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Test lab report – BBC-Metrawatt/Goerz DMM • Transducers

Power line disturbances – Part 2 • Multi-channel TV sound

Troubleshooting telephones

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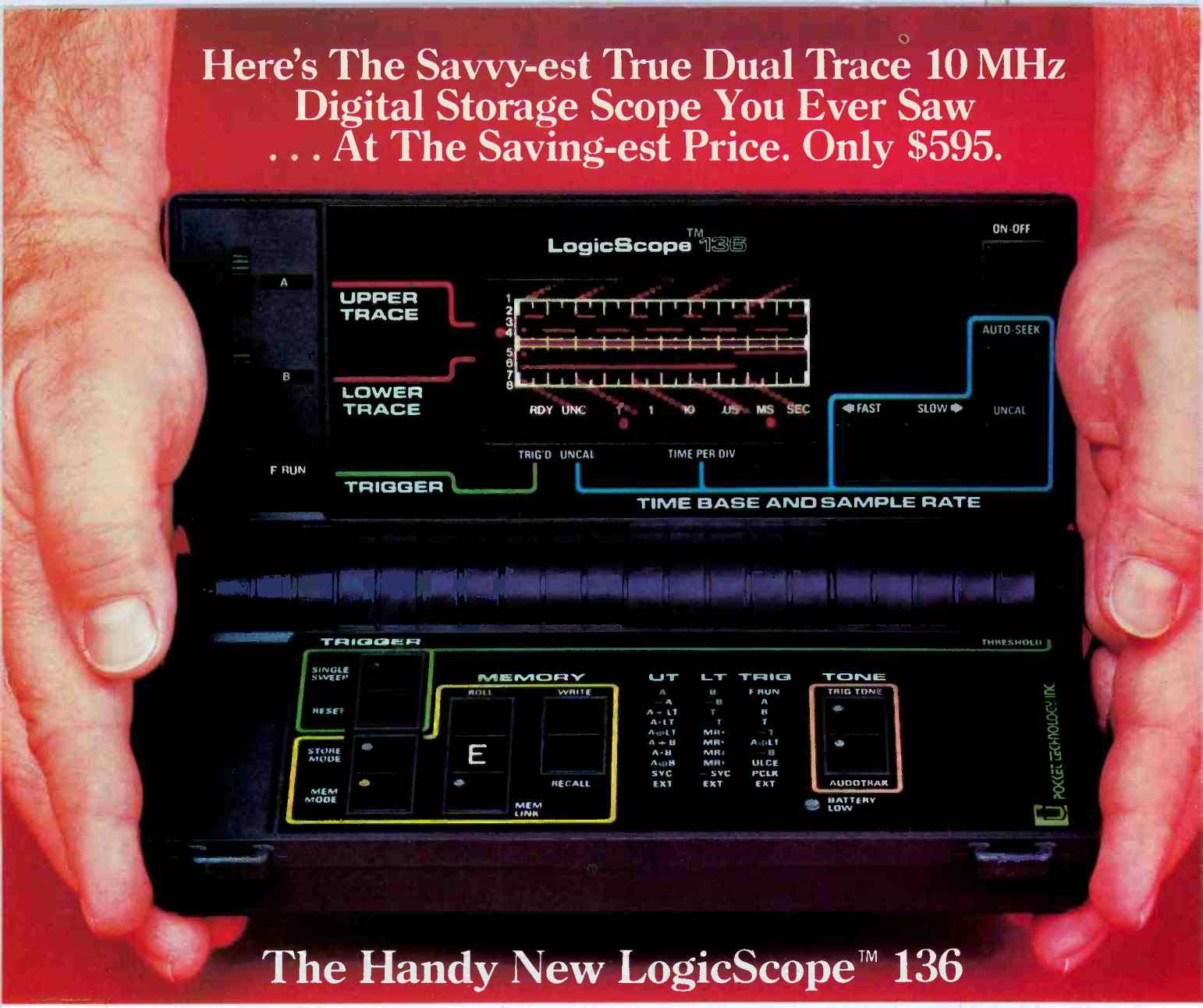

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ELECTRONIC Servicing & Technology

Volume 5, No. 3 March 1985

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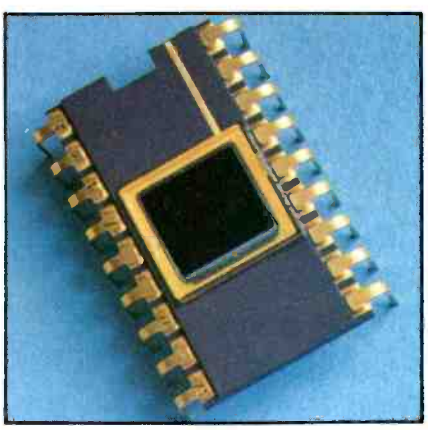
Now that telephone company customers can purchase their own telephones, someone will have to provide service for them. Read the article starting on page 12 for a logical, step-by-step troubleshooting procedure. (Photo courtesy of B&K Precision)



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Editorial

Don't take your electric power for granted

Living in one of the most technologically developed nations in a highly developed world, there are many things we take for granted. We expect to be able to pick up the telephone and get an immediate dial tone, and then with a few flicks of the finger, speak to almost anyone anywhere in the world.

We go to the grocery store expecting to be able to pick up the cut of meat and fresh produce of our choice without ever once giving a thought to the complex chain of events, each a marvel of modern technology, it took to get it there.

It's not surprising, then, that we take the electrical power coming into our homes for granted. We walk into the house, flip the switch and the light comes on. Turn the knob and the television lights up with pictures. Not only that, but we're ordinarily unmindful that all the time we were gone from the house, the electricity was powering the refrigerator to preserve food from spoiling, keeping all the clocks on time, and continuing to operate the air conditioner or furnace to keep the house comfortable.

Until recently, all of the electrically operated devices in the home have been pretty tolerant of minor disturbances in the electric power delivered to our homes. If the voltage coming into the house is interrupted for a few thousandths of a second, or drops 10 or 20 percent below its nominal value, the clock on the wall might lose a little, or the refrigerator motor might get a little warmer momentarily, but no problem.

If you happen to have a digital clock, though, you've probably begun to become more aware that the power coming into your house isn't quite as steady as you once thought it was. Every once in a while you come back with no inkling that you had a power failure, but find that the digits on the clock have all switched to 00:00 and are blinking. And that only tells you that there's been a complete interruption of your electric power, however short it might have been. It can't tell you if the voltage has sagged or surged above nominal, or if there's been a spike, or several, of higher than normal voltage.

Although motors and heating elements and other electrical equipment can tolerate or ignore momentary variations in the ac line power coming into the house, many of today's highly sophisticated highly sensitive devices cannot. Many of today's semiconductors can be destroyed or permanently damaged by such faults. Digital circuitry such as in clocks can be totally disrupted by power interruptions or spikes. Digital computers may give incorrect results, or even be damaged by such disturbances.

This issue features the second of a 2-part series that takes a detailed look at what causes power line disturbances, their effects and what corrective measures can be taken. Reading it might help you save some computer data–or may help save your computer or other solid-state electronics products.

Nils Conrad Persson

ELECTRONIC *Servicing & Technology*

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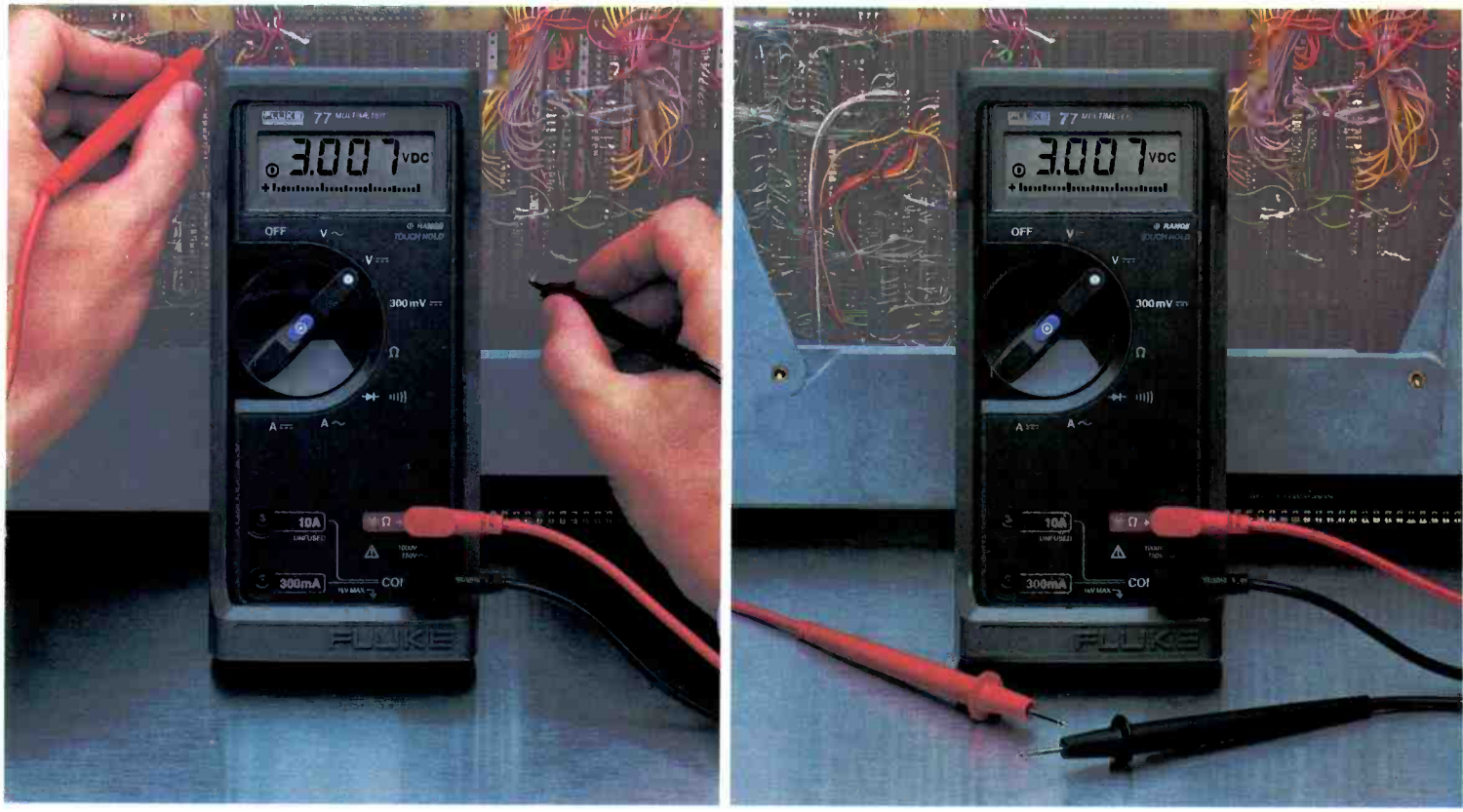

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Technology

New thyristor expected to simplify, lower cost of consumer-product control

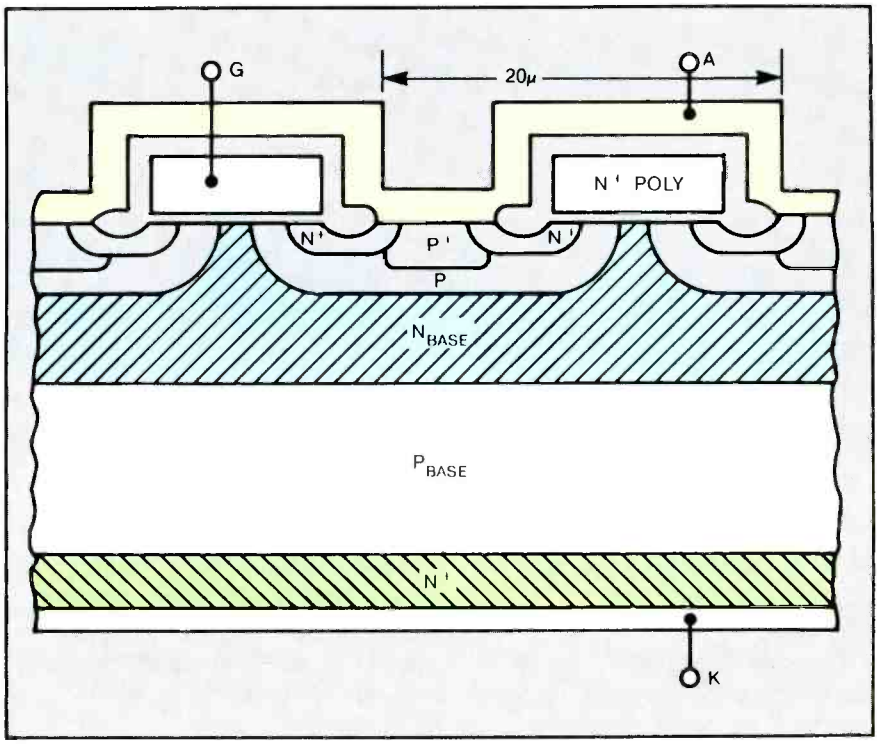
A new kind of power electronic device to simplify and reduce the cost of control circuits for a wide range of industrial and consumer products is under development at the General Electric Research and Development Center, Schenectady, NY.

Known as an MOS-controlled thyristor (MCT), the device is essentially a thyristor that incorporates metal-oxide-semiconductor field effect transistors (MOSFETs) for gating both on and off. As such, it will function like a thyristor under steady state conditions (it will have the high current density characteristic of thyristors). But thanks to the MOS gating, it also will exhibit the capability to be turned on and off reliably.

This development is a radical departure from standard thyristors, which ordinarily cannot be turned off at all. As a result, most control circuits employing thyristors require elaborate backup commutation circuitry for turnoff. Such circuitry is as large and as lossy as the main power circuit.

With this device, a charge applied to the MOS gate will turn on the field effect transistors (FETs), effectively shorting one of the emitting junctions of the thyristor to turn the device off. The current density that can be turned off will depend on the size of the MOSFET.

Through computer modeling and mathematical analysis, the performance of this MOS-controlled thyristor has been compared to several other types of power devices. Compared to a 600V MOSFET, for example, it is projected to have about 20 times higher current density at a 2V forward drop.



This illustration displays a new kind of power electronic device, known as an MOS-controlled thyristor (MCT). It is essentially a thyristor that incorporates metal-oxide-semiconductor field effect transistors (MOSFETs) for gating both on and off.

A number of experimental devices rated at 1200V (the ideal breakdown voltage) have been fabricated. Preliminary tests indicate that a 15V gate signal will be required to turn off one of the new thyristors rated at 1000A per square centimeter.

The key to accomplishing the all-important turn-off function is to have FETs highly interdigitated on the cathode surface. Turning on these FETs causes such a high emitter short density that the device turns off.

GE has fabricated experimental MOS-controlled thyristors with as many as 6000 cells. Each of the cells measures about 20 microns on a side.

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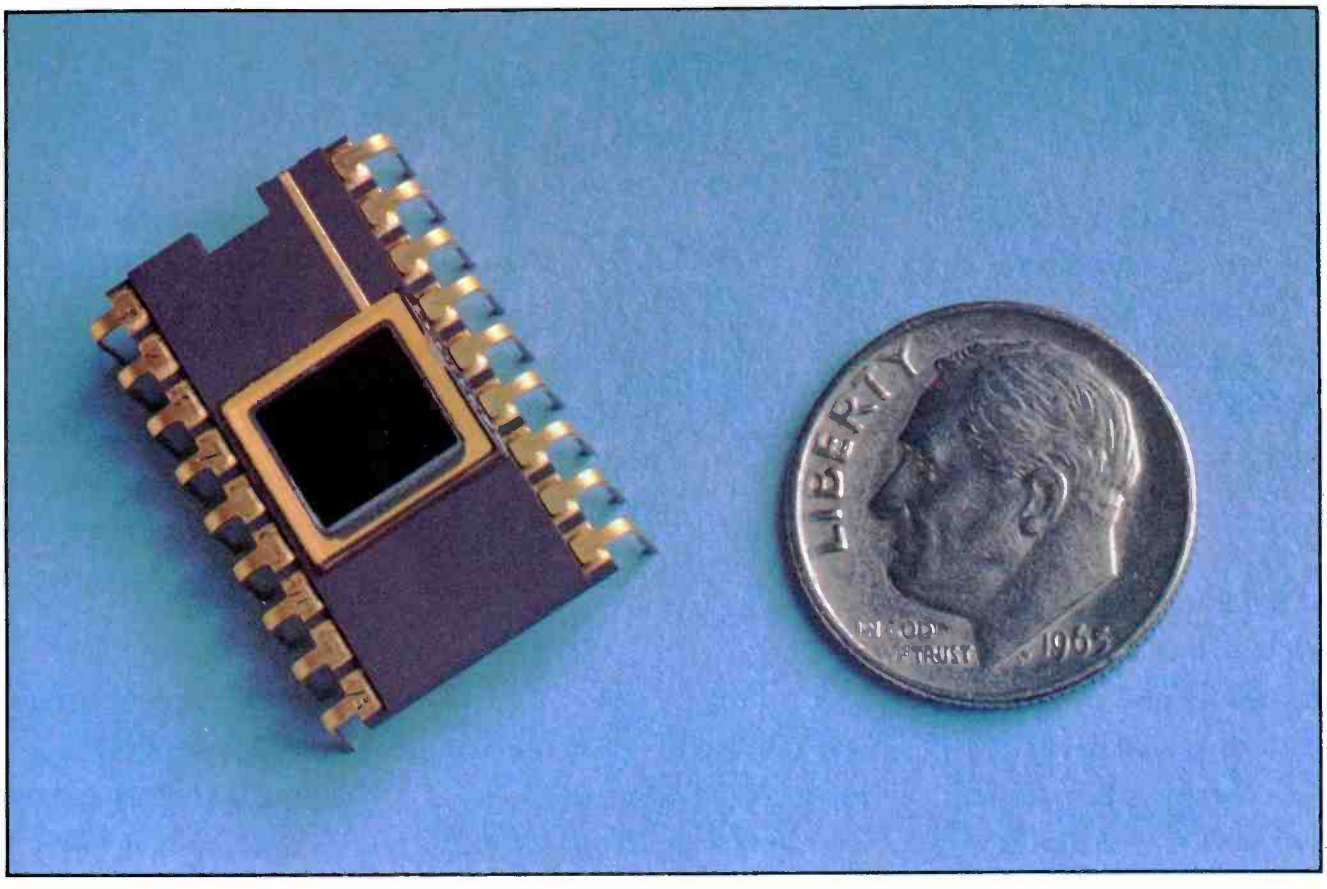

This new CCD imaging device provides 206,336 picture elements on its 8mm diagonal sensor. Small size, combined with low-light capability, low power requirement and freedom from lag make it useful in robotics, pattern recognition, industrial surveillance, medical and scientific applications.

A silicon imaging device that produces color TV pictures with the look of film has been designed and developed by RCA.

Known as RCA SID504, the chip is a charge-coupled device (CCD) that replaces conventional vacuum tubes. It can transfer information three to five times more efficiently than comparable existing devices while providing one of the lowest noise readouts in CCD technology.

This device will provide major advantages in electro-optic applications, especially in low-light areas where precise image reproduction is of significant importance. These applications include inspection, process control, pattern recognition, robotics and a variety of industrial surveillance, scientific and medical instruments.

The device surpasses the capabilities of conventional tubes. This improvement is due to its capability to handle direct bright lights, while at the same time producing clean images from shadows. It can practically see in the dark, producing clear images from as little as three footcandles of light, marking a genuine breakthrough in solid state imaging performance.

Advantages of the CCD include its ability to see sharper detail in rapidly moving objects and to perform over a wide range of lighting conditions. As a result, the blurs normally associated with fast action scenes in tube pictures have been reduced by the RCA chip. Because there is no image lag, it is possible to obtain faster shutter speeds and shorter exposures.

The device also eliminates blooming, a glare caused by objects reflecting too much light into the TV camera. The entire image sensing area is light-sensitive. It has no opaque areas to cause aliasing, which occurs when small picture details are obscured and lost in the image output. Other advantages of the RCA chip include its immunity from magnetic fields, acoustic interference and geometric distortion of the picture.

ES&T

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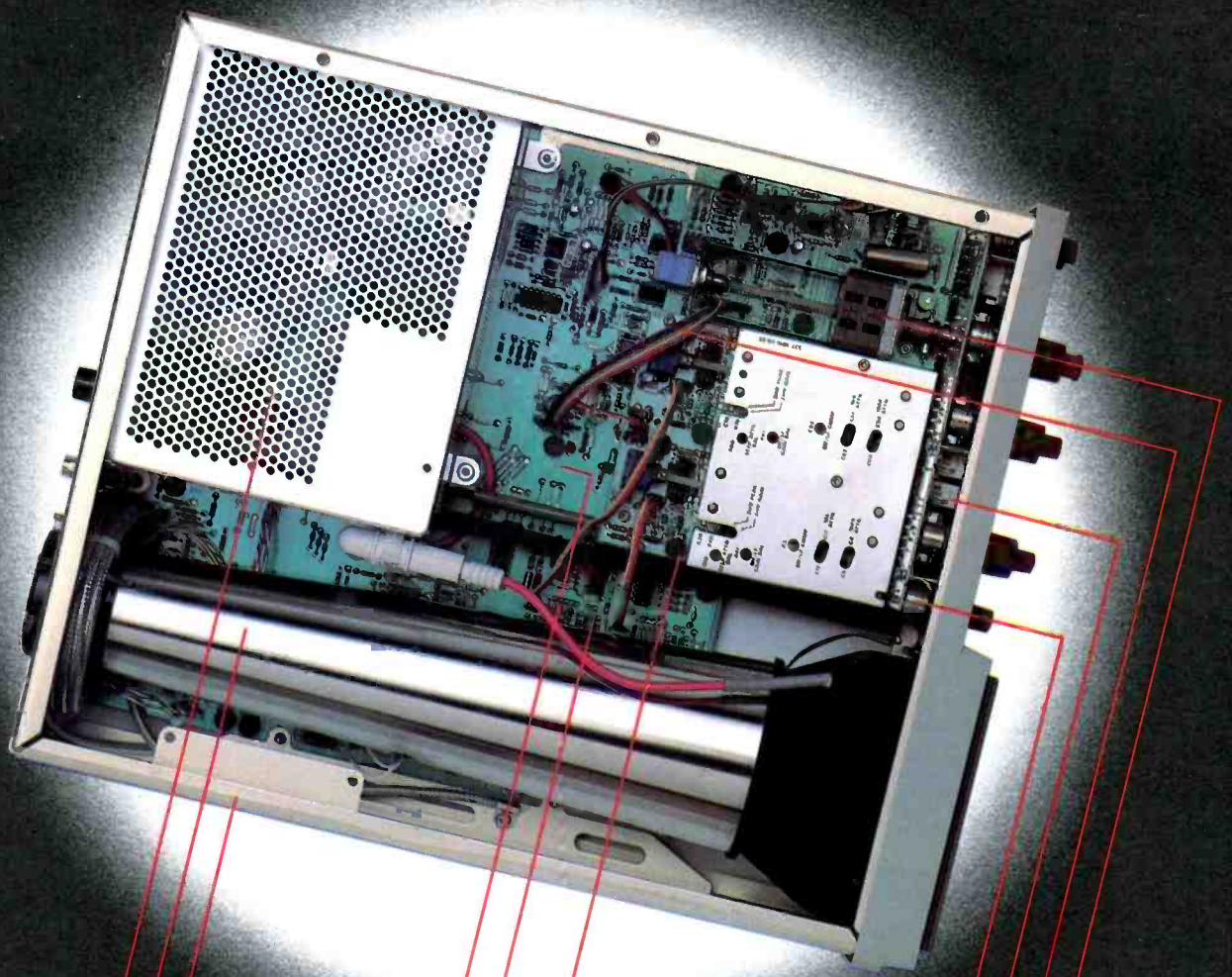

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Circuit board mounted timing switch eliminates hand wired and soldered components and reduces potential intermittents.

Minimal cabling helps reduce potential intermittents and allows easy removal of circuit boards.

Circuit board mounted pots and switches mean no hand wiring to break off. These parts are machine soldered for reliability.

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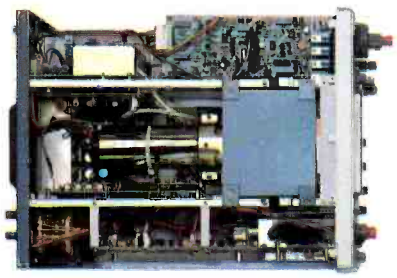

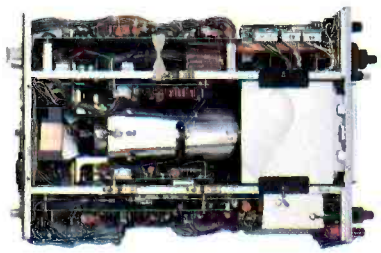

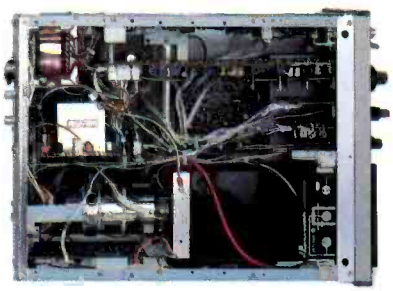

Take a look at Tek's simplified, practical internal design (opposite) and you'll see why the 2200 Series delivers unparalleled performance and reliability compared to any competitive scope on the market. You get quality that's unmistakably Tektronix in scopes so advanced, they cost you less to buy and own.

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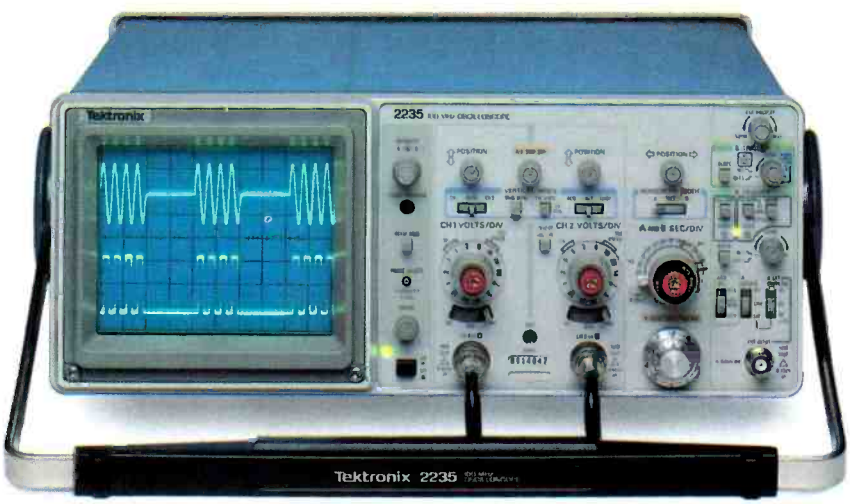

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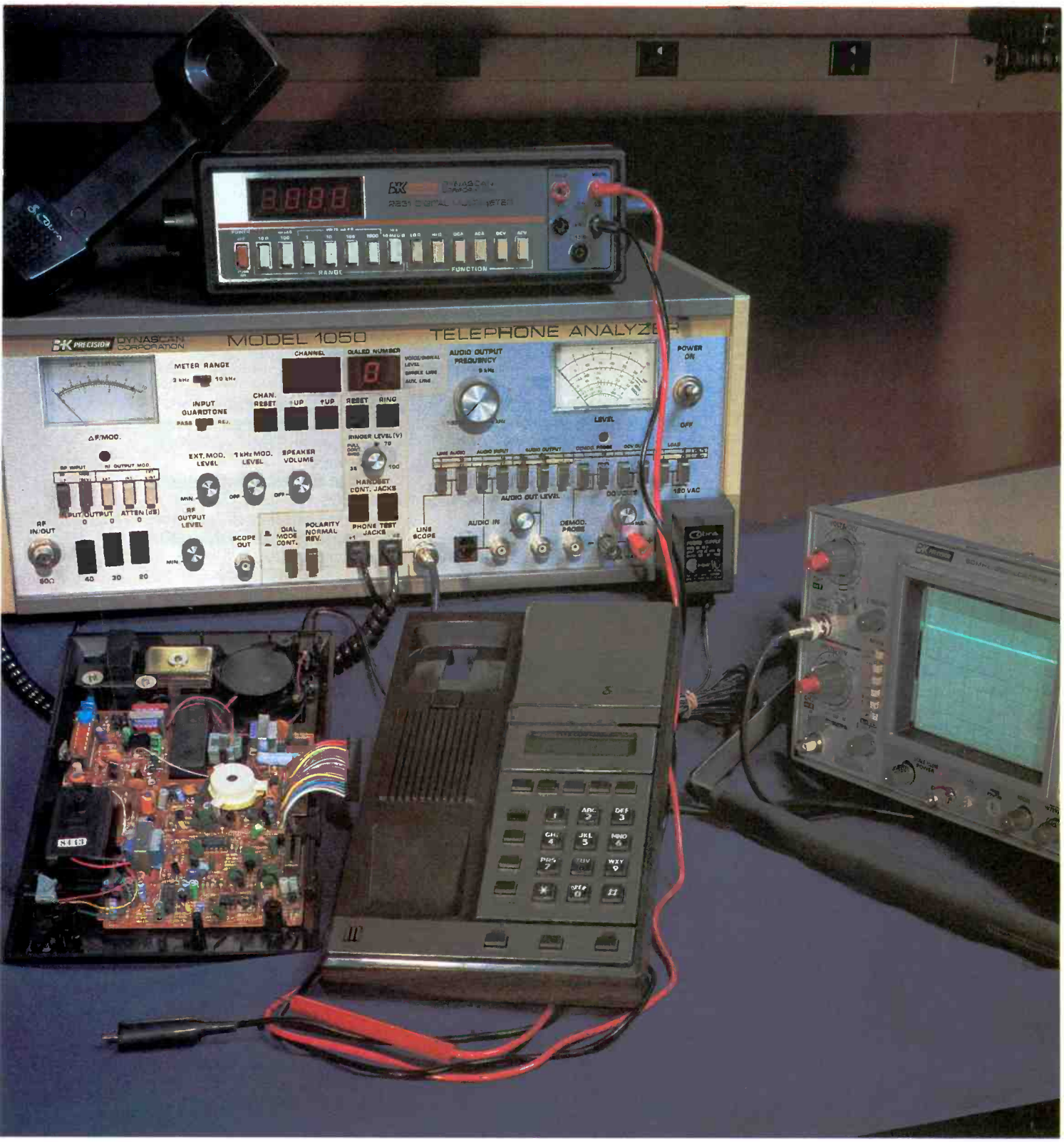
TROUBLESHOOTING TELEPHONES

By Christopher Kite



As a result of the Bell system break-up, independents were allowed to sell telephones, and they have since saturated the market, offering many different makes and models. Prior to the January 1984 break-up, your local phone company was responsible for keeping your telephone in proper operating condition.

But now, most people own their own telephones; and the responsibility of servicing them no longer lies exclusively with the telephone company. Individual owners may service their own telephones or bring them to independent servicers. Because of these recent changes a new servicing opportunity has been created.

Tools and test equipment

Telephone troubleshooting requires the same basic methods of troubleshooting as other electronic equipment. A logical pattern of checks and measurements will most effectively isolate the defective part. This article outlines one logical pattern of checks and measurements with enough detail to help develop some insight for adapting the technique to all telephones.

One of the most valuable tools for troubleshooting corded telephones is at least a fundamental knowledge of normal circuit operation. I recommend reading the article "What's Inside Your Telephone?", found in the February 1984 issue of **Electronic Servicing & Technology,** as a prerequisite for telephone troubleshooting. Correct test equipment is the other requirement for telephone troubleshooting.

Much of the test equipment needed to troubleshoot and repair telephones is specialized. First, you'll need a telephone line simulator, or it will be necessary to tie up a telephone line (for some tests two lines are needed). A 48V dc power supply fed through a 1.5kΩ series resistance may be used for the basic telephone line simulator, with input/output jacks for applying ring voltage and test tones, and measuring dialing and audio signals.

Servicing of telephones, which contain specialized circuits and functions, is facilitated through the use of the appropriate test equipment.

Telephone troubleshooting requires the same basic methods of troubleshooting as other electronic equipment.

You will also need a 20Hz ring generator that will provide an output variable from 45V to 100Vrms. This is a special-purpose device used only for telephone testing. Ideally, the ring generator should shut off automatically when the telephone is taken off-hook. If not, you must be very careful never to take the telephone off-hook when the high voltage (45V to 100Vrms) signal is applied. Applying such a high voltage to an off-hook telephone may cause damage to the telephone.

For all tests referred to in this article, it is assumed that the ring generator in use possesses an automatic shut off feature. Another special-purpose device is a dial decoder to determine whether the telephone is dialing the correct digits.

I use a B & K-Precision model 1050 telephone analyzer. It takes care of my special-purpose needs, because it includes a telephone line simulator, variable level 20Hz ring generator, audio generator, audio level meter, cord tester and pulse and DTMF dial decoders. It also contains features for servicing cordless telephones.

A less expensive piece of equipment you could use is a unit like the B&K-Precision model 1045 telephone product tester. It contains a telephone line simulator, two level 20Hz ring generator, cord tester, voice and DTMF signal level tester and pulse and DTMF dial decoders. General purpose test equipment such as a multimeter and oscilloscope are needed, of course, and a second telephone in good working condition is very handy for some tests. As you gain experience, you may wish to alter the pattern of checks and measurements and develop your own set of short cuts.

Figure 2 is a schematic diagram of an electronic telephone. Several of the troubleshooting examples refer to Figure 2 to demonstrate specific examples in detail. Although circuits may vary from one telephone to another, most technicians should be able to adapt the troubleshooting techniques to other circuit configurations.

Checking the weak link

Possibly the most common cause of telephone problems is the failure of handset and telephone cords. When a telephone does not operate properly, check the cords first. Cords are subjected to quite a bit of hard use, often being stretched, twisted and nicked-up through normal everyday use. If an intermittent problem develops, it's a good bet that one of the cords is at fault.

Both handset and telephone line cords should be tested and replaced if not good. Figure 1 shows the two different types of cords. When testing the cords, it is important to bunch up and then stretch the cord to simulate the conditions the cord goes through during a telephone conversation.

Carefully inspect the cord for signs of excessive wear, nicks, cuts and frayed wires, and replace the cord if any problems are spotted.

To test a cord, disconnect both ends of the cord from the telephone and put one lead of an ohmmeter or continuity tester at each end of one of the cord's conductors. Resistance should be very low (almost zero or right at zero). High resistance readings indicate an open is present in the cord and that the cord should be replaced.

With one of the leads still touching the conductor at one end of the cord, touch the lead at the other end to each of the other conductors one at a time. Resistance should be infinite or very close to infinite. Low resistance readings indicate a short is present in the cord, and it should be replaced. Test each conductor of the cord in the same way. The dedicated testers allow a quick and simple test for detachable telephone and handset cords that checks for both short and open circuits. Plug both ends of the cord into telephone jacks on the front panel of the instrument, and a pair of LEDs will light if the cord is good.

Check ringing

After verifying that the cords are in good shape, or after replacing the cords if necessary, test the telephone for ringing. At the same time, also check the ring threshold voltage. This threshold is the minimum voltage at which the telephone will ring. Apply a 20Hz, 100V signal to the telephone (when on-hook) and note whether or not the telephone rings. If it doesn't ring, the ringer is defective and must be repaired. If it does ring, decrease the 20Hz signal level to 45Vrms.

If the telephone will not ring with a ring voltage of 45Vrms or lower, the ringer circuit is probably defective. Although the telephone company generally supplies 80Vrms to 130Vrms to the telephone line, telephone line resistance and loading from other telephone devices on the same line can cause the voltage to drop as low as 45Vrms.

When you lift the telephone off-hook, ringing should stop immediately. If the telephone continues to ring, the telephone is not coming off-hook properly, and this problem should be investigated. Before checking the switch or other electrical parts inside the telephone, make sure nothing prevents the hook switch from moving.

If the telephone fails to ring during this test, several things can be checked to isolate the problem.

Much of the test equipment needed to troubleshoot and to repair telephones is specialized.

Check the on-hook impedance of the telephone. If the reading is low (about 250Ω), the telephone is causing the ring generator to detect an off-hook condition. A probable cause would be shorted or leaky ringer coupling capacitors (C701 and C702), or a shorted or leaky transient suppressor capacitor (C722).

If the reading is high (much greater than 250Ω), there are several possible causes. Possibly the most common cause I have seen in older telephones is that the telephone is actually wired for 3-wire operation: Two wires are used for voice communications and dialing and a third wire is used for ringing. The simplest way to eliminate this problem is to connect the ring wire (the yellow one) to one of the other two wires (usually the green one). With newer telephones this is not a problem.

Usually when there's a problem, the ring signal must be traced through the telephone's ringer circuit to find the point where the signal path is disrupted or severely attenuated. The specific ring circuit for each telephone may differ and the measurements should be adapted to the specific telephone being tested. However, to demonstrate the technique, take a look at points of measurement for the telephone depicted in Figure 2. This is the schematic diagram of a telephone with an electronic ringer circuit.

While applying a 100Vrms, 20Hz signal to the on-hook telephone, first measure from the junction of D701 and D703 to ground using an oscilloscope. Because D701-D704 forms a full wave bridge rectifier, the 20Hz ring signal should be converted to a 40Hz ripple signal. If the signal is absent, check for an open C701, C702 or R701 or a shorted C722 or Z701. An abnormal signal may be caused by bridge diodes D701-D704 or

Figure 1. When testing either the handset or telephone line cord, you should alternately bunch the cords up and stretch them out to simulate actual use conditions.

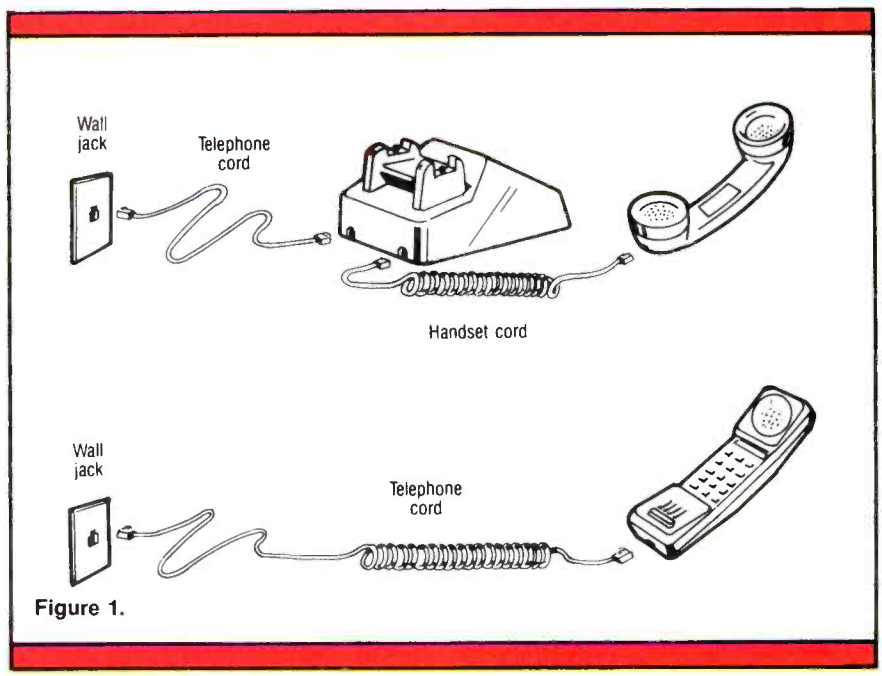


Figure 1.

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shorted C721. If the signal is normal at the first point of measurement, you might jump to buzzer BZ701 for the next measurement. Because the 40Hz ripple acts as a power source for oscillator TR711, the signal should be interrupted at a 40Hz rate. Presence of the signal means the buzzer itself is defective. If the signal is absent, check the contacts of switch S801, then check TR709, TR710, TR711 and associated components.

Checking dialing

Check the ability of the telephone to dial correctly next. Test each digit 0 through 9 for both tone and pulse dial telephones. For tone dial telephones, the level of the dialing signal should also be checked.

Standard rotary dial telephones use a set of contacts that are mechanically opened and closed to dial numbers. When the dial is released, contacts open and close accordingly. For example, for the digit 7, the contacts open and close 7 times. A mechanical governor controls the rotation speed and the period and repetition rate of dial pulses. The dial pulses may be observed on an oscilloscope connected across the telephone line. Usually, if a rotary dial telephone will not dial, it is because the contacts are bent, oxidized or corroded away. Oxidized contacts may be carefully cleaned, but if the contacts are bent or corroded, they should be replaced.

Usually, if a rotary dial telephone will not dial, it is because the contacts are bent, oxidized or corroded away.

If a push-button type pulse dial telephone fails to dial numbers, the first step is to check the dialing IC. Observe the output of the dialing IC (pin 18 on IC701) while dialing a number. The output should pulse a certain number of times for each digit pressed (1 pulse for the 1 digit, 5 pulses for the 5 digit, 10 pulses for the 0 digit).

If the dialing IC checks out all right, the problem is probably with the switching transistors (TR701, 702). These transistors take the place of the mechanical contacts on rotary dial telephones, *opening* and *closing* the line in response to the period and repetition rate established by the dialing IC (IC701).

One of the more common faults I have noted in troubleshooting electronic telephones is the failure of these switching transistors to turn off completely during dial pulses. If these transistors allow as little as 1mA of leakage, some or all of the dial pulses may not be recognized by the telephone exchange. You may confirm this by examining dial pulses on an oscilloscope. Using dc coupling on the oscilloscope, note the dc reference level with the telephone on-hook. Next, note whether the line switches all the way to the reference level during dialing pulses. Figure 3 shows what you may observe on the oscilloscope.

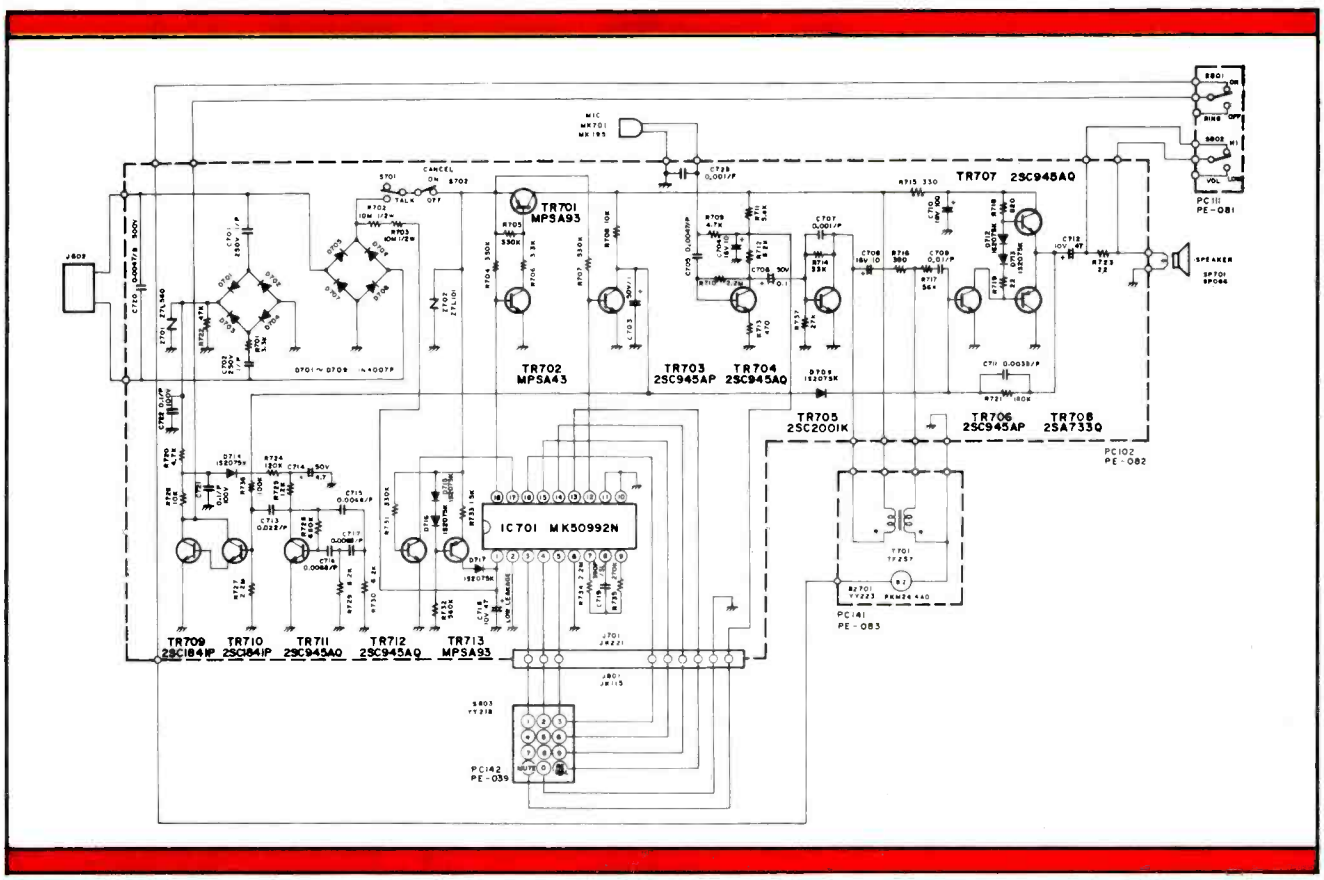

Figure 2. Schematic diagram of a typical corded telephone.

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I have also noted that telephones with this problem appear to break down gradually, with the problem first occurring when the telephone line voltage is high. That is, they may dial normally when the telephone line voltage is 48V or less, but may not work when stressed with a higher telephone line voltage such as 52V. Thus, it may be wise to increase the voltage to approximately 52Vdc when testing dialing. This significantly improves the ability to reject telephones with marginal switching transistors and those with impending failure.

Touch Tone and equivalent DTMF dialers produce a pair of tones for each digit. Improper level or improper frequency can cause dialing failure. Each tone should produce an amplitude of at least 0.05Vrms. On B & K-Precision testers, an LED lights if the DTMF level is sufficient. The DTMF dialing module is typically replaced rather than repaired.

Checking audio

Check the level and quality of audio in both directions. The voice at the earpiece should be loud enough and clear enough so that it can be easily understood. Outgoing voice should also be loud enough and clear enough to be easily understood at the other earpiece. Also, the sidetone volume should be at a level where the person speaking into the telephone does not feel the need to shout or whisper.

If the level of outgoing audio from the telephone is below 0.1Vrms, the outgoing audio circuitry must be checked (TR704,705). Use an audio generator to inject a signal (between 300 and 3000Hz) into the telephone at the microphone and trace the signal through the telephone. This should result in tracking down the problem, most likely a lack of amplification or a presence of unwanted attenuation.

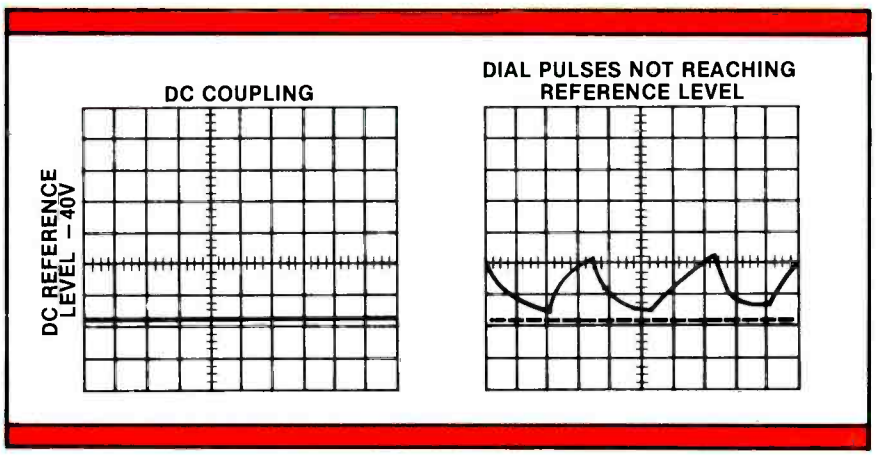
ITT telephones are practically identical to AT&T telephones in many ways, allowing you to substitute ITT parts for AT&T parts.

Insufficient input audio volume requires the troubleshooting of the audio input circuits and amplifier (TR706-708). Once again, use the audio generator as a signal source (inject the signal at the telephone line) and trace the signal through the telephone. As in the previous case, the probable cause will be lack of amplification or presence of unwanted attenuation.

If both the incoming audio volume and the sidetone are low, the problem is most likely in the audio amplifier (TR706-708). Check that the gain of this amplifier stage is up to specifications. Another possibility for the cause of low incoming audio volume and sidetone is the failure of the hybrid transformer (T701); however, the failure of the transformer usually results in low audio output level as well.

If a total lack of incoming and outgoing audio exists, yet dialing and ringing functions are operating properly, a break in the circuitry is probably between the switching transistors (TR701-703) and the microphone amplifier (TR704,705). Use the line simulator to supply power to the telephone and check voltages using a multimeter.

Figure 3. If a pulse-dial telephone is not dialing properly, or at all, check the dial pulses on an oscilloscope. Here, the dial pulses do not reach the reference level, indicating a problem.

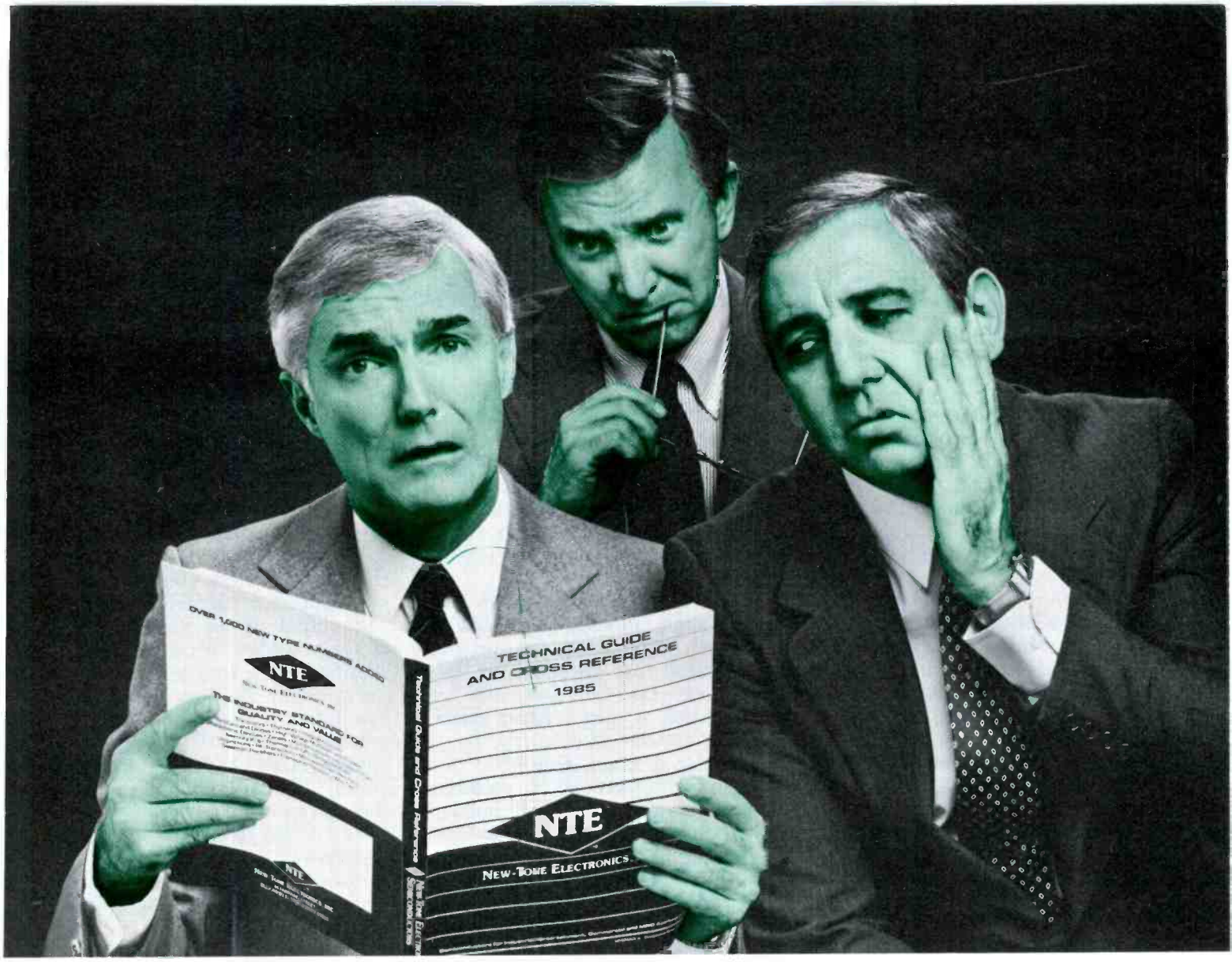


Some common problems with telephone servicing

As with servicing any electronic hardware, there are problems with servicing telephones. Possibly the most frustrating will be trying to track down replacement parts for AT&T telephones. They claim that no replacement parts are available (according to the AT&T Sales and Service center, you must bring a telephone into one of their Phone Centers to have it repaired). ITT telephones are practically identical to AT&T telephones in many ways, allowing you to substitute many ITT parts for AT&T parts. If you are in the telephone sales business, as well as the telephone servicing business, you may want to point out the lack of replacement parts as a reason for buying other brands of telephones.

Another problem is the large number of *throw away* telephones on the market. Imagine a customer's surprise (as well as unhappiness) when the repair bill is much higher than the initial cost of the telephone. This can be avoided by forewarning the customer that the repair bill is liable to be higher than the original cost and that replacement might be the best alternative.

Another problem is the rapid change that has come about in telephones. Once only a few basic telephone designs were being used, now many different types of telephones are on the market, with more being introduced all the time. This leads to rapid outdating of the telephone models; causing it to become hard to get the necessary servicing information and parts.



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Circle (12) on Reply Card

New circuity lets you

Listen to TV sound in stereo

Or hear your program in another language

By Billy D. Cox

Since the inception of television, TV sound has been monaural. In other words, it has been single channel. Some TV sets may have multiple speakers, but the same sound is fed to both speakers. FM radio converted to stereo about 20 years ago, and AM radio is now converting to stereo in some areas within the United States. Because AM and FM radio have converted to stereo (or are in the process of doing so), the market is ready for stereo television.

Multichannel TV sound

Multichannel TV sound (MCTVS) is sometimes referred to as MTS for multichannel television sound and MCS for multichannel sound, and it may be identified with other abbreviations. MCTVS is a system for providing compatible TV sound (monaural), stereo sound and a monaural second audio program (SAP).

SAP is sometimes called separate audio program or alternate audio channel. A professional audio channel is available for transmitting telemetry or voice signals. Because the primary purpose for MCTVS is to provide stereo TV signals along with the other signals, more than one channel is needed, therefore multichannel is used to describe it.

Multichannel TV sound must maintain monaural compatibility with existing TV sets. The existing monaural L+R signal when matrixed with the stereo L-R signal in the audio frequency spectrum provides separate left and right decoded output signals.

A *MCTVS encoder* block diagram for the TV station transmitter is shown in Figure 1. The *composite output* signal becomes the input to the *aural modulator* of the station transmitter. The audio left and right channels and the SAP channel are pre-emphasized by 75μsec. Companding is performed by the dbx (dbx is the trademark of dbx, Inc.) compressor circuits for the L-R signal and the SAP channel signal.

Companding is an audio noise reduction process, in which the *quiet* portions of the program material are boosted in level before transmission and are restored to their original relative level at the receiver by the expander circuitry. One other noise eliminating process is performed by this system; the L+R channel is modulated at twice the deviation of the L+R channel making it 2(L-R) in the composite output signal.

The left (L) and right (R) audio input signals are applied to the matrix. The R signal is added to the L signal in the matrix plus (+) circuitry and is output as the L+R signal. The L+R signal is passed through a low-pass filter (LPF) where the audio excursions are limited from 50Hz to 15kHz. The signal is then passed to the pre-emphasis circuitry where it receives 75μsec of pre-emphasis. Next, the L+R signal is applied to the adder to be added to the other signals (L-R and stereo pilot) if they are to be transmitted from the TV station.

The difference signal for the left and right inputs is amplified two times (2x) in the matrix and output from the matrix as two times L-R [2(L-R)]. This signal is sent to the dbx compressor which provides the necessary pre-emphasis and low-pass filtering.

The output of the dbx circuitry is applied to the balance modulator circuit. The purpose of the balance modulator is to position the L-R channel at the proper location in the frequency spectrum or baseband spectrum. The balance modulator is referenced at 31.468kHz (2fH) by the 15.734kHz reference oscillator and pilot generator.

The pilot signal (15.734kHz) or fH is output from the generator and applied to the adder circuit. The output of the balance modulator is without a carrier due to suppression of the carrier by approximately -60dB by the circuit. The output is double-sideband suppressed carrier AM; this signal is applied to the adder circuit. The output of the adder is passed through a 50Hz to 47kHz low-pass filter and fed to the output adder. The output of this adder is the composite audio signal to the aural modulator. Frequency range of the output is 50Hz to 105kHz.

The reference oscillator and pilot generator is referenced to the horizontal pulses and outputs the necessary signals for the MCTVS system. Two other signals or carrier frequencies are output as the 78.67kHz carrier (5fH) and 102.27kHz carrier (6.5fH). The 5fH carrier is used for the second audio program and the 6.5fH carrier is used for the professional channel (sometimes called the telemetry channel).

The second audio program is input into a 50Hz to 10kHz low-pass filter and then sent to the dbx circuitry. This circuitry is the same as was used in the L-R channel except for the bandpass of the LPF portion. The output of the compressor is sent to the FM modulator. The FM modulator is centered at the 5fH pilot and its output is passed through a 78kHz bandpass filter and applied to the output adder.

Usually the professional channel is used for the TV station's pur-

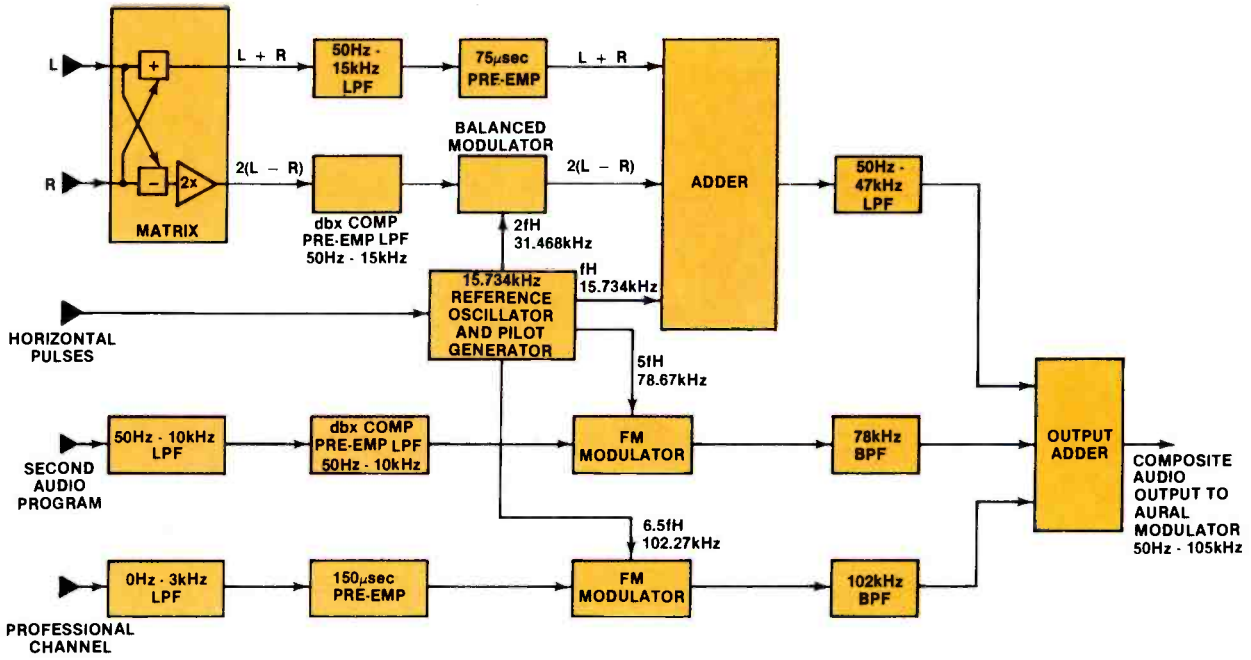

FIGURE 1 MCTVS ENCODER BLOCK DIAGRAM

LEGEND:

LPF = low-pass filter	dbx COMP = dbx compressor	DSB-SC = Double sideband-suppressed carrier
PRE-EMP = pre-emphasis	fH = pilot signal	PHASE DET = phase detector

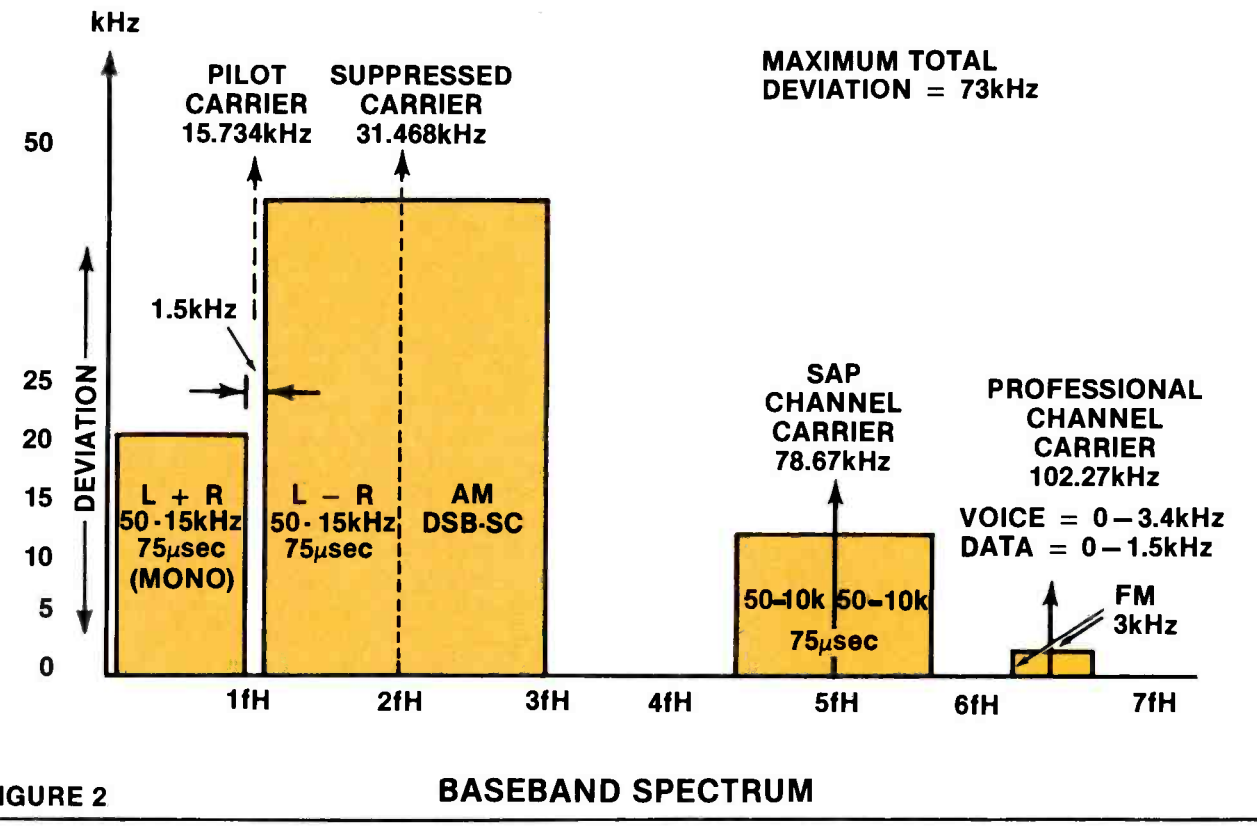

FIGURE 2 BASEBAND SPECTRUM

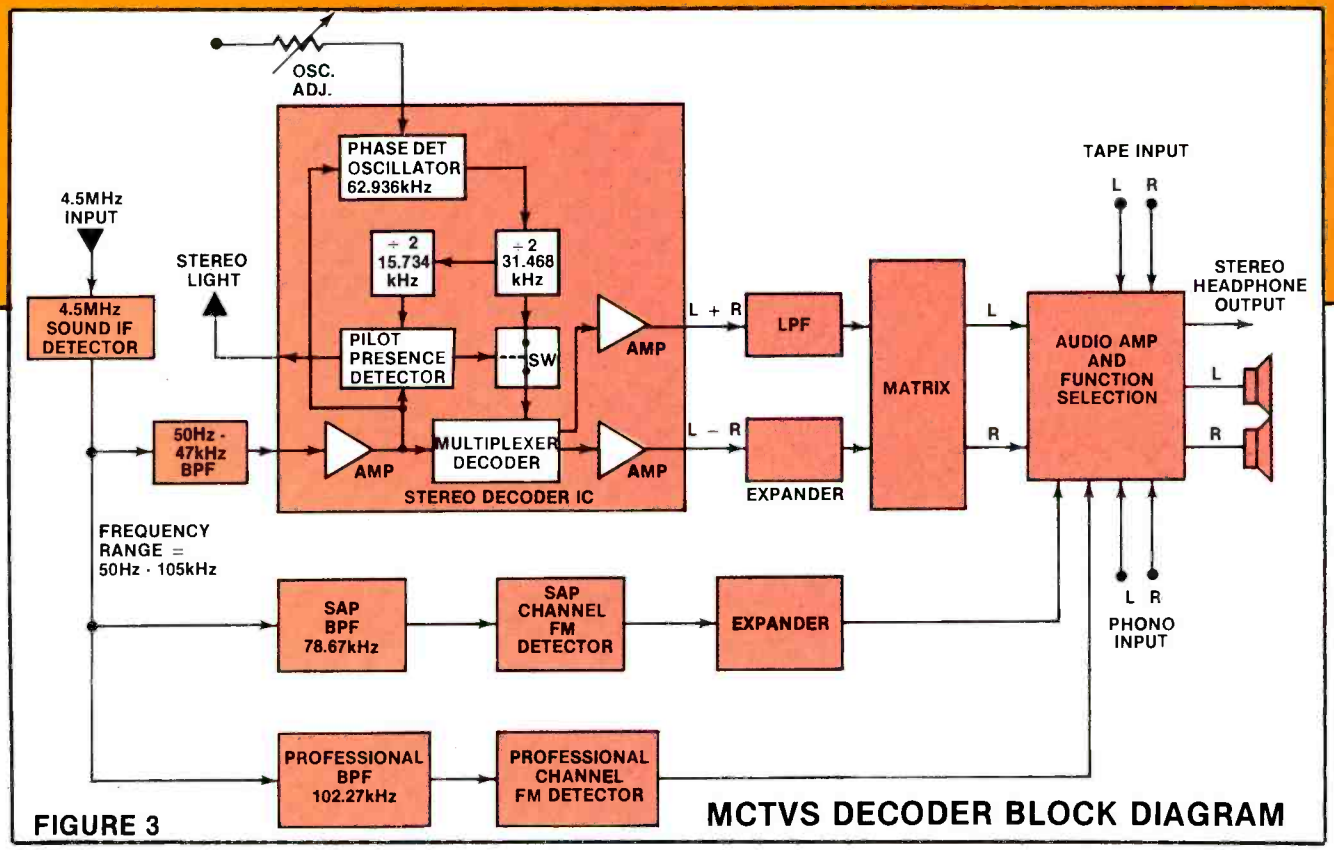

FIGURE 3 **MCTVS DECODER BLOCK DIAGRAM**

poses. This channel can handle audio or data. This signal is passed through a 102kHz bandpass filter. This filter's output is applied to the output adder. The output adder sends a composite audio signal to the aural modulator of the station transmitter.

Baseband spectrum

Figure 2 shows the baseband spectrum for MCTVS. The pilot frequency is chosen to be the same as the horizontal frequency (15.734kHz) to eliminate noise located at the horizontal frequency. The stereo L-R channel is located at 2fH or two times the horizonal frequency. This channel is inserted into the baseband spectrum as double sideband-suppressed carrier AM. The SAP channel is centered at 5fH and can be active simultaneously with the other channels. This is useful for broadcasting a second language or other audio information at the same time as the stereo or monaural broadcast.

This system's advantage is that the same special de-emphasis expander can be used for SAP and stereo, because both have the same 75μsec special pre-emphasis in their channels. The professional channel can handle data or voice in special service applications.

Block diagram

The block diagram shown in Figure 3 shows the basic MCTVS decoder system. The 4.5MHz sound IF is coupled to the decoding system for processing. This system has a stereo decoder, SAP and professional detector.

The stereo decoder receives the output signal from the 4.5MHz detector. This signal is passed through a 50Hz to 47kHz bandpass filter to the stereo decoder IC. This spectrum of signals will only pass the L+R and L-R channels.

If the signal is being transmitted from the TV station in stereo, the 15.734kHz pilot will be present and detected by the pilot presence detector, which will close the electronic switch within the IC, allowing the 31.468kHz signal to be passed to the multiplexer/decoder. The 31.468kHz carrier is the center of the L-R channel and is inserted to allow the detection of the double-sideband suppressed carrier AM signal. The input signals are decoded and made available as L+R and L-R signals.

The pilot presence detector also provides a signal to turn on the stereo light when the pilot signal is detected. The incoming signal is also applied to the phase detector/oscillator frequency to exactly 62.936kHz.

This signal is divided by two to develop the 31.468kHz signal for the L-R channel. The 31.468kHz signal is divided again by two to provide the 15.734kHz signal for the pilot presence detector. The pilot presence detector uses the 15.734kHz signal to compare the incoming signal for the presence of the stereo carrier.

The stereo decoder outputs the L+R and L-R signals and sends the L+R signal through a low pass filter to the matrix. The L-R signal is sent to the expander circuit for processing and then to the matrix. The matrix outputs the left and right channels of low level audio. These signals are applied to the audio amplifier/function selection circuits for processing.

The SAP signal is input via the SAP bandpass filter into the SAP channel FM detector where it is

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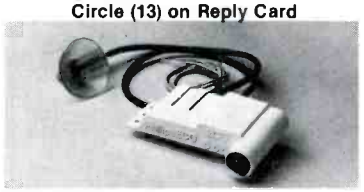

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Common applications: For use in television service and repair.

Circle (14) on Reply Card

EMF® Transient Voltage and RF Interference Suppressors

EMF transient voltage surge suppressors by Philips ECG clamp voltage spikes on 120 VAC line to levels safe for all electronic equipment. They can handle up to 40% greater surge current than other suppressors. Single outlet suppressors are available in both two- and three-prong versions.

The multiple outlet EMF315 incorporates both a spike suppressor and a PI filter to suppress RF interference on the AC line. RF interference causes audio and video degradation and causes digital equipment to function imperfectly.

Common applications: Electronic equipment such as hi-fi and television, stereo, computers or other line-operated electronic equipment subject to voltage surges and radio frequency interference from the AC line.

Circle (15) on Reply Card

ECG® A-STAT Material

Philips ECG has two sizes of anti-static foam that will prevent damage to semiconductors from static electricity. The A-STAT 12 measures 12″ x 12″ and is perfect for bench use. The A-STAT 2 measures 3″ x 5″ and can be carried in the tool box. When semiconductors are kept in A-STAT foam, static electricity is shunted through the foam instead of into the semiconductor, where it could have caused damage.

Common applications: Essential for semiconductor protection on the workbench or in the field.

Circle (16) on Reply Card

The one thing we make that you have to replace every year.

The new and expanded ECG® Semiconductors Master Guide.

Your new Master Guide will be looking as dog-eared as the old one before long. Because this year the Master Guide has been expanded to include more than 400 new products and almost 25,000 new cross references. The Master Replacement Guide for 1985. 656 pages. Over 3,500 different ECG devices that provide replacement coverage for more than 227,000 industry types. And everything in the book is cross-referenced so you can find what you're looking for fast, and be sure it fits. Plus, everything we make meets or exceeds the original JEDEC or application specs. So it works. It's the only book you'll need. But you'll need a new one every year.

To get a copy of the new Master Guide, go to your nearest Philips ECG distributor. For his name and location, just call: 1-800-225-8326 (in Mass., 617-890-6107).

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

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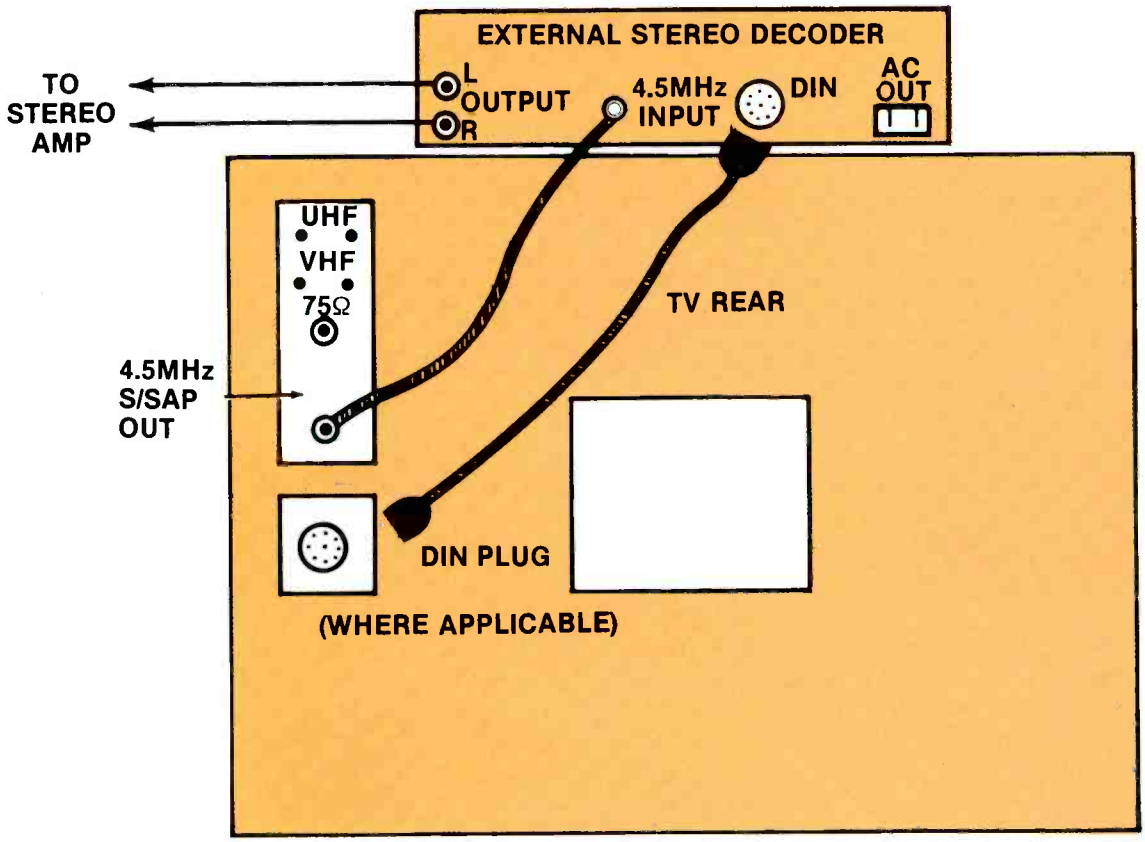
Circle (17) on Reply Card



EXTERNAL STEREO DECODER CONNECTION

FIGURE 4

decoded and sent to its expander circuit for processing. The SAP signal is then applied to the audio amplifier/function selection circuitry for processing.

The professional signal is input to the professional channel FM detector via the professional bandpass filter. This signal is also applied to the audio amplifier/function selection circuitry.

Expectations

Almost all of the U.S. TV set manufacturers and some foreign manufacturers are producing sets capable of receiving stereo and/or SAP programming. Some sets are adaptable by connecting an external decoder to a 4.5MHz output jack on the rear of the set. Most sets manufactured for MCTVS will have the decoding device built-in. The majority of these sets will also have built-in stereo amplifiers and speakers. Most of the first decoders will feature stereo and SAP capabilities, but not the professional channel. Most likely the SAP channel will be used for foreign language reception in the beginning.

General Electric, NAP (Magnavox, Philco and Sylvania audio/video) and Zenith have introduced external decoders and converters for their late '84 and '85 TV lines. These manufacturers also have models with built-in decoders.

RCA has built all of their CTC131/132 chassis televisions, as of this writing, with the MCTVS decoders inside the cabinet. Other dealers and suppliers are getting on the bandwagon with this new product. The biggest problem will appear when many customers own these sets and there are not enough TV stations with stereo transmitting capabilities.

Connecting an external decoder

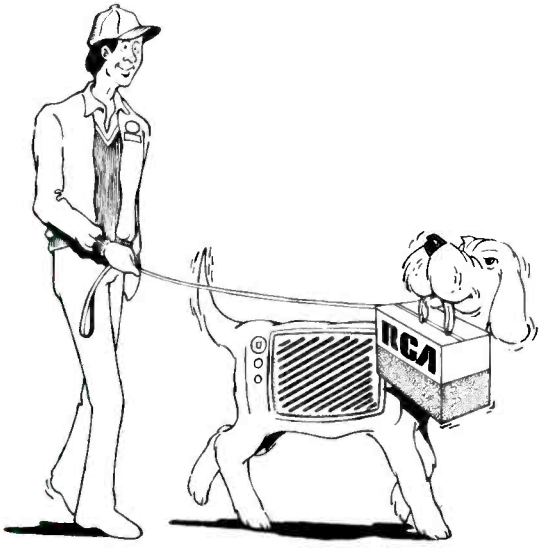
Cables are furnished with most of the external decoders. These will include the 4.5MHz cable and audio output cables. Some decoders will come with a DIN type cable that is also connected between the TV and decoder. Figure 4 shows a typical illustration of a connected decoder.

If the DIN cable is connected, most of the time an external stereo amplifier is not needed because the decoded signals are amplified by the TV's internal stereo amplifier. If the set has only a 4.5MHz output, then an external stereo amplifier must be used.

Servicing the decoder

Currently, most decoders will be serviced as an exchange item; either in warranty or after warranty with a small exchange fee. It is expected that most decoders will require repair by the manufacturer because the test equipment required for this type of servicing will be expensive. Test equipment will be available at a reasonable cost as soon as it can be developed.

ATTENTION TV TECHNICIANS



Diehl Engineering, the same people who conceived, designed and now manufacture **Super Tech** diagnostic computers for analyzing start up, shut down, flyback and flyback related circuits, now has something else that will make your job faster, easier and much more profitable.

A NEW PUBLICATION

You might say that our monthly **Technician / Shopowner** newsletter is an all out training program for those who are already working in the TV service industry, as well as for those who soon plan to be doing so.

Each month we take at least one concept, circuit or function and totally disect it. We then explain every conceivable aspect in plain and simple English. When we are finished, you not only understand the operation, you also understand how the operation, "inter-reacts" with all of the other circuits that it is related to.

Once every aspect of operation has been explained, we show you how to break the subject down into sections. Then, show you how to troubleshoot each section on an individual basis.

Because of the manner in which our pulication is written, the subject knowledge that is gained in each monthly issue is so broad, that it "spills over" into your every day troubleshooting routine.

Our **Technician/Shop owner** monthly newsletter is 100% devoted to the TV technician. It contains nothing but pertinant information on TV repair. We do not sell advertising space. Those who subscribe, do so because of its technical content, which we pledge to be far superior to anything else that you can obtain.

Each monthly issue (manual) contains up to 68 pages filled with schematics, diagrams and illustrations that relate to the very circuits that you are seeing today. We do not teach this year's chassis, we realize that you are seeing sets that are five, ten or even fifteen years old.

Our newsletter is not a collection of part numbers that cause specific problems in specific chassis when they fail. Instead, we explain what each indiviual component in a given circuit does, what purpose it serves, and what effect it will have if and when it fails.

Our subscribers can look at any resistor, any capacitor, any diode, any transformer, etc., in any circuit, and know exactly what purpose it serves. They will know what turns the circuit on, what turns it off, why and when such action occurs, and what happens if a specific action does not occur.

Our subscribers will no longer have to be content to know that R421 causes a particular chassis to shut down if it becomes open, they will know **why** it does.

Our subscribers will no longer run around in circles hoping to stumble over a "bad" component, they will know **exactly** what they are looking for, and - - - how to find it!

When it comes to troubleshooting color TV sets, we have introduced more, innovative techniques than any other firm in the world (including manufacturers).

In case that amuses you, consider this:
Everyone else in the industry is telling you to probe here and there in this chassis, there and somewhere else in another chassis, in hopes of isolating the actual circuit that has failed. Conventionally, one specific technique that works for one chassis may do nothing but smoke components in the next.

Yet, while others have been teaching "conventional" techniques (usually a different one for each chassis), we at **Diehl Engineering** designed a computer that will isolate the defective stage in any hi-voltage circuit that employs a horiz output transistor (including Sony). With our **Super Tech** computer, you push the same four buttons no matter which set you are working on. Any brand, any age any chassis, Super Tech will give you an **accurate** answer.(see our ad on pg. 25)

We are not implying that those who teach "conventional" techniques are technically incompetant. Far from it, some of them are brilliant! We simply have a new and much easier way of looking at things. Ours is easier to understand and far more versatile. Because of the manner in which we present it, the retention level is also higher (according to those who are now using our literature).

Any staff that can design a computer that can analyze **any** hi-voltage circuit (except for those which use a trace and retrace SCR i.e. RCA CTC 40-81) must surely have a thorough knowledge of **all** circuits. Soon we will release similiar computers for vertical and audio circuits, another for tuner, IF, AGC, video, blanking, ABL, Chroma, matrix and CRT, and still another for troubleshooting VCR!

The point is, we at **Diehl** engineering understand circuitry. We also know how to **explain** circuitry in such a way that it is easily understood.

Each month's issue is printed in the form of a manual. Each manual is pre-drilled so that it can be filed in a 3 ring binder for instant reference (the 3 ring binder is not provided).

The First Issue covers resistors, capacitors, diodes, inductors, transistors, IC chips and time constant circuitry. It explains how each component works, why it works, why it fails, and how each component relates to the overall circuit, all in plain and simple, down to earth, everyday English, without the use of mathmatical formulas. After reading this issue, you can look at any component in any circuit and **truly** understand **what** it does, **why** it does it and what will happen if it doesn't do it; right down to each individual resistor, capacitor, and diode.

The Second Issue covers SCR driven hi-voltage circuits such as those used in RCA CTC 40-81, Philco, Coronado, Bradford, etc. After reading this issue, this circuit will become no more complex than simple amplifier. Over 30 illustrated schematics are used to teach this circuit in absolute detail. Such things as HV regulator functions, shut down features, etc. are thoroughly explained.

The Third Issue covers RCA LV regulator circuits (CTC 85 and up). It explains how each individual component operates, what it does, when it does it and, how to effectively troubleshoot the overall circuit.

Our no paid advertising policy makes our newsletter a little more expensive, but it also gives us "cover to cover" space for nothing but pertinant technical information on TV service. At $9.95 per issue, a twelve month subscription costs only $119.40. Very economical, considering that its technical content is equal to a "full blown" study course on TV repair. If you wish, you may try the first three issues for only $21.00 (just seven dollars per issue, a savings of $8.85 off the regular price).

For immediate service on C.O.D., Visa, or Master Charge orders:
Phone (806) 359-1824 or (806) 359-0329.

If you are looking for help - - - we have it!
Diehl Engineering, 6004 Estacado Lane, Amarillo, Texas 79109.

Circle (**27**) on Reader Service Card.

OLD RELIABLE JUST GOT MORE RELIABLE.

News

Silicon market to be chipped away by semiconductor material

The end may be in sight for silicon, the semiconductor material that made the computer boom possible and gave its name to California's *Silicon Valley*. Use of gallium arsenide (GaAs) in semiconductors, a faster, harder substance, will multiply nearly tenfold by 1992, to nearly $3.2 billion.

"The Gallium Arsenide Semiconductor Market," a new study by Frost & Sullivan, acknowledges that GaAs semiconductors will comprise only 5 percent to 7 percent of the total U.S. market by 1992, but notes that in many fields GaAs is in an excellent position to challenge silicon, and the technology is headed in that direction. GaAs implementation will curve sharply up from the $254 million registered in 1983 to $339 million in 1984 and $440 million in 1985, passing the $1 billion mark by 1988 (constant dollars used).

Integrated circuits (ICs) will be the major market for semiconductors, and according to this study accelerated progress is being made in developing GaAs ICs in the 1980s, owing to several material factors:

- In lower field intensities, the greater electron mobility of GaAs could translate into (processing) speeds ranging from three to 10 times as fast as silicon at similar power.
- GaAs can be operated at much higher temperature levels than silicon, an important reliability characteristic.
- GaAs has superior radiation resistance, important for hazardous and harsh radiating environments. This is of particular note for satellite applications, as the military will be the largest GaAs user.

The study cautions that the market will be limited, however, as considerable work must be done before GaAs can challenge silicon in the high-density areas of very large scale integration and very high speed ICs.

Within the segment, microwave uses are predicted to consume the most devices because of the growth of electronic warfare and radar systems. Optoelectronic uses will probably constitute the second largest category of military/aerospace, though digital applications will grow more rapidly as they begin from a near-negligible base of $2 million in 1984 and reach $470 million by 1992.

Mass applications for GaAs such as satellite broadcasting systems, cellular radio, digital audio and TV are on the horizon, the study says. Communications will represent 23 percent of the 1992 market. Optoelectronic devices will dominate the segment becaue of fiber-optics, accounting for three-quarters of use with the balance devoted to microwave applications. Digital devices will be held back, pending technological developments.

Non-military data processing will represent nearly one-tenth of the GaAs market by 1992, as it grows from a nearly nonexistent 1984 presence to $285 million. The

material will be used most in fabrication of fast-access memories and in gate array logic.

Consumer and other industrial applications are the remaining segments discussed in the 242-page study; together they will represent little more than one-tenth the 1992 total, composed almost entirely of optoelectronic and microwave uses.

High technology soldering tapes available

New instructional video cassettes are available from the Consumer Electronics Group of the Electronic Industries Association (EIA/CEG), Washington, DC. The tapes, available in both Beta and VHS formats, teach the proper soldering methods and equipment used when replacing and handling highly sensitive integrated circuits and chip components.

According to Don Hatton, director of the CEG's product services department, these full-color tapes, which are designed in a step-by-step format, are an important addition to any electronics vocational teaching curriculum, or for any technician already on the job.

The High Technology Soldering tapes can be obtained by sending a check or money order (payable to Electronic Industries Association) to *EIA/Consumer Electronics Group, Dept. PS, P.O. Box 19100, Washington, DC 20036.* A full-length, 45-minute version targeted for instructors costs $20. An abbreviated, 15-minute version for electronics technicians is priced at $15. All prices include postage.

Humidity cuts down wear-and-tear on home computers

During the winter, dry indoor air can wreak havoc on home computer systems. It causes a buildup of static electricity that can ruin tapes and floppy disks, damage equipment and cause electronic failures.

But home computers and EDP systems don't have to suffer from excessive dryness during the cold months of the year. There's an easy way to change dry air into moist air that's safe for electronic systems in the home.

The key is *humidity.* Many people don't understand humidity because they can't see, touch or smell it. But its presence can make a big difference in prolonging the life of home computer equipment.

Humidity is the amount of moisture in the air. Relative humidity is the percentage of water vapor the air is holding compared to the amount of water it's capable of holding. Heated air has great ability to hold extra moisture. If this extra moisture isn't present, the indoor relative humidity is very low, because it decreases as the air temperature increases.

Many homes have an indoor humidity drier than the Sahara Desert when it should be about 35 percent.

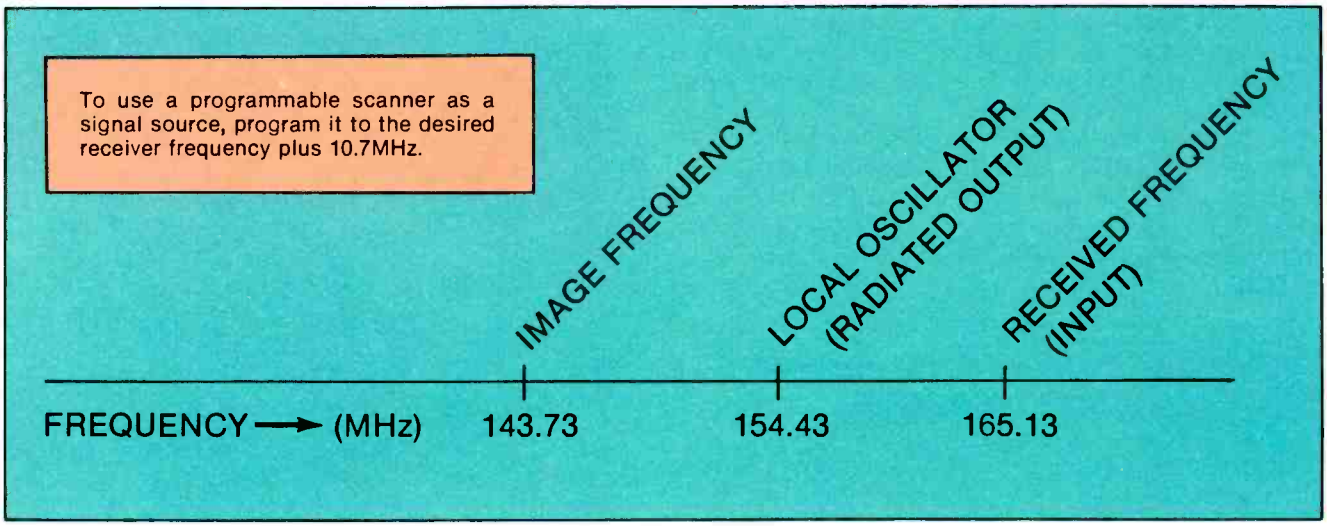
The relative humidity figure mentioned on radio and television is usually the outdoor relative humidity. Relative humidity of 50 percent means the air is half saturated.

Even with today's well-insulated, tight homes, added indoor humidity is still needed. The water vapor from a morning shower,

Continued on page 57

Using a programmable scanner as a signal generator

By David McLanahan



When it comes to checking or working on police/fire scanning receivers, as we all know, old-style analog signal generators just don't hack it. Receiver pass bands are narrow, analog generators are hard to set precisely, and they drift.

The proper instrument, a synthesized digital frequency generator, is much nicer and easier to use, but is expensive, especially for a small shop that doesn't specialize in scanner repairs.

Another solution, perfectly adequate for occasional jobs, is to use the incidental radiation from the local oscillator of a (separate) programmable scanner. For example, on high band, the Regency ACT-T-16K 16-channel *Touch* uses low injection with an intermediate frequency of 10.7MHz.

Thus, to use the Touch as a signal source, program it to the desired receiver frequency plus 10.7MHz. (i.e., to check a scanner on 154.43MHz, program the Touch to 154.43 + 10.7MHz or 165.13MHz, see illustration.) The local oscillator signal will then be available, air radiated throughout the shop, without connection to the Touch.

There's another trick: Like many programmable scanners, the Touch features a *priority channel.* When set to a non-priority channel, the receiver switches to its priority channel about once a second to check for carrier.

If the desired signal is put on a non-priority channel with the priority channel tuned to a vacant frequency, the radiated signal pulses, giving it a distinctive sound that is easy to find and to tune. Signal attenuation is most easily had by moving the scanner under repair away from the Touch.

The accuracy of this scheme depends on the accuracy of the master oscillator in the programmable scanner being used as the signal source. My experience has shown most programmables to work fairly well on frequency, but this is easy to check if you have a reliable base station within receiving range.

Program in the frequency of this base, then program in the two frequencies 5kHz on either side (high and low). During a transmission, switch between the -5kHz and the +5kHz. If the audio quality seems equally degraded both sides of center, you can be confident the receiver is on frequency to within about 1kHz. If you don't find degradation at ±5kHz, try again in ±10kHz.

One last wrinkle: Periodically you may be faced with a scanner of unknown receiving frequency. Set the programmable scanner to search across the likely frequency range and monitor the set being tested. When the signal is heard, stop the search and read the frequency from the programmable. Because of the speed of the search and response time, this will not give an accurate figure, but you can now plug in and try discrete frequencies until you find the correct one.

To play these tricks with another programmable, you will have to determine your intermediate frequency and whether local oscillator injection is high or low (compared to the received signal). Check your service literature or experiment. 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.

DUMONT
DL1390W 2301-1
DL1391WR 2306-1

EMERSON
M19R 2301-2
EC-131A 2302-1
ECR-161 2303-1
ECR-221 2305-1
EC-191 2307-1

GENERAL ELECTRIC
Chassis 25PM-A 2303-2
Chassis 17AC-F 2305-2

HITACHI
CT1940/41 2300-1

JC PENNEY
16-240 2303-3
685-2030B,-10 2307-2
685-2076K,-20/080K,-20/098K,-20 2311-1

PHILCO
R2981SSL01 2309-1

QUASAR
Chassis ANDC105 2308-1

RADIO SHACK
16-240 2302-2

RCA
Chassis CTC126A,B 2299-1
Chassis CTC117C 2300-2
Chassis CTC125B 2306-2
AXR095L,Y,CXR095L 2308-3
FKR620TR,GKR792T/94H/98P 2310-3

SEARS
401.50440450 2301-3
401.50240450 2307-3
195.21353450,564.40840450/51 2309-2
564.40390450 2311-2

SHARP
19J63/65 2304-1
FF19663 2308-2
13J31/33 2310-1

SONY
Chassis SCC-470N-A, 0-A 2302-3
Chassis SCC-548D-A 2304-2
Chassis SCC-470P-A,Q-A 2310-2

SYLVANIA
BWE150SL01 2304-3

TOSHIBA
Chassis TAC8325/365 2299-2

WARDS
GGV17693A 2305-3

What do you know about components?

TRANSDUCERS

By Sam Wilson

For a convenient definition, *a transducer is a component that converts energy from one form to another.*

Actually, this is just a model we use to explain transducer action. Purists are quick to point out that – short of an atomic bomb – there is no gizmo that can actually convert energy from one form to another.

To be technically correct, *a transducer is a component that permits the energy of one system to control the energy of another system.* I'm not entirely satisfied with this definition either, but now is not the time to blaze new trails. For the purpose of this article, I will use the simple model stated in the first line.

Microphones and loudspeakers are likely the first transducers that you studied in school. You were probably told the microphone converts sound energy into electrical energy and the speaker converts electrical energy into sound energy. In other words, you studied transducers on the basis of the model. As with other models used for teaching electronics, nothing is wrong with that as long as you realize it *is* a model.

Microphones and speakers are good examples because they show that one important application of transducers is to interface an electronic system with a human.

Transducers are also used extensively in making measurements. In that application, they are often called *sensors.*

All transducers are divided into two major categories: active and passive. Active transducers convert the energy being sensed into a voltage. Passive transducers do not generate a voltage.

Passive transducers

In most cases, a passive transducer converts the energy being sensed into a value of inductance, capacitance or resistance. Three examples are shown in Figure 1.

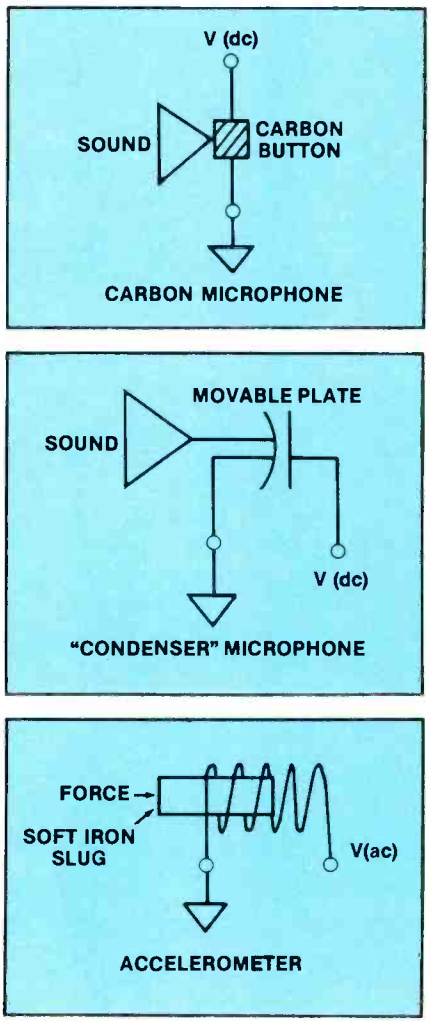


Figure 1. In most cases, a passive transducer converts the energy being sensed into a value of inductance, capacitance or resistance.

In the carbon microphone, the sound energy produces changes in the resistance of the carbon button. With a dc voltage applied, the resistance changes produce current changes. When the current flows through a resistor, a signal voltage exists across that resistor.

In the condenser microphone, the sound energy produces changes in capacitance by varying the distance between the plates. With a dc voltage applied, the varying capacitance produces a charging and discharging current. That current, flowing through a resistor, produces a signal voltage.

In the accelerometer, an ac current is delivered to the coil. During acceleration, the inertia of the slug causes it to move into the coil and change the inductance. The greater the acceleration, the greater the inductance and the greater the inductive reactance. So, the current is decreased by an amount that depends upon the amount of acceleration. (The slug moves against a return spring that is not shown in the illustration.)

Active transducers

Because there are only six methods of generating a useful voltage, the number of possible variations in the construction of active transducers is limited. Generation of electrostatic voltages by rubbing two insulating materials together is *not* a method used to make active transducers.

Any time two dissimilar metals are immersed in an acid or alkali solution a voltage is generated. You can perform an interesting experiment to demonstrate this fact. Take a piece of coathanger wire and a glass of your favorite soft drink. You may have to use the lowest current scale of your VOM, but you will measure a voltage or a current that is the result of a voltage-generated by this simple battery.

Active transducers are not usually made with the chemical method of generating a voltage. A few years ago, you could buy an E-cell that measured elapsed time

using this method, but I haven't seen these types advertised lately.

Any time you heat the junction of two dissimilar metals, a voltage is produced across the ends. This is called the Seebeck effect, and it is illustrated in Figure 2. The transducer made this way is a thermocouple. If you remove the candle and reverse the direction of current, the junction will get colder. That is named the Peltier effect. (You have to have the right combination of metals to get any appreciable amount of cold, but refrigerators have been made using this strange principle.)

The thermocouple ammeter in Figure 3 shows how the Seebeck effect is used to measure current. The current being measured (I) heats the wire, and the thermocouple generates a voltage proportional to the heat. Because it is based on the heating effect of the current, this instrument measures true RMS values.

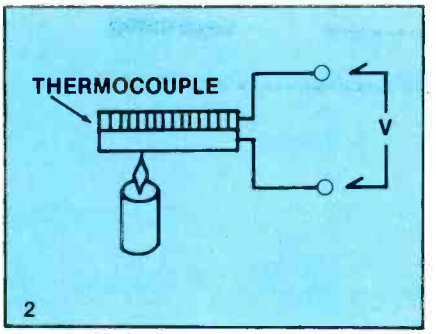


Figure 2. A transducer that exhibits a voltage output when a junction of two dissimilar metals is heated is called a thermocouple.

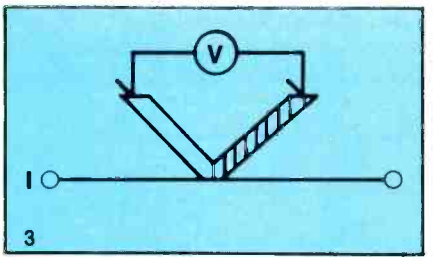


Figure 3. A thermocouple ammeter measures true RMS.

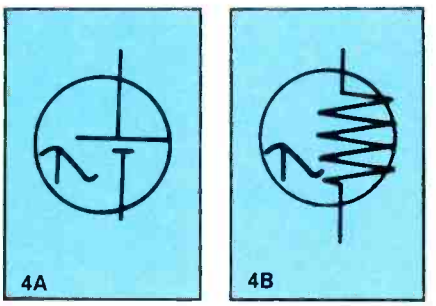


Figure 4. The symbol in *a* is that for a photocell. At right, *b*, is the symbol for a light-sensitive resistor.

Figure 4A shows the symbol for a photocell that produces a voltage when exposed to light. This active transducer should not be confused with the light-sensitive resistor which changes resistance when exposed to light. The symbol for the passive transducer is shown in Figure 4B.

One application of photocells is in cameras that automatically adjust the diaphragm according to the amount of light present. You'll never guess who first patented the idea – Albert Einstein.

Certain materials produce a voltage when a strain is present. (Don't confuse the terms stress and strain. Stress is the force applied, and strain is the deformity produced.) Voltages produced this way are called piezoelectric poten-

tials. It is interesting to note that human bone is a piezoelectric material.

Any time a relative motion exists between a conductor and a magnetic field, a voltage is produced. This is a statement of Faraday's Law. Dynamic microphones and dynamic cartridges operate by this principle.

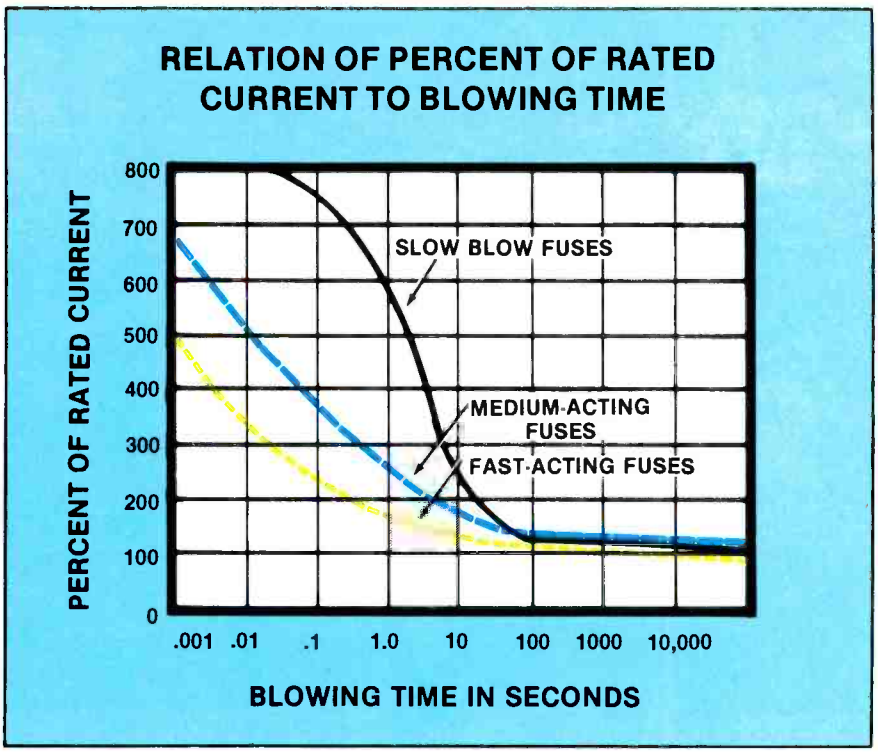


Figure 5. Fuses are manufactured to interrupt current at different values of overcurrent and time, depending upon the intended application.

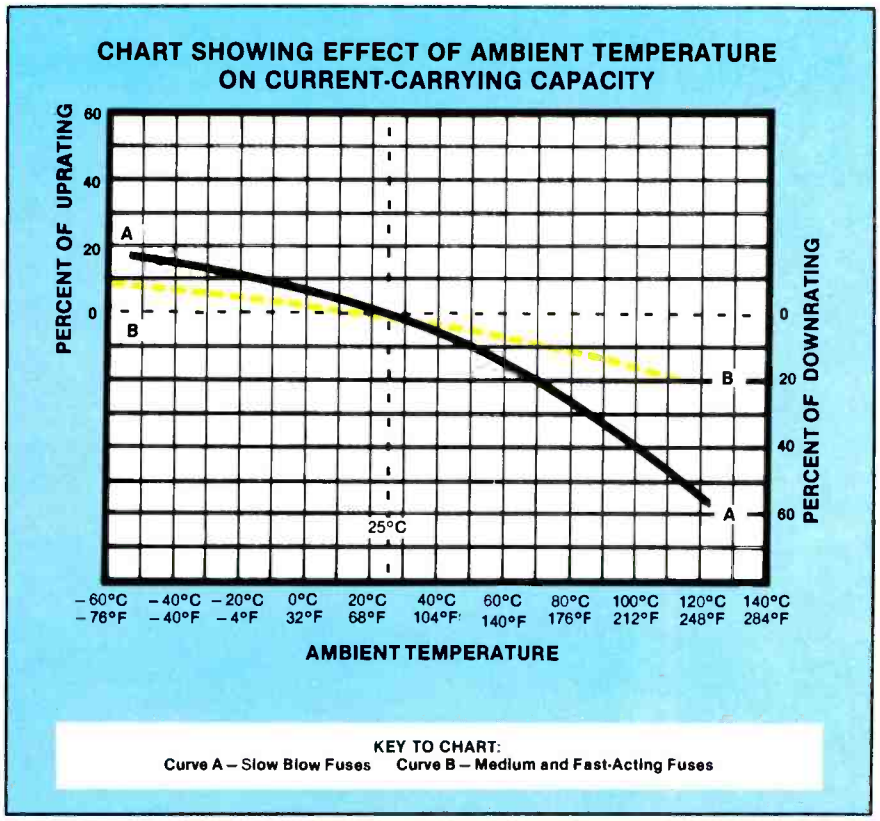


Figure 6. Fuses must be selected with the ambient temperatures in which the circuitry will operate in mind.

In a future issue, we will discuss some practical circuits using these active and passive transducers.

A word about fuses

Several people have asked me to put a few words into this series about fuses – specifically, about the meaning of the 3AG identification. I was fortunate to have an up-to-date catalog from Littlefuse to help provide this information.

The first packaged (plug-in) fuse was developed by Thomas Edison in the 1890 decade. Automotive fuses first appeared in 1914. The letters AG stand for automotive and glass, because that's what they were designed for.

Fuses are identified by their *rated* current. Theoretically, a 1A fuse should be able to operate without interruption in a circuit with a current of 1A flowing. But manufacturers recommend reducing the rating to 75 percent of the stated value. The reason is because those ratings are made under ideal conditions.

The standard *voltage* ratings of fuses are: 32, 125, 250 and 600. Always use a fuse in a circuit where the voltage across an open fuse is equal to or less than the rated voltage. For example, you can use a 125V fuse in a 100V circuit, but not in a 150V circuit.

Using the proper voltage rating will assure that the fuse will safely and properly interrupt an overloaded circuit. The voltage rating does *not* have anything to do with arcover after the fuse has opened.

In addition to their current and voltage ratings, fuses are rated by the way they interrupt the circuit. The three ratings are: *fast-acting, medium* and *slow-blow*. Figure 5 shows how long it takes the fuse to interrupt a circuit for various overloads. Make sure you get the right fuse when you replace one in a circuit. The wrong one can result in damage to circuit components – and fire is a possibility!

Fuses are rated for a 25°C ambient (surrounding) temperature. Figure 6 shows how they should be derated for operation at higher temperatures.

Be careful when you solder pigtail fuses! Overheating can melt an internal solder connection and completely change the characteristics of a fuse. ES&T

Troubleshooting Tips

Intermittent operation
General Electric AB/AC (Photofact 1904-1)

My experiences with GE AB and AC color receivers parallel those of Homer Davidson ("Tips for Servicing GE's AB/AC Chassis" in May 1984 **Electronic Servicing and Technology**). I believe those models would have been outstanding examples of reliability if the griplets had not been used. These griplets have caused more than 90 percent of the failures we have repaired.

However, our experiences differed in one respect. All our color problems originated with the griplets on copper wire W30A and W30B, which Davidson did not mention. And a few failures of one color came from heater-to-cathode shorts in the picture tube.

The following is our list of common faults, with the most numerous first:

- **W32A and W32B; W42A and W42B.** Connect A with B to correct failure to start-up, dead or intermittent operation, problems in the horizontal oscillator, or zero or low-voltage source voltages.
- **W41A and W41B; and resistor R650 (4.7Ω).** Connect W41A to W41B and check or replace R650 to correct missing or insufficient height.
- **W39A and W39B; W36A, W36B and W36C.** Connect A to B to C when the vertical jitters or there are other vertical problems.
- **W30A and W30B; and picture-tube shorts.** Connect A to B and check for CRT shorts when there are color problems.
- **W12A and W12B; W15A, B and C; or W16A and W16B.** Connect A to B to C when the automatic frequency control shifts erratically.
- **W18A and W18B; W17A and W17B.** Connect A to B to eliminate sound problems.

I hope these suggestions will be of help to other technicians.

George P. McKnight
St. Marys, PA

Have you missed reading our Troubleshooting Tips column in recent months? We've missed bringing it to you. We need more Troubleshooting Tips – if you have any tips for our readers, please send them in! For writing guidelines to submit T-Tips write to:
Conrad Persson, Editor
Electronic Servicing & Technology
P.O. Box 12901
Overland Park, KS 66212

Feedback

Phone servicing uses more than four tools

I disagree with one portion of the article, "Operation and Servicing of Cordless Telephones," which appeared in the November and December issues of **ES&T.** I would like an opportunity to present another point of view for **ES&T** readers.

Before further complaint, I must congratulate author Paul Yost for this timely topic and the good job of explaining functional operation of cordless telephones. It is easy to understand.

The portion with which I disagree concerns test equipment needed for cordless telephone servicing. Yost said, "The most surprising thing about cordless telephone servicing is the amount of test equipment you don't need," then lists only four required items. This statement is further emphasized editorially by a bold inset. I feel this is an oversimplification. Although it is *possible* to perform basic servicing of cordless telephones with these four pieces of equipment, several functions are *not measured* and some of the testing methods are *inconvenient* or *inefficient.*

The degree of emphasis given in the magazine article leads the reader to strongly believe that only four items of test equipment are required, and that any additional equipment is probably a waste of money. I think this would be true only to a hobbyist or where cordless telephones are seldom serviced. Efficiency and complete testing would demand additional equipment for troubleshooting, adjustment and repair of cordless telephones as part of a service business.

George Gore
Manager, Engineering Administration
B&K Precision Test Instruments

Editor's response

Good point. It is frequently possible to service electronic equipment with a minimal complement of test gear, but it may be inefficient. I have called Gore and invited him to submit an article describing the procedures for servicing cordless telephones, using a more comprehensive set of diagnostic equipment. We hope to publish the article in the near future.

Nils Conrad Persson

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, rather than to us.*

Basic Radio Electronics, by Sam Kelly, Tab Books, $14.45 paperback.

If you are interested in radio electronics, this book covers a great amount of information concerning the history of radio communications and the basics of electronic components and practice. For example, technical information about shortwave listening as a hobby, radio antennas and radio direction finding is included.

You can build electronic projects with the construction information in this book. Projects range from simple to complex. This book also features a basic guide to learning the Morse code, a glossary of radio terms, phonetic alphabet for radio-telephone communications, and a source list of electronic parts and components suppliers.

The author, Sam Kelly, is an electronics engineer who holds both first class radio-telephone and advanced radio licenses.

Tab Books, Blue Ridge Summit, PA, 17214

39 One-Evening Electronic Projects, by Robert J. Traister, Tab Books, $9.65 paperback.

This project guide provides detailed, step-by-step directions, schematics and parts lists for 39 inexpensive electronic projects, which all can be completed in one evening.

Beginners can use this book to make a field strength meter for measuring the output power of a CB or ham transmitter. Building instructions for two different crystal radio receivers, a 1-transistor pre-amplifier and a miniature PA sysem are included. For those more experienced in electronics, modifications of these projects are also given.

Tab Books, Blue Ridge Summit, PA 17214

The CET Exam Book, by Dick Glass and Ron Crow, Tab Books, $9.65 paperback.

For anyone planning to take the CET exam, this book is a comprehensive study guide. It prepares you for the associate level exam. The authors, Dick Glass and Ron Crow, have both been involved with the organization, development and administration, of the ETA Certification Program since its beginning.

Samples of all questions used on the exam, plus answers to the questions and explanations of the principles involved are provided in this book. It covers the latest technical information used on the exam. It also includes sample quizes on each topic and shows how to examine test scores to determine where extra study is needed. By analyzing your test scores, you can determine the achievement level you need to meet.

Tab Books, Blue Ridge Summit, PA 17214

Reports from the test lab:

BBC-Metrawatt/Goerz DMM

Each test lab report is based on examination and operation of the device in the ***ES&T*** *laboratory. Personal observations about the performance of new and useful features are highlighted, along with tips about using the equipment for best results.*

By Carl Babcoke, CET

Digital multimeters are everyday tools used for servicing electronic equipment. Yet, many DMMs are limited in their capacity and measurement functions. A new DMM, the MA-5D, recently introduced by BBC-Metrawatt/Goerz, offers many additional features not usually available on DMMs. After a thorough review in the **ES&T** test lab, the MA-5D proved to be an excellent performer and a valuable tool to assist servicers of electronic equipment.

BBC-Metrawatt/Goerz DMM

The uncluttered front panel with its white lettering on satin black gives few hints about the excellent performance and unusual features of the BBC-Metrawatt/Goerz model MA-5D DMM (Figure 1). Its German origin is revealed by the precision workmanship and some different terms in the instruction manual (for example, the word *mains* refers to the incoming ac power, and *poled* was used instead of polarized). Briefly, the MA-5D offers high accuracy, such as ±0.05 percent-of-reading +1− digit dc voltage basic accuracy, RMS mesaurements of all ac signals, 10MΩ input resistance for all ac and dc voltage ranges, between 10pF and 3000μF, five decibel ranges with 0.01dB resolution, and internal NiCd rechargeable batteries for up to 14 hours of portable operation.

Readout and general information

High contrast, sharp ½-inch digits provide a maximum reading of 29999 (before overrange) on the 4¾-digit liquid-crystal display (LCD). This readout gives an extra digit for all readings between 19999 (which is usual for most 4½-digit meters) and the MA-5D's 29999 maximum. Therefore, measurements between 2V and 2.999V, 20V and 29.999V or 200V and 299.99V have greater resolution accuracy than others having the usual 4½-digits.

Overrange is indicated by displaying the leading 2 and the appropriate decimal. All other digits are blanked so they cannot be seen (Figure 2). Negative dc voltages and currents are shown by a minus symbol to the left of the first digit. Positive is indicated by the absence of a symbol. When the batteries need recharging, double points are shown in two places on the readout. Automatic zeroing, automatic decimal placement and automatic overrange indication are provided.

Only two test jacks are used for all functions and ranges, except for the 20A current range. The safety test probes have plastic covers (at the meter ends) that cover the metal, preventing the operator from suffering electrical shocks. Also, each test probe has a ridge to prevent the operator's fingers from slipping down and touching the metal probe tip. A plastic channel, provided below the on/off button, supports the test leads and directs them to the left when desired.

Dc-voltage measurements

These are full-scale values of the five dc-voltage ranges: 300.00mV; 3.000V; 30.000V; 300.00V; and 1000.0V. Evidently, the 1000.0V range is a 3000.0V range that for the meter's protection should not have more than 1000V applied to it. The lowest reading is 0.01mV. Accuracy of the 300mV range is specified as ±0.05 percent +2 digits, and all other ranges are rated at ±0.05 percent +1 digit. Input resistance is 10MΩ for all ranges.

Ac-voltage measurements

The ranges for ac voltages are the same as those previously listed for dc voltage, but accuracy at 60Hz is ±0.25 percent +20 digits. The lowest reading is 0.01mV. The exact frequency response was not stated, but according to the literature, the ac-coupled true-RMS measurements cover 15Hz to 20kHz. One range's response was tested and found to be acceptable.

An internal converter and proper calibrations provide true-RMS readings for all ac ranges. This has great value with non-sinusoidal waveforms where average-

responding operation (as with most DMMs) shows incorrect readings.

Five direct-reading decibel ranges are supplied from full scale −20dB to +60dB. Resolution is an excellent 0.01dB. Few DMMs have decibel functions, so this one is welcome.

Current measurements

Six current ranges in both dc and ac cover measurements from 300.00mA full scale to 20.000A full scale. Actually, the 20A range is a 30A range, but it should not have 30A for more than 10 seconds. Limit the long-term current to 20A or less.

Accuracy of all dc current ranges is ±0.35 percent +2 digits, while the ac accuracy at 60Hz is ±0.5 percent +20 digits. These ac current readings are true RMS and the frequency response is excellent.

Resistance measurements

Five decaded resistance ranges cover 3.000kΩ to 20.000MΩ (less one least-significant digit). Accuracy of all but the 20MΩ range is specified as ±0.2 percent +2 digits, and the 20MΩ range accuracy is rated at ±0.5 percent +3 digits.

Voltage across open test probes is about 2.5V, with the + lead positive. With a resistor value just below overrange, the test probe voltage is about 1.5V, which will produce conduction in transistor and diode junctions. The instruction manual recommends the 3K range for forward-biased junctions because about 0.5mA of constant current flows. However, the readout is in ohms. The test does not reveal characteristic voltage drops as some diode tests do.

Capacitance measurements

Model MA-5D has five capacitance measuring ranges from 300.00nF (0.3μF) to 3000.0μF full scale. The smallest reading is 0.01nF (or 10pF). Accuracy of all ranges is specified as ±0.75 percent +5 digits.

Although the capacitance test is not affected by the polarity of electrolytic capacitors, there is a dc voltage of about 1.5V, with positive at the positive probe jack. Internal capacitor leakage or paralleling resistances *decrease* the capacitance readings. A chart on page 7 of the instruction manual gave minimum allowable resistances. However, practical tests indicated far more leakage can be tolerated if extreme accuracy is not imperative. For example, a 1MΩ resistor paralleled with a 74μF capacitor reduced the reading on the 300μF range by only 0.04 percent. Readings of smaller capacitances are reduced more by leakage than are the larger values.

Figure 1. Model MA-5D from BBC-Metrawatt/Goerz is a high-accuracy 4-¾ digit DMM with ½-inch high LCD digits in the readout giving a maximum count of 29999. All functions are selected by one knob, and the ranges are selected by a second knob. Only two test-lead jacks are used, except when 20A current is measured.

Figure 2. As shown, overrange activates the leading digit two and the decimal for the range. The display does not flash. Negative voltages and currents are identified by a minus sign at the left, but positive values or ac produce no polarity sign. Notice the German ground emblem above the negative probe jack.

Seven functions can be selected by a knob near the front panel's center. Up to six ranges of the selected function can be selected by the knob at the panel's right.

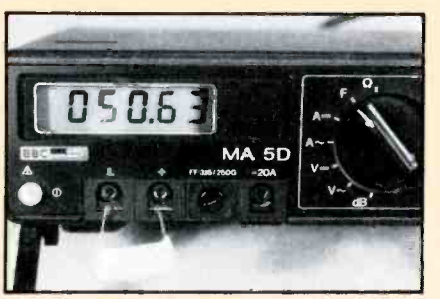


Figure 3. Components with small lead wires can be plugged into spring-loaded jacks that are just below the test-lead jacks. A 50.63nF (or 0.563μF) capacitor is shown in the photograph while plugged into the spring clips and undergoing a test for capacitance. Between the + jack and the 20A jack is the plug-in fuse.

Other features

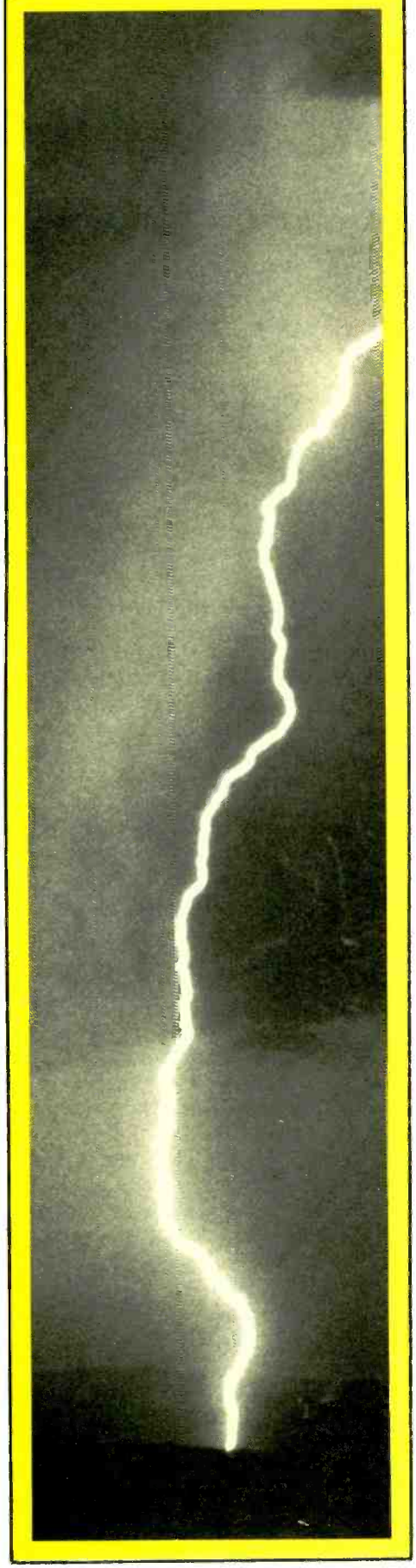
Some lugs and leads of capacitors and resistors can be inserted into a slot below each test-lead jack (Figure 3). This can be convenient when testing small components. An adjustable stand can be positioned to tilt the DMM up until the readout is visible to the technician. When this stand (or bail) is folded against the case, the left side can be used as a carrying handle. A special FF3.15 fuse protects all current ranges (except the 20A range) and all capacitance ranges, in conjunction with protective diodes. The front-panel fuse can be removed by rotating the slotted cover counter-clockwise until the fuse is loosened and can be pulled out by thumb and finger.

Comments

No gee-whiz bells and whistles are found on this model. It does not talk, buzz or autorange; but the functions it includes have extreme accuracy and stability. And the DMM is easy to operate. Model MA-5D should operate reliably for many years. The manufacturer says the range and function switches are industrial-heavy-duty types, and the precision resistors are oversized for stability.

Also, the DMM has 37 ranges with seven functions including capacitance and decibel tests. And the internal rechargeable batteries allow extended operating time between changes. Many technicians can use these features to good advantage. Model MA-5D from BBC/Metrawatt/Goerz performed all functions very successfully.

Part two



Don't let power line disturbances damage your electronic equipment

By Jerry Whitaker, Editor. *Broadcast Engineering*

Throughout the past 10 years, the performance of discrete transient suppression devices available has greatly improved. Transient suppression technology has come a long way from the days of spark gaps and resistor-capacitor (RC) snubbers. The wide variety of new devices available at reasonable prices make tight control over unwanted voltage excursions possible, and allow the complicated electronic equipment being manufactured today to work as intended. Much of the credit for transient suppression work must go to the computer industry, which has been dealing with the problem for more than two decades.

Types of devices

Transient suppression hardware can be divided into three general categories: (1) ac filters, (2) crowbar devices and (3) voltage-clamping components.

The simplest type of ac power-line filter is a capacitor placed across the voltage source. The capacitor's impedance forms a voltage divider with the impedance of the source, resulting in the attentuation of high-frequency transients. This simple approach has definite limitations in spike suppression capability, and may introduce unwanted resonances with inductive components in the ac power distribution system. Adding a series resistance will reduce the undesirable resonant effects. However, it will also reduce the effectiveness of the capacitor in attenuating a transient disturbance.

Crowbar devices include gas tubes (also known as spark-gaps or *gas-gaps)* and semiconductor-based active crowbar protection circuits. Although these devices and circuits have the capability to shunt a substantial amount of transient energy, they are subject to *power-follow* problems. Once a gas tube or active crowbar protection circuit has fired, the normal line voltage, as well as the transient voltage, will be shunted to ground. This power-follow current may open protective fuses or circuit breakers if a means of extinguishing the crowbar clamp is not provided.

Voltage-clamping devices are not subject to the power-follow problems common in crowbar systems. Clamping devices include selenium cells, zener diodes and varistors of various types.

Zener diodes, using improved silicon rectifier technology, provide an effective voltage clamp for the protection of sensitive electronic circuitry from transient disturbances. Power dissipation for zener units is usually, however, somewhat limited (compared to other suppression methods).

Selenium cells and varistors – although very different in construction – act on a circuit exposed to a transient overvoltage in

Editor's note: In part 1 of this 2-part series, the author examined the nature of power-line disturbances and their effects on electronic equipment. In this installment, he discusses some of the devices used for transient suppression.

Also, the editors have compiled a sampling of commercial products intended to keep power line disturbances from causing malfunction or damage in sensitive electronic equipment.

similar ways. Figure 1 illustrates the *variable nonlinear impedance* exhibited by a voltage-clamping device, and shows how these components are able to reduce transient overvoltages in a particular circuit.

The voltage divider network established by the source impedance (Z_s) and the clamping device impedance (Z_c) acts to attenuate voltage excursions seen at the load. It should be understood that the transient suppressor depends upon the source impedance to aid the clamping effect. A protection device cannot be effective in a circuit exhibiting a very low source impedance, because the voltage divider ratio is proportionately reduced.

A typical voltage vs. current curve for a voltage clamping device is shown in Figure 2. When the device is exposed to a high voltage transient, the impedance of the component changes from a high standby value to a low conduction value, thereby clamping the voltage at a specified level.

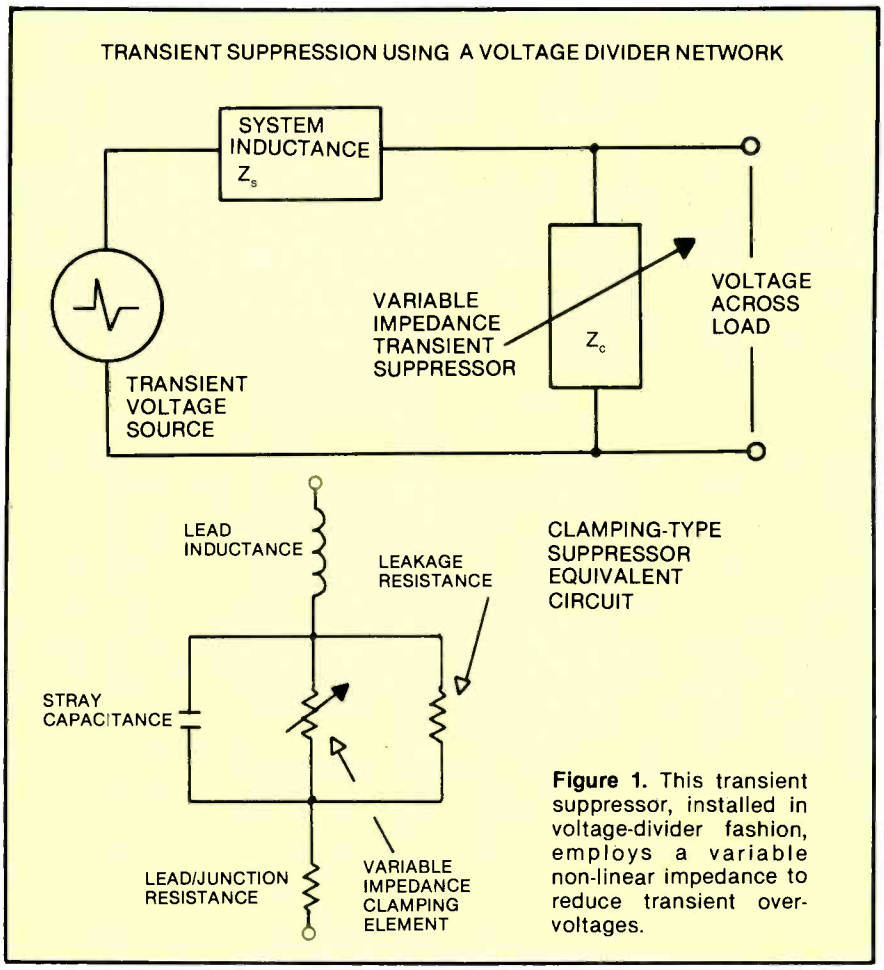


Figure 1. This transient suppressor, installed in voltage-divider fashion, employs a variable non-linear impedance to reduce transient overvoltages.

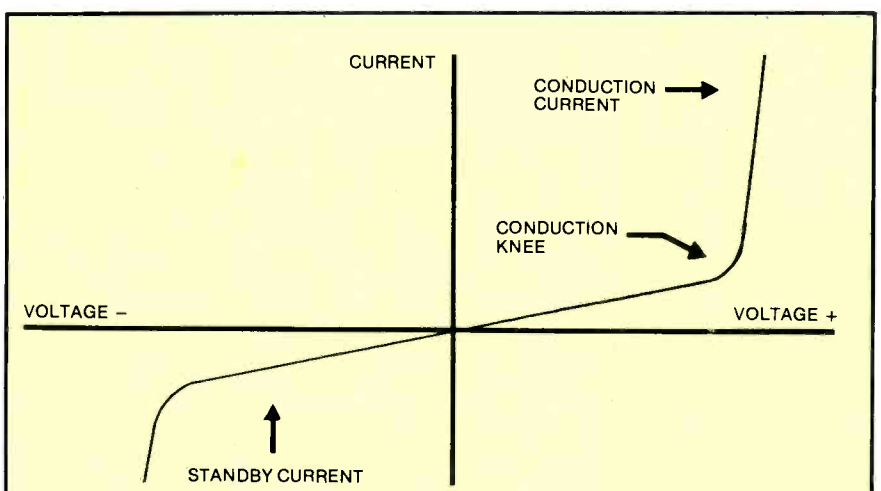


Figure 2. A voltage clamping device exhibits a voltage vs. current curve of this general shape. When a high-voltage transient occurs, the impedance drops, clamping the voltage at a specified level.

Selecting a protection device

Selection of a transient suppression device for a particular application is a complicated procedure that must take into account the following items:

- The steady-state working voltage, including normal tolerances.
- The transient energy to which the protection device is likely to be exposed.
- The voltage clamping characteristics required in the application.
- Circuit protection devices (such as fuses or circuit breakers) present in the system.
- The consequences of protection device failure in a short-circuit mode.
- The sensitivity of the load equipment to transient disturbances.

Most manufacturers of transient suppression equipment offer detailed application handbooks that should be consulted whenever use of a particular protection device is planned. The specifications and ratings of suppression components are not necessarily interchangeable from one manufacturer to another, so pay careful attention to the selection process.

The addition of transient suppression devices to a piece of equipment or ac power distribution system should be weighed carefully. Allowances must be made for operation of the circuit under all anticipated conditions. An incorrectly placed transient suppressor can end up causing many more problems than it solves.

Electronic equipment protection devices

The effects of power-line disturbances are varied; they range from causing incorrect results in computer operations, to the infliction of severe damage on electronic products. With the flood of such sensitive equipment currently in the marketplace, the problem is widespread. The severity of the problem depends upon the condition of the power delivered by the utility in a given community.

Manufacturers are meeting this problem with a vast array of surge suppressors, power conditioners, and uninterruptable power supplies, featuring varying degrees of power conditioning ability.

Shown here is a sampling of these products, each with an edited version of the manufacturer's statement of its capabilities. Many of these devices have been featured in ES&T's *Products* department during the past several months.

Surge and spike protector

PTI Industries offers a surge and spike protector for use with all voltage-sensitive equipment, including computers. The PTI unit offers 0.1ns response time to surges and provides complete noise filtering from 100kHz to 100MHz.

The protector is the first unit to provide brownout notification when the line voltage drops to 100V. A reset button also safeguards equipment from initial line surges that inevitably follow a blackout condition.

Circle (126) on Reply Card

Power system

A new version of the 500W rated uninterruptible power system (UPS) is available from Gould Power Conversion Division. The on-line system provides continual voltage regulation and noise elimination to personal computers, point-of-sale systems and other sensitive loads, as well as battery reserve during complete power outages. Model GSU 3056 includes an internal 10min battery or can be used with external 48V batteries for periods up to several days.

Circle (127) on Reply Card

Power control center

The Power Commander computer control center from Perma Power Electronics provides fingertip control for a personal computer and up to four peripherals, while protecting sensitive circuitry from data loss and physical damage caused by electrical power line surges, including lightning and utility company switching. Power commander also reduces RF and EMI noise interference from power lines and power supply cords.

Five outlets are provided to accommodate a computer, monitor and printer, as well as two auxiliary peripherals, such as added disk or tape drives, modems or printers.

Circle (132) on Reply Card

Power fail interrupt

Electronic Specialists has developed power fail interrupt computer equipment protection. Available as an option on their complete line of power conditioning and protection apparatus, this unit interrupts protected computer equipment ac power for even a momentary power line disruption. Power is restored via a front panel manual reset switch.

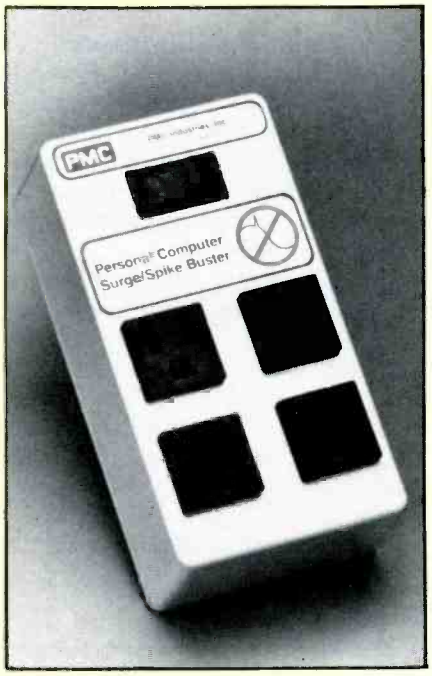
Circle (129) on Reply Card

Surge suppressor

PMC Industries manufactures an ac line transient surge suppressor designed to specifically protect microcomputers and microprocessor-based instrumentation. Model 033 provides protection by sensing and suppressing high voltage transients that can cause serious damage and data scrambling.

The unit has suppression capabilities of 15,000A maximum surge current with an energy absorption of 200J. It is designed for use on any standard 120Vac line and responds to transients and surges in less than 25ns. The unit offers two 3-wire grounded outlets, a 15A fuse, on/off switch and indicator light and 6-foot, 3-wire grounded line cord.

Circle (123) on Reply Card



Mini/microcomputer regulator

A portable mini/microcomputer regulator, available from Sola Electric, extends the output range of Sola's plug-in power conditioner line up to 3kVA. This UL-listed model protects sensitive electronic equipment, such as microcomputers, terminals or test instruments from most ac power problems except total line failure.

The 3kVA unit features high noise attenuation, exceeding 60dB for transverse-mode and 120dB for common-mode noise. By contrast, ultra isolation transformers typically reject only common-mode noise. The new model also maintains sine wave output containing less than 3 percent THD.

Circle (124) on Reply Card

Uninterruptible power system

Kalglow Electronics offers a standby, uninterruptible power system to its Aegis line of power conditioning equipment. The Line-Saver, model LS-240, is engineered to give standby, back-up power available in 120/240V, 60/50Hz with 240VA, 150W capacity. The unit uses the Pulse Width Modulation technology to regulate the rms ac output voltage for greater efficiency to various load conditions.

The PWM ac output will also increase battery efficiency to increase back-up time. An internal 12V sealed, rechargeable battery, four Spike-Spiker voltage surge protected and EMI/RFI filtered ac outlets, audible and visual power failure warning system, test mode indicator and switch and replaceable external fuses are included.

Circle (125) on Reply Card

Voltage spike protector

A voltage spike protector with built-in noise filtering capabilities – designed to protect high-tech computers, audio and video devices and sensitive solid-state equipment – is available from General Electric. The GESP-753 can save expensive electronic equipment from sharp spikes in electrical voltage, which often occur during electrical storms.

The GESP-753 plugs into the upper outlet of any wall grounding receptacle. A stabilizing pin fits into the grounding contact of the unused outlet to hold the unit in place. Once plugged in, a built-in light indicates that protection circuits are working. The power cord of electronic equipment to be protected is plugged into one of the three grounded outlets.

Circle (122) on Reply Card

Smart line voltage detectors

The Remotector detector modules VMD400/VMD410, available from Superior Electric Company, are portable multiphase/multichannel instruments that can be installed to computers and other sensitive electronic equipment. They detect, identify and quantify incoming power line voltage abberations. The information can be communicated directly for display on any ASCII terminal screen or personal computer equipped with an RS232C port configured in the standard 10-bit ASCII code.

Detectors monitor single and 3-phase lines up to 680V. Independent voltage thresholds can be set for sag, surge, low average, high average and impulse levels. Thresholds for frequency deviation and common mode noise are also included.

Circle (130) on Reply Card

Computer power conditioner

Shape Magnetronics offers a Personal Computer Line Tamer power conditioner. This unit removes spikes, transients, common and transverse noise and also provides line isolation and protects against surges, undervoltages and overvoltages by providing constant voltage, clean power to the computer. These PC Line Tamers feature four rear panel plug receptacles, a 6-foot power cord and a front panel power switch.

Circle (120) on Reply Card

Voltage surge suppressor

RCA Distributor and Special Products Division offers a 3-outlet voltage surge suppressor and interference filter to protect sensitive solid-state equipment against power line transients and RF or electromagnetic interference. Model AH040 is useful for guarding computers from data loss, and to protect audio, television and other video equipment. This unit plugs into the lower outlet receptacle and accepts up to three power cords. A built-in light indicates when the unit is functioning properly.

Circle (121) on Reply Card

Uninterruptible power system

The Mini-UPS offered by Sola Electric is a portable, plug-in uninterruptible power system designed to protect small electronic equipment from all potential ac power line problems, including blackouts, brownouts, transients and noise. This unit is available in 400VA (60Hz) and 600VA (50Hz); and a UL-listed 750VA (60Hz) is also available.

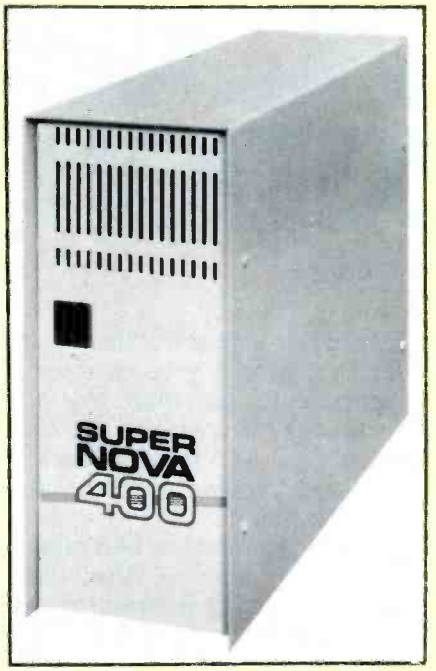
The Mini-UPS contains a sealed lead-acid type battery. In a blackout situation, the Mini-UPS provides up to 20 minutes of regulated power from its battery backup. It responds to ac line fluctuations, regulates output voltage and isolates the load from transients and brown-out conditions.

Circle (134) on Reply Card

Voltage regulators

Powermark Division of Topaz has introduced a new portable ac voltage regulator for protecting sensitive electronic equipment against problem-causing voltage fluctuations. The regulator features a duplex output receptacle and a 6-foot line cord for easy plug-in installation. Rated for operation at 1kVA, it is suitable for use with microcomputers, word processors, electronic test equipment, digital process controllers or any other device that needs stable ac power in order to operate properly.

Circle (128) on Reply Card



Uninterruptible power system

Nova Electric Company's Super Nova 400 is a 400VA off-line uninterruptible power system. This unit provides isolation and power conditioning, isolating the users' equipment from transients (spikes) and noise, commonly found on the ac power line. In the event of a power failure, a high-speed relay transfers the load to the battery-inverter system, maintaining continuous power to the customer's equipment. After power is restored, the load is automatically retransferred back to the ac line and the batteries are recharged by the on-board battery charger.

Circle (133) on Reply Card

ES&T

PART ONE

The VIDEO CONNECTION

By Martin Clifford

A video system consists of a TV receiver as the central component, with one or more add-on units.

Add-ons can consist of nothing more than a transmission line connected to an outside antenna, or may also include an RF pre-amplifier, one or more VCRs, a videodisc player, additional TV sets, an image enhancer, a switcher, a stereo synthesizer, a decoder, a complete TVRO (television receive only satellite system), a special effects generator, a video camera, a timer, one or more microphones, an interference filter, a personal computer, a video game, an A/B locking switch, a cable TV signal converter and a voice tracker. Further, the TV system may be a component type instead of an integrated unit, possibly comprising a separate tuner, monitor, plus an individual audio voltage and power amplifier using external speakers. Even these additions aren't all the possibilities, because the number and diversity of add-ons continue to increase.

Video connection components

Various accessory units are needed for video connections. In general, they include 2-wire transmission line, sometimes called 300Ω line, coaxial cable, jacks, plugs, baluns, RF pre-amplifiers, signal splitters and multiple TV set couplers. A crimping tool is also helpful when connectors are to be fitted to coaxial cable. Spade lugs are useful for 300Ω transmission line.

How much of this material, and its variety, will be needed depends on the installation's complexity: the number of televisions and add-on components to be connected.

In some instances, there is one (and only one) way to interface components, but there are other instances in which there's a possibility of several arrangements, depending on the results to be achieved.

Video systems are becoming increasingly complex. Also, the interconnections have become so extensive that the rear of the TV set (or sets) and the required cabling cause problems for the service technician who must often spend considerable time tracing wiring.

The interconnecting cables are passive, not only introducing signal loss, but contribute signal cross modulation affecting picture display. Cables can also become loose, producing intermittents that are difficult to locate. And although disconnecting cables to bring a TV set back to the shop may be simple, putting cables back to where they originally were can be a time consuming nuisance.

Impedance

All components, whether active or passive have impedance, including input and output impedance. Impedance although always expressed in ohms, cannot be measured with a VOM or VTVM. It is the vector sum of two electrical characteristics, resistance and reactance, and quite often resistance is just a small fraction of the total.

A small section of 300Ω transmission line (its impedance) may have a measured dc resistance of less than 1Ω. The characteristic impedance of a transmission line is not a function of its length, but its resistance is, and so the longer the line, the greater the signal loss.

For maximum delivery of signal energy from a source, such as an antenna, to a TV receiver, the impedances at all wire or cable connecting points must match. Impedance mismatching not only produces signal loss, but can result in signal reflections along the line, yielding one or more multiple images to the right of the main image on the TV screen (ghosts).

Impedance mismatching cannot damage components but it can result in less than optimum picture display. The problem becomes increasingly serious in fringe areas dependent solely on network broadcast TV.

75Ω and 300Ω line

Fortunately, video connectors and components are either 75Ω or 300Ω, and sometimes are both. Thus, the antenna terminal input of a TV set may be 300Ω for VHF and UHF, or a combination of 75Ω and 300Ω. This does not mean these impedances must be accepted as restrictive for with the use of a balun (an acronym for **bal**anced to **un**balanced), impedances can be changed from 75Ω to 300Ω, or vice versa.

Baluns

Interconnecting video components requires an understanding of baluns, transmission lines and connectors. Although a balun is a simple device, has no moving parts and is fairly inexpensive, a video system can work well or poorly depending on if these are used and how they are used.

A balun is a plastic-encased RF transformer with an input terminal and one or more output terminals. It is lightweight and can be supported easily by its connecting leads. These leads are 300Ω transmission line, coaxial cable or some combination of these two.

Figure 1 shows a single-way balun, that is, a balun having a single output. This unit has a 75Ω input impedance and an output impedance of 300Ω. The balun is often marked either *input* and *output* or *75* and *300*.

If there are no markings, then you can be sure the coaxial connection is 75Ω; the twin lead connection is 300Ω. The advantage of a single-way balun is that either terminal can be used as input or out-

put. That is, it can be a 75Ω to 300Ω balun or a 300Ω to 75Ω balun.

The balun may have a single output, two outputs or three. Because a balun is an RF transformer, it can be one of three basic types; step-down, step-up or one to one.

The unit shown in Figure 2 is a step-up type having two outputs: 300Ω for a TV set's UHF input; 300Ω for a TV set's VHF input. The RF transformer in this balun has a 75Ω primary winding and may have either a pair of 300Ω secondary windings or may be a tapped secondary with a pair of 300Ω outputs.

Signal separator balun

When the balun supplies two or more outputs, it is also known as a signal separator or band separator balun. In Figure 3, the signals are frequency separated with one set of leads for VHF, the other for UHF.

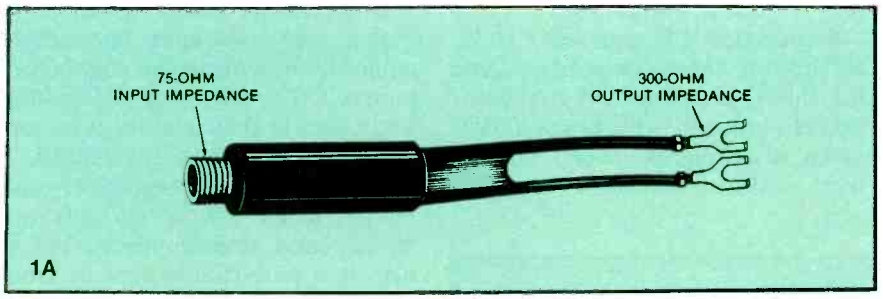
This balun is intended for use with an outdoor antenna using 300Ω twin lead as the down lead transmission line from the antenna to the receiver. The balun is mounted directly at the antenna terminal board of the TV set, and is supported by it. One pair of leads connect to the VHF screw terminals; the other pair to the UHF terminals.

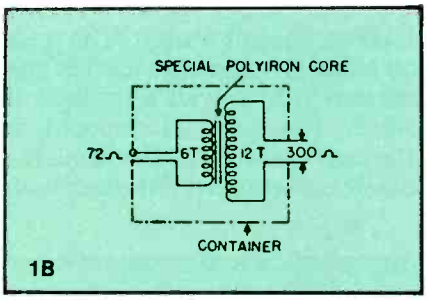
Outdoor antennas are usually 3-way types, supplying VHF, UHF and FM signals. The balun in Figure 4 can be used to supply signal input to the VHF and UHF terminals of the television and can also drive the input of an FM receiver. The FM terminals can be ignored if not needed.

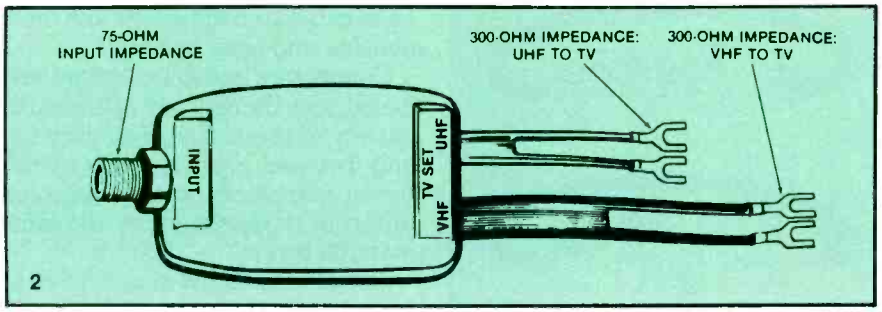
For the balun in Figure 5, the transmission line from the antenna is coaxial cable, while the TV receiver is equipped with input via a coaxial connector and also has twin lead, spade terminal equipped, for connection to the UHF terminals of the television. This balun also has screw-type terminals for connection to an FM set using a suitable length of twin lead. FM receivers usually have a 300Ω input.

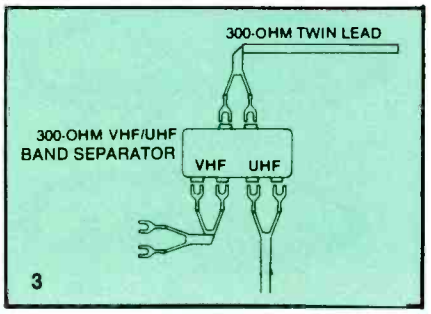
Quick-connect balun

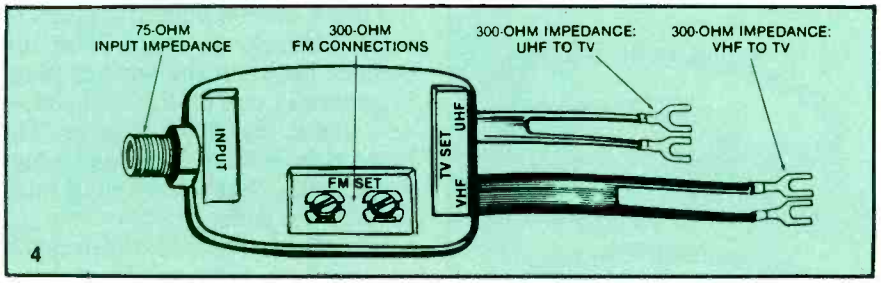
Some physical differences do exist among baluns. The one in Figure 6 is a quick-connect type intended for use with a 300Ω downlead from the antenna. The 75Ω output terminal of the balun











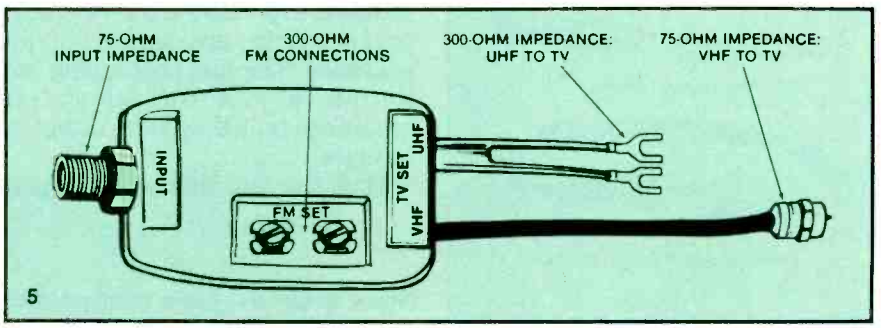


Figure 1. Circuit arrangement of a balun. This type is reversible: the input can be used as an output; the output as an input.

Figure 2. Balun with a pair of 300Ω outputs for VHF and UHF. (Courtesy Vidline Video Accessories).

Figure 3. Band-separator balun with 300Ω input and a pair of 300Ω outputs for VHF and UHF.

Figure 4. Three-way balun with 75Ω input and 300Ω outputs for VHF, UHF and FM. (Courtesy Vidline Video Accessories).

Figure 5. Signal-separator balun with 75Ω input and 300Ω output for UHF, 75Ω output for VHF and 300Ω output for FM. (Courtesy Vidline Video Accessories).

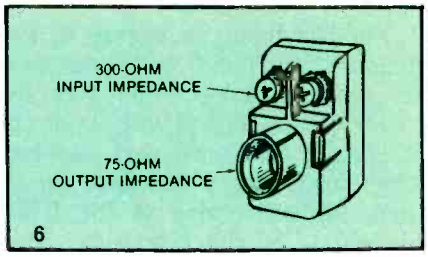


Figure 6. Quick-connect type of balun with 75Ω output impedance and input impedance of 300Ω. (Courtesy Vidline Video Accessories).

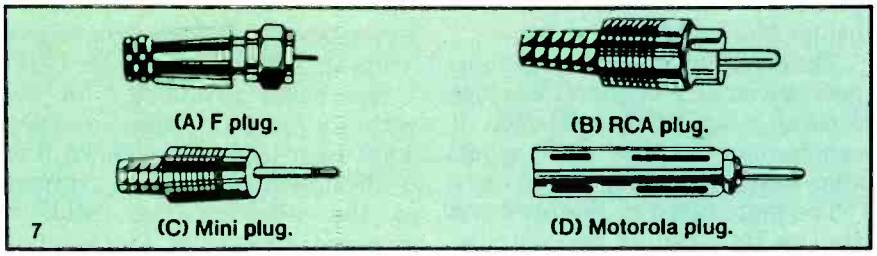


Figure 7. Common plug types.

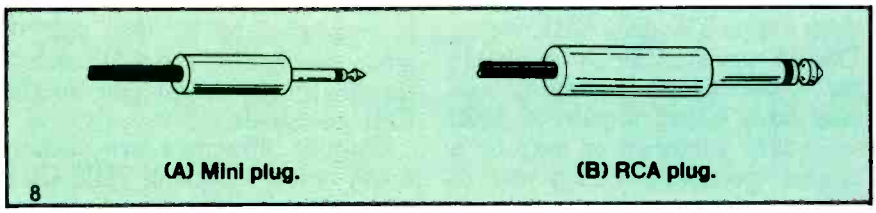


Figure 8. Mini and RCA plugs for audio.

simply slides onto the coaxial connector of the antenna terminal block of the TV set.

Although all TV sets are designed for VHF and UHF, in some areas the user either cannot receive UHF or doesn't want it. The push-on balun is sometimes used in connection with a wall receptacle in which the coax is brought in through the walls of the home to a baseboard-mounted 75Ω coaxial connector. In that case, the push-on balun is simply made to slide on to the coax connector of the wall receptacle.

Cable connectors

Sometimes it is necessary to interconnect video components, and for these, pre-prepared connector cables equipped with plugs and/or jacks are helpful. Video component interconnections are invariably by coaxial cable. Cable connector kits are available in 3-, 6-, 10-, 12-, 15- and 25-foot lengths and in shorter lengths, such as 30 inches.

However, it is also possible to make your own coax connecting cables by mounting the connectors yourself. The advantage of making your own is that it costs less, and you can tailor-make any length.

Rolling up large lengths of coax behind a TV set is not only unsightly and uneconomical, but it also is a potential source of trouble. Crimping tools for joining coax cable to connectors are inexpensive and easy to use.

Connectors consist of plugs and jacks, and there is an astonishing variety of these. They can vary not only between models made by different manufacturers but between different models made by the same manufacturer.

Jacks, also called receptacles or female fittings, are usually mounted on components; plugs or male fittings on cable. The difference between the various plugs is generally one of size and shape; and this is also true of jacks. The basic rule is that jacks and plugs must mate, that is, the plug must fit into the jack.

Sometimes the size difference is so small it is easy to make a mistake, especially if the two plugs or two jacks are similar in appearance. The fact that a plug will fit into a jack isn't always an assurance that they were designed to mate.

Thus the fact that a 10-pin plug

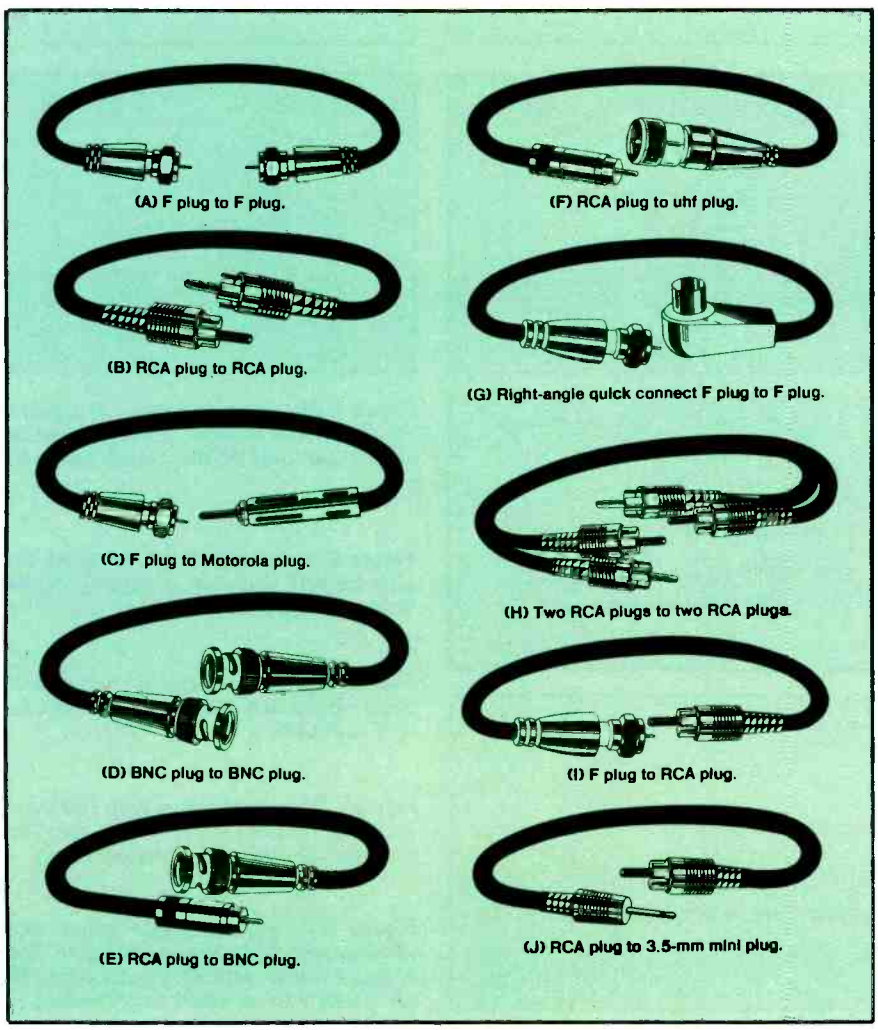


Figure 9. Coaxial cable terminated by various plugs (Courtesy Recoton).

fits into a 10-pin jack doesn't necessarily mean it is suitable because the manufacturers of video cameras and portable VCRs don't always follow the same wiring arrangement.

If a plug and jack do not mate, you have two options. Either the plug can be replaced or an adapter can be used. The plug fits into the adapter and the adapter fits into the jack.

A large variety of adapters is available. For example, an F barrel can be used to connect two *F* cables; an RCA jack to BNC plug can be used to adapt RCA cables to fit BNC connections; an RCA jack to F plug adapts RCA cable to fit F connections; an F jack to RCA plug adapts cable so it fits RCA connections.

Some manufacturers, such as RCA and Motorola, make their own plugs and jacks. VCRs, whether RCA or not, often use RCA jacks on all audio/video inputs and outputs, and so these would require RCA plugs to make connections.

Another commonly used connector is the F plug, often found on cable connections between a VCR and a TV set, between amplifiers and switchers. It is also used as a coax cable connector between an antenna and the terminals of a TV set. Figure 7 shows some common types of plugs. 7A is an F plug, B is an RCA, C is a mini type and D is made by Motorola.

In some instances, a plug is intended for audio use; in others for video. Thus, Figure 8A illustrates a mini plug and 7B an RCA plug, both for audio. The fact that a plug is identified as an RCA type doesn't necessarily mean it is for video. Figure 7B and Figure 8B are both RCA plugs: 7B is for video; 8B for audio.

Joining a pair of components can be done easily enough by using a suitable length of coaxial cable terminated at each end by a plug. The problem is that the video components made by different manufacturers use different types of jacks; and so a connecting cable can be terminated at one end by one plug and by a completely different plug at the other end. Figure 9A to 9J are examples of some of the possible combinations.

The plugs shown in this drawing are single-pin types. Multi-pin plugs are also used, as, for example, when connecting a portable VCR to a video camera. Thus, it is possible to have an 8-pin plug, 10-pin or 12-pin. In some cases, not all the pins are active.

Coaxial cable

Unlike twin-lead transmission line, which is fairly well standardized at 300Ω, coaxial cables come in a fairly wide assortment of impedances. The most commonly used is RG-59U, but even this cable is available with differing electrical characteristics.

In the next installment

Understanding connectors, baluns, transmission lines, signal separators and cables is essential for making suitable video connections. With this information at hand, we can start (in the next installment) with simple hookups, but watching them becomes increasingly complex. ES&T

Test your electronic knowledge

1. A non-inductive wirewound resistor has a:
A.) thermoplastic coating.
B.) voltage-dependent resistance.
C.) bifilar winding.
D.) hum bucking coil.
E.) special color code.

2. The advantage of carbon film resistors over carbon composition resistors is:
A.) They are made with higher power ratings.
B.) They have a positive temperature coefficient.
C.) They generate less noise.
D.) They are not affected by very high current surges.
E.) They can be made with tolerances of ± 3 percent.

3. You would expect to find a swamping resistor in a:
A.) humidifier.
B.) parallel-tuned circuit.
C.) negative feedback amplifier circuit.
D.) parallel-diode connection.
E.) differential amplifier.

4. Which of the following is the purpose of the diode in the circuit of Figure 1?
A.) It is used for temperature stabilization.
B.) It protects the emitter-base junction from a reverse bias.
C.) It protects the base-collector junction from a forward bias.
D.) It rectifies the incoming signal.
E.) It makes Class C operation possible.

5. A one-million farad capacitor is made with two pieces of wire placed end-to-end as shown in Figure 2. The problem with this capacitor is:
A.) The plates should be square.
B.) The plates should be made of aluminum.
C.) It won't work with air as a dielectric.
D.) The plates should be made of a semiconductor material.
E.) None of the above is correct.

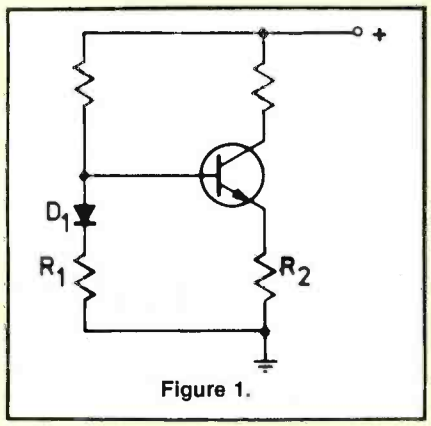


Figure 1.

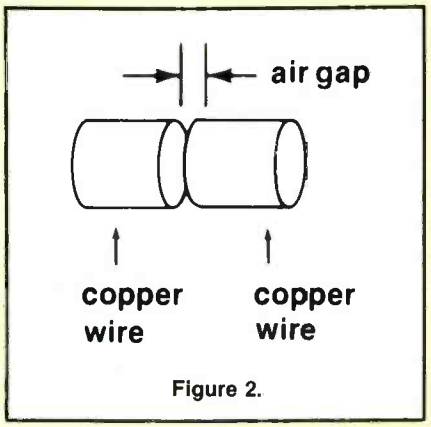


Figure 2.

6. When making signal adjustments in a VHS machine, always use:
A.) a tone burst.
B.) a pulse code modulated signal.
C.) a phase-modulated audio signal.
D.) an NTSC signal.
E.) a pulse-width modulated signal.

7. The rated voltage of a transformer is the voltage it delivers:
A.) with no load.
B.) under full load.

8. The picture tube heater is glowing and the high voltage is normal. However, there is no raster. With these symptoms the defect is usually in:
A.) the horizontal oscillator.
B.) the color killer.
C.) the video stage.
D.) the sync signal.
E.) the low-voltage regulator.

9. In a satellite TV receiving system, the output of a low-noise amplifier (mounted on the TVRO dish) is the downlink signal with frequencies in the range of 3.7 to 4.2GHz. Which of the following is used to eliminate the need for expensive specially designed cables for delivering the signal to the receiver?
A.) Use a downconverter.
B.) Use a nuvistor amplifier interface.
C.) Use twin lead with quarter-wave standoffs.
D.) Use a #10 solid copper bus.
E.) Use an artificial transmission line.

10. A dielectric that is permanently charged is called:
A.) an ion retainer.
B.) a grain boundary.
C.) a bead ledge.
D.) an electret.
E.) a Hall device.

Editor's note: The questions in this quiz are based on articles that have appeared in this magazine in recent months.

Answers to quiz

1. C. (What do you know about components? – June 1984)

2. C. (What do you know about components? – June 1984)

3. B. (What do you know about components? – June 1984)

4. A. (Characteristics of resistors – July 1984)

5. E. (What do you know about components? – August 1984)

(The problem is the very low voltage rating.)

6. D. (VHS basic recording and playing – June 1984)

7. B. (266 Ready-to-build power supply circuits – July 1984)

8. C. (Ten Dogs in TV repair – September 1984)

9. A. (Introduction to satellite TV receiving systems – September 1984)

10. D. (What do you know about components? – September 1984)

News

Continued from page 27

boiling water or drying a load of clothes is only temporary. It escapes through open doors, fireplaces, exhaust fans, electrical outlets and any other openings in construction where air can escape. This type of humidity can't be controlled. What occurs inside the home are periods of too much humidity along with periods of not enough humidity. And that's when owners of home computers run into problems.

If there isn't enough humidity present, warm air tries to get moisture from anything it can. Furniture, walls, even home computer systems. What happens? Floppy disks warp, equipment malfunctions and electronic failures occur.

A humidifier will help control the humidity in the home, increase the life of home electronic systems and make the environment more comfortable indoors.

Humidifiers are available in both portable and installed units. Installed units are probably best for homeowners and are available for use with any type of heating system.

The best humidifiers have these capabilities:

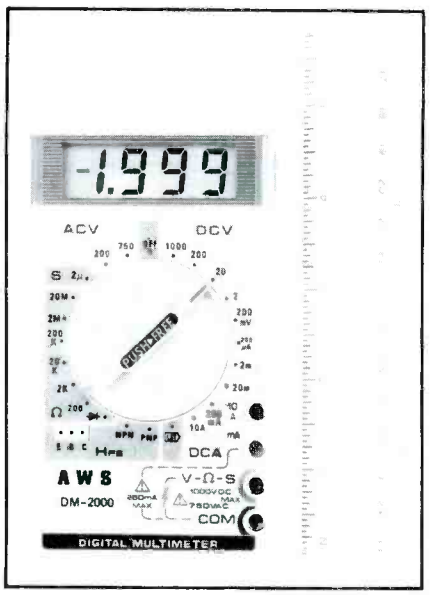
- Provides a relative humidity of at least 35 percent throughout the entire home;
- Has an accurate humidistat installed to measure the humidity level and control operation of the humidifier;
- Provides humidity in vapor form, not water (which leaves a residue of mineral deposits in the home);
- Requires little maintenance;
- Requires reasonable installation costs.

A free booklet on the need for humidity in the home is available by writing to: Research Products Corporation, 1015 E. Washington Ave., Madison, WI 53701. Or call 1-800-356-9652. In Wisconsin call 608-257-8801. Ask for the Humidification Facts booklet.

Products

3½-digit DMM

A.W. Sperry Instruments, Hauppauge, NY, has introduced their new DM-2000 rotary switch 3½-digit multimeter. This compact DM-2000 (4.8"x2.8"x0.9") features eight functions and 22 ranges. All



ranges are overload protected. Solid-state protection on all resistance ranges protects the instrument and user up to 250Vac/dc without fuse blow. A number of optional accessories are available for the DM-2000.

Circle (75) on Reply Card

TVRO interference trap

Model 4518-60/80F, available from *Microwave Filter Company,* Syracuse, NY, combines two traps (60MHz and 80MHz) in one case,

eliminating the need for two separate traps. The trap is placed between the downconverter and receiver (70MHz IF) to eliminate video interference due to 4GHz terrestial microwaves. It has a notch depth of 40dB and the 3dB bandwidth is 3MHz.

Circle (76) on Reply Card

Outlet power center

Ultima Electronics, Farmingdale, NY, announces the availability of a single-socket Surge-Free electronic outlet power center for home use. Designed for home owners, the SF-10 model is compact and unobtrusive. It features a solid-state, surge clamping electronic circuitry.

Rated safe at 15A, 125Vac, the SF-10 detects and suppresses destructive effects of high voltage transient spikes and surges to sensitive electronic equipment, protecting home computers, color TV sets and microwave ovens.

Circle (77) on Reply Card

Coaxial cable stripper

The TOR-1C coaxial cable stripper and the TOR-1F dual line stripper offered by *Davle Tech,* Fair-

lawn, NJ, are a suitable complement to the electrical and electronic technicians tool kit. Each tool comes with a spare set of blades.

Circle (78) on Reply Card

Module cross reference

RCA Distributor and Special Products Division, Deptford, NJ, has expanded and updated its Cross Reference Volume II of TV modules for RCA TV chassis. This volume covers color chassis CTC93A through CTC132A. It cross references the modules in three different listings: stock number to module designation, module designation to stock number and chassis to circuit.

Circle (79) on Reply Card

Uni-link LNA cables

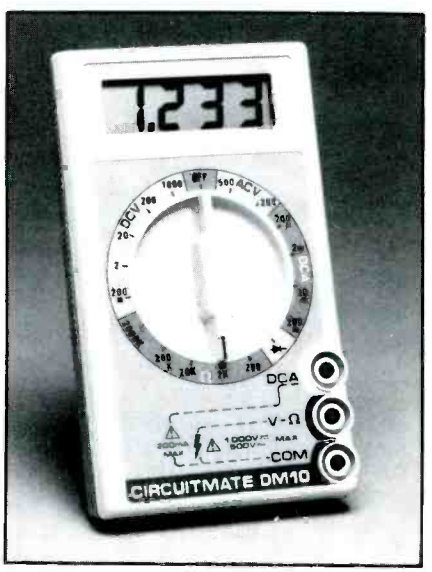
Precision Satellite Systems, Clearwater, FL, offers their uni-link LNA cables. These cables are available in RG-213 and RG-214 type cable, with lengths varying from 14 inches to 14 feet. Special ordered lengths are also available.

Cables are hand soldered, crimped and fully weatherproofed with coax-seal on each connector. The ends are fitted with heat shrinkable tubing. These cables carry a full 1-year guarantee.

Circle (80) on Reply Card

3½-digit DMM

The Instrumentation Products Division of *Beckman Industrial Corporation,* Brea, CA, has added the DM10, a new 3½-digit DMM, to its Circuitmate line. The DM10 is the same size as a pocket calculator and includes a rotary switch, ½-inch high digital LCD display, five dc voltage ranges



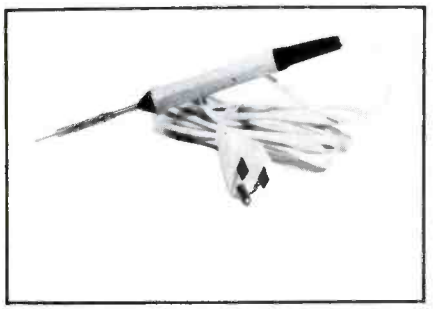
from 200mV to 1kV, overload protection to 1kVdc in all ranges above 200mV, and 500Vdc for the 200mV range. In ac volts, the ranges are from 200Vac to 500Vac, with overload protection in all ranges to 500Vac/dc.

Five resistance ranges, overload protection to 250Vac/dc and a diode test function are also included. Test leads are provided. Battery life is 150 hours with an ordinary zinc-carbon battery.

Circle (81) on Reply Card

Miniature soldering iron

M.M. Newman Corporation, Marblehead, MA, offers an industrial grade, precision miniature



soldering iron that is ready to use in 45 seconds. It accepts a wide variety of interchangeable slide-on tips. The Antex model C/3U features a cool, non-charring thermoplastic grip handle and is grounded directly from the tip through a 6-foot cord with a molded 3-prong plug.

Circle (82) on Reply Card

Microprocessor-controlled DMM

Penril's Triplett Electrical Instrument Corporation, Bluffton, OH, has introduced its model 4700 DMM. This test instrument uses microprocessor control to provide features beyond standard volt-ohmmeter capability. The unit is suited for in-the-field and laboratory usage for industrial, commercial, communications or consumer electrical/electronic applications, using true RMS measurements to directly measure complex non-sinusoidal signals.

The instrument offers an audible continuity function, permitting quick testing of diodes, logic probes, voltage measurements displayable in dBm, plus the capability to store an input signal as an offset or relative function. Each measurement function has auto-polarity, overrange indication, overload protection and quantitized feedback A/D conversion, yielding accurate linear measurements.

Circle (86) on Reply Card

Power console

PMC Industries, San Diego, CA, has introduced a power console with a built-in hospital grade Pass and Seymour ground fault interrupter. The unit is intended for use with equipment, instruments or tools in areas where shock potential exists such as wet labs, instrument and equipment repair shops, home work shops or any area where worker shock protection is a concern.

Model 020 plugs into any 120Vac, 15A, 60Hz 3-prong outlet, and has a main *on/off* lighted rocker switch. The G.F.I. has built-in test and reset buttons which trip instantaneously at 5mA (± 1) to ground and comes with instructions for use and test recording.

Circle (83) on Reply Card

Precision DMM

A DMM model 7101 offered by *Spanta,* Franklin Lakes, NJ offers versatility. It can measure 11 separate functions: dc voltage; ac voltage; dc current; ac current; continuity indication; resistance; diode test; high speed audible and visual conductance; logic level; hFE test; and capacitance.

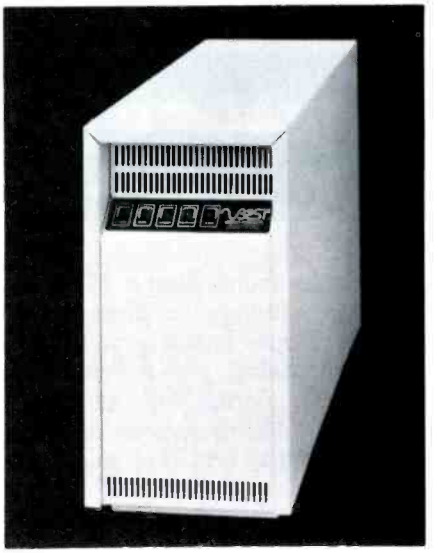
The LCD provides clear indication with a 3½-digit resolution. Basic dc accuracy is 0.1 percent. Overload protection is designed into the unit, which has a 600V double-fused current input and safety designed test leads.

Circle (84) on Reply Card

Uninterruptible power systems

Best Power Technology, Necedah, WI, offers two new uninterruptible power systems with computer interface capability. Micro-Ferrups 250VA and 500VA uninterruptible power systems come equipped with an on-board microprocessor and RS232 port. These features allow the display of line power conditions at a computer terminal. System status and alarm messages can be continuously monitored to effect an orderly shut down.

Micro-Ferrups protects sensitive electronic equipment against blackouts, brownouts, spikes,



sags, surges, noise and frequency shifts. These UPS systems provide no-break uninterrupted power regardless of the condition of the incoming line.

Circle (85) on Reply Card

PC board repair kits

Cir-Kits available from *Pace,* Laurel, MD, provide an efficient, low-cost way to repair and/or replace lifted, damaged or missing lands, plated-thru holes, conductors and edge connectors on printed circuit assemblies. Cir-Kits reduce downtime and eliminate the practice of discarding PC boards that can be repaired. Cir-Kits come in three different models to suit various types and levels of repair in factory or field.

Circle (87) on Reply Card

Self-contained desoldering station

The V-185 Vac-Kit, available from *Plato Products,* Glendora, CA, is a self-contained production desoldering station. The pulsed vacuum system develops a vacuum of 21 inches high in 40ms. The V-185 does not have a high speed vacuum pump to be maintained or replaced.

Its hand piece features a quick cleaning solder collector and non-clogging tip and conduit. Replacement tips are available in sizes for most all applications. The V-185 provides RFI/EMI protection for voltage sensitive devices and is fully grounded. Plato Vac-Kits are covered by a 6-month warranty.

Circle (88) on Reply Card

Literature

Available from **Shape Magnetronics** is a 2-page supplement to the Line Tamer power conditioner technical catalog. This supplement features a listing of available receptacle configurations and a handy circuit breaker selection chart.

The receptacle chart lists 74 of the most commonly used receptacles. A diagram of the configuration, the NEMA identification code and the amperage and voltage rating of each receptacle listed are provided in the chart. The circuit breaker selection chart provides a reference for those applications which may require circuit breaker protection. The chart gives information on the size breaker needed for the different sizes of single-phase Line Tamers for input and 3-phase Line Tamers for output.

Circle (100) on Reply Card

Texwipe Company, Upper Saddle River, NJ, has published a 16-page catalog of the recently introduced Read/Right line of precision cleaning products and kits for computers and office equipment.

The catalog contains sections on cleaning kits for microcomputers, CRT screens, computer printers, tape transports, disc drives and office equipment including microfiche and microfilm readers. Other selections describe products such as static controllers, premoistened cleaning pads, solvents, solutions, compressed gas dusters, wipers, swabs and gloves.

Circle (101) on Reply Card

Two of the **Electronic Industries Association/Consumer Electronics Group's (EIA/CEG)** booklets, "Video: Your New Window on the World" and "Audio: Your New World of Listening," have been revised. Produced by the association as a public service, these booklets are designed to make buying audio and video equipment easier.

"Video: Your New Window on the World" contains explanations of monitors and monitor-receivers, high-fidelity sound in VCRs, stereo TV, cable services, permium program services and wireless remote controls. The 32-page booklet also discusses televisions, VCRs, video cameras, videodisc players, home computers, teletext and videotex, satellites and antennas.

Covering audio aspects, "Audio: Your New World of Listening" includes sections on component systems, the compact disc, compacts, micros, midis, rack systems, personal portables and car audio. There are also tips on taping, selecting a system and shopping for a retailer. A 5-page glossary defines the technical terms that may confuse audio equipment buyers.

Both booklets contain sections on service, safety and warranty. Single copies of both booklets are available free from the EIA/CEG by sending a #10, self-addressed stamped envelope with 37-cents postage to EIA/Consumer Electronics Group, P.O. Box 19100, Washington, DC 20036.

Circle (102) on Reply Card

Rush Wire Strippers announces the availability of a free 8-page brochure describing the complete range of model DCF wire stripping and twisting tools. This brochure includes technical and application data for four different DCF models, which are used to strip round, rectangular or square magnet and enamel coated wires. Application data is also included on two DCF models used for twisting stranded wires or for making twisted pairs. All units may be hand-held or bench-mounted, and they are easily adjustable for different wire sizes. Operating heads are interchangeable.

Circle (103) on Reply Card

"Power: Problems and Solutions," a 12-page guide to recognizing and resolving electric power fluctuations, blackouts and noise, is available from **Triad-Utrad,** a division of MagneTek, Huntington, IN. This manual includes an overview of ac power, sections on spotting power problems and solving them, a trouble-shooting chart and a glossary of electrical and electronic terms.

Circle (104) on Reply Card

Philips ECG, Waltham, MA, has published an 8-page, 4-color brochure describing the company's new high-technology chemical line. This brochure reviews all 18 aerosol spray products in the line, explains how they are used and summarizes their specifications.

The brochure categorizes each product by principal application. A variety of cleaning, lubricating, shielding and testing agents for commercial, industrial/MRO and high-technology applications are described. Products are offered in aerosol cans and many are available in bulk containers.

Circle (105) on Reply Card

MCM Electronics, Centerville, OH, has introduced their new catalog No. 9. This catalog contains more than 4500 items in its 128 pages, including test equipment, computer accessories, telephone accessories, speakers, TV parts, flybacks, yokes, switches, fuses lamps, capacitors, resistors, cartridges, styli, wire, CATV equipment and a selection of Japanese semiconductors.

Circle (106) on Reply Card

The **Vigor Company,** New York, has recently published a 31-page catalog of electronic and production assembly tools. This catalog offers an inventory of high-quality precision tools, including: cleaners, dividers, drills, drill press, eye loupes, files, gauges, holders, knives, lamps, magnifiers, flexible shaft motors, pin vises, pliers, nippers, scales, balances, scissors, shears, screwdrivers, scrapers, torches, tweezers and vises. The catalog contains detailed photographs or illustrations of each item, complete descriptions, shipping weights and stock numbers.

Circle (107) on Reply Card

Microwave Filter Company, Syracuse, NY, introduces the C/84, catalog of filters and traps for CATV. It also includes filters for MATV, SMATV and TVRO systems. Channel deletion filters, which allow interference free channel reuse without impact to adjacent channels, are covered.

A complete line of selective channel bandpass filters for every channel allocated is also described.

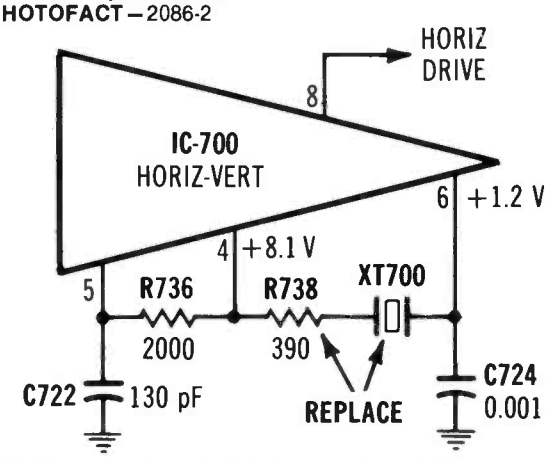
Circle (108) on Reply Card

Symcure

Symptoms and cures compiled from field reports of recurring troubles

Chassis – Sylvania E-32
PHOTOFACT – 2086-2

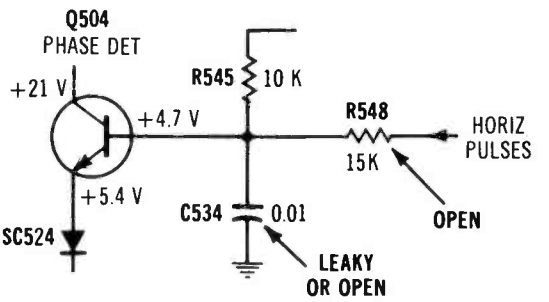
1



Symptom – Horizontal tearing or loss of locking
Cure – Check R738, and if it is okay, replace the 503.5kHz crystal XT700

Chassis – Sylvania E-32
PHOTOFACT – 2086-2

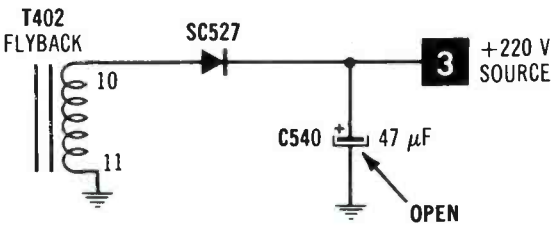
2



Symptom – Severe pie-crusting, double keystone, or shutdown
Cure – Check C534 and R548, and replace if defective

Chassis – Sylvania E-32
PHOTOFACT – 2086-2

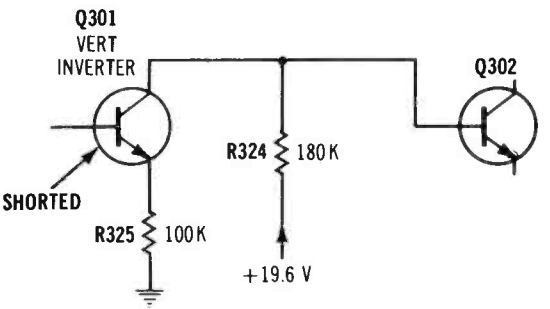
3



Symptom – Insufficient brightness
Cure – Check capacitor C540, and replace it if open

Chassis – Sylvania E-32
PHOTOFACT – 2086-2

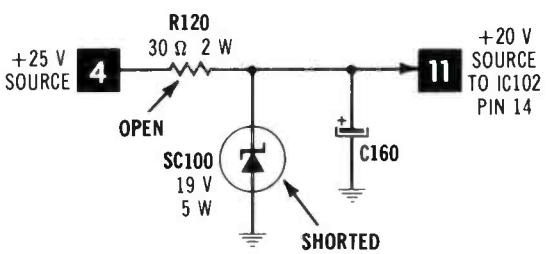
4



Symptom – Picture is upside down (inverted)
Cure – Check Q301, and replace it if shorted or otherwise defective

Chassis – Sylvania E-32
PHOTOFACT – 2086-2

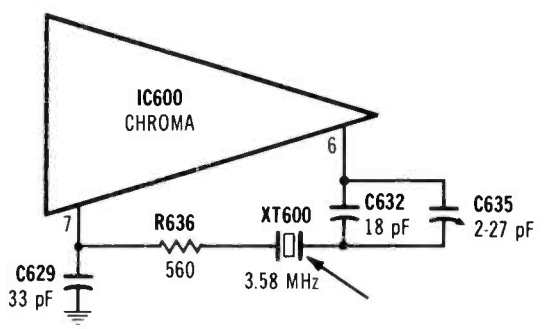
5



Symptom – No sound
Cure – Check R120, if it is open zener diode SC100 probably is shorted; replace both components

Chassis – Sylvania E-32
PHOTOFACT – 2086-2

6



Symptom – Intermittent loss of color
Cure – If tapping the color circuit restores the color, replace crystal XT600

Readers' Exchange

Wanted: Two books, *Practical CB Radio Troubleshooting and Repair* (hardback) by David F. Norman and *Modern CB Radio servicing* (paperback) by Marvin Hobbs. If anyone has these in mint condition, I would consider any reasonable price and would also gladly pay postage. *John L. Wingerfield, P.O. Box 685, Cedaredge, CO 81413; 303-856-6341*

For Sale: Conar 281 signal generator, $40. Conor oscilloscope model 250, make offer. B&K 470 CRT tester and rejuvenator, like new, $200. *Andrew K. Oberg, 828 Jefferson, Joplin, MO 64801*

For Sale: Obsolete radio tubes, post World War II era. Call or send s.a.s.e. *Elmwood TV, 136 Market Square, Newington, CT 06111; 203-666-1990*

Needed: Schematic for Morse electrophonic AM/FM stereo radio phono, T36-1 chassis. *Joseph J. Mehalko, 324 4th St., Blakely, PA 18447*

Wanted: Power transformer for model 34 oscilloscope. Built as part of the Bell & Howell's electronic course. Scope manufactured by Electro Lab. *Daniel Ritter, 26 E. Cumberland St., Allentown, PA 18103*

Wanted: Vertical output transformer for a RCA chassis CTC 53E, part No. 135770 (want a salvage one to save cost). Also, Zenith service manual for chassis 25GC50 or Sams folder. Both must be reasonable. *A. Edward Ruppel, 1207 Adams St., Saginaw, MI 48062*

Needed: Manuals on B&K models 400, 530, 650, 707 and 1243. Will buy or copy and return. **For Sale:** Old Tektronix and HP oscilloscopes; they work but are shop worn, $100 each. *Jim Corliss, 2446 Vista Drive, Upland, CA 91786*

For Sale: RCA senior VoltOhmyst, type WV-98A VTVM in excellent condition with probe, 5 sets of new RCA tubes and manual. Send money order for $30 to *B.H. Mineer, P.O. Box 379, South Portsmouth, KY 41174*

For Sale: Staco L501 variable (0-150Vac) power supply, $50. Heath IG-5257 post/sweep generator, $100. Heath IG-5237 FM stereo generator, $100. *David Knapp, Northwoods Electronics & Appliance, P.O. Box 159, Lac du Flambeau, WI 54538; 715-588-3674*

Wanted: B&K model 1040 CB Servicemaster and model 2040 B&K 40-channel PLL CB signal generator. Write or call with price and details. *Mark Pupilli, P.O. Box 117, Blanford, IN 47831; 317-832-7695*

For Sale: B&K 1077B TV analyst, $250. Sencore SM158 sweep marker generator, new $125. More than 350 new TV tubes, $150. *Al Dolgins, 1905 N. Woodley St., Arlington, VA 22207; 703-524-2493*

For Sale: Sams Photofact folders, No. 1438-1899, $1200, includes cabinets. Complete NRI color TV course with all kits, 25-inch color TV, scope, stereo and meter, $700. *Frank Wolff, 6 White Street, Topsham, ME 04086; 207-729-0566*

Wanted: Sams Photofact folders, No. 1200-1700, cheap. *James Gregorich, 117 Second St. N, Virginia, MN 55792; 218-749-4355*

Needed: Schematic or Sams AR manual for a Pioneer KP-500 car stereo cassette, "Super Tuner." *Calvin S. Logue, Jr., 17 J Washington Lane, Westminster, MD 21157*

For Sale: Sencore VA48 TV-VTR-MATV video analyzer, two years old, $850. *Boston TV Sales and Service, 3025 Davie Blvd., Fort Lauderdale, FL 33312; 305-587-2522*

Needed: Schematic diagram for Minneapolis-Honeywell electronic panel model No. MD50352A!K1, MD74000A1. Will copy and return or will pay for copy. *August Aubert, Box 700, Cornell, WA 99326; 509-234-2471 (collect calls okay)*

For Sale: Sencore SC60 oscilloscope, $1000. Sencore SG165 AM/FM stereo analyzer, $500. Simpson 465A autoranging DMM, $225. All equipment in excellent condition, including accessories and instruction manuals. Send s.a.s.e. for complete listing. *Clarence G. McKee, 9516 Zion Road, Rives Junction, MI 49277; 517-569-3139*

Needed: Tekfax volumes 100, 102, 115, 116 and 117. *C.T. Huth, 130 Hunter St., Tiffin, OH 44883*

For Sale: Sencore CB analyst, like new, model CB42, $1000 (Canadian). *Ron Zima, Zima Electronics, 4097 Carroll Ave., Niagara Falls, Ontario Canada L2E 5Z8; 416-356-0454*

Wanted to Buy: Vertical output transformer (new or used) for Panasonic model CT-210 (Sams 1306-2). PN is TLV524 (ETV-57D5A) *Jim Burns, 241 Cavalier Court, Martinez, GA 30905; 404-860-2438*

For Sale: Hewlett-Packard 410-C solid-state general purpose voltmeter with RF probe, $600. Tektronix R7403N/7A12/7B50 60+MHz dual trace scope system, like new, $1500. Heath IB-3128 RLC bridge, $90. Fisher 300 FM multiplex generator, $135. *Ronald R. Zimmerman, Electronic Services Co., 2860 Hwy. K, Franksville, WI 53126; 414-835-4000*

Wanted: Chassis test jig, prefer Telematic but will consider others, will pay cash. *Scott's TV & Electronic Service, Route 3-3186, Pottsville, PA 17901; 717-429-0660*

Wanted: Atari part No. CO 14795. It is the P.I.A. for the 400-800 computer. *Ship and Shore Electronics, Box 203, Deale, MD 20751; 301-867-4006*

For Sale: Heathkit sweep generator model IG-57-A. Sencore picture tube tester and restorer, model 143. Paco capacitor/resistor ratio bridge model 20. All in excellent condition, make offer. *William J. Maida, 341 Isabella Drive, Longwood, FL 32750; 305-830-0308*

For Sale: Sencore SG-165 stereo analyzer, never used, bought for $1095—will sell for $800. *Paul Krug, K&K Electronics, Route 2, Cherry Tree, PA 15724; 814-948-9137*

For Sale: Ryder's TV manuals, volume 1-24. Ryders radio manual #20. Sencore model SM152 sweep/marker generator. Make offers. *Harlan Hoxie, 4520 Zenith Ave. N., Minneapolis, MN 55422*

Wanted: Manual with schematic for a Telequip D-52 scope. Willing to buy or copy and return. *Bill Morel, 1445 NW 9th St., Homestead, FL 33030; 305-247-6349*

For Sale: Simpson 463 DMM with carrying case, $175. Beckman HD 100 DMM, $150. *Stanley Todorow, G3468 Belle Bluff Drive, Grand Blanc, MI 48439*

For Sale: FC45 frequency counter, $250. Sencore PS163 scope, $400. EICO 633 CRT tester with adapters, $80. UPS included. *Bill Bechtold, 7429 Frederick, Omaha, NE 68124; 402-397-2461*

Needed: Schematic diagram for b&w TV camera, Civikon by Intel, made in Japan. Also, schematic diagram of telephone modem by AMP Phonics, TV-phone model 62, serial No. 5-0020. *Gustavo Diaz, 8181 NW South River Drive, Lot A-112, Medley, FL 33166*

Wanted: Hickok model 217 semiconductor analyzer in good condition, reasonable. *Paul Capito, 637 W. 21st. St., Erie, PA 16502*

Wanted: Schematic or other technical informaton on Bradford AM/FM multiplex system, model No. 1404 C41 WTG 59030. **Also:** schematic and manufacturer's data on Denon AM/FM multiplex stereo, model MS 990A, serial No. 10198, made by Nippon Columbia Co. *Paul H. Langheld Sr., 50 North St., Northampton, MA 01060*

For Sale: Sams Photofact folders and some test equipment. Write or call for information. *Gary Borresen, 1306 Umatilla, Albany, OR 97321; 503-928-2356*

For Sale: Multimeters—RCA senior VoltOhmyst, new meter movement. Simpson 260 needs minor repairs. Micronter 22-202A in good condition. $150 for all three or make offer for the one you want. *Gary H. Thompson, 3648 Eastside Hwy. #5, Stevensville, MT 59870*

For Sale: Sencore CR31A CRT tester and beam builder, $500. Sencore TC62 tube checker, $175. Heathkit 3117 tube checker, $125. Heathkit 5218 VTM, $75. *Daniel Lee, Dan's TV, Heritage Apt. #104, 512 2nd Ave. E., Osakis, MN 56360; 612-859-2851*

For Sale: Sencore SC-60 dual trig scope, A-1 condition, complete with probes and instructions, $895. *Val Obal, 3201 S. 73 St., Omaha, NE 68124; 402-393-0459*

For Sale: Capacitor analyst B&K model 801, $40. Jerrold TV remote control system, works with any TV set, new, $35. CATV AM/FM receiver cabinet model 4033A, 75Ω input, $7.50. All equipment in good condition with leads and manuals. Send s.a.s.e. for list. *Able TV & Electronics, 6333 Hwy. 2321, Panama City, FL 32404*

Needed: A good used color tube, round type No. 21FJP22, state condition and price. Also, manual or schematic for a Knight KG-221A VHF-FM receiver. Will pay for copying and shipping. *Lawrence Olson, 5225 W. 147th St., Oak Forest, IL 60452*

Needed: Conar Instruments, RC tester model 311 and operating manual. *Joseph J. Franco, 803 New Jersey Ave., McDonald, OH 44437*

Coming in...

APRIL

Servicing typical Samsung TV problems—Throughout the past 10 years, servicing foreign TV models has been aided by more accessible replacement parts and service literature. Homer Davidson discusses 10 typical troubleshooting tactics to service the 13-inch Samsung color TV receiver. Many of these servicing examples can be applied to similar models.

The video connection—The setup of a video system may be simple, but it may also be subject to connection faults. In the second installment, Martin Clifford will discuss impedance matching and other connection considerations.

Tools and test equipment—There has been both evolution and revolution in tools and test equipment for electronic servicing. Old equipment has been improved and updated. And new equipment, such as logic analyzers for digital work, has been developed. Here's a look at some of the new servicing products available.

What do you know about components?—Next month Sam Wilson reviews the production procedures for thick film and thin film components. He also discusses the application of zener diodes.

Plus our regular monthly features:
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Photofact
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New Products
New Literature
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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. National (800) 223-8314, NY State (800) 446-4430. 1-85-tfn

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BOOTLEGGERS BIBLE for CB Modification $12.95, CB Radio Repair $10.95. Linear Amplifier Planbook $14.95, kits, etc. Catalog $1.00 refundable—APS, POB 263 Newport, R.I. 02840 401-846-5627. 12-84-tfn

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VIDEO HOOK-UP DIAGRAM MANUAL—Shows how to hook-up TV, VCR, Satellite, Stereos, Multi-sets. $6.00. NorthStar Video Services, Dept. E, P.O. Box 1992, Hollywood, FL 33020. 3-85-3t

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EQUIPMENT—Sencore SC61, Dual trace 50MHz, brand new $2195, lists for $2995. B&K 1077B, $325. Delco #10420 0-16VDC supply, 8 amps max $85. Sencore #TR139 transistor checker $49. Sams 66-1185, 4 filing cabinets $700. RCA #WV-98C, SeniorVoltOhmnist $95. All items—price listed or best offer, shipping additional. Member of NESDA. Terrick TV, 809 Amity St., Homestead, PA 15120. Phone: 412-462-8720. 3-85-1t

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HOW TO LOAD AND UNLOAD a console TV of 200 pounds in a van or truck. This can be done easily by a 70-year old man alone. For information, write to FAMILY TV, 5802 N. Armenia, Tampa, Florida 33603. 3-85-3t

HELP WANTED

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PICTURE TUBE REBUILDING EQUIPMENT, working or not, write or call: Chicago Television, 633 North Semoran Blvd., Orlando, Florida 32807. Ph. 275-9543. 11-84-9t

WANTED: Old tubes and parts for tube type radios, including capacitors, coils, knobs, vibrators, Rider Manuals, etc. Antique Electronic Supply, 1725 W. University, Tempe, AZ 85281. 2-85-2t

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