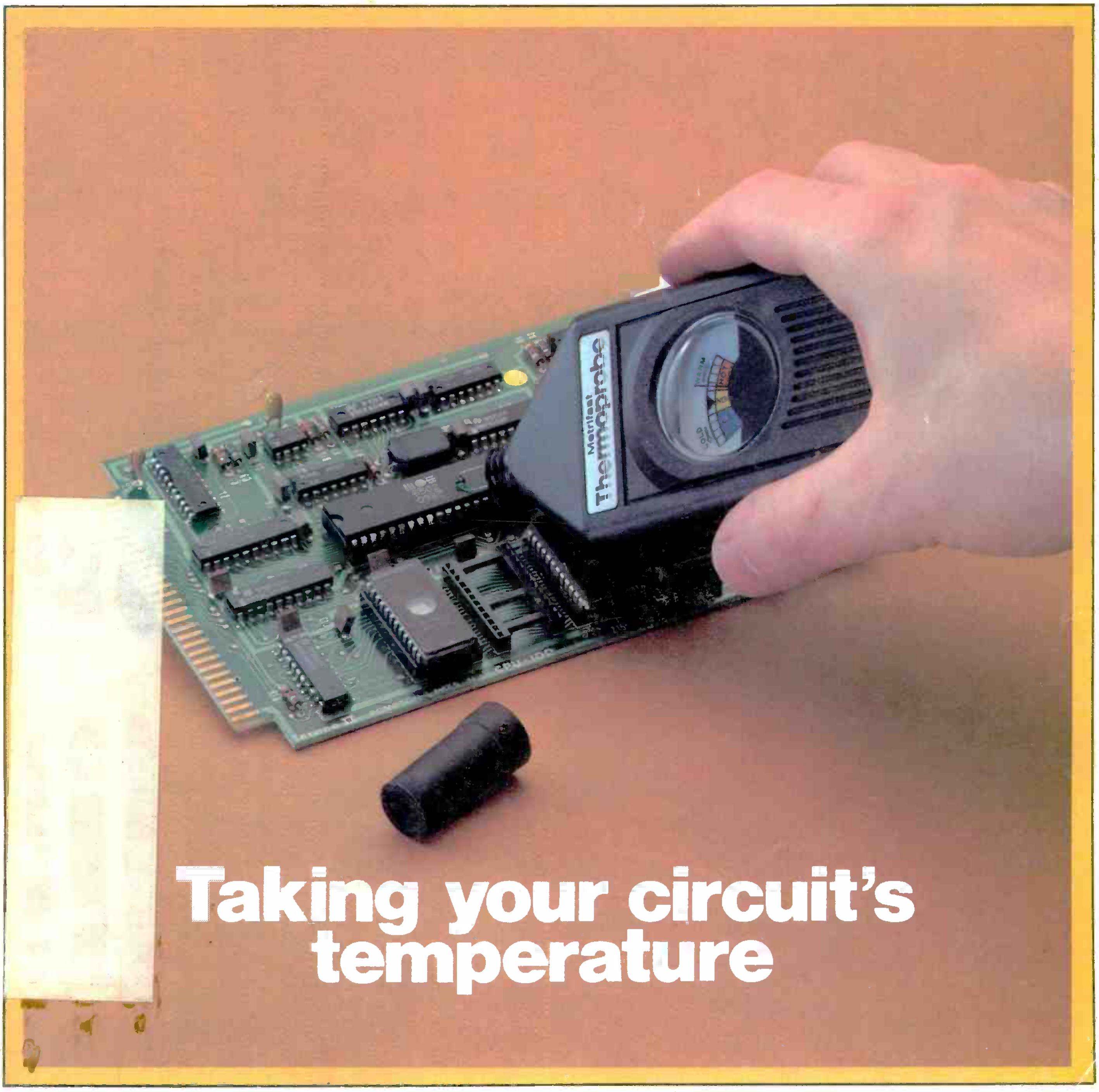
# ELECTRONIC Servicing & Technology™

APRIL 1984/$2.25

**Tuner tune-ups**

**Inside a microcomputer**




# Taking your circuit's temperature

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

# CHROMATENNA™ Antennas


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

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

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

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

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

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

## "Just one call shows you why MCM is . . .

# THE ONLY ELECTRONIC PARTS COMPANY YOU'LL EVER NEED.

Your business depends on quality parts and quick, efficient service and delivery. That's why we at MCM try our best to meet your needs. We have over 4,000 electronic items in stock to let you get all the quality replacement parts you need in just one call. Our friendly salespeople take pride in knowing your business needs and giving the prompt, personal attention you deserve.

Our shipping department is fast and dependable. You can be sure that we'll ship exactly what you need right away. The parts are on their way to you within 24 hours.

Best of all, we won't make you pay more for our great service. Saving you money with some of the lowest prices in the industry is just part of what makes us your best choice.

Here is what some of our customers say about MCM:

"I appreciate your large stock of semiconductors and your quick service. I have a small business and your company has been of tremendous help."

"I have dealt with many companies in the past and your service is the finest of them all."

We know you'll feel the same when you've given us a call! Join our satisfied customers by calling for your **NEW FREE 96-PAGE MCM ELECTRONICS' SUMMER CATALOG #6. CALL TODAY TOLL FREE FOR YOUR COPY.**
**1-800-543-4330**
**(In OHIO 1-800-762-4315).**

**mcm ELECTRONICS**

RIGHT PARTS, RIGHT PRICE,
SHIPPED RIGHT AWAY.

858 E. CONGRESS PARK DR. CENTERVILLE, OHIO 45459

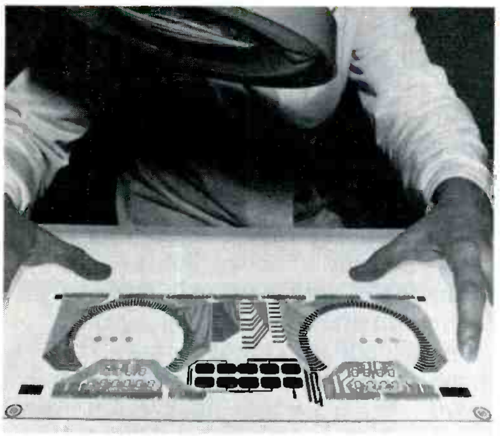
**Circle (30) on Reply Card**

*The how-to magazine of electronics...*

# ELECTRONIC Servicing & Technology

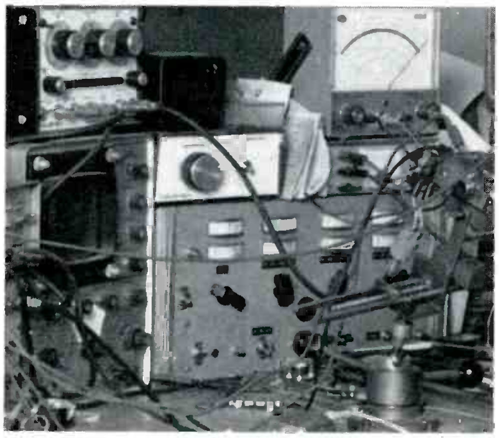
April 1984
Volume 4, No. 4


The Thermoprobe may be used to identify dead active components on printed circuit boards without direct contact. See related story on page 9. *(Photo courtesy of Metrifast)*



Page 6

Page 46



Page 54

# Departments



**Next month...**

**Building a thermal probe.** This simple inexpensive thermal probe can help you diagnose component problems by taking their temperature.

# The silent, invisible world of electronics

Electromagnetic waves race silently, invisibly, through space at the speed of light, carrying television, radio, data or other information. Within electronic circuits, electrons speed through conductors as bidden by the circuit components with no discernible evidence that anything is taking place.

Electronic phenomena take place in a realm that's denied to human senses. In effect, we are deaf and blind when it comes to electronics. This characteristic sets electronics apart from most other pursuits. Mechanical things, for example, can be viewed in operation. You can see valves opening and closing, pistons sliding, gears turning. However complex, mechanical systems can be seen, heard, felt, and their operation comprehended.

One of the great challenges of electronics is to deal with the abstract, to visualize with the mind's eye that which can't be seen. For example, have you ever wrestled with the concept of what's actually taking place when a tank circuit oscillates or how an arithmetic/logic unit (ALU) of a computer adds two numbers.

Fortunately, the same technological wizards who have designed and manufactured the many electronic products we enjoy have also designed and manufactured many highly sophisticated test instruments that make it possible to convert the invisible electronic phenomena into forms that we can comprehend with our limited senses: deflection of a meter pointer, illumination of digits on a digital readout, a waveform traced out on the face of an oscilloscope.

These instruments are only as good as the ability of the user to apply them and interpret their readings. If used improperly, they can give seriously erroneous information. An old fable about perceptions gives an idea of what can occur. Four blind men were asked to describe an elephant. One felt the leg and said "an elephant is like a tree." Another felt the trunk and said "an elephant is like a snake." The third felt a tusk and said "an elephant is like a piece of pipe." The fourth felt the elephant's ear and said "an elephant is like a palm leaf."

In spite of the sophistication of modern electronic instruments, whenever we use them we're always in jeopardy of being like the four blind men in the fable, gathering only some of the required information and misinterpreting the results. A thorough understanding of the operation of the circuits being examined can help avoid such errors. We hope that the articles in this issue, such as "Inside a microcomputer," enhance your understanding of circuit operation and help you to avoid this type of error.

Nils Conrad Persson

ELECTRONIC
Servicing & Technology

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



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

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

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


ISSN 0278-9922 $2.00 + 0.00

INTERTEC PUBLISHING CORP.

# OMNITRON
# APRIL SPECIALS
USE ETD NUMBERS FOR SPECIALS

**Silicon H.V. Triplers HIGH VOLTAGE MULTIPLIERS**

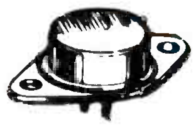
Minimum 9/may asst.

## Original ECG *SYLVANIA/RCA* Triplers

| ECG-500A | ECG-523 | ECG-526A/SK3306 |
|---|---|---|
| 212-139 | 212-141 | 212-141-02 |
| 212-139-01 | 212-141-01 | 212-141-03 |
| 212-139-02 | 212-141-01 | 212-141-04 |
| #ETD-20 | #ETD-21 | #ETD-22 |
| $10.99 ea | $10.99 ea | $10.99 ea |

2SC1308K #ETD-5B

2SC1172B #ETD-5C



$1.49 ea 100 up
$1.69 ea 30-99
$1.99 ea 10-29

## Jerrold 60 Channel Cordless Cable TV Converter

reg. $189.95

**$89.95**

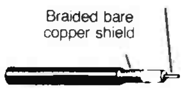
MODEL DRX3-105

#ETD-1

## RG-59/U 75 OHM Co-Axial Cable Copper Braided Shield

#ETD-6

**$44.50/1000 ft.**




White or Black

**#ETD-7** F-59 Connector with Separate Ferrule

7¢/1000 lot
10¢/100 lot

**#ETD-8** Matching Transformer 75-300 Ohm

29¢/500 Lot
44¢/100 Lot
59¢/ea.

**#ETD-9** 2-Way-75 Ohm Splitter

59¢/100 Lot
89¢/50 Lot
1.49/ea.

## OMNI-PHONE III

**$19.95** ea/2 Lot

$24.95 ea.

- True Touch Tone*
- Works on all systems
- Desk or wall application
- Fully modular
- True bell ringer
- FCC approved
- Brand new
- 1 year warranty

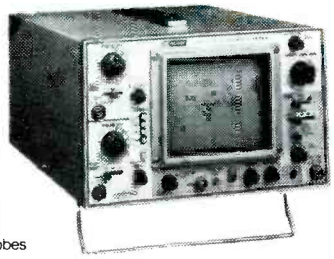
*Registered trademark of AT&T

#ETD-10

## 10 MHz Dual Trace Scope

**$435.00** B+K PRECISION

Reg. $545.00
Model 1476A



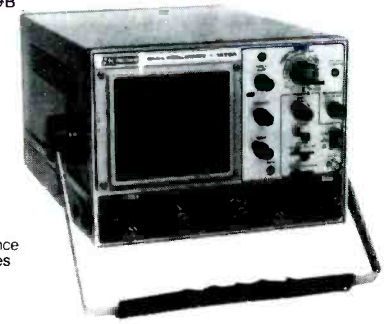
dual trace
10mV/div sensitivity
video sync separators
include probes

#ETD-2

## 30 MHz Dual Trace Scope

**$635.00** B+K PRECISION

Reg. $795.00
Model 1479B



dual trace
5mV/div sensitivity
10:1/reference direct probes included

#ETD-3

## 100 MHz 8-Trace, 4 Channel Dual Time Scope

B+K PRECISION

**$1489.95**

MODEL 1590P
Reg. $1995.00

FEATURES
- 100 MHz response and 3.5ns rise time
- 120 MHz response at −6dB
- 1mV/division sensitivity to 100 MHz
- 500m V/division cascade sensitivity
- 2nd/division sweep rate with 10x magnifier
- Four-input operation provides trigger views or four separate inputs
- Selectable 1MΩ or 50Ω inputs
- Alternate timebase operation
- 20 MHz bandwidth limiter for best view of low frequency signals
- Lighted function pushbuttons employing electronics switching with non-volatile

# ETD-4

## DIGITAL CAPACITANCE METER

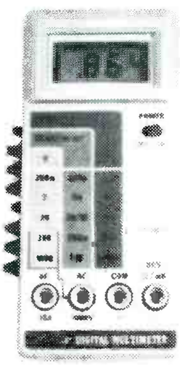
**$59.95**

- 1pF to 1999 uFd
- Accuracy .5%
- 3½ digit .5" LCD display
- 8 ranges 200 pF to 2000 uFd
- .1pF resolution
- .5 second sampling time
- Crystal Osc time base
- 1 yr. warranty

#ETD-11

## DIGITAL MULTIMETER

**$39.95**

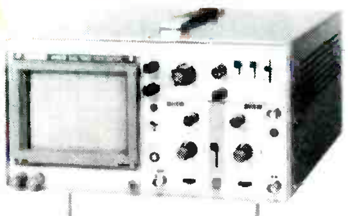


- 0.5" LCD display
- DC input impedance 10M
- DC 100uV, 100mA, 0.1 ohm resolution
- DCA up to 10A
- Auto polarity
- Low battery indicator
- Overload protection

# ETD-12

## EICO 20MHz Dual Trace Scope

**$450.00**



#ETD-13

Reg. $799.95
Model 482
Features
Dual Trace
- 5mV/cm
- 5mV/cm sensitivity
- Automatic triggering
- Add and subtract mode
- Built in component tester
- 17.5 nanosecond rise time
- Includes 10:1/direct probes
- Automatic selection of alternate or chop mode.

Send Purchase Order, Check, Money Order or C.O.C.

**or Call Toll Free 800-223-0826**

In N.Y. State (212) 855-5580

**SHIPPING ORDERS**

| For Orders | ADD |
|---|---|
| $25-100 | $6.50 |
| $100-$500 | $8.50 |
| $500-$750 | $10.50 |
| $750 - and up | $15.50 |
| Parcel Post | $20.00 |

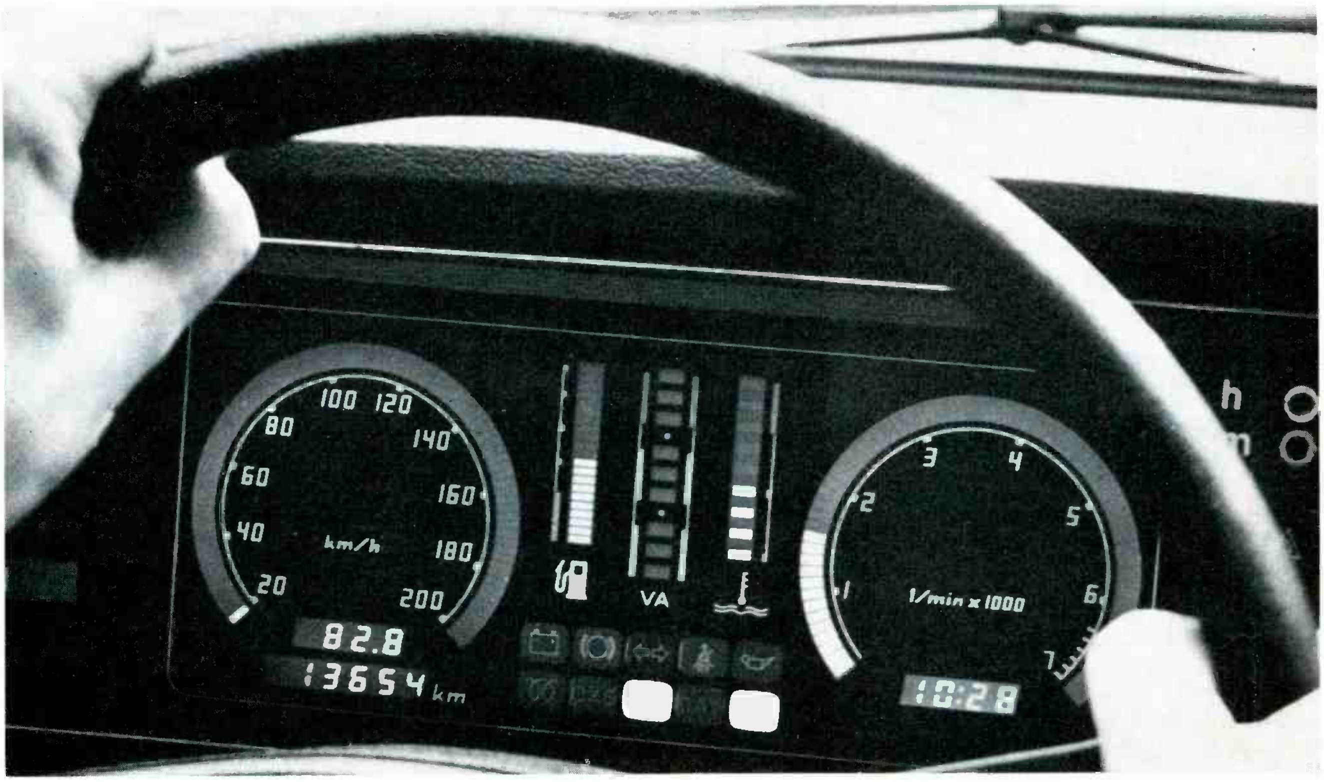
MASTER CARD • VISA

Write for FREE 136 page Catalog

**OMNITRON ELECTRONICS**
770 Amsterdam Ave., NY 10025

Circle (5) on Reply Card

# Liquid crystal displays get larger




In automobiles, large-scale LCDs will replace individual instruments with an "information center" from which the driver may obtain all necessary information at a glance.

Small-scale liquid crystal displays, now common in such consumer products as electronic watches and calculators, have begun to appear in other products as well. Several manufacturers have used LCDs as the picture "tube" in hand-held televisions.

Now large-area LCDs with integrated electronic drive circuitry are ready for production after many years of development by the Technical Tube Division of AEG-Telefunken under partial sponsorship by the West German Federal Ministry for Research and Technology. These LCDs combine a number of different indicators in a single unit with an area of up to 7.9 inches x 11.8 inches. As a result, one display can be used to replace clusters of individual instruments

# We advanced the technology to make the soldering simple.


By changing the grounded heat sensing tips, the Weller WTCPR automatically controls output and temperature in three stages (600°F, 700°F and 800°F). Once selected, you can be assured of constant, accurate temperature control without dials to turn or settings to watch. To make working with sensitive components that safe and simple, Weller has incorporated state-of-the-art technology into an attractive impact resistant case, that's ideally suited to assembly work. Check with your Electronics Distributor.

## More Weller advances

If voltage transients are your problem, the WTCPZ has a special zero voltage electronic switching circuit to prevent possible damage to sensitive components.

WTCPE Soldering Station features the WEC24 iron which has adjustable control circuitry completely contained in the handle.

# The Weller® WTCP series

CooperTools

**The difference between work and workmanship.**

BOKER® CRESCENT® LUFKIN® NICHOLSON® PLUMB® WELLER® WISS® XCELITE®

The Cooper Group PO Box 728 Apex NC, 27502 USA Tel (919) 362-7510 Telex 579497

Circle (6) on Reply Card

such as in motor vehicle dashboards or aircraft cockpit panels.

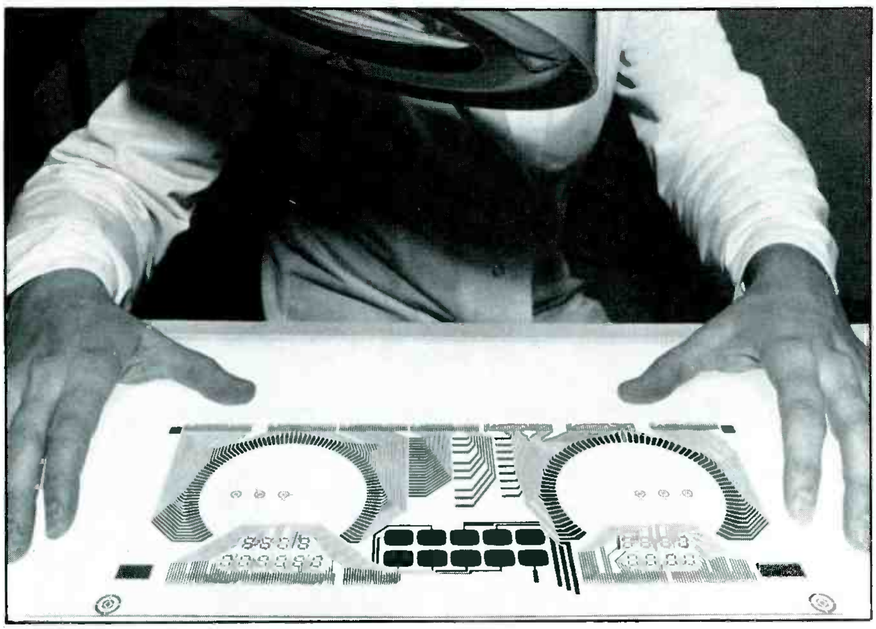
**Production problems overcome**

Small-sized LCDs have been produced in large quantities for many years for use in such products as pocket calculators and wristwatches. Mass production of larger-sized LCDs has been hampered by major technical difficulties. A high degree of uniformity and flawlessness is demanded of the individual thin films (electrodes, orientation and protective films). The liquid crystal layer has a thickness of roughly $0.4 \times 10^{-3}$ inch and this must be maintained to within $0.02 \times 10^{-3}$ inch to $0.06 \times 10^{-3}$ inch, depending on the operating mode, so as to prevent color irregularities and ensure a uniform appearance over the entire surface of the cell. The developers used the elasticity of the 0.043-inch thin glass layers in conjunction with spacers, to maintain the specified tolerances over the entire surface of the display even when the individual pieces of glass had a waviness of around $0.043 \times 10^{-3}$ inch over 1 inch. The range of operating temperatures has been expanded to −40°F to 176°F thanks to the use of better liquid crystal materials and the highly uniform cell thickness.

**Dashboard indicators**

Because of their low energy requirements, LCDs have to a large extent replaced active indicator elements, such as LEDs, in battery-powered equipment. Their thin construction and their direct compatibility with modern electronic microcircuitry have led to their increasing use as indicators in measurement, control, and monitoring units for instruments and plant engineering.

The range of applications will grow now that it is possible to produce large-area LCDs. Such displays convey vast quantities of information because hundreds of displays segments can be housed on a single liquid crystal cell. Groups of individual mechanical or electromechanical displays can be replaced by a single integrated electronic display. Linear and circular scales can be combined without difficulty, as can segment and dot matrix displays. The use of microelectronics in automotive engineering makes it possible to display not only the traditional variables, but also a variety of other information, such as the outside temperature, fuel consumption and time since last inspection. The LCD developed by AEG-Telefunken can be integrated into electronic circuits to create an "information center" from which the driver can obtain all the relevant information at a glance.



The fabrication of large-scale LCDs requires uniformity and high quality of materials and processes.

**High visibility**

Liquid crystals are particularly suitable for large-area displays because they reflect the surrounding light. A light source can be fitted behind the display at the same time, since the reflecting film also transmits light (transflector). In darkness, the letters and symbols light up against a dark background, making them easy to see. Color films inserted between the liquid crystal cell and the transflector ensure color brilliancy even in darkness. Another advantage of LCDs is their slimness: depending on the lighting system used, their thickness varies between 0.6 inch and 2 inches, making them particularly suitable for vehicle dashboards.

Individual displays can be combined into large display panels for presenting information on large surfaces, such as destination signs in public transport systems. The standard mechanical or electromechanical systems used in the past are thus replaced by electronic displays that do not fade even in strong ambient light, which can be rapidly updated, and which can require only low voltages for operation.

**How do LCDs work?**

LCDs are based on the fact that certain organic substances go through one or more intermediate phases between the liquid and solid crystalline states. As in the case of liquids, the molecules are still mobile but already spatially ordered in accordance with fixed rules, as in the case of crystals. This is known as the liquid crystal phase.

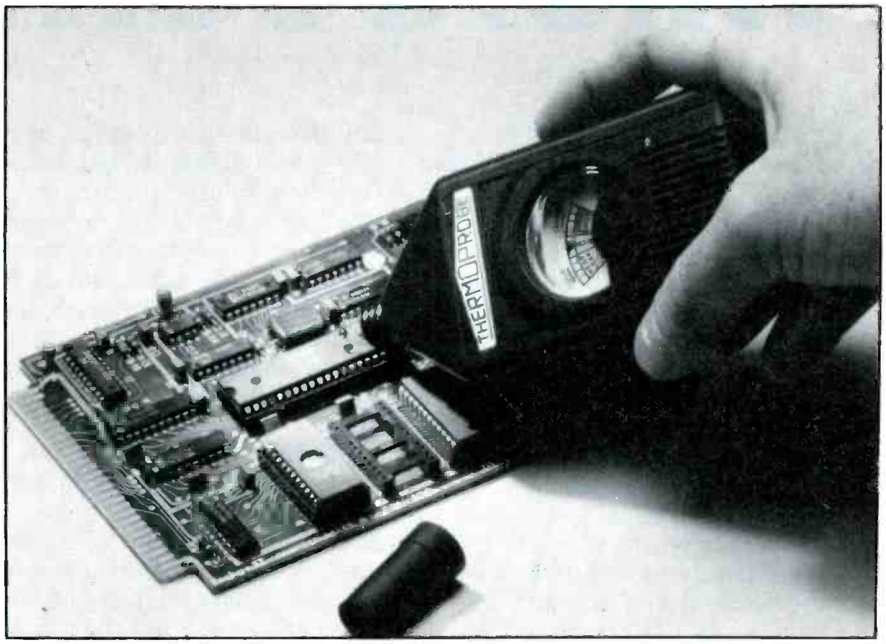
An electric field can alter the orientation of the molecules' longitudinal axes in such a way as to alter the optical properties as well. The most common type of cell, the "Twisted Nematic" cell, is fitted with polarization filters offset, for example, at angles of 90 degrees. Special orientation films ensure that the liquid crystal molecules are ordered in such a way that the plane of vibration of the incident polarized light is also deflected by 90 degrees, and the light can pass through the cell unobstructed. If an electric field is applied, the molecular structure is straightened and the activated area becomes dark against an otherwise light background. When the two polarization filters are parallel to one another, bright activated areas are obtained against a dark background giving maximum brilliance in large-sized displays.

**Seven contacts activate displays**

In order to reduce the number of external connections required to drive the hundreds of individual cells in a large area display, it was necessary to design driver integrated circuit modules suitable for mounting directly onto the LCD panel. Each IC can drive up to 40 display segments. An interconnect path laid down on the rear of the front panel permits the input information to be entered serially and passed from one drive module to the next until it reaches the correct address, namely the driver module and memory location allocated to the specific segment to be activated.

The IC thus acts as a series-parallel converter making it possible to drive the LCD via an input on only six to eight contact lines. This leads to low assembly costs and ensures high reliability under the toughest operating conditions.

# Taking your circuit's temperature



When a person is ill, one of the first things medics do to get an idea of the nature and severity of the problem is to take the patient's temperature. Now, that technique has been extended to electronic circuits. With a new electronic test instrument called Thermoprobe it may be possible to quickly identify dead active components on printed circuit boards without direct contact.

The solid-state device consists of a thermistor probe connected to a modified wheatstone bridge circuit and is designed to measure minute temperature changes as small as 1/25 of a degree Fahrenheit (1/45°C). Because dead resistors, transformers, diodes or ICs do not emit heat they can be quickly identified on the units' built-in S-meter as the thermistor probe is moved in close proximity to them.

The 6-inch long unit is operated by removing the protective front cap and pointing the thermistor probe within 1/16 inch of the PC board surface. The nulling wheel at the side of the unit is then turned clockwise until the meter indicator reads "normal." Now the thermistor probe is moved slowly approximately 1/16 inch above the components on the PC board. The meter indicator will quickly move to the right or "warm" area of the dial each time the unit is passed over an operational active component. The dial indicator will move back to the nulled position if the active component being tested is dead and therefore not emitting any heat.

Small, shirt-pocket size and low cost make the device useful in field service applications for computers, electronic instrumentation, video and Hi-Fi equipment. It uses a 9V battery. ES&T

# Inside a microcomputer

By Bernard Daien

The microprocessor, also referred to as a microprocessor unit (MPU), is the basis of small computers that are being sold for less than the price of a color TV set. It is also being built into many other familiar devices such as microwave ovens and automobile emission systems.

Despite their widespread use, MPUs are not as familiar to consumers or service technicians as they should be. MPU *architecture* (the arrangement of what's inside) is not nearly as well understood as the workings of a color TV, although the TV is more complicated.

Part of the problem is the way in which MPU architecture has been presented; usually in a series of definitions, with little understanding of why each section of the MPU is needed, how it ties in with the rest of the circuitry, and what it does. After all, the MPU is just another large scale integrated circuit and should be treated as such. To be more precise, it is a large scale digital IC.

### MPUs and CPUs

The microprocessor unit (MPU) is also known as a *central processing unit* (CPU). Before the advent of ICs, the functions of an MPU were performed by several separate circuits. Together, these circuits make up the CPU. The CPU, reduced to a single IC, is an MPU. (The functions of the CPU and the MPU are identical; it is simply the method of fabrication that is different.)

The MPU (CPU) has two main sections, the *control unit*, and the *arithmetic and logic unit* (ALU). These two sections are the brain of any computing or control system of modern digital design, but only the brain. In order to turn it into a working computer, some memory, and input and output devices must be added. The input/output (I/O) devices may be teletype machines, printers, CRT displays, or telephone couplers to transmit and receive information over telephone lines.

Starting with an MPU, we can expand into a small computer, or an automatic control system for manufacturing, etc. This article describes how the MPU itself functions, and how it interrelates with the memory and I/O devices.

### The control section

The control section is connected to the ALU and other parts of the system by means of *buses* (conductors). Generally there is a control bus of four or fewer wires, a data bus of eight wires, and a memory bus of 16 wires. The control bus controls the action of tri-state logic devices and turns I/O devices on or off. The data bus handles data from various sources and does it with eight bits of parallel information simultaneously. (The word "bit" is derived from binary digit.) Eight bits, taken together, are often called a binary *word*. The term *byte* is often used in place of word.

The 16-wire memory bus handles 16 bits, which offer more than 64,000 possible combinations, and therefore have the capability of selecting (addressing) a word stored in memory out of 64,000 possible locations. Such a system is said to have an addressing capability of 64K and will therefore handle a 64K memory.

The control section fetches instructions from the memory, interprets them and is instrumental in carrying out the instructions by sending commands over the control bus to the other parts of the system.

### The ALU

The ALU performs arithmetic operations and digital logic operations such as ORing and ANDing. The ALU has the various registers used for short-term shortage of data while operations are being executed. Simply stated, most data handling is performed in the ALU section. Figure 1 is a block diagram of the ALU and control sections and their buses. Figure 2 shows some of the internal architecture.

Both the ALU and the control section are part of the same IC. Today they are more convenient concepts than anything else: holdovers from an era when the MPU was made of discrete components on separate circuit boards for each section. Figure 2 is representative of a typical MPU, drawn for explanatory use only. Some of the labels used may be strange, but they will be discussed in proper sequence.

### The function of the MPU

The MPU is capable of performing a wide range of tasks, including those that require many different steps performed in order. This requires a series of instructions called a program. Because the program is entered into the MPU system all at once by the programmer, some memory circuitry is required that can hold the entire program until it is implemented step by step.

Suppose, for example, you want

the MPU to add some numbers. The numbers are the *data* and must be entered into memory. An *instruction* is also entered, indicating what is to be done with the data. It would be possible to design some digital logic circuit boards that would do addition, but then you would have to either rebuild them, or build some new ones if you wanted to do subtraction. The MPU-based system can be programmed and readily reprogrammed to do many different tasks.

But programs are not free. They take skill and time to create, and must be run and rerun to be sure they are free of errors. This costs money. One set of problems has been exchanged for another set. In the buzz words of the digital business, "we have traded hardware for software." (Software is programming. Hardware is actual electronic equipment.) Often the general purpose MPU with its software can replace special purpose hardware and save money on the cost of a product. Sometimes the opposite is true. The application must be examined to determine if such a digital system is advantageous.

The MPU, along with some memory, a power supply, some input and output devices (which are needed to interface with the outside world) becomes a microcomputer system: a small system that is not as fast or as flexible as a larger system. It does things one step at a time in accordance with the program, while a larger computer would be able to do much more in less time. Again, in computer jargon, you would say, "the MPU is not as *powerful* as a large computer." MPUs today are much faster and more flexible than they were a few years ago, but the larger machines have progressed also and remain ahead. The MPU of today compares favorably, however, with the larger machines of just a few years ago and are adequate for many tasks at lower cost.

### The bus system

As previously mentioned, there are several buses within the MPU: the data bus, the memory bus, and a control bus. These interconnecting conductors do not consist of wires, but are metallic deposits formed during the fabrication of the IC as one of the manufacturing steps. There are quite a few wires since the data bus has eight, the memory bus 16, and the control bus may have four for a total of 28. Some of the buses are brought out to pins on the IC to provide external access to them. This takes up a lot of space on the chip, and the bigger the chip the harder it is to manufacture without a defect and the more it costs.

In order to keep the amount of space devoted to the bus system to a minimum, the data bus is usually bidirectional in modern MPUs. Because information flows in both directions on a data bus, like trains using a single track to move in two directions, it is necessary to ensure that only one device is putting information on the bus at any instant. Any number of devices can receive information simultaneously, but only one device can transmit on the bus at a time.

This is accomplished by *time sharing*. The simplest way to do this is by using tri-state devices connected to the bus. A tri-state logic device has three states: a "one," a "zero" or "disabled." When disabled, the output of the logic device is in a high-impedance state and looks like an open circuit to the bus. It is, for all purposes, disconnected from the bus. There

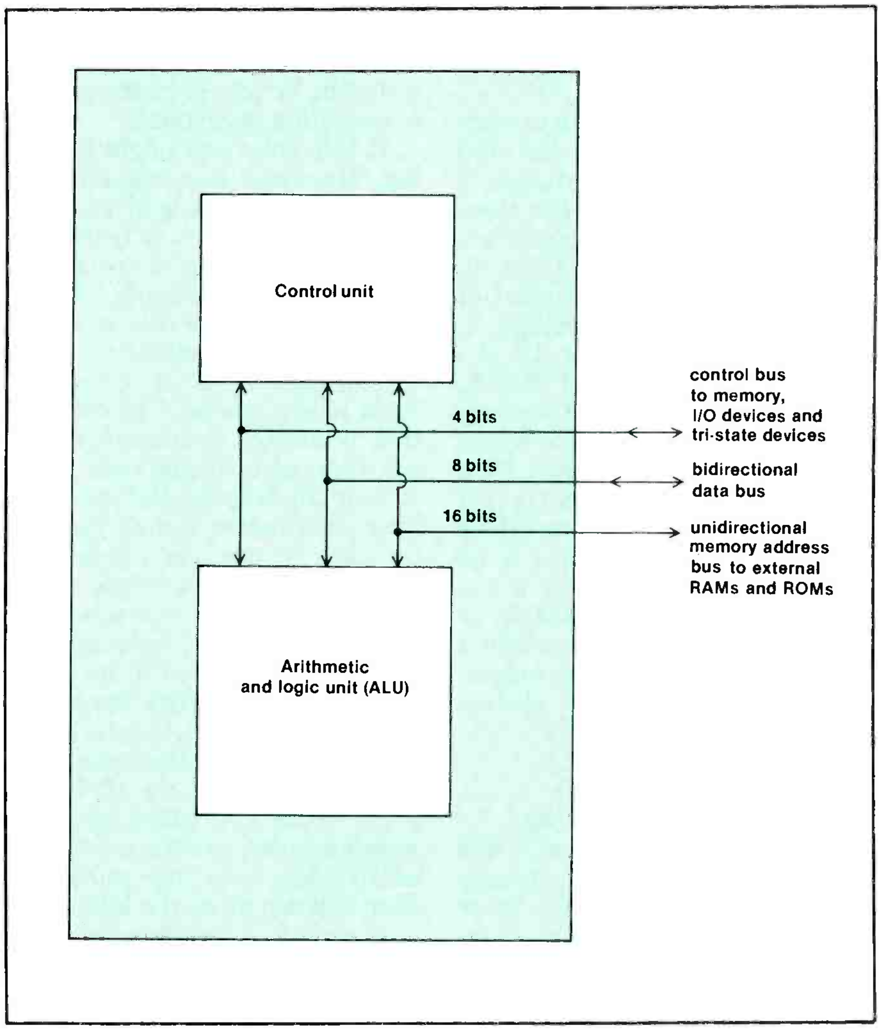



**Figure 1.** Block diagram of a microprocessor unit (MPU), also known as a central processing unit (CPU).

is an *enable* (or *disable)* input that controls the state of the tri-state device. That input is driven by the control section via the control bus.

It is possible to use the bidirectional bus for memory addressing with consequent further space reduction. However, because the data bus has only 8 wires, it would be necessary to transmit two consecutive words of 8 bits each in order to provide the 16 bits of information needed for a 64K memory, therefore the 16-bit memory bus is commonly employed.

Without the use of a bidirectional data bus, you would need 8 wires for data going one way and another 8 lines for data in the other direction, so the bidirectional bus saves 8 data bus wires. Remember that these buses are all internal, and all handle information in parallel form: all 8 wires are used simultaneously, and all 8 bits are transmitted and received together.

The timing of the system to coordinate the bidirectional bus and other circuitry in the system is controlled by the clock. The clock is a stable digital pulse generator, (often part of the MPU chip), which regulates the movement of data and timing of operations in the system. An article in the November 1982 issue of ES&T, Digital building blocks: Clocking, discussed the clock in some detail. A digital system controlled by a single timing source (clock) is said to be *synchronous* (modern MPUs are all synchronous). There is no point in enabling a circuit if the data needed is not yet available, as just one example for the need for a clock. The MPU would be a disorganized, uncoordinated system without clocking.

### Microinstructions and Macroinstructions

Go back now to Figure 2, the block diagram with some strange names inside the blocks. You know by now that program instructions and data are stored in the memory banks of the system. The information must be stored in a location in the memory that is numbered, so that you can return to that location to retrieve the stored information later on. The entering of information into the memory is termed *writing,* and the recovering of the information is termed *reading.* The process of assigning a definite location, or returning to that location is called *addressing* because you are using a specific address.

In order to accommodate lengthy programs, it is necessary to add external memory to the MPU, but there is also some limited amount of internal memory in various forms inside the MPU. These memories have several names, depending primarily on the use to which the memory is put. Modern MPUs have several internal *registers,* which can be used for different purposes, and the name assigned changes with the use to which the register is put at the moment. (Remember, a register is just a small memory used for short-term storage of information, while the system is in the process of executing operations.)

At this point you might be asking, "How does the computer know what to do when it is given an instruction?" The answer is that the microprocessor has a *read only memory* (ROM) internally, which is programmed at the time of manufacture with the ability to direct certain operations on command. ROM is like a book. The information is stored permanently, and can be read over and over again without destroying the contents. New information cannot be written into it, and old information cannot be altered or erased.

Upon receiving a program instruction, the MPU looks up that particular instruction in its internal ROM and performs the operations wanted. This process is called *decoding.* The instructions that have been placed in the MPU's internal ROM are called *microinstructions;* they are the most basic instructions, and by combining them you can make the MPU do a wide variety of functions. In order to differentiate between microinstructions and program instructions, the latter are termed *macroinstructions.* The microinstructions control the small steps the MPU must perform, such as moving information into or out of a register, or clearing information out of registers. It is the microinstructions that order the transfer of information onto and off of the buses, for example.

The microinstructions eliminate the need to spell out all these little operations in the program instructions (macroinstructions) each time a program is entered. This reduces the time and effort required in programming, which otherwise would be a long, tedious, error-prone process, demanding that the programmer understand every little step in the working of the computer.

What if you want to perform tasks that cannot be performed by means of the microinstructions alone? Simply add on extra memory with more capability. The memory can be in the form of *random access memory* (RAM), also known as read/write memory, because you can write new information into it, simultaneously erasing the information previously stored. Or, you can add ROM for storing information that will not need to be erased or altered.

How do the micro and macroinstructions involve the boxes in Figure 2? This is best explained with an example. Add two numbers on your computer. You enter the data, numbers 2 and 8. You also enter the instruction *add.* But, you have omitted an important step *initializing.* When you use a pocket electronic calculator, before doing any calculations you must first press the clear key in order to clear the various sections of the calculator of any information left over from previous calculations or random information resulting from turn-on transients, etc. The same clearing, termed "initializing," must be done with the computer system.

With all sections cleared, the computer will put the first data entry, 2, into a register, which holds it while you enter the second data entry, 8, which is stored in another register. When the instruction add is carried out, a microinstruction is decoded that indicates the steps


# look closer at a DSM!

**Here's a flat-panel scope, a transient recorder, and a 32-range DMM in a compact 4 lb. box.**

Now you can use one instrument to capture 2 μs transients, evaluate their waveform characteristics on a flat-panel LCD, and simultaneously measure their true RMS values.

It's all made possible with the first in a new class of instruments from BBC, the Digital Scope Multimeter, Model M 2050 DSM. By applying precision European engineering to the measurement needs of design and service engineers, BBC is revolutionizing test and measurement.

**Large Flat-Paneled Scope Display**

The LCD provides excellent resolution, 128 dots by 64 dots, for waveform displays. It measures 4-5/8 in. (118 mm) x 1-5/8 in. (42 mm). Simultaneous display capabilities let you use the scope portion of the LCD to evaluate signal characteristics while the DMM portion displays the true RMS signal value. Your measurement evaluations will be more accurate and consistent.

**Transient Recording**

Two independent memories of 512 words (horizontal dots) with 8-bit vertical resolution let users capture information about events ranging from 2 μs to 1-hr in duration. Five selectable trigger points (0, 25%, 30%, 75%, and 100%) give users options as to how much data is stored before and after the triggering event.

**True RMS Multimeter Measurements**

You get 15 voltage ranges (to 650V), 15 current ranges (to 10A), and two resistance ranges (200Ω and 20kΩ). True RMS and Averaging RMS modes are switch selectable. All ranges are overload-protected (Spikes to 6,000 V or 60A).

**Performance Packed and Portable**

An impact resistant case protects the M 2050 DSM. When open, the display angle is easily adjustable. When closed, the display and the controls are protected, the meter shuts itself off, and the tilt bail becomes a carrying handle.

**Affordable and Available**

The price of the M 2050 DSM is only $1,795.00 (for the optional analog output, add $200.00). Rechargeable batteries for 8 hours of portable operation are available for $35.00

BBC's M 2050 DSM and other innovative instruments are available via select distributors throughout the U.S. If your instrumentation supplier doesn't carry BBC yet, we'll gladly tell you who does. Call toll free:

**1-800-821-6327**
(In CO, 303-469-5231)

BBC-Metrawatt/Goerz
6901 W. 117th Avenue
Broomfield, CO 80020, Telex 45-4540

*Engineering Excellence in Test and Measurement*

BBC GOERZ METRAWATT

**Circle (7) on Reply Card**

required for addition and initiates the execution of the addition. The two data entries are added and the result is then stored in a register until it is used. The register used for this purpose (arithmetic) is called an *accumulator*.

Each program entry is numbered, but the number assigned is not necessarily the order in which the entry is made. In other words, the fifth entry could be numbered "9". When the program instructions are executed, they are executed in the number assigned, not in the order entered.

The program macroinstruction may often call out the register you want information held in. However, the process of getting the information into and out of that register – all the little steps such as clearing the register, putting data on the proper bus, getting it off the bus – is accomplished by means of the microinstructions.

How does the computer know what order to execute the program in? Remember, the programmer assigned a number to each program entry; really a memory location in the add-on RAM. When the program is executed, a register, called the *program counter* (PC) stores the address of the *next* instruction to be read out of the memory, much the way you would use your finger to move down the lines of a page, keeping track of the next line you intend to read.

It takes a finite amount of time to execute an instruction retrieved from memory, and the instruction must be stored until the operations indicated are completed. This is accomplished by storing the instruction for a short interval in the internal *instruction register*. The instruction held in the instruction register is decoded into a series of operations by the *instruction decoder*. There are some MPUs that have several *general purpose registers* that perform the functions of the specific registers discussed here. As a result, their block diagrams will only show the several general purpose registers. Regardless of what they are called they do the same tasks.

Remember, the accumulator stores data; the instruction register stores instruction words. The program counter is used to point to the location in memory of the next instruction to be executed. Sometimes you may want to change the order in which instructions are executed. Instead of progressing step by step in the order in which the program is numbered, the programmer may wish to alter the sequence. The contents of the *index register* can be used to change the address in the program counter. This is done by adding or subtracting the contents of the index register to the contents of the program counter, causing the program counter to move forward or backward by the desired number. This gives you the ability to avoid being locked rigidly into the program's number sequence.

The *memory address register* (MAR) is frequently not shown on MPU block diagrams. It is used to store the address word for a memory and can store either instruction words or data words. If an instruction is involved, the MAR receives it from the program

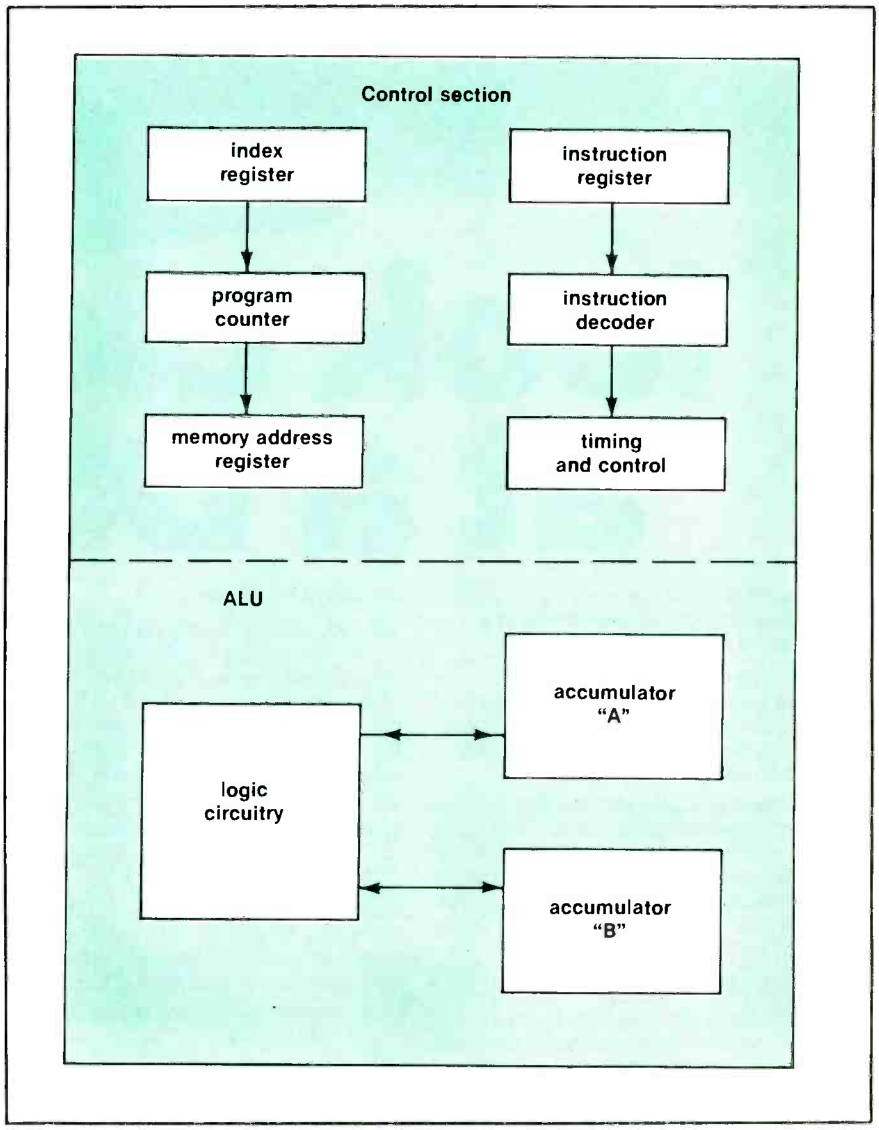



**Figure 2.** Major internal sections of an MPU.

Note: Many MPUs have several internal registers, used as accumulators, etc. as needed.

# The complete library of replacement semi's.


Here's the one guide that has it all—the new ECG® Master Guide. It's 545 pages, packed with over 3000 ECG semiconductors that replace over 200,000 industry numbers. And our replacements meet or exceed the specs of the original parts. So if it's ECG, you can count on it to fit and work.

Reduce equipment downtime and save yourself endless hours of parts hunting. For everything from analog amplifiers to zener diodes, go with replacement semiconductors from ECG. Get your new ECG Master Guide and our "Counterpoints" product updates from your nearest distributor. For his name and number, call 1-800-225-8326 toll-free (in Massachusetts, dial 1-617-890-6107). Or just send $3.25 for your ECG Master Guide to Philips ECG, Inc., Dept. EST, 70 Empire Drive, West Seneca, NY 14224.

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

**PhilipsECG**

*A North American Philips Company*

counter, but if data is involved, it gets it from the memory itself where it has been stored.

### More registers

The *memory data register* is another register not usually shown in architecture diagrams of MPUs. It is used for short-term storage of data being transferred into or out of memory. The word is held long enough for the desired operations to be performed; meanwhile freeing the memory for the writing or reading of other memory words.

Remember, the bidirectional data bus can handle only one signal at a time, and with all the activity going on in the computer, registers are needed to hold information until the bus is able to handle it in accordance with the micro and macroinstruction.

### The stack

A special register called *the stack* is unique because it is not really a separate register at all, but is simply a part of the external RAM, which is set aside for this use. The amount of RAM set aside is determined by programming, and the boundaries of the stack within the host RAM can be changed as required. Finally, the stack is a *last-in first-out* memory (LIFO). This means that the first word stored will be the last to be retrieved; while the last word stored is the first to be retrieved. Visualize this as a box full of books. The first book put into the box will be on the bottom, and therefore the last to be taken out, while the last book put into the box is right on top and therefore the first to be taken out.

The stack is very important and unusual when compared to other registers in the MPU. First, how are the limits of the stack within the RAM defined? This is taken care of by the *stack pointer*, another register, which normally stores the first address of the stack. As words are written into the memory, the stack pointer increases by one number (increments) the address held in the stack pointer. Thus, the stack pointer stays in step with the stack. Because the entries into the stack are made in sequence, this is a simple process.

As the words in the stack are read out, the stack decreases by one (decrements) the number of the address held, again staying in step with the stack. Because there is a last-in first-out memory in the stack everything stays coordinated, and as a result, the stack pointer always points to the top address in the stack. (The process of writing into the stack is often referred to as *pushing*, while reading out of the stack is called *popping*. These terms apply only to the stack.)

How does the stack pointer start with the first address in the stack? Remember initialization? During



## Symcures Wanted

**Electronic Servicing and Technology** needs a broader variety of television Symcures. Especially needed are reports of Quasar, General Electric, Sylvania (or Philco), Sony Sears and Magnavox.

Symcures are, by definition, solutions to problems that have been encountered during the repair of *more than one* television set of the same make and model, and that may reasonably be expected to be a source of *recurrent* failure.

Please give the brand, model number, Photofact number, a brief description of the symptoms, a rough hand-drawn schematic of the area containing the defect, and a short description of the cure (including whether the defective component was open, leaky, shorted or intermittent).

ES&T editors will adapt the material to the Symcure format and have Photofact-style schematics prepared.

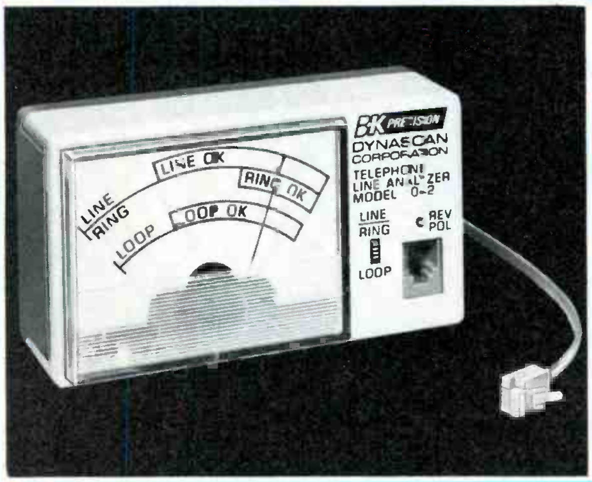
Send seven Symcures each time. Only six will be published, but the extra gives the editor a spare for one already printed in the past (or otherwise not suitable to the format). $30 will be paid for each page of six actually published (remember to include full name and address).

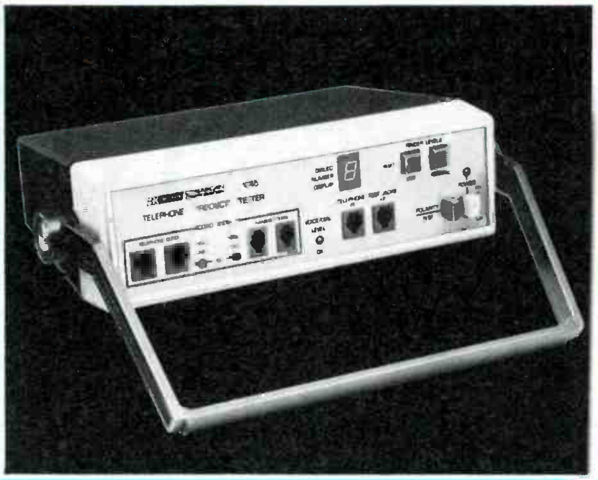
Send to: Symcure Department
Electronic Servicing and Technology
P.O. Box 12901
Overland Park, Kansas 66212

# NEW! The first complete line of telephone testers designed for the phones you sell.

From B&K-PRECISION, the Test Instruments Group of Dynascan Corporation...

makers of Cobra Telephone products



**For quick line checks**

## the telephone line analyzer

Allows you to quickly determine if the problem is in the phone itself or in the phone company lines. Tests for telephone line and ringing circuit operation and for defects in the telephone line cord. Small, compact, fast and easy to use. No external power required. No batteries to replace. Blister packed for quick merchandising; the Model 1042 sells itself at a suggested retail price of **$19.95**

**For comprehensive performance tests**

## the telephone product tester

An in-shop or in-store tester that can be a profit source when you charge for telephone testing. A great way to instantly check-out customer returns. Tests corded and cordless phone operation and automatic phone dialers for all basic functions; defects in line and hand set cords, tone or pulse dial operation, ringing circuit operation, sound volume and voice quality. Can also be used by non-technical personnel to screen returns before giving them to repair technicians. Statistics show that over half the returns are good.
Model 1045 – **$395**

## For your service department

**Coming soon!**
The Model 1047 cordless telephone tester allows full radio frequency testing and alignment of base and portable units of cordless phones, without expensive signal generators and deviation meters.

**Coming soon!**
The Model 1050 telephone analyzer combines the features of the 1045 and 1047 for full analyzing and servicing of corded and cordless phones, answering machines and automatic dialers.

**LEARN MORE AT YOUR LOCAL B&K-PRECISION DISTRIBUTOR**

B&K PRECISION DYNASCAN CORPORATION

6460 West Cortland Street • Chicago, Illinois 60635 • 312/889-9087

International Sales, 6460 W. Cortland St., Chicago, IL 60635
Canadian Sales, Atlas Electronics, Ontario
South and Central American Sales, Empire Exporters, Plainview, NY 11803

Circle (8) on Reply Card


initializing, the stack is first cleared of any old addresses held in the stack, and the first step is then loaded into the stack.

### Uses of the stack

The stack is used to preserve the *status* of the MPU when interruptions are required in the operation of the MPU. The word status means the conditions of all the registers, etc. When a situation arises that requires interrupting the normal routine of the MPU, all of the various registers have their contents transferred in an orderly sequence into the stack. The information is held in the stack, and when the MPU goes back to its normal routine, the contents of the stack are transferred back into the registers. (Everything goes back to where it came from originally, thanks to the action of the LIFO stack and its stack pointer.)

What sort of circumstances would require interruption of the normal operations of the MPU? One common example is a teletype input, which from time to time receives incoming messages. If the MPU does not accept the data from the teletype it may be lost, so the teletype has a priority, which enables it to interrupt whatever the MPU is doing. After the teletype has finished, the MPU goes back to its normal routine. Sometimes the programmer may wish to interrupt an operation in progress, go on to something else momentarily, then go back to the original operation. These interrupts are handled with the aid of the stack.

We have now covered the purpose and operation of the various blocks in Figure 2, the architecture (organization) of a typical MPU. However, there are some things that are not usually shown in MPU block diagrams such as the *condition code register* (CCR), also known as the *status register* or *flag register*. This register is really a group of *flags*. (A flag is simply a flip flop that changes state to indicate a certain event has occurred.) Just one example: One of the flags in the flag register is the *zero* flag. If this flag is in the *set* state (high), it indicates that the result of a previous operation was zero, or the binary word 00000000. This is useful because the accumulator holds the result of arithmetic operations, and the zero flag indicates that the accumulator is empty and therefore available for use. If there is a number other than zero in the accumulator, the zero flag would be reset (low). The CCR may have up to eight flags, monitoring the status of various parts of the MPU. The reason the CCR is often not mentioned is that references are made to the individual flags instead, such as *the zero flag.* The *negative flag* indicates that the result of the arithmetic operation was a negative number.)

### Instruction cycles

The steps involving the execution of a program instruction are broken down as follows: a complete instruction cycle is executed in two main steps, termed fetching and executing. Fetching is reading the desired instruction out of the memory and transferring it into the instruction register. Each of these two steps is further divided into smaller steps called machine cycles. Machine cycles are divided into even smaller steps controlled by the clock. Many microprocessors use a multiphase clock, in which each clock cycle is divided into smaller time intervals called states. A machine cycle usually is three to five states long, and that is about as close as you can get in getting a feeling for the movements involved in an instruction cycle.

Look at what happens when a macroprogram, which has been entered into the RAM in a series of program instructions, is read out of the RAM during the fetch cycle, one address at a time. (The program counter increments after each instruction is read out in turn.) During the fetch cycle, the various flags in the CCR are periodically examined. The CCR provides information about the status of the MPU's various sections, which enables the control unit to decide what actions can take place. For example, information cannot be placed into a register until the register is cleared.

The macroinstruction that has been fetched from the RAM is decoded into a series of microinstructions needed to execute the macroinstruction. After this has been done, the second macroinstruction is fetched and so on. Decoding is done by a decoder, a circuit that converts binary into some other system of numbers. The instruction decoder is merely a binary coded decimal (BCD) to decimal decoder, which results in an output appearing on one of the decoder's output lines (instruction lines).

The entire series of microinstructions required to complete a macroinstruction is known as a *microroutine*. Restating the above in another way, the instruction decoder recognizes the MPU's instruction set and generates the internal commands needed to execute them. Each individual step, such as moving data into or out of an accumulator, is the result of a microinstruction from the control unit. By means of the proper sequence of control signals, which control the various sections of the MPU, the control unit is able to originate a series of microinstructions that together are a macroinstruction. This process is instruction decoding.

### Coming up

The next article about MPUs will discuss how the MPU addresses the memory (RAM) and how the MPU interfaces with input/output devices. Remember, everything in the MPU works in parallel format, eight bits at a time, but the telephone line has only a pair of wires, and therefore must handle binary information in serial form one bit at a time. There must therefore be some means of converting serial to parallel in order to input information, and parallel to serial in order to output information. ES&T

# AVOIDING ELECTROSTATIC-DISCHARGE DAMAGE

Static electricity is a problem in the electronics industry because of its ability to damage certain electronic parts. If the discharge happens to pass through an integrated circuit, the resulting current flow through the device can raise the temperature of internal junctions to their melting point. Devices such as Metallic Oxide Semiconductors (MOS) are voltage and field sensitive. Breakdown occurs whenever the voltage across the structure exceeds its dielectric strength. The resulting damage can range from complete destruction to latent degradation that results in limited life and premature field failure. Test your "ESD I.Q." When you check the answers you may be in for some surprises.

### Technology quiz on electrostatic discharge

1. In order to feel a static discharge, the voltage level (in volts) must be at least:
   (a) 50
   (b) 100
   (c) 1000
   (d) 4000
   (e) 5000

2. An electrostatic charge can be generated by:
   (a) walking across a carpet
   (b) walking across a vinyl floor
   (c) handling a plastic bag
   (d) picking up a box from a table
   (e) working at a bench.

References
1. Electrical Overstress/Electrostatic Discharge EOS/ESD Symposium Proceedings, Reliability Analysis Center, Griffis AFB, 13441 (1979, 1980 & 1981).
2. "Control Electrostatic Discharge Damage to Semiconductors," IEEE Proceedings, 12th Annual Reliability Physics Symposium (1974).

All integrated circuits and many other semiconductors are electrostatically sensitive and therefore require the special handling techniques described under "Electrostatically Sensitive (ES) Devices" in the *Servicing Precautions* section of basic service data.

Adapted from the RCA Communicator, Vol. 8, No. 1

3. The conductive skin of workers who handle sensitive devices must always be grounded. Wrist ground straps provide the most convenient method. The wrist strap should be connected directly to ground through a resistance. The resistance should be:
   (a) 100Ω
   (b) 1000Ω
   (c) 100kΩ
   (d) 250kΩ
   (e) 1MΩ

4. The most commonly used value corresponding to human body capacitance is:
   (a) 0.10-20pF
   (b) 100-200pF
   (c) 500-600pF
   (d) 1000-2000pF
   (e) 4000-5000pF.

5. Which of the following are susceptible to damage from ESD?
   (a) MOS structures
   (b) bipolar junctions
   (c) metallization runs
   (d) piezoelectric crystals
   (e) film resistors.

6. The ESD voltage range that should cause concern to the electronics industry begins at:
   (a) 100V
   (b) 500V
   (c) 1000V
   (d) 4000V
   (e) 7000V

7. What is a typical electrostatic voltage level generated by opening a vinyl envelope or bag under low humidity conditions?
   (a) 100V
   (b) 500V
   (c) 1000V
   (d) 3000V
   (e) 7000V

8. Which of the following materials would be suitable for nonstatic generating work surface or packaging material?
   (a) unfinished wood
   (b) paper
   (c) carpet
   (d) cardboard
   (e) plastic bubble pack.

### Handling static-sensitive devices

The EIA standard ESD caution symbol shown here is used extensively in service data and on replacement parts packages to remind technicians to use caution when servicing and handling assemblies that contain elec-

# N.A.P. Lowers Prices ON VCR PARTS

## VCR parts prices have just undergone a major repair.

Now N.A.P. offers you a more competitive price on top of all their other advantages. Quick service. Dependable supply. Compatible with many VHS models of other brands such as RCA, Quasar, G.E. and Panasonic. Plus the kind of consistent quality you've come to expect from the name behind names like **Magnavox, Sylvania** and **Philco.**

So, erase last year's price lists. Shop and compare. You'll find our new lower prices another great reason to stock N.A.P. parts.


NAP **CONSUMER ELECTRONICS CORP.**
**Product Services Operation**
P.O. Box 309, Dept. 849
Greeneville, TN. 37744-0309
1-615-639-1121, Ext. 5803

A North American Philips Company

Circle (9) on Reply Card

trostatic sensitive (ES) devices.

As indicated in the text accompanying the symbol, special handling techniques are required for ES devices. The portion of the "Servicing Precautions" section of service data relating to handling of ES sensitive devices is reproduced below.

Some semiconductor (solid-state) devices can be damaged easily by static electricity. Use the following techniques to help reduce the incidence of component damage caused by static electricity.

1. Immediately before handling any semiconductor component or semiconductor-equipped assembly, drain off any electrostatic charge on your body by touching a known earth ground. Alternatively, obtain and wear a commercially available discharging wrist strap device, which should be removed for potential shock reasons before applying power to the unit under test.
2. After removing an electrical assembly equipped with ES devices, place the assembly on a conductive surface such as aluminum foil, to prevent electrostatic charge buildup or exposure of the assembly.
3. Use only a grounded-tip soldering iron to solder or unsolder ES devices.
4. Use only an anti-static type solder removal device. Some solder removal devices not classified as "anti-static" can generate electrical charges sufficient to damage ES devices.
5. Do not use freon-propelled chemicals. These can generate electrical charges sufficient to damage ES devices.
6. Do not remove a replacement ES device from its protective package until immediately before you are ready to install it. (Most replacement ES devices are packaged with leads electrically shorted together by conductive foam, aluminum foil or comparable conductive material.)
7. Immediately before removing the protective material from the leads of a replacement ES device, touch the protective material to the chassis or circuit assembly into which the device will be installed.
   *Caution:* Be sure no power is applied to the chassis or circuit, and observe all other safety precautions.
8. Minimize bodily motions when handling unpackaged replacement ES devices. (Otherwise harmless motion such as the brushing together of your clothes fabric or the lifting of your foot from a carpeted floor can generate static electricity sufficient to damage an ES device.

**Replacement parts**

Replacement devices identified as static sensitive include the symbol and the words "static sensitive" printed on each package. Various protective packaging methods are used – depending on the degree of susceptibility. A simple paper or cardboard box may be sufficient for a power transistor, diode or SCR. ICs and other sensitive devices require a more sophisticated approach to ESD protection – such as conductive foam, shorting bars, etc. In many instances large printed boards and/or assemblies are wrapped in conductive plastic to provide overall ESD protection.

An additional word of caution: Treat the "defective" parts with the same respect as the new replacement parts installed during service. If a replacement component, module, or printed circuit board is received in protective packing, return the "defective" part in the same packing. ES&T

## Answers to ESD quiz

1. *d.* It is not until such discharges are of approximately 4000 volts that they can be felt, such as when one touches a metal doorknob after crossing a carpet. Many sensitive devices, however, are damaged by lower potentials that are not perceptible.

2. *All.* An electrostatic charge is caused by the separation of surfaces resulting in electron transfer and an excess or deficiency of electrons on a surface.

3. *c,d, or e.* They would bleed off the static charge. 250kΩ may be the preferable value as it would allow enough sensation to warn the operator should he or she contact an exposed circuit. 100kΩ would provide an increased sensation, and 1MΩ probably would not warn the operator of exposure to a live circuit.

4. *b.* The capacity of a person is a function of his or her proximity to other objects and can change during simple movements.

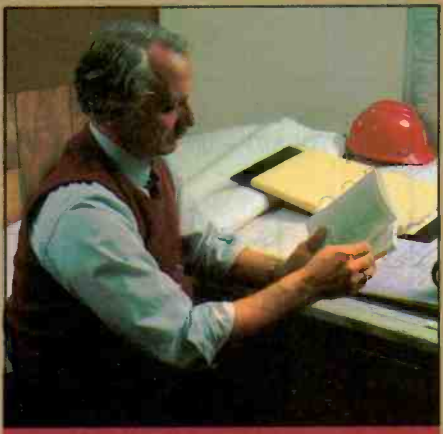
5. *All.* a,b,c,d can be destroyed or seriously degraded. Also, e, because even some passive devices, such as film resistors and chip components, can also be zapped by ESD. The most common degradation results in a change of value.

6. *a.* The range of ESD sensitivity begins at 100V for MOSFET devices, 150V for some bipolar functions, 250V for CMOS and 300V for Schottky diodes and TTLs. Newer technologies will be sensitive below 100V.

7. *e.* This surprisingly high potential can easily be measured by an inexpensive hand-held static meter.

8. *a,b, & d.* Commonly used packaging materials such as plastic bags, bubble pack, and styrofoam are hazardous to use for sensitive parts. Most man-made materials are unsafe for such use.

# Sams Books.
# For Job Security



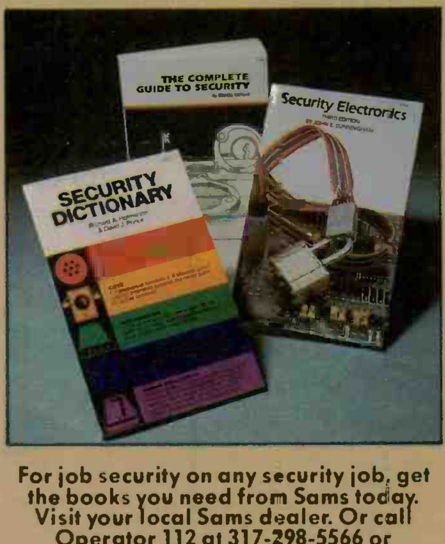
# On Any Security Job.

If you're a business owner breaking into the security market, an electronics designer developing new crime controls, or already active in the security field, you need Sams books. Because when it comes to security electronics, Sams knows all about it.

Technicians of all levels trust Sams for books that are easy to read and understand, no matter what the subject is. Fact is, Sams has been a leading publisher of technical books since 1946.

So if you'd like to learn more about security systems, these Sams books can help:

For a broad overview of security and how it can prevent crime, read THE COMPLETE GUIDE TO SECURITY. It covers every security measure from ordinary door locks to sophisticated alarm systems for home, business, car, apartment and travel applications. Includes a glossary of common security words and slang expressions. No. 21955, $13.95.




**For job security on any security job, get the books you need from Sams today. Visit your local Sams dealer. Or call Operator 112 at 317-298-5566 or 800-428-SAMS**

SECURITY ELECTRONICS (3rd Edition) provides a more detailed look at the many security devices available: electromagnetic detectors, photoelectric detectors, infrared detectors, intrusion alarms, data encoders, electronic eavesdropping devices, and more. Circuit diagrams and illustrations show you how they work and when they're used. This book is a must for students and engineers interested in security electronics. No. 21953, $13.95.

THE SECURITY DICTIONARY is the first comprehensive volume that brings together definitions and descriptions of the terms and products associated with the security field. It covers video equipment, computer hardware and software, ultrasonics, fiber optics, biometric ID, infrared sensors and microwaves. It's the perfect on-the-job reference for security system designers and installers. No. 22020, $8.95.

SAMS™

**What Technology Is All About.**

HOWARD W. SAMS & CO., INC.
4300 West 62nd Street, P.O. Box 7092, Indianapolis, IN 46206

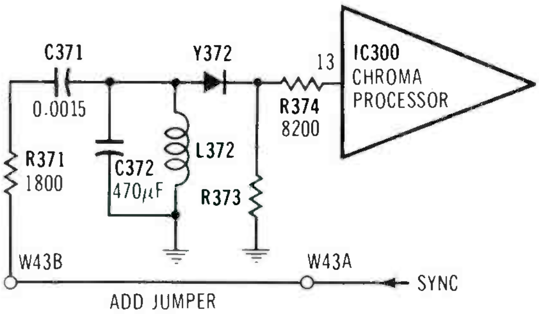
Offer good in USA only. Prices and availability subject to change without notice. In Canada, contact Lenbrook Electronics, Markham, Ontario L3R 1H2.

**Circle (10) on Reply Card**

# Symcure

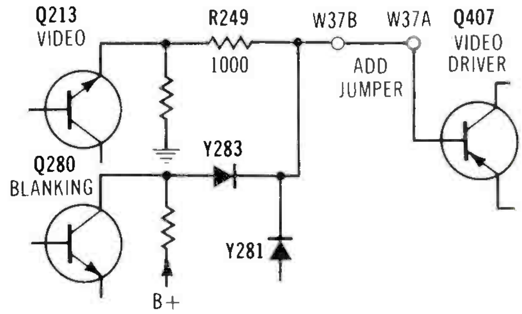
**Symptoms and cures compiled from field reports of recurring troubles**

**Chassis** – General Electric EC or EM 1
**PHOTOFACT** – 1918-1



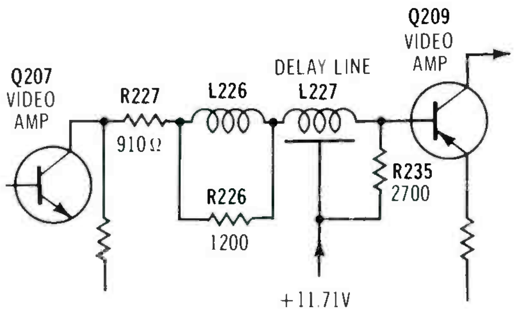

**Symptom** – Intermittent loss of color or color locking
**Cure** – If area around griplets W43A and W43B causes problem when moved, add an insulated jumper wire soldered between those points.

**Chassis** – General Electric EC or EM 2
**PHOTOFACT** – 1918-1



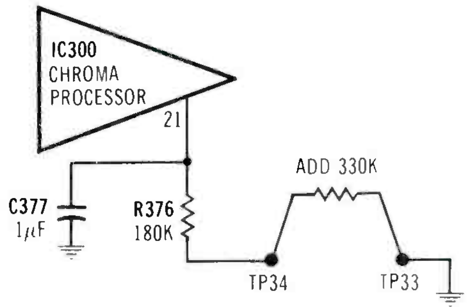

**Symptom** – No raster, but HV and audio are normal
**Cure** – Add an insulated jumper wire between griplets W37A and W37B.

**Chassis** – General Electric EC or EM 3
**PHOTOFACT** – 1918-1



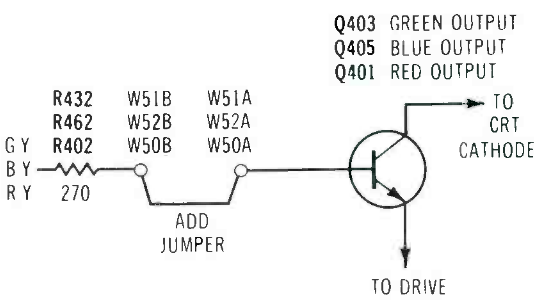

**Symptom** – No raster, but HV and audio are normal
**Cure** – If video is lost between Q207 and Q209, replace the delay line.

**Chassis** – General Electric EC or EM 4
**PHOTOFACT** – 1918-1



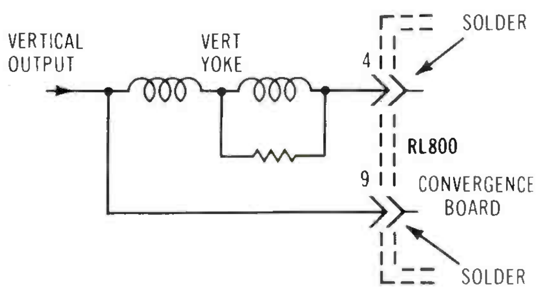

**Symptom** – Erratic or no color on some cable or translater channels
**Cure** – Add a 330k ½W resistor between testpoints **TP33** and **TP34** (this decreases sensitivity of color killer).

**Chassis** – General Electric EC or EM 5
**PHOTOFACT** – 1918-1




**Symptom** – Magenta, cyan or greenish-yellow raster
**Cure** – Add insulated wire jumpers, as shown, in the base circuits of all three color-output transistors.

**Chassis** – General Electric YC-2 6
**PHOTOFACT** – 1664-1




**Symptom** – Intermittent loss of height
**Cure** – Remove convergence board and check for broken solder connections at RL-800 pins 4 and 9. Resolder them.

# QUALITY RUNS IN THE FAMILY

Model SC-1018*

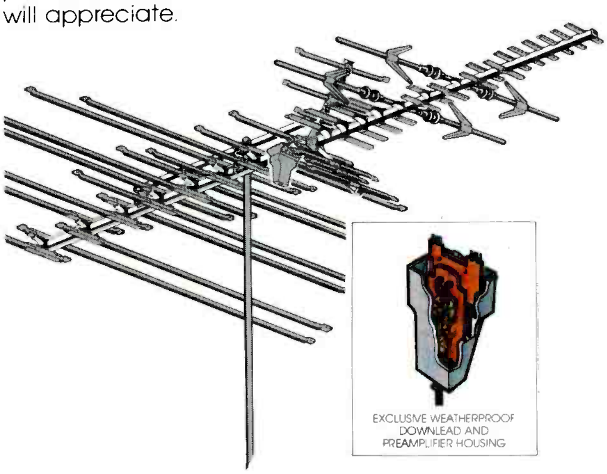
The quality of the picture on your television set hinges on the sensitivity and accuracy of the antenna. Whether it's broadcast television or satellite TV, the Winegard axiom still applies, "Your TV reception is only as good as the receiving antenna."

No matter if you have the most sophisticated TV set on the market or latest state-of-the-art satellite video receiver, you can still have bad pictures. The most important component in an outdoor TV antenna or satellite TV system is the antenna . . . the critical pont at which the signal is received.

Winegard has been an industry leader in the innovation, engineering and manufacturing of outdoor TV antennas for 30 years. We recognize the importance of a quality receiving antenna to maximize reception performance. We have taken our expertise and applied it to satellite dish technology. The end result is the most advanced consumer satellite TV dish ever introduced!

## A CLEARLY SUPERIOR SEE-THROUGH DISH

Winegard's new 10-foot perforated aluminum dish has a sharp, clean look of quality. It's a new level of dish technology offering advantages other see-through dishes can't deliver . . . like 39.5dB gain, F/D "Deep Dish" ratio of 0.283, lightweight but rugged construction, super-easy assembly, anodized protection, high performance and a look of class that your customers will appreciate.



EXCLUSIVE WEATHERPROOF DOWNLEAD AND PREAMPLIFIER HOUSING

Winegard's dish is shipped in four quarters and requires just 16 stainless steel nuts and bolts and 20 to 30 minutes for assembly. Four complete 10-foot perforated satellite systems that include antenna, pedestal or post mount, back-up structure, Polarotor I, 24-channel receiver, LNA, wire and choice of motorized or non-motorized are available.

## CHROMSTAR II™ - ALL THE BEST FEATURES

Best performance! Highest quality! Finest construction! Competitively priced! Antennas engineered in the Winegard tradition of quality and craftsmanship.

Chromstar II antennas feature sharp directivity and high gain. They're rugged. High tensile aluminum alloy tubing provides rigidity and stability, and each antenna boasts famous Winegard anodizing. Super-tough construction throughout.

Winegard also features a complete Chromstar II line of preamplifiers for every conceivable application with solid-state design, superior performance, and completely weatherproof protection.

Compare Winegard Chromstar II antennas and preamplifiers with competitive models. You'll see, Chromstar II antennas and preamplifiers set the standard.

*Patent Pending

FOR SALES INFO CALL (319) 753-0121

WINEGARD® TELEVISION SYSTEMS

PRINTED IN U.S.A. WINEGARD COMPANY • 3000 KIRKWOOD STREET • BURLINGTON, IOWA 52601

**Circle (4) on Reply Card**

# Satellite receiving systems

By Martin Clifford, technical consultant,
KLM Electronics

As TV frequencies become higher, they assume quasi-optical properties, so the best path between a TV station and TV receivers is line of sight, with no signal-reflecting hills, bridges, buildings or terrain between them. This is so fundamental that in the early days of TV broadcasting various proposals were made to have TV transmitters in planes circling at about 10,000 feet. A more practical approach was to put the TV transmitting antennas on the top of the tallest buildings.

Line-of-sight TV transmission presents serious problems in areas having high hills and mountains. These are solved by putting the transmitting antenna on a mountain top, processing the TV signal by using repeater amplifiers and delivering it via coaxial cable to valley dwellers. Known as community antenna TV (CATV), this was the forerunner of the cable systems we have today.

It wasn't until satellites came along that the entire United States could have access to television. The first satellite to transmit TV pictures was Telstar, launched in 1962. Telstar, however, rotated rapidly around the earth, taking its transmitted signals along with it. TV pictures could be received from Telstar until the earth interposed its bulk between its transmitters and home TV receivers.

This is the first in a series of articles that will describe consumer-owned satellite receiving equipment. The series will continue for the next several issues and will include vital information such as troubleshooting TVRO systems, what is coming in Direct Broadcast Satellite transmission, and a discussion of whether current TVRO systems will be able to receive DBS broadcasts.

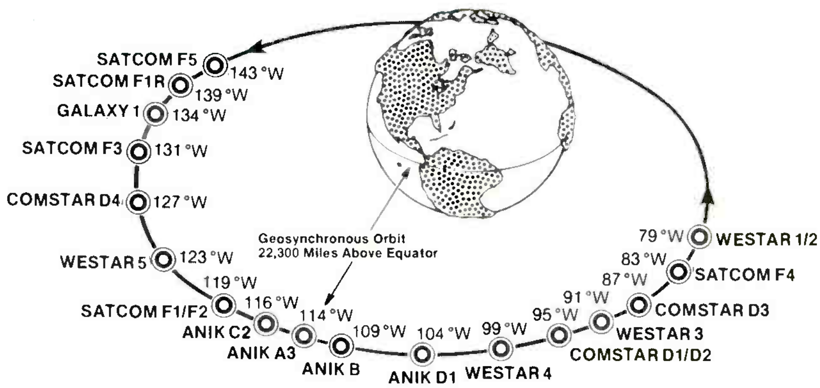



**Figure 1.** All communications satellites are in orbits directly above the equator, traveling in the same direction as the earth's rotation and at the same speed, so they appear to be stationary above a spot on the earth's surface. They are said to be "geosynchronous," or "geostationary."

*(Illustration courtesy of SAT-Guide/CommTek Publishing Company.)*

### Geosynchronous orbit

If a satellite is put into orbit fairly close to earth, possibly a hundred or so miles above the surface, its speed is such that it exceeds the speed of the earth's rotation. But, put that same satellite some 50,000 miles out and its rotation will lag behind that of the earth. Between these two extremes, 22,300 miles above the equator, a satellite will appear suspended in space. The satellite seems fixed above a spot on the earth's surface, although both the earth and the satellite are rotating, because one orbital day for a satellite is equivalent to one rotational day for the earth. Such satellites are known as geostationary or geosynchronous (Figure 1).

Each North American satellite, and there are now about 15, occupies a specific position or orbital slot, but the total number of satellites in space around the earth is increasing.

Because satellites are in an arc 22,300 miles above the equator, a single satellite can *see* about one-half the surface of the earth, so just a pair could supply worldwide television. However, space is too valuable to limit it this way, with the result that satellites are spaced at about 4 degrees. Because the orbital path is a circle and because any circle, regardless of size is 360 degrees, this indicates a maximum possibility of 90 satellites. The distance from one satellite to another is 1838 miles with a single orbit covering a distance of 164,884 miles.

### How it works

Basically, every satellite is a repeater station. TV programs produced on earth are beamed up to a selected satellite. The signal is picked up by a transceiver, a combined receiver/transmitter or transponder is amplified, changed in frequency, and then beamed back to earth. Because of the height, there is no signal interference, and ghosts caused by signal reflections are completely absent. The picture is free from electrical interference and is studio monitor quality, but the actual quality of the TV signal is determined by the TV receiver in the home. HDTV, high-definition television, if and when it arrives, will come via satellite.

### TVRO

Satellite TV starts with an earth station that can receive programs live from a studio, or which can use prerecorded videotapes or videodiscs. As a check on the signals it transmits to its satellite, the earth station has receiving equipment, so an earth station is a 2-way setup.

TV viewers require just half this setup and are concerned only with *receiving* TV signals. Such a satellite receiving system is called a TVRO system, a television receive only arrangement.

### TVRO and the law

In the early days of satellite TV, the FCC required licenses for both transmission and reception. However, on Oct. 10, 1979, the FCC removed the licensing restriction for receiving satellite signals. Anyone can install a TVRO system without a federal license provided the TVRO is not for commercial use. The sale of TVRO equipment and its use is legal. The ruling by the FCC has been interpreted to mean that even commercial enterprises – hotels, motels, bars, hospitals, high-rise apartment houses and condominiums – cannot only use satellite programs, but can distribute them on a "free" basis to multiple viewers.

### Installation

In the early days of color TV, installation was an important part of the purchase because critical adjustments needed to be made to the TV set in the home. That is approximately the position of satellite TV today. The most conspicuous part of a TVRO is its dish, a metallic reflector whose average diameter ranges from about 8 feet to 15 feet, although some are smaller or larger.

The dish (Figure 2) must have a

**Figure 2.** The TVRO dish is a reflector that focuses signals received over a large area onto the opening of a small section of waveguide. The antenna is a probe about 1-inch long mounted at the end of the waveguide.

clear view of those satellites whose signals are to be received. This line of sight means there must be no obstructions in the way – no bushes, trees, buildings, poles, walls, hills or signs. Further, the dish must be able to tolerate wind stress so it must be securely supported, generally by wooden or metallic members anchored in concrete. Depending on conditions, in some areas satellite TV reception will be impossible. In others, just one or two satellites will be available, while in some locations the signals of all the satellites will be used.

### Uplink and downlink signals

Signals sent from an earth station to a satellite, known as uplink signals, are in the frequency range of 5920MHz (5.92GHz) to 6400MHz (6.4GHz). The transponder in the satellite downconverts these to 3720MHz (3.72GHz) to 4182MHz (4.182GHz).

### The dish

Sometimes mistakenly called an antenna, the dish collects the downlink signals and, similar to the reflector in an auto headlight, focuses the received signals onto the opening of a small section of waveguide mounted so it faces the front center of the dish, but a few feet away from it. The waveguide, whose entrance is called a feed, is just a small section of transmission line. A probe, with a length of about 1 inch, is mounted at the end of the waveguide and is the antenna.

### The LNA

From the antenna probe the signal is fed into a preamplifier, actually a high-gain, solid-state preamp, using special transistors such as GaAsFETs and bipolar transistors. Known as a low noise amplifier (LNA), the gain of the these units is in the range of 100,000.

### The downconverter

Because the dish is located outdoors, the signal, still in the gigahertz range at the output of the LNA, must be delivered to a satellite receiver in the home. This could be done via coaxial cable, but the signal losses would be severe. Consequently, the LNA, mounted close to the dish, is followed by a downconverter, a component that converts the frequency of the signals down to 70MHz. The frequency conversion is similar to that taking place at the input side of any superheterodyne. Downconversion is accomplished by a mixer stage whose output is 70MHz. This frequency can be regarded as the intermediate frequency output of the downconverter.

In some installations, the LNA and downconverter form an integrated unit; in others, they are separate components. Whatever the arrangement, the LNA and

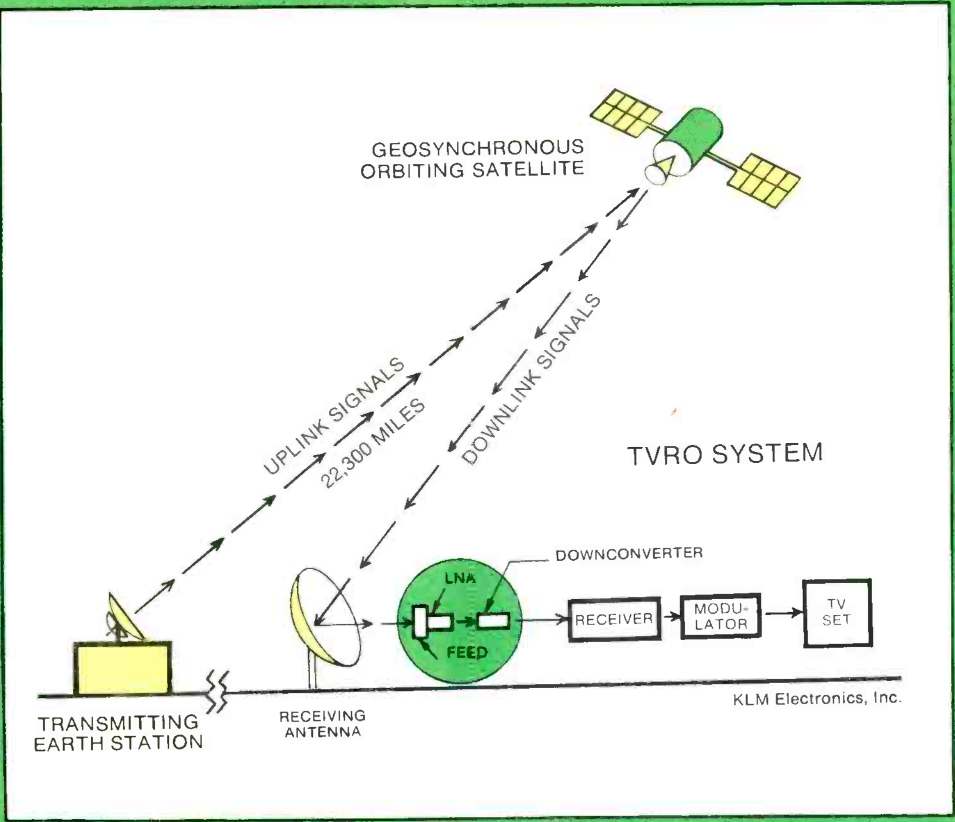
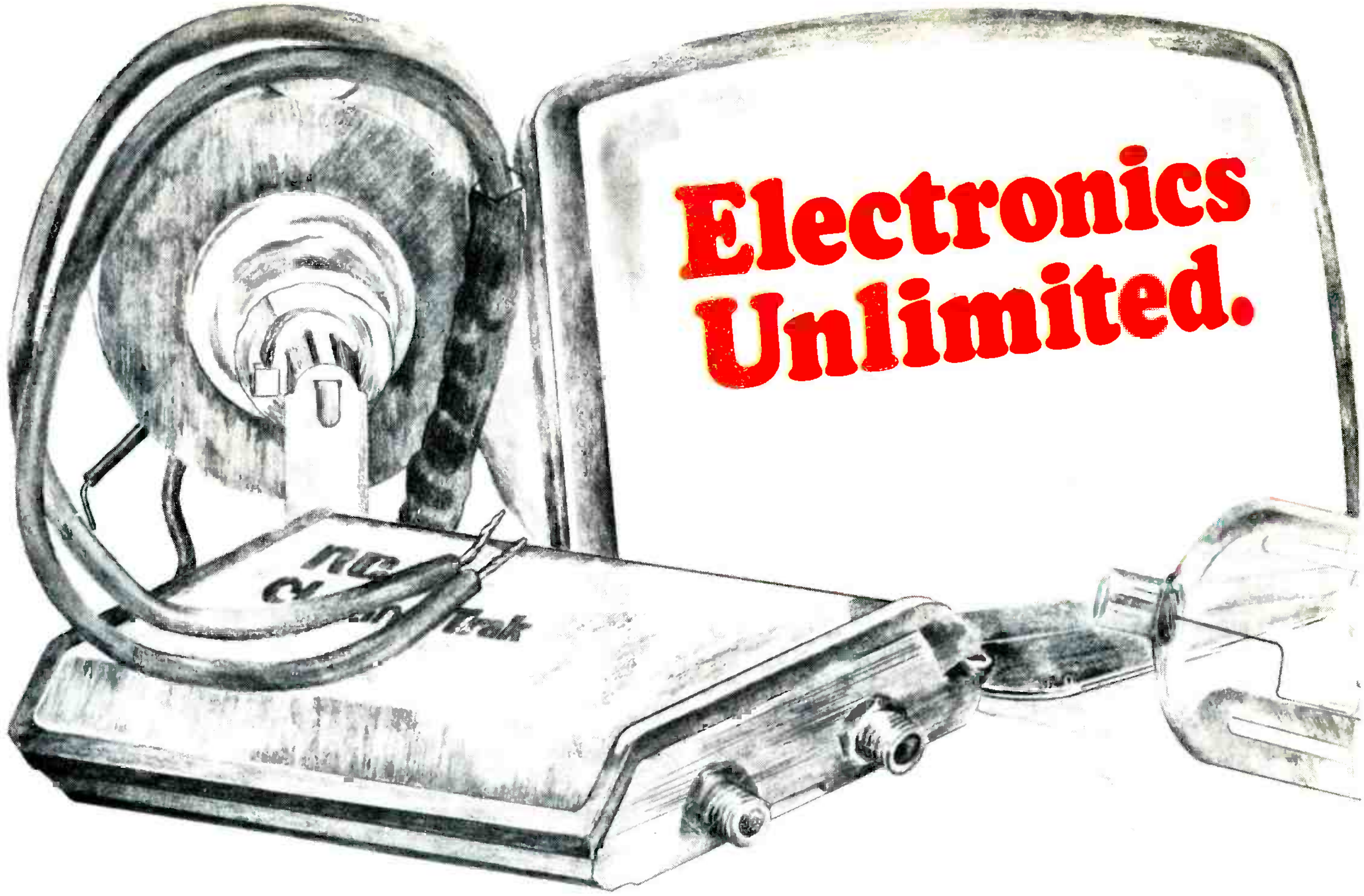
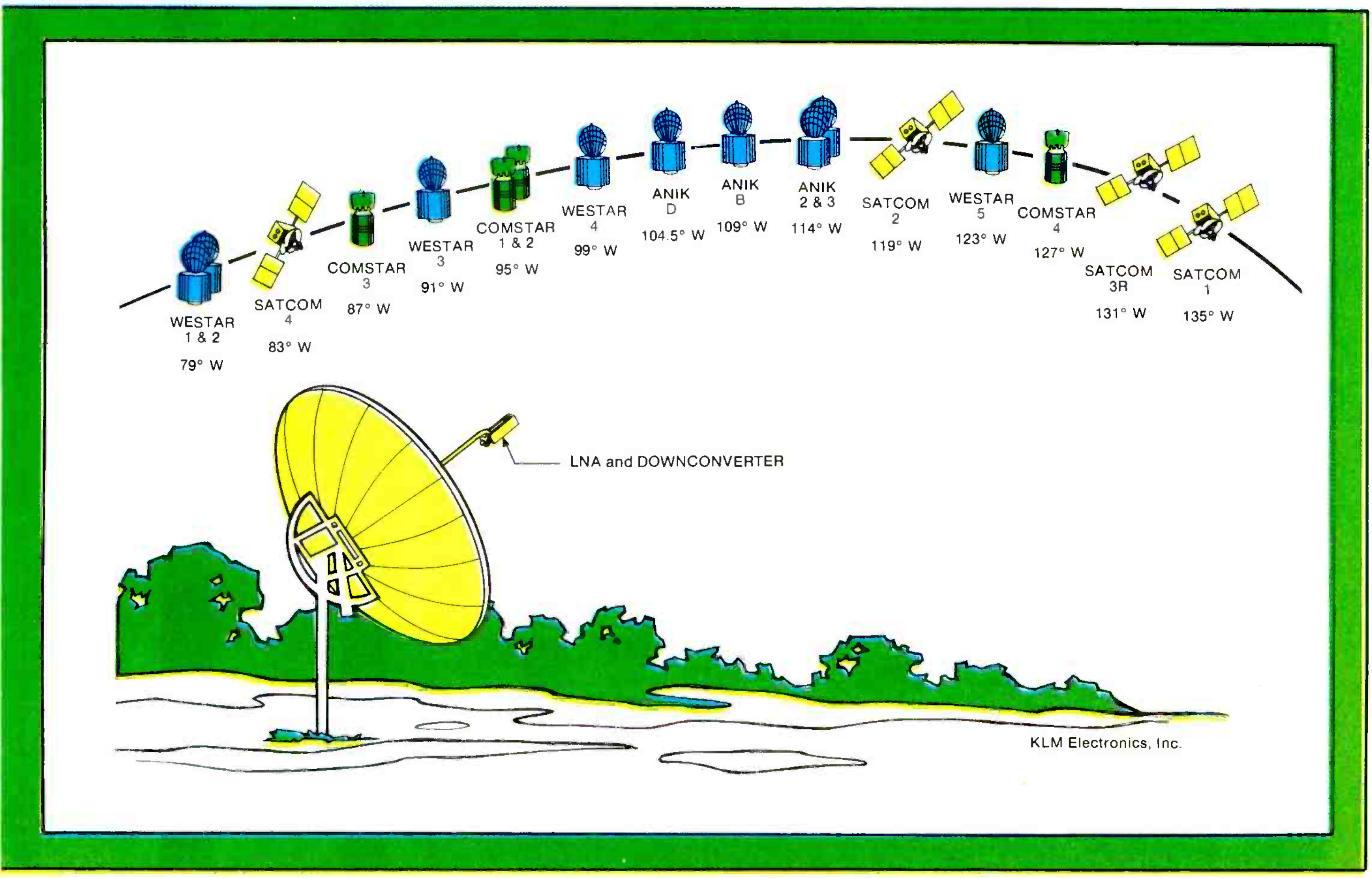



**Figure 3.** In a TVRO system, once the signal is picked up by the antenna it is amplified by the low-noise amplifier (LNA), downconverted to 70MHz and sent via coaxial cable to a satellite receiver. The modulator, frequently included in the satellite receiver, is required to convert the signal into a form usable by the TV set.

# Electronics Unlimited.





downconverter, which are mounted outdoors, must be housed in a waterproof enclosure.

### The satellite receiver

The 70MHz output of the downconverter is delivered to a satellite receiver in the home via coaxial cable. Unlike terrestrial broadcasts in which the video signal is amplitude modulated and the sound signal is frequency modulated, the downlink signals (audio and video) are FM. This isn't an arbitrary choice because the low level of the received signal makes it an easy target for interference from electrical noise, which is a type of AM.

Because the audio and video satellite signals are FM, they are not suitable for input, as is, to the antenna terminals of the TV receiver. At this time, two changes must take place. The audio and video signals must be stripped (demodulated) from the IF carrier. They must then be used to modulate a carrier whose frequency is acceptable at the input of the TV receiver.

**Figure 4.** Satellites are spaced four degrees apart above the equator. The TVRO dish must be aimed directly at a satellite, either manually or by a motor, in order to receive signals from that satellite.

### The modulator

Following the demodulation process in the satellite receiver the signals are modulated onto a carrier. This carrier can have a frequency corresponding to VHF Channel 3 or 4. The type of modulation used is that of an NTSC signal; it is FM modulation for the audio, amplitude modulation for the video.

The satellite receiver may be an integrated unit containing a modulator, or the modulator may be a separate component. The advantage of the integrated unit is that fewer external connections are required (Figure 3).

In the rather unlikely condition that the TV receiver is intended only for satellite TV (Figure 4), the output of the modulator can be connected to the antenna input terminals. However, because the TV set will probably be used for VHF, UHF and a VCR, and possibly a video game, computer screen, or some combination of these devices, a signal switcher is desirable. The alternative is to switch program sources at the antenna input terminals, which would be a nuisance.

### Stereo

Because satellite TV, unlike regular broadcast TV, has a stereo capability, the sound output can be fed into the preamp of a hi-fi system. The TV set can also be used for sound reproduction, but this is mono only. TV sets are not noted for audio quality.

### The commercial aspect

Satellite TV is a growing, booming market with benefits all around. It is a way of bringing broadcast television to many homes that have either had no television or just one or two stations. For technicians it offers opportunities in installation, repair and maintenance. For dealers it means sales, not only of the original TVRO equipment, but aftermarket add-on components and maintenance service contracts. ES&T

# Test your electronic knowledge

By Sam Wilson, ISCET test director

These questions are similar to questions used on the various CET tests. All questions on the actual CET test are multiple choice, and a grade of 75 percent or better is required for passing. These questions are related to general subjects in the associate level CET test. (Answers on page 65.)

1. Which of the following statements is correct regarding a Class A NPN transistor amplifier?
   A. Increasing the gain of the amplifier automatically increases its bandwidth.
   B. Increasing the gain of the amplifier automatically decreases its bandwidth.
   C. The gain and the bandwidth of the amplifier are not related in any way.

2. Which of the following statements is correct regarding a Class A PNP transistor amplifier?
   A. Its base should be negative with respect to its collector.
   B. Its collector should be negative with respect to its emitter.
   C. Its emitter should be negative with respect to its base.
   D. All of these statements are correct.

3. Adding an RF amplifier will
   A. increase the total noise generated in the receiver.
   B. decrease the total noise generated in the receiver.
   C. not affect the receiver noise.

4. Which of the following has no influence on the impedance of a parallel-lead transmission line?
   A. The diameter of the conductors.
   B. The distance between the conductors.
   C. The length of the conductors.

5. Which of the following statements is correct when comparing a "condenser" microphone with a carbon microphone?
   A. Both require a dc current for their operation.
   B. The "condenser" microphone has a better low-frequency response.
   C. Both work best in a vacuum.
   D. Both require a dc voltage source.

6. If you wind an inductor with a bifilar winding, it will have
   A. maximum inductance and minimum inductive reactance.
   B. minimum inductance and maximum inductive reactance.
   C. maximum inductance and inductive reactance.
   D. Minimum inductance and inductive reactance.

7. The following question concerns power supply filters: When comparing a capacitive input filter with a choke input filter,
   A. the capacitive input filter will result in a higher output voltage.
   B. The choke input filter will result in a higher output voltage.

8. Esaki diodes are also called
   A. tunnel diodes.
   B. Shockley diodes.
   C. Schottky diodes.
   D. light-emitting diodes.

9. Voltage is a unit of
   A. power.
   B. force.
   C. work.
   D. mechanical advantage.

10. In a certain AM receiver the signal is detected by heterodyning it with an oscillator signal. This is an example of
   A. an envelope detector.
   B. a slope detector
   C. a product detector.
   D. a bead-ledge detector.

ES&T

# Books

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

**Crash Course in Microcomputers, Second edition, by Louis E. Frenzel Jr.; Howard W. Sams & Company; $21.95 paperback.**

This updated edition begins with basic concepts and definitions of terms before it starts readers on a detailed introduction to computer-system components and architecture. From there, the author covers subjects such as input/output and storage device peripherals, software, programming, applications and more.

The book contains new chapters covering 16-bit microcomputers and the new features of 16-bit Basic programming language. Its microcomputer applications section now includes descriptions of different types of software and how to buy it, coverage of major trends and more. The book is illustrated with many new drawings and photos.

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

**Linear IC/Op Amp Handbook—2nd Edition, by Joseph J. Carr; Tab Books; 364 pages; $21.95 hardbound, $13.95 paperback.**

This updated edition has new information on isolation amplifiers, instrument applications for measurement and control, the use of transducers for converting physical parameters into electrical signals, and projects using the Wheatstone bridge (including a Wheatstone bridge transducer preamplifier, a Null voltmeter, and a programmable-gain amplifier).

Beginning with the operation of op amps and the characteristics of inverting and non-inverting followers, the handbook gives information on power supply considerations, overload and related faults, unity gain amplification, input impedance, audio applications and more. Differential amplifiers are fully covered with information on maintaining high CMRR, the use of a single op amp as a differential amplifier, instrumentation amplifiers, IA adjustments, and projects that illustrate these principles.

A section discusses solving op amp problems from dc errors, thermal drift, and instability of oscillation to noise considerations.

Op amps in computation—summation circuitry, alternate analog multiplier circuits, and methods for extending multiplier capabilities—and the use of op amps in instrumentation design are detailed. Data is given on active filter circuits (from filter characteristics to peaking amplifiers, gyrator filter circuits, high fidelity tone controls, and biquadratic bandpass filters), regulated power supplies, and miscellaneous op amp circuits from AGC amplifiers to change-of-slope detectors, and a precision variable reference power supply.

Published by Tab Books, Blue Ridge Summit, PA 17214.



# Tuner tune-ups

## *Avoid unnecessary tuner replacement*

Tuner deterioration or failure is a frequent cause of TV difficulties. So when a customer brings in a set and complains of a "snowy" picture, ordinarily the technician confirms the snow and checks the tuner by jumping in a tuner subber or analyst.

Even if the picture clears up with the substitute in place, there are a couple of other checks that should be made before the tuner is removed for rebuilding or replacement.

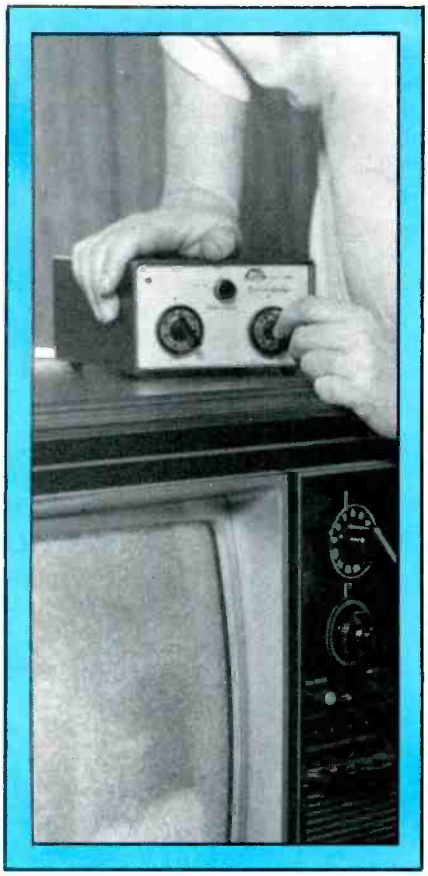
Jerry Morganette, Tuner Repair, Department Manager at PTS Corporation, Bloomington IN, says "The technician should check for proper supply voltages. If they're not correct, when the tuner is reinstalled it will not operate any better than before it was sent in for repair."

PTS tries to avoid this problem with a note suggesting the voltage checks. "We regularly get tuners that will need cleaning, some alignment adjustment, and go through a total overhaul. That puts the tuner in great shape but won't help get the set fixed if any of the supply voltages to the tuner are incorrect," Morganette says.

A good first step in assuring prompt set repair is to check the supply voltages leading to the tuner before replacing the tuner itself. A voltage check of the B+, AGC and AFC could diagnose problems outside of the tuner that frequently are mistaken for actual tuner failure.

### Lightning damage

Another common problem masquerading as a tuner problem is lightning damage. Again, a weak, snowy picture indicates a possible tuner problem as a distinct possibility. A tuner subber may again indicate tuner failure. But in this case, you should also check for a damaged balun coil, often located on the back of the set at the antenna input terminals completely separate from the tuner.



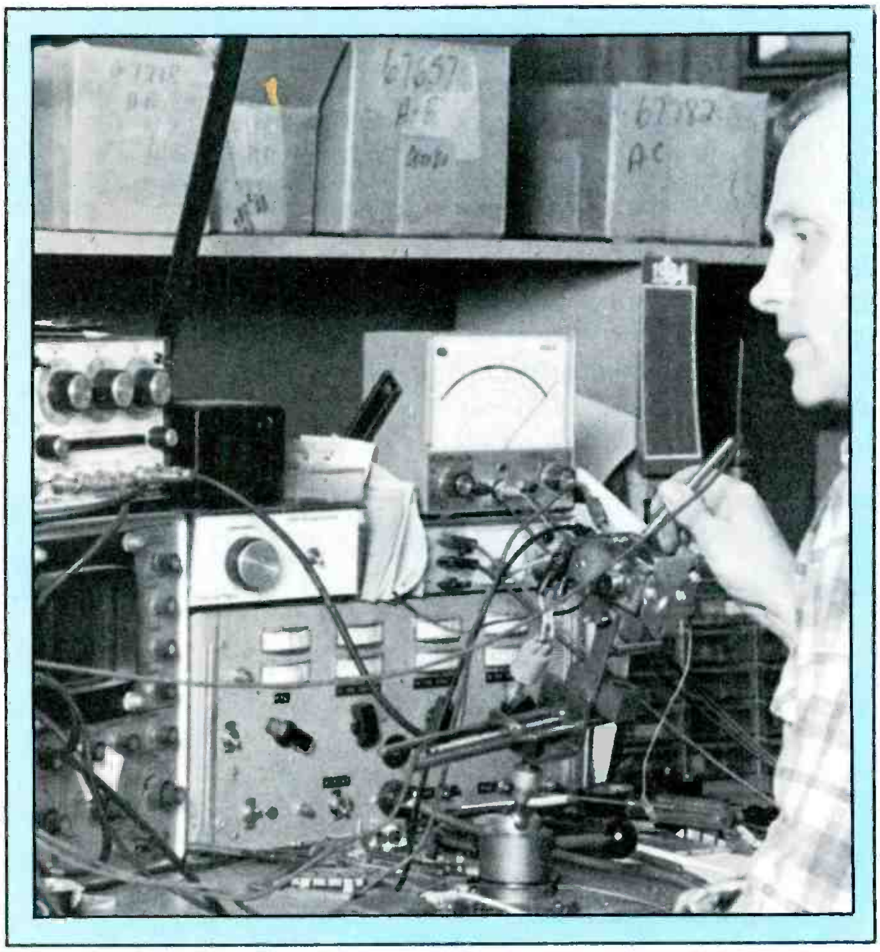
A tuner subber can help isolate a problem to the tuner. The snowy picture indicates possible tuner failure, but further testing is advised before sending the tuner in for rebuilding.

A quick check for damaged balun coil or antenna matching coil assemblies is easily made by coupling one side of a 300Ω lead through a caprisistor into the control grid of the RF amplifier (tube-type tuners) or the emitter of the RF amplifier (transistor-type tuners) with the other side of the 300Ω lead connected to ground. *Caution:* This check should only be performed while employing an isolation transformer on the TV under test.

"Maybe it's because there are so many real tuner failures that technicians are quick to pull the tuner," Morganette says. "The tuner requires an exact voltage from the television in order to function properly. Voltage tolerances for tuning or switching AFC and AGC are critical and must meet manufacturers' specifications."

While unnecessary tuner repair is a big problem, real tuner failure remains one of the most common TV repairs. Jim Young, a specialist in varactor tuner repair at PTS, and author of two varactor manuals used exclusively by PTS observes that as electronics has become more sophisticated, tuner repair has become more challenging. "But this sophistication has led to some good things too," Young says. "Some of the problems we used to look for are almost outdated. Problems we look for now include bad etchings and shorted tuning diodes. Today's electronic tuners employ a maze of tuning diodes and switch diodes, eliminating many of the mechanical problems associated with yesterday's tuners.

"Many of the newer tuners now have built-in prescaler circuits. The state of the art today is a



A few quick voltage checks will help technicians avoid unnecessary tuner repair. Here, a PTS technician checks the B+ voltage.

UHF-VHF combination band with built-in prescaler chips. Some include a phase-lock looping circuit and are cable ready."

In fact, many of the problems associated with the new varactor tuners are actually more difficult to diagnose than those of their predecessors. Proper operation of the varactor tuner is often still dependent on mechanical functions located in the tuning control assembly.

Suspected culprits often include dirty or worn contacts, broken wires, worn gears, and open etchings. Again, a thorough check of all incoming supply voltages can help isolate a tuning contact assembly problem that might otherwise be diagnosed as a varactor tuner failure.

Varactor tuners do have their share of failures. Like standard tuners, these units require expensive equipment to repair. Parts inventory requirements are even more extensive. For example, in many units a defective tuning diode must be replaced with a matched set of all diodes in the associated circuitry.

The final decision on whether or not to ship the tuner out for rebuilding is up to the shop owner. It's important to keep in mind that repair specialists have the test equipment and parts inventory to make TV repair faster and more economical for the consumer and more profitable for the shop owner. However, unnecessary tuner repair can and should be avoided. A few quick checks could save time, money and a customer. ES&T

# Build these electronic accessories for your car

## Audible signals may save your battery

*One of the wonderful things about modern electronics is that it is possible, for a few dollars, to collect some components, wire them up and produce a useful device. This is especially true today, since ICs now contain complete circuits that replace many components. The circuits described in this article can be built from readily available parts, and might help you avoid a tow, or worse, a costly repair bill.*

It can be a costly matter if you fail to notice that one of the "idiot lights" on your dashboard has come on indicating trouble. Give your oil and temperature warning lamps an audio backup with this complete system. A 12-second delay mechanism permits normal starting of the engine without activating the sounder. Switch $S_1$ allows you to silence the sounder, although LED $D_1$ continues to glow as a constant reminder. The backup is ideal for use in a central control panel for monitoring your vehicle's operating status at a glance, and it fits any standard 12V negative ground system.

For assembly and installation, power this circuit with the decoupler/regulator circuit in Figure 3 attached to a source that is hot while the ignition switch is on. The sensor wires leading to the oil and temperature lamps may be connected in either order (consult your vehicle's wiring diagram for the most convenient tap-in points). To test circuit operation, connect a dc voltmeter to Test Point 1 as shown on the schematic diagram. Then turn on the ignition switch without starting the engine so that the warning lamps glow. The voltage seen at Test Point 1 will slowly rise, triggering the sounder after about a 12-second interval. In service, either lamp coming on is sufficient to activate the sounder.

### Headlamp-ON reminder

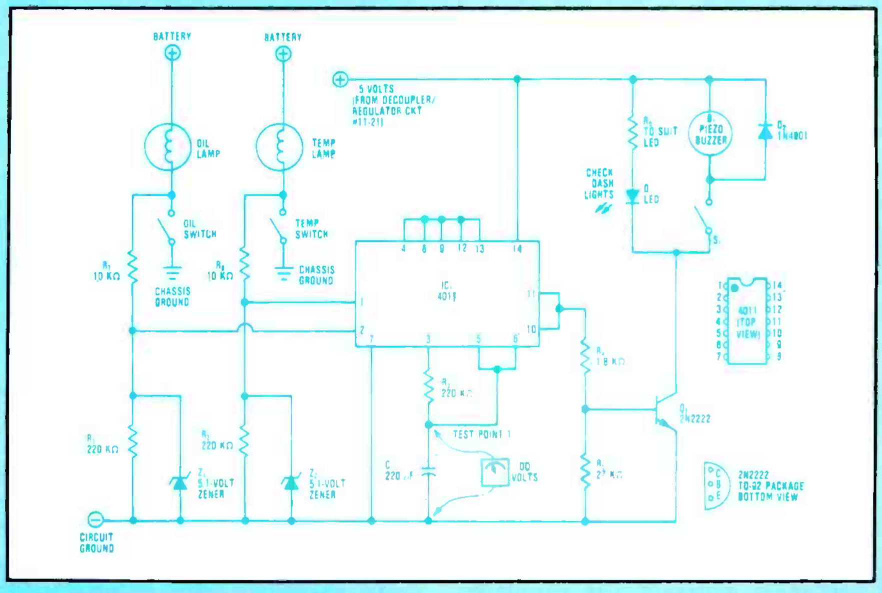



**Figure 1.** The warning light backup sounds an audible alarm within about 12 seconds when the dashboard warning light comes on.

#### Parts list

- $B_1$ – Any 5V, low-current piezo buzzer (Radio Shack 273-060)
- $C_1$ – 220$\mu$F, 16V aluminum electrolytic (Radio Shack 272-1006 or 272-956)
- $D_1$ – Any red light-emitting diode (Radio Shack 276-026)
- $D_2$ – 1N4001 diode (Radio Shack 276-1101)
- $IC_1$ – 4011 integrated circuit (Radio Shack 276-2411)
- $Q_1$ – 2N2222 or similar transistor (Radio Shack 276-1617)
- $R_1$,$R_2$,$R_3$ – 220,000Ω, ¼W (Radio Shack 271-1350)
- $R_4$ – 1800Ω, ¼W (Radio Shack 271-1324)
- $R_5$ – 27,000Ω, ¼W (Radio Shack 271-1340)
- $R_6$ – To suit LED
- $R_7$,$R_8$ – 10,000Ω, ¼W (Radio Shack 271-1335)
- $S_1$ – On/Off switch (Radio Shack 275-602)
- $Z_1$,$Z_2$ – 5.1V, 1W zener diodes (1N4733)

# Idiot light audio backup

Never again will you return to your car to find your battery run down because you accidently left the headlamps on. This "smart" circuit constantly monitors the voltage levels in your vehicle's electrical system and sounds a tone when the headlamps are on but the ignition switch is off. A 5-second delay mechanism permits normal operation of controls yet triggers the sounder before you can exit from the vehicle. It connects to any standard 12V system and is ideal for use in a control panel for monitoring your vehicle's

From the book, *Workbench Guide to Semiconductor Circuits and Projects*, by Michael Gannon, Copyright 1982 by Prentice-Hall, Inc. Published by Prentice-Hall, Inc., Englewood Cliffs, NJ 07632.

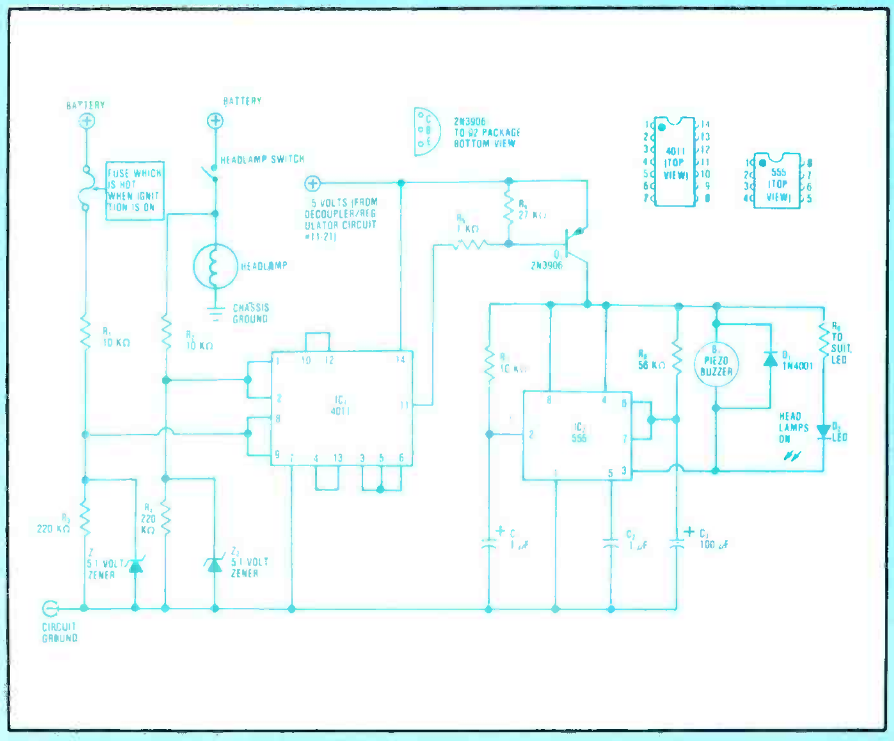



**Figure 2.** This audible alarm circuit will grab your attention within five seconds if you turn your ignition switch off and leave your headlights on.

operating status at a glance.

For construction pointers, power this circuit with the decoupler/regulator circuit of Figure 3 connected to a source that is hot, regardless of the position of the ignition switch. The sensor wires leading to an ignition-switch-activated fuse and to a headlamp-switch-activated point in the wiring system are not interchangeable and must be connected as shown. Consult your vehicle's wiring diagram for the most convenient tap-in points.

**Parts list**

- $B_1$ – Any 5V, low-current piezo buzzer (Radio Shack 273-060)
- $C_1$ – 1μF, 25V solid tantalum (Radio Shack 272-1419)
- $C_2$ – 0.1μF, 50V ceramic disk (Radio Shack 272-135)
- $C_3$ – 100μF, 25V aluminum electrolytic (Radio Shack 272-1016 or 272-1028)
- $D_1$ – 1N4001 diode (Radio Shack 276-1101)
- $D_2$ – Any red light-emitting diode (such as Radio Shack 276-026)
- $IC_1$ – 4011 integrated circuit (Radio Shack 276-2411)
- $IC_2$ – 555 integrated circuit (Radio Shack 276-1723)
- $Q_1$ – 2N3906 or similar transistor (Radio Shack 276-2034)
- $R_1$,$R_2$ – 10,000Ω, ¼W (Radio Shack 271-1335)
- $R_3$,$R_4$ – 220,000Ω, ¼W (Radio Shack (271-1350)
- $R_5$ – 1000Ω, ¼W (Radio Shack (271-1321)
- $R_6$ – 27,000Ω, ¼W (Radio Shack 271-1340)
- $R_7$ – 10,000Ω, ¼W (Radio Shack 271-1335)
- $R_8$ – 56,000Ω, ¼W (Radio Shack 271-043)
- $R_9$ – To suit LED
- $Z_1$,$Z_2$ – 5.1V, 1W zener diodes (1N4733)

## Decoupler/regulator for use with mobile projects

Although an automotive-type battery is a good source of power for use with the more delicate varieties of semiconductor circuitry, all bets are off when this same battery is simultaneously used in a motor vehicle. Voltage spikes, which are generated by a variety of causes and regularly pass through the wiring system, are easily capable of causing instability in, if not physical damage to, sensitive semiconductor components. What's more, using a 24V booster to start the engine or connecting jumper cables improperly usually means instant destruction for such frail parts.

Protect the delicate semiconductor components of your mobile projects from almost certain harm with the decoupler/regulator illustrated in Figure 3. The 5V regulated output will accommodate most types of semiconductor circuits and will provide them with up to 100mA of current. The 10V output can accommodate most of the rest, although with only fair regulation.

For construction, install this protective circuit inside the same metallic circuit box used for the project circuitry (if possible). Be sure to mount the box in a cool, protected location, and ground it to the vehicle's chassis. To wire this circuit into the vehicle's system, first attach the negative power lead as close as possible to, if not directly on, the negative pole of the battery. This will minimize pickup of unwanted transient voltages. Next, connect the positive power lead to an always-hot point (such as the clock fuse or positive pole of the battery) if circuitry must operate with the ignition switch off...otherwise to a fuse feeding relative transient-free gear such as the radio if circuitry must operate while the ignition switch is on.

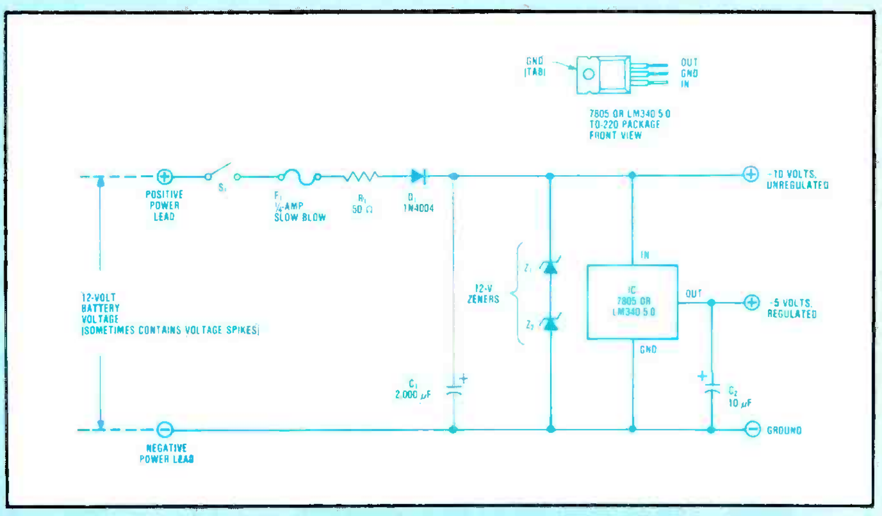



**Figure 3.** This decoupler/regulator will keep the electronic components in the projects shown in figures 1 and 2 from being damaged by transients or overvoltage conditions.

**Parts list**

- $C_1$ – 2000μF, 25V aluminum electrolytic (Radio Shack 272-1020)
- $C_2$ – 10μF, 25V solid tantalum
- $D_1$ – 1N4004 diode (Radio Shack 276-1103)
- $F_1$ ¼A, slow blow fuse
- $IC_1$ – 7805 or LM340-5.0 3-terminal voltage regulator (Radio Shack 276-1770)
- $R_1$ – 50Ω, 1W (Radio Shack 271-133)
- $S_1$ – On/Off switch (Radio Shack 275-612)
- $Z_1$,$Z_2$ – 12V, 1W zener diodes (1N4742) (Radio Shack 276-563)

ES&T

# Readers' Exchange

**For sale:** Heath IG5257 sweep generator, never used, $130. *Joe Konney, 3155 N. Long, Chicago, IL 60641; 312-777-5538.*

**For sale:** GE, Panasonic, RCA and Zenith modules, asking one half of dealer cost. Send SASE for list. *Gregory Inman, 2966 Norwood Ave., Slayton, MN 56172; 507-836-8831.*

**Needed:** Heath model SM-2420 or SM-4130 frequency counter; Microcraft model CS1F code star reader, and EMC model 802 signal tracer/generator. *Caswell Davis Jr., 601 Delmar, Apt. 2, San Antonio, TX 78210.*

**For sale:** Tektronix scope, dual trace, 50MHz, model 453, $575. *Woody's TV Service, 3133 8th St., Meridian, MS 39301; 601-482-3995.*

**For sale:** Approximately 1300 Sams from 400 to 1800. All for $750 plus shipping; or will sell sets of 100 for $2 each. *A. Ramos, 2008 N. Highland, Amarillo, TX 79107; 806-381-0914.*

**For sale:** B&K 1077B TV analyst, $150 plus freight; B&K 415 sweep marker/generator, $200, plus freight, never used; Sencore TF 46 Super Cricket transistor and FET tester, $100. Manuals, cables included. *Owen Mullet, 1318 Killarney, Greenville, IL 62246.*

**Needed:** Circuit descriptions for Sabtronics equipment, model 8100 frequency counter, model 2000 digital voltmeter, model 2035A digital voltmeter. *Charles R. Wells, 2085 Barcelona Drive, Florissant, MO 63033.*

**For sale:** Tektronix 2213 oscilloscope, perfect condition with probes and manuals, $950; Beckman HD-100 DMM, $110. *Jim Bresemann, 9414 Sheridan Road., Kenosha, WI 53140; 414-694-7932.*

**For sale:** B&K 1077B analyst, $400; Eico 944 flyback and yoke tester, $75; Conar 682 pattern generator, $75. All 3 for $500. All in excellent condition with leads and manuals. *Johnny's TV Service, Route 1, Box 249, Jonesville, SC 29353.*

**Needed:** Sencore CA55 capacitor analyzer, mint condition. *James G. Hamlett, 330 Everingham Road, Syracuse, NY 13205; 315-492-1487.*

**Wanted:** Field strength meter, ESR electrolytic meter and Photofact Sams and MHF. *Richard Salazar, 10940 Sunnyslope Drive, Riverside, CA 92505; 714-785-1303.*

**For sale:** FC45 frequency counter, $400; B&K 820 capacitance meter, $90; Eico 633 CRT tester with adapters, $130. UPS included. *Bill Bechtold, 7429 Frederick, Omaha, NE 68124; 402-397-2461.*

**For sale:** Sencore SG165, $495; B&K model 415, $195; both in mint condition with all probes and books; Leader LCG 388 color bar generator, $75. *Bruce McFarland, 220 Norman Ridge Drive, Bloomington, MN 55437.*

**For sale: Electronic Servicing & Technology** October 1966 to present; Also *Electronic Technician/Dealer* June 1966 to June 1980, at 30¢ per issue. *Steven Barach, Box 54, Pengilly, MN 55775; 218-885-2701.*

**For sale:** B&K CRT tester/rejuvenator, model 465, $85; Sencore tube tester model TC 142, $35, or both for $100. Tekfax schematics from #802 (August 1963) to #1850 (June 1980), more than 1000 diagrams, $75. *M. Danish, Mike's Repair Service, P.O. Box 217, Aberdeen Proving Ground, MD 21005; 301-272-4984 after 6 p.m.*

**Needed:** Manuals for Singer/Metrics spectrum analyzer model SB-12BS, type T-100 SSB-4, RF7-A tuning head, REC-1 converter; General Radio 783A power meter; 8Ω 250W power resistors. *J. Allen Call, 1876 E. 2990 South, Salt Lake City, UT 84106.*

**Needed:** Schematic for Philco vidicon camera model 367-1548-3. Will buy Panasonic NV-3160 VTR, working or not, if reasonable. *Bert Kuschner, 3340 Turtlemound Road, Melbourne, FL 32935.*

**For sale:** Sencore VA48 analyzer, all cables and manuals, $850; Sencore TF46 Supr Cricket, $140; Sencore CB41 CB tester, $120. *Steve Evans, 105 Altadena Drive, Pittsburgh, PA 15228; 412-344-5264.*

**Needed:** Used McGraw-Hill N.R.I. master course in video/audio servicing with 65 lessons and N.R.I. lab and parts to perform experiments and reference kits. *John P. Caputo, 271 Cadman Plaza East, G.P.O., Room 606, Brooklyn, NY 11201.*

**Needed:** VU meter for Akai M-8 R[illegible]pe recorder, new [illegible]d. *John P. Dinges Jr., 15831 S. Harley St., Ore[illegible] City, OR 97045; [illegible]-9547.*

**Needed:** Schematic or manual for GE b&w model [illegible] 132 [illegible] 1644-1) and Panasonic model CT-21P color (1028-3). Will [illegible]y expe[illegible]es or cost. *Cogshell's TV Service, P.O. Box 125 UAPB, Pi[illegible]uff, [illegible]R [illegible]1601.*

**For sale:** Sencore FC51 in mint condition, [illegible]0 or trade for Sencore VA48. *William Schwandt, P.O. Box 386, Blooming Grove, TX 76626; 214-695-2994.*

**For sale:** B&K analyst model 1077B, $400; Sencore SG-165 AM/FM stereo analyzer, $400; B&K CRT checker model 470, $100. Will ship UPS collect. Tim P. Logan, P.O. Box 452, Port Angeles, WA 98362; 206-457-4401, *ext. 249.*

**Needed:** Service manual for Singer b&w TV model HE-8132; service manual for Sansui stereo receiver model 6060; service manual for Olympic color TV model CT-911. Will buy or copy and return. *John D. Cameron Jr., Tallahassee Electronics, 104 Bradford Road, Tallahassee, FL 32303; 904-386-8594.*

**For sale:** Hal Communications Corporation model ST-6000 FSK demodulator (new), $550; RCA model WA-504/44D audio generator, $100; Kenwood model TR-9000, 2meter, FM all mode transceiver, $290. *William Shevtchuk, 1, Lois Ave., Clifton, NJ 07014; 210-471-3798.*

**Needed:** Schematic for an Akai reel-to-reel model X1800SD cross-field. Will buy or copy and return. *Ralph Turner, 2800 Vigo St., Lake Station, IN 46405.*

**Needed:** For MGA model CH160 flyback transformer part #334P05301. *Robert Hullender, 603 Landing St., Kings Mountain, NC 28086.*

**For sale:** Hickok transconductance vacuum tube tester model 536 with CRT adapter, $75; Hickok oscilloscope DC-4.5MHz, model 675A, $75; Sencore FE-16 field effect meter, $50. *Edward H. Frazier, Route 2, Box 632, Brownsville, TX 78520; 512-542-1960.*

**Needed:** Three power transformers with the following voltages: 125-0-125 volt Thordarson part no. 22R39; 300-0-300 volt Thordarson part no. 24R21U; 350-0-350 volt Thordarson part no. 24R164. Will take anything close to the above values. *Gordon Hilt, 7 Peterson Road, Muskegon, MI 49445; 616-744-5371.*

**For sale:** Kenwood model TR-9000 2-meter all-mode transceiver including power supply, $350; KDK model 2030 2-meter FM transceiver (brand new), $245; Flesher Corporation model TU-170 RTTY demodulator, $150. *William D. Shevtchuk, 1, Lois Avenue, Clifton, NJ 07014; 201-471-3798.*

**For sale:** Heathkit sweep generator model IG-57-A; Sencore picture tube tester and restorer model 143, make offer. *William J. Maida, 341 Isabella Drive, Longwood, FL 32750.*

**For sale:** B&K model 466 picture tube tester/rejuvenator, $125; in like-new condition, complete with 6 color adapters and 6 b&w adapters, instruction and set-up chart booklets. (Model 466 is the predecessor of current model 470 and is very similar.) Will ship UPS collect. *C.A. Caputo, 7 Donna St., Peabody, MA 01960; 617-535-1091.*

**Needed:** Schematic and service manual for a Dumont 304-A oscilloscope. Will buy or copy and return. *Glen Ransier, 1310 S. 9th St., Sunnyside, WA 98944.*

**Needed:** Schematic or manual for Dumont model 274 oscilloscope, will pay $5. *A. Schaffer, 1967 Cecilia Place, Seaford, NY 11783.*

**Needed:** Schematics for Century model MC 57B OC PLL FM/AM/FM multiplex, 8-track cassette stereo player/recorder with ALC, or manufacturers' address. *Gilbert C. Schunacher, 4753 N. 54th St., Milwaukee, WI 53218.*

**For sale:** Sencore CR31A meter assy 23B53, new, still in box, was $45, will accept $35 or best offer. *Al Nikora Sr., 5298 Argyle Court, Sterling Heights, MI 48078; 313-268-6938.*

**For sale:** Back issues of **ES&T** from January 1978; also want schematic for Olympic TDA-301 8-track tape recorder. *G. Epstein, 200-27 46th Ave., Bayside, NY 11361.*

**Needed:** Schematic or service manual for Grundig RTV-600 stereo. *Walford Thomas, Route 1, 9400 Key Lane, Mustang, OK 73064.*

**For sale:** Sams photofacts, 1 through 250, hardbound covers. Also, Sams auto radio series, 19 through 81. All for $100 plus shipping. *Arnold Scheafer, 102 E. 4th Ave., Milbank, SD 57252; 605-432-5870.*

**For sale:** Obsolete radio tubes. *Elmwood TV Inc., 136 Market Square, Newington, CT 06111; 203-666-6007.*



Circle (27) on Reply Card

# MOVING?

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

**ELECTRONIC** Servicing & Technology

Subscriber Services
P. O. Box 12901
Overland Park, KS 66212

Name ______________

Address ______________

City ______________

State______ Zip ______

**Needed:** Service manual and or schematic diagram of model S-55 Paco wide band oscilloscope, made by Division of Precision Apparatus Co. *Joe LaGuardia, 30064 S.W. 158th Court, Homestead, FL 33033.*

**Needed:** Manuals/schematics on old Eico, Heath, RCA, Precision/Paco, Simpson, General Radio Co., Ad-Yu Electronics Inc., American Electronic Labs Inc., Hickok, Bruel & Kjaer, Krohn Hite Corp., Ph Coleman Instruments Inc. and Electronic Measurements Co. *C. Davidson, 8105 Rider Ave., Baltimore, MD 21204.*

**For sale:** RCA 10J106A test jig with 38 adapters, $500. Sams, AR's, CB's, MHF's, TR's, send SASE for list. *Hughes Electronic Service, Route 4, Box 458, Kings Mountain, NC 28086.*

**For sale:** Keithley model 502 milliohmmeter, all new batteries, works, needs calibration. Complete with case and test leads, $300 or B.O. plus shipping. Fluke model 823A 0-500V ac-dc differential voltmeter, with manual, working condition, $200 or B.O. plus shipping. Money order or cashiers check. *Fred Sarg, 15 Cedarhurst Village, Salisbury, MD 21801; 301-228-2400 or 301-546-1941.*

**For sale:** Excess inventory and equipment at super prices. Large quantity of tubes, transistors, belts, wheels, RCA and Zenith parts and modules, etc. SASE for complete list and prices. *Don Gross, Vision Enterprises, R.D. 3, Tobes Hill, Hornell, NY 14843; 607-324-4257.*

**For sale:** TV and radio tubes, many vintage types, closing out, retiring. 80 percent off list and more in quantity. SASE for list. *R. Krum, 644 Lincoln Ave., Maywood, NJ 07607.*

**For sale:** Sencore VA 48 video analyzer, not used since factory calibration and update on Dec. 6, 1983. Complete with manuals and test leads and also, an AT218 RF-IF attenuator, $850 includes UPS within the 48 states. (Send SASE for proof of factory service.) *J.C. Nissen, 140 Santa Paula, Hemet, CA 92343.*

**Needed:** Manual/schematic for a Pathco model 101 Fatha-Cal produced by Marco Products of Florida. Will copy and return or purchase. *Charles H. Wohlfert Jr., PSE Inc., Box 209, Endicott, NY 13760-0209.*

**For sale:** Admiral flybacks 79D163-3, 176-1, 177-3 and 178-1. Like new from factory reject chassis, $14. *George D. Jenkins, 9 Airlane, Bridgeton, MO 63044.*

**For sale** [illegible] ar 223 tube tester, $ [illegible] Western Electric 65B standard signal generator [illegible] RCA Mark II col[illegible]t jig, $75; magnifying light, $30, plus shipping. [illegible] *C. Pullen, 672[illegible] Botetourt Drive, Ft. Washington, MD 20744; 301 [illegible]48.*

**Needed:** N[illegible] pow[illegible] transformer, part #32B73 or B30510, or Thordarson power [illegible] #24R[illegible] Also new or good used 310DMB4 picture tube. Please send prices and [illegible]ditions. *John B. Andrade, Andrade Radio & TV Service, Route 1, Box [illegible] San Gregorio, CA 94074.*

**Needed:** Instruction manual and schematic for a Voice of Music stereo tape recorder model 1492 tape deck. Will buy or copy and return. *Ed Tiesman, 1231 12th Ave., Fulton, IL 61252.*

**Needed:** Schematic or data for Tecraft 2meter transmitter TR20/144 and converter CC-144. Needed for restoration of old equipment. *Connelly, 329 76th St., North Bergen, NJ 07047.*

**For sale:** Rider TV service manuals (11 each) #2, 3, 4, 5, 7, 8, 9, 10, 11, 12 and 13. Excellent condition. Make offer for all, will ship UPS COD. Also for sale, Hallicrafter's 7-inch b&w TV, rare, excellent condition, make offer. *Stewart Electronics, 3134 Fruitvale Ave., Oakland, CA 94602; 415-533-9100.*

**Needed:** Exchange excess photofacts and AR manuals. Send list of your excess and needs, and I'll send my list. Suggest price if buying or selling only. *Sunset Electronics, 12200 N.E. 12th, Bellevue, WA 98005.*

**For sale: Electronic Servicing** issues from 1969 through 1983, $50 plus shipping charges. *Mrs. Dorothy Beal, Route 1, Box 43, Mason, IL 62443; 618-483-5295.*

**For sale:** Approximately 400 copies of **ES&T**, 1948-1983, $125; 320 copies of *Electronic Technician/Dealer*, 1954-1982, $100; 400 copies of *Radio Electronics*, 1947-1983, $125; all plus freight or delivery, free NY metropolitan area. *Roy Berthold, 27 Cottonwood Road, Port Washington, NY 11050; 516-883-0914.*

---

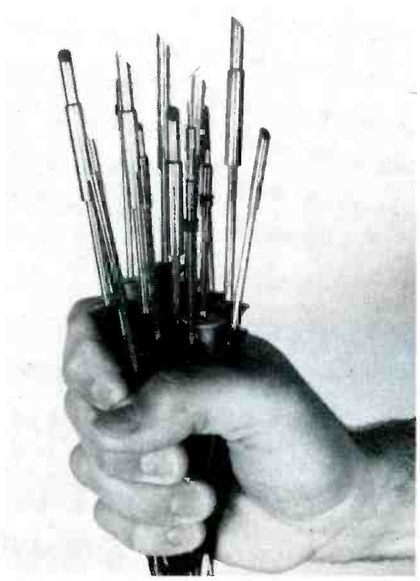
*Readers' Exchange listings are free and are limited to three items per month. "For sale" items must be used equipment sold by individuals, not companies. Send information to: Readers' Exchange, Electronic Servicing & Technology. P.O. Box 12901, Overland Park, KS 66212.*

---

# Products

### Miniature soldering system

An assortment of 15 miniature soldering irons and 23 tips, available from *Wahl Clipper,* allows a technician to choose from more than 270 different soldering combinations to match precise soldering needs. The Oryx miniature irons, all weighing ½ ounce or less, are available in temperatures ranging from 575° to 850°F, from 5W to 25W, and from 4.5V to 24V.



The irons can be combined with any of 23 tips ranging in size from 1/25-inch to 3/32-inch in several choices of configuration. Tip construction is nickel-plated or iron-plated copper for most applications, with solid nickel, gold end and bare copper alloy (NASA) tips available for special requirements. Tip changes are easy with no tools required. Cooled tips simply slide off and on.

Circle (70) on Reply Card

### Video handbook

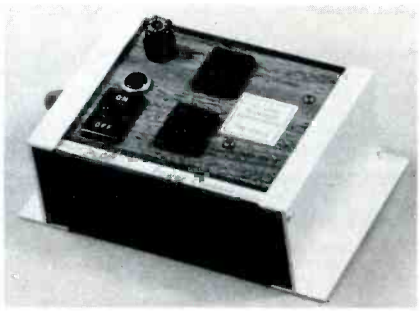
A video systems handbook entitled *How to Hook Up Your Video System,* has been published by *RCA*. Applicable to all makes of video equipment, this 52-page manual contains information for the video neophyte as well as the video expert. It describes and depicts a variety of products such as adapters, batteries, cables, connectors, couplers, converters, splitters, switches and matching transformers.

One section of the handbook contains 36 simplified connection diagrams to guide the layman in hooking up various video equipment. Some of the arrangements include connecting antenna and cable inputs to multiple TV receivers; VCR tape duplicating using a video monitor; interconnecting a video monitor, VCR and video camera; and connecting an antenna to a TV receiver with multiple devices.

Circle (71) on Reply Card

### Surge suppressor

*PMC Industries* has introduced an ac line transient surge suppressor designed specifically to protect microcomputers and microprocessor-based instrumentation. The model 033 provides protection by instantaneously sensing and suppressing very high voltage transients that can cause serious damage and data scrambling.

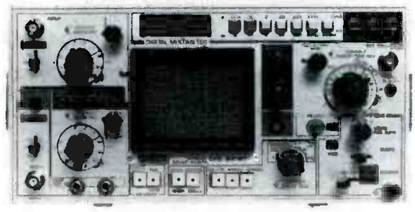


The unit has suppression capabilities of 15,000A maximum surge current with an energy absorption of 200J. It is designed for use on any standard 120Vac line and responds to transients and surges in less than 25ns. The unit offers two 3-wire grounded outlets, a 15A fuse, on/off switch and indicator light,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

Circle (72) on Reply Card

### Oscilloscope

The model MS-3020 from *North American Soar Corporation* is a 15MHz triple trace, real time oscilloscope with a 3½-inch flat face internal graticule CRT. Other capabilities are a variable trigger delay plus single sweep; a built-in "quick tracer" type component tester for cold circuit, individual component or full board circuit evaluation; and a five function, 3½-digit LED display DMM that can be operated independently or simultaneously in the same circuit as the oscilloscope. The scope has a digital storage section with 1024 words of

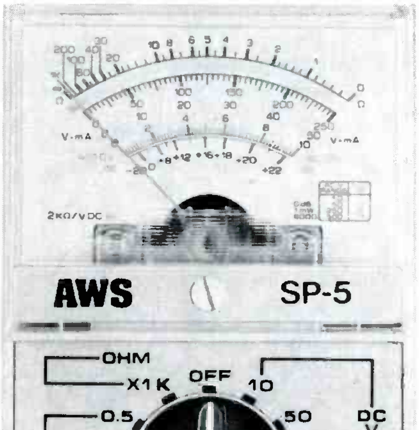


memory. This capability plus the single sweep facilitates analysis of a single occurring transient. The oscilloscope also has rear panel BNC connectors for pen recorder output of X-Y and sync of the stored Channel 1 waveform.

**Circle (73) on Reply Card**

### Analog multimeter

*A.W. Sperry Instruments* has introduced the model SP-5 pocket-sized analog multimeter. The meter has four functions, 12 ranges, a mirrored scale plate, safety designed recessed test lead connections, a thermoplastic case and diode protected meter move-

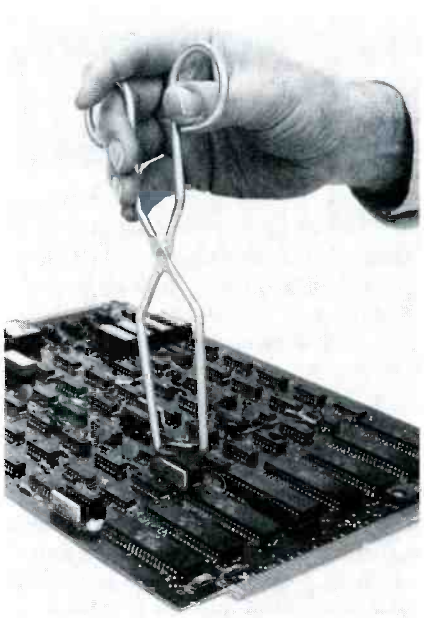



ment. Ranges are 10/50/250/500 dc volts, 10/50/250/500 ac volts, 0.5/50/250 dc milliamps, 0-1MΩ (5KΩ mid-scale) and −20 to +56 decibels. The SP-5 comes with one set of TL-41 test leads, one B-1 battery, operating instructions and a 1-year warranty.

**Circle (74) on Reply Card**

### Chip extractor

A specially engineered tool to facilitate the removal of socket-type chips from integrated circuit boards is available from *P.K. Neuses*. The model N-922 chip extractor allows a service engineer or technician to directly uproot any size socket-type chip easily and without bending of pins. The tool was developed in response to



requests for an inexpensive chip extractor that would allow removal of chips without damage to pins.

The model N-40-T dual-purpose voltage regulator/adjuster is also available to aid in the removal of soldered chips.

**Circle (75) on Reply Card**

### Frequency counter

The model FC71 1GHz frequency counter from *Sencore* provides FCC-accurate measurements for more than 9 hours on one battery charging. The FC71 uses a unique (patent pending) method to hold 0.5 part-per-million accuracy (0-40 degrees C) all the way to 1GHz.

The FC71 uses a microprocessor-controlled timebase that compensates for crystal drift. This results in accuracy comparable to an ovenized system without the battery drain of an oven. The accuracy is twice as good as a conventional TCXO (temperature-compensated crystal oscillator) timebase.

To further extend battery life, the FC71 uses a custom-made, wide-temperature, LCD display and CMOS microprocessor. It has

To get more information...

on items advertised or described in this publication, use the Reader Service Card.
As a free service for our readers, we forward your inquiry to the product's manufacturer. Reader Service Card is pre-addressed.

...ff circuit that removes ...ter 30 to 45 minutes of ...on. The FC71 can also be ...ed from the ac line or from


external 12Vdc sources, such as automotive batteries. Use of either external power source overrides the auto-off circuit, allowing continuous measurements.

**Circle (76) on Reply Card**

### Telephone products tester

A telephone product tester that can be used by the consumer at a retail outlet to test his telephone or by the retailer to quickly test customer returns of telephone products has been introduced by B&K-Precision. Model 1045 can be used to test the basic operational functions of corded telephones, cordless telephones, answering machines and auto-dialers without

using a separate telephone line or the aid of a salesperson. The model 1045 tests the ring, dial–both pulse and tone dial, redial, voice level, voice quality, line cord, handset cord, side tone, and ring back tone. All tests determine whether functions work by providing the required test signals and by verifying that signals are above minimum requirements.

**Circle (77) on Reply Card**

### Battery-powered counter

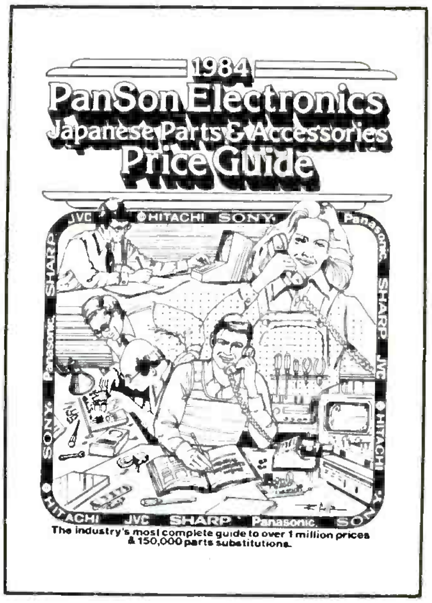
*Leader Instruments* has introduced the LDC-831, a 150MHz, 4½-digit battery-powered frequency counter. The LDC-831 has simple operating controls and green LEDs for a bright, clear display. For high-frequency applications, the LDC-831 can provide up to 6½ digits of resolution. The five most significant digits are displayed using the 0.01-second gate time. By then switching to the 1-second


gate, all four digits to the right of the decimal point are displayed. The combination of the two readings yields 6½ digits of resolution. The basic accuracy of the LDC-831 is ± 10 ppm.

**Circle (78) on Reply Card**

### Parts guide

*PanSon Electronics* is offering a comprehensive guide to original Japanese parts. The *1984 PanSon Electronics Parts and Accessories Price Guide* is a 2-inch thick,




1160-page guide that contains more than 1,120,000 prices for more than 560,000 Japanese parts and accessories. The guide also lists more than 150,000 substitute part numbers, plus parts that are no longer available. A 25-page section of technical aids is also included. The manufacturers listed in the guide are Sony, Panasonic, JVC, Sharp, Hitachi and Quasar.

**Circle (79) on Reply Card**

# Answers to quiz

*(from page 52)*

1. *B* Gain and bandwidth are trade-offs in amplifier design. What you do to increase one automatically decreases the other. At one time, I offered a prize to any technician who could simultaneously increase the gain and bandwidth of a Class A amplifier. I had no takers, but many technicians have told me that it just seems to them it should be possible.

2. *B* Be careful when selecting an answer in this type of question. You are not being asked to give the polarity of voltage with respect to common or even with respect to the emitter. What is asked is what is the voltage relationship between two electrodes in the transistor.

3. *A* Technicians sometimes get careless when they answer this type of question. Most of the noise generated by a receiver comes from the RF and front-end sections of a receiver. That noise will certainly increase if you add an RF amplifier. However, the signal-to-noise ratio will be improved when the RF amplifier is added. The question does not, however, refer to signal-to-noise ratio. You are being asked about the total noise.

4. *C* The *characteristic impedance,* which is also called the *surge impedance,* is determined by the physical dimensions of the transmission line.

5. *D* Current flows in a carbon microphone, but not in a "condenser" microphone.

6. *D* A bifilar winding is a noninductive winding used with wire-wound resistors. It would make a poor inductor.

7. *A*

8. *A* Be sure to understand the operations of all of the types of diodes used for detectors in this question.

9. *C* If you answered *B*, you may have been confused by the term *electromotive force.* That term is no longer being used in modern technological literature because it is misleading. Voltage is NOT a unit of force, but rather, it is a unit of work.

10. *C* A beat-frequency oscillator (BFO) is an example of a product detector. The term *bead ledge* is used in tire molds and has nothing to do with electronics.

Coming in the May ELECTRONIC Servicing & Technology

**Interpreting waveforms, Part II.** A solid understanding of how waveforms are affected by various circuit components can be valuable in troubleshooting electronics equipment.

**Inside a microcomputer, Part II.** You don't really know about microcomputers until you know something about how they interface with peripherals and how computer languages are structured.

## Marketplace



# MOVING?

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

Name ______________________
Address ______________________
City ______________________
State ______________ Zip ______________

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

# Classified

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

Each initial or abbreviation counts a full word.

Minimum classified charge $10.00.

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

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

## FOR SALE

**FREE VIDEO SWAPSHEET!!** Lists your FREE ad to SWAP, BUY, SELL videotapes, equipment. VIDEOBARTER, 7216-EST Enders, San Diego, CA 92122. 4-84-1t

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

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

## FOR SALE (CONT.)

**CB RADIO BOOKS,** kits, modifications. Catalog $1.00 refundable. APS, POB 263, Newport, RI 02840. 6-83-12t

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

**INDIVIDUAL PHOTOFACT FOLDERS** (not sets). Under #200 $5.00—#201 to #1200 $3.00 first-class postpaid. Loeb, 414 Chestnut Lane, East Meadow, NY 11554. 3-84-3t

**ELECTRONIC SURPLUS: CLOSEOUTS, LIQUIDATIONS!** Parts, equipment stereo, industrial educational. Amazing values! Fascinating items unavailable in stores or catalogs anywhere. Unusual FREE catalog ETCO-011, Box 762, Plattsburgh, NY 12901. 6-78-tfn

**SCRAMBLED TELEVISION,** encoding/decoding. New book. Theory/circuits, $9.95 plus $1 shipping. Workshop, Box 393ES, Dept. E, Bethpage, NY 11714. 7-80-tfn

**WHOLESALE**—transistors, flybacks, yokes, batteries, Weller/Xcelite, VCR, computer parts. Apple Compatible computers, printers, drives, monitors, custom electronics software. More. Send for catalog. United Service Association, Old Grand Union Shop. Ctr. Rt. 9W, Stony Point, N.Y. 10980 (914) 942-2173. 1-84-tfn

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

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

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

## FOR SALE (CONT.)

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

**FOR SALE:** Electronic Sales and Service, Radio, TV, and Stereo. Established 14 years. Bldg, land, inventory, name. Partial retirement, would work for new owner, Fresno, Calif. call 209-255-1957. 2-84-3t

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

**FULL LINE of TV converters. Wireless and manual compatable to Jerrold and Oak Systems. This month special Jerrold DRX400 only $82; RG59U 1000 ft rolls only $39; F59U fittings only $9/100 pcs. RED COAT ELECTRONICS, New Address and Phone: 104-20—68th Drive, Forest Hills, N.Y. 11374, Tele. (212) 459-5088. 4-84-tfn**

**THORDASON FLYBACKS**—SEARS FLY 358, 346, 359, 364 (2pcs), 381, 396, 406, 407 (2pcs), 441 (2pcs), 442 MAGNAVOX 362 (3pcs), 378 SYLVANIA 498. $200.00 for all ALEX TV, 201-549-1095. 4-84-1t

**ATTENTION:** Eliminate the high cost of replacing the horizontal output and the regulator transistor in Sony. Average replacement expenses for both $3.50. For information send $29.95 to REACTION ELECTRONICS, 7601 18th AVE., BROOKLYN, N.Y. 11214. 4-84-1t

**JERROLD CAC-11** Coloraxial cable 1000'/$300.00; 2000'-5250'/$.25 per foot. Retired MAGNAVOX Center with tubes, modules, panels and test equipment. Request lists and make offers! Apex Magnavox, 1502 NE 105 St., Miami, FL 33138. (305) 895-1270 evenings. 4-84-1t

## FOR SALE ([illegible])

**SINEWAVE TV DESCRAMBLER**, [illegible] and sound [illegible] TV or VCR. Complete kit and instruction manual [illegible] to go $114.95 plus $6.10 S/H. Quantity discounts available, dealers welcome. Free flyer information. CABLE SEARCHER, PO Box 182, Carle Place Station, NY 11514. 4-84-3t

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

## BUSINESS OPPORTUNITIES

**ESTABLISHED ELECTRONIC SERVICE** business in Albuquerque, New Mexico. $35,000. Phone 505-268-3109 and leave name and phone no. 4-84-1t

**TEXAS SUNBELT**—Thriving TV & Video Sales & Service, RCA, Zenith, Litton, in booming east Texas area. Total package includes modern custom building, 3000 sq. ft.; display, sales and warehouse with complete inventory; tools, fixtures. On ½ acre, 300 ft. frontage on major highway. Large trade area. Contact Glen Drennan, Agent, 214-675-8856. 4-84-3t

**TV Service business,** Florida's west coast, near New Port Richey, semi-rural improved 5 acres, 12 by 60 mobile home converted to shop. Small 2 bedroom frame house. Well, 2 septic tanks, fenced, $70,000. 133 Shirla Rae Dr., Spring Hill, FL 33526. 4-84-1t

**COTTONWOOD, ARIZONA.** The sunshine state, commercial property corner lot on post office main throughfare, includes store and 3 residential rentals, $115,000 terms available. Meyer's Realty, P.O. Box 431, Cottonwood, Arizona 86326, 602-634-4200. 4-84-1t

**TV SALES & SERVICE** Auto Radio, AC Delco & Ford Warranty; in Eastern North Carolina. Owner retiring after 50 years. Details: Call 919 523-4567. 4-84-1t

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

## HELP WANTED

**EXPERIENCED TV TECHNICIAN** for benchwork and service calls in small shop in rural area in sunny Southern California, (805) 646-5818 anytime. 4-84-1t

## WANTED

**INVENTIONS,** ideas, new products wanted for presentation to industry and exhibition at national technology exposition. Call 1-800-528-6050. Arizona, 1-800-352-0458. X831. 2-84-5t

**WANTED:** Used CTR rebuilding machine, Raymond Mailhot, 107 W. 5th Ave., La Sarre, Quebec, Canada J9Z-1K5. 4-84-3t

**WANTED** Picture Tube Rebuilder for newer type tubes including Sony. Write or call Mr. Eiden, 414-648-5766. P.O. Box 211, Lake Mills, Wis. 53551. 4-84-1t

## SERVICES

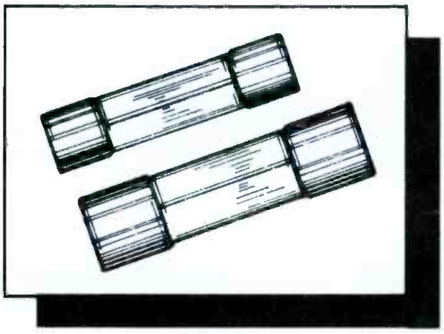
**SPEAKER RECONING:** Most makes, sizes, models. For prompt service send to Mercury Speaker Reconing, 2018 W. Division St., Chicago, Illinois, 60622; (312) 278-2211. 9-83-tfn



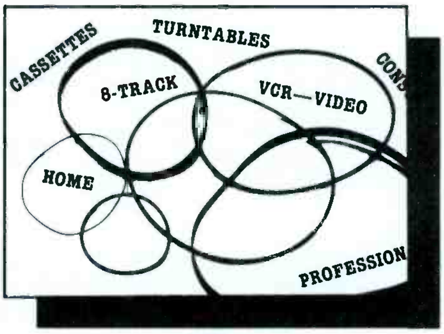
# Advertisers' Index

# ALL THIS...

Telephone



Fuses

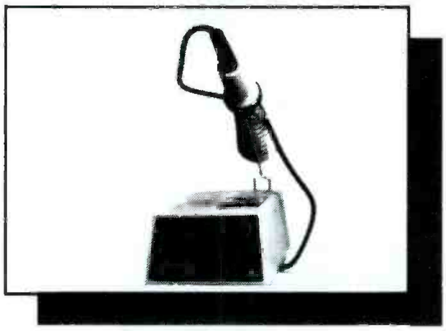



Belts


Semiconductors

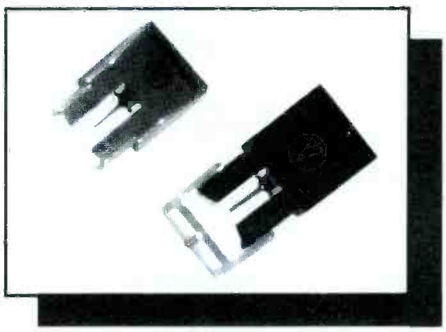
# FREE!

## CEI's Spring/summer Catalog!



Solder Equipment

Speakers



Styli

## CALL TOLL FREE TODAY!

**1-800-543-3568**
National Wats

**1-800-762-3412**
Ohio Wats

CEI Consolidated Electronics, Incorporated

705 Watervliet Ave.
in Dayton call 252-5662


Tubes

Telex No. 288-229

Circle (1) on Reply Card

# The people who gave you the Video Service Standard of the 70's. Now Introduce the all new standard for the 80's—MODEL VA62.


# Cut your video service time in half

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

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

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

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

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

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

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

**Please send complete VA62 details:**

Name ______________________
Address ____________________
City _______________________
State ______________ Zip ________
Phone ______________________
(Mail to Sencore, 3200 Sencore Drive, Sioux Falls, SD 57107)

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

SENCORE