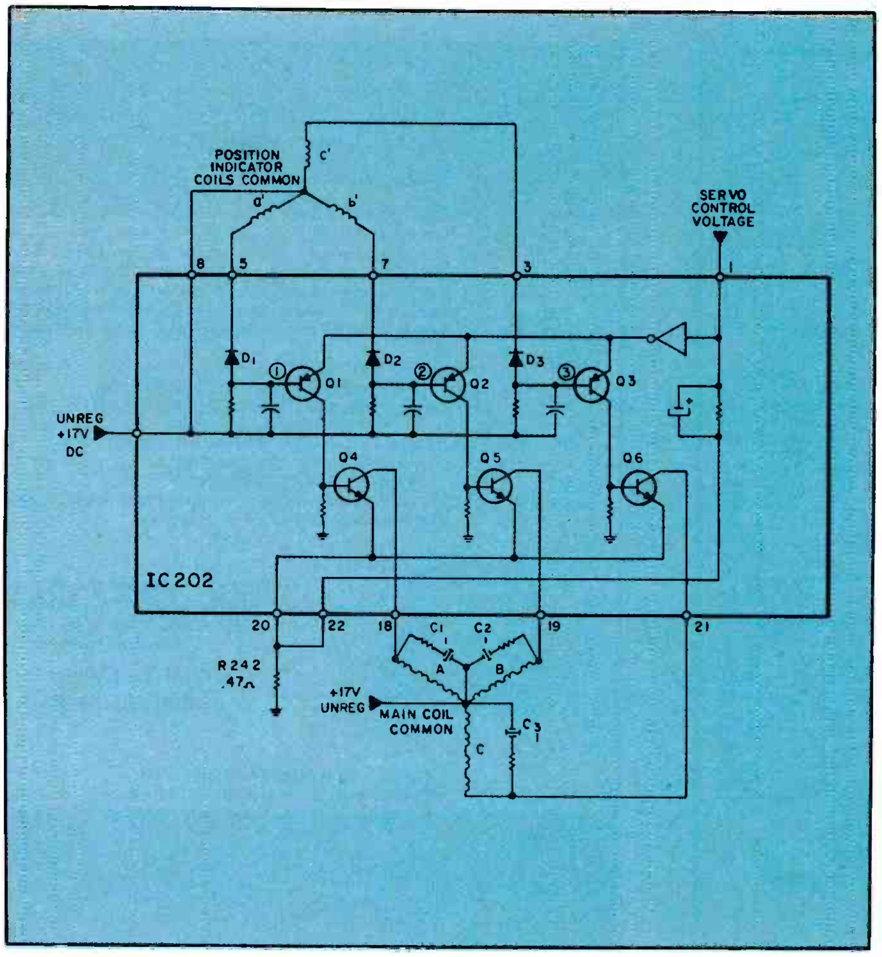


Figure 14. DD cylinder motor schematic

These sine waves bias-on Q1, Q2 and Q3 when each reaches the most negative excursion, as shown by the timing chart. Of course, Q1 conduction turns-on Q4, Q2 conduction turn-on Q5, and Q3 conduction turns-on Q6. Therefore, each set of four driving or main coils is energized in a C, B, A, C, B, A sequence, which rotates the motor CCW. The current flow produces magnetic fields that pull the magnetic ring toward each main coil. A resonant circuit across each set of main coils forces current to flow in the opposite direction after each driving transistor's current is stopped.

For example, when Q4 is biased-on, a magnetic north pole is formed in main coil A, which pulls the magnetic ring toward it. After Q4 is biased-off, the non-polarized capacitor C1 discharges with current flowing through the coil in the opposite direction, thus forming a south pole that pushes the magnetic ring away and contributes to the motor rotation.

Switching of the magnetic fields has two pair of main coils with current at all times, while one pair of coils has no current. This produces a smooth and constant application of power to the head-cylinder motor. If these coil currents should overlap or have a gap, a jerky motor rotation would result, which would degrade the picture with instability.

Of course, the motor rotational speed must be adjustable by the servo system. The circuits previously described show the input signals for the cylinder servo control, which produces the servo speed-control dc voltage that is applied to the emitters of Q1, Q2 and Q3 (Figure 14). Variations of the servo control voltage determine the length of transistor conduction times. Shortening the time that current flows through the coils will slow the motor's rotational speed. Lengthening the time that coil current flows will force the motor to rotate faster. Therefore, the motor (and thus the video heads) rotational speed and phase can be adjusted rapidly, accurately and automatically to provide a stable picture.

Feedback

Keeping up with technology

I have been a constant subscriber to **ES&T** for more than 20 years and have been in electronics repair for 37 years. I enjoy reading **ES&T** and have gained a lot of knowledge from it. I pride myself in trying to keep up with the ever increasing technology, solid state, ICs, etc. Even so, I find it more and more difficult for a man of my age to keep up with the rapid changes, and I need some information.

I have been trying to repair this new breed of automotive radios. I refer to the digital tuning systems, which are becoming more common. For example, I was working on a 1980 model GM radio, as in the Sams AR-312 pages 63-92. Frankly, I do not understand the complete working of the integrator chip and I cannot find any source of information in my library of books. I hope your staff can get someone to write an article (or series) on this type of equipment.

I will be watching for more informative articles, as I do truly enjoy your magazine and will continue my subscription.

Melvin Breyfogle
Estherville, IA

In-quiz-itive thinking

In the *Test your electronics knowledge* quiz, August 1984, my approach to question nine brought to mind a subtle but not unusual applications problem. The question referred to a diagram and asked what would be the resistance in ohms between points x and y. When thinking about the answer, I took the two extremes possible for the center resistor, it being the crucial element to the answer. First, I mentally took it out and then put a short circuit at that point. In both cases, the answer was the same: 1000Ω, the correct answer.

From an applications point of view, the existence of a short or open obviously has no effect on the total resistance (or impedance), but can have a great effect on the circuit operation. In the case of hooking up four loudspeakers to an amplifier in a series parallel arrangement, the difference is night and day. With the short at the center point, any one speaker can fail and be disconnected for repair, but the other three will keep working. With an open at that point, if one fails, two will not be working, and assuming a low Z transistor output, a significant loss in output level will result.

With a short at the center point, the electrical damping of the individual loudspeakers will be superior. Because of this, the short at that point is the only correct way to wire up series parallel speaker combinations (always parallel units, then put them in series). This way the paralleled voice coils will cause less interaction between the individual speakers. This would still hold true for larger series parallel arrays constructed to avoid the expense of 70V transformers. The *continued operation* benefit then becomes the most important aspect, not the damping.

In the case of four equal resistors being connected to achieve the same value as one, but with four times the wattage, different consequences will result, depending on the existence of a short or open at the center point during some time of failure mode. As I have never seen this particular phenomenon described in print, I thought your readers might be interested. Thanks for a useful magazine.

Chuck McGregor
Rowayton, CT

*Do you have a question or an idea for an article you would like to see in **ES&T?** Your comments are always welcome. Please write to: Nils Conrad Persson, Editor, Electronic Servicing and Technology, P.O. Box 12901, Overland Park, KS 66212.*

Test your electronic knowledge

By Sam Wilson

1. Which of the following is the largest value?
(A) attowatts
(B) femtowatts
(C) picowatts

2. Each resistor in Figure 1 has a resistance of 6Ω. Draw lines to represent connecting wires that will result in a resistance of 4Ω between terminals *a* and *b*.

3. If the circuit in Figure 2 is working properly (R is not open), a positive-going signal at *a* will cause:
(A) a negative-going output signal.
(B) a positive-going output signal.

4. For the voltage amplifier in Figure 2, the power supply voltage should be:
(A) positive.
(B) negative.

5. Resistor R in the circuit of Figure 2 is open. The voltmeter should indicate:
(A) a negative voltage.
(B) a positive voltage.
(C) zero volts.

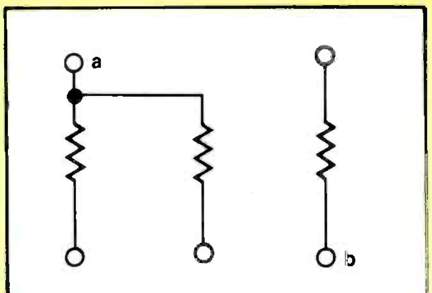


Figure 1

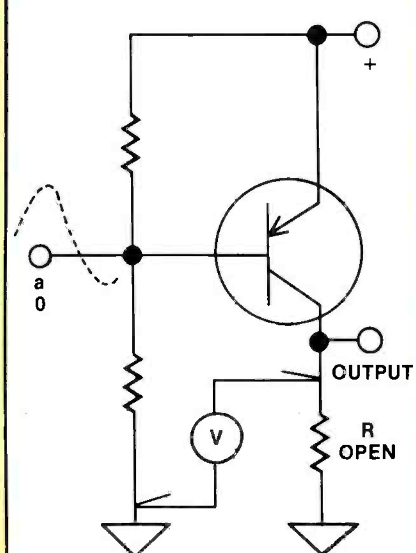


Figure 2

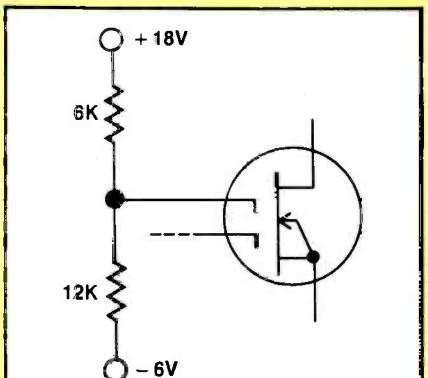


Figure 3

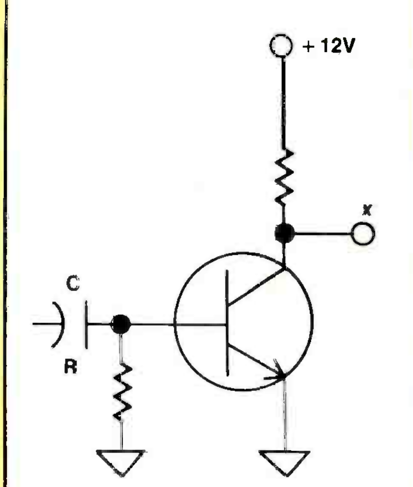


Figure 4

6. The no-load output of a certain power supply is 440V. When that supply is delivering its rated current, the output voltage drops to 400V. Which of the following is the closest value of the percent regulation?
(A) 8 percent
(B) 9.09 percent
(C) 10 percent
(D) 11.1 percent
(E) 12 percent

7. The power gain of a transistor amplifier can be determined as follows:
(A) square the voltage gain and divide by the base spreading resistance.
(B) multiply the collector voltage by the collector current.
(C) multiply the collector current by the collector resistance.
(D) multiply the current gain by the voltage gain.
(E) all of these choices are correct.

8. Adding a bleeder resistor to the output of a power supply will:
(A) improve the power supply percent regulation.
(B) decrease the power supply percent regulation.
(C) increase output of the supply.
(D) have no effect on the percent regulation.
(E) prevent burnout of the rectifier diode.

9. What value of gate voltage (on G_2) should you measure in the circuit of Figure 3?
(A) +10V
(B) +5V
(C) 0V
(D) −5V
(E) −10V

10. Regarding the circuit of Figure 4, assume there is no input signal.
(A) It uses the equivalent of Grid-leak bias.
(B) The dc voltage at point x should be about 0V.
(C) The dc voltage at point x should be about 12V.

Answers to Quiz

1. (C)

2. See Figure A.

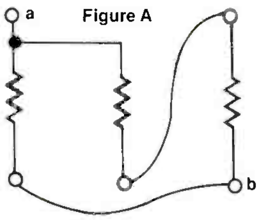


Figure A

3. (A) Even though the emitter is at a high positive voltage, the circuit is a common-emitter amplifier. So, there is a 180° phase shift.

4. (A)

5. (B) There has been a lot of discussion about this circuit in the past. Building the circuit and making the test always ends the discussion.

6. (C) The percent regulation is calculated as follows:

$$\text{Percent regulation} = \frac{\text{(no-load voltage)} - \text{(full-load voltage)}}{\text{full-load voltage}}$$

In most cases a low value of percent regulation is desired.

7. (D) Remember – you're looking for *power* gain.

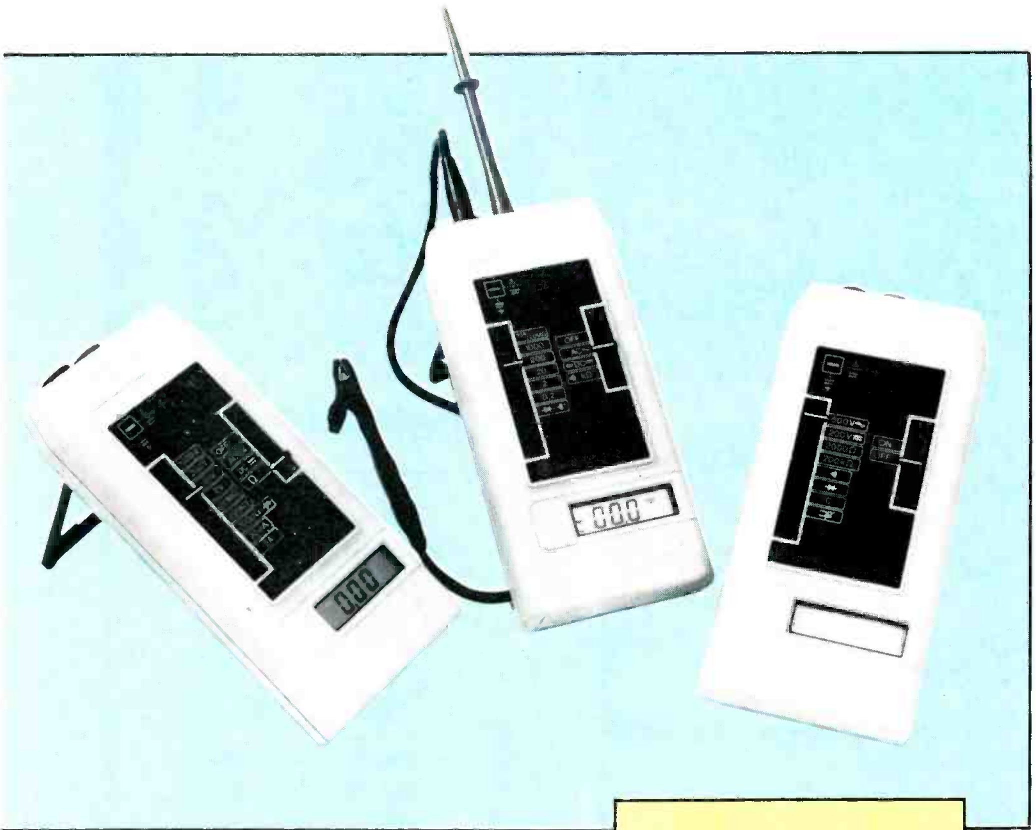
8. (A) Although the percent regulation *is* improved slightly, that is not the reason for the bleeder resistor. As its name implies, it is there to bleed off the charge on the filter capacitors when the supply is de-energized.

9. The voltage difference is 24V. One-third of that voltage is dropped across the 6K resistor. So, the voltage at the gate is (18V) − (1/3·24V) = 10V. The correct choice is (A).

10. (C) The transistor is cut off because there is no positive voltage on its base. Therefore, there is no voltage drop across the collector resistor. ES&T

Tools and test equipment for audio servicing

By Donald Aldous, Technical Editorial Consultant, "Hi-Fi News & Record Review"



Digital multimeters provide accurate readings from conveniently sized packages.

Today's home electronic equipment from most of the well-known manufacturers is exceptionally reliable, and it is by no means unusual for complex audio/video systems to run for years without breakdown.

When failures do occur, it will probably expedite servicing to determine into which of the following categories they fall: (1) *Infant mortality.* These early failures are caused by defective components and bad solder joints, and can or should be detected by a *soak test* by the manufacturer; (2) *Maturity.* These are failures that occur during an extended period of equipment operation and are regarded as random; (3) *Senility.* Failure rates start to rise as equipment gets older, often due to plugs and sockets losing contact, solder joints start to oxidize, and in rotating equipment, vibration results in broken leads. Continued failures in this case means replacing the equipment.

There are two approaches to audio/radio servicing: the first involves a bench crammed with test gear; every supply and signal voltage monitored and checked out with faults found by readings of meters or oscilloscopes that deviate from the specs.

The second approach is testing and checking with a small combination of instruments, supported by a maximum of common sense and experience. Of course, accurate diagnosis is vital, so what can be regarded as the most important instruments for audio/radio servicing? (1) Audio millivoltmeter, (2) sine/square wave generator, (3) oscilloscope and (4) distortion measuring set.

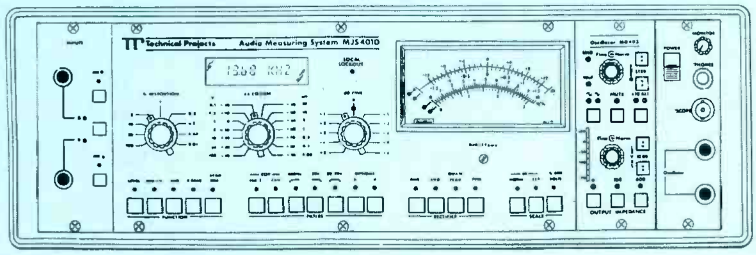
One series of useful audio servicing instruments is offered by The AVO company, now part of Thorn EMI Instruments. This series includes the Avometer 2000 series of DMMs. Another unit is a handheld, battery-operated inductance, capacitance and resistance meter, with power derived from a single, internal 9V battery, with fuse. This lightweight component tester covers six inductance ranges (2mH to 200H); seven capacitance ranges (200pF to 200μF) and seven resistance ranges from 20Ω to 20MΩ. The liquid crystal display is 3.5 digits.

A typical hi-fi system consists of an amplifier with alternative pickup inputs, tuner, tape cassette deck and turntable, plus microphone inputs and alternative headphone outlets.

Taking the amplifier as the *heart* of an audio system, servicing starts with checks on output power, input sensitivity, frequency response and distortion. The more refined checks would have to be undertaken on signal-to-noise ratio, transient response, damping factor, balance and stereo separation, and the power supply could be tested.

An audio measuring system

The minimum of equipment for these tests was listed earlier, but recently a complete Audio Measuring System, MJS401D, has been designed and manufactured by Technical Projects Ltd. Described as a "user-friendly" instrument, this single unit provides a rapid means of performing the following measurements on all types of



Audio measuring system gives quick, accurate measurements of level, frequency, THD and other audio parameters.

Notch filter/tracking high-pass filter combination is used for THD measurement.

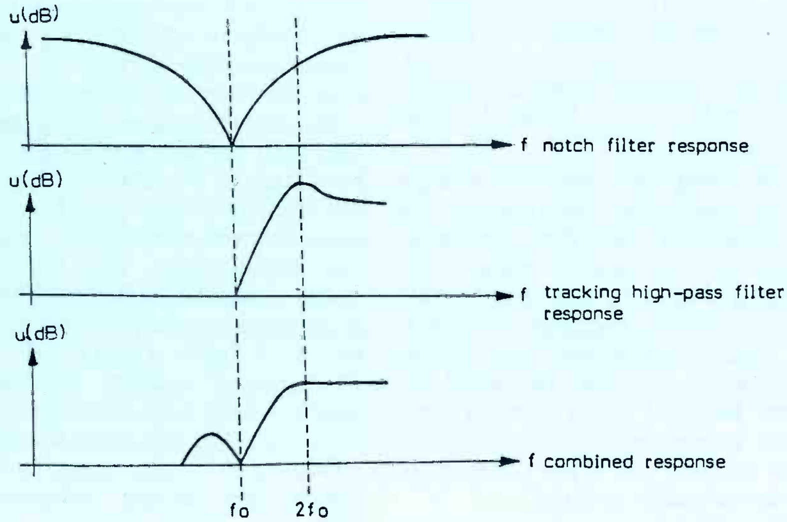
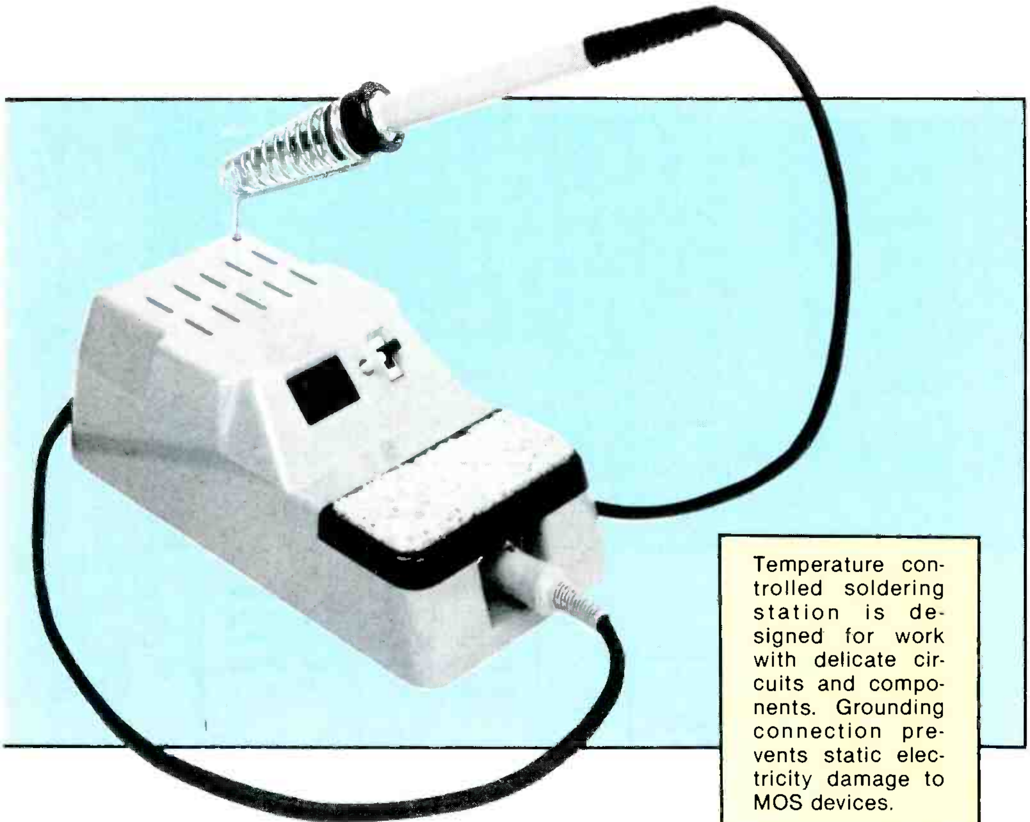


Figure 1 - DISTORTION MEASUREMENT



Temperature controlled soldering station is designed for work with delicate circuits and components. Grounding connection prevents static electricity damage to MOS devices.

audio equipment: level, frequency, total harmonic distortion (THD), crosstalk, noise and two optional features – intermodulation distortion (IMD) and internal tone source.

The designers examined today's audio measuring instruments and came up with a unit that eliminates many of the shortcomings frequently found in test equipment, such as meter pegging, oscillator to input feedthrough, grounding problems and easily damaged inputs. Most of all, Technical Projects' engineers made it fast and easy to use even if the operator is under pressure or tired.

The 401D has a microprocessor to assist the user unobtrusively. It improves the speed and accuracy of measurement, allows for optional IEEE bus control, and with its intelligent interlocking system throughout the instrument, there is no unnecessary button pushing.

The many features of this test instrument cannot be enlarged upon here, but it is worth noting that the 401D provides rapid frequency measurement and display – even at low frequencies. The microprocessor control circuitry enables the resulting frequency to be displayed as a 4-digit figure on the 10-character vacuum fluorescent display, along with the appropriate units (i.e., Hz, kHz, and so on).

One other facility must be mentioned – the unique system for measuring total harmonic distortion (THD) in the 401D comprises both a *notch* filter for removing the fundamental, and a tracking high-pass filter to attenuate any hum or noise interference lower in frequency than the fundamental. (See diagram). The notch filter is a unique Technical Projects circuit, which offers rapid nulling. Automatically both tuning and level setting can be performed, with no manual controls at all.

Soldering

Often taken for granted by technicians and hobbyists, soldering irons have recently undergone some improvements and transformations, which make them more suitable for working with modern circuits.

The Antex CS 17W iron is a miniature design with the element inside a stainless steel shaft covered by a slide-on bit. The ceramic shaft insulation first used on the Antex 25W iron and with this latest mini-model ensures a leakage current of less than 2mA. Different elements are produced ranging from 220V-240V, through 100V-120V to the CS12E 12V type. An unusual design from Antex is the TCSU1 soldering station, which meets the latest requirements in temperature controlled soldering of delicate circuits and semiconductors. An important addition is the anti-static ground connection to protect MOS devices from damage, often undetected, due to static electricity.

Another soldering iron designer/manufacturer is S & R Brewster, producing a broad range of irons, from the mini 16-18W to big industrial models. One useful accessory they offer is a Universal Stand, with a steel base and non-slip feet, eliminating the need to attach it to the bench.

Coming in...

NOVEMBER

- **Servicing cordless telephones**—Only recently have cordless telephones become a consumer product. For that reason, servicing information is frequently hard to come by. This first half, of a 2-part article on servicing cordless telephones, provides a list of required test equipment. It includes many detailed illustrations and photos to describe how they operate and also how to diagnose and correct problems.
- **Build this digitally-controlled precision timer**—RC controlled timers are useful until timing tolerances better than about 2 percent are required, or until you want to use them for long timing periods. This circuit-construction project yields a timer that gives times with errors of a fraction of a second in several hours. And the parts should be no problem to find.
- **Neons, lasers, LEDs**—This next installment in the *What Do You Know About Components* series, by Sam Wilson, gets into the little-discussed and even less well understood areas of electronics, including neon lamps, lasers and LEDs. The theory of operation and some of the characteristics of these devices are discussed.
- Plus our regular monthly features:
  Literature
  New Products
  News
  Technology
  Profax
  Readers' Exchange

Literature

RCA Consumer Electronics Division offers its 1984 Technical training catalog. This 10-page catalog lists publications designed to assist those who want to service RCA consumer electronic products. Publications listed include troubleshooting guides, workshop training manuals, self-study courses and technical manuals.

Circle (85) on Reply Card

Continental Resources, Bedford, MA, has issued its 1984 electronic instrument rental catalog. This 68-page catalog describes more than 1500 items, including analyzers, meters, oscilloscopes, generators, microprocessor development systems, recorders and telecommunications equipment. Continental Resources has expanded its inventory to include models from Tektronix, Hewlett-Packard, Fluke and Dranetz. All items appear with full specifications and monthly rental rates. Instruments are fully tested, calibrated (traceable to the National Bureau of Standards), and guaranteed to meet manufacturers' specifications.

Circle (114) on Reply Card

A 144-page catalog from **Electronic Tool Co.** is a comprehensive buyer's guide illustrating and describing hundreds of hand tools, tool kits, test equipment and related products. An expanded section covers a complete line of tool kits for anyone involved in repair, maintenance and servicing of electronic and electro-mechanical equipment. Prices, illustrations and specifications for many name brand tools and pieces of test equipment are included.

Circle (116) on Reply Card

A 4-page brochure from **The Eraser Company,** Syracuse, NY, details a range of die blade automatic hand wire and cable strippers. The brochure includes technical and operating data for the models A, B, D & F die blade hand wire and cable strippers for stripping wires and cables of sizes from 12 to 24 AWG. The lightweight, automatic hand wire strippers will strip most insulation types, including PVC, polyethylene, nylon and some Teflon insulations. Wires are stripped without nicking, cutting or deforming the conductors.

Circle (117) on Reply Card

A 128-page catalog of electronic test accessories – test leads, patch cords, cable assemblies, adapters and black boxes – has been published by **ITT Pomona Electronics,** Pomona, CA. The catalog contains specifications and photographs of 817 products. Also included are order and price information and a special quotation form for customers with special needs in electronic test accessories.

Circle (118) on Reply Card

GPIB instruments, logic analyzers, digital multimeters, ac and RF voltmeters, electronic counters, function, pulse and signal generators, switching systems – are described in full in the new 1984-85 **Racal-Dana Instruments Catalog.** This resource file provides application assistance, detailed product specification as well as an overview of Racal-Dana capabilities across a broad spectrum of test and measurement instrumentation.

Circle (119) on Reply Card

A new edition of the *Replacement Parts Handbook* has been published by the **Consumer Electronics Group** of the **Electronic Industries Association (EIA/CEG).**

The handbook is more than twice the size of the original, and lists replacement parts outlets and ordering procedures for 50 consumer electronics companies across the country.

Other publications available from the EIA/CEG include the updated *Safety Guidelines* and two *Interference Handbooks,* one for audio systems, and an updated one for television.

Safety Guidelines is aimed at consumers and technicians, and contains updated Underwriters Laboratories (UL) requirements for the safe installation and servicing of consumer electronics products, including antennas, televisions and audio systems.

The EIA/CEG's *Interference Handbook* for television and audio systems helps technicians and consumers identify and eliminate common interference problems. These can originate from such sources as CB radios, unshielded motors and car ignition systems.

Circle (121) on Reply Card

E-Z Hook, a division of Tektest, Arcadia, CA, offers a new 114-page full color catalog of electronic test accessories. The E-Z Hook catalog of electronic test accessories contains specifications, configuration diagrams, application examples and ordering information on E-Z Hook's complete line of products, including dip testing accessories, continuity and voltage testers, multilead assemblies, test wires, wire products, jumpers, probes and patch cords, components and adapters, coaxial test accessories, cables and connectors.

Circle (124) on Reply Card

Storm Products announced the publication of their *Molded Computer Cable Selection Guide.* The free guide represents thousands of connector/pinning/cable variables. Users can design and select exactly the cable configuration needed without searching through many different catalogs and cable listings.

All popular connector types are listed in the guide, including RS232C, RS449, Centronics and DIN. Any of the connectors can be molded with the user's choice of cable; plenum, low capacitance/twisted pair plus 100 percent shielding and standard shielded and unshielded general purpose cables. A large selection of pinning in standard wiring configurations and customs are indicated.

Circle (125) on Reply Card

News

October 1984--Computer Learning Month

The Electronic Industries Association's Consumer Electronics Group (EIA/CEG), Washington, DC, commended the Senate for giving unanimous approval to a resolution designating October 1984 as "Computer Learning Month."

EIA/CEG Senior Vice President Jack Wayman recognized Senator Pete Wilson (R-CA) for his outstanding leadership in sponsoring and securing adoption of this resolution.

"The Wilson resolution," Wayman explained, "will help to focus national attention on the importance of home and business computers and how they simplify and enrich our daily lives. In addition, Computer Learning Month hopefully will extend educational opportunities to many thousands of Americans who might not otherwise be exposed to the new technology or to computer literacy."

Home video product sales increase

Data collected by the marketing service department of the Electronic Industries Association Consumer Electronics Group indicate that sales of most home video products increased in July.

Sales of video cassette recorders (VCRs) amounted to more than 480,000 units in July, up 48 percent over July 1983. On a year-to-date basis, VCR sales now stand at nearly 3.4 million units, a 78 percent gain over the same seven-month period a year ago. EIA's Consumer Electronics Group has predicted that VCR manufacturers will sell some 7 million units to the nation's retailers during 1984.

Color television sales topped the million-unit mark in July, bringing year-to-date sales approximately 8.3 million units. While sales of color sets were up 18 percent for the first seven months relative to the January-July period last year, sales of black-and-white televisions dropped more than 32 percent in July (and 19 percent on a year-to-date basis).

Projection television continued to post impressive sales gains in July, rising 46 percent to more than 13,000 units. For the first seven months, sales of projection televisions are running some 40 percent ahead of last year's pace. Color video cameras also enjoyed a solid sales month in July, expanding 22 percent. Year-to-date sales of these cameras exceed a quarter million units, an 18 percent improvement over last year's January-July figures.

Readers' Exchange

For Sale: Sencore VA48, in mint condition with all accessories and manuals, $750 firm. We pay UPS. *Cecil F. Mott, 221 Mobil Land Court, Bloomington, IL 61701; 309-663-8416/827-6867 after 5 p.m.*

Wanted: Swept function generator (sine, square, etc.) to about 1MHz with output for oscilloscope drive. **Also wanted:** Dynaco FM-5 tuner RF section (front end) and RF section for Dynaco AF-6 tuner. *R.M. Query, Box 23717, Washington, DC 20026-0717; 703-354-3721, after 4:30 p.m.*

For Sale: Kantronics Hamsoft (Rom cartridge) for Vic20 computer. Receive and send morse, RTTY Ascii, $29. Also, MFJ super audio filter, 721 SSB/CW, $35. *John J. Augustine Jr., 530 N. 9th St., Reading, PA 19604.*

For Sale: Howard motormatic radio, 9 push-buttons, 3-band age, old 30s. *Gary Adams, 12029 SE Hwy. 484, Belleview, FL 32620; 404-245-2772.*

Wanted: Schematic for United model #C-140 color TV set (13-inch). Also want schematic for Hufco model #TWS-6 frequency counter to be used with amateur radio equipment. *Scott's TV/CB and Electronics Service, RD3-3186, Pottsville, PA 17901.*

Wanted: TV service manuals and/or Sams Photofacts for new TV repair shop. *Charles Smith, P.O. Box 429, Copake, NY 12516; 518-329-4582.*

Needed: Schematic for TI SR-51-II hand calculator (vintage 1976). *Augustus Sisko, 15 Nostrand Drive, Toms River, NJ 08757.*

Needed: Color module for Sony chassis SCC-100R-B part number (on circuit board) 1-585-921-11. *Keith's TV Repair, 214 S. Third St., Albion, NE 68620.*

For Sale: Sencore CA55 cap analyzer and Sencore DVM38. $850 for both, plus postage. *Dan's TV, 235 Central, P.O. Box 42, Osakis, MN 56360; 612-859-2851.*

Needed: Power transformer for Rauland model 2135 amplifier, LP-0314. *Steve Halvorson, 612-445-2969 or 612-445-7276.*

Needed: Vertical output transformer #987939 (T-W39) for Emerson TV, model 35P04. *Charles E. Hess, 201 S. Oak St., Buchanan, MI 49107.*

Needed: High voltage cup for GE TV C-2 chassis, model #WM 373 CWD-2. Please state price. *George Saylor, 2319 Parrish St., Philadelphia, PA 19130.*

For Sale: Sencore VA48 with AT218 IF attenuator, all manuals and cables, $850. Sylvania CK-3000 test jig with 50 adaptors, $325. B&K model 1246 digital IC color generator, $125. All items excellent condition. *Paul A. Graffeo, 17 Archer Drive, Stony Brook, NY 11790; 516-689-9149.*

For Sale: Heath/Zenith linear circuits course, EH-701, $25. TTL and CMOS course EH-712, $25. Both with parts, never used. Heath IM-2215 DMM with ac adaptor and leather case, $48. *G.E. Guthrie, 609 S. Third, Kissimme, FL 32741; 305-846-0452.*

Needed: Complete VHF/UHF tuner assembly, including cables, mounting bracket, on/off switch, tuner knobs and three controls, all to fit a Silvertone color TV model 528.43513303, serial no. Y32311774. *Steve's Radio Service, P.O. Box 168, Wickes, AR 71973.*

For Sale: Used CRT rebuilding machine. *Cappel's TV and Audio, 912 Milan St., New Orleans, LA 70115.*

Needed: Copy of owners manual and schematic for Knight R100A shortwave receiver. *Chet Romag, 23 Lombard Grove, Thorp, WI 54771.*

Needed: Sams Photofact auto radio series, volume AR5 and AR7. Cheo. model 987086-87-88 (1955-AR5), 987575 (AR7). Will buy or pay for copies of pictorial schematics. Let me know, phone or send card or letter. *Arthur Hall, 603 Glenpark Court, Nashville, TN 37217.*

For Sale: Sencore DVM38 and Sencore C.A. cap analyzer, $400 for each piece. Also new, but older coils, yokes, flys, all for $50, plus shipping. *Dan's TV, P.O. Box 42, Osakis, MN 56360; 612-859-2851.*

Needed: Sencore #TC162 or similar tube tester, also B&K 467 Beltron CRT tester and rejuvenator. *H.W. Childers, 1322 Eastus Drive, Dallas, TX 75208.*

Needed: Industrial tube type 8233, new or used, reasonable. *Donald Haws, 13613 Applewood, Grandview, MO 64030.*

Wanted: A good used picture tube #520 HB8J for a Sony television. *Victor Scheideler, 2381 Hamms Road, Burlington, WI 53105.*

Wanted: Power supply, 0-150V or more at 500mA or more. *Ray Mackie, Box 1155, Kodiak, AK 99615-1155; 907-486-6046.*

For Sale: Sams Photofact folders, #55-1000. Complete for $300. Will ship UPS collect. *Scott Electronics, 1940 Merrill Drive, St. Charles, MO 63301; 314-947-0791.*

Needed: Schematics and information on Hygain model Hy Seas 55 channel radio telephone. Inform price and call: 415-533-9100 or write: *Stewart Electronics, 3134 Fruitvale Ave., Oakland, CA 94602.*

Needed: Model 685 EICO transistor analyzer. Also model 615 EICO tube test adapter. Please send price and condition. *Kermit Shetley, 2031 Woodland Hill Drive, Cape Girardeau, MO 63701.*

Needed: Service information on 1977 Ford auto radio, model D8AF19A171 AA found in Sams index. Photofact AR-272 (out of print). Reasonable price or will copy and return. *S.O. Sellers, 7308 Franklin Drive, Rock Creek, Bessemer, AL 35023.*

For Sale: Sencore TF17 transistor-FET tester, almost new, $40 plus shipping. If you write and don't get a reply, it's already sold. *T.W. Benson, 204 Riverside Ave., Tallasse, AL 36078.*

For Sale: B&K model 1471B dual trace scope, with 2 probes and manual, like new, $375. B&K model 1465 scope with probe and manual, like new, $275. RCA model WR-89A crystal calibrated marker generator with cable and manual, good condition, $150. Precise model 630 RF-AF and TV marker generator with cable and manual, $35. Heathkit model IG-62 color bar and dot generator with cable and manual, $35. *Frank N. Sachs, 6803 Navajo Drive, Baltimore, MD 21209.*

Needed: A schematic and parts list for an electronic Cordavox accordion model CG. Also need schematic for a stereo recording reinforcement mixer made by Technical Audio Products, TAPCO model 6200A. Will pay for the copy and postage. *Arthur R. Vickery, P.O. Box 742, Torrington, CT 06790.*

For Sale: Sencore FS-13A field signal strength meter, like new, $60. *George H. Blecker, 271 Emporia, Apt. 7, San Antonio, TX 78209.*

For Sale: Sencore VA48 video analyzer, complete with manuals and cables, $825 with shipping. *Mike Kauffman, 22 Dulany Court, Sterling, VA 22170-5614.*

Needed: Schematic and alignment instruction for Knight-KG2100 dc oscilloscope. Will pay reasonable fee for manual or its reproduction. *Osce Cloud Jr., 2709 Mt. Park Circle, Huntsville, AL 35810.*

Needed: Schematic diagram and parts list for Music Masters model SC-2000-A Fun-Mate organ. Will buy or copy and return. *William Hartley, Hi-Fi Workshop, 1201 Paul Ave., Schenectady, NY 12306.*

Wanted: Instruction manual for B&K DVM model 263. **For Sale:** B&K picture tube tester, model 467 and Heathkit DVM IM 2202. Both for $175, plus postage. *Kenneth Miller, 10027 Calvin St., Pittsburgh, PA 15235; 412-242-4701.*

For Sale: Tubes, parts and diagrams. Give model and make of set you need. Best offer takes. *Florian A. Rogowski, 25103 Cunningham, Warden, MI 48091.*

Needed: TA 7153P IC or GE IC 238 IC. *L.O. Robensin, 4662 Esther St., San Diego, CA 92115.*

For Sale: Used TV test equipment, new radio-TV tubes—including obsolete types. Sams Photofact folders. Send s.a.s.e. to *Maurer TV Sales and Service, Quasar Color TV, 29 S. 4th St., Lebannon, PA 17042; (717) 272-2481.*

Needed: Schematic and PC board layout for Heathkit model ET-3200, digital design experimenter. *S.O. Sellers, 7308 Franklin Drive, Bessemer, AL 35023.*

Needed: Service manual or schematic for Philco Precision visual alignment generator for TV and for FM model 7008. *Joseph Erickson, Service Tech., Sight and Sound Center, 8880 Turnerville Road, Lake City, MI 49651.*

For Sale: B&K model 415 sweep/marker generator, new, never used, $300 or best offer. *Dean Danks, Ontonagon Radio Service, Star Rt., 6A, Ontonagon, MI 49953.*

Books

Editor's note: Periodically **Electronic Servicing & Technology** *features books dealing with subjects of interest to our readers. Please direct inquiries and orders to the publisher at the address given for each book, rather than to us.*

Video Cameras: Theory and Servicing, by Gerald P. McGinty; Howard W. Sams & Company; $14.95 paperback.

This book starts with an explanation of the basic theory of how a video camera converts a visual image into an electrical signal, then proceeds step by step through a complete description of theory of operation of a video camera, including such concepts as beam focus and deflection, lenses, light values and signal processing.

One chapter presents a review of the NTSC system with special attention to how that system affects a camera. Included are block diagrams of affected circuitry, vector diagrams, graphs and actual oscilloscope and vectorscope waveform photographs. Other chapters cover black-and-white camera adjustments, 3-tube camera alignment and single-tube camera alignment.

The last chapter, *Troubleshooting,* attempts to answer the question "where do I start?" for someone who approaches a dead video camera for the first time. This chapter includes some important precautions and gives several basic checks for isolating the cause of the problem.

Published by Howard W. Sams & Company, 4300 W. 62nd St., Indianapolis, IN 46268.

The Complete Guide to Satellite TV, underwritten by KLM Electronics, $11.50 paperback.

This guidebook covering all aspects of satellite TV is an easy-to-read essential sourcebook for anyone who is thinking about installing a satellite system, who wants to get the most out of an existing system, or who wants a thorough understanding of this new technology.

Author Martin Clifford, veteran electronics writer and syndicated columnist, explains in plain English how satellites are used for TV broadcasting and what advantages satellite TV has over other broadcast systems. There are instructions for planning and selecting an earth station, details for determining the best spot for a satellite dish, and inside tips on installing and aligning an entire system. The function and use of satellite TV equipment is also clearly explained.

A handy glossary defines confusing engineering jargon and common acronyms. The 250-page text is illustrated with pictures and charts. The book also includes a detailed analysis of all system components: the dish, tracking sytem and different types of each; the feedhorn, low-noise amplifier, downconverter, receiver, etc.

Signal processing and conditioning techniques, electronic and mechanical specifications, and FCC regulations are also discussed. A chapter on system design explains the practical considerations and technical analysis that go into engineering a satellite TV system.

Published by KLM Electronics
P.O. Box 816, Morgan Hill, CA 95037

Products

Programmable UHF signal generator

Leader Instruments, Hauppauge, NY, introduces the LSG-203, a frequency modulated, programmable signal generator operating in the frequency range of 800 to 999.99MHz, covering the cellular mobile telephone and paging systems bands.

Featuring keyboard control of operating frequency deviation and attenuation factors, the LSG-203 offers 100Hz resolution and RAM storage for 100 sets of test conditions. Data storage is protected from accidental loss by battery backup.

Either dBm or dBμ can be selected for readout of output level. The range is −123dBm to −3dBm (−10dBμ to 110Bμ) in 1dB steps. Deviation is setable from 0 to 10kHz with 100Hz resolution, and readout is provided with a 3-digit display. All controls except power on-off can be remotely controlled.

Circle (60) on Reply Card

Hand-held DMM

A.W. Sperry Instruments, Hauppauge, NY, announces a new DMM, model DM-7010. This feature-packed DMM boasts nine functions on 33 ranges with basic dc accuracy of 0.05 percent of reading. The DM-7010's features include: four and one-half digits with a maximum display of 19,999, ac and dc current functions, resistance and conductance capability, diode and continuity tests, frequency counter up to 200kHz, overload protection on all ranges, safety designed input jacks and a built-in tilt stand.

A number of useful accessories are also available for the DM-7010. They are: model C-36 carrying case, model SJA-870 ac current jaw adaptor, model HVP-860 high voltage probe, and model HFE-840 transistor/diode test adaptor.

Circle (61) on Reply Card

Component tester

Barcor, Northbrook, IL, has introduced the Circuit-Check, a hand-held, low-cost instrument to test PC boards for dead components.

Circuit-Chek replaces conventional voltmeters for testing components both in the field and in the shop. In addition to locating dead/active components such as resistors, transformers, diodes, or ICs, the unit is suited to find short circuits when used with CMOS circuitry.

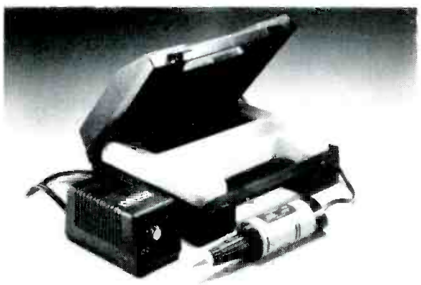
This non-contact device operates by pointing the probe within 1/16-inch of the PC board surface. A nulling wheel on the side of the instrument is turned clockwise until the meter indicator reads normal. As the probe is moved slowly above an active component on the PC board, the indicator will move to the right or *warm* area of the dial. When going over a dead component, the dial indicator will move back to the null position.

Circuit-Chek offers rugged construction and shirt-pocket size, which makes it suitable in field service applications for computers, electronic instrumentation, TV, video and stereo equipment.

Circle (62) on Reply Card

Electric mini-drill

The EDG-9 electric mini-drill, from *Davle Tech,* Fair Lawn, NJ, offers precision performance and features at an economical price. The lightweight, versatile, portable hand drill with continually adjustable speed from 0-16,500 rpm, is suitable for most light drilling applications when conducting either workbench or field applications.



The EDG-09 contains a heavy duty industrial quality electric drill, a 110V transformer featuring a 12V ac/dc output with variable power output control from 0-2A and a rugged molded plastic carrying case. The drill accepts any accessories for cutting, polishing, grinding, drilling, engraving or removing burrs.

Circle (63) on Reply Card

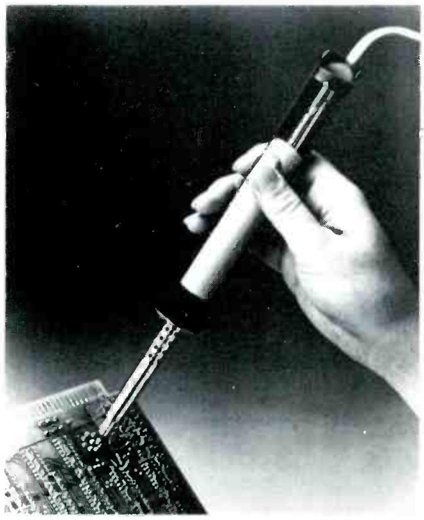
Contamination control

One of the innovations from *Wilshire Contamination Control,* Carson, CA, for clean room and personal computer application is a swab with a disposable/replaceable head. Suitable in situations where fresh, clean heads are constantly needed without discarding the entire product. The rigid aluminum handle is designed to accept clean heads as needed. The replaceable head is constructed to a 100 pore per inch polyurethane foam with a reticulated cell structure for maximum cleaning efficiency and flexibility.

Circle (64) on Reply Card

Electric desoldering tool

Paladin Corporation offers an electric desoldering tool designed for low-volume applications. It's low cost and compact design make it a workable tool for hobbyists, field service workers and in rework. The Solder Scooter electric desoldering tool (PA 1707/PA 1706) incorporates a 30W heater.



This ceramic substrate heater melts the solder joint. The vacuum pump pulls solder from the board, and the integral removal reservoir makes it simple. PA 1707 comes with a 2-cord plug and the PA 1706 has a 3-cord grounded plug. Replacement tips are available.

Circle (65) on Reply Card

Cordless voltage tracer

Model 915 electronic *Quik-Chex* voltage tracer introduced by *Triplett Corporation,* Bluffton, OH, is a portable, pocket-size, cordless tester that can quickly trace voltage presence, ground faults, defective fuses or identify hazardous electrical equipment. The battery operated electronic Quik-Chex with a built-in solid state high gain amplifier, has an integral indicator lamp which glows when its single blade-type probe is touched to a surface having voltage.

The voltage tracer will operate from 6 to 240Vac or Vdc with no indication if the blade is at ground potential. Poorly grounded wiring systems, equipment or lines with induced voltage will cause the tracer to glow dimly.

The Quik-Chex is safety designed and tested at 1500V for many hours. An epoxy-imbedded input resistor protects against moisture and arc over, providing extra isolation for the user.

Circle (66) on Reply Card

Snap-in circuit protector

Mechanical Products, Jackson, MI, offers model 1610, a special mid-amp series circuit protector which snaps directly into a 3AG fuseholder–providing improved contact, easy replacement and resetting ability. It is equipped with a 7/16-inch mounting bushing, fuse clip terminals, and can be either automatically or manually reset. Mechanical Products 1610 comes in standard amp ratings 5-10, plus 12, 15, 18, 20, 30 and 35 standard amp ratings. Special ratings are available on request. It is rated for 250Vac/50Vdc.

Circle (67) on Reply Card

Satellite TV receiver

A commercial satellite TV receiver that meets the specs of most high-end receivers–at a lower cost–has been introduced by the *Winegard Company.* Burlington, IA. Model RC-7000 receiver features block downconversion (from 3.7-4.2GHz to the 114-1.64GHz range) and crystal-controlled, phase-locked-loop synthesized tuning, making fine tuning unnecessary.

Accompanying the receiver is Winegard's model CV-7000 block downconverter, which can be mounted close to the commercial system's low noise amplifier, eliminating costly, high-loss cable runs to the receiver. A high-quality 75Ω cable can be used to connect the output of the block downconverter to the receiver. Power is supplied to the downconverter and LNA through the same coax cable, simplifying installation. A nominal +15Vdc at 0.5 amp is available at the receiver's IF input for this purpose.

Classified

Advertising rates in the Classified Section are 50 cents per word, each insertion, and must be accompanied by payment to insure publication.

Each initial or abbreviation counts a full word.

Minimum classified charge $10.00.

For ads on which replies are sent to us for forwarding (blind ads), there is an additional charge of $3.00 per insertion to cover department number, processing of replies, and mailing costs.

Classified columns are not open to advertising of any products regularly produced by manufacturers unless used and no longer owned by the manufacturer or distributor.

FOR SALE

CABLE CONVERTERS, decoders, $1.00 Refundable APS, POB 263ES Newport, R.I. 02840. 1-84-tfn

SUBSCRIPTION TV MANUAL, covers all three major scrambling systems, only $12.95. Includes theory, circuits,. waveforms and trouble shooting hints. Save your VIDEO GAME CARTRIDGES on EPROM with our EPROM duplicator. Plans $9.95. Catalogue $2.00, refundable. RANDOM ACCESS, Box 41770A, Phoenix, AZ 85080. 8-83-tfn

PRINTED CIRCUIT boards from your sketch or artwork. Affordable prices. Also fun kit projects. Free details. DANOCINTHS INC. Dept. ES, Box 261, Westland, MI 48185. 5-81-tfn

FOR SALE: B&K & SENCORE equipped TV Shop complete and more. Includes Sams 1090 to 2263 – Freq. counter – Alignment Gen. – 1000 new tubes – 10 years Electronic Servicing – Boxes of standard parts new – All in A-1 condition. Retiring. Call (305) 289-0054 or write HALL's TV, Rt. 1, Box 123, Marathon, FL 33050. Best offer over $5000 – $20,000 replacement value. 10-84-1t

SCRAMBLED TELEVISION, encoding/decoding. New book. Theory/circuits, $9.95 plus $1 shipping. Workshop, Box 393ES, Dept. E, Bethpage, NY 11714.7-80-tfn

TUBES – Receiving, Industrial and Semi-conductors, factory boxed. Free price list. Low; low prices. **TRANSLETERONIC INC.,** 1365-39th Street, Brooklyn, NY 11218E, 800-221-5802, 212-633-2800. 5-82-tfn

TV TROUBLE ANALYSIS TIPS. Over 300 symptoms/remedies by circuit area; tough ones over the years. Save time and money. Send $12.50 to CHAN TV, 8151 Grandview Rd., Chanhassen, MN 55317. 5-82-tfn

FULL LINE of TV converters. Wireless and manual compatable to Jerrold and Oak Systems. This month's special the Technica 140CHL stereo and video compatable out-put wireless converter. The only unit with a wireless volume control adjustment only $159; cable 15dB Amp in-line type only $20. RED COAT ELECTRONICS, new address and phone: 104-20 – 68th Dr., Forest Hills, NY 11374, Tele: (212) 459-5088. Catalogue $3 for specials. 10-84-tfn

SINEWAVE TV DESCRAMBLER, video and sound in TV or VCR. Complete kit and instruction manual ready to go $114.95 plus $6.10 S/H. Quantity discounts available, dealers welcome. Free flyer information, CABLE SEARCHER, PO Box 182, Carle Place Station, NY 11514. 8-84-3t

INDIVIDUAL PHOTOFACT FOLDERS (Not sets). #1 to #1400 $3.00 first-class postpaid. Loeb, 414 Chestnut Lane, East Meadow, NY, 11554. 9-84-3t

MAKE TELEPHONE answering machine servicing simple & professional. Without tying up your phone lines, our ring simulator will activate any machine on the market. You can hear the outgoing message, give your message, and also have the availability to check machines that have remote capability. Send your check for $85.00 made payable to PSI, INC. to cover cost of machine shipping and handling or call: (201) 845-6669. PSI, Inc. is located at: 34, Route 17 North, Paramus, New Jersey, 07652. 4-84-tfn

CB RADIO TECHNICIANS! We specialize in CB repair/modification books, plans, kits. Also digital frequency expanders, RF amps, outboard oscillators, FM conversions, speech processors, IF interference filters, other technical information not available elsewhere. Catalog $2. CBCI, Box 31500E, Phoenix, AZ 85046. (602) 996-8700. 3-84-tfn

LIQUIDATING entire shop due to death. TV parts, Sams photofacts, tubes, test equipment. Tools & transistors. Wally's Electronics, 111 Howard Rd., Chesapeake, Va 23320, (804) 547-4719. 10-84-2t

SONY – PANASONIC – RCA – ZENITH EXACT REPLACEMENT PARTS – SONY PARTS AND TRINITRON SPECIALISTS. LARGE INVENTORIES, CALL 516-678-1700 OR WRITE WITH PART NEEDED. GREEN-TELE-RADIO, 172 SUNRISE HIGHWAY, ROCKVILLE CENTER, NY 11570. 3-74-tfn

AUTOMOBILE RADIO and tape replacement parts. Delco, Chrysler, Philco-Ford, Motorola, Panasonic and many others. Large inventory. Laran Electronics, Inc., 3768 Boston Road, Bronx, NY 10469. (212) 881-9600, out of New York State (800) 223-8314. 5-79-tf

SAVE TIME ON COLOR TV REPAIRS. Over 3,000 tips on 31 brands. 116 page manual, $21.00 PP. Send check or M.O. to: A.F. FERNANDEZ, P.O. BOX 546110, Surfside, Florida, 33154. 8-84-4t

TV SHOP CLOSED OUT. Inventory for sale. Best offer takes. Box 425, San Ysidro, CA 92073. 9-84-2t

HELP WANTED

TV TECH NEEDED: Must be experienced on road and bench. Good pay. Incentive plan. Reply Box 894, Union, NJ 07083. 9-84-2t

SERVICES

SPEAKER RECONING: Most makes, sizes, models. For prompt service send to Mercury Speaker Reconing, 2018 W. Division St., Chicago, Illinois, 60622; (312) 278-2211. 9-83-tfn

WANTED

PICTURE TUBE REBUILDING EQUIPMENT, working or not, write or call: Chicago Television, 633 North Semoran Blvd., Orlando, Florida 32807. 8-84-3t

BUSINESS OPPORTUNITIES

LEARN TO REPAIR HOME VIDEO GAMES IN YOUR OWN SHOP! Did you know that more than 9 million HOME VIDEO games have been sold? Now you can learn to repair! Atari, Coleco, Intellivision, or Atari 400/800 computers in your own shop. Our courses are taught on VIDEO TAPE (Beta or VHS) and come with a manual containing all the necessary technical information you will need to do repairs. For more information or to order, call: Electronic Institute (800) 221-0834 (outside N.Y.) or (212) 377-0369 (in N.Y.) Customized live in shop training courses are also available, call for more information and price schedules. 7-83-tfn

TV-VIDEO RENTAL SYSTEMS. Manual or computerized for Apple and trs 80 computers. Increase your income, cut your workload and payroll. $5.00 for printouts and complete details. GOLDCOAST COMPUTERS, BOX 33, OWENSBORO, KY 42302. 7-84-tfn

TV SALES & SERVICE. Indiana, Pa. Complete inventory and equipment. Grossed $50,000.00 last year and growing. Owners health reason for sale. Can take over for $10,000.00 (412) 349-7230. 10-84-1t

MOVING?

If you're planning a move in the near future, don't risk missing an issue of Electronic Servicing & Technology. Please give us 6-8 weeks notice if you're planning on changing your address. Just write in your new address below and mail this coupon, WITH YOUR SUBSCRIPTION MAILING LABEL, to:

ELECTRONIC Servicing & Technology
Subscriber Services
P. O. Box 12901
Overland Park, KS 66212

Name ____________
Address ____________
City ____________
State ______ Zip ____________

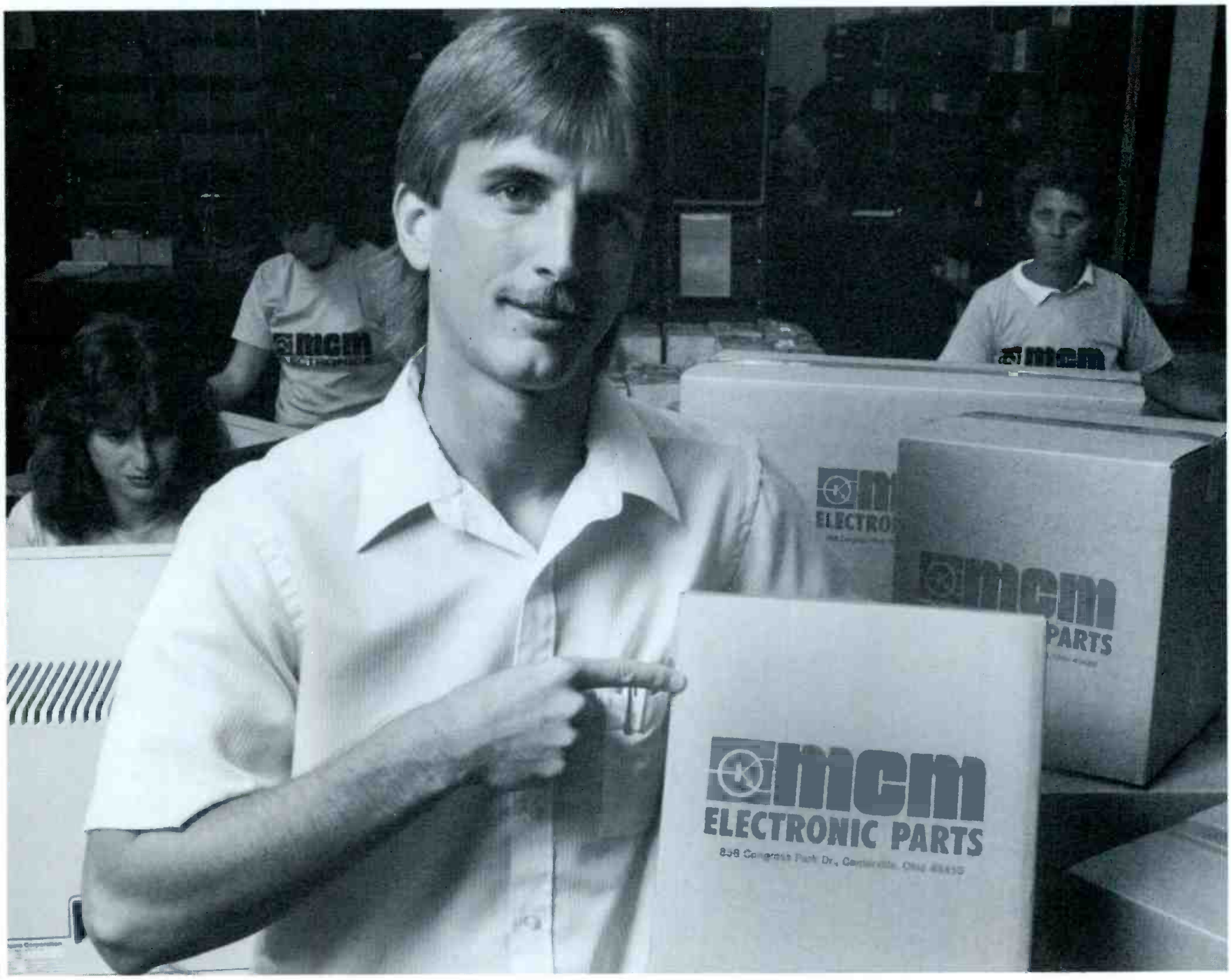
ELECTRONIC Servicing & Technology

Advertising Sales Offices

NATIONAL SALES MANAGER
Greg Garrison
P.O. Box 12901
Overland Park, KS 66212
Phone: (913) 888-4664

Advertisers' Index

Reader Service Number — **Page Number**



"FAST DELIVERY... YOU CAN COUNT ON US!"

At MCM we know when you need electronic parts, you need them *FAST.* That's why we have **EXPRESS DELIVERY SERVICE.** Our NEW Computer Aided Ordering System moves your order through *FAST* and *ACCURATE!*

You can count on our **EXPRESS DELIVERY SERVICE** for dependable delivery to your business, on time, every time.

So the next time you need the Right Parts at the Right Price, *Shipped Right Away*...call us at MCM! You can count on us!

CALL OR WRITE TODAY FOR YOUR FREE 120 PAGE CATALOG! OVER 4500 ITEMS!

CALL TOLL FREE 1-800-543-4330
(in Ohio, 1-800-762-4315)

mcm ELECTRONICS

858 E. Congress Park Drive, Centerville, Ohio 45459

SOURCE NO. ES-3

Circle (1) on Reply Card

Cut your video service time in half

The Sencore VA48 TV Analyzer, introduced in 1976, quickly became the industry standard for video service. It is now used by more than 22,000 technicians nationwide who have averaged an overall 54% reduction in service time, according to a recent survey of VA48 owners.

But Times Change: Today's video circuits include projection TV, 4-head VCRs, SAW filters, comb filters, integrated flybacks, cable-ready tuners, and many more circuits you just can't service effectively with the VA48. That's why we now have the VA62—the only video analyzer that equips you for all of these new video circuits—and then some.

In a Nutshell: Here's what makes the VA62 unique:

- It's a TV analyzer—Fully updated for the latest circuits.
- It's a VCR analyzer—Makes VCR analyzing a snap (using two inexpensive accessories) . . . and it meets all manufacturers' requirements.
- It's cable-ready—Test all the latest digital tuners.
- It has unique patterns—Special test patterns, plus standard patterns simplify troubleshooting.
- It's obsolete proof—It can be updated as needed for new circuits or formats . . . quickly and inexpensively.

Guaranteed Results: The VA62 can cut your service time in half on all video circuits—new and old. We guarantee it or we'll refund your money at the end of 30 days.

Update Today: If you're ready to update your bench to service the new circuits of the 80's, write or call toll-free today for a complete color brochure.

TOLL-FREE 1-800-843-3338
In Canada Toll-Free 1-800-665-4871
South Dakota, Alaska, and Hawaii call collect at 605-339-0100.

Please send complete VA62 details:

Name ____________
Address ____________
City ____________
State ____________ Zip ______
Phone ____________
(Mail to Sencore, 3200 Sencore Drive, Sioux Falls, SD 57107)

For Information Circle (2) on Reply Card
For Demonstration Circle (3) on Reply Card

SENCORE