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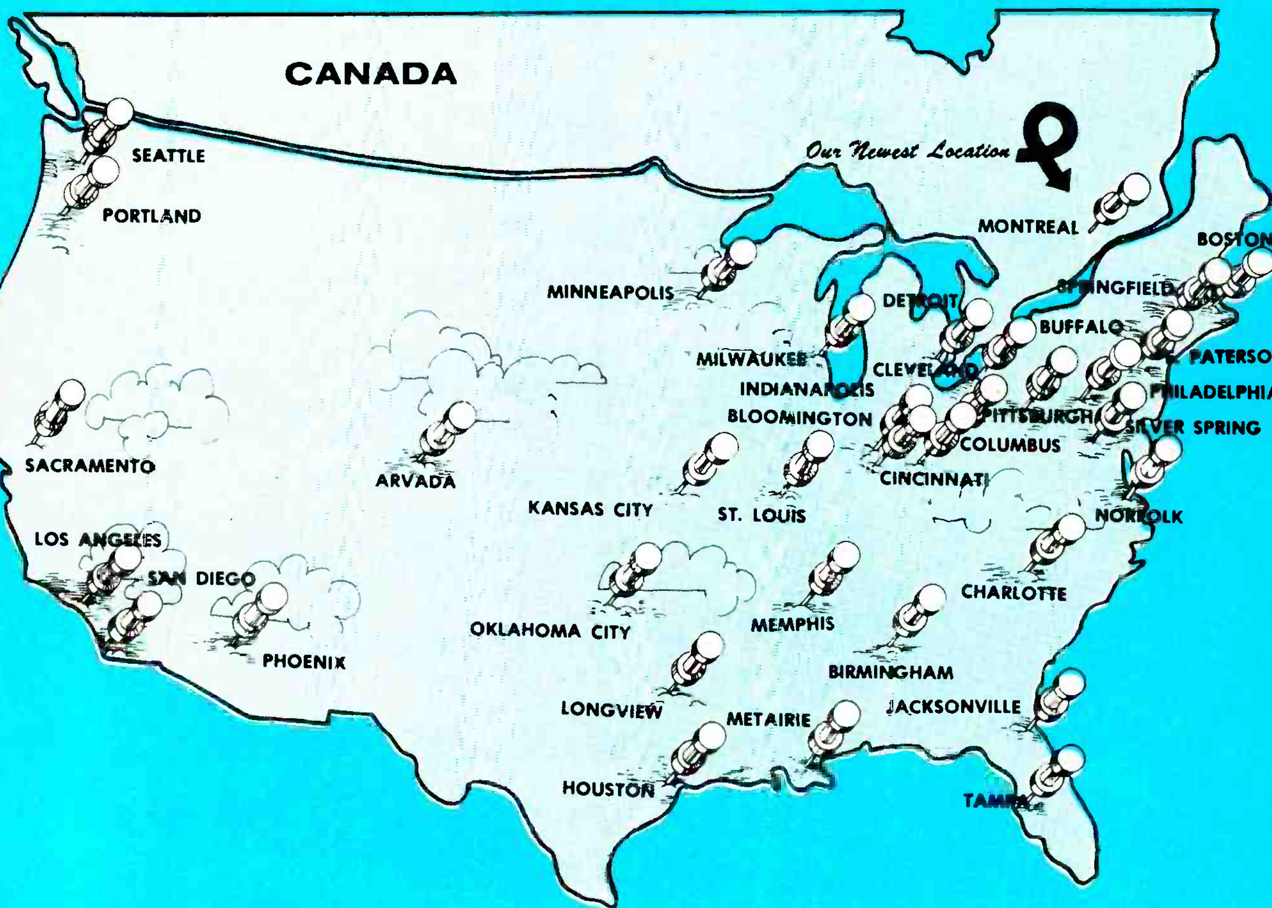


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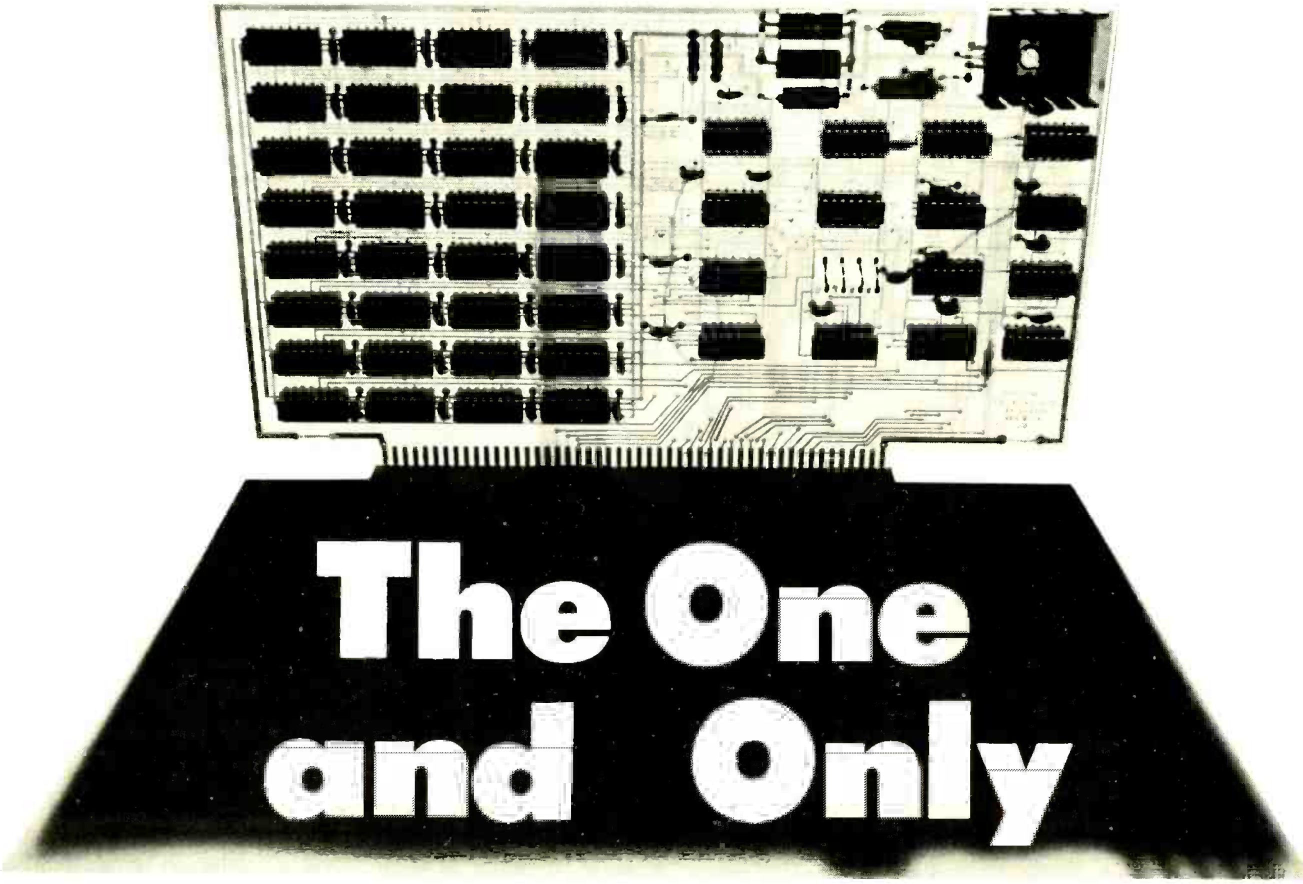


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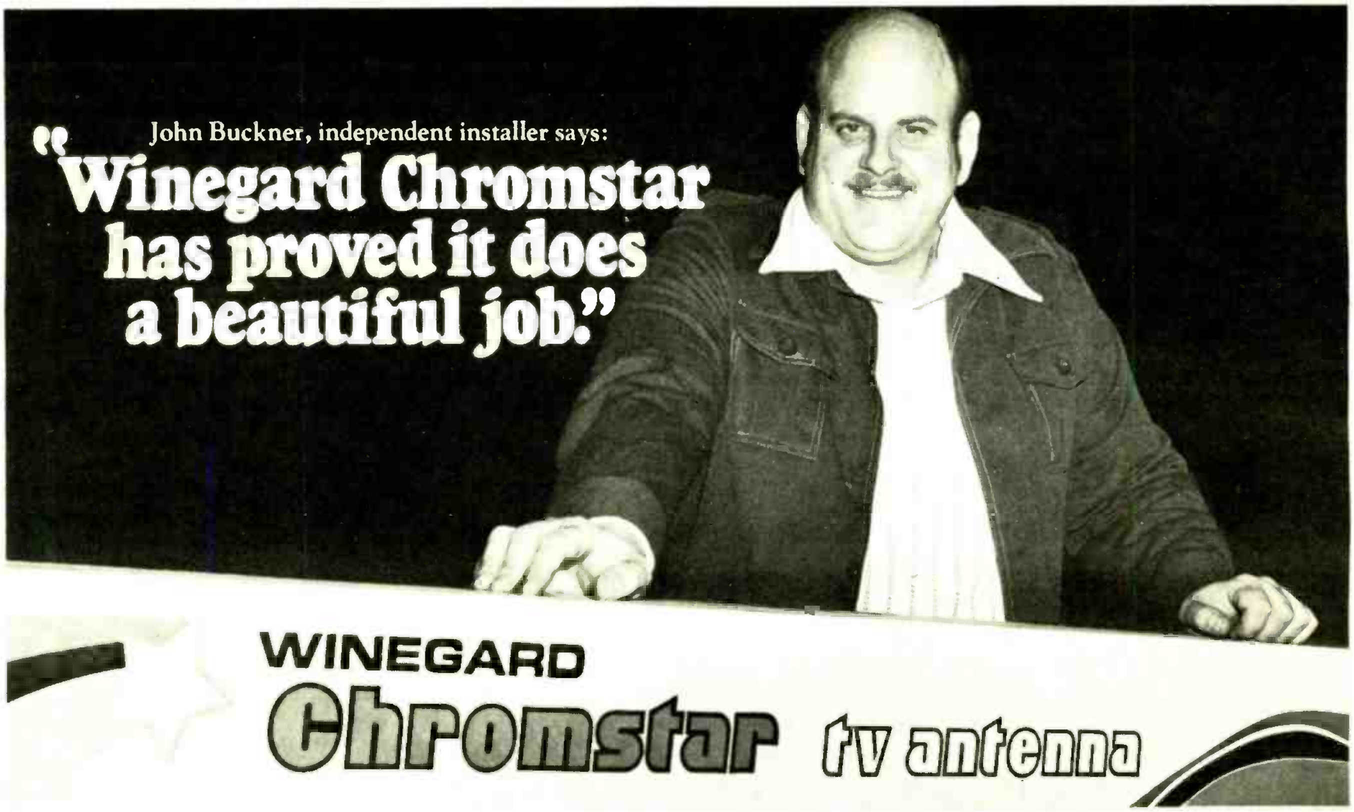


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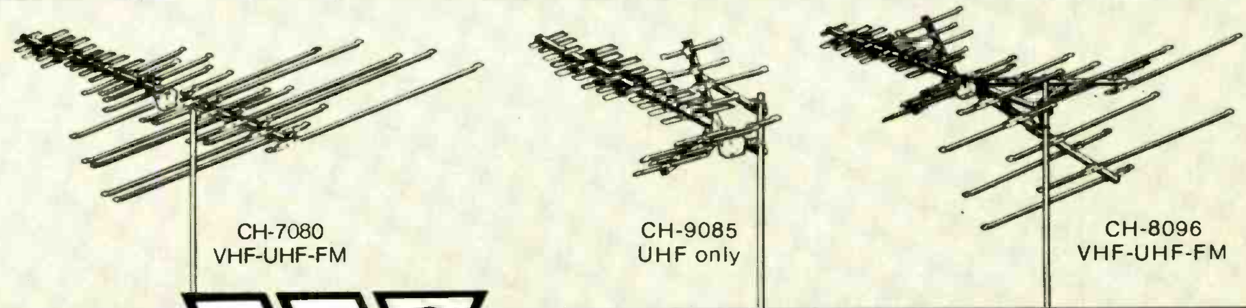


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# Radio-Electronics®

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

**Electronics publishers since 1908**

APRIL 1976 Vol. 47 No. 4




### ON THE COVER

A modern CB test bench might look like this one, fully equipped with the latest test gear specifically designed for speedy servicing of CB transceivers. Note the B&K model 1049 CB Servicemaster that works in combination with existing test gear. See our story on CB test gear on page 33


**GARAGE DOOR OPENERS can be money makers. To see how to install them turn to the story on page 50.**


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# looking ahead

## Microcam

Also on the broadcast front, helping CBS cover the political conventions this summer will be the first electronic camera claimed to be smaller and lighter than a film camera. The culmination of many years of increasing miniaturization of television cameras for use in "electronic newsgathering," the Microcam was developed by Thomson-CSF Laboratories (formerly CBS Labs) under a CBS contract, but will be offered to all broadcasters later this year.

The camera is a full-featured studio-quality color unit using three Plumbicon pickup tubes, but weighs only eight pounds. An accompanying control unit with battery can be belt-mounted and adds another three pounds, for 1½ hours' operation. The camera can operate on flashlight batteries in an emergency. Its developers claim it is one-half the weight and size and requires one-half the power of the nearest competitive electronic camera. An added feature is its adaptability to charge-coupled semiconductor pickup devices, when they are available, as substitutes for tubes—which could further reduce the size, weight and power requirements.

## More TV games

There are going to be plenty of video game attachments on the market this year, according to plans now being made. In addition to those mentioned last month, these companies are also planning to enter the TV game field: APF Electronics, a leading calculator supplier, is expected to field a tennis-football-squash-handball game this summer, to sell at about $80. Dyn Electronics plans a Ping Pong and tennis wireless game at less than $70 by about the same time. Gran Prix, an importer, hopes to have a hockey-tennis-Ping Pong attachment in the $50-to-$60 range. The toy manufacturers are eyeing the field, too. Coléco will soon display a game using General Instrument's six-game chip at $50 to $70. Mego's, which makes Star Trek and other action games, will have a $50 chip-controlled unit soon. Ideal, Mattel, Kenner and Aurora—all leading toy makers—are looking closely at the field and could move in soon.

## Historic plant closed

When RCA ends receiving tube manufacture July 30, it will be a sentimental occasion tinged with history. Its plant in Harrison, NJ, was originally built by Thomas A. Edison in 1882 to produce electric light bulbs. General Electric acquired it in 1892 and continued to make bulbs there until 1918, when it started output of radio tubes. The Harrison plant was an important source of tubes for RCA Radiola radios throughout the '20's and was sold by G-E in 1930 to the RCA Radiotron Company, a subsidiary of RCA.

The plant is being closed because of the sharp decline in demand for receiving tubes in the face of the shift to solid-state devices. Industry-wide sales of receiving tubes have declined from 442,000,000 in 1966 to about 80,000,000 in 1975—the latter figure being less than RCA alone sold in the heyday of receiving tubes. RCA's move leaves G-E and Sylvania as the sole U.S. manufacturers of receiving tubes. RCA will continue to market RCA tubes made by others.

## Computerized slides

Today, when you see a still picture (such as a station identification) on television, you're usually looking at a 35-mm slide. Later this year, you may be seeing the product of a computer. Ampex and CBS have developed the first practical broadcasting device to use digital recording techniques for video images—the Electronic Still Store system, or ESS. ESS converts any video signal (from film, tape or live camera) into digital form and stores it on a standard magnetic computer disc pack.

Up to 1500 still frames can be stored on a single disc, to be selected for readout, in any order, from a bulk memory with an access time of less than 100 milliseconds. The system has three modes of operation—record, reproduce and rearrange. In the latter mode, selected stills may be arranged in any order for sequential programming. One of the most attractive features of the system is that the discs have virtually unlimited shelf storage life, helping to alleviate the always-acute storage problem at TV stations. CBS will take delivery of the first ESS unit around midyear.

## Videodisc standards

The home videodisc came closer to reality as three major developers of optical disc systems agreed on standards for interchangeability of video records. Prime movers in the agreement were Philips and MCA. Both had agreed to merge their similar but different systems. Also participating in the standardization move but without committing themselves on production of the optical system was Zenith, and the French electronics combine Thomson-CSF is expected to join in.

The resulting specifications theoretically supply everything a manufacturer needs to know to build an optical videodisc player or make a disc. Among the specs selected: (1) 1800 rpm in a counterclockwise direction as viewed from the objective lens (underneath the discs in the prototypes already demonstrated). (2) The disc plays from the inside out. (3) Two basic disc sizes—12 and 8 inches. (4) Both rigid and flexible discs, the former 1.1-mm thick, the latter 0.2-mm. (5) Two sound channels, at 2.3 and 2.8 MHz on the carrier. (6) Direct NTSC encoding, frequency-modulated.

The last specification—direct NTSC encoding—came as something of a surprise, as previous demonstration optical disc systems have used separate luminance and chrominance signals, encoded in a non-standard manner. The direct encoding will simplify the electronics in the player and should result in a better picture.

The interchangeability pact, of course, doesn't include the RCA capacitance disc system, which is basically incompatible with the optical design, despite reports that some sort of playable signal has been obtained optically from an RCA disc. So it still appears that two systems will fight it out in the marketplace.

## 364,000,000 TV sets

While we're on a statistical kick, we can't resist noting that by latest count there were approximately 364,000,000 television sets in use in the world, and that color sets passed the 100,000,000 mark during 1975. Of the 146 countries with television stations, the United States has by far the most sets—57,700,000 color and 63,400,000 monochrome, for a total of 121,000,000. That's an average of 1.7 sets per American home. In terms of color sets in use, Japan (with 19,800,000 sets) is second to the U.S.; the United Kingdom is third with 6,820,000, followed by West Germany with 4,350,000 and Canada with 4,100,000. In monochrome, the Soviet Union is second with around 50,000,000 (this includes some color sets—no breakdown is available). Others in order are West Germany (13,250,000), Italy (12,450,000), France (12,000,000) and the United Kingdom (10,900,000).

**by DAVID LACHENBRUCH**
CONTRIBUTING EDITOR

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# new & timely

## Quadriphonic broadcasting now feasible, says committee

The National Quadriphonic Radio Committee, sponsored by the Consumer Electronics Group of the Electronic Industries Association, has reported to the FCC that quadriphonic broadcasting is compatible with existing systems and with the FCC's allocation plan. It also reported that it can be carried out with commercially available equipment, or equipment well within present technology.

The report was the result of a 45-month study of quadriphonic broadcasting. The committee studied five proposed systems and conducted subjective and objective tests to determine the compatibility, feasibility and practicality of the system. The tests consisted of subjective listening, closed-circuit and over-the-air broadcast tests in both home and mobile situations.

The Committee made it clear that the report was not intended to recommend or propose a specific system, but to assist the FCC in issuing a public notice for proposed rules that would establish a standard for quadriphonic FM broadcasting.

## New guide for WWV/WWVH issued by National Bureau of Standards

"The Use of NBS High Frequency Broadcasts for Time and Frequency Calibrations," is the title of the new guide published by NBS for all who use WWV or WWVH for getting standard time and frequencies or for more specialized uses.

In addition to discussing the widespread use of the signals for standard time and frequency information, the authors place special emphasis on using WWV/WWVH signals to measure time or set clocks with an accuracy of ± 100 microseconds, or to calibrate frequency to a few parts in $10^{10}$. Specific suggestions are given on making observations, optimizing reception and measurement conditions, and using such items of equipment as oscilloscopes, delay circuits and time-interval counters.

Dimensions and construction details for several antennas are given, and instructions for measuring or computing receiver and propagation delays, great circle distances and incident wave angles.

The guide, identified as NBS Technical Note 668, is obtainable from the Superintendent of Documents, Government Printing Office, Washington, DC 20402, for $1.05.

## Sixty-one seconds make a minute

For the fourth year in succession, the official time and frequency stations WWV at Boulder, CO; WWVH at Maui, HI; and WWV's low-frequency supplements (WWVB and WWVH) welcomed in the New Year with a 61-second minute. The extra second was added to the last minute of the last day of the old year. Thus December 31 was actually the longest day of the year—24 hours and one second long.

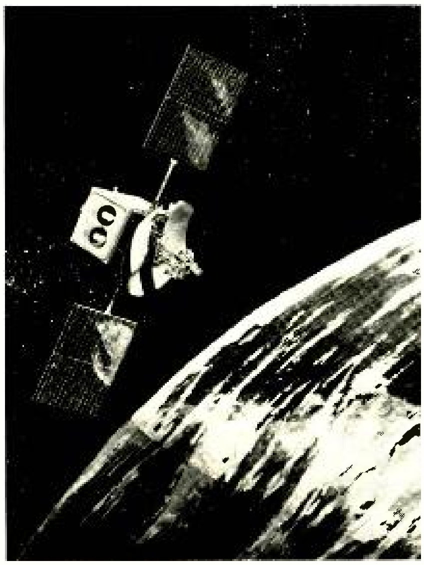
The extra second was a time correction. The Earth has recently been slowing down in its annual circular tour and the added second has been necessary to keep our clocks from running ahead of the sun. The difference is not important to the average individual—at the present rate it would be 60 years before we would have to set the clocks back one minute—but is taken into account by astronomers, navigators and other specialized groups.

Since the National Bureau of Standards started making these corrections in 1972, five seconds have since been added—the first in June of that year, and the other four as "leap seconds" at the end of the last minute of each year.

## New communications satellite doubles previous capabilities

"A new generation of satellites," providing low-cost communications unmatched by any other carrier, according to RCA Communications president Howard R. Hawkins, was launched last December 12.

Satcom I will serve the whole 50 states of the USA, It will maintain a 22,300-mile-high orbit over the equator at a point approximately south of Los Angeles. Its 24 channels give it twice the communications capacity of earlier satellites.



**RCA SATCOM-I SPACECRAFT, shown above as it would look if the photographer could get near enough to take a picture, is equipped with 24 transponders—double the communications capacity of any conventional satellite now in orbit. The solar panels have 71 square-feet of silicon cells always oriented toward the sun.**

Each of these 34-MHz channels is designed to carry 1,000 voice-grade circuits, one FM/color TV transmission or 64 million bits-per-second of computer data. The antenna directs all 24 channels to Alaska and the continental United States, and couples 12 channels to the Hawaii spot beam. A special modification of the Thor-Delta launch vehicle, providing 30 percent more power than earlier rockets, was necessary to put the one-ton satellite into orbit.

The craft is powered by a combination of solar-array panels and three nickel-cadmium batteries, with a maximum power of 740 watts. Its life period, with continuous full power, is designed to be eight years.

## M. Harvey Gernsback now Fellow of the Radio Club of America

The Editor-in-Chief and Publisher of **Radio-Electronics** was elevated to the status of Fellow of the Radio Club of America, for "contributions to Signal Corps publication during World War II and in electronics publication to the present," at the Club's annual meeting last November 21.

At the same meeting, Dr. Henri Busignies, chief scientist emeritus of ITT, also a Fellow of the Club, was awarded the highest honor of the association—the Armstrong Medal—for his military and civilian work in automatic direction finding, electronic navigation systems and moving-target radar. Edgar F. Johnson, head of the radio company that bears his name, received the Club's Sarnoff Citation for his services to radiomen, particularly amateurs, and his influence on radio since 1920.

A special feature of the meeting was the presentation of a charter to the Club's Section 1, Washington, DC, the first local section in the Club's 66-year history. It was announced that Section 2, the California Section of the Club, would be chartered at a semi-annual meeting and banquet in Washington late in March.

## Science depends on engineers says Bell's James B. Fisk

"It takes a lot of engineering to make the fullest use of research," Dr. James B. Fisk, recently retired President and Chairman of the Board of Bell Laboratories, told a recent meeting of the National Academy of Engineers at Washington, DC.

Dr. Fisk, in a speech accepting the Academy's Founders Medal, cited the

*(Continued on page 12)*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# new & timely

(Continued from page 6)

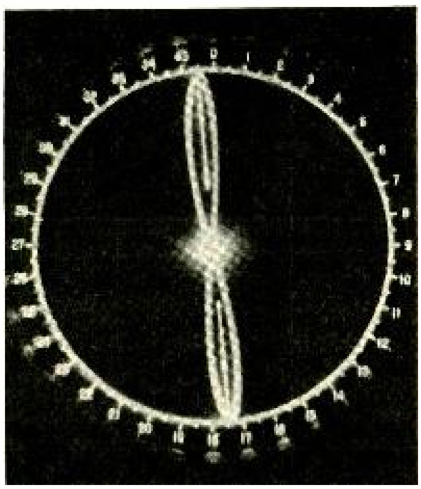
transistor, which required an entire organization to develop practical uses after it was discovered, as a particularly apt example. A "happy blending of basic science with the ingenious skills of the design, development and manufacturing engineers," he said, "has enabled us to do things widely beneficial to people."

### "Breakthrough" World War DF presented to Smithsonian

The Smithsonian Institution has received the precursor model of an invention that was a decisive factor in defeating Hitler's submarine "wolfpacks" in the most critical days of World War II. Known as the "Huff-Duff" instant radio direction-finder, it was presented to the Institution by its inventor, Dr. Henri G. Busignies, chief scientist emeritus of ITT.

The German submarine reported to home base with a radio technique designed to make detection impossible. The messages were recorded, then the submarine surfaced and sent everything in a "squirt" that might last less than a second. Ordinary direction finders were helpless against this technique.

The "Huff-Duff" scanned the whole horizon like a fast radar, making more than one 360° scan during even the shortest transmission. The strength of signals received from any direction was displayed on a cathode-ray (picture) tube. Since the signals were strongest when the antenna was pointed in the direction of the incoming signal, the resulting patterns was described as "an electronic finger pointing" at the submarine source. Cross bearings from two stations receiving the signals pinpointed the position of the sub. Air and Navy forces were then dispatched to "search and destroy," and merchant convoys warned of the danger area.



**SUBMARINE AT 355 DEGREES, says the electronic finger of the Huff-Duff display. Pictures like these meant destruction to the German submarine "wolfpacks" of World War II.**

German submarine losses rapidly increased to 40 per month, and Allied convoy ship losses dropped to an astounding 2 percent of those at the height of the submarine campaign.

### Six youthful members of 4-H get Westinghouse scholarships

Projects ranging from bringing a juke box back to life to constructing an electric automobile won $800 scholarships for six 4-H members at the 54th National 4-H Congress in Chicago last December. The scholarships were from Westinghouse Electric Corp., sponsor of the 4-H Electric Program Contest.

The electric car, built from a $15 junked automobile, was the project of 16-year-old Randy Atkins, Cedar Bluff, VA. His car cruises 60 to 70 miles between charges and can travel at 55 miles per hour. It is powered by eight 6-volt batteries.

Lynn Ann Goddard, 18, won her scholarship by organizing a 4-H electric club for younger members and teaching them the rudiments of electrical maintenance (her own field of expertise), electrical theory and electrical safety.

A versatile battery charger built from parts out of a power scrubbing machine was the entry of E. Michael Krenzer, 16, Spencerport, NY, while Andrew J. Kutlik, also 16, Lodi, CA, designed and built an electric combination lock and alarm system.

William C. Padgett, Jr., 18, Walterboro, SC, submitted a juke box that was originally discarded. He raised the value from zero to $650 with an expenditure of $35 in parts and a great deal of time. The prize-winning entry of Norman Shubert, 18, Danube, CA, was a synchronous converter and transformer.

### Brazil's color TV system good for both PAL and NTSC

Brazil exhibited a new television system, PAL/M, at the International Telecommunications Exhibition in Geneva last Fall. The PAL/M system has the same high quality of the German PAL delay-line system, while being compatible with the American NTSC system.

The Brazilians suggest that their solution to the "which system" problem may be the answer for some countries who have not decided which system to adopt, but may have pilot transmitters or large numbers of receivers using the NTSC system, which was the first to be widely used but does not reproduce color with the same fidelity as PAL.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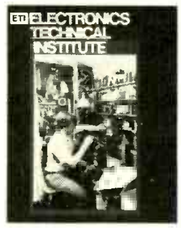


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# letters

### HELP!

I must say that you have a very fine magazine. I enjoy it very much. The departments, Service Clinic, Service Notes, and Letters are a lot of help.

Would you please print a request for help? I have this old Stewart-Warner radio that I would like to restore. I would like to ask for anything that would be of help to me. Old service notes, schematic, circuit diagrams, etc. The information on the set describes it as a Stewart-Warner Speedometer Corp., item "900 series", model 801, series B.

ARNOLD AMERSON
*130 Alves Lane, Apt. #1*
*Pittsburgh, CA 94565*

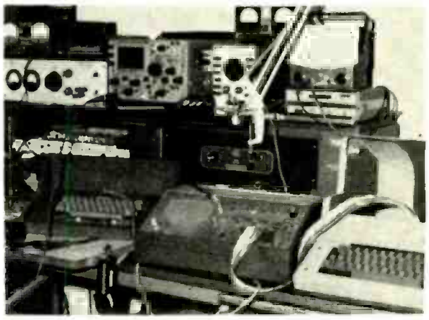
*Sorry Mr. Amerson. We opened our archives, but no luck. We did discover, however, a tremendous amount of dust.*

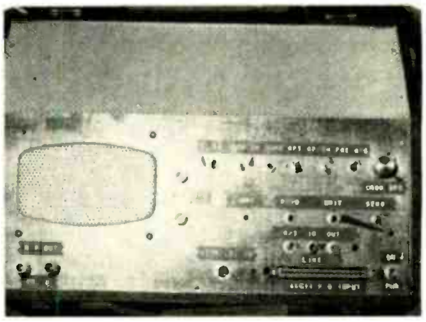
*Okay readers; dust off your files and see if you can help. Send any information you can dig up on this radio directly to Mr. Amerson.—Editor*

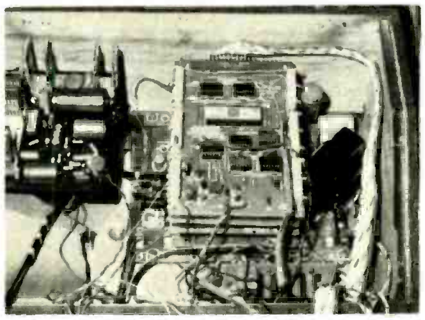
### DIGITAL STOPWATCH

Reader John Morse, of Bridgeport, CT, tells us that he has come across two versions of the Novus Mathbox model 650 calculator—one of several models recommended in the November issue as the basis for a digital stopwatch. One version—obviously the one used in the stopwatch shown in the article—has the IC's mounted on a PC board. The second, and presumably a later version, has all the electronic components potted into a glob on the back of the read-out. This one is unsuitable for use in the construction of the stopwatch.

You can probably identify the two versions by opening the battery compartment and pulling out the battery holder. You'll see either the PC board or the glob on the back of the read-out. Mr. Morse also mentioned that in the model 650 Mathboxes he's seen, versions with the PC board have serial numbers beginning with "1" while the serial numbers on the others begin with "2".—*Editor*





### SX-70 BATTERIES

I look forward to every issue of your magazine as I have for the past ten years. As a hobbyist I particularly enjoy your hobby oriented projects. I would like to pass this item on to your other readers.

One asset other experimenters may have overlooked is the battery that comes with every pack of Polaroid SX-70 film. The battery measures 1/10"×3½"×4¼" and is easily removed from the disposable pack after the last picture has been taken. The 6-volt cell, in its own protective pack, has two openings where you can solder on leads. With two silicon diodes in series it provides 5 volts for digital IC work. Four batteries provide ±12 volts for op-amp projects. They can even be series-strung to replace expensive 22.5 and 67.5 volt batteries in tube and transistor applications.

One bonus they provide is that they come from the camera at a consistent 6.23 volts (checked with an accurate source) which provides for a calibration

*(continued on page 16)*

# The Black Watch kit

## At $29.95, it's

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★**complete**–right down to strap and batteries.

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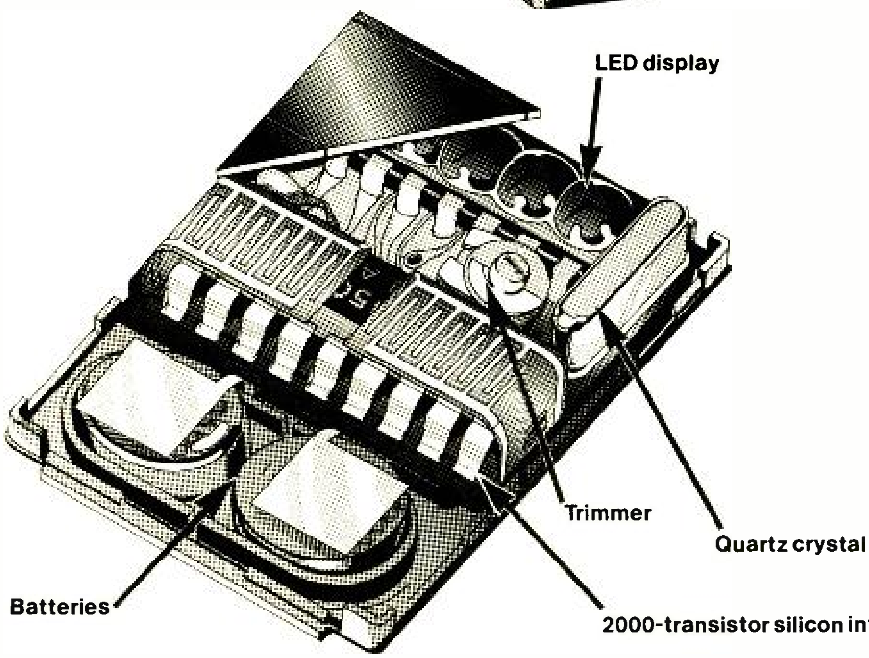
The Black Watch kit is unique, too. It's rational–Sinclair have reduced the separate components to just four.

It's simple–anybody who can use a soldering iron can assemble a Black Watch without difficulty. From opening the kit to wearing the watch is a couple of hours' work.

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## LETTERS

*(continued from page 14)*

check on test equipment. Their flat shape allows them to be used in many projects where standard batteries with their bulky holders would not fit. Their shelf life and current capacity make these a valuable power source that are presently being thrown in the garbage by the million.

2nd LT. KENNETH M. SCHULTZ
*Goodfellow Air Force Base*
*San Angelo, TX*

### MORE HI-FI

I think your in-depth hi-fi test reports are very good. My only criticism is that there aren't more test reports in each issue. I realize that with the proliferation of equipment available—it is impossible to cover everything. I do appreciate the fact that you are testing items other than receivers, turntables, etc. I especially appreciate your rear-view photo and the Overall Product Analysis.

I, personally, would like to see in-depth reports on several of the many system add-ons for improving dynamic range and increasing the S/N ratio.

I am learning more about audio and what the specifications mean all the time—my education coming mainly from reading reports and studying the explanations and comments made regarding specs in the reports.

I got turned on to Len Feldman via *Rolling Stone*. He really knows hi-fi and more important, he obviously loves to talk about it and explain it to others. Many equipment reports appearing in other magazines seem to go out of their way not to criticize any product. I like the way your reports take a stand on the competitive value of an item.

Keep up the good work.

BILL HATCHEL
*Hayward, CA*

*Thanks for your comments concerning our hi-fi test reports. They are well noted. But perhaps now is a good time for an explanation of our editorial policy.*

*We too would like to devote more space and cover more equipment than we presently do. Each month we find it increasingly difficult to "squeeze" the vast amount of information in our test reports into the available number of pages. But we would also like to increase the number of construction, educational and service oriented articles as well.*

*If* **Radio-Electronics** *was a magazine devoted to one specialized area (high-fidelity, for example), the decision would be easy—but it isn't.* **Radio-Electronics** *is a diversified magazine covering many specialized areas in electronics. We cannot devote more space to one specialized area without sacrificing the others.*

*Your comments, however, DO COUNT! We must have the support of our readers. Write to us, let us know about what you would like to see appear.*—Editor

### KOMPUTER KORNER

Komputer Korner is one of the best ideas the editors have had for quite some time. Microcomputers and microprocessors are being widely used now, and this type of information should be of great value to your readers.

The reason I read **Radio-Electronics** is to become more informed about new electronic developments. When I read a good informative story published in an electronics magazine it makes a favorable and lasting impression. Komputer Korner is exactly that type of story.

My congratulations go to Tim Barry for the fine job he is doing on Komputer Korner, and I sincerely hope to see more information of this type on microprocessors and microcomputers in the months to come.

DAVID H. SCOTT
*Mt. Home, ID*

*I thought all our ideas are "best" ideas! Oh well.*

*Komputer Korner is a monthly column that we hope will be with us for a long time. Although we are publishing only one column per month, there are two different Komputer Korner columns. One column, as you noted, is being written by Tim Barry. The second column is the result of the combined efforts of John Titus, David Larsen and Peter Rony. Watch for them both.*—Editor **R-E**

**DON'T MISS THEM!**

This month's hi-fi test reports include the new Fuji FX-C60 cassette tape and the Harman-Kardon Citation 16 power amplifier. Turn to pages 53 and 55, respectively, for the complete story and full specifications.

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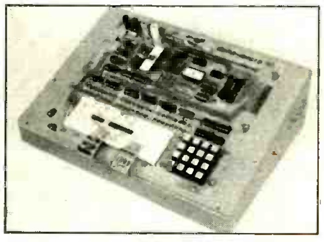

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# KOMPUTER KORNER

*Microcomputer anatomy and the way it communicates to the outside world is described this month.*


**PETER RONY, JOHN TITUS, and DAVID LARSEN***

*This article is reprinted courtesy American Laboratories


IN THIS COLUMN WE WILL DISCUSS THE "anatomy" of a typical microcomputer system. (See Fig. 1, page 24.) This system is based upon the 40-pin 8080 microprocessor chip and possesses all of the minimum requirements for a computer.

- It can input and output data.
- It contains an arithmetic/logic unit (ALU), located within the 8080 chip, that performs the arithmetic and logical operations.
- It contains "fast" memory (speed is an important requirement for a functional computer these days).
- It is programmable, with the data and program instructions capable of being arranged in any sequence desired.
- It is digital.

## Memory

Lets first consider the data communication between the 8080 central processing unit (CPU) and memory. The following definitions[1,2] will be useful in the ensuing discussion:

*memory*—Any device that can store bits in such a manner that a single bit or group of bits can be accessed and retrieved.

*memory cell*—A single storage element of memory.

*memory word*—A group of bits occupying one storage location in a computer. This group is treated by the computer circuits as an entity, by the control unit as an instruction, and by the arithmetic unit as a quantity. Each bit is stored in a single memory cell.

*memory address*—The storage location of a memory word.

*memory data*—The memory word occupying a specific storage location in memory, or the memory words collectively located in memory.

*random access memory*—A memory into which bits can be written (stored) and then read out again (retrieved).

*read-only memory*—A memory that can be repeatedly read out, but cannot be written into.

*programmable read-only memory*—A read-only memory that is field programmable by the user.

*volatile memory*—In computers, any memory that can store information only as

*(continued on page 22)*

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*At 26, Bill De Medio has more freedom, more security, and gets more respect than guys twice his age. (Photograph by Frank Cowan.)*

## KOMPUTER KORNER

*(continued from page 18)*

long as power is applied to the memory.

*read*—To transmit data from a memory to some other device.

*write*—To transmit data into a memory from some other device. A synonym is *store*.

The 8080 microprocessor uses 8-bit words that are stored in memory by a 16-bit memory address bus. The memory address bus determines a specific storage location in memory. Therefore, $2^{16} =$ 65,536 different memory locations can be accessed by the microprocessor. This memory access is direct, which means that you don't have to engage in any special tricks or digital electronic gimmicks to access any given memory location within the 65,536 possible locations. Forty-pin integrated circuit chips do have their advantages, and this is one of them. The total memory capacity of the 8080 microprocessor is known in the trade as "64K." This is far more memory than you will ever need for most applications, but it is nice to know that you have such power in reserve.

Data is transferred between the 8080 CPU and the memory via 8-bit input and output buses, both of which are shown in Fig. 1. By "input," we mean "input into the CPU." The term "output" is defined in a similar fashion. Our point of reference is always the CPU. Data leaving the CPU is always considered to be "output data;" data entering the CPU is always considered "input data." In the figure, we have indicated that the input and output data is transferred between the *accumulator* and memory. This is frequently the case, but in a more detailed look at the 8080 chip, you will discover that data stored in memory is transferred to other internal *registers* within the 8080 chip as well. The most obvious such register is the *instruction register*, from which the decoding of the instruction occurs. Other registers, known as *general purpose registers*, are classified by the letters B, C, D, E, H, and L.

The accumulator register is the heart of the entire microcomputer. Arithmetic and logic operations are always performed to or on the eight bits of data present in the accumulator. All input and output data passes through the accumulator with the aid of two computer instructions called IN and OUT.

Between the 8080 CPU and memory there is a single output line called memory READ/WRITE. When this line is at a logic 1 level, you are able to read data into the CPU either from memory or from an external device. When this line is at a logic 0 level, you are able to write data from the CPU into memory or an external output device.

As a final point, you can use any type of "fast," digital electronic memory device, including random access memory (RAM), read-only memory (ROM), and programmable read-only memory (PROM). What do we mean by "fast" memory? Simply that the memory can perform either a read or write operation during a single microcomputer instruc-

*(continued on page 24)*

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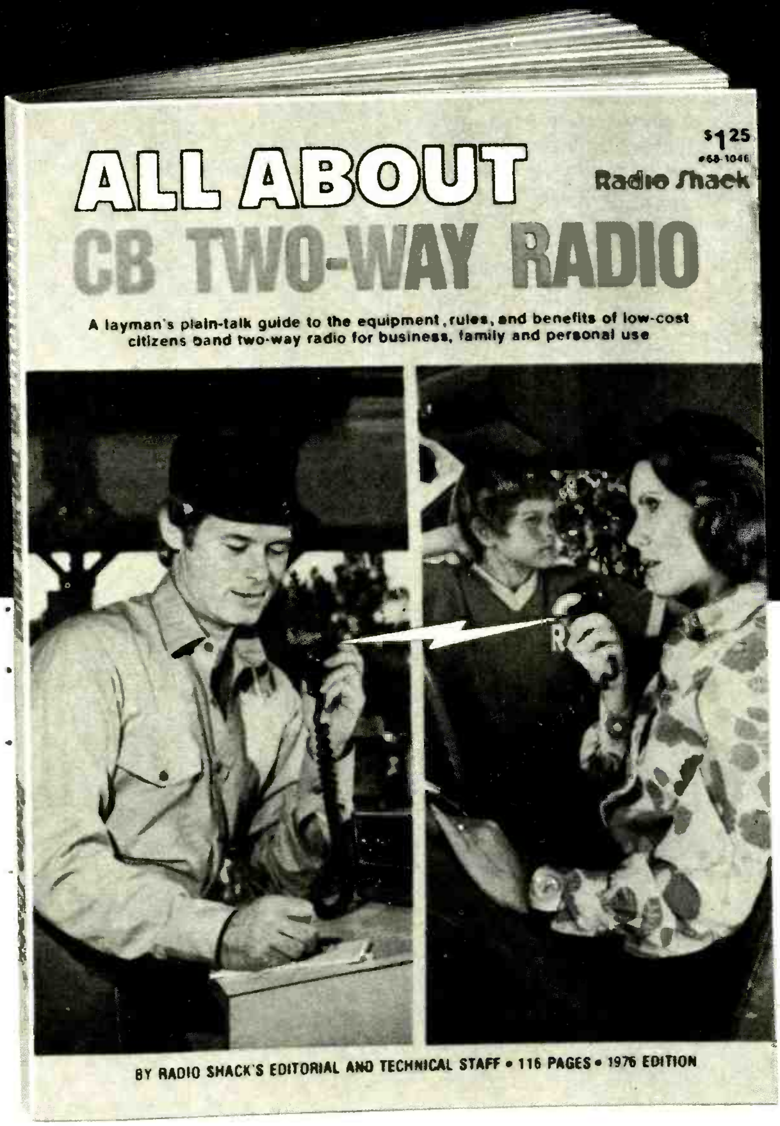


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## KOMPUTER KORNER

*(continued from page 22)*

tion. A typical 8080 microcomputer system operates at a clock rate of 2-MHz and a read or write operation takes only 3.5 μs. Thus, RAM, ROM and PROM all need an access time of about one to two microseconds to allow you to take full advantage of the maximum clock speed. Slower semiconductor memories can be used, but the microcomputer will have to "wait" while a read or write operation is completed.

### Data output

The 8-bit output bus between the 8080 CPU and memory also serves as the output data bus to an external output device. When you provide output to an external device, there are several important points that you must remember:

- You must select the specific output device that will receive 8-bits of data from the CPU.
- You must indicate to this device when output data is available on the output data bus.
- The device must capture this output data in a very short period of time, typically 1.5 μs.

The third point is perhaps the most important. Keep in mind that the microcomputer is operating at a clock rate of 2 MHz. Each computer instruction is executed in a very short period of time, which ranges from 2 μs to 9 μs. Thus, accumulator data designated as "output data" to an external device is not available for very long. You must capture it while it is available. We will discuss the techniques that you should use in a subsequent column; this topic is certainly among the most interesting topics that can be discussed in the area of computer interfacing.

### Data input

The basic considerations that apply to data output also apply to data input to the CPU from an external device. Thus:

- You must select the specific device that will transmit 8-bits of data to the CPU.
- You must indicate to this device when the CPU is ready to acquire the input data.
- You must insure that the CPU acquires this data in a very short period of time, typically 1.5 μs.

### Input/output device addressing

The 16-bit memory address bus is time shared so that it can provide, at certain times, an 8-bit device identification number called a *device code*. Eight bits of information allow you to decode $2^8 = 256$ different devices. When used in conjunction with 2 output-function pulses called IN and OUT, the microcomputer system can address 256 different input devices and 256 different output devices. We might point out here that a "device" can be a complex machine such as a teletype, a CRT display, or a simple device such as a single integrated circuit chip. This is another interesting topic for discussion that we shall reserve for a subsequent column.

### Microcomputer interrupt

Not shown in Fig. 1 is a single input line to the microcomputer that generates

*(continued on page 30)*

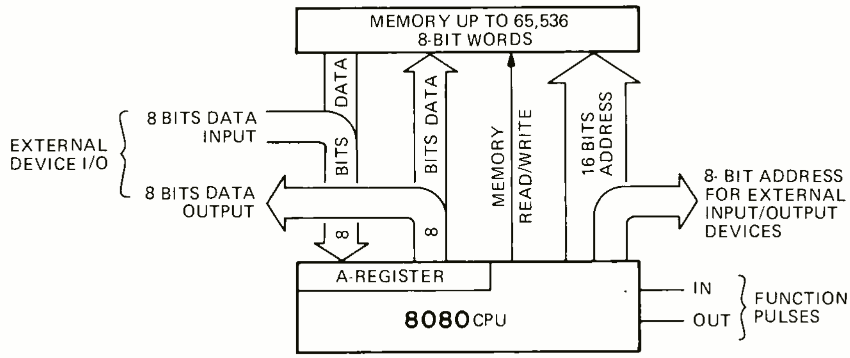


FIG. 1


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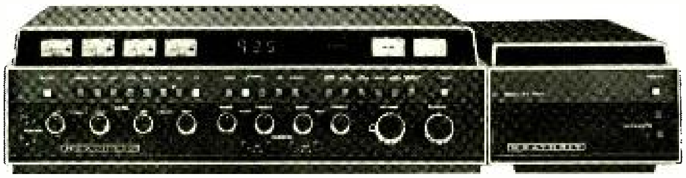

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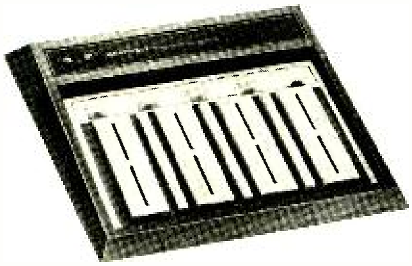

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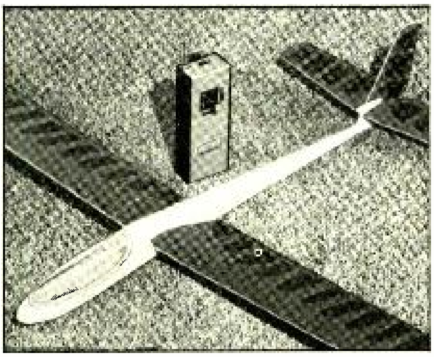

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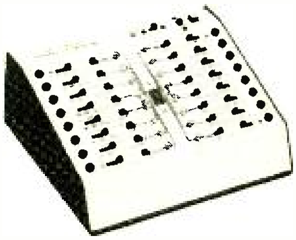

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**KOMPUTER KORNER**
*(continued from page 24)*

a program *interrupt* during microcomputer operation. Such an interrupt would be generated by an external device that wishes to transfer data to or from the computer. This particular topic is quite complex and it will be a number of months before we tackle it in this column.

The above is about the best that we can do to describe the general "anatomy of a microcomputer in one thousand words or less. Microcomputers are fascinating machines. They are small and relatively inexpensive, so one is less likely to be intimidated by them. They are far simpler than their minicomputer and computer counterparts and can be readily repaired by the simple process of chip substitution. **R-E**

*References*

1. Graf, R. F., *Modern Dictionary of Electronics,* Howard W. Sams & Co., Inc., Indianapolis, IN, 1972.
2. Blukis, J. and Baker, M., *Practical Digital Electronics*, Hewlett-Packard Co., Santa Clara, CA, 1974.

### Computer calls to computer via amateur radio satellite

Two North American radio amateurs have made the first claimed remote access of a computer, not only through a two-way radio link but also via an amateur communications relay satellite.

An "execute program" command was transmitted by WB4BWK, W. Franklin Mitchell, Jr., Due West, SC, to VE2BYG/3, Randall S. Smith, Barrie, Ontario, via the AMSAT/OSCAR 7 satellite. On reception, it executed the stored program which consisted of a message from VE2BYG/3 to WB4BWK. The data was transmitted in ASCII code at a rate of 110 baud (110 units per second). The FCC has granted a waiver to hams interested in computers and radioteletype, permitting them to transmit ASCII-coded information by way of the satellite.

### Calculators good for kids say mathematics teachers

The little hand-held electronic calculator, which formerly aroused some doubts in the minds of educators, is now acclaimed as a "valuable instruction aid" by the National Council of Teachers of Mathematics. "In the classroom," reads the Council's policy statement, "the calculator should be used in imaginative ways to reinforce learning and to motivate the learner as he becomes proficient in mathematics."

According to articles in *Arithmetic Teacher* and *Mathematics Teacher*, organs of the Council, important teaching uses of the calculator are to encourage inquisitiveness and creativity, to promote independent problem solving, to solve problems that would be impractical to attempt with pencil and paper, and to decrease the time needed to handle difficult computations. The little computers can also be used more prosaically to solve consumer problems and to verify the results of pencil-and-paper calculations. **R-E**

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*Circle 20 on reader service card*

# New CB Test Gear

*Using the new CB test gear is easy and CB service is a whole new field for the consumer electronics technician. Consider getting started now*

**JACK DARR**
SERVICE EDITOR

THE CITIZENS BAND HAS LITERALLY EXploded! For the last year or so, the sales of CB radios have soared to astronomical figures. A recent report (R-E January 1976) said that they had reached a level of 100,000 units a month, and the only reason they weren't selling more was that the setmakers couldn't keep up. The FCC has a tremendous backlog of license applications (about 350,000).

So there they are, "out there", and someone has to service them. The regular two-way radio repair shops can't keep up with the vast numbers of jobs. This makes it a lucrative field for the consumer electronics men. Only a few added test instruments will be needed. Most of them aren't hard to fix, with proper equipment.

The only new thing will be transmitter servicing. And with the right instruments, this isn't too tough. The transmitters and receivers are crystal-controlled, which makes frequency calibration very simple. Receivers are straight single conversion or dual conversion superheterodynes, with only one new circuit, the squelch. We'll cover the typical circuits, test equipment and methods, and the legal requirements of CB radio servicing, and show you some of the ways to make this easier.

To repair the transmitters, a technician must hold an FCC Operator's License of at least a Second Class Radiotelephone grade, or higher. To get one you must pass the FCC test (which isn't any tougher than the CET test!) For a very helpful book on this, get a copy of Edward M. Noll's "Radio Operator's License Handbook, 3d Edition" (Sams, 21112). It explains all of the Rules and Regulations ("R&R" 's) and gives sample questions with the answers. For a higher Class, "First Class Radiotelephone License Handbook" by the same author (Sams 21144), which covers First and Second Class 'phone license material.

The FCC requires that you have a copy of "FCC Rules and Regulations (R&R's), Part 95" in your possession. This, with some Amendments, covers Citizens Band operation, and tells you what you can and can not do, and so on. This is available from the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402 for a "nominal fee".

The most important thing in the R&R's is the statement that "Only those persons properly licensed are permitted to make repairs or adjustments which may result in illegal operation." What this means in English is that the transmitter must be on-frequency within the stated tolerance, and must not radiate a higher rf power than the license calls for. The original CB radios used a rating of "5 watts input" meaning 5 watts input power to the final rf stage. The rule now is "4 watts (of rf power) input to the antenna", which is about the same thing.

If you're interested, "input power" is figured by reading the voltage and current of the final rf stage, and then multiplying to get W=EI. We now have direct-reading rf power meters, and the power measurements are as easy as reading the battery voltage with a VOM! Fig. 1 shows one of the new CB test instruments. We'll be talking about these and several others as we go.

The rule about radiation of too much rf power isn't hard to comply with! In most cases, the problems we find are *too little* rf output. Off-frequency operation is very unlikely. With crystal control, the only thing that could cause this would be a bad crystal. This would throw the transmitter so far off that it wouldn't work at all.

**FIG. 1—WATTMETER MONITORS transceiver power output and antenna standing wave ratio. This unit has three power scales.**

(There is one thing that can result in illegal operation! This is the use of a "PEP Booster" (PEP = Peak Envelop Power) of 50 watts rating that raises the transmitter output to that figure. These are completely illegal, and woe be to the CB operator caught using one! The FCC does monitor the CB bands, and the use of such a thing can mean a stiff fine.)

No periodic frequency checks or logs are required, as in commercial two-way radio service. However, for best operation, the frequency of both receiver and transmitter should be *checked* each time the set is serviced. Another new instrument that makes this really a snap is the digital frequency counter, such as the Simpson 7026 in Fig. 2. All you do is push the button, and these instruments give you a direct readout of the operating frequency down to the least significant digit. Frequency tolerance for the CB band is .005% or 50 parts per million which is easy to get with modern crystals. This is roughly ± 135 *hertz*.

## The CB radio

Most of the CB sets you'll see wil be "transceivers" (transmitter and receiver in a single case, sharing not only the power supply but quite a few circuits as well). I believe that the majority of these are mobile units with a 12 volt dc power supply. There are ac-powered base station units, but a lot of these are identical to the mobiles, with the addition of only a 12 volt dc power supply from the AC line.

**FIG. 2—FREQUENCY COUNTERS like this one read CB frequencies to an accuracy within 0.1 Hz.**

There are quite elaborate versions, some costing as much as a commercial two-way radio. The vast majority, though, will be the simpler ones used in cars and trucks. Solid-state circuitry is almost universal, because of the space saving. Some of these units are amazingly compact, though they have all of the functions of the bigger ones.

There are three main groups of frequencies used. The "27-MHz band" has 23 channels, and this is where most of the activity is. A band of frequencies around 72 MHz is used for radio control of models, and there is a "UHF Band" from 462.55 MHz to 467.725 MHz. Amplitude modulation is used almost exclusively.

## Transmitter testing

This is the part that will be new to most technicians. However, with the proper instruments, it isn't at all difficult. If you know the fundamentals of the operation, no problems. Let's review a few of the basic principles.

The rf circuits of the transmitter put out a radio-frequency signal at the carrier frequency. The first check is for correct frequency; just feed the signal to a dummy load, couple the frequency counter to this and push the transmit button. Read the channel frequency from the counter readout. Channel 5, for instance, is 27.015 MHz.

Next we check the rf power output. This, too, is a cinch with the right instruments. The SWR/rf power meter of Fig. 1 will give you a direct reading. Fig. 3 shows another type, with a digital readout, that does not require a direct connection to the transmitter.

For bench tests, the rf is fed into a "dummy load". This is a resistance with 50 ohms impedance (the characteristic impedance of most CB transmitters). Thank goodness for a standard!

By coupling a "linear detector" to the dummy load, the rf signal and modulation can be read on an oscilloscope. Fig. 4 shows the schematic of such a detector; it must be built into a shielded case (A "Band-Aid" can is very handy, and common!)

There are a couple of reactions that can be of a lot of help. Let's go over them quickly. The reading you see on the rf power meter, without talking into the mike, is the unmodulated rf carrier power. It would look something like Fig. 5 if you had a 50 MHz scope, which isn't necessary. To make this useful for communications, we must "add intelligence" to it; or, "modulate" the carrier with an audio frequency.

Maximum modulation should be just a little below 100%. Fig. 6 shows an rf carrier with about 95% modulation. Notice that the peak value of the rf waves is just about twice the peak of the unmodulated carrier. This happens because we are *adding* the power in the modulating signal

FIG. 3—FIELD STRENGTH METER with digital output. It has a frequency range of 2 to 1100 MHz.

to that of the rf carrier.

Let's say that the rf signal in Fig. 5 has an amplitude of 5 volts peak. Now if we modulate this with a 5-volt peak audio signal, the *voltage* on peaks will be doubled, because the two voltages (of the same polarity) will add. So, the peaks of the full-modulated signal in Fig. 6 will be 10 volts, and the carrier will be driven down to almost zero at points where the modulating voltage is opposite-polarity.

Would you like a fine simple test for

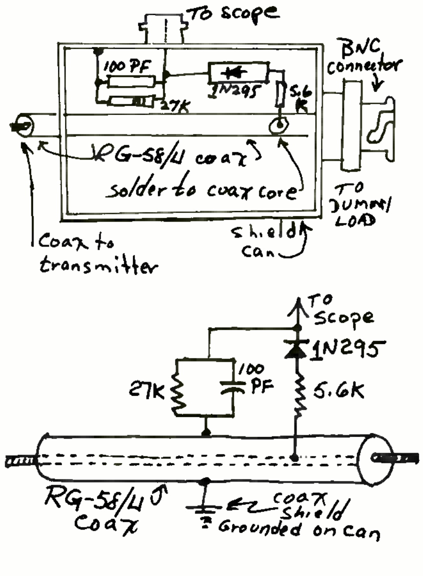



FIG. 4—LINEAR DETECTOR CIRCUIT. Use this to read the modulation of the transmitter and detect any sign of distortion. A sinewave input must be used.

this? Good; we have one. Just push the transmit button. Note the rf power reading. Now whistle loudly into the mike and watch the meter. If the reading *goes up* roughly 22%, you are getting 100% modulation! (It doesn't come out double because the peak reading we just gave is voltage, and this is a *power* reading.)

There is one more, before we leave this section. If you whistle into the mike and

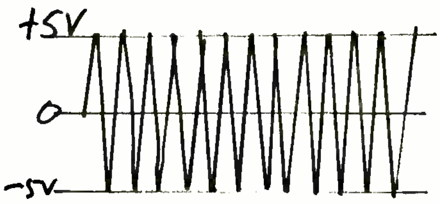



FIG. 5—UNMODULATED RF CARRIER with positive and negative peak voltages of 5 volts. You see this when you key the rig.

the power reading *goes down* look out. This means that you are *over-modulating* the rf carrier, and actually losing power output. There will also be quite a bit of distortion. Why? Fig. 7 shows the answer. Let's say that you have the same 5-volt peak rf, but that your modulation is 8 volts peak. On the cancel-peaks, the rf carrier will be driven "below zero", as shown. So, you actually do not get as much rf power out as before, and the recovered audio will be distorted. In actual CB transmitters, this is usually due to a drop in the rf power output, rather than to an increase in audio modulating voltage. You come out with the same condition; too much modulating signal for the amount of rf. Common causes are mistuning of the rf final amplifier stage ("final"), mismatch to the antenna, and so on.

Now what if the modulator does get weak? This can happen if the mike is defective or if a driver stage in the transmitter has a bad transistor. Now the carrier will be *under*-modulated. The audio will be "clear but weak". The rf power meter will not show the normal rise in

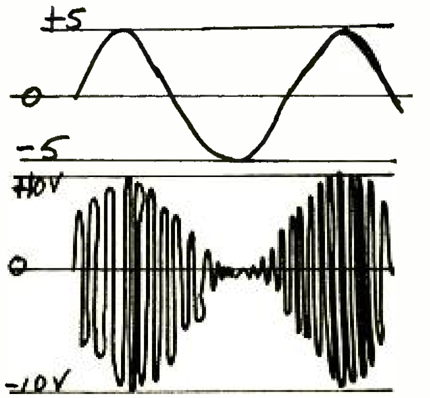



FIG. 6—(top) AUDIO MODULATING signal, also positive and negative volts peak. (bottom) 100% modulated rf signal. Note that where modulation and rf voltages add, we get peaks of +10 and −10 volts. This is voltage; the power increases by about 22%.

power with modulation, but it will not go down.

In the typical CB transmitter, the modulator stage is also the receiver audio output, so that any problems such as this will show up in the receiver too. (One "goody" for doing this is an open emitter bypass capacitor in the audio driver stage! This reduces the gain and causes quite a bit of distortion; check this with a scope on the emitter. Should be no signal present at all.)

### Final tests

For the best results, the CB transmitter should be checked with the antenna normally used; on the vehicle, etc. If there is any trouble in the antenna, it will show up as a loss of rf power output. (And with only 4 watts of rf, we can't put up with

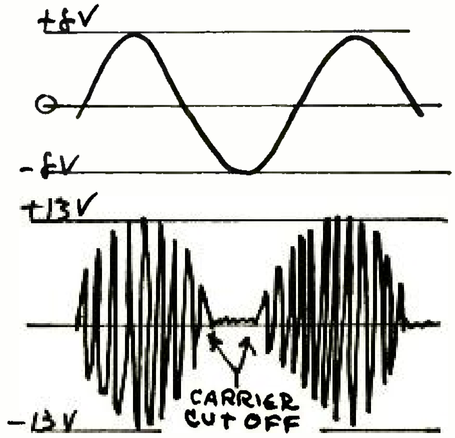



FIG. 7—EXCESS MODULATION voltage or low RF voltage causes overmodulation, and loss of RF power output.

any loss at all!) One common cause of this is "standing waves" on the transmission line.

What's a "standing wave?" When the transmitter sends out an rf signal, it travels to the antenna through the transmission line. If the line, and the antenna, are perfectly *matched*, the antenna absorbs all of the rf power. (Where does it go? It radiates off into space as an electrical field. This is the only "one-way circuit" in electronics!)

However, if the antenna or transmission line isn't matched to the transmitter output stage, there will be a *reflection* of power from the antenna back to the transmitter! One cycle of rf will go down the line, bounce off the mismatch, and start back toward the transmitter. On the way, it will meet other cycles of rf coming from the transmitter. The two will add and cancel, and the result will be rf signals that simply run back and forth in the transmission line.

This does nothing at all for the total rf power output, since these standing waves represent precious rf power. They are called "Voltage Standing Waves" and the voltage standing wave ratio is a measure of the efficiency of any transmitter-antenna system. The abbreviation for this is VSWR or "Viz-War" if you want to call it that.

How do we check for this condition? (Are you ready for this one?) You read it on a VSWR Meter! This is a special rf power meter, which can be switched so that it reads "forward power" or normal rf output, or reversed so that it reads power *coming back* from the antenna. It is calibrated so that it reads the VSWR directly as a ratio. Such an instrument is shown in Fig. 8. This can be connected in series with the transmission line to the antenna and left there. In the FORWARD position, it will tell the operator whether he's "getting out" or not.

Standing-wave problems are often caused by improper tuning of the final in the transmitter. Most of the CB antennas used are well-built commercial designs, that have very low VSWR's. A VSWR of 1:1 is "perfect", and anything above this should be checked out. If you do run into problems, there is a little device called an "Antenna Matcher" which can help; Fig. 9. It can be installed in the transmission line, tuned up and left there.

A quick check of transmitter adjustments can be made, in the vehicle, with a simple rf detector, of the type shown in Fig. 10. It is just a radiation detector. You set it near the antenna and push the transmit button. Then, check all of the rf tuning adjustments on the transmitter. Set these for a peak on the rf meter, and there you are.

This is one fast way of catching any defective stages in the transmitter. If *any* of these adjustments fail to show a definite *peak*, that stage has a problem! After using such an instrument for only a little while, you'll be able to get a very good idea of whether this transmitter is putting out normal rf power. Set the meter about the same distance from the antenna each time, and the rf reading will be close to the same.

Summing up on the transmitters, the final in a CB transmitter is something of a "broadband" affair. Since it isn't possible to provide really sharp tuning adjustments for each of the 23 channels, the finals are "peaked" somewhere near the center of the band.

So make your tuning adjustments on Channel 11 or 12; then check for rf output


**FIG. 8—STANDING-WAVE-RATIO bridge reads relative forward power or reflected power and SWR.**

on Channel 1 and Channel 23 to make sure that something isn't causing too much of a "droop" in the curve. Since the whole CB Class-D band is only 300 kHz from one end to the other, it's not impossible to get good results over the whole band.

## Checking receivers

The typical CB receiver will be crystal-controlled. This makes it handy. You don't need a very accurately calibrated rf signal generator for alignment work! Just tune the signal generator for maximum output through the front end, and there you are.


**FIG. 9—ANTENNA TUNER for 27-MHz Citizens band offers improved operation of CB transceivers and reduces harmonic rediation and television interference. It can tune the transmission line to a 1:1 SWR.**

For sensitivity tests, the generator should have an accurately-calibrated output attenuator. Most of the better CB receivers have astonishingly good sensitivity, often down around 1.0 microvolt or better.

The receiver's RF amplfier stage is also somewhat wideband, but the sensitivity is attained in the IF stages. Many of them use dual-conversion IF's, with the first one up around 10 MHz, and the second down around 455 kHz. Both oscillators will be crystal-controlled for stability.

## The squelch circuit

There is one circuit used in all CB receivers that isn't common in the broadcast types. This is the "squelch". This circuit does just what its name implies; it squelches the "blow" or hiss that would be heard in the absence of an incoming signal. (In the very first two-way police radios, it wasn't used. The constant roar drove the poor officers mad, so they simply turned the volume down. So they missed a lot of calls. This spurred the development of a working squelch circuit.)

The operation of a squelch circuit is simple. The most common type uses a high bias on one of the audio preamplifier stages. This cuts off the tube/transistor, so that there is no sound in the speaker. The RF and IF stages are still picking up the random noise or blow. This is rectified, and used to maintain the cutoff bias.

When a signal is picked up, these stages will "quiet" because the signal overrides the random noise. This drop in the noise voltage causes the squelch circuit to develop a bucking voltage which "opens" the audio stage by cancelling the cut-off bias; the signal goes through.

In case you're wondering how the set can tell the difference between the noise and the signal, this, too, is fairly simple! The noise is "white noise", or random samples of all kinds of frequencies, mostly very high. So, we pick off only the very high-frequency signals and use them to hold the squelch off. The voice signals are,

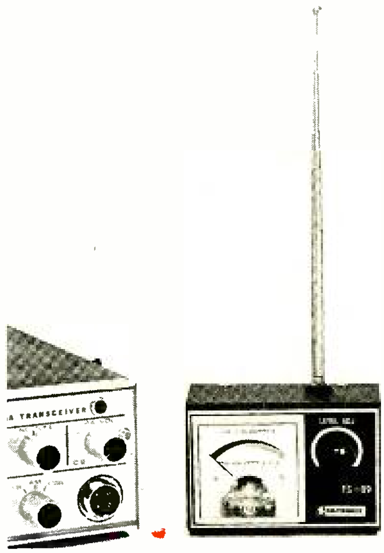


**FIG. 10—FIELD STRENGTH METER indicates relative field strength of CB antenna power over a frequency range of 1.5 to 200 MHz. A 7-ounce instrument.**

by comparison, very low frequencies, so they have no effect on the squelch circuit itself.

Most problems in the squelch circuits will be due to weak tubes, leaky transistors, bad resistors, and so on. A very good check for the condition of this circuit is just turning the squelch control. If this will "break" (let the speaker blow) somewhere near the center of rotation, the squelch is in pretty good shape.

If you must turn it all the way to one end, and then it barely breaks the squelch, something has drifted off value, and will cause trouble very soon. If the squelch won't break at all, you may have trouble in the RF or IF stages, or in the controlled stage. Check the dc voltages with and without an input signal, and it shouldn't take long to pin down the guilty part.

## Odds and ends

Watch out for "Unauthorized Repairs"! Quite a few CB operators are amateurs. I don't mean amateur operators—I mean amateur *technicians*! When you get one of these sets, look it over very carefully. Check the type and *location* of all tubes and transistors. This kind of thing isn't hard to spot if you're looking for it, but it can really throw you a curve if you're not really on your toes.

One set came in with simply awful sensitivity on the receiver. The rf tube was checked, and found to be perfectly good, also brand new. After much digging around, we noticed that the dc voltages around this tube socket were in very funny places for the tube in use. It turned out that the original tube was a dual-triode. The one in it was a triode-pentode. You may find a transistor installed backward, or npn's used where a pnp should be, and all sorts of goodies like that.

This brings up a very important point—service data. With the right service data, we would have caught the tube substitution instantly; it wasn't there (at the time! It is now). You can get full service data for all of the U.S. makes of CB sets in Sams Photofact "CB Radio Series" of manuals. This will save a great deal of time in checking parts, locating tuning adjustments, and many other things.

### Check that voltage regulator!

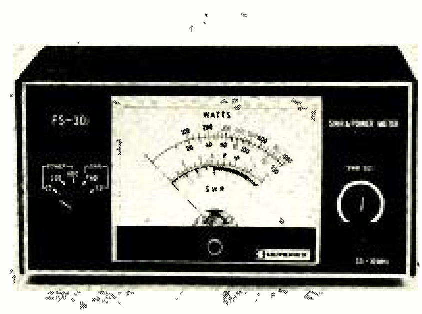
Like all other electronic equipment, CB radios have their own peculiar problems. Since the majority of them are solid-state, and also used in vehicles, the car's electrical system must be in good shape. If the trouble is blown rf or audio transistors, etc., check the vehicle's voltage regulator.

It must never be higher than 13.8 volts with the engine running at cruising speed. If this voltage goes up to 15.5 or 16 volts, look out. Many operators have a habit of making long transmissions without letting up on the key. This normally heats up output and audio transistors, and if the supply voltage is too high, can lead to failure due to overheating of the junctions.


**AUTORANGING FREQUENCY COUNTER is great for CB service work. You only have to turn it on and select the mode.**

In some sets, these transistors are not derated enough to begin with, and a 30 to 40% increase in the supply voltage can drive them into breakdown.

In certain sets, the rf output transistors will have to be replaced by the exact equivalents, due to socket or basing problems. Many of these are EIAJ types, such as 2SC1173, and others which do not as yet have U.S. exact duplicates. Mostly, the cases won't fit, and the extra wiring needed to convert may upset the stray capacitance of the final, and cause tuning problems. This will soon be remedied, I'm sure, but for now you may have to dig up exact duplicates. The back pages of **Radio-Electronics** are a good place for this! There are quite a few semiconductor supply houses listed in here who stock these special types of CB transistors.




**WATTMETER MONITORS transceiver power output and antenna standing wave ratio. The unit has a flat response directional coupler independent of frequency from 3.5 to 30 MHz. Three power reading scales cover 0 to 1000 watts. Expanded range calibration of the SWR scale permits direct reading of from 1:1 to 3:1 SWR.**

### Final notes

In general, the TV technician who wants to get into CB radio work won't have too many problems. Practically all of his regular test equipment can be used, with only a few instruments added. As I said before, the FCC license test isn't any harder than the CET tests. You don't have to make periodic frequency checks; the only thing you might do here, if you do make a frequency check, is to note it on the statement, with the date and results. (You charge for this, of course!)

So, there you are. As so many of the CB operators say today "Arkie to Screwdriver-Jockey—Out!". **R-E**

### Electronic games on home TV making a sudden upsurge

According to a number of dealers, electronic TV games became an important factor in toy departments for the first time last Christmas season. Odyssey, a Magnavox product, was introduced three years ago, but felt its first heavy demand last year with the result that the company's production lines worked full time to fill Christmas orders. Odyssey was described in full in the December, 1975 issue of this magazine (page 29) with block diagrams of the circuitry.

Another company, Broadmoor, puts out a game that requires a modified TV set, since the game signals are injected into the video circuitry. It plays hockey and tennis. Atari, maker of sports-arcade electronic games, produces a very popular game called Pong.

### Coding system to combat video tape pirating

A device to prevent illegal copying of videotapes has been developed by Goldmark Communications Corp., Byron Motion Pictures and Teletronics International, three organizations working in the television and motion picture field.

Called "Stop-Copy," the system uses a specially devised technique to code the magnetic tape electronically. The special coding permits a program to be played through the videocassette, but if an attempt is made to record the program on another videocassette recorder, the coding prevents video recording and the result is a blank copy. While the "Stop-Copy" system is not yet compatible with all types of video recorders, a more completely compatible type is under devolopment.

The developers warn that although the present device is successful in preventing ordinary illegal duplication, it could possibly be circumvented by a skilled electronic technician. More sophisticated technology may be required to deter the professional who decides to engage in program pirating.

### COMPUTERIZED NEWSPAPER MAKEUP

**MODERN NEWSPAPERS have replaced the traditional type-case and blue pencil with computerized composition and electronic-display editing. The above scene at the *Minneapolis Star and Tribune* is typical. Display ads are set up with the help of a Raytheon 1,000-line television screen and solid-state memory composition system. Items can be set up or erased either by the keyboard or with an "electric pencil" applied directly to the face of the tube. What the pencil crosses out is erased in the computer and can be replaced by material typed in from the keyboard. Display type of different sizes and faces can be selected and typed in almost as easily as typing one size and face on a standard typewriter.**

# Tachometer and Over-Speed Alarms

*The versatile CD4001 IC is the heart of these practical tachometer and over-speed alarm circuits that you can build and connect to any vehicle with a 6- or 12-volt electrical system*

**R. M. MARSTON**

MANY MODERN SEMICONDUCTOR DEVICES have practical applications in automobiles. One of the most useful devices is the CD4001 COS/MOS digital integrated circuit. The CD4001 is an inexpensive and readily available quad 2-input NOR gate that features near-infinite input impedance, a low output impedance, near-zero quiescent current consumption, and the ability to operate from any supply source in the range of 5 to 15 volts.

The CD4001 is very versatile and can readily be made to act in a variety of gate, logic, inverter, and multivibrator roles. In this first part of this 2-part story, we show how you can use a single CD4001 IC to make an inexpensive but highly efficient precision tachometer or RPM meter for your car.

In Part 2 of the series, we'll go on to show how the basic tachometer circuit can be expanded so that it also acts as a precision red-line or over-speed alarm. This alarm generates an audio/visual output when the engine or vehicle speed exceeds a pre-set limit.

The tachometer and over-speed alarm circuits can be used on any gasoline-powered vehicle having a 12-volt electrical system. If required, the tachometer circuit can also be used on vehicles with 6-volt electrical systems by using a simple adapter device that is also described in this article. Before looking at the first of these circuits, let's digress a little and take a brief look at the characteristics of the CD4001 integrated circuit that forms the basis of these designs.

## The CD4001 IC

The CD4001 COS/MOS digital IC is a quad 2-input NOR gate. The basic circuit and pin connections of the device are shown in Fig. 1. A full description of this unit was given in the September 1974 issue of **Radio-Electronics**. For our present purpose, it is sufficient to know that each of the four gates of the device features a near-infinite input impedance, a low output impedance, near-zero quiescent current consumption, and the ability to operate from any supply source in the range 5 to 15 volts.

If a rising or falling voltage is applied to the input of a COS/MOS digital IC element, the output of the device remains unaffected until the input signal reaches a value known as the *transition* voltage, at which point the output may switch rapidly from one logic state to the other. The transition voltage of a device is usually specified as a percentage of its supply voltage: The CD4001 has a typical transition voltage value of 50% of its supply voltage, the actual production spread limits being 30% to 70%.

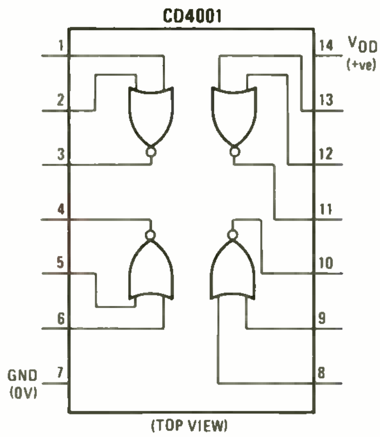



**FIG. 1—LOGIC DIAGRAM and pin connections of the CD4001 quad 2-input NOR gate.**

The CD4001 is a very versatile device. Each logic element of the CD4001 can be used as a NOR gate by using the connections shown in Fig. 2. A NOR gate provides a low (logic 0) output if either input is high (logic 1). Alternatively, the NOR gates can be used as NOT elements or simple pulse inverters by using the connections shown in Fig. 3. A NOT element provides a low output when the input is high, and vice versa. Note when using this device (and all other COS/MOS digital integrated circuits), that the unused input pins of the IC must be disabled by connecting them to one of the circuit supply lines.

Any two or more gates of a CD4001 IC can be cross-coupled to make a highly efficient version of any one of the three basic types of multivibrator. Figure 4-a shows the connections for making a simple 800-Hz astable multivibrator or square-wave generator that operates whenever its power supply is connected, and Fig. 4-b shows a gated version of the same basic circuit. The Fig. 4-b circuit can be gated on by applying the full positive supply voltage to pin 2 of the IC, and can be gated off by reducing the voltage on pin 2 to zero.

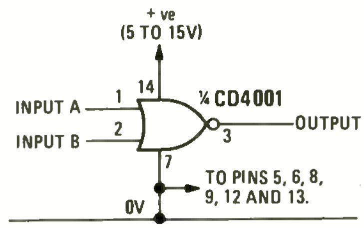



**FIG. 2—A NOR GATE is obtained by connecting one of the gates of the CD4001 as shown.**

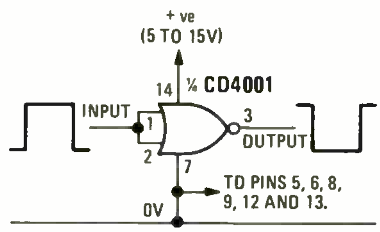



**FIG. 3—A PULSE INVERTER is obtained by connecting one of the gates of the CD4001 as shown.**

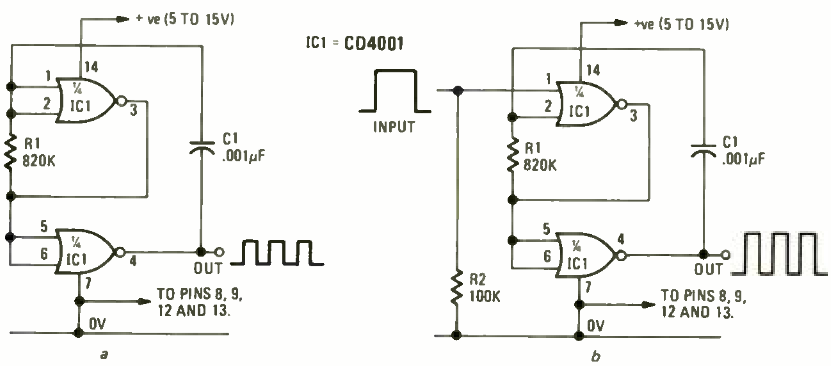



**FIG. 4—ASTABLE MULTIVIBRATOR circuits operating at 800 Hz are shown. Circuit shown in *a* is a simple astable while circuit shown in *b* must be gated to operate.**

Figure 5 shows how two of the gates of a CD4001 can be cross-coupled to form a monostable multivibrator. An outstanding feature of this particular circuit is that it can be triggered by any input waveform shape, irrespective of its rise-time or duration. The duration can be longer or shorter than that of the actual output pulse. The shape of the output pulse is independent of the shape of the trigger signal. The output pulse of the circuit is actually initiated at the moment that the input trigger signal *rises* above the transition voltage. The circuit is unaffected by input voltages that *fall* below the transition voltage.

Finally, Fig. 6 shows how the monostable multivibrator described above can be used as a simple but very accurate linear-scaled analogue frequency meter, giving a full-scale reading of 1-kHz on an inexpensive 1-mA moving-coil meter.

Here, the input trigger signals are fed to the gate-A—gate-B monostable circuit via the Q1 preamplifier and via the gate-D inverter stage. The output pulses of the monostable are fed to the 1-mA meter via gate C and current-limiting resistor R8. The supply line of the circuit is stabilized at 6.8 volts by the R9—D2—C4 network. Consequently, a current pulse of fixed amplitude and fixed length is fed to the meter each time the monostable is triggered.

The average current flowing in the meter in the above circuit is equal to the product of the peak pulse current and the pulse length and the repetition frequency of the pulse. In practice, the circuit gives a peak pulse current of approximately 2 mA and has a pulse length of 0.5 ms, so the meter reads its full-scale value of 1 mA at 1 kHz, and reads 0.5 mA at 500 Hz and 0.1 mA at 100 Hz. The circuit thus acts as a linear-scale frequency meter.

Note that the meter in this circuit can not be damaged by applying too high an input frequency, since the maximum meter current is limited to 2 mA by R8, and all 1 mA moving-coil meters can withstand this magnitude of overload quite easily.

The Fig. 6 circuit can be made to read precisely 1 kHz at full scale by simply feeding an accurate 1 kHz signal to its input and adjusting R6 for the full-scale reading. The linearity of the circuit is equal to that of the basic meter. The circuit can be triggered from any input waveform shape, and has an input sensitivity of approximately 100 mV RMS and an input impedance of about 10,000 ohms.

The circuit can be made to read alternative full-scale frequency values by altering the values of C3 and/or R6—R7. Higher frequencies can be obtained by reducing the values of these components, and vice versa. The circuit gives a useful performance up to frequencies of a few hundred kHz.

The Fig. 6 circuit can easily be adapted to function as a tachometer, and forms the basis of the tachometer and red-line or over-speed alarm circuits described in this article.

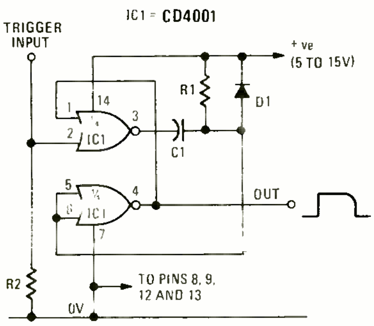



**FIG. 5—MONOSTABLE MULTIVIBRATOR provides an output pulse when it is triggered.**

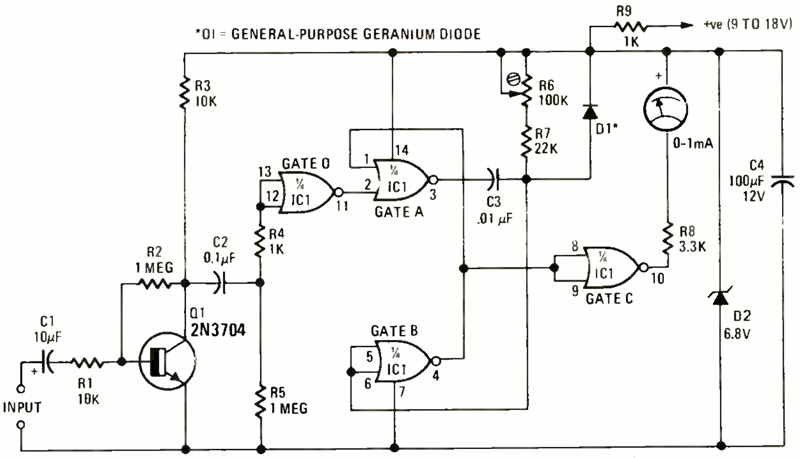



**FIG. 6—LINEAR SCALE analog frequency meter has a 1 kHz full-scale reading.**

## A high-performance tachometer

Fig. 7 shows how the Fig. 6 circuit can be adapted for use as a tachometer or RPM-meter on vehicles equipped with 12-volt electrical systems. Circuit operation relies on the fact that a vehicles contact breaker (breaker points) develops a waveform with a basic frequency that is directly proportional to the engine's RPM. In the Fig. 7 circuit, this waveform is picked up and used to trigger a monostable multivibrator. The output frequency of the multivibrator is indicated on a 1-mA meter in the same way as the Fig. 6 circuit. In this case, however, the meter is calibrated directly in RPM rather than in frequency.

The interesting technical feature of the Fig. 7 circuit is the method of converting the basic contact breaker signal into a form suitable for triggering the COS/MOS monostable multivibrator. Fig. 8 shows the actual waveforms that are obtained in different parts of the circuit when it is connected to a 4-cylinder engine at 3000 RPM. Note particularly the details of the contact breaker signal appearing at point "A" of the circuit.

As the contact breaker first opens, the ignition coil is thrown into oscillation at a frequency of approximately 10 kHz. In the first half-cycle of this oscillation, a peak signal of about 250 volts is developed across the contact breaker. This peak voltage drops rapidly to about 30 volts as ionization takes place across the vehicles spark plug gap. After 1.5 ms or so, the ionization process ceases and the coil again goes into oscillation.

This time the coil oscillates at a frequency of about 2.5 kHz. As this oscillation dies away the contact breaker voltage

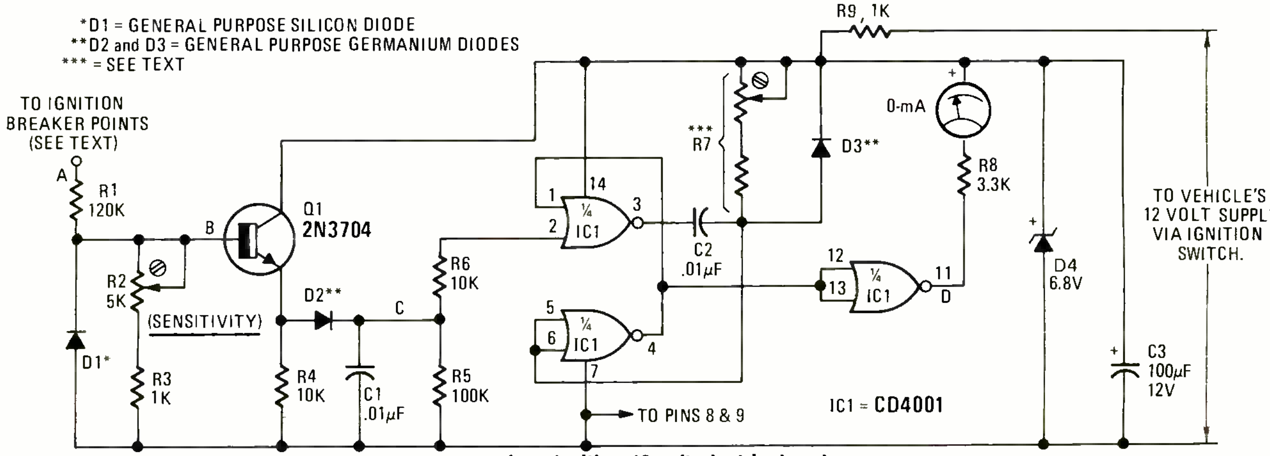



**FIG. 7—TACHOMETER CIRCUIT can be used on any car equipped with a 12-volt electrical system.**

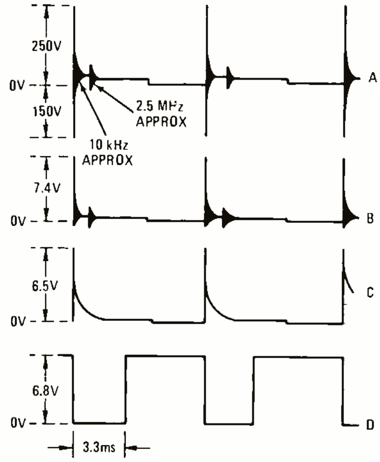



**FIG. 8—VOLTAGE WAVEFORMS obtained from tachometer circuit when it is connected to a 4-cylinder engine operating at 3000 RPM.**

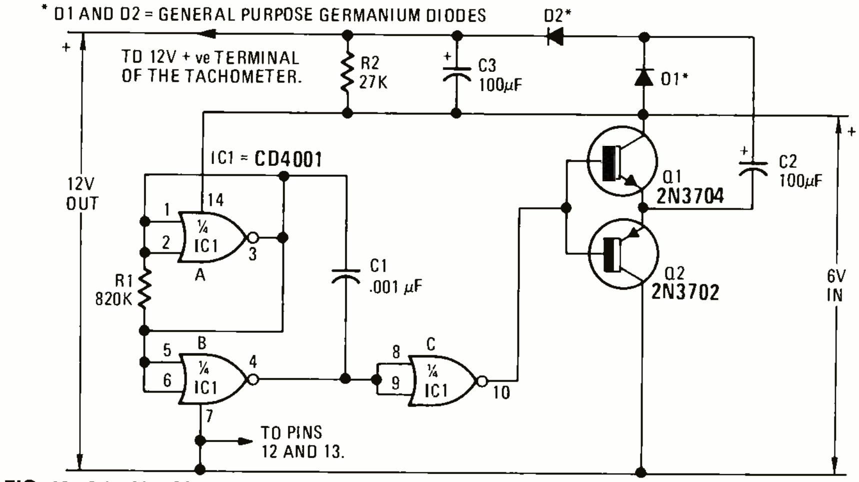



**FIG. 10—6-to-12 VOLT converter enables the tachometer circuit to be used with cars equipped with 6-volt electrical systems.**

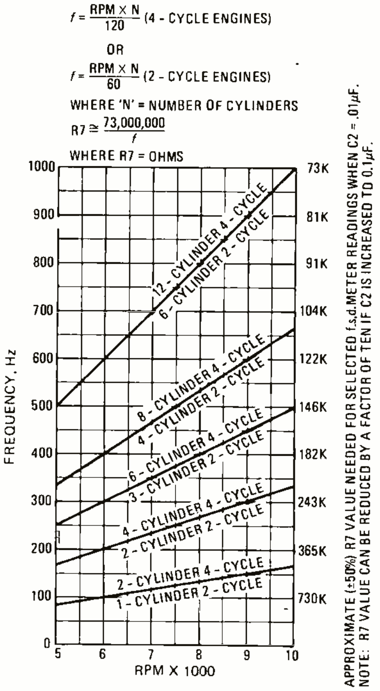



**FIG. 9—RELATIONSHIP between frequency, RPM and the value of R7 needed to provide full-scale readings for different types of engines. The value of C2 is .01 μF.**

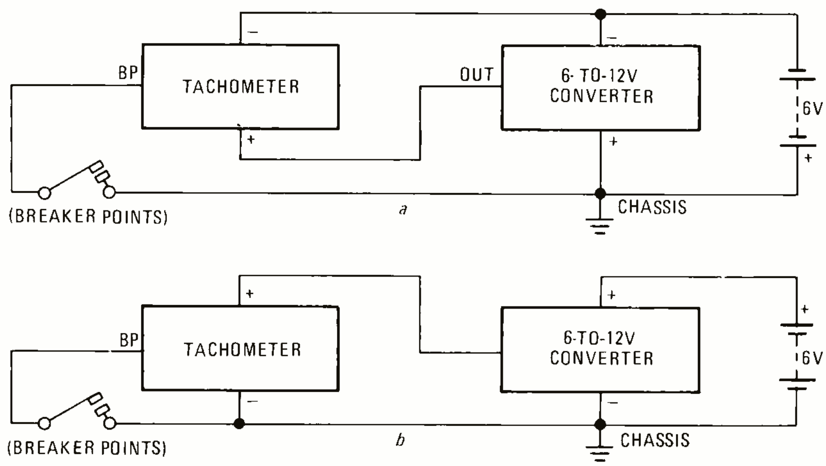



**FIG. 11—METHOD OF CONNECTING tachometer to 6-volt systems via the converter on cars with + ground is shown in *a* and — ground is shown in *b*.**

stabilizes at the vehicles battery voltage of roughly 12-volts. Eventually, the contact breaker closes again, and the voltage falls to zero. When the contact breaker reopens, another high-voltage oscillation is initiated, and the waveform repeats.

Thus, the contact breaker signal is quite complex and contains a variety of frequency and voltage components. To trigger the tachometer, we need to detect the basic contact breaker frequency but reject all the transient oscillatory voltages. The Fig. 7 circuit achieves this as follows:

First, the basic contact breaker signal is applied to the base of emitter follower Q1 via voltage divider R1–R2–R3 and diode D1. The voltage divider reduces the amplitude of the signal by a factor of about 40, and the diode eliminates the negative parts of the signal at point "B" of the circuit. Any positive portions of the signal at point "B" that significantly exceeds the 6.8 volt Zener-stabilized supply of Q1 causes the base-collector junction of the transistor to become forward biased, so positive signals are automatically clipped at about 7.4 volts at point "B" of the circuit.

The signal appearing at the emitter of Q1 is similar to that of the base, except that approximately 600 mV is subtracted from all parts of the waveform by the forward-biased base-emitter junction of the transistor. This waveform is fed to a peak-detecting time-constant circuit formed by D2–C1 and R5, with the result that a pulse waveform with a short rise-time and a relatively long fall-time is developed at point "C" of the circuit. This waveform is used to trigger the monostable multivibrator via R6.

Note that, since the monostable is fired by a positive-going transition voltage with a nominal value of 3.4 volts (= 50% of the 6.8-volt supply), and since the input attenuator provides a division factor of about 40, the monostable actually triggers at the moment that the contact breaker signal rises to approximately 126 volts. This occurs as the breaker points first open. The monostable is thus triggered synchronously with the contact breaker, but is unaffected by voltage transients with a magnitude lower than 126 volts or so. The Fig. 7 circuit thus acts as a versatile and accurate tachometer or RPM meter.

The tachometer circuit can be fitted to any vehicle having a 12-volt electrical system, irrespective of the systems polarity. The supply leads for the tachometer are connected to the vehicle's battery via the ignition switch, and the circuits input terminal is connected to a suitable pick-up point. On vehicles with conventional ignition systems, the terminal is connected to the contact breaker. On vehicles fitted with capacitor-discharge ignition systems, the terminal should be connected to the high-voltage output point of the C–D ignition unit.

Before attaching the unit to the car, it must first be calibrated to give the appropriate full-scale RPM readings for the particular vehicle in question. The procedure here is to first decide the full-scale RPM reading that is required, and then consult the graph of Fig. 9 to find the frequency that corresponds to that reading on that particular vehicle.

Thus, a frequency of 333 Hz corresponds to a reading of 10,000 RPM on a 4-cylinder 4-cycle engine. The output of a square wave generator set to this frequency, with a peak amplitude of approximately 6.8 volts, is then connected to the input of the tachometer circuit after first setting potentiometer R2 to its maximum value. Then adjust R7 to give the full-scale

*(continued on page 82)*

# Inside 30 Channel MATV Systems

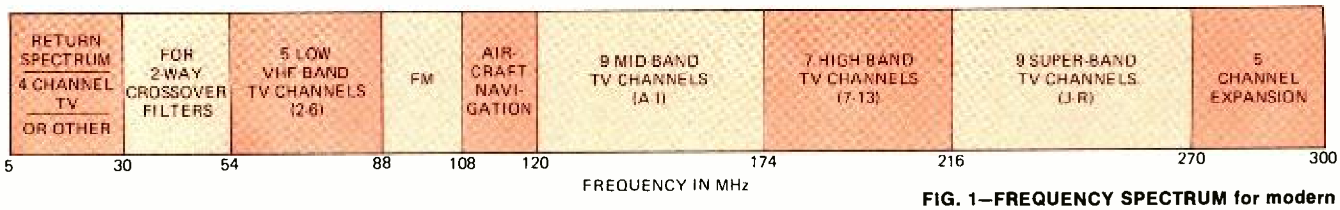



**FIG. 1—FREQUENCY SPECTRUM for modern CATV systems.**

*The demand for more channels in master-antenna TV distribution systems increases as such systems are specified for new hotels, apartment complexes and shopping centers. Here are how the wideband systems work.*

**BERT WOLF***

THE NEW TREND IN MATV (*M*ASTER *A*ntenna *TV*) systems is toward more channels and more services. Like CATV (*CA*ble *TV*) systems, MATV has been moving steadily toward more program choice over the past 26 years.

For a long time, systems were confined to the low VHF band (channels 2 thru 6). Then, new equipment permitted systems to carry the high VHF band (7 thru 13) channels. Once the technology permitted adjacent-channel operation, systems carrying up to 12 VHF channels were possible.

However, 12 channels were still not enough. Modern CATV systems use the midband (120 MHz to 174 MHz) and the super-band (216 MHz to 300 MHz), giving them 30 to 35 channel capability without UHF distribution. CATV systems convert UHF channels to lower frequencies to reduce cable attenuation and the high costs of UHF signal distribution. Figure 1 shows the spectrum for today's CATV systems.

Modern cable-TV systems typically exceed 12-channel capability and the FCC currently *requires* a minimum of 20-channel capability in the 100 largest TV markets. They also require 2-way capability, at least on a non-voice basis. Two-way capability typically involves the use of the sub-channel band (5-30 MHz) for return information.

Many MATV systems are now being designed to carry over 20 channels so that they can accept a CATV feed. Other MATV systems are being designed for more than 12 channels to accommodate all the available off-air channels plus local closed-circuit TV channels. As a result, there is a growing requirement for MATV systems with a capability of over 20 channels.

*V.P. & General Manager, Jerrold Electronics DSD Division.

### Equipment requirements

Most passive MATV equipment (splitters, tap-offs, etc.) in use over the past 10 years are capable of passing the entire VHF spectrum (54 to 216 MHz). For an all-channel MATV system to be CATV compatible, all equipment must be capable of passing 5 to 806 MHz to include the whole spectrum shown in Fig. 1.

The most critical piece of active equipment for a 30-channel system is the internal distribution amplifier. Figure 2 shows a typical MATV amplifier capable of covering the entire 5 to 300 MHz spectrum. An important feature of amplifiers designed to handle mid-band channels is that they must use push-pull circuitry. This is essential to eliminate second-order distortion.

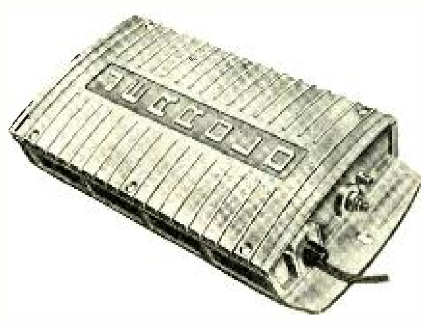


**FIG. 2—JERROLD MODEL IDA-45 30-channel amplifier with 2-way capability.**

Second order distortion is not important in ordinary MATV amplifiers. This is because of the standard VHF frequency assignments established by the FCC. Take any pair of picture carrier-frequencies in the VHF band (channels 2 thru 13) and you will find that neither their sum nor their difference frequencies (which are generated when two frequencies are mixed) fall within the VHF low-band (channels 2 thru 6) or the VHF high-band (channels 7 thru 13). Similarly all of the second harmonics of the low VHF band carriers (except channel 6 sound carrier) fall between the two VHF bands.

Figure 3 shows the spectrum obtained when 12 continuous-wave signals on the VHF picture carrier-frequencies were sent through a broadband VHF amplifier. Notice that none of the beats or harmonics are in a position to cause interference.

When it comes to the mid-band, however, second-order distortion becomes a very important factor. Mid-band channels are in the portion of the spectrum most affected by second-order distortion. Push-pull circuitry cancels second-order distortion, making it possible to carry these extra channels.

Figure 4 is a functional block diagram of the output section of a typical push-pull RF amplifier. The first hybrid inverter splits the input signal into two equal portions. It sends half of the sig-

## FCC CATV TECHNICAL STANDARDS

| | FCC CATV STANDARD |
|---|---|
| Channel Capacity | 20 channels, minimum, in top 100 markets |
| Subscriber Tap Level Range | 0 dB mV to 12 dB mV |
| Limit Between Adjacent Channels | 3 dB maximum |
| Limit Between Non-Adjacent Channels | 12 dB maximum |
| Visual To Aural Carrier Ratio | −13 dB to −17 dB |
| Signal-To-Hum | 5%, −26 dB maximum |
| Channel Frequency Response | ± 2 dB max., −1 to +4 MHz of visual carrier |
| Carrier-To-Noise | 36 dB minimum* |
| Carrier Interference | 46 dB minimum |
| Isolation Between Outlets | 18 dB minimum* |
| System Radiation Limits below 54 MHz | 15 μV/meter @ 100 feet |
| 54 to 216 MHz | 20 μV/meter @ 10 feet |
| Above 216 MHz | 15 μV/meter @ 100 feet |
| 2-way Capacity | at least non-video capacity |

*Jerrold 30 Channel Standard is identical to FCC CATV Standard except that Jerrold requires a carrier-to-noise of 50 dB minimum and the Isolation Between Outlets to be 18 dB minimum. (Required to limit noise addition to incoming signal to less than 0.5 dB, if incoming C/N is 40 dB or less.)

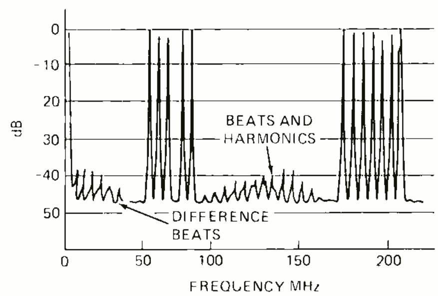



**Fig. 3—FREQUENCY SPECTRUM of 12 continuous-wave signals with appreciable 2nd-order distortion.**

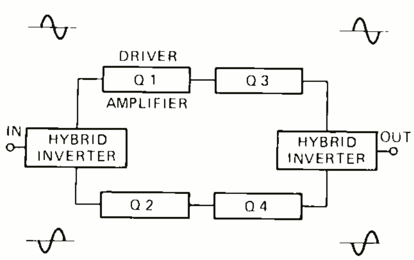



**FIG. 4—PUSH-PULL AMPLIFIER eliminates 2nd-order distortion.**

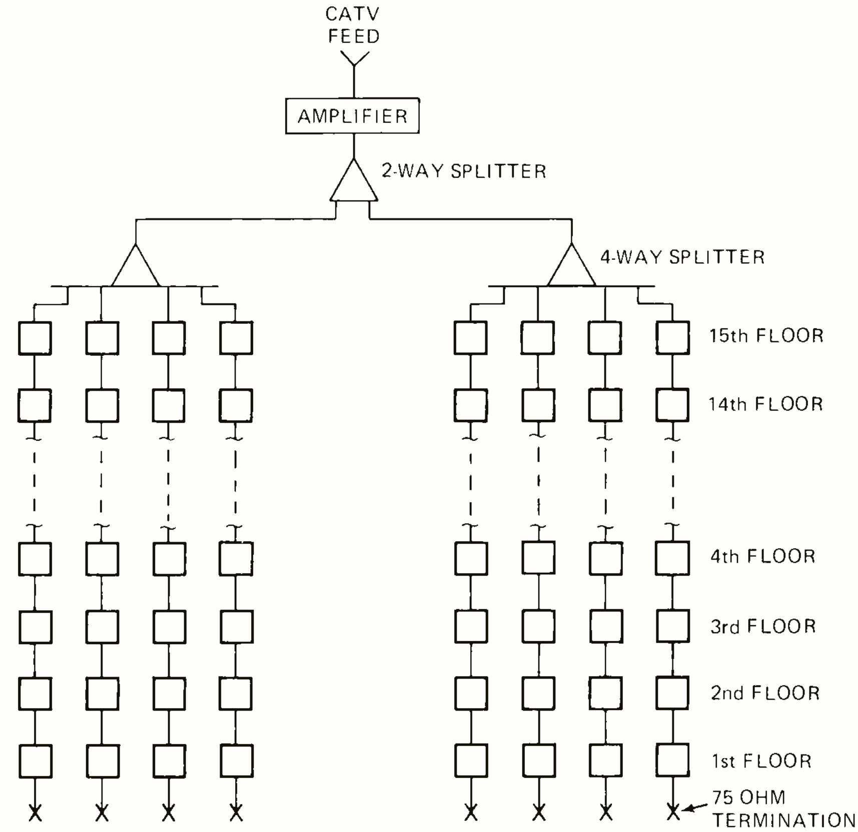



**FIG. 5—CONVENTIONAL MATV RISER system has high distribution losses.**

nal in-phase to driver amplifier Q1. The phase of the other half of the signal is inverted 180 degrees and sent to driver amplifier Q2. Transistors Q1 and Q2 are a matched-pair arranged in a common-emitter configuration.

The second hybrid inverter inverts the signal from Q4 and then combines it with the signal from Q3. A push-pull RF amplifier provides exactly the same advantages as a push-pull audio amplifier. Even harmonics are mixed at exactly the same amplitude, but 180° out of phase. Therefore, they cancel each other and the second-order harmonic distortion is eliminated.

For large MATV systems, high-output capability is very important. Output capability is related to the number of channels carried by the amplifier and the amount of cross-modulation distortion that can be tolerated. MATV amplifiers should be rated at 0.15% cross-modulation (−57 dB) or better if they are to accept a CATV feed or if cascading is required. In systems where no implifier cascading is required, 0.5% cross-modulation (−46 dB) is generally considered tolerable.

### Typical 30-channel MATV systems

A typical MATV system is shown in Fig. 5. Observe that the risers go from apartment to apartment. There is no direct access to each apartment and therefore no direct control over a cable TV connection without entering an apartment. At that point it is still impractical to discontinue service without affecting the other sets on the same riser. Another problem with the conventional riser system shown in Fig. 5 is that distribution losses are high.

A better way to do the job is shown in Fig. 6. This system uses one central core riser with horizontal feeders. Notice that this system does provide direct access to every subscriber at the central core. Further, only one line extender is required, rather than eight. Electrical contractors are accustomed to running conduit for vertical risers and it will take time before specifications can be changed to accommodate a central-core horizontal-feeder system.

In many instances, 30-channel MATV systems will be two-stage affairs. The first stage is to build a self-contained, fully functional system that provides excellent quality and program variety. The second stage is to interface the MATV system with the CATV system as soon as a CATV feed becomes available. By planning ahead, you protect the system from obsolescence. When CATV comes to the area, no rewiring or extra equipment will be required.

Even if a CATV feed never becomes available ,a 30-channel MATV system can still deliver excellent services. In

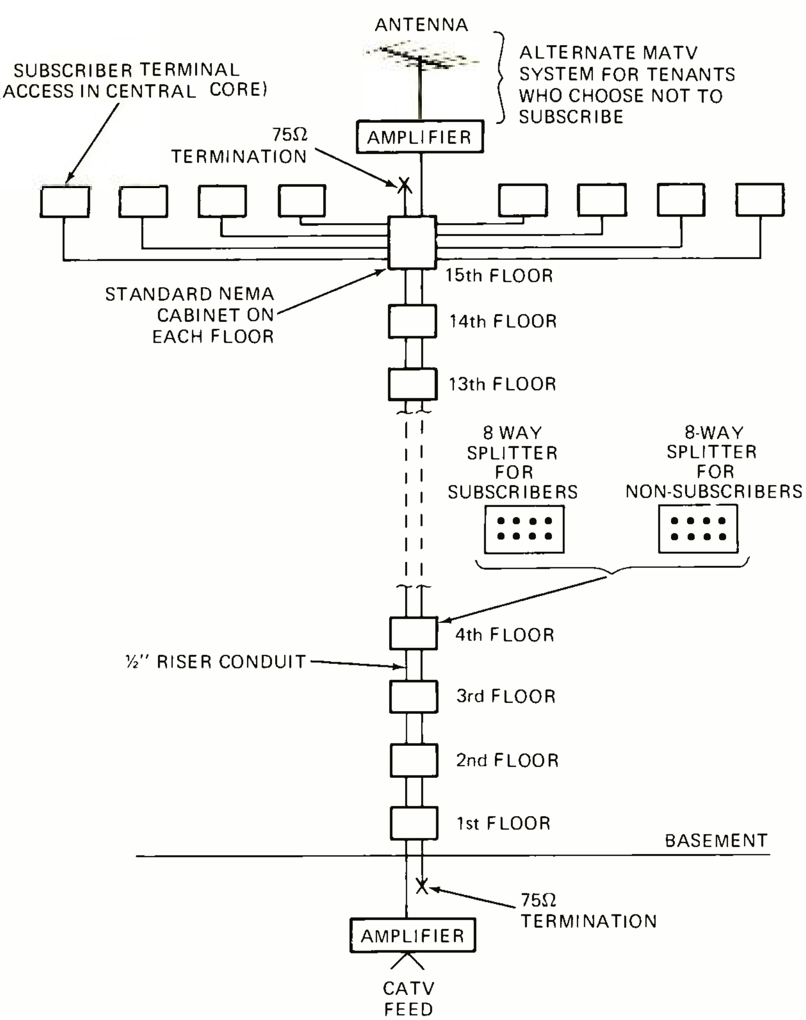



FIG. 6—CENTRAL CORE RISER system has a single vertical riser.

addition to all available off-the-air channels, many other program sources are possible. Premium movies are becoming commonplace in hotels and motels. They may soon be available to residents in suitably equipped apartment house complexes, condominiums, housing developments and trailer parks as well.

Closed-circuit TV channels are being used both for security and entertainment. Some systems, for example, use one CCTV channel to watch the front door and another channel to see who is in the elevator. CCTV channels are also useful for time-message-weather-music, watching swimming pools and recreation areas.

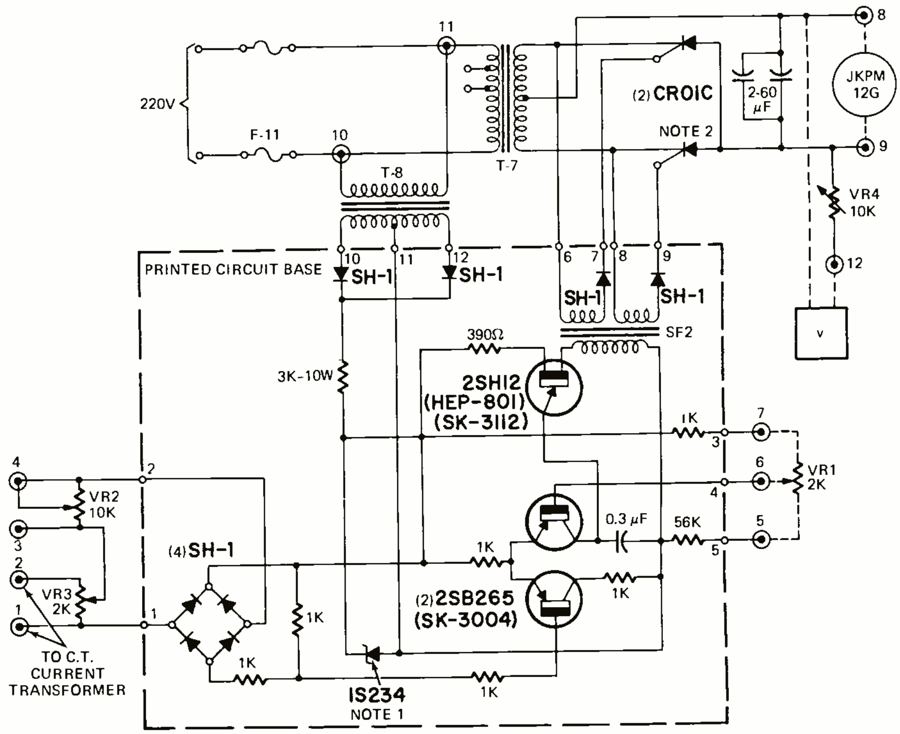
Hospitals, nursing homes and medical schools often use converters to provide restricted acces to certain programs. Anyone connected to the system can watch entertainment programs, but only authorized personnel equipped with converters can watch televised operations and medical training programs telecast on sub-, mid- and super-band channels.

The two-way capability of MATV systems may eventually be used to monitor fire and burglar alarms, polling, shop-at-home services, student response systems, etc. The possibilities are mind boggling.

We have the technology for 30-channel MATV systems right now. They cost a little more than conventional MATV systems, but they are obsolescence-proof. **R-E**

# Substitutes For Transistors

***We have a machine of Japanese manufacture, with a solid-state control unit. A copy of the schematic is attached (see diagram). The transistors actually used are noted beside the symbols. It is still working, but I'd like to have information as to substitutes available in this country, before they blow out.—W.A., Conyngham, PA.***




There *is* a wise move. After an unknown device has blown, it's very difficult to get any exact data on it. I've noted possible substitutes on the diagram, where I could get the data. There are a couple of things that you will have to verify; see the "notes" marked.

**1. The Zener diode.** No listing on a 1S234, but this is obviously a Zener. Read the DC voltage across it. This will give you the correct rating.

**2. These are SCR's.** There are many of these available. To get the correct ratings, measure the maximum voltage across them. Also, open the circuit and insert a milliammeter (ammeter?) and see what the maximum current is. Note this on the schematic, as well as the normal DC voltages on all of the transistors. "SH-1" and -2 are common silicon diodes, I'm pretty sure. **R-E**

# CUTTING AUDIO TEST TIME

*New audio test equipment reduces measurement time while increasing measurement accuracy. Here's what this new equipment is all about.*

**LEN FELDMAN**
CONTRIBUTING HI-FI EDITOR

IT TAKES A TECHNICIAN ABOUT TEN MINutes to plot the frequency response of an audio amplifier, using a fixed-frequency audio oscillator and an AC VTVM, if you count the time needed to transcribe the thirty or more readings from the meter to a piece of semi-log graph paper. The same task can be performed in a few seconds using a modern audio sweep generator, a chart recorder and/or a storage oscilloscope equipped with an audio frequency graticule.

The very best distortion analyzers, equipped with automatic nulling and even automatic level set (such as the Sound Technology 1700A described in the October issue of R-E) can provide a single reading of total harmonic distortion in less than five seconds. However, distortion analyzers cannot tell you what harmonics make up the total distortion and what the contribution of each of those harmonics is. It has become increasingly apparent in recent years that a single figure of THD does not provide us with enough information to determine the "audible annoyance factor" of that distortion. High-order harmonics are known to be more bothersome, subjectively, than simple second- or third-order harmonic distortion.

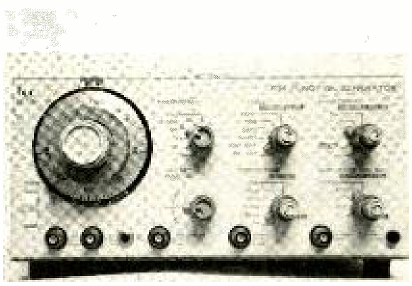


FIG. 1—IEC MODEL F34 function generator delivers square waves, triangular waves, pulses and tone bursts.

Rumble meters, used to measure rumble of turntable systems, give a single figure (in dB) of signal-to-noise ratio but the reading does not tell us the frequency or frequencies of the offending noise. Is it primarily sub-sonic rumble (in the 5 to 30 Hz range) or is it caused by multiples and sub-multiples of the rotation frequency of synchronous motors used to drive the turntable (usually at 1800 RPM, or, 30 Hz)?

With the development of audio sweep generators some years ago, there began a steady but growing trend towards simplification, automation and reduction of the time required to make many of the audio test measurements we have mentioned. Audio sweep generators, such as the IEC Model F-34 shown in Fig. 1, use a voltage-controlled oscillator (VCO). The output frequency of the VCO depends upon the instantaneous voltage applied to a varactor diode—a diode whose effective capacitance varies with DC voltage applied to it. Such diodes serve as the frequency-determining capacitance in oscillator circuits. A change of voltage of as little as 5 volts can cause the frequency of oscillation to change over a wide range.

An elementary system of sweep frequency analysis is shown in block diagram form in Fig. 2. The sawtooth generator develops the ramp voltage required to sweep the VCO over its desired range of audio frequencies. The ramp or triangular voltage is also applied to the horizontal input of an oscilloscope to develop a horizontal trace in synchronism with the changing audio frequencies. Output from the oscillator is applied to the amplifier under test and output of the amplifier is displayed vertically on the oscilloscope.

The oscilloscope photo of Fig. 3 shows the response of an audio amplifier over the range from 300 Hz to 20,000 Hz when the high-cut filter of the amplifier is switched into the circuit. The upper trace is the input signal, unvarying in amplitude over the specified range, while the lower trace is a display of the output of the amplifier under test. Frequency sweep in this case was linear, but if the ramp voltage

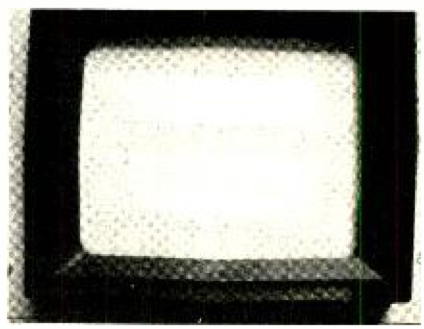


FIG. 3—SWEEP GENERATOR output is shown in upper trace. Frequency response of amplifier with high-cut filter turned on is shown in lower trace.

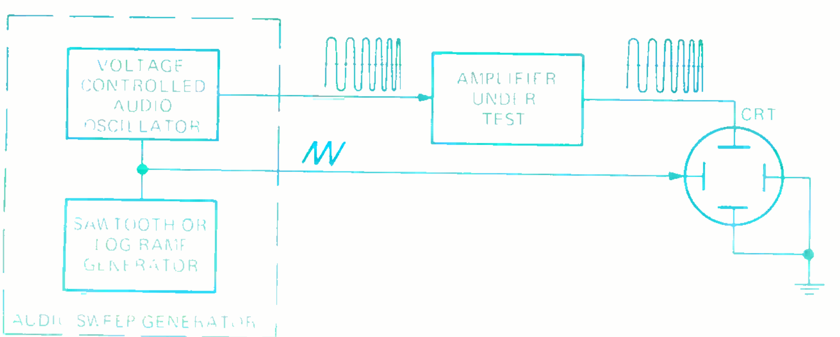



FIG. 2—AUDIO SWEEP GENERATOR is used to display the frequency response of an amplifier on a CRT.

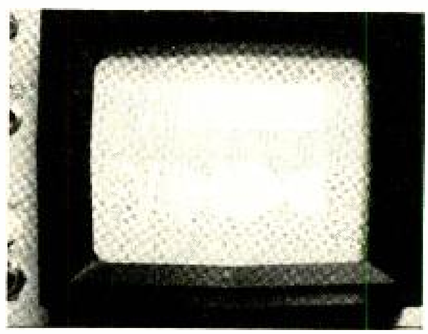
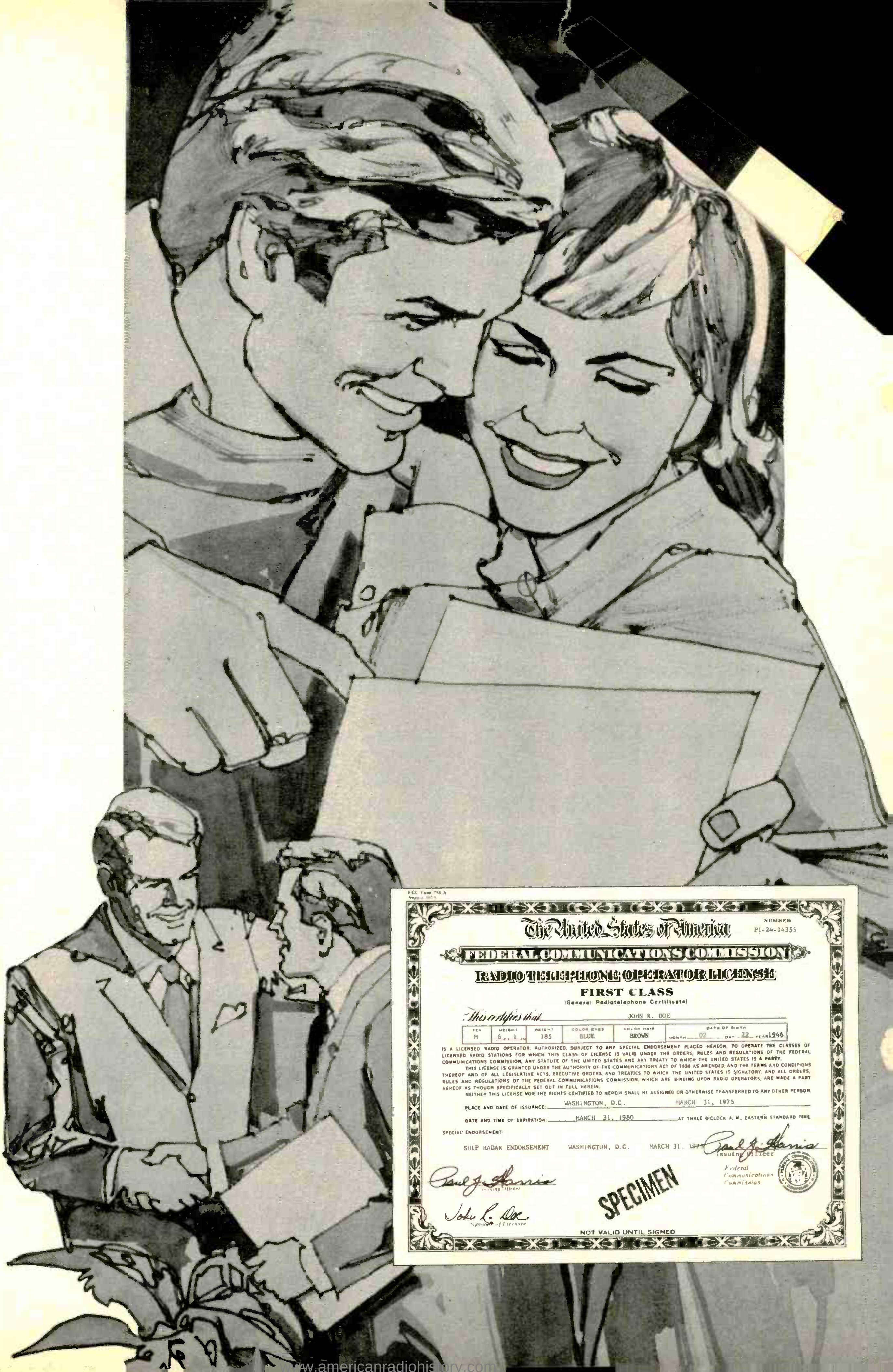


FIG. 4—FREQUENCY RESPONSE of an audio system with two notch filters is shown in the lower trace. Upper trace shows output of sweep generator.



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NUMBER
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FIRST CLASS

(General Radiotelephone Certificate)

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used to control the oscillator and the horizontal scope trace had been logarithmic, the display could have been made similar to the more familiar frequency plots of audio products. Vertical amplitude in Fig. 3 is also represented linearly, but again, insertion of a linear-to-log amplifier ahead of the connection to the scope's vertical plates could have altered the display so that it could be calibrated in dB's.

The oscilloscope photo of Fig. 4 shows the effect on response of a given amplifier when two notch filters are inserted in series with the sweep signal at frequencies of 2 kHz and 12 kHz. Notch filters are often used in sound reinforcement work to cancel audio feedback at specific frequencies. With such a convenient display available, it becomes easy to "tune" the filters to the exact desired frequency or, conversely, to read off the exact center, frequency of the filters after they have been tuned. To convert this display to the more familiar "single line" frequency plot, it is only necessary to add a wide-band amplitude detector, as shown in Fig. 5. The detector converts the sweeping audio frequencies into "average amplitude" and the oscilloscope photo of Fig. 6 (converted to dB as well) is equivalent to that of Fig. 4 but more easily interpreted.

A unit that combines all these functions plus more is Fidelity Sound's model 100 Audio Frequency Plotting System, shown in Fig. 7. This test equipment consists of two sine/square/triangle function generators, a pulse generator, frequency counter and peak amplitude measurement sections. The equipment is primarily intended to generate a frequency response plot on an X-Y chart recorder or on a oscilloscope. Its audio sweep generator provides manual frequency adjustment or log/linear sweep from 20 Hz to 20 kHz. The peak amplitude measurement section measures internal or external signals from microphone levels all the way up to power amplifier output levels. The frequency counter has a 6-digit display and reads either internal or externally connected frequencies. This system sells for $525.

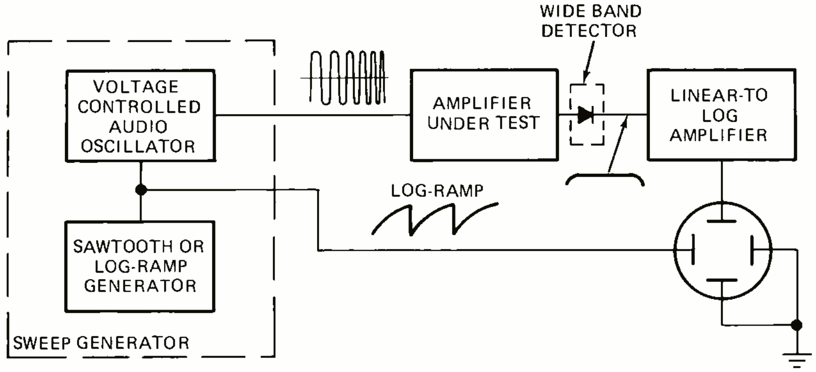



**FIG. 5—CONVENTIONAL SEMI-LOG frequency response display can be obtained with the setup shown.**

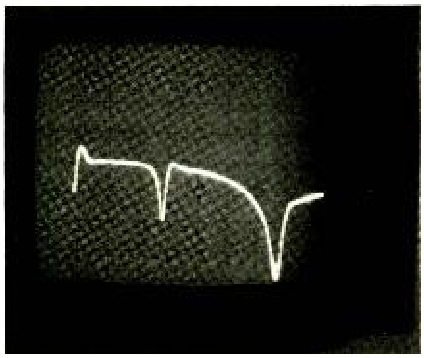


**FIG. 6—FREQUENCY RESPONSE of amplifier with vertical axis of oscilloscope calibrated in dB.**

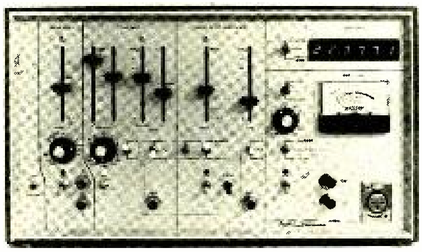


**FIG. 7—FIDELITY SOUND MODEL 100 combines function sweep generator with frequency counter and amplitude meter.**

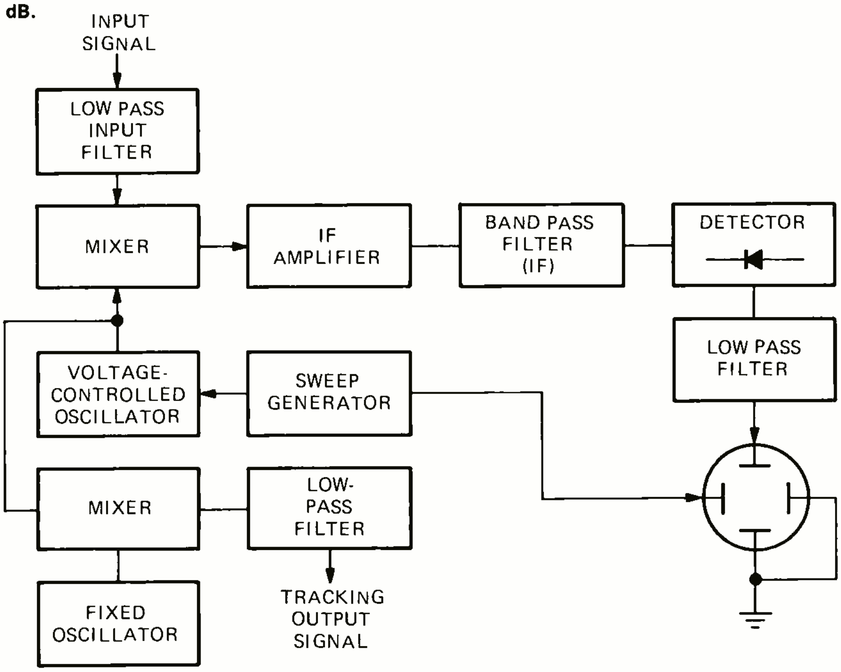



**FIG. 8—LOW-FREQUENCY spectrum analyzer system.**

## Low-frequency spectrum analyzers

Recently, two well known manufacturers of sophisticated test equipment have introduced low-frequency spectrum analysis equipment that could revolutionize and simplify audio equipment testing beyond the hopes of audio technicians and engineers. Spectrum analysis—or the investigation of signals in the frequency domain, as opposed to time domain observations on an oscilloscope—has been used in the radio-frequency region for years. With improvements in filter design, integrated circuits, circuit stability and reduced noise and oscilloscope storage techniques, it is now possible to display audio system performance in terms of spectral or frequency content.

The basic approach to audio spectrum analysis is shown in the block diagram of Fig. 8. The system operates as if it were a wide-range, tunable band-pass filter, controlled by the output voltage of the self-contained audio sweep generator. An incoming signal enters the first mixer through a low-pass input filter. The other input to the heterodyne mixer is the output of a VCO. The output frequency of the VCO varies upward from the center frequency of the intermediate amplifier. Sweep range is adjusted to correspond to the portion of the audio spectrum to be examined. When the frequency difference between the input signal frequency and the VCO frequency equals the IF center frequency, the signal is detected and appears as a vertical deflection on the CRT.

Changing the bandwidth of the IF bandpass filter changes the analyzer's resolution. The narrower the IF bandwidth, the longer the time required for the filter to reach a stable output. This characteristic imposes limitations on the rate at which a given range of frequencies can be swept. The entire spectrum of interest cannot be observed simultaneously, as it can when an oscilloscope is used in the time domain.

Two different methods are used to overcome this viewing problem. A storage CRT may be used as a display mechanism. Using a storage scope, the sweep can be slowed down as much as needed, depending upon filter bandwidth, and the resulting curve can be stored and displayed on the CRT face almost indefinitely for detailed examination. This is the approach taken by Tektronix in their 5L4N Spectrum Analyzer. The analyzer itself is a plug-in module, shown in Fig. 9, and it

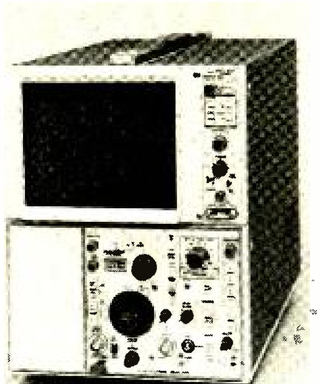


**FIG. 9—TEKTRONIX MODEL 5L4N plug-in module spectrum analyzer.**

can be used with any one of many oscilloscope main-frame and plug-in units in that company's 5100 series of oscilloscope products. Optional plug-ins are available to convert the storage oscilloscope to time domain use for such applications as real-time storage of non-recurring signals such as musical energy frequency distribution, noise, etc. With these additional plug-ins, the storage scope can then be used as an ordinary oscilloscope, with the added advantage of being able to examine a permanently stored waveform trace at will.

The second approach to overcoming the slow-sweep rate of narrow-bandwidth filter spectrum analyzers involves the conversion of the vertical input signals from analog form to digitalized data. This digitalized data is recurrently circulated in a shift register and, as each digital word is recirculated, it is reconverted to its analog value and displayed on the face of an ordinary oscilloscope having normal persistence.

A block diagram of the Hewlett-Packard Model 3580A, which uses this analog-digital-analog display method is shown in Fig. 10. With the exception of the different display method, the basic scheme is similar to other traditional spectrum analyzers. The output of a fixed-frequency oscillator (100 kHz) is mixed with the output of a VCO. The output of the mixer is fed through a low-pass filter that provides a signal whose frequency corresponds closely to the IF frequency at every instant of time. The one-piece HP 3580A is shown in Fig. 11. The tracking generator output (see Fig. 10) is connected to the input of the circuit to be tested, while the output of the test circuit is connected to the analyzer's input terminals. The resulting single-line trace on the oscilloscope represents the frequency response of the circuit under test.

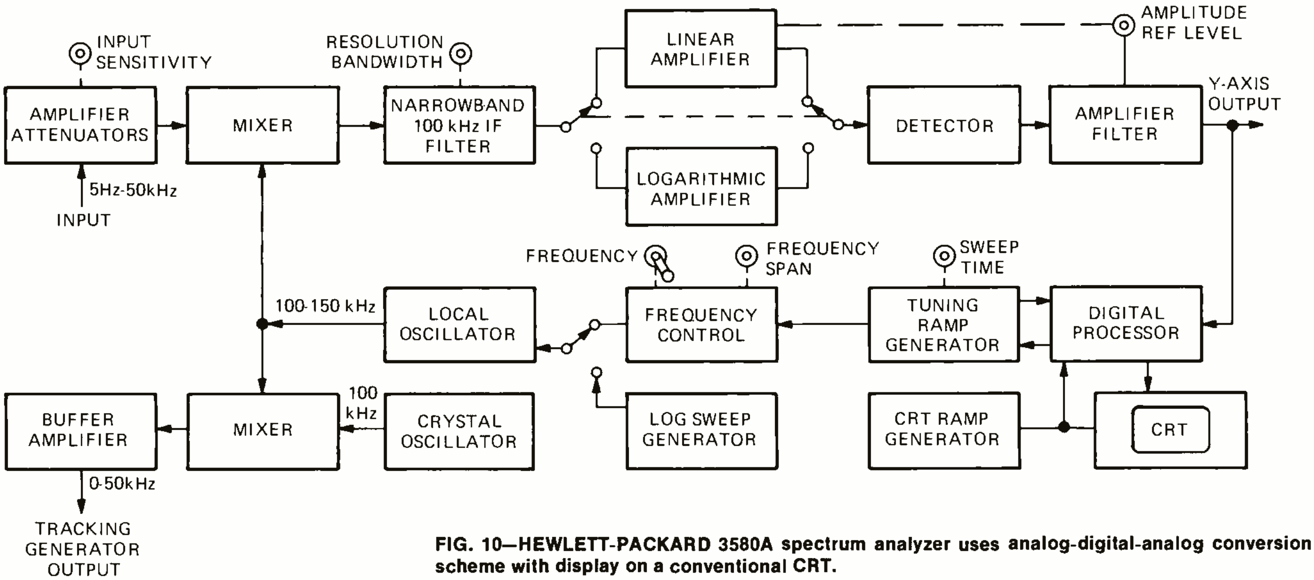



**FIG. 10—HEWLETT-PACKARD 3580A spectrum analyzer uses analog-digital-analog conversion scheme with display on a conventional CRT.**

## Applications of spectrum analysis

Tektronix has published a most informative booklet, entitled "The Tektronix Cookbook of Standard Audio Tests." Of course, the booklet emphasizes the use of their 5L4N Spectrum Analyzer, but it is a storehouse of useful information regarding audio amplifier testing. Using just the spectrum analyzer (complete with storage scope mainframe) and a separate audio oscillator, plus load resistors and matching pads you can easily build yourself, the booklet lists the following audio performance tests that can be easily made with this equipment: Power Output, Frequency Response, Harmonic Distortion, Distortion vs. Output, IM Distortion, Power Bandwidth, Damping Factor, S/N Ratio, Square Wave Response, Crosstalk, Sensitivity and Transient Intermodulation Distortion.

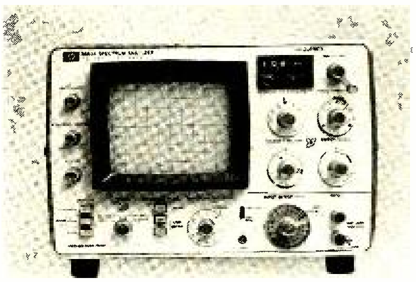


**FIG. 11—HEWLETT-PACKARD MODEL 3580A low-frequency spectrum analyzer.**

Referring back to the question of harmonic content, it should be obvious that spectrum analysis will not only show distortion but will "break up" that distortion into its various harmonic components. If a single frequency signal is applied to the amplifier under test and the analyzer sweeps from one end of the audio spectrum to the other, distinct "blips" will be displayed at those frequencies where signals appear. By setting a zero-dB reference for the fundamental signal, the presence of all order harmonics is not only seen visually, but their amplitude, in dB, is instantly readable from the analyzer as shown in Fig. 12. To arrive at a conventional measurement in total percentage of distortion, simply add the various harmonic components together using the proper correction factors when adding "dB" numbers. A handy table is supplied in the Tektronix booklet for this purpose. Harmonic contributions that are 6-dB or more lower than the major harmonic contribution can be ignored in determining the total harmonic distortion.

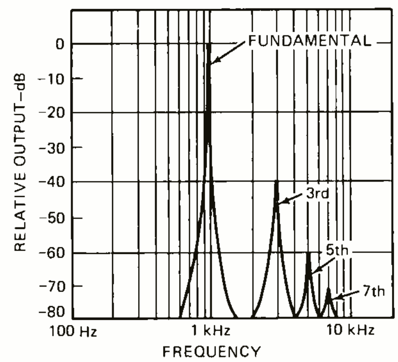
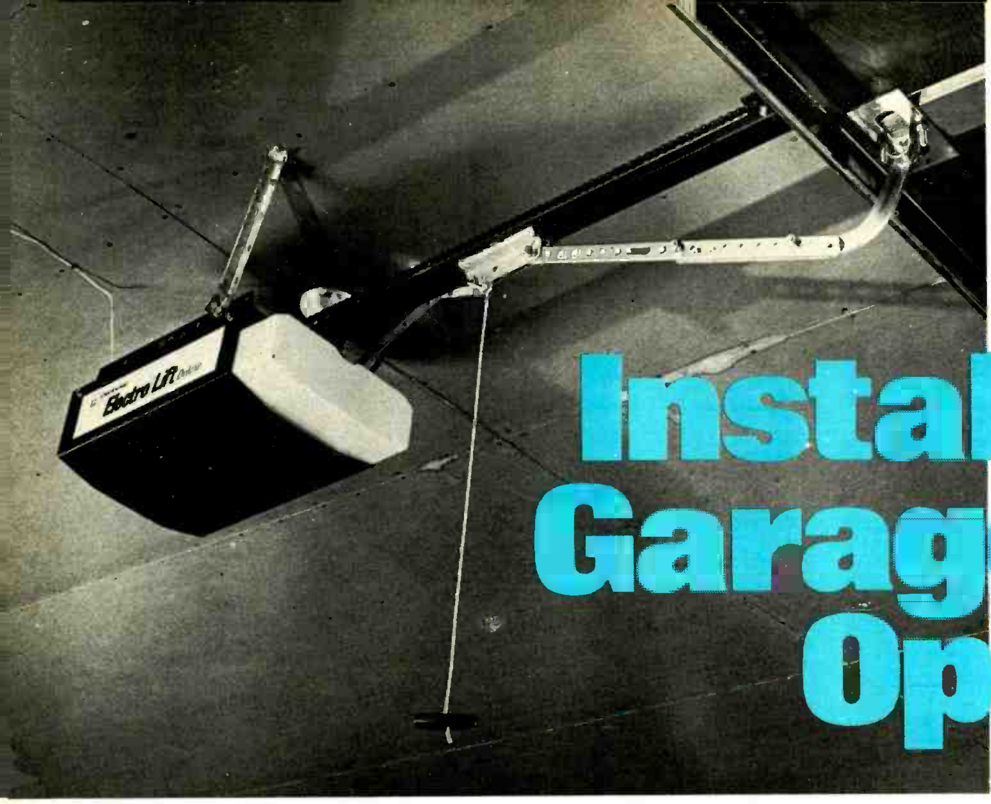



**FIG. 12—1-kHz OUTPUT SIGNAL from an amplifier is displayed on a spectrum analyzer as a fundamental plus the odd-order harmonics.**

With greater emphasis on performance specifications in high-priced audio equipment, the need for performance verification increases and test instruments such as spectrum analyzers, though relatively expensive (the Hewlett-Packard unit costs about $4500.00, while the elements needed to put together the Tektronix system run just under $4000.00), are likely to find their way onto the test benches of hi-fi company engineering departments and better-equipped hi-fi service centers. They may well pay for themselves in a relatively short time in terms of the test time and measurement time they can save. **R-E**



# Installing Garage Door Openers

THE NEXT TIME YOU'RE ON A SERVICE CALL, SEE IF YOUR CUSTOMER has a garage-door opener. If your customer does not, you have the opportunity to make that service call more lucrative by selling and installing an automatic garage-door opener.

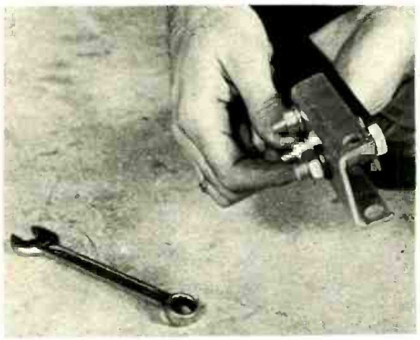
Today's garage-door openers are easy to install because manufacturers have replaced the lollipop rail with the split rail. The lollipop rail is a long, one-piece rail used to guide the opener's drive chain and door arms. The one-piece design is awkward, if not downright difficult to store and carry. The newer split-rail comes in pieces and is ready to bolt together at the installation site. It's as strong as the lollipop rail and allows for smaller packages for easy storage and carrying.

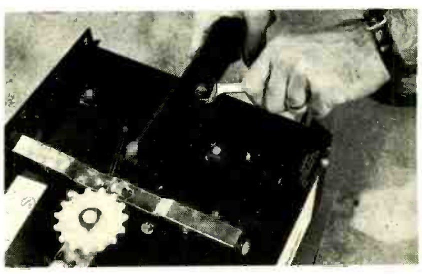
Because of this new, compact packaging, more electronic distributors are carrying garage door-openers in stock. This means you can easily pick up one or two openers at your distributor and keep them in your car trunk, ready to go when your customer needs one. And with this ready availability of openers from a wholesale source, you won't have much money tied up in inventory.

Installation is fast and goof-proof, taking less than two hours and using common tools. Most likely, you already carry most of the necessary tools for a garage-door opener installation. All you need is a screwdriver, pliers, wire cutters, adjustable end wrench, claw hammer, socket wrench, electric drill and stepladder. Everything else you need, from hardware to wire to lubricant, is generally included in the garage-door opener package.

### Installation

There are three basic steps to installing a modern garage-door opener—assembling the unit, attaching the unit to the garage, and installing the radio controls. It's that simple, and just about that easy, especially since car installation of the transmitter is eliminated by the use of portable solid-state transmitters.





**The first step is assembling the unit** (top left) This begins with the assembly of the split rail. Most manufacturers use a three-piece rail that easily bolts together.

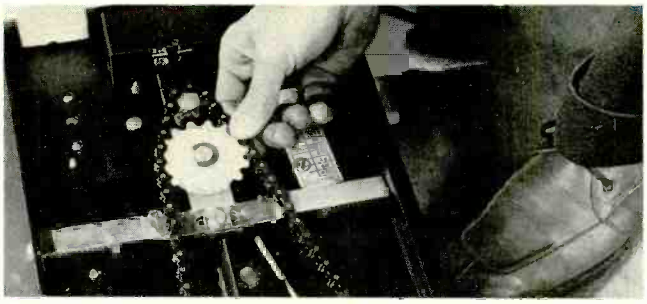
**Attach the drive-chain sprocket bracket** (top right) to the rail next, making certain the bracket and the rail are aligned.

**The trolley assembly** (lower left), the piece that connects the ends of the chain and actually pulls the garage-door open, slides onto the rail.

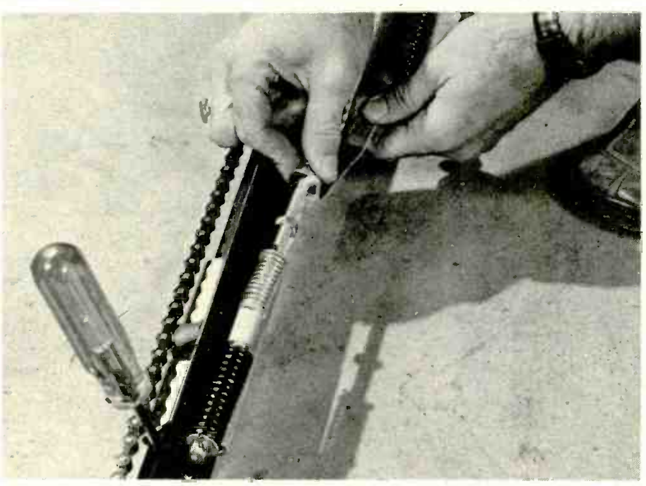
**The rail is next attached** to the power head (lower right). Place the power head on the package in which the system came to avoid scratching the cover. For extra convenience, a support may be placed under the sprocket bracket. Align the two holes in the motor end of the rail with the holes in the power head chassis and bolt the rail to the power head.

*Installing electronic garage-door openers has always been profitable. Solid-state electronics and new mechanical designs have made the job easier and more lucrative. Here's how it's done, step-by-step*

**LEE PHILIP STRAL**

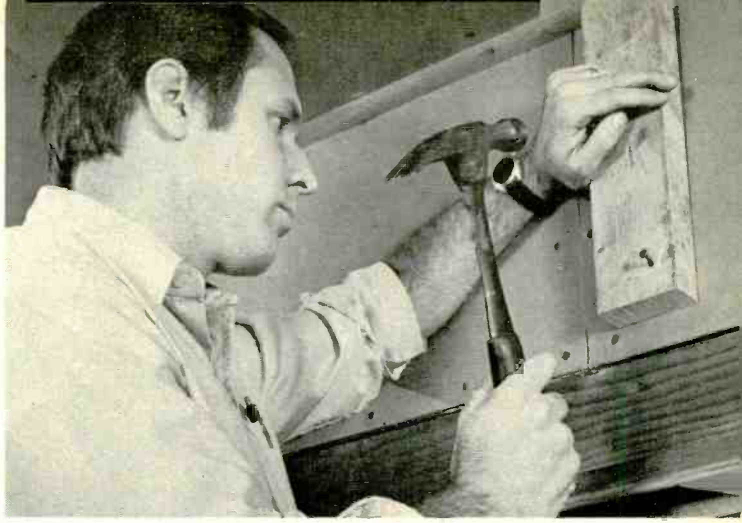


**The drive chain is installed** once the rail is attached to the power head. This is accomplished by first looping the drive chain over the sprocket wheel on the power head.

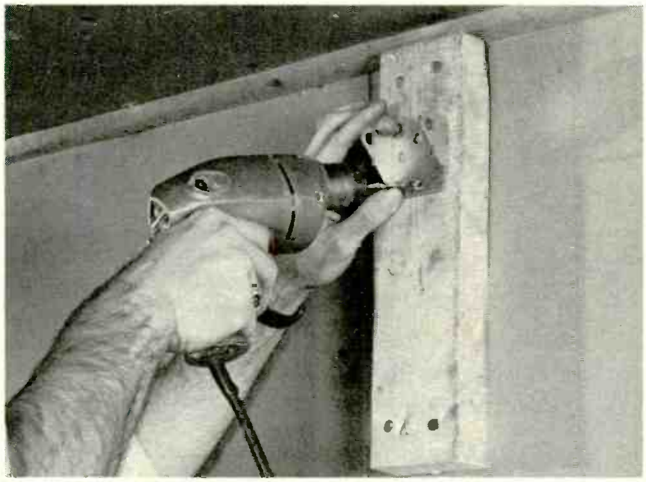


**Next, attach the drive chain** to the trolley. First insert a screwdriver in the hole in the front end of the rail and slide the trolley up to the screwdriver. Thread a nut onto the trolley stud and fasten one end of the chain to the trolley.

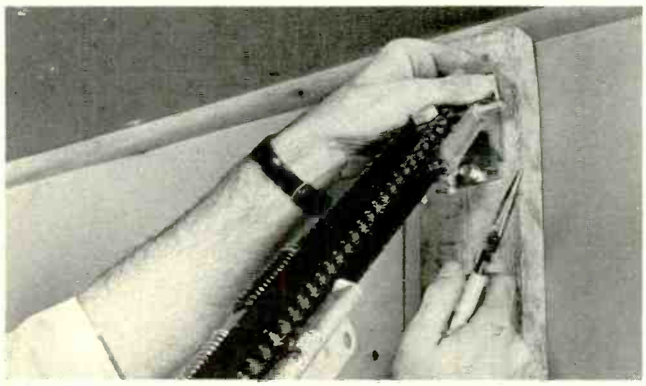
**Then, extend the chain** around the idler sprocket wheel and forward to the trolley, being sure the teeth of each sprocket wheel engage the chain. Connect the end of the chain to the trolley and the unit is now ready to attach to the garage.



**Attaching the opener** to the garage begins with the installation of the header bracket on the vertical center-line of the garage door on the header wall above the door. If there is no stud on the header wall behind the center line, nail a 2 × 4 to reinforce the bracket.

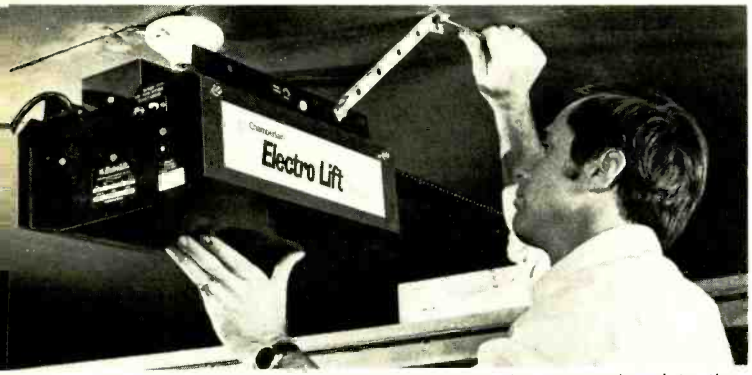


**Next, mount the header bracket** to the header wall along the vertical center-line of the garage door.



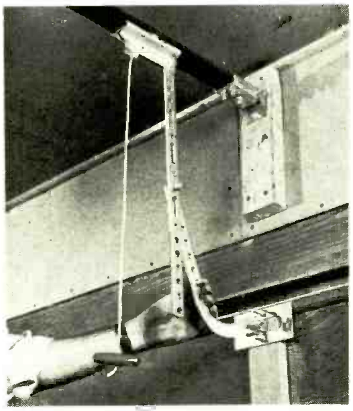
**With the power head** still on the packaging material, raise the rail and attach it to the bracket.

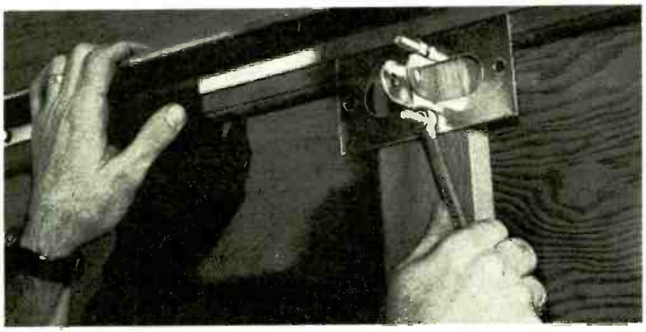
**Next, raise the power head** onto a stepladder and open the garage door, making sure the door clears the rail. To properly position the unit, place a 2 × 4 on edge along the top section of the door, resting the rail on the piece of wood. The 2 × 4 is not a necessity, but it is convenient for establishing an ideal door-to-rail distance.



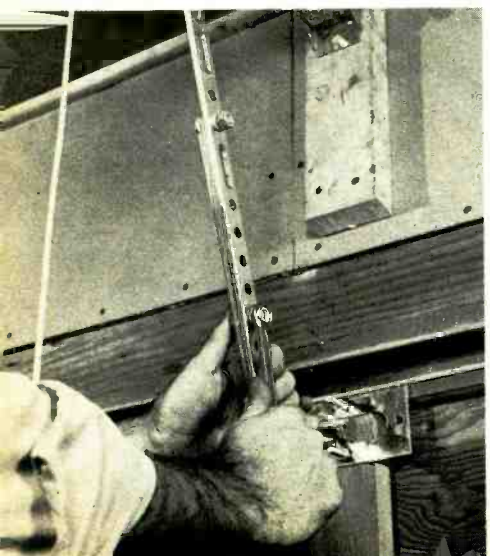

**Hanging brackets are used** to secure the power head to the garage. Measure the distance between the opener and the garage ceiling and cut both hanging brackets just beyond that length. Notch the ends of the bracket and bend them so the bracket hole is flush against the garage ceiling. Fasten the hanging brackets, first to the chassis, then to the roof supports.

**After the opener is secured,** close the garage door and attach the emergency release cord to the trolley release lever. Attach the straight door-arm to the trolley assembly on the rail and connect the curved door-arm in the vertical opening of the straight door-arm and, before temporarily connecting the two, find the best location for the door bracket on the garage door.



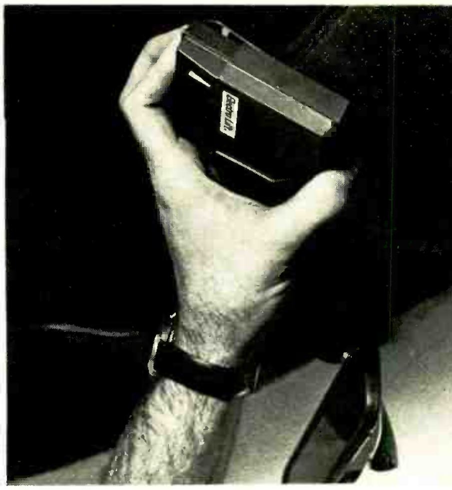


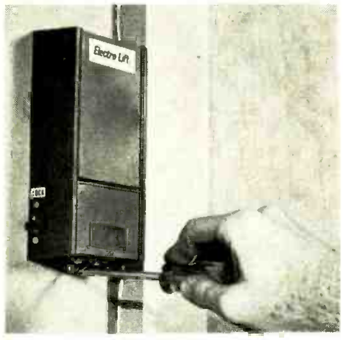
**Ideally, the bracket** should be in horizontal line with the top rollers of the door. When this is not possible, place the bracket as close to this alignment as possible, but within the upper eight inches of the top section of the door. When the best location for the door bracket is found, press the garage door snugly against the floor, mark the door bracket locations on the door and bolt the bracket in place.



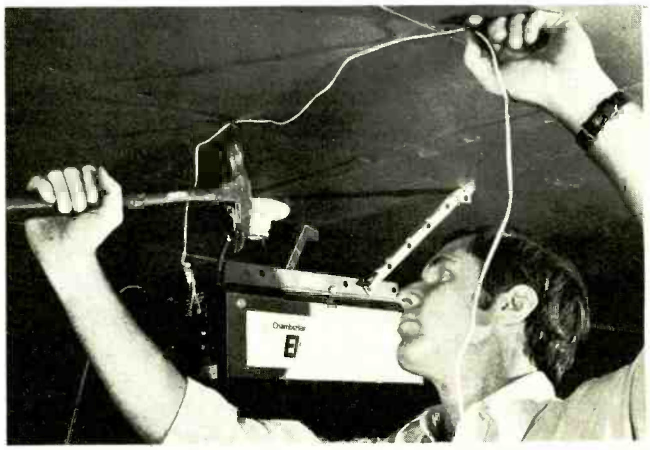
**Pull the emergency release cord** and slide the trolley back from the door. Mark where the curved door-arm meets the bottom of the vertical opening on the straight door-arm and connect the curved and straight door-arms.

**Installing the radio controls,** once the most difficult part of the job, is now the easiest. Modern garage-door openers no longer require wired-in transmitter installation in the car. Instead, a compact, battery operated transmitter just clips to the sunvisor.



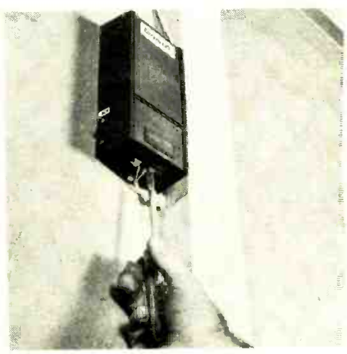


**The receiver,** also compact, easily attaches to the interior wall of the garage. (On some units, it's housed within the power head.) The antenna plugs into the receiver.



**The receiver connects to the power head** by running wires from the receiver, up the wall and across the ceiling to the power head.

**Attach the wires** to the power head and then to the receiver.



After this is done, just connect the power and the installation is complete.

Installing a garage door opener can make a service call more lucrative. So, too, can recommending accessories to go along with the opener. *(continued on page 92)*

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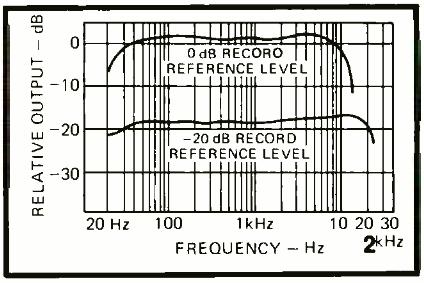
# Radio-Electronics Tests Fuji Model FX C-60 Tape

**LEN FELDMAN**
CONTRIBUTING HI-FI EDITOR

ALL OF OUR HIGH-FIDELITY EQUIPMENT REports to date have concerned themselves with the electronic hardware used to reproduce music in the home. An equal partner in the sound reproduction process is so-called "software"—the tapes and discs that we use as program sources. While few of us have any control over the quality of the discs we buy (choosing a recording ordinarily involves musical tastes rather than technical quality considerations), we can exercise a measure of selectivity when it comes to selecting the raw tape to be used on our open-reel or cassette tape decks.

Tape characteristics do vary greatly from brand to brand and from formulation to formulation. In attempting to test any tape, and especially cassette tapes, one has to establish not only reference levels of performance, but a standard tape deck whose performance capability does not become the limiting factor in the measurements made. In this, and any future cassette tape evaluations, we selected the Nakamichi model 1000 cassette deck because of our previous experience with this machine. It is capable of delivering uniform frequency response at the relatively slow cassette speed out to at least 20,000 Hz. Its bias is set such that Nakamichi's own EX tape will deliver 0-dB playback level (as indicated on its self-contained level meters) for 0-dB input recording level at mid-frequencies. Under these calibrated conditions, the reference Nakamichi tape (EX C-60) tested on the reference deck at a record level of —20 dB resulted in a response curve that was down 3 dB at 21.0 kHz.

Without altering any bias calibration settings, we ran a response curve of the new Fuji FX C-60 tape, a photo of the cassette is shown in Fig. 1. Fuji is perhaps best known in this country and abroad for its photographic film products, but we learned that the company has also been manufacturing video tape and related products for some years. According to their descriptive literature, Fuji FX tapes are made with a gamma-ferric formulation, using particles which the company calls Pure Ferrix. The size of the particles is said to be 0.4 microns with a length to width ratio of 8:1. Be that as it may, the results of our frequency response tests are shown in Fig. 2. The first thing we noted



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was that for the same 0-dB recording level used with our reference tape, the Fuji sample delivered an output level of +1.5 dB, consistent with its claims for higher output. The response curve shows a slight rising characteristic above 3000 Hz. This rising response will be welcomed by owners of cassette decks that tend to roll-off response long before our reference deck and will lend a measure of "brightness" to resultant recordings. The —3-dB point using our reference deck occurred at a frequency of 21.5 kHz, a shade better than the reference tape.

Next, we measured distortion at several recording levels. At the 0-db record level, THD measured just over 1.0%. The 3.0% distortion level occurred at a recording level of +7.5 dB, which means that the FX tape offers excellent "headroom" or dynamic range capability. At recording

## SUMMARY OF MANUFACTURER'S SPECIFICATIONS:

### PHYSICAL PROPERTIES

**Width Tolerance:** +0.00, —0.05 mm. **Length:** 90 m (295.28"). **Breaking Strength:** 1.4 kg (3.09 lbs). **Yield Strength:** 0.6 kg (1.32 lbs). **Maximum Elongation:** 30%. **Residual Elongation:** 0.02%. **Surface Resistance:** 1.7 × $10^9$ ohms. **Thickness:** Backing, 12$\mu$; Coating, 6$\mu$; Overall, 18$\mu$. **Width:** 3.81 mm (0.150").

### MAGNETIC PROPERTIES:

**Coercivity:** 345 oersteds. **Retentivity:** 1520 gauss. **Saturation Flux-density:** 1820 gauss.

### ELECTRO-MAGNETIC PROPERTIES:

**Operating Bias Current:** 105%. **Sensitivity** (333 Hz). +1.0 dB. **Sensitivity Uniformity:** (333 Hz) 0.3 dB. **Relative Frequency Response** (10 kHz): +2.2 dB. **Output fluctuation** (8 kHz): 0.3 dB. **Maximum Output Level:** +4.0 dB at 333 Hz. **Signal-to-Noise Ratio** (1000 Hz): 58 dB. **Erasure Effect:** (1000 Hz): 76 dB. **Print-through** (1000 Hz): 56 dB.

## RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Fuji Photo Film U.S.A., Inc.** Model: **FX-60 Cassette Tape**

### OVERALL PRODUCT ANALYSIS

| | |
|---|---|
| Retail Price | **$3.50** |
| Price Category | **Medium** |
| Price/Performance Ratio | **Excellent** |
| Styling and Appearance | — |
| Sound Quality | **Very Good** |
| Mechanical Performance | **Excellent** |

Comments: In addition to our laboratory testing, we used several of the new Fuji FX-60 cassettes to record a variety of program material, including music, test tones of sustained duration and voice. Playback of constant level recorded tones resulted in no audible variation in output level over a period of some ten minutes and there were no "drop-outs" during this same time period, indicating a high degree of consistency and uniformity in tape formulation and ferrix coating. As with any tape product, results will depend partly upon the bias conditions, equalization and overall quality of the machine with which the tape is used. However, the greater output at upper-mid to high frequencies of this new tape formulation should find favor with many cassette deck owners who seek better high-frequency response without sacrificing signal-to-noise capability or low distortion.

levels lower than —3 dB, THD readings become rather meaningless since the distortion meter begins to integrate residual noise into the single reading.

From a system point of view, the other important electrical characteristic that requires measuring is signal-to-noise ratio. Two methods were used in our tests. The unweighted S/N measurement that takes into account noise at all frequencies resulted in a reading of —51 dB below the 3.0% distortion level. By installing an "A" weighting network between the output terminals of the deck and the meter, the reading improved to —58 dB. The "A" weighting network takes into account the audible effect of wideband noise that tends to be less bothersome when the noise consists of low frequencies. By way of comparison, our reference tape, tested under the same conditions, had a headroom of +6.0 dB (for 3% THD) and an "A" weighted signal-to-noise ratio of 55 dB when measured under the same conditions.

### Mechanical considerations

The two halves of the new Fuji FX cassette package are held together with five tiny Philips head screws. The cassette package itself is precision molded and dimensional tolerances of our samples were extremely well maintained. The reference Nakamichi deck used in our tests is one of the few available that has three separate heads. It is therefore necessary to align the record head with respect to the playback head when a new cassette is inserted. This is easily accomplished by means of a tiny control that is rotated until a pair of LED indicators blink on and off equally. Normally, the adjustment is made before starting recording and re-checked from time to time during passage of the tape to make certain that variations in tape positioning have not taken place. We found no substantial difference in the alignment settings indicating a high degree of accuracy for both the precision tape and the package that contains it.

Based upon our tests, we would conclude that Fuji Film has developed an excellent cassette tape suitable for use by serious home recordists. We understand that there are plans afoot for the company to introduce a line of open-reel tapes as well as additional formulations of cassette tape. If the excellent quality of this first variety is carried over into these additional lines we should be hearing more about Fuji tape products in the future. **R-E**

# Harman-Kardon Citation 16

JOINING THOSE COMPANIES WHO SPECIALize in high-powered, high-priced, superperforming basic power amplifiers is Harman-Kardon, with their impressive looking Citation 16, shown in Fig. 1. The massive rack-mountable front panel of this amplifier is highlighted by brushed aluminum covering most of its lower section, and a series of colored LED display lamps that are arranged in a pattern slanting from center upward to the left and to the right. Each set of eight LED's is arranged to flash successively, from the lowest to the highest depending upon the instantaneous power delivered by the amplifier to each speaker. Calibration of these lights is in dB, from 0 dB down to —30 dB. The 0-dB point corresponds to different power levels, depending upon the setting of a rotary control at the center of the unit. One position of this control is used to test all the lamps, while another position can turn off the display entirely, if desired. The lower two-position control sets the display sensitivity for 4 ohm or 8 ohm loads. Table I, reproduced from a card supplied with the amplifier, shows the wide range of display levels available —all the way from 0.0039 watts to 160 watts. Thus, the LED display can be used to indicate power even when listening at moderate or background music levels. Separate neon indicator lights adjacent to the power on/off switch shows the user that both channels are being powered.

The rear panel of the Citation 16 (see Fig. 2) contains the left and right phonoplug inputs and the instrument-type output terminals nestled between dual-banks of ten transistors each, mounted on heat sinks to the left and right of the input and output terminals. Eight transistors are used in the output stages of each channel, while the remaining pair are drivers. Separate 4 ampere line-fuses are provided for each channel since this amplifier uses two completely separate power supply systems, including two identical power transformers that can be seen in the photo of the internal layout of the amplifier, Fig. 3.

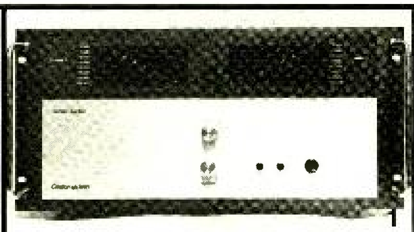

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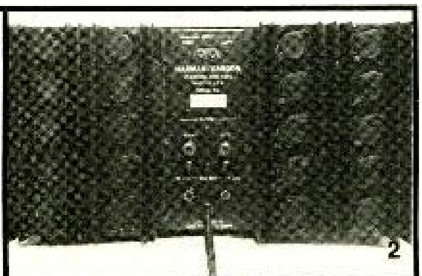
**TABLE I**

| | display setting | | | |
|---|---|---|---|---|
| | • | •• | ••• | •••• |
| 0 db | 4W | 16W | 64W | 160W |
| -3 db | 2 | 8 | 32 | 80 |
| -6 db | 1 | 4 | 16 | 40 |
| -9 db | .5 | 2 | 8 | 20 |
| -12 db | .25 | 1 | 4 | 10 |
| -18 db | 0625 | 25 | 1 | 2.5 |
| -24 db | .0156 | .0625 | .25 | .625 |
| -30 db | .0039 | .0156 | .0625 | .1562 |



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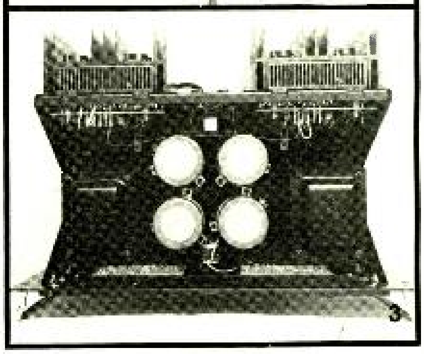

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### Circuit highlights

Individual circuit board modules (for each channel) include a driver board, an LED display board and an output heatsink assembly. In addition, a small relay printed-circuit board delays turn-on of the amplifier for about one second to prevent "pops" or power bursts from reaching the speakers.

Each of the two independent power supplies delivers two sets of voltages: ±60 volts to power the output and driver stages and ±12 volts to drive the LED display circuits.

The driver board provides circuitry for gain and drive and also includes circuitry used in a current-foldback protection arrangement that protects the amplifier from damage due to short circuits or overloads at the output. The electronic

**MANUFACTURER'S PUBLISHED SPECIFICATIONS:**

**Power Output:** 150 watts-per-channel minimum continuous power, driven into 8 ohm loads from 20 Hz to 20 kHz. **Rated Harmonic Distortion:** Less than 0.05% from 1 watt to 150 watts at any frequency from 0.5 Hz to 20 kHz. **IM Distortion:** Less than 0.05% from 0.015 watts to 150 watts. **Frequency Response:** From 0.5 Hz to 120 kHz at 1 watt into 8 ohms. **Hum and Noise:** Better than 100 dB below 150 watts. **Damping Factor:** 300. **Square Wave Risetime:** 3 microseconds. **Slew Rate:** Greater than 30 volts-per-$\mu$s. **Input Impedance:** 10,000 ohms. **Input Sensitivity:** 1.25 volts for 150 watts. **Phase Shift:** Less than 0.5 degrees at 20 Hz; less than 12 degrees at 20 kHz. **Dimensions:** 9⅛" high × 19⅛" wide × 13$\frac{5}{16}$" deep. **Weight:** 55 pounds. **Suggested Retail Price:** $795.

protection circuit insures the passage of full load-current when an 8 or 4 ohm load is present, but senses the presence of a short circuit and reduces the current level to a point where the transistor thermal dissipation is in a safe area. The circuit is designed so that the amplifier will deliver 11.1 amps peak current required for a 250 watt output into 4 ohm loads, but delivers progressively less current as the load impedance is reduced from 4 ohms to zero ohms, at which time maximum current is limited to approximately 8 amperes.

The amplifier can also be driven in a bridge mode (that is, monophonically) by rearranging the connection of two internal jumpers. In this mode, the channel identified as "A" is driven with the input signal and connection to a single speaker is made by connecting its terminals to each of the positive output terminals of the amplifier. Under these conditions, the Citation 16 can deliver approximately 500 watts of power to a 4 ohm load!

The technical manual supplied with the unit goes into great detail regarding the circuit design, explaining what Harman-Kardon believes to be the importance of fast risetime and good slew-rate and detailing how these criteria were met in the design. Each driver board uses a balanced IC for an input stage plus ten bipolar transistors.

**TABLE II**

**RADIO-ELECTRONICS PRODUCT TEST REPORT**

Manufacturer: **Harman-Kardon** Model: **Citation 16**

**AMPLIFIER PERFORMANCE MEASUREMENTS**

| POWER OUTPUT CAPABILITY | R-E Measurement | R-E Evaluation |
|---|---|---|
| RMS power/channel, 8-ohms, 1 kHz (watts) | 194 | Superb |
| RMS power/channel, 8-ohms, 20 Hz (watts) | 183 | Excellent |
| RMS power/channel, 8-ohms, 20 kHz (watts) | 180 | Excellent |
| RMS power/channel, 4-ohms, 1 kHz (watts) | 272 | Superb |
| RMS power/channel, 4-ohms, 20 Hz (watts) | 259 | Excellent |
| RMS power/channel, 4-ohms, 20 kHz (watts) | 218 | Excellent |
| Frequency limits for rated output (Hz-kHz) | Under 10 to 59 | Superb |
| **DISTORTION MEASUREMENTS** | | |
| Harmonic distortion at rated output, 1 kHz (%) | 0.003 | Excellent |
| Intermodulation distortion, rated output (%) | 0.04 | Very good |
| Harmonic distortion at 1 watt output, 1 kHz (%) | 0.005 | Superb |
| Intermodulation distortion at 1 watt output (%) | 0.01 | Very good |
| **DAMPING FACTOR, AT 8 OHMS** | Over 200 | Excellent |
| **FREQUENCY RESPONSE AT 1 WATT/CH (Hz-kHz ±___ dB)** | 4-60, 0.5 | Excellent |
| **HUM & NOISE, REFERRED TO 150 WATTS (dB)** | 106 dB | Excellent |
| **INPUT SENSITIVITY FOR FULL OUTPUT (mV)** | 1200 | |

## Laboratory measurements

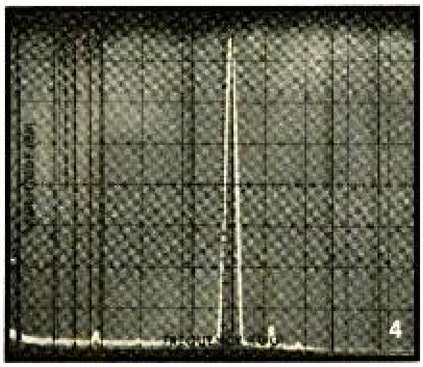
A summary of significant laboratory measurements made on the Citation 16 power amplifier is listed in Table II. The amplifier delivered far more power at mid-frequencies and at the frequency extremes than its conservative rating would suggest. Note, too, that while no "official" power rating is listed by the manufacturer for 4-ohm operation, we were able to read an output of over 250 watts-per-channel when a 4-ohm load was connected, at the 20 Hz extreme. This measurement was obtained after first subjecting the amplifier to the usual pre-conditioning test at one third rated power for one hour. No thermal shutdown of the amplifier occurred at any point in all of our various tests.

While most manufacturers rate the power bandwidth for full power output at from 20 Hz to 20 kHz, the Citation 16 delivered full power (150 watts-per-channel into 8 ohms, both channels driven) all the way down to below 10 Hz (the limit at which our distortion analyzer can read THD) and up to 59 kHz.

Reducing the output power to the published rated power output of 150 watts-per-channel, THD measured 0.003% at mid-frequencies, while IM was a low 0.04% at this same power level. Though not shown in Table II, we also measured THD at 150 watts output at the frequency extremes and, amazingly, the THD at 20 Hz was as low as that measured at mid frequencies, while at 20 kHz, THD still measured a very low 0.03% for one channel and 0.02% for the other.

It is difficult to confirm a damping factor as high as that claimed by Harman-Kardon (300) but we were able to measure in excess of 200 for this parameter. Residual hum and noise bettered claims of the manufacturer by a full 6 dB, measuring 106 dB on each channel.

We applied a portion of the output of one channel of the amplifier to our spectrum analyzer when the amplifier was just beginning to clip with a 1000 Hz input signal (at an output power level of 195 watts into an 8 ohm load) and examined the harmonic distortion content. Results are shown in the scope photo of Fig. 4. To



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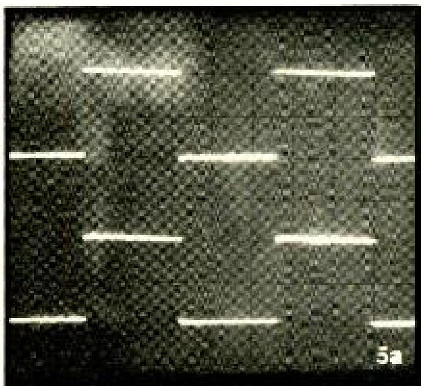
the right of the fundamental 1 kHz signal can be seen a second harmonic component which is 72 dB below the fundamental (corresponding to approximately 0.025%), while the barely perceptible third harmonic contribution is down about 75 dB (equivalent to a distortion of 0.0177%).

Since Harman-Kardon emphasizes the importance of square wave response in evaluating amplifier performance, we decided to put the Citation 16 to this test as well. Figure 5 shows scope photos of input (upper trace) and output square wave signals applied to the amplifier at frequencies of 100 Hz (Fig. 5-a), 1 kHz (Fig. 5-b) and 10 kHz (Fig. 5-c). There is virtually no evidence of overshoot or tilt in any of these traces.



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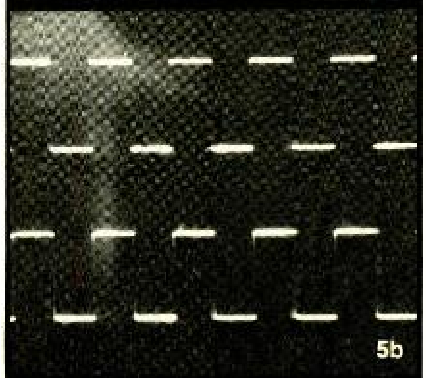
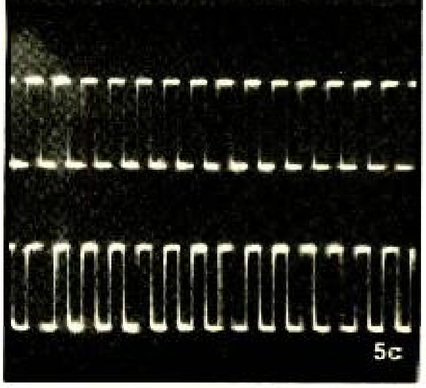


5b



5c

**TABLE III**

**RADIO-ELECTRONICS PRODUCT TEST REPORT**

Manufacturer: **Harman-Kardon** Model **Citation 16**

**OVERALL PRODUCT ANALYSIS**

| | |
|---|---|
| Retail price | **$795.00** |
| Price category | **High** |
| Price/performance ratio | **Very good** |
| Styling and appearance | **Excellent** |
| Sound quality | **Excellent** |
| Mechanical performance & layout | **Excellent** |

Comments: It is clear that the designers of this new Citation amplifier were intent upon producing the most reliable and rugged power amplifier they knew how to make. Harman-Kardon's design philosophy regarding bandwidth and phase response is well known for audiophiles. They believe in wide-as-possible bandwidth—far beyond audible limits, and have incorporated that philosophy in this design. While we do not propose to get involved in this age old debate (there are equally respected manufacturers who differ violently with this concept, and maintain that extended bandwidth offers no audible benefit to the consumer and costs involved in extending bandwidth might be put to better use), we can only judge the results by what we heard during our listening tests. Sound reproduction, using the Citation 16 hooked up to a pair of low-efficiency speakers capable of response down to below 30 Hz was so clean and transparent as to defy description.

As for reliability and fool-proof design, the Citation 16 can operate into short circuits, unloaded operating conditions, and the kinds of reactive loads presented by electrostatic and other esoteric speaker designs.

The LED power display is effective and provides the more serious and technically oriented audiophile with a very accurate and continuous means of monitoring power fed to the loudspeakers. We suspect that Harman-Kardon's profit margin on the Citation 16 will not be eroded by their very generous two-year service warranty on parts and labor.

### Summary

In addition to subjecting the amplifier to the laboratory tests described, we spent a great deal of time listening to the amplifier connected to several pairs of our favorite speakers. Our conclusions are summarized in Table III. Certainly, just under $800.00 is a lot of money for a power amplifier and there are other basic amplifiers around that provide as much power (or more) for less money. In our opinion, however, power output alone is not the sole criterion for judging this kind of component. Reliability, durability and just plain excellence of reproduced sound must play a part in the selection process too. Harman-Kardon seems to have taken all these factors into account—and more—in producing this latest unit in the respected Citation series **R-E**

### PICTURE RUNS SIDEWAYS!

***The picture runs sideways in this Curtis-Mathes 56M-5748; just like a vertical roll, but crosswise. Now and then it will lock in, then start sliding again. The horizontal hold will stop it, but it slips again in a minute or two. Three shops have said this is a lemon. —L.B., El Paso, TX.***

Well, there's an old saying that I just made up: "When you get a lemon, make lemonade!" Joking (?) aside, we have a couple of facts. First, we know the horizontal oscillator is running pretty well because the picture is straight-sided and you can tell that there is only one picture present. However, you do not have any horizontal sync to speak of. The oscillator is freewheeling.

Ground the AFC grid of the horizontal oscillator tube. This should have some effect on the picture. If it doesn't, turn it off and see if this grid shows a short to ground! (Frankly, from the description, that's what it sounds like!) Another possible cause of this is an open socket contact on the AFC grid of the horizontal oscillator tube. I had a set of another make with this problem and it was hard to catch. (It was trying to tell me what it was, but I didn't listen).

Check out the entire horizontal AFC circuit including the diode unit, all resistors and capacitors, and check *continuity* on the little ceramic capacitor that couples the horizontal sync from the sync-separator to the diode unit. If this is open, you could get exactly the same symptoms.

### PHOTOSENSITIVE TRANSISTOR!

We had a mysterious hum in a small transistor amplifier. Checking filters did not help. We finally found that you could cover one of the transistors with your fingertips, and the hum stopped! Or, turn out the bench lights! The transistor was a little plastic TO-92 case, but it was a light brown instead of the normal black.

Investigation and checking with the maker disclosed that this was actually the cause. The fix? Cover the transistor case with black tape. All transistor junctions are photosensitive, and the case of this one let in just enough of the fluorescent light to make it hum.

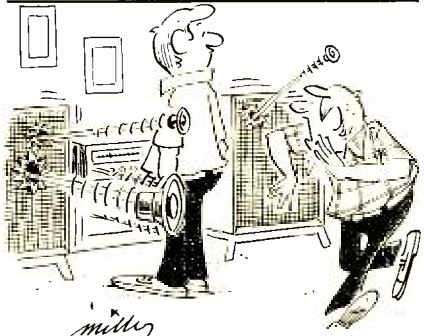
Thanks to Charles Varble, Chart TV, St. Louis, for this cute one!

### SAME WAVEFORM GRID AND CATHODE?

***I've been all over the place in this Admiral 8T950 color set, trying to find out why I can't get enough height. I need about three inches at bottom of the raster. All of the parts in the output circuit have been checked, and the tube changed. I see one funny thing. I get the normal waveform on the output tube grid, but I also get the same waveform on the cathode. That isn't right, is it?—J.M., Pettus, WV.***

No, sir! This cathode is well bypassed! Whenever you see the same waveform with almost the same amplitude on both grid and cathode of an amplifier tube, you've got a terrific *degeneration* that reduces the gain of the stage very badly. The normal cathode waveform should be a distinct parabola with a P-P amplitude of about 11 volts. Check that 50-$\mu$F electrolytic capacitor that bypasses the cathode. I'll bet you it's open.

(I won! It was.)



*"I said, 'turn down the volume!'"*

# BAUDOT to ASCII

*Build this converter so you can use your Baudot or other teletypewriter as an input device for the TV Typewriter*

ROGER L. SMITH

LAST MONTH WE DESCRIBED AN ASCII TO Baudot converter that let you connect your TV Typewriter or Mark 8 Minicomputer to a teletypewriter for hard-copy print-out. Now, we show how to use your teletypewriter as an input device.

## BAUDOT to ASCII converter

The BAUDOT to ASCII conversion circuit may not be necessary for your application if all you wanted was a print-out device. However, if you intend to use your BAUDOT Teletype (or Kleinschmidt or Creed) machine for an input device, or if you are a ham operator and want to receive the BAUDOT RTTY signals on your TV Typewriter, you will want the BAUDOT to ASCII converter also.

The BAUDOT to ASCII conversion is simpler in that extra characters (shifts) don't need to be generated. The incoming serial BAUDOT data is clocked into the shift register IC13 (see Fig. 1). The leading "space" pulse starts the clock, which is stopped when this bit reaches flip-flop IC14-b. Gates IC19 and IC21 determine if the character is a LETTERS or FIGURES shift character and sets or resets flip-flop IC17-a accordingly. The proper PROM (IC20 or IC22) is then selected and the correct ASCII output character appears for the equivalent BAUDOT inputs. The shift inputs will generate a null.

Notice that the output ASCII data is not valid until the "data ready" line goes high ("1"). If your set-up requires a logic "0" signal for "data ready", use the $\overline{Q}$ output (IC15-a pin 4). This line will remain high for 10-ms during which time the device being driven gates in the ASCII character. The PROM truth tables for IC20 and IC22 are shown in Tables I and II. These tables are on pages 00 and 00.

## Adjustment

If you build the BAUDOT to ASCII Converter, you will need to adjust the oscillator (IC18). With all circuits hooked up (see Fig. 2), set the oscillator to a high rate (200K trimmer near minimum), and while typing a "K", adjust the oscillator until the "K" is received on the ASCII device. Keep turning the trimmer until you get a "Q", then back off half-way. Notice that if you are using *both* boards, you must add a suitable switch to change connections to pin 23 of the timing board when connecting the TV Typewriter I.

The boards are well suited for use with either TV Typewriter. If you are using the Model CT-1024 (Terminal System Kit from Southwest Technical Products) you can cut off the excess portion of the circuit board. Connection to a regular ASCII-encoded keyboard or Ham radio gear is also possible so long as the devices provide the proper "data ready" signals. The use of these boards with the Mark-8 Minicomputer or other minicomputers is appealing. Output from the computer can then be the normal ASCII (as it would probably be for other output devices). Computer memory would not be used up in storing the codes, timing would be handled by the converter board and the software program would be simplified. **R-E**

### CONNECTION OF BAUDOT TO ASCII CONVERTER

**TV Typewriter I**

On the timing board, cut the foil connection to pin 23. The REPEAT switch becomes the RECEIVE/NORMAL switch. (Substitute suitable switch if both boards in this article are to be used.

Add Molex pins and jumpers as shown in Fig. 4-a.

**Note:** CR and LF are not stored in TV Typewriter.

**TV Typewriter II (CT-1024)**

Add Molex plug P1 (09-52-3151) and wire the pins as shown in Fig. 4-b.

**Note:** CR and LF are not stored in TV Typewriter.

**Minicomputer Connections**

Connect as shown in Fig. 4-c.

**Ham radio connections**

Follow the schematic and observe power connections.

### ADDITIONAL PARTS FOR ASCII TO BAUDOT CONNECTION

**TV Typewriter I:**

| Quantity | Type |
|---|---|
| 1 | 74123 dual monostable IC |
| 1* | 2524 512-bit shift register IC |
| 3 | 2200 ohms, ¼ W resistor |
| 1* | 6800 ohms, ¼ W resistor |
| 2 | 220 pF disc capacitors |
| 1* | SPST switch |
| 6 | Molex connector (part #09-52-3103) |
| 60 | Molex pins ¾-inch (part #08-54) |

**TV Typewriter II (CT-1024):**

| Quantity | Type |
|---|---|
| 1* | 2102 1024-bit memory |
| 1 | 330 ohm, ¼ W resistor |
| 1 | .1 uF disc capacitor |
| 1 | Molex 15-pin connector (part #09-52-3151) |
| 15 | Molex pins ¾-inch (part #08-54) |
| 1* | SPST switch |

### ADDITIONAL PARTS FOR BAUDOT TO ASCII CONNECTION

**TV Typewriter I:**

| Quantity | Type |
|---|---|
| 6 | Molex connectors (part #09-52-3103) |
| 60 | Molex pins ¾-inch (part #08-54) |

**TV Typewriter II (CT-1024):**

| Quantity | Type |
|---|---|
| 1 | Molex connector (part #09-52-3151) |
| 15 | Molex pins ¾-inch (part #08-54) |

*These parts *not* required if you can set your Teletype margins to 32 spaces and you have automatic CR and LF.

## ASCII TO BAUDOT CORRECTION

Mr. Roger Smith called our attention to several discrepancies in his article "ASCII to BAUDOT" in the March issue. They are as follows:

The schematic in Fig. 1 shows a connection between pin 3 of IC2-a and pin 2 of IC5-a. This connection is in error. Pin 2 of IC5-a should connect only to pin 11 of IC7. Pin 3 of IC2-a should connect to the top end of C1 at the junction of the lines to pin-15 IC7 and pin-4 IC9-a.

In Table 1, delete the 1's from the $B_2$ and $B_0$ output columns for word 31. Delete "BELL" and substitute "NULL."

## PARTS LIST BAUDOT TO ASCII CONVERTER

R22, R24—330 ohms, ¼ watt
R23—1000 ohms, ¼ watt
R25-R31, R35—2200 ohms, ¼ watt
R32—100,000 ohms, ¼ watt
R33—200,000 ohm, trimmer
R34—33,000 ohms, ¼ watt
R36—20,000 ohms, ¼ watt
R37—100 ohms, ¼ watt
C21, C27-C30—.1 μF, disc
C22—.1 μF, 10%, ceramic
C23—1 μF, 50 volt, electrolytic (upright)
C24—.01 μF, disc
C25—100 pF, disc
C26—.001 μF, disc
C31—10 μF, 25 volt, electrolytic
IC13—74194
IC14, IC17—7474
IC15—74123
IC16—7404
IC18—555 timer
IC19, IC21—7430
IC20, IC22—8223 32 × 8 PROM
See Connection Details for listing of additional parts

**The following items are available from Southwest Technical Products Co., 219 W. Rhapsody, San Antonio, TX 78216:**

**A kit of all basic parts (order additional parts separately) for the BAUDOT To ASCII Converter for $19.50 postpaid.**

**Etched and drilled printed circuit board for the BAUDOT To ASCII Converter for $4.35 postpaid.**

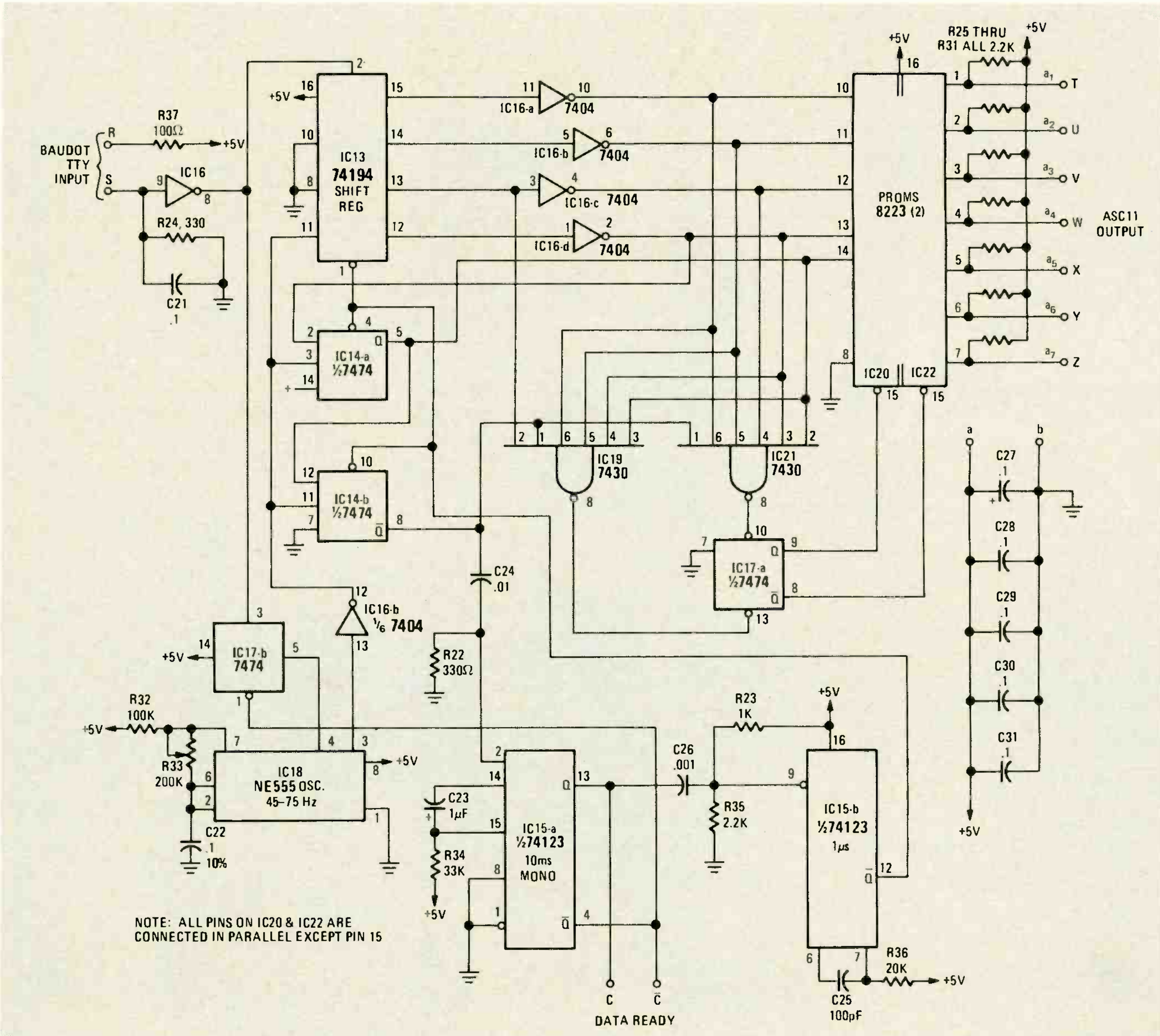
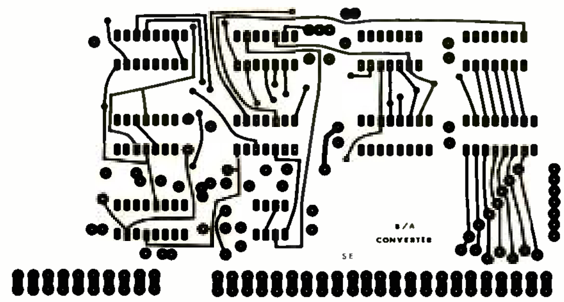
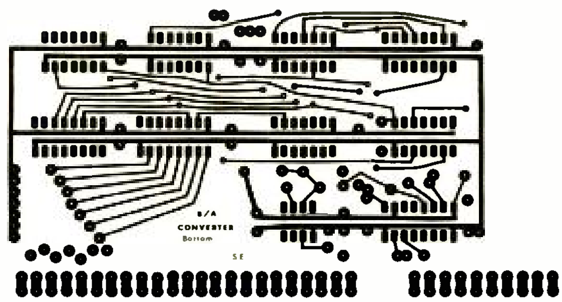



**FIG. 1—BAUDOT TO ASCII CONVERTER schematic diagram.**



BAUDOT TO ASCII CONVERTER printed circuit board foil pattern. Component side of double-sided board is shown ½-size.



BAUDOT TO ASCII CONVERTER printed circuit board foil pattern. Bottom-side of double-sided board is shown ½-size.

All other necessary construction and descriptive material on this project appeared in the February 1976 issue under the title "ASCII To Baudot Converter" and this material should be scanned if any further details are needed.

Elsewhere in this issue, on page 82 you will find the component-layout diagram for the printed-circuit board and Charts I and II, which are the Truth Tables for the type 8223 PROM used for IC20 and IC22. We do hope that you have enjoyed this project along with the others in this series of ad-ons to TV Typewriter II. **R-E**

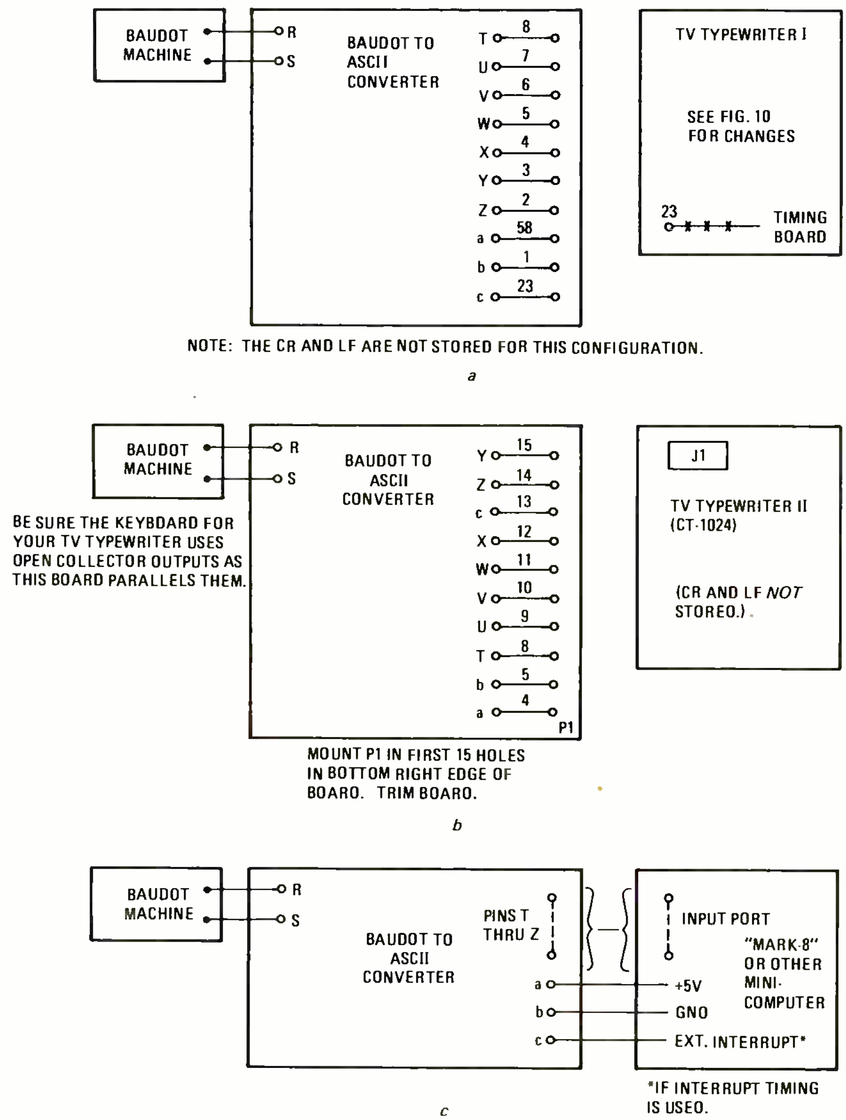



**FIG. 2—BAUDOT TO ASCII CONVERTER connections to TV Typewriter I are shown in a, TV Typewriter II are shown in b, and mini-computer is shown in c.**

## VERTICAL SWEEP GONE

***This little Airline portable, a GEN-3267A, has got us going. No vertical sweep. Still, we can drive it with a B & K Analyst, clear black to the pin-10 grid of the 17JZ8, and get sweep. Everything else is fine, but no vertical sweep.—O.W., Durant, OK.***

This has just got to be something in the *feedback loop,* from plate of the output section to grid of the input section. This is what makes the circuit oscillate. Take it out, and all you have is a two-stage R-C coupled *amplifier.* If you can get sweep by feeding a drive signal to the input grid, the "amplifier" part is OK.

Suggestion: feed your drive signal to the input grid. Now follow it with a scope, from the output plate back to the input grid. Something in there will be *open.*

## SHORTED CRT IN SCOPE

***(This is the end result of quite a bit of correspondence about a problem of severe blooming in the CRT of an Eico 460 oscilloscope. The reader wrote:)***

Thank you for the hints about the trouble in my scope. I finally found that the DC voltage on the grid and cathode of the CRT were both the same. This was caused by an internal short between these elements. I blew this out by discharging a 40-$\mu$F capacitor across them.—S. Goldhor, Hayward, CA.

# Serial Interface for TV II

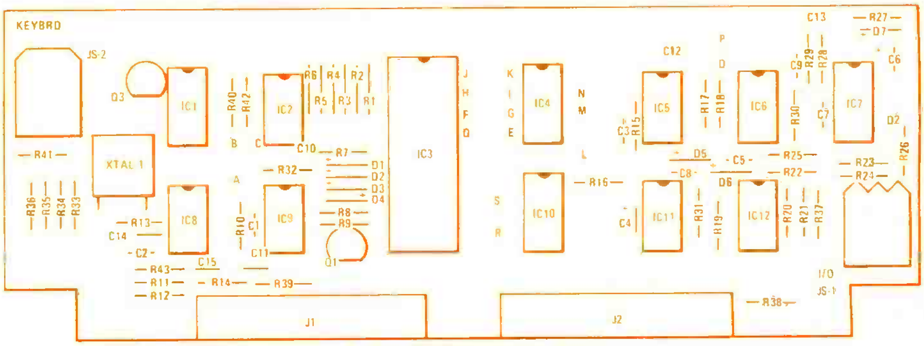
*To connect TV Typewriter II to a telephone or other two-wire system or to a magnetic-tape memory you need an adequate modem. Here's how to build one*

**ED COLLE**

FOR THE TV TYPEWRITER II TO COMMUNICATE via a two-wire system, a phone line or a magnetic-tape data storage system, the parallel ASCII data must be broken down into sequential one-bit-at-a-time form both when coming out of the keyboard and going into the terminal. The serial interface or UART (*U*niversal *A*synchronous *R*eceiver/*T*ransmitter) provides this conversion from the parallel form into a series of properly timed one's and zero's including not only the serial data, but the start, stop and parity bits as well. The reverse is true during the receive mode. The baud rate or speed at which the serial data is transmitted or received can be selected from 110, 150, 300, 600 or 1200 baud with a single-pole rotary switch. There is a provision for "echo off" where the data is transmitted to the receiver, but is not put up on the screen until it is transmitted back by the receiver and displayed by the terminal; or "echo on" where the data is transmitted and simultaneously put up on the screen and is not echoed back by the receiver.

The input/output connections are type RS-232 compatible which will attach directly to most couplers and data sets, however, to record on or playback from magnetic tape it will be necessary to build some kind of FSK encoder/decoder system to get the digital data on and off the tape since this is not provided by the interface. Data to be transmitted can either be provided by the screen-read board or the keyboard. The interface normally monitors the keyboard, however, a "ready to send" command from the screen board locks out the keyboard and allows the screen-read board to transmit its data.

The entire circuit is built on a 3⅜" × 9½" circuit board that is plugged onto the main board at connector strips J1 and J2 just behind the cursor and screen-read boards. Switch connections to the serial



PC TOP LAYOUT—SERIAL INTERFACE BOARD

**FIG. 2—COMPONENT PLACEMENT diagram.**

### SPECIFICATIONS

| | |
|---|---|
| **Receive Format:** | E1A RS-232 and TTL compatible with a mark equal to + 1.5 to − 25 volts and a space equal to + 3 to + 25 volts. The range from + 1.5 to + 3 is the hysteresis region. |
| **Input Impedance:** | 1800 ohms |
| **Transmit Format:** | E1A RS-232 with a mark equal to − 4.7 volts and a space equal to + 4.7 volts (2000-ohm load) |
| **Baud Rates** | |
| Standard: | 110 baud |
| Optional: | 110, 150, 300, 600, 1200—selectable |
| **Stop Bits:** | Automatic selection of 2 stop-bits for 110 baud and 1 stop-bit for 150, 300, 600 and 1200 baud |
| **Parity** | |
| 7 bit: | odd, even, none |
| 8 bit: | no parity (bit 8 programmable to a 0 or 1) |

### PARTS LIST
### Serial Interface Board—110 baud

**All resistors are ¼-watt, 10%, unless noted**

R1-R7, R16, R24—22,000 ohms
R8, R15, R17, R20-R22, R29, R31, R37, R39, R42—1000 ohms
R9, R27—47,000 ohms
R18, R38—12,000 ohms
R19—2000 ohms
R23—3900 ohms
R25—27 ohms
R26—2700 ohms
R28—5600 ohms
R30—330 ohms
C3—470 pF capacitor
C4, C6—33 μF, 25 volt electrolytic
C5—.01 μF capacitor
C7—100 pF capacitor
C8—.001 μF capacitor
C9—330 pF capacitor
C10-C13—0.1 μF capacitor
D1-D7—1N4148 silicon diode
Q1—2N5210 silicon transistor
Q2—PNP general purpose transistor, gain = 100, maximum $V_{ce}$ = 40 volts
IC2—7493 counter
IC3—S1883 UART
IC4, IC10—74157 data selector
IC5—74132 quad NAND gate
IC6—7400 quad NAND gate
IC7—74123 dual one-shot
IC9—7474 dual type-D flip-flop
IC11—7404 hex inverter
IC12—7403 quad open collector NAND gate

### PARTS LIST
### 150, 300, 600, 1200 baud option

**All resistors are ¼-watt, 10%, unless noted**

R10—180 ohms
R11, R13—1800 ohms
R12, R14—470 ohms
R32-R36, R40, R41—1000 ohms
R43—2700 ohms
C1, C14—300 pF capacitor
C2—50 pF capacitor
C15—.005 μF capacitor
Q3—2N5210 silicon transistor
IC1—7497 rate multiplier
IC8—7404 hex inverter
XTAL 1—307.200 kHz series resonant crystal

**The following items are available from Southwest Technical Products Corp., 219 West Rhapsody, San Antonio, TX 78216.**

**CT-S Serial Interface Kit .......... $39.95**
**S1-b Serial Interface Circuit .... $11.75**
**Other add-ons for TVT-II include:**
**Screen Read Board Kit .......... $17.50**
**(September 1975 issue)**
**Manual Cursor Kit .......... $11.50**
**(November 1975 issue)**

interface board are provided by a 12-pin connector (J1) while the keyboard is plugged into another 12-pin connector (J2) rather than J9 of the main terminal board as is done if the interface board is not used.

### How it works

The serial interface circuit has been designed around a single UART chip that actually does most of the work. The other circuitry on the interface board interfaces the chip itself to the circuitry on the main terminal board. The schematic diagram appears in Fig. 1.

During the transmit mode, both the outputs from the keyboard and the screen-read board are fed into data selectors IC4 and IC10. These data selectors select either one of the two sets of inputs with the input from the screen-read board taking priority. Normally the keyboard is selected as the input. However, if the screen-read board starts to send data, the incoming low-to-high transition at J2 pin-13 triggers IC7-a, a retriggerable 350 ms one-shot. This selects the screen-read inputs and locks out the keyboard by driving pin 1 of IC4 and IC10 low. It also blocks any data from being received during a screen read operation if the jumper from S to R is installed by forcing pin 8 of IC9-a low. This gates the "output data available" line into the "reset data available" line of the UART chip. Since the keyboard and receiver are disabled for at least 350 ms after

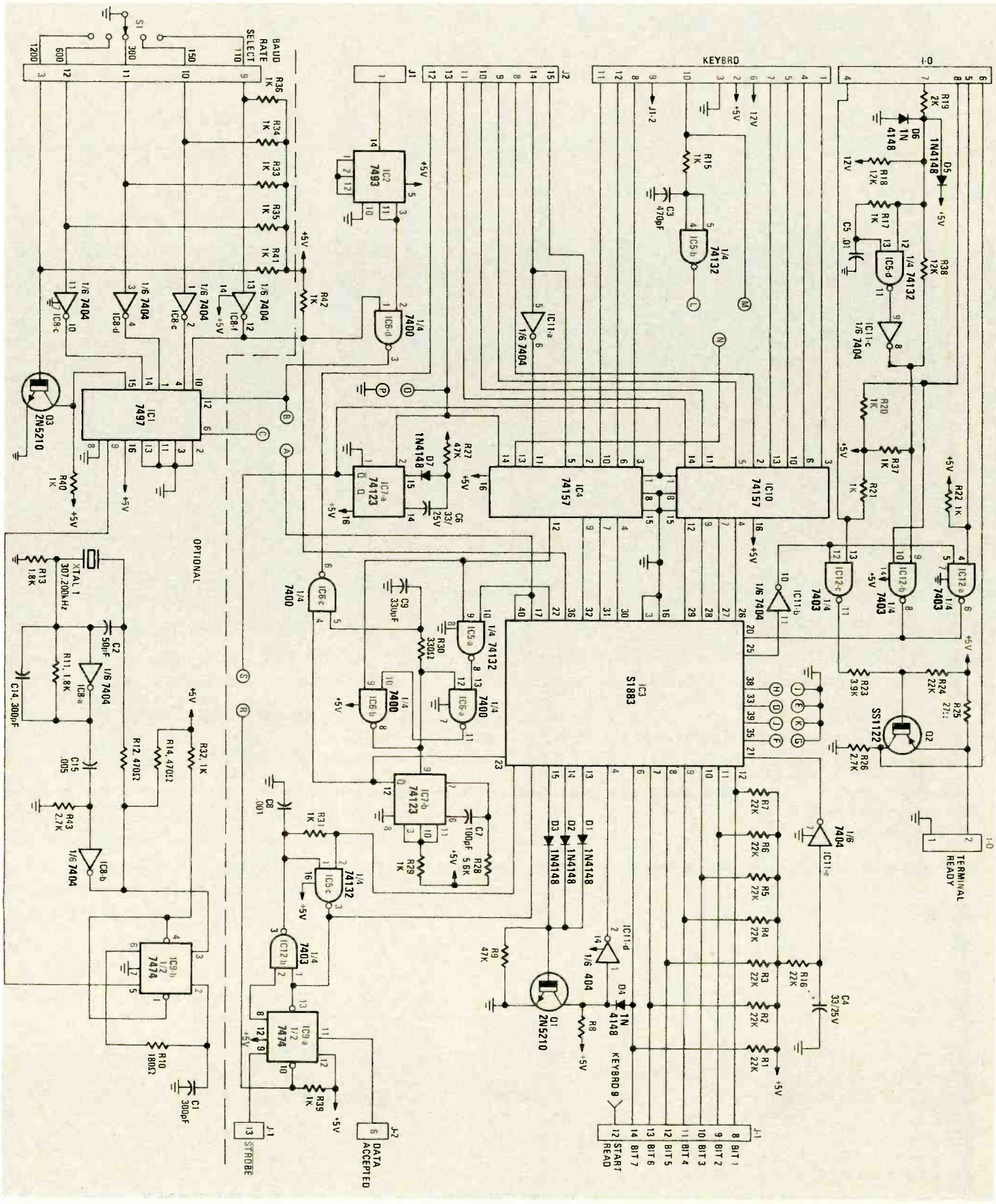


FIG. 1—SERIAL INTERFACE OPTION for TV Typewriter II.

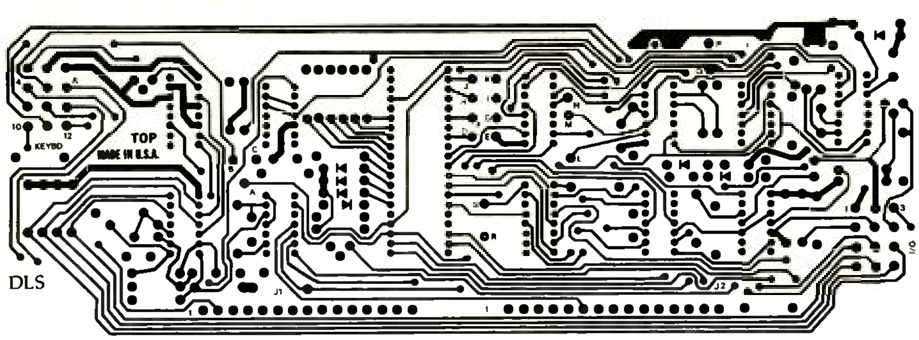



**FIG. 3—FOIL PATTERN of component side of double sided board shown ½ size.**

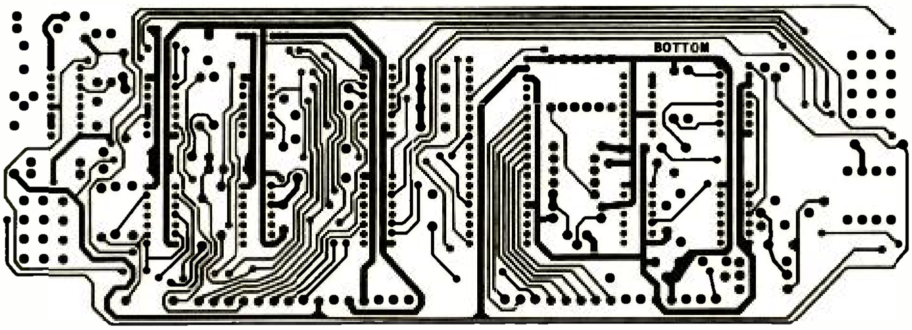
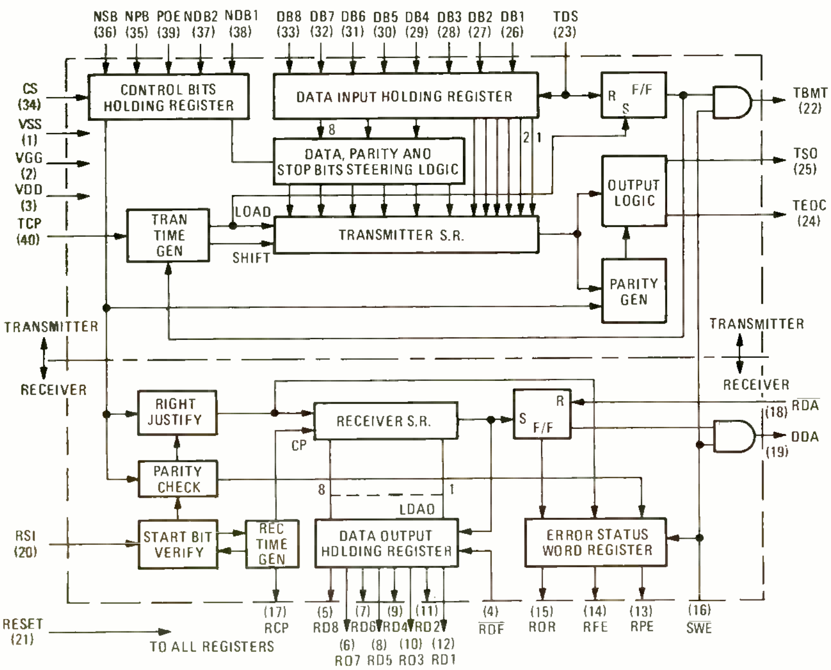
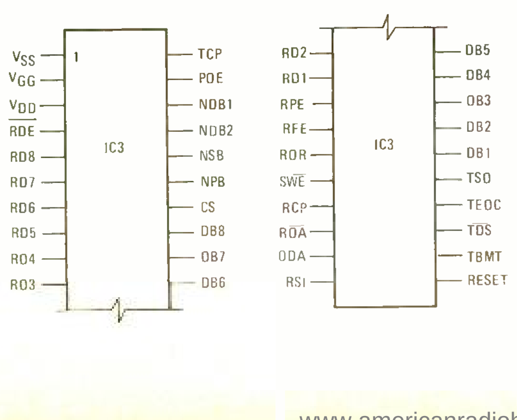



**FIG. 4—FOIL PATTERN of foil side of double sided board shown ½ size.**




each character is dumped during a screen-read operation, there may be problems with a computer sending a return message too soon after the screen-read operation is completed, especially when using high baud rates. In these situations, you may not want to lock out the receiver during a screen-read transmission and can omit the jumper between points S and R. You must be sure, however, that the TV Typewriter II is not in the echo mode and that the computer does not attempt to send data to it until the screen dump has been completed. This is indicated by an "!" transmission if the auto-stop function on the screen read-board is being used.

Regardless of whether the data to be transmitted comes from the screen-read board or the keyboard, it exits from the data selector IC4 pin-12 to IC5-a pin 9 where it is gated with the transmitter buffer empty output from the UART chip, IC3 pin 22. When IC3 pin 22 goes high, it sets the output of the AND gate latch (IC6 pin 11) high. Each time this (IC6-a and IC6-b) latch is set, a 250-ns pulse is generated that loads the data at the output of the IC4 and IC10 data selectors into the input buffer of the UART chip. At the trailing edge of the same pulse, a pulse is supplied to the screen read board until it resets and forces IC6-a pin 9 low which resets the (IC6-a and IC6-b) latch. This reset pulse that is sent to the screen-read board allows it to find and store its next character until the UART transmitter buffer is ready for it. This double buffering enables the transmitter to transmit at up to 1200 baud without gaps or hesitations.

The serial data leaves the UART chip, (IC3 pin 25) and is gated with the transmitter on/off input at IC12-c. Transistor Q2 then converts the serial TTL level output to RS-232 format.

During the receive mode, the incoming RS-232 serial data is converted into TTL compatible levels by a Schmitt trigger circuit consisting of IC5-d and its related components. The output at IC11-c pin 8 is then gated and fed into the serial input terminal of the UART chip (IC3 pin 20.) When the UART chip sees the stop bits of the character being received, output data available line changes to logic "1" (IC3 pin 19). If IC9-a pin 8 is at a logic "1" level, it means the terminal already has a character awaiting loading and is not ready to accept the new character waiting in the receiver data holding registers. When the character in the terminal's register is finally loaded, the character accepted line feeding IC9-a (pin 11) changes to a logic "0" and toggles IC9-a forcing pin 8 low. This permits IC12 to pulse the output of IC5-c low clearing the output data available line and generating a negative going keypress strobe to load the new character into the terminal's data registers. Note that the keypress strobe jumper of the main terminal board must be wired for a negative strobe when the serial interface is being used.

If an error is detected by the UART chip, it drives one of three IC3 outputs high. IC3 pin 14 changes to a logic "1" if a stop bit does not follow after the start bit and the correct number of data bits. IC3 pin 13 changes to a logic "1" if there is a parity error received. IC3 pin 15 changes

*(continued on page 80)*

# R-E's Service Clinic

## Horizontal oscillators

*Oddball symptoms*

by **JACK DARR**
SERVICE EDITOR

THE RECENT SERVICE CLINIC ABOUT horizontal oscillator circuits got quite a bit of mail. Mainly requests for more information on this circuit. So, here it is. Let's look at some of the oddball symptoms you will find. With a little cool, logical thinking, you can get a handle on any of them.

OK, here's one; an oldie. When the antenna signal is applied to the receiver, the horizontal oscillator runs and you get a raster. Horizontal hold isn't too good. Turn to a dead channel or remove the antenna signal and out goes the raster and high voltage! Or, just the opposite. Raster off-channel, no raster with an antenna signal. (*Not* to be confused with an AGC blackout. If this happens, you do have high-voltage, but the tube is cut-off.) Weird, eh? Not too. The problem is in the *horizontal AFC.*

Why? Because the *only* difference between the two conditions is the presence or absence of the horizontal *sync.* In the first case, the horizontal oscillator will run when there is sync, but won't run without it. In the opposite case, the oscillator will run if the sync is not present; when the sync appears, this throws the oscillator so far off that it dies!

The major cause of this is a defective AFC diode unit. Sometimes due to a bad part in the anti-hunt circuit, etc., but mostly the diodes. To check, kill the AFC and see if this will keep the oscillator running, on- and off-channel.

In one really wild case, in an old Philco, the horizontal sync wasn't too bad but the vertical sync was terrible. After checking out the vertical circuits, I finally found that the ground-side of the *horizontal* AFC diode was shorted! This was pulling down the amplitude of the composite sync and upsetting the vertical oscillator first.

Another puzzler (unless you know it's there) comes up in sets using only the boost for the plate voltage supply of the horizontal oscillator. Figure 1 shows a typical example, an Admiral T2H-1A chassis. The complaint is often "no raster" or "narrow raster".

The horizontal oscillator plate voltage will be well below normal. Here, note that there is no direct path from the horizontal oscillator supply back to the B+. Oh, no? There is, if you'll trace it out. When the set is turned on, the DC voltage appears immediately, since solid-state diodes are used in the DC power supply, However, the damper tube must warm up enough to conduct current before any DC voltage shows up on the oscillator.

Without any output signal from the horizontal output stage, only the B+ voltage appears on the damper cathode.

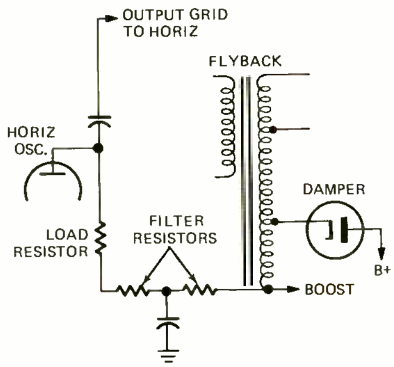



FIG 1

This is connected to the oscillator plate through two resistors. There will be enough voltage to *start* the oscillator. Once it starts running, it drives the horizontal output stage, producing a flyback pulse. This pulse is rectified by the damper tube, producing a much higher voltage, and everything starts to work.

If you have this kind of trouble, check the *boost* voltage. The boost capacitor is returned to ground instead of to B+. It develops about +340 volts DC. If you measure only the B+ voltage of about +135 volts, you have no boost at all. A good check for this is to drive the horizontal output with a substitute drive signal.

If the boost voltage and high-voltage appears, then you have some problem in those resistors feeding the horizontal oscillator. If you still have no boost, check things like the boost capacitor, the horizontal winding of the deflection yoke, and the damper and horizontal output tubes. In one odd variation of this, I found 0 V DC on the damper cathode. This turned out to be an open cathode connection inside the damper tube! You should see the B+ voltage here before the horizontal output tube starts to work.

In another queer case, in an RCA CTC-53, the raster and high-voltage

**This column is for your service problems—TV, radio, audio or general and industrial electronics. We answer all questions individually by mail, free of charge and the more interesting ones will be printed here.**

**If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. If return postage is not included, we cannot process your question. Write: Service Editor, Radio-Electronics, 200 Park Ave. South, N.Y. 10003.**

was lost, the grid drive to the horizontal output tube disappeared and the plate voltage on the horizontal oscillator stayed well up. Substitution of all three tubes—oscillator, output and damper—did nothing. Eventually, the cause was discovered by looking at the *top* of the chassis. The horizontal oscillator tube was *going out* when the problem showed up. This was due to a heater-cathode short in the tube *ahead* of it in the series-heater string! (Look at *both* sides of the chassis!)

There are a lot of questions on another type of circuit. This circuit has a "starter" resistor going to B+, and a "running" resistor that goes to the boost. The most common question is: "The resistors and tube are good, but I can't get enough DC voltage on the plate! When I turn it on, the plate voltage jumps away up and then drops to almost nothing." There's a simple answer to this; the horizontal oscillator is *not running* at all!

When the oscillator is running, its plate current is a series of pulses. The average plate current is quite low, so the DC voltage stays high. However, if the oscillator is not running, its plate current is constant and the average current is much greater. So, there is a large voltage drop across the load resistors. The quickest check for this is to scope the plate of the oscillator tube, or the grid of the horizontal output. Be sure that there is the proper drive signal there. If it's not, then you have pinned down the cause of the trouble.

The average oscillator circuit has only about 5 parts, so it shouldn't take too long to find out which one is causing the trouble. If all of these parts seem to be good, but the oscillator still won't run or won't run on-frequency, scope the DC voltage-supply lines—the B+. You should see absolutely zero signal of any kind here. If you see anything, this means that there could be a feedback loop through the DC power supply which can cancel the oscillations!

Another odd symptom is the intermittent-start horizontal oscillator. Sometimes it starts, sometimes it doesn't. Touch any part of the circuit with a test probe and away it goes, and keeps running. One typical circuit is the Colpitts, shown in Fig. 2. If you run

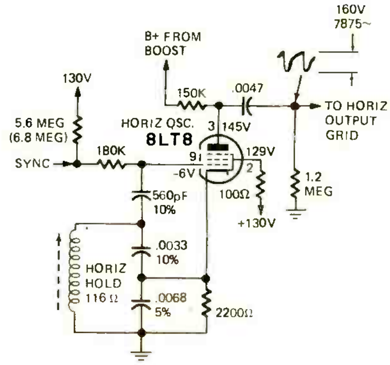



FIG. 2

into this kind of problem, replace *both* of the capacitors across the oscillator coil. Be sure to use exact duplicates. (One final hint: it is always a good idea to put them back *exactly* where they were. If you reverse them, you will see some peculiar reactions indeed. The source of this item will remain anonymous, which means "Don't give your right name!") **R-E**

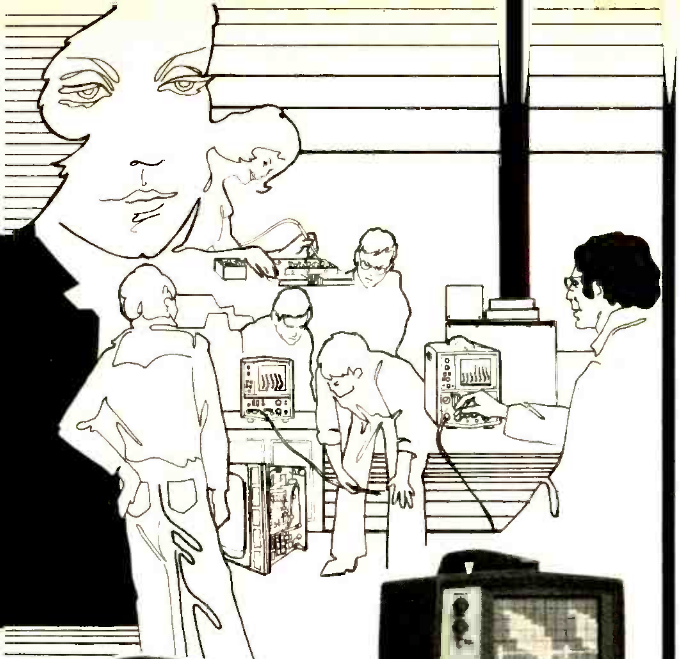


# reader questions

## WHA' HOPPEN?

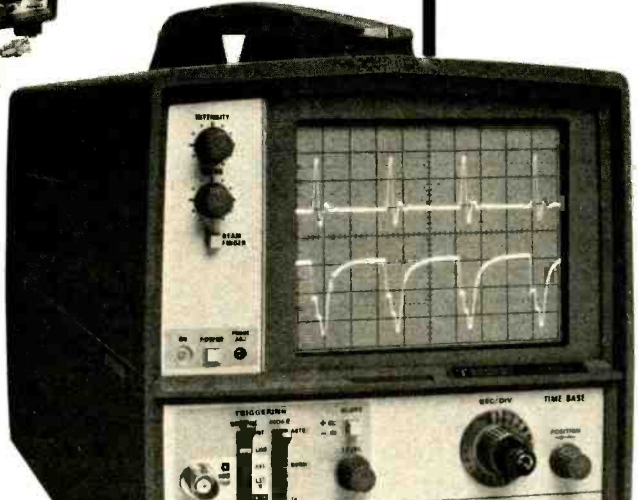
***Thank you for your letter and the help. I finally fixed this Zenith 18CC29. You told me to read the 6LB6 cathode current. I did. It went up from 200 to 300 then to 390 mA. Sides of the picture pulled in. I checked both tubes, and all of the parts in the high voltage, boost and sweep circuits. No luck. Everything checked good! Finally decided to change the 6HV5 high-voltage regulator tube just to see what would happen. That did it! 6LB6 current nor-***

*(continued on page 66)*



T921

T912



T922

T935

T932

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## READER QUESTIONS

*(continued from page 64)*

***mal, full picture. Tried the old one; same thing. Picture pulled in and current went up. Now you tell me what happened —R.B., Santa Ana, CA.***

Rubbing the crystal ball, the Swami replies: "From past experience, I'd say that the 6HV5 tube had a very bad case of *grid emission.* I have seen the same symptoms when a horizontal output tube developed this trouble, but I've never seen it happen in a regulator tube. Anything can happen, can't it?" Thanks. This could happen in any set using this type of high-voltage regulator; so, try a new tube to make sure!

### MORE ON PM MAGNET ERASURE

I have a letter from Mr. William A. Manly, Director Product Development of the Cobaloy Co., Arlington, TX, 76011, with some very useful data on erasing tapes with a PM magnet. The original was in answer to R. G. of Baltimore in the Oct. 75 issue of **R-E.** I said that I didn't think it would hurt. Mr. Manly warns that this might be bad advice, depending on the intended *use* of the erased tapes. For ordinary low-fi, voice and similar applications, OK. But—now I quote:

"It's true that this erasure method will not result in any permanent damage to the tape or the recorder. A tape thus erased, however, will have a very high level of *background noise* on it (the so-called "DC noise") some 6 to 20 dB above the true (bulk-erased) background noise. Such a tape will have a tendency to magnetize the heads of any machine it's used on. If the heads are magnetized, they will tend to erase the short wavelengths of any tape containing information subsequently played on the machine. None of this makes any great difference to the inexpensive machine that employ DC erase and biasing, but I suspect that if R.G. is using 10.5-inch reels as he says, he could well be using a pretty good machine and these considerations would definitely apply.

"For voice-only and other undemanding uses, DC erase is fine. I would not recommed it for any high-quality use where quality of recording is a consideration. By the way, the field of such a strong magnet should be kept well away, at least three feet, from *any* tape containing data that he wishes to keep. It will not only erase the signals, but a lower intensity exposure to powerful magnetic fields will cause print-through to appear on the tape."

Thank you very much, sir! I intended the original reply to say something like that, but I didn't get it in plainly enough. I appreciate the information and it will be duly filed for the next question on the subject.

### ODD VOLTAGES

***This G-E T2250-H radio runs for 10 minutes then stops. I can't make sense out of the DC voltages! Any helpful hints?—S.C., Mentone, CA.***

The power supply in this set is unusual. For one thing, be sure that you have the correct schematic; Sams 1038 shows both early and late production runs. There is some difference! When it stops, check the detector to see if you have a signal. If you do, the problem is in the audio stages. If you don't, the problem is in the IF or front end. (Feedback: reader found out that he *was* using the early production schematic on a late production chassis! Also, the audio output transistors were intermittently opening up!)

### NO HV REGULATION

***I really need help with this Zenith 14A10C29 color TV. I have no high-voltage regulation at all. The high-voltage varies from 20 kV to 30 kV with the setting of the brightness control. Not much change in picture size, but I do lose focus. All tubes have been subbed in the high-voltage and video circuits. The horizontal output tube grid-drive and cathode current is normal. Voltages on the high voltage regulator tube are off, but I can't find any bad parts in there.—D.B., Portsmouth, VA.***

The 6HV5 high-voltage regulator grid-voltage comes from the boost, through several resistors *and a VDR.* You have undoubtedly checked the resistors, but a VDR is usually "checkable" only by substitution! Be sure that you get the correct one; this is a Zenith 63-8161.
(Feedback: that was it!)

### OUTPUT TUBE HOT

***The 6LF6 horizontal output tube in this Motorola TS-929 gets red hot; intermittently, of course. When this happens, the grid bias on the 6LF6 goes to zero. The bias comes from the FA panel. I've changed all the tubes on this panel, no help. Output transformer and yoke checked out. Any solution will be appreciated.—C.F., Pineview, GA.***

I think you have the key clue; the zero bias on the 6LF6. Scope the FA panel output. If this signal is still present there while the 6LF6 grid drops to zero, you have an intermittent open in one of the *connectors* between the FA panel and the horizontal output. Sometimes one of the contact pins will be pushed back to the point where it makes intermittent contact with the board or plug.

### OUTPUT TUBE CUT OFF

***The horizontal oscillator is working in this Zenith 14A9C50. The screen grid of the 6LB6 reads +300 volts or more! No, it's not the screen bypass or***

*(continued on page 68)*

## C-MOS

| | | | |
|---|---|---|---|
| 4000 | 6/1.00 | 4044 | 1.25 |
| 4001 | 4/1.00 | 4046 | 2.00 |
| 4002 | 5/1.00 | 4047 | 2.00 |
| 4006 | 1.25 | 4049 | 2/1.50 |
| 4007 | 1.25 | 4050 | 2/1.50 |
| 4008 | 1.25 | 4051 | 1.50 |
| 4009 | 2/1.00 | 4053 | 1.75 |
| 4010 | 2/1.00 | 4071 | 3/1.00 |
| 4011 | 4/1.00 | 4073 | 3/1.25 |
| 4012 | 4/1.00 | 4081 | 2/1.50 |
| 4013 | 3/1.00 | 4082 | 2/1.50 |
| 4014 | 1.00 | 4402 | 1.00 |
| 4015 | 1.10 | 4403 | 1.00 |
| 4016 | 2/1.35 | 4404 | 1.00 |
| 4017 | 1.10 | 4412 | 1.25 |
| 4018 | 2/1.25 | 4416 | 1.50 |
| 4020 | 1.20 | 4426 | 1.75 |
| 4021 | 1.25 | 4428 | 2.25 |
| 4022 | 1.25 | 4441 | 2.00 |
| 4023 | 4/1.00 | 4449 | 2.00 |
| 4024 | 2/1.50 | 4507 | 2/1.00 |
| 4025 | 4/1.00 | 4508 | 1.00 |
| 4027 | 2/1.00 | 4510 | 1.85 |
| 4028 | 1.00 | 4511 | 1.85 |
| 4029 | 1.25 | 4512 | 1.65 |
| 4030 | 2/1.00 | 4516 | 2.00 |
| 4033 | 1.90 | 4518 | 1.25 |
| 4035 | 1.25 | 4519 | 1.50 |
| 4040 | 1.35 | 4520 | 1.25 |
| 4041 | 1.25 | 4528 | 1.60 |
| 4042 | 1.00 | IM5003C | 4.00 |
| 4043 | 1.35 | | |

## DTL IC's

| | | | |
|---|---|---|---|
| 930 | 6/1.00 | 9300 | |
| 931 | 4/1.00 | | |
| 932 | 7/1.00 | 9300 | 1.00 |
| 933 | 5/1.00 | 9301 | 1.25 |
| 935 | 5/1.00 | 9304 | 1.00 |
| 936 | 7/1.00 | 9313 | 1.00 |
| 938 | 4/1.00 | 9316 | 1.00 |
| 944 | 4/1.00 | 9318 | 2.75 |
| 945 | 6/1.00 | 9321 | 1.75 |
| 949 | 6/1.00 | 9334 | 2.00 |
| 952 | 4/1.00 | | |
| 953 | 5/1.00 | | |
| 957 | 4/1.00 | | |
| 958 | 4/1.00 | 93L00 | 2/1.50 |
| 962 | 5/1.00 | 93L08 | 5.00 |
| 9093 | 5/1.00 | 93L16 | 1.00 |
| 9099 | 7/1.00 | 93L18 | 4.00 |
| 9158 | 4/1.00 | 93S16 | 5.00 |
| 958C/MUL | 5.75 | 96L02 | 1.00 |
| 960C/MUL | 7.50 | 9615 | 2.75 |

## LINEAR IC's

| | | | | | |
|---|---|---|---|---|---|
| 300H | V Reg | 1.00 | 556N | Dual Timer | 1.35 |
| 301H | Op Amp | 3/1.00 | 565N | Ph Lock Loop | 1.00 |
| 301N | Op Amp | 4/1.00 | 567M | Tone Decoder | 1.85 |
| 302H | V Fol | 1.85 | 702H | Linear | 2/1.50 |
| 304H | Neg Reg | 1.00 | 703H | RF/IF Amp | 1.50 |
| 305H | V Reg | 1.25 | 709H | Op Amp | 3/1.25 |
| 306H | V Comp | 2.40 | 709N | Op Amp | 3/1.25 |
| 307H | Op Amp | 3/1.25 | 710H | V Comp | 3/1.25 |
| 307M | Op Amp | 2/1.25 | 711H | Dual Comp | 2/1.00 |
| 308H | Op Amp | 2.75 | 711N | Dual Comp | 2/1.00 |
| 308N | Op Amp | 1.00 | 715H | Linear | 3.25 |
| 309K | 5-V Reg | 1.00 | 716H | Audio Amp | 3.25 |
| 310H | V Fol | 1.55 | 723H | V Reg | 2/1.10 |
| 310M | V Fol | 1.65 | 723N | V Reg | 2/1.10 |
| 311H | V Comp | 1.00 | 725H | Ins Op Amp | 3.75 |
| 311M | V Comp | 2/1.75 | 733H | Dif Vid Amp | 1.00 |
| 311N | V Comp | 2/1.75 | 733N | Dif Vid Amp | 1.00 |
| 312H | Op Amp | 2.00 | 739N | Dual Aud Pre Amp | 1.15 |
| 318H | Dual Comp | 2.00 | 740H | FET Op Amp | 7.00 |
| 320T-5V | Neg Reg | 1.25 | 741H | Op Amp | 3/1.00 |
| 320T-6V | Neg Reg | 1.25 | 741 | Op Amp | 3/1.00 |
| 320K-12V | Neg Reg | 1.50 | 747H | Dual Op Amp | 1.00 |
| 324M | Quad Op Amp | 2.50 | 747N | Dual Op Amp | 1.50 |
| 324N | Quad Op Amp | 2.50 | 748H | Op Amp | 3/1.25 |
| 339N | Lo V Quad Comp | 1.00 | 748M | Op Amp | 3/1.25 |
| 340T-5V | Pos Reg | 1.25 | 749N | Dual Aud Pre Amp | 1.50 |
| 340T-8V | Pos Reg | 1.25 | 760N | Dif V Comp | 3.00 |
| 340T-12V | Pos Reg | 1.25 | 781N | Gain Cont IF Amp | 2.00 |
| 340T-15V | Pos Reg | 1.25 | 1414N | Dual Dif Comp | 1.50 |
| 340T-18V | Pos Reg | 1.25 | 1458M | Dual Op Amp | 2/1.15 |
| 370N | AGC/Sq Amp | 1.75 | 2900N | Quad Amp | 1.00 |
| 373N | AM/FM IF Det | 1.30 | 3065N | TV Snd Sys | 2/1.50 |
| 380M | Audio Amp | 1.00 | 3900N | Quad Amp | 1.00 |
| 381 | Dual Pre Amp | 1.40 | 4136N | Quad 741 | 2.00 |
| 555M | Timer | 3/1.45 | 4558M | Dual 741 | 2/1.25 |
| | | | AH0019 | DPST Analog Sw | 4.00 |

## WANT TO PLAY VIDEO GAMES ON YOUR OWN TV?

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## JADE Co

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## MEMORY

| | | |
|---|---|---|
| P-1101A | 256w x 1b st RAM | 2.25 |
| P-1103A | 1024w x 1b st RAM | 2.75 |
| C-1702A | 256w x 1b Eras PROM | 15.00 |
| P2102A | 1024w x 1b st RAM | 2.00 |
| N-2431Y | Sub System | 2.50 |
| N-2505K | 512 b Shift Reg | 2.00 |
| MM-5013 | 1024b Shift Reg | 4.00 |
| C-8008 | 8b CPU | 21.50 |
| C-8080 | 8b CPU | 35.00 |
| N8223B | 256b BiPo PROM | 3.50 |
| N8225B | 64b Scratch Pad | 2.00 |
| TMS3002LR | 100b Shift Reg | 4.00 |
| TMS3132NC | 144b Shift Reg | 3.00 |
| 93403DC | 16w x 4b RAM | 4.00 |

## CHIPS

| | | |
|---|---|---|
| 5314 | 24 pin 6 Dg Clock | 4.00 |
| 5316 | 40 pin 4 Dg Alarm | 5.75 |
| 5736 | 6 Digit Cal | 2.00 |

## IC Sockets

| | Low Pro | Standard | Wire Wrap |
|---|---|---|---|
| 8 | 5/1.00 | 4/1.00 | -- |
| 14 | 4/1.00 | 4/1.25 | 3/1.00 |
| 16 | 4/1.25 | 3/1.00 | 3/1.25 |
| 18 | 3/1.00 | 3/1.25 | 2/1.25 |
| 22 | 3/1.25 | 2/1.25 | -- |

## TTL IC's

| | | | |
|---|---|---|---|
| 7400 | 6/1.00 | 7443 | 1.00 |
| 7401 | 6/1.00 | 7445 | 2/1.35 |
| 7402 | 5/1.00 | 7446 | 2/1.45 |
| 7403 | 5/1.00 | 7447 | 2/1.50 |
| 7404 | 5/1.00 | 7448 | 2/1.75 |
| 7405 | 5/1.00 | 7450 | 5/1.00 |
| 7406 | 3/1.00 | 7451 | 5/1.00 |
| 7407 | 3/1.00 | 7453 | 5/1.00 |
| 7408 | 4/1.00 | 7454 | 5/1.00 |
| 7409 | 4/1.00 | 7460 | 5/1.00 |
| 7410 | 6/1.00 | 7470 | 3/1.00 |
| 7411 | 4/1.00 | 7472 | 3/1.00 |
| 7412 | 4/1.25 | 7473 | 3/1.00 |
| 7413 | 2/1.15 | 7474 | 3/1.00 |
| 7414 | 2/1.40 | 7475 | 2/1.00 |
| 7416 | 3/1.25 | 7476 | 3/1.00 |
| 7417 | 3/1.25 | 7479 | 1.00 |
| 7418 | 4/1.25 | 7480 | 2/1.00 |
| 7420 | 5/1.00 | 7482 | 2/1.85 |
| 7421 | 3/1.10 | 7483 | 2/1.40 |
| 7423 | 3/1.10 | 7485 | 2/1.85 |
| 7425 | 3/1.25 | 7486 | 3/1.25 |
| 7426 | 3/1.00 | 7488 | 3.50 |
| 7427 | 3/1.00 | 7489 | 3.00 |
| 7428 | 2/1.00 | 7490 | 2/1.00 |
| 7429 | 3/1.25 | 7491 | 1.00 |
| 7430 | 5/1.00 | 7492 | 2/1.00 |
| 7432 | 4/1.25 | 7493 | 2/1.00 |
| 7433 | 2/1.25 | 7494 | 2/1.70 |
| 7437 | 3/1.25 | 7495 | 2/1.60 |
| 7438 | 3/1.25 | 7496 | 2/1.50 |
| 7439 | 3/1.25 | 7493 | 3.75 |
| 7440 | 5/1.00 | 74100 | 1.00 |
| 7441 | 2/1.65 | 74107 | 3/1.00 |
| 7442 | 2/1.00 | 74109 | 2/1.00 |

## TTL IC's

| | | | | | |
|---|---|---|---|---|---|
| 74110 | 1.75 | 74176 | 1.00 | 74390 | 1.75 |
| 74111 | 1.75 | 74177 | 1.00 | | |
| 74116 | 2.00 | 74180 | 1.00 | | |
| 74120 | 1.75 | 74181 | 2.10 | High | Speed |
| 74121 | 3/1.10 | 74182 | 1.00 | | |
| 74122 | 3/1.10 | 74184 | 2.25 | 74H00 | 3/1.00 |
| 74123 | 2/1.25 | 74185 | 2.00 | 74H01 | 4/1.00 |
| 74125 | 3/1.35 | 74186 | 7.00 | 74H04 | 3/1.00 |
| 74126 | 3/1.35 | 74187 | 5.25 | 74H05 | 3/1.00 |
| 74128 | 1.50 | 74190 | 1.25 | 74H08 | 3/1.25 |
| 74132 | 1.00 | 74191 | 1.15 | 74H10 | 3/1.00 |
| 74136 | 2/1.70 | 74192 | 1.00 | 74H11 | 3/1.00 |
| 74141 | 1.00 | 74193 | 1.00 | 74H20 | 3/1.00 |
| 74145 | 1.00 | 74194 | 1.00 | 74H21 | 3/1.00 |
| 74148 | 1.90 | 74195 | 2/1.50 | 74H22 | 3/1.00 |
| 74150 | 1.00 | 74196 | 1.00 | 74H30 | 3/1.00 |
| 74151 | 2/1.50 | 74197 | 1.00 | 74H40 | 3/1.00 |
| 74153 | 2/1.50 | 74198 | 1.45 | 74H50 | 3/1.00 |
| 74154 | 1.10 | 74199 | 1.50 | 74H51 | 3/1.00 |
| 74155 | 1.00 | 74200 | 5.50 | 74H52 | 3/1.00 |
| 74157 | 2/1.45 | 74221 | 1.35 | 74H53 | 3/1.00 |
| 74158 | 2.00 | 74251 | 2.00 | 74H55 | 3/1.00 |
| 74159 | 2.95 | 74265 | 2/1.50 | 74H60 | 3/1.00 |
| 74160 | 1.25 | 74273 | 2.00 | 74H61 | 3/1.00 |
| 74161 | 2/1.85 | 74278 | 2.40 | 74H62 | 3/1.00 |
| 74162 | 1.50 | 74279 | 1.00 | 74H71 | 2/1.25 |
| 74163 | 1.00 | 74283 | 1.65 | 74H72 | 2/1.25 |
| 74164 | 1.05 | 74284 | 5.00 | 74H73 | 2/1.50 |
| 74165 | 1.00 | 74285 | 5.00 | 74H74 | 2/1.50 |
| 74166 | 1.25 | 74293 | 1.00 | 74H76 | 2/1.35 |
| 74167 | 4.50 | 74298 | 1.95 | 74H78 | 2/1.25 |
| 74170 | 2.00 | 74365 | 2/1.50 | 74H102 | 1.00 |
| 74173 | 1.35 | 74366 | 1.00 | 74H103 | 2/1.50 |
| 74174 | 1.10 | 74367 | 2/1.50 | 74H106 | 2/1.85 |
| 74175 | 1.00 | 74368 | 2/1.50 | 74H183 | 2.00 |

## TTL IC's

| | | | | | |
|---|---|---|---|---|---|
| 74L00 | 4/1.00 | 74LS04 | 3/1.15 | 74LS194 | 2.00 |
| 74L02 | 4/1.00 | 74LS05 | 3/1.15 | 74LS195 | 2.00 |
| 74L03 | 4/1.00 | 74LS10 | 3/1.00 | 74LS196 | 2.50 |
| 74L04 | 4/1.00 | 74LS11 | 3/1.00 | 74LS197 | 2.00 |
| 74L10 | 4/1.00 | 74LS14 | 1.75 | 74LS248 | 1.75 |
| 74L20 | 3/1.00 | 74LS20 | 3/1.35 | 74LS249 | 1.90 |
| 74L30 | 3/1.00 | 74LS21 | 3/1.10 | 74LS251 | 1.90 |
| 74L42 | 1.35 | 74LS27 | 3/1.10 | 74LS253 | 1.90 |
| 74L51 | 3/1.00 | 74LS30 | 3/1.10 | 74LS260 | 2/1.50 |
| 74L54 | 3/1.00 | 74LS32 | 3/1.25 | 74LS266 | 2/1.85 |
| 74L55 | 3/1.00 | 74LS51 | 3/1.00 | 74LS295 | 1.90 |
| 74L71 | 4/1.00 | 74LS74 | 2/1.25 | 74LS365 | 2/1.70 |
| 74L72 | 3/1.25 | 74LS76 | 2/1.25 | 74LS386 | 1.00 |
| 74L73 | 2/1.00 | 74LS83 | 1.95 | 74LS670 | 4.75 |
| 74L74 | 2/1.00 | 74LS85 | 1.60 | 7520 | 2/1.50 |
| 74L75 | 2/1.00 | 74LS86 | 2/1.70 | 7522 | 2/1.50 |
| 74L78 | 2/1.55 | 74LS95 | 1.90 | 7523 | 2/1.50 |
| 74L85 | 1.50 | 74LS107 | 2/1.25 | 7524 | 1.85 |
| 74L86 | 2/1.35 | 74LS109 | 2/1.25 | 7525 | 1.25 |
| 74L90 | 1.50 | 74LS112 | 2/1.25 | 75107 | 2/1.35 |
| 74L91 | 1.40 | 74LS113 | 2/1.35 | 75110 | 1.25 |
| 74L93 | 1.50 | 74LS114 | 2/1.35 | 75113 | 1.25 |
| 74L95 | 1.50 | 74LS132 | 1.35 | 75115 | 1.90 |
| 74L98 | 2.50 | 74LS136 | 2/1.25 | 75150 | 1.25 |
| 74L121 | 1.00 | 74LS138 | 1.75 | 75154 | 1.50 |
| 74L123 | 1.00 | 74LS139 | 1.75 | 75325 | 1.80 |
| 74L157 | 1.75 | 74LS151 | 1.40 | 75361 | 1.25 |
| 74L164 | 2.00 | 74LS153 | 1.65 | 75450A | 3/1.00 |
| 74L192 | 2.50 | 74LS155 | 1.50 | 75451 | 3/1.35 |
| 74L193 | 2.50 | 74LS158 | 1.40 | 75452 | 3/1.35 |
| | | 74LS174 | 1.90 | 75453 | 3/1.25 |
| Schottky | | 74LS175 | 1.90 | 75454 | 2/1.00 |
| | | 74LS191 | 2.50 | 75460 | 1.60 |
| 74LS00 | 3/1.15 | 74LS192 | 2.50 | 75491 | 3/1.25 |
| 74LS02 | 3/1.15 | 74LS193 | 2.50 | 75492 | 2/1.00 |

## PLIERS

| | |
|---|---|
| 7" Needle Nose Pliers | 4.25 |
| 4½" Round Nose Pliers | 4.00 |

## SWITCHES

| | |
|---|---|
| V3-101-D8 10A 125V Switch | 2/1.75 |
| 311SM56 10A 125V Switch | 2/1.50 |

## RESISTORS

¼W 5% 100/$1.95

100 of any of the following Ohm values for only $1.95.

| | | | |
|---|---|---|---|
| 5.6 | 43 | 330 | 3.9K |
| 10 | 51 | 360 | 4.7K |
| 11 | 56 | 510 | 10K |
| 13 | 62 | 820 | 18K |
| 18 | 75 | 910 | 39K |
| 20 | 150 | 1.1K | 120K |
| 24 | 160 | 1.3K | 470K |
| 27 | 180 | 1.6K | 560K |
| 30 | 200 | 1.8K | 1.8M |
| 33 | 240 | 2.4K | 8.2M |
| 36 | 270 | 3.0K | |
| 39 | 300 | 3.3K | |

Or get any of the following assortments for only $1.95. Each assortment consists of 10 resistors from the 10 different Ohm value groups listed.

Asst. 1
10 each of 10, 18, 20, 36, 75, 180, 360, 2.4K, 3.3K and 18K Ohm Values

Asst. 2
10 each of 5.6, 18, 27, 180, 200, 270, 360, 10K, 470K and 8.2M Ohm Values

Asst. 3
10 each of 10, 18, 51, 180, 360, 1.8K, 3.3K, 18K, 470K, and 1.8M Ohm Values

Asst. 4
10 each of 11, 20, 30, 75, 240, 360, 820, 1.1K, 3.3K and 120K Ohm Values.

Asst. 5
10 each of 10, 18, 75, 150, 180, 270, 330, 910, 4.7K, and 470K Ohm Values.

Asst. 6
10 each of 13, 24, 27, 33, 39, 43, 56, 62, 75, 160 and 200 Ohm Values

Asst. 7
10 each of 240, 300, 510, 1.3K, 1.6K, 3.0K, 3.9K, 39K, 560K, and 8.2M Ohm Values

## DIODES

1N4148 Switching Diode

20/1.00 100/4.00

Zeners

400MW 5%

| | | | |
|---|---|---|---|
| 1N746A | 3.3V | 7/1.00 | 100/11.00 |
| 1N747A | 3.6V | 7/1.00 | 100/11.00 |
| 1N748A | 3.9V | 7/1.00 | 100/11.00 |
| 1N749A | 4.3V | 7/1.00 | 100/11.00 |
| 1N750A | 4.7V | 7/1.00 | 100/11.00 |
| 1N751A | 5.1V | 6/1.00 | 100/13.00 |
| 1N752A | 5.6V | 6/1.00 | 100/13.00 |
| 1N753A | 6.2V | 6/1.00 | 100/13.00 |
| 1N754A | 6.8V | 6/1.00 | 100/13.00 |
| 1N755A | 7.5V | 6/1.00 | 100/13.00 |
| 1N756A | 8.2V | 5/1.00 | 100/15.00 |
| 1N757A | 9.1V | 5/1.00 | 100/15.00 |
| 1N758A | 10V | 5/1.00 | 100/15.00 |
| 1N759A | 12V | 5/1.00 | 100/15.00 |

1N4728-57 Series

1 Watt 5% Zeners

5/1.00 or 100/15.00

Any 1 Voltage Listed Below

| | | | | |
|---|---|---|---|---|
| 3.3V | 5.6V | 10V | 18V | 33V |
| 3.6V | 6.2V | 11V | 20V | 36V |
| 3.9V | 6.8V | 12V | 22V | 39V |
| 4.3V | 7.5V | 13V | 24V | 43V |
| 4.7V | 8.2V | 15V | 27V | 47V |
| 5.1V | 9.1V | 16V | 30V | 51V |

Axial Lead Silicon Rectifiers

| | | | |
|---|---|---|---|
| 1N4001 | 50V | 20/1.00 | 100/4.00 |
| 1N4002 | 100V | 15/1.00 | 100/5.25 |
| 1N4003 | 200V | 12/1.00 | 100/6.50 |
| 1N4004 | 400V | 10/1.00 | 100/8.00 |
| 1N4005 | 600V | 8/1.00 | 100/10.00 |
| 1N4006 | 800V | 8/1.00 | 100/10.00 |
| 1N4007 | 1000V | 8/1.00 | 100/10.00 |

### Bridge Rectifiers

| | | | |
|---|---|---|---|
| MDA942-1 | 1.5A | 50V | 1.75 |
| MDA942-2 | 1.5A | 100V | 1.95 |
| MDA942-3 | 1.5A | 200V | 2.30 |
| MDA942-4 | 1.5A | 300V | 2.90 |
| MDA942-5 | 1.5A | 400V | 3.35 |
| MDA942-6 | 1.5A | 600V | 3.60 |
| MDA970-1 | 4.0A | 50V | 2.25 |
| MDA970-2 | 4.0A | 100V | 2.50 |
| MDA970-3 | 4.0A | 200V | 3.00 |
| MDA970-4 | 4.0A | 300V | 3.60 |
| MDA970-5 | 4.0A | 400V | 4.25 |
| MDA952-1 | 6.0A | 50V | 2.75 |
| MDA952-2 | 6.0A | 100V | 3.25 |
| MDA952-3 | 6.0A | 200V | 3.60 |
| MDA952-4 | 6.0A | 300V | 4.25 |
| MDA952-5 | 6.0A | 400V | 5.00 |
| MDA952-6 | 6.0A | 600V | 5.75 |

## TRANSISTORS

| | | | |
|---|---|---|---|
| 2N718 | 5/1.00 | 2N3692 | 10/1.00 |
| 2N910 | 5/1.00 | 2N3772 | 1.50 |
| 2N916 | 3/1.25 | 2N3773 | 2.50 |
| 2N929 | 5/1.00 | 2N3904 | 8/1.00 |
| 2N930 | 5/1.00 | 2N3905 | 6/1.00 |
| 2N1131 | 4/1.00 | 2N3906 | 8/1.00 |
| 2N1132 | 4/1.00 | 2N4037 | 4/1.00 |
| 2N1305 | 4/1.00 | 2N4124 | 8/1.00 |
| 2N2219A | 5/1.00 | 2N4125 | 6/1.00 |
| 2N2222A | 6/1.00 | 2N4126 | 7/1.00 |
| 2N2270 | 5/1.00 | 2N4400 | 7/1.00 |
| 2N2369 | 10/1.00 | 2N4401 | 10/1.00 |
| 2N2484 | 6/1.00 | 2N4402 | 8/1.00 |
| 2N2904A | 6/1.00 | 2N4403 | 5/1.00 |
| 2N2905A | 6/1.00 | 2N4918 | 2/1.15 |
| 2N2906A | 6/1.00 | 2N4919 | 2/1.25 |
| 2N2907A | 6/1.00 | 2N4920 | 2/1.00 |
| 2N2958 | 2/1.25 | 2N4921 | 2/1.00 |
| 2N2959 | 2/1.00 | 2N4922 | 2/1.25 |
| 2N3018 | 4/1.00 | 2N4923 | 2/1.75 |
| 2N3053 | 5/1.00 | 2N5190 | 2/1.35 |
| 2N3055 | 2/1.50 | 2N5192 | 2/1.75 |
| MJE3055 | 1.00 | 2N5193 | 2/1.50 |
| 2N3136 | 5/1.00 | 2N5194 | 2/1.75 |
| 2N3250 | 3/1-00 | 2N5195 | 2/1.95 |
| 2N3638A | 9/1.00 | 2N5447 | 8/1.00 |

## SCR's

1.0 Amp

| | | |
|---|---|---|
| 2N1595 | 50V | 2/1.50 |
| 2N1596 | 100V | 1.00 |
| 2N1597 | 200V | 1.25 |
| 2N1598 | 300V | 1.50 |
| 2N1599 | 400V | 2.00 |

4.0 Amp

| | | |
|---|---|---|
| C106F1 | 50V | 3/1.25 |
| C106B1 | 200V | 2/1.00 |
| C106D1 | 400V | 4.00 |

1.6 Amp

| | | |
|---|---|---|
| 2N2322 | 25V | 1.00 |
| 2N2323 | 50V | 1.25 |
| 2N2324 | 100V | 1.50 |
| 2N2325 | 150V | 1.75 |
| 2N2326 | 200V | 2.25 |
| 2N2327 | 250V | 2.75 |
| 2N2328 | 300V | 3.25 |
| 2N2329 | 400V | 4.00 |

16 Amp

| | | |
|---|---|---|
| 2N681 | 25V | 1.25 |
| 2N682 | 50V | 1.60 |
| 2N683 | 100V | 1.95 |
| 2N684 | 150V | 2.25 |
| 2N685 | 200V | 2.40 |
| 2N686 | 250V | 2.70 |
| 2N687 | 300V | 3.00 |
| 2N688 | 400V | 3.50 |
| 2N689 | 500V | 4.00 |
| 2N690 | 600V | 4.50 |
| 2N691 | 700V | 5.25 |
| 2N692 | 800V | 6.00 |

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*Circle 16 on reader service card*

## READER QUESTIONS

*(continued from page 66)*

***resistor; I read −110 volts on the control grid! When I touch my scope probe to the 6LB6 grid, the raster comes back, full-screen. Otherwise, no raster at all. Get out the crystal ball, I need it!—R.D., Guttenberg, NJ.***

You're so right; that output tube is firmly cut off by that much negative grid voltage. What you are probably doing with the scope probe is bleeding off enough of this to let the tube conduct. (This can happen if the grid resistor is completely open; even the high impedance of a FETVM will give it enough drop to let it work).

Trace the high-voltage hold-down circuit back over to the high-voltage regulator. You'll see a VDR in shunt to ground, a pulse-coupling capacitor to the flyback, and then a diode back to B+ connected to the cathode of the 6HV5. One of these parts is bad, causing the circuit to develop far too much negative voltage.

### LOSS OF VERTICAL SWEEP

I noticed an item in the October issue of **R-E** on loss of vertical sweep. I just had a novel case in a CTC-25 RCA! The symptom was a lot of B+ on the grid of the 6GF7 vertical output tube. Started with heavy foldover and finally killed the oscillator. The tube conducted so heavily that it melted solder on the terminal strip where R164 and R165 are; these are the cathode resistors, near the 6JE6.

This was traced to an insulation breakdown in the SERVICE switch. Pin 2 of this had +405 volts on it and it was leaking to pin 7, which goes to the grid of the vertical output tube. (Thanks very much to Donald A. Donadio, Winston-Salem, NC!)

### ODDBALL AFT PROBLEM

This one happened to me! The set was an RCA CTC-28E and it had AFT problems all over the place. At times the AFT wouldn't work on the low channels, then it would act up on the high channels. Voltage tests and a sweep test showed that the AFT seemed to be pretty close to normal. Marker right on crossover, etc. The set did not work too badly without AFT.

After some scratching of head, I finally decided to check the alignment. The only thing I could see was that the color looked a bit low on the curve, with the pix carrier a bit high. Would moving these help? You're darn right! Now the AFT works on low channels but not on highs!

The tuner showed a decided instability on 7 and 11. So, I ran a neutralization alignment on it. That did it, for the high channels. (The tipoff symptom on this is a "hot leadin" on a high channel; touch it and you'll see beats in the picture. This seems to always show a need for neutralization).

### YOKE RETURN CAPACITOR BURNING

***The yoke-return capacitor (C228) has burned up three times on this CTC-40 RCA. Originally the boost rectifier was shorted, too. Now we get good color, plenty of sweep, but the capacitor keeps burning up. What's the reason for this? —A.M., Morgan Hill, CA.***

The reason this capacitor burning up is that it's carrying too much current for its voltage rating. RCA is now sending out special capacitors for this. I'd replace it with one of them. Early models used two 1.5-$\mu$F capacitors in this position, in parallel.

You might check the waveform on this capacitor; this should be only about 35 volts P-P. You shouldn't get more than this if your sweep is normal.

### GREEN STRIPE AT LEFT

***After replacing several tubes, the raster and picture on this RCA CTC-22 reappeared. However, I have a small green stripe on the left side of the screen. All voltages are OK. However, scoping the control grids, I found a positive going spike in the waveform right after the horizontal blanking pulse. It was 35 volts P-P!***

***Someone had replaced the clamp diode on the green amplifier output with an ordinary silicon rectifier. I tried other diodes on hand, and each one showed a change in the spike! Any ideas?—E.S., Niagara Falls, ON.***

Yep; if you can't get an exact duplicate of the original diode, use some kind of "fast-recovery" diode. RCA SK-3127, etc. These have a recovery time of less than 1.0 microsecond, and ought to help. There are several of these; use the one that will hold the applied DC voltage and have a very fast recovery.

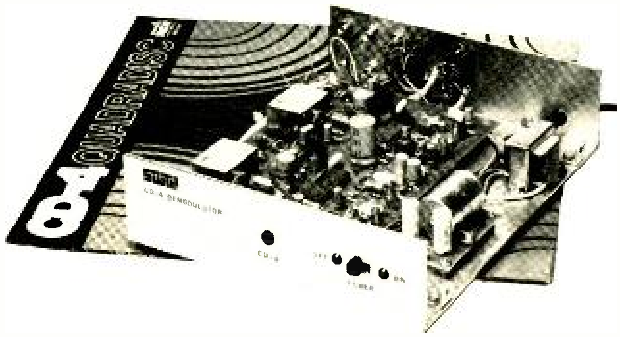
### HIGH CATHODE CURRENT

***I can't get the 21JS2 cathode-current down far enough to suit me on this Motorola TS-925. It's working pretty well as far as the high-voltage and sweep are concerned, but I have an uneasy feeling that it might not stand up for too long in this shape. Do you have any suggestions on this?—J.B., Greenup, KY.***

Adjust the horizontal efficiency coil for a dip. If this still doesn't bring the cathode current of the 21JS6 down far enough, try reducing the screen-grid voltage on this tube. You can cut this down until you begin to lose width or high-voltage.

(Field feedback; it worked! Dropped 21JS6 screen grid from 220 volts to about 175, and it works fine!) **R-E**

# CD-4 DEMODULATOR



## TRUE FOUR CHANNEL SOUND

Southwest Technical Products is proud to offer the most advanced CD-4 demodulator available. Our new CD-4 has characteristics superior to anything previously available thanks to the QSI-5022 integrated circuit used in the unit. This IC and the balance of the circuit was designed by Quadracast Systems Inc. under the direction of Mr. Lou Dorren. The QSI-5022 contains all the sub-system functions needed to demodulate a CD-4 disc, from the phono cartridge input to the output drive for the four power amplifiers. It may be used with either an RIAA equalized magnetic cartridge, or a semiconductor cartridge with flat equalization.

## INEXPENSIVE

Now anyone can afford to add discrete true 4 channel sound to their system. You no longer need be satisfied with matrix techniques that produce acoustrical enhancement, but not true 4 channel sound. The Southwest Technical Products CD-4 demodulator when added to your system will produce four channel sound from a CD-4 encoded disc that will equal, or surpass anything you can buy—no matter what the price.

## EASY INSTALLATION

The SWTPC demodulator connects between the cartridge and the volume-tone control portion of your system. If you did not want tone controls, actually all that would be needed in addition to our CD-4 demodulator would be volume controls for the front and rear amplifiers. The demodulator is self powered from any 115 Volt 60 Cycle line. When normal stereo discs are played on your system a muting system automatically turns off the rear channels. A manual override 2 or 4 channel selector switch is provided on the rear panel.

## SIMPLE CONSTRUCTION

As shown in the photograph, the vast majority of the parts mount on the epoxy-fibreglass circuit board. Part numbers and package outlines printed on the top of the board make proper assembly quite simple. Anyone with a minimum of electronic experience should be able to assemble this project without any problems. A copy of the article describing the CD-4 demodulator and assembly instructions are supplied in the kit.

**CD-4 Demodulator Kit ........... $50.00 ppd**

## CD-4 CARTRIDGE

For those who do not already own a CD-4 cartridge, we are offering the "Technics" EPC-451C semiconductor strain-gauge cartridge at a special low price when purchased with our new CD-4 demodulator kit. This cartridge features a Shibata-type stylus and excellent response out to 50 kHz. This eliminates any chance of "carrier drop-out", or "carrier crosstalk" which result in abnormal noise or distorted sound. The EPC-451C produces a high output (about 30 times that of an average magnetic cartridge) and does not pick up hum from magnetic, or electrostatic fields. Easily replaced stylus.

**EPC-451C CD-4 Cartridge ........ $25.00 ppd**

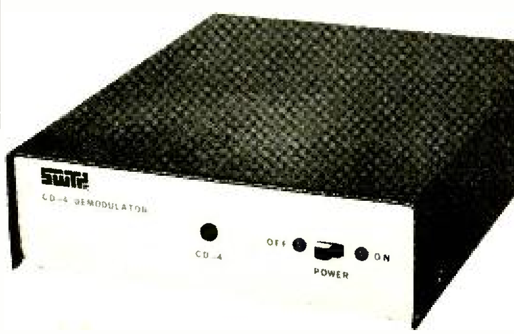
## TEST RECORD

Lou Dorren has recorded a special test record for Southwest Technical Products Corp. that will allow you to properly adjust your CD-4 demodulator for the best possible sound. This special test and demonstration record is yours for only $5.00 when purchased with the CD-4 demodulator kit.

**CD-4 Test Record ...................... $5.00 ppd**

## WANT MORE INFORMATION?

Send the coupon below and $0.50 and we will send you by return mail a copy of the article describing our new CD-4 kit along with our catalog of other kit projects.

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*Circle 22 on reader service card*

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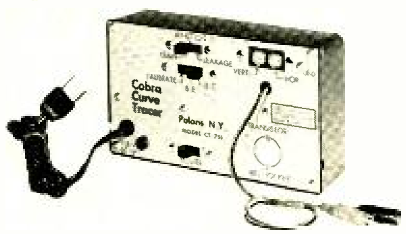
# new products

*More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Reader Service Card inside the back cover.*

**CURVE TRACER,** *Cobra model CT-751*, provides a quick and easy way of checking transistors, diodes, IGFET's, LED's, Zeners, photocells, selenium rectifiers, capacitors, and controls. The instrument produces a clearly defined waveform on any general purpose oscilloscope. Identifies NPN and PNP

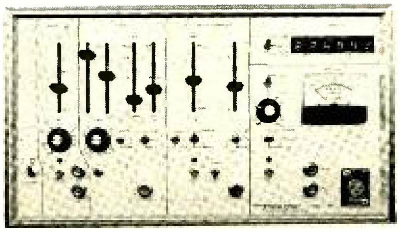


devices for polarity and function and a unique switching system makes it easy to perform tests without need to change or reverse connections. A transistor socket plus test leads provide maximum versatility. Complete with easy-to-follow instructions and sample waveform chart. Operates on 105-125V 60Hz. Measures only 6" × 3" × 1½".—**Polaris New York,** 2862 Fulton Street, Brooklyn, NY 11207.

*Circle 31 on reader service card*

**AUDIO FREQUENCY RESPONSE PLOTTING SYSTEM,** *model 100,* consists of two sine, square, and triangle function generators, pulse generator, frequency counter and peak amplitude measurement sections. It is primarily intended to generate a frequency response plot on an X-Y recorder or scope.

The time base generator offers symmetrical or independent control of the positive and negative sides of the ramp providing a duty cycle of 0.7% to 99.3%. Frequency range is .0035 Hz to 100 kHz. Output amplitude is 15 volts peak-to-peak into 500 ohms with ±5 volt DC offset. The time base output drives the X axis of an X-Y recorder.



The audio sweep generator provides manual frequency adjustment or log/linear sweep of 20 Hz to 20 kHz. Blanking mode produces zero reference line on X-Y recorder. Output is 15 VP-P into 500 ohms or 10 VP-P into an 8-ohm speaker.

The pulse generator frequency range is .0035 Hz to 525 kHz. Pulse width is adjusted independent of frequency from 4 seconds to 40 nanoseconds. Outputs are complimentary TTL.

The peak amplitude measurement section measures internal or external signals from mike to power-amplifier level. Amplitude output drives Y axis of X-Y recorder.

The 6" digit frequency counter is line triggered and reads either internal or external signals. Sensitivity is 50-mV peak at 20 kHz. Dimensions: 8 × 14 × 3 inches. Price; $525. Warranty: 1 year.—**Fidelity Sound,** 9764 Vine Street, Bloomington, CA 92316.

*Circle 32 on reader service card*

**TV SIGNAL INDICATOR,** the *model 200 Levelite,* is a totally new type of equipment that can be used to make rapid go- no-go tests on home TV installations and MATV systems. It checks signal levels at the antenna, preamplifier, splitter, tapoff or the 300-ohm terminals at the back of the TV set. Three adapters provide for connections to F-, G- and autoplug-type fittings and 300-ohm terminal screws.

Signals fed into the *Levelite* are amplified and detected to develop a DC voltage. This DC voltage, amplified by an IC, drives an LED. (It works from composite signals on

TV channels 7 through 13 only due to the possibility of erroneous indications from FM signals in the 88—108-MHz band.)

The device has two LED's. The green indicates the presence of signal; the red shows battery power. The brightness of the green LED provids an indication of signal strength. The brightness threshold of the green LED is selected by a two-position range switch. In the DISTANT position, the green LED lights when the signal is −6 dBmV (500 μV) or greater. In the LOCAL position, the LED lights dimly when the signal is ±6 dBmV (2000 μV) or greater. From dimmest glow to maximum brightness is about 4 dB. Operated easily with one hand, the *model* L-200 operates over a range of 20°F to 100°F.—**Jerrold Electronics Corp.,** 200 Witmer Rd., Horsham, PA 19044.

*Circle 33 on reader service card*

**REPAIR MODULES PARTS KIT.** The most needed parts kit enables a servicer to repair rather than change a defective solid-state module. The kit contains the solid-state devices which, in G-E's experience, are the most frequently needed for in-home repair of any G-E modular color solid-state chassis produced from 1961.

The kit has a cross reference chart and location diagram to expedite part location in the box. The parts are individually packaged and marked with the exact catalog number to further simplify identification. Also contained in the modular chassis kit is a *Module Repair Digest* identifying those components


which are the most likely cause of failure. With this digest, the technician can choose between repairing or replacing a failed module. The kits also show basing diagrams for listing transistors.

The parts kit *(EP50X16)* is now available from General Electric at a price approximately on-half the sum of the regular individual parts prices. For further information contact your nearest **G-E zone office or Regional Parts Center.**

*Circle 34 on reader service card*

**ELECTRONIC ORGAN KIT,** this organ has two manuals, each with a complement of 61 keys and can produce a variety of tonal effects, suitable for popular, classical or litur-

gical music. The average price of a kit with optional accessories is about $2500.—**Schober Organ Corporation,** 43 West 61st Street, New York, NY 10023.

*Circle 35 on reader service card*

**DIGITAL MULTIMETER** *DVM34*, a portable DVM for service applications with a 3½-digit LED display and long battery life. The unit features a basic 0.1% accuracy, 15-megohm input impedance. Five-function unit measures


from 100 microvolts to 2000 VDC, 100 microvolts to 1000 VAC, 10 milliohms to 20 megohm, and 100 nanoamps to 2A AC and DC. 50 kV DC voltage capabilities are available with an optional 1%, 50-kV high-voltage probe. High and low-power ohms function provides increased accuracy when measuring resistance in solid-state circuits. Auto-ranging circuit automatically steps down to the next lowest range on AC and DC volts, whenever the reading is "180" or less. Price: $295. High voltage adaptor probe: $25.00.—**Sencore Inc.,** 3200 Sencore Drive, Sioux Falls, SD 57107.

*Circle 36 on reader service card*

**POWER AMPLIFIER** dual-channel *2400/XXIV*. A professional stereo power amplifier in a 19" rack mount with handles and anodized black face plate. The amplifier delivers 200 watts RMS per channel, both channels driven into four or eight ohms from 20 Hz to 20 KHz with no more than 0.5% total harmonic distortion. Maximum harmonic and intermodulation distortion 0.05%, input sensitivity 1.5 volts, RMS ± 0.25 dB frequency response (20 Hz to 20 KHz) at rated power and better than −100-dB noise level below rated power.—**S.A.E. Scientific Audio Electronics Inc.,** 701 East Macy Street, Los Angeles, CA 90014.

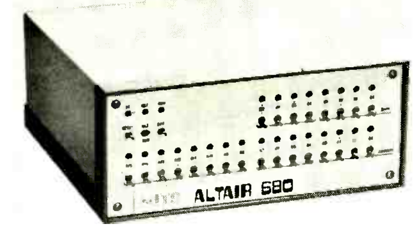
*Circle 38 on reader service card*

**INFRARED TRANSMITTER** *IS76*. Infrared transmitter intended for use with a TV set, that can be adapted to a variety of output characteristics to permit wireless broadcast of audio to a remote headphone. The complete system consisting of the *IS76* transmitter, *IE76* receiver and *DT444* headphone works on a carrier frequency of 95 kHz, is frequency modulated, and covers a frequency range of at least 40 to 10,000 Hz with less


than 1.5% distortion. The transmitter is $92.50, the receiver is $76.00, the headphones, $119.50.—**Revox Corporation,** 155 Michael Drive, Syosset, NY 11791.

*Circle 39 on reader service card*

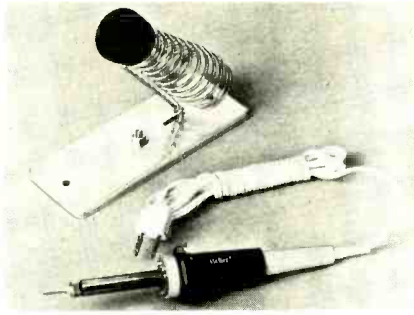
**MICROCOMPUTER,** *Altair 680*, based on the 6800 microprocessor IC. Specifications include MPU 8-bit parallel processor, 16-bit




address bus, ability to address 65K bytes memory, 72 basic instructions, 4 microsecond cycle time. Memory 1K RAM built-in on main circuit board, plus built-in provisions for an additional 1K ROM or PROM. Built-in I/O port and interface circuitry on main printed circuit board can be set up for RS232 or for 20 mA or 60 mA current loop TTY. Optional software includes PROM monitor, assembler, debug, and editor. Available full front panel model, $345 as a kit, $420 assembled. Altair's 680 MPU board only: $195 as a kit, $275 assembled.—**MITS, Inc.,** 6328 Linn, N.E. P.O. Box 8636, Albuquerque, NM 87108.

*Circle 37 on reader service card*

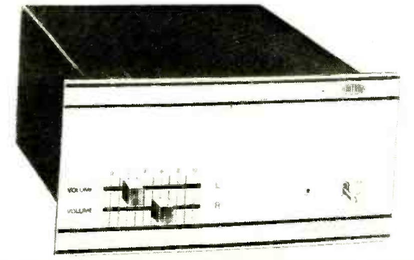
**SOLDERING IRON,** *model WP-25* pencil-type iron with stainless-steel barrel and heat-shield handle. 25-watt iron has a nominal temperature range of 840-degrees F is 7⅞"



long and weighs 1¾ oz. Available with both two- and three-wire cords, and in a 40-watt *model WP-40* with a temperature range of 950-degrees F.—**Weller-Xcelite Electronics Division,** The Cooper Group, Apex, NC 27502.

*Circle 40 on reader service card*

**POWER AMPLIFIER KIT,** *model UK 192*, delivers 50-watts continuous power output minimum per channel at 1% total harmonic distortion. Frequency response is within 2 dB



from 8 to 80,000 Hz. Input sensitivity is 1 volt for full power output. Input impedance is 1000 ohms and output impedance is 4 ohms. $139.95 in kit form.—**Amtroncraft Kits Ltd.,** One West 13 Street, New York, NY 10011.

*Circle 41 on reader service card*

**CD-4 DEMODULATOR KIT,** *model 5022*, complete with case and power supply, inserts between phono cartridge and the four discrete inputs of any quadriphonic system. The switch on the back of the case defeats the

quadriphonic functions, allowing stereo records to be played as well. An indicator light on the front panel shows when CD-4 records are playing. The demodulator is priced at $50.00, and a model *EPC-451C* semi-conductor strain gauge cartridge is also available for $25.00. A CD-4 test record is available at an additional cost of $5.00.—**Southwest Technical Products Corp.,** Box 32040, San Antonio, TX 78284.

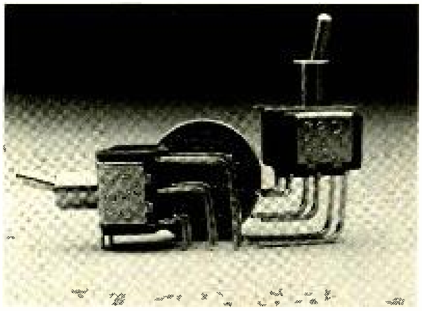
*Circle 42 on reader service card*

**MINI-TERMINAL,** *model B-R-B*, video terminal displays 1280 ASCII dot matric characters in 16 lines. Unit features selectable standard baud rates from 110 to 9600, RS-232 serial data interface, backspace capability, ultra-reliable detachable keyboard, half and duplex operation, and composite video put. Board only model for custom designs

and suitcase model also available. Complete unit $875.—**Winteck Corporation,** 902 N. 9th Street, Lafayette, IN 47904 .

*Circle 43 on reader service card*

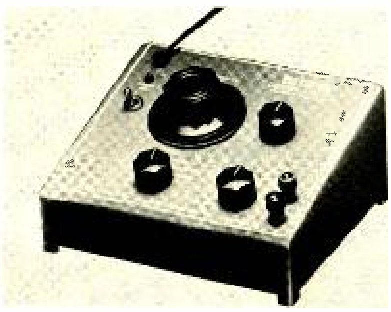
**TOGGLE SWITCHES,** subminiature double pole, double-throw vertical mounting *model AV2*, is only 1.373 inches long. Minimum electrical life is 100,000 make-and-break cy-



cles, minimum insulating resistance is 1000 megohms, minimum dielectric strength is 1000 volts RMS at sea level.—**C & K Components Inc.,** 103 Morse Street, Watertown, MA 02172.

*Circle 44 on reader service card*

**FUNCTION GENERATOR,** *Design Mate 2*, three waveform function generator provides a short-proof output amplifier, that delivers both variable signal amplitudes and constant



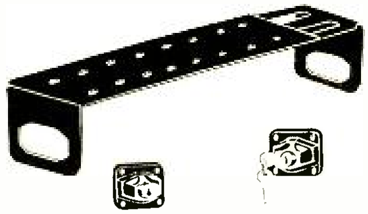
output impedance. Completely wired, tested and calibrated, useful for testing audio amplifiers, op-amps and educational laboratory designs. Complete with instruction manual, application notes and operation theory, $64.95.—**Continental Specialties Corp.,** 44 Kendall Street, Box 1942, New Haven, CT 06509.

*Circle 45 on reader service card*

**MOUNT 'N LOCK** *Model ML-1* is designed for easy mounting and removal of electronic equipment, such as radio transceivers, scanners, depth finders, tape players and many other similar devices in cars or boats. They offer maximum security after installation and all mounting hardware is completely inaccessible until equipment is removed. Mount

*Circle 26 on reader service card*

'n Lock is adjustable to fit any size equipment of any depth and any height and widths



of 5¼" to 11".—**South Shore Trading Corp.,** 1311 Bellmore Avenue, North Bellmore, NY 11710.

*Circle 46 on reader service card*

**CB RADIO,** *Messenger 130A.* 23-channel unit has a PA function and includes the option of private listening with automatic speaker silencing when the handset is lifted from its

cradle. Operates with either positive or negative ground electrical systems and features improved receiver noise suppression circuitry. Price: $199.95.—**E. F. Johnson Company,** Waseca, MN 56093.

*Circle 47 on reader service card*

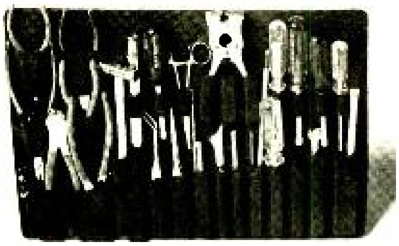
**NEW PLIERS.** A new chain-nose plier, features an extra long reach and includes serrated jaws for positive pulling or side holding grip, or drawing and looping of wire. The thin chain nose head allows for working


in close quarters or reaching way back into assemblies. The cushioned handle gives a firm but comfortable grip.

This tool is a proven electricians' favorite, with unlimited household and hobby uses. Hunter's long-reach chain-nose plier is available boxed or packaged on a 5⅛ "× 9⅞" color-coded card. Being blister packed onto a card of this size makes this tool practically shoplifter proof.—**Hunter Tools,** Marshall Industries, 9674 Telstar Ave., El Monte, CA 91731.

*Circle 48 on reader service card*

**TOOL ORGANIZER,** molded of tough urethane, is ideal for holding a large selection of small tools. When set up next to work bench, keeps tools out of grit and grime of tool box.



One piece unit has no stitching, seams, flaps or rivets. Five year guarantee, $12.75.—**Platt,** 2301 South Prairie Avenue, Chicago, IL 60616.

*Circle 49 on reader service card* **R-E**



*Circle 68 on reader service card*

# new lit

*All booklets, catalogs, charts, data sheets and other literature listed hee with a Reader Service number are free. Use the Reader Service Card inside the back cover.*

**GENERATORS AND MEASUREMENT EQUIPMENT.** Here is an 80-page catalog listing all Wavetek function and sweep function generators, sweep signal generators, television test equipment, phase meters, transmission level test sets, plus accessories and options. Many standard and not so conventional instruments can be found in the pages of this catalog along with much useful information on how to use this equipment to speed servicing. More than 50 different instruments are described and illustrated.—**Wavetek**, P.O. Box 651, San Diego, CA 92112.

*Circle 50 on reader service card*

**CITIZENS BAND CRYSTALS.** An 8-page folder listing a large variety of standard-channel and special-frequency crystals made to fit most Citizens band tranceivers. Many types of crystals are illustrated and a page of typical transistorized oscillator circuits is included.—**JAN Crystals**, 2400 Crystal Drive, Ft. Myers, FL 33901. **R-E**

*Circle 51 on reader service card*

**SERIAL INTERFACE**

*(continued from page 62)*

to a logic "1" if there is a condition where the receiver is being sent characters faster than it can accept them. If any one of these three error conditions occurs, transistor Q1 turns on and presents a "?" to the terminal as an error indication for the character(s) for which the error was received.

The standard baud rate for the unit is 110 baud and is derived from the 15,840 Hz phase-locked oscillator on the main board that is brought in through pin 1 of J1. The 15,840 clock frequency is divided-by-nine by IC2 to produce 1760 Hz required by the UART chip for 110 baud. For higher baud rates, a crystal oscillator with a 307.200 kHz crystal is required as well as IC1 and IC8. Inverters IC8-a and IC8-b form an oscillator with a frequency of 307.200 kHz that is fed to flip-flop IC9-b pin 4 where it is divided by two and in turn fed to a programmable divider, IC1 pin 9. By selecting correct inputs of this integrated circuit, the correct output frequency neccesary for each baud rate can be easily set. A five position rotary switch can be attached at jack J1 that grounds the selected baud rate line providing easy selection of either 110, 150, 300, 600 or 1200 baud. The 110-baud input inverter (IC8-f) also drives the stop bit select line of the UART chip, IC3 pin 36, to select the correct number of stop bits for 110 baud operation.

A terminal ready signal is provided at J1 pin 2 to tell external devices when the terminal is powered up, however, this output is a sense line only and should not be loaded when anything sourcing or sinking a current of more than 5 mA.

A power-up reset is provided by IC11-e to clear the registers inside the UART chip when power is applied to the terminal.

**Construction**

It is not very difficult to assemble the unit, just be sure to orient all of the integrated circuits, diodes, electrolytic capacitors, transistors, and connectors as shown in Fig. 2. Note that the connectors are notched and must be installed exactly as shown in the drawing. The foil pattern of the component side of the double sided printed circuit board is shown in Fig. 3, while the foil pattern of the foil side of the board is shown in Fig. 4. If you use the 150, 300, 600 or 1200 baud option, install the parts used for the crystal controlled oscillator and its related circuitry. Also attach a jumper between points A and C on the interface board. The various baud rates are selected by grounding the appropriate pin of connector J1. If you are not using the optional baud rates and wish to use the standard 110 baud then attach a jumper between points A and B instead of A and C on the interface board.

Without the screen-read board inserted on the TV Typewriter II main terminal board it will be necessary to jumper point O to P on the interface board. With the screen-read board installed on the main terminal board, omit the jumper.

If you want to guarantee that the receiver remains off during a screen-read dump, you will probably want to jumper point S to R on the interface board. If high baud rates are used and/or the turn-around time from whatever feeds the terminal is fast you may have to omit this jumper. If so, you must be sure the terminal is not in the echo mode and that whatever feeds the receiver of the terminal doesn't transmit during the time a screen-dump operation takes place.

It is also necessary to program the interface board for the correct parity and number of bits to be handled. The transmit and receive formats are identical and are programed with jumpers as follows:

**Odd parity, no bit 8**—jumper J to K and jumper I to H
**Even parity, no bit 8**—jumper I to H
**No parity, no bit 8**—jumper G to F and jumper I to H
**No parity, bit 8 = 1**—jumper G to F
**No parity, bit 8 = 0**—jumper G to F and jumper E to D

The appropriate keypressed strobe jumper should be installed. If your keyboard's strobe is positive going and narrow or if it is negative going and the data is held for at least 100 nanoseconds after the trailing edge of the strobe pulse, solder a jumper wire between pads L and N. Almost all keyboards will work in this configuration. Jumpering pad M to N instead is used for positive edge level triggering where the pulse is clean and there is no ringing. The board must not be wired for a positive keypressed strobe (M to N) if the screen-read board is used.

Before plugging the interface board into the main terminal board, be sure to insert the indexing key in J2 pin 2 to prevent the board from being plugged in backwards. Then orient the interface board so its component side is toward the center of the main terminal board and plug it into connectors J1 and J2.

Input/output and control lines for the interface are accessed thru connector J1. J1 pin 7 is the RS-232 compatible input and J1 pin 6 is the RS-232 compatible output. Pin 2 of J1 is a terminal ready status line that is high when power is applied to the terminal. You must be sure not to draw more than 5 mA from this pin when sensing this line. J1 pin 5, pin 4 and pin 8 control the receiver off, transmitter off and echo off, respectively. Grounding the respective control line shuts off the selected function and J1 pin 1 is ground. Note that when the serial interface board is used, the keyboard must be plugged into jack J2 on the interface rather than the J9 connector on the main terminal board on the chassis.

## Checkout and use

The easiest way to check the unit out is to operate it in the echo mode and the receiver and transmitter switched off. This should display everything that is typed on the screen where it can be seen and checked. Since this mode uses both the transmit and receive circuitry, it is a good way to check everything on the interface for proper operation. If you have any problems, remove power and check carefully for assembly errors. If you find it necessary to troubleshoot the circuit, you will need an oscilloscope, a good background in digital theory and a thorough knowledge of how the unit operates. **R-E**



*Circle 64 on reader service card*



*Circle 65 on reader service card*



*Circle 66 on reader service card*

## BAUDOT TO ASCII

*(continued from page 59)*

**TABLE I**
**TRUTH TABLE FOR 8223 PROM—TO BE USED AS IC22**
**Check that the symbols given here agree with your machine**

| WORD | INPUTS | | | | | | OUTPUTS | | | | | | | | SYMBOL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | ENABLE | $B_7$ | $B_6$ | $B_5$ | $B_4$ | $B_3$ | $B_2$ | $B_1$ | $B_0$ | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | Null |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | | 1 | | 1 | | 1 | | | T |
| 2 | 0 | 0 | 0 | 1 | 0 | 0 | | | | | 1 | 1 | | 1 | CR |
| 3 | 0 | 0 | 0 | 1 | 1 | 0 | | 1 | | | 1 | 1 | 1 | 1 | O |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | | | 1 | | | | | | Space |
| 5 | 0 | 0 | 1 | 0 | 1 | 0 | | 1 | | | 1 | | | | H |
| 6 | 0 | 0 | 1 | 1 | 0 | 0 | | 1 | | | 1 | 1 | 1 | | N |
| 7 | 0 | 0 | 1 | 1 | 1 | 0 | | 1 | | | 1 | 1 | | 1 | M |
| 8 | 0 | 1 | 0 | 0 | 0 | 0 | | | | | 1 | | 1 | | LF |
| 9 | 0 | 1 | 0 | 0 | 1 | 0 | | 1 | | | 1 | 1 | | | L |
| 10 | 0 | 1 | 0 | 1 | 0 | 0 | | 1 | | 1 | | | 1 | | R |
| 11 | 0 | 1 | 0 | 1 | 1 | 0 | | 1 | | | | 1 | 1 | 1 | G |
| 12 | 0 | 1 | 1 | 0 | 0 | 0 | | 1 | | | 1 | | | 1 | I |
| 13 | 0 | 1 | 1 | 0 | 1 | 0 | | 1 | | 1 | | | | | P |
| 14 | 0 | 1 | 1 | 1 | 0 | 0 | | 1 | | | | | 1 | 1 | C |
| 15 | 0 | 1 | 1 | 1 | 1 | 0 | | 1 | | 1 | | 1 | 1 | | V |
| 16 | 1 | 0 | 0 | 0 | 0 | 0 | | 1 | | | | 1 | | 1 | E |
| 17 | 1 | 0 | 0 | 0 | 1 | 0 | | 1 | | 1 | 1 | | 1 | | Z |
| 18 | 1 | 0 | 0 | 1 | 0 | 0 | | 1 | | | | 1 | | | D |
| 19 | 1 | 0 | 0 | 1 | 1 | 0 | | 1 | | | | | 1 | | B |
| 20 | 1 | 0 | 1 | 0 | 0 | 0 | | 1 | | 1 | | | 1 | 1 | S |
| 21 | 1 | 0 | 1 | 0 | 1 | 0 | | 1 | | 1 | 1 | | | 1 | Y |
| 22 | 1 | 0 | 1 | 1 | 0 | 0 | | 1 | | | | 1 | 1 | | F |
| 23 | 1 | 0 | 1 | 1 | 1 | 0 | | 1 | | 1 | 1 | | | | X |
| 24 | 1 | 1 | 0 | 0 | 0 | 0 | | 1 | | | | | | 1 | A |
| 25 | 1 | 1 | 0 | 0 | 1 | 0 | | 1 | | 1 | | 1 | 1 | 1 | W |
| 26 | 1 | 1 | 0 | 1 | 0 | 0 | | 1 | | | 1 | | 1 | | J |
| 27 | 1 | 1 | 0 | 1 | 1 | 0 | | | | | | | | | Null |
| 28 | 1 | 1 | 1 | 0 | 0 | 0 | | 1 | | 1 | | 1 | | 1 | U |
| 29 | 1 | 1 | 1 | 0 | 1 | 0 | | 1 | | 1 | | | | 1 | Q |
| 30 | 1 | 1 | 1 | 1 | 0 | 0 | | 1 | | | 1 | | 1 | 1 | K |
| 31 | 1 | 1 | 1 | 1 | 1 | 0 | | | | | | | | | Null |
| ALL | x | x | x | x | x | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |

## TACHOMETER AND SPEED ALARMS

*(continued from page 39)*

reading on the meter.

Note that R7 comprises a fixed and a variable resistor in series. The graph of Fig. 9 shows the approximate total value of R7 that is needed to give full-scale meter readings at particular frequencies when C2 has a value of .01 μF. Note that, if preferred, C2 can be increased to 0.1 μF and the R7 value can then be reduced by a factor of ten.

Once the unit has been attached to the car, the SENSITIVITY control R2 should be adjusted to slightly above the minimum value at which triggering can be reliably obtained without interference from spurious signals. The setting up procedure is then complete, and the tachometer is ready for use. The tachometer can readily be transferred from one vehicle to another by simply adjusting R7 to give the required full-scale RPM reading, and adjusting the R2 SENSITIVITY control to suit the individual vehicle.

### A 6-to-12 volt converter

Figure 10 shows the circuit of a simple 6-to-12 volt converter that can be used to enable the tachometer circuit to operate

**TABLE II**
**TRUTH TABLE FOR 8223 PROM—TO BE USED AS IC20**
**Check that the symbols given here agree with your machine**

| WORD | INPUTS | | | | | | OUTPUTS | | | | | | | | SYMBOL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | $A_4$ | $A_3$ | $A_2$ | $A_1$ | $A_0$ | ENABLE | $B_7$ | $B_6$ | $B_5$ | $B_4$ | $B_3$ | $B_2$ | $B_1$ | $B_0$ | |
| 0 | 0 | 0 | 0 | 0 | 0 | 0 | | | | | | | | | Null |
| 1 | 0 | 0 | 0 | 0 | 1 | 0 | | | 1 | 1 | | 1 | | 1 | 5 |
| 2 | 0 | 0 | 0 | 1 | 0 | 0 | | | | | 1 | 1 | | 1 | CR |
| 3 | 0 | 0 | 0 | 1 | 1 | 0 | | | 1 | 1 | 1 | | | 1 | 9 |
| 4 | 0 | 0 | 1 | 0 | 0 | 0 | | | 1 | | | | | | Space |
| 5 | 0 | 0 | 1 | 0 | 1 | 0 | | | 1 | | | | 1 | 1 | # |
| 6 | 0 | 0 | 1 | 1 | 0 | 0 | | | 1 | | 1 | 1 | | | , |
| 7 | 0 | 0 | 1 | 1 | 1 | 0 | | | 1 | | 1 | 1 | 1 | | . |
| 8 | 0 | 1 | 0 | 0 | 0 | 0 | | | | | 1 | | 1 | | LF |
| 9 | 0 | 1 | 0 | 0 | 1 | 0 | | | 1 | | 1 | | | 1 | ) |
| 10 | 0 | 1 | 0 | 1 | 0 | 0 | | | 1 | 1 | | 1 | | | 4 |
| 11 | 0 | 1 | 0 | 1 | 1 | 0 | | | 1 | | | 1 | 1 | | & |
| 12 | 0 | 1 | 1 | 0 | 0 | 0 | | | 1 | 1 | 1 | | | | 8 |
| 13 | 0 | 1 | 1 | 0 | 1 | 0 | | | 1 | 1 | | | | | 0 |
| 14 | 0 | 1 | 1 | 1 | 0 | 0 | | | 1 | 1 | 1 | | 1 | | : |
| 15 | 0 | 1 | 1 | 1 | 1 | 0 | | | 1 | 1 | 1 | | 1 | 1 | ; |
| 16 | 1 | 0 | 0 | 0 | 0 | 0 | | | 1 | 1 | | | 1 | 1 | 3 |
| 17 | 1 | 0 | 0 | 0 | 1 | 0 | | | 1 | | | | 1 | | " |
| 18 | 1 | 0 | 0 | 1 | 0 | 0 | | | 1 | | | 1 | | | $ |
| 19 | 1 | 0 | 0 | 1 | 1 | 0 | | | 1 | 1 | 1 | 1 | 1 | 1 | ? |
| 20 | 1 | 0 | 1 | 0 | 0 | 0 | | | | | | 1 | 1 | 1 | Bell |
| 21 | 1 | 0 | 1 | 0 | 1 | 0 | | | 1 | 1 | | 1 | 1 | | 6 |
| 22 | 1 | 0 | 1 | 1 | 0 | 0 | | | 1 | | | | | 1 | ! |
| 23 | 1 | 0 | 1 | 1 | 1 | 0 | | | 1 | | 1 | 1 | 1 | 1 | / |
| 24 | 1 | 1 | 0 | 0 | 0 | 0 | | | 1 | | 1 | 1 | | 1 | — |
| 25 | 1 | 1 | 0 | 0 | 1 | 0 | | | 1 | 1 | | | 1 | | 2 |
| 26 | 1 | 1 | 0 | 1 | 0 | 0 | | | 1 | | | 1 | 1 | 1 | ' |
| 27 | 1 | 1 | 0 | 1 | 1 | 0 | | | | | | | | | Null |
| 28 | 1 | 1 | 1 | 0 | 0 | 0 | | | 1 | 1 | | 1 | 1 | 1 | 7 |
| 29 | 1 | 1 | 1 | 0 | 1 | 0 | | | 1 | 1 | | | | 1 | 1 |
| 30 | 1 | 1 | 1 | 1 | 0 | 0 | | | 1 | | 1 | | | | ( |
| 31 | 1 | 1 | 1 | 1 | 1 | 0 | | | | | | | | | Null |
| ALL | x | x | x | x | x | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | |

*(continued on page 86)*

on vehicles equipped with 6-volt electrical systems. Circuit operation is quite simple. Gates A and B of the CD4001 IC are wired as a simple astable multivibrator or square-wave generator that operates at about 800 Hz. The output of the astable multivibrator is fed to complementary emitter-follower stage Q1—Q2 via a spare inverter-connected gate of the IC. The output of the emitter follower is fed to a voltage-doubler circuit comprising C2—D1—D2—C3 and R2. The output of the circuit is taken from this voltage-doubler stage.

In practice, a vehicle equipped with a 6-volt electrical system generates approximately 7-volts under actual running conditions, and the converter gives a nominal output of about 11-volts to the tachometer under this condition. This output voltage is more than adequate for driving the tachometer circuit.

Figs. 11-a and 11-b show how the converter and the tachometer can be connected to vehicles having either a positive ground or a negative ground electrical system.

In the concluding part of this article, we'll show how the basic tachometer circuit can be expanded so that it also acts as a red-line or over-speed alarm. **R-E**

## READER QUESTIONS

(continued from page 68)

### OUTPUT TUBE OVERHEATING

***The 6BQ5 output tubes in one channel of this Truetone DC5941 amplifier get red hot after about 10 minutes. I tried new tubes; no luck. Is there a Sams folder on this chassis?—J.M., Birmingham, AL.***

Look in Sams Photofact 466-4. This is an Airline, but the same amplifier. The overheating problem is probably due to a bias defect. If the cathode resistor and bypass capacitor are OK, then the coupling capacitor from the driver is probably leaky. Pull the 6BQ5 tubes, turn the set on, and read the DC voltage on the grids of the 6BQ5's. This voltage should be zero. If you read any positive voltage, the coupling capacitor is leaking.

### SUBSTITUTE TRANSISTOR

***I need a substitute for the output transistor in a Bendix 248 automobile radio. The number on it is 4080187-0507 and I can't find that either! Help!—R.S., Sacramento, CA.***

There's a trick in looking up part numbers in transistor guides. Look for the first two digits; in this case "40". The computer that sorts out the numbers "keys" on the first two digits.

In this case, RCA lists an SK-3024 as an exact replacement for that long numbered transistor.

### SEVERE JITTER

***The picture in this RCA CTC-51K is very unstable. Severe horizontal jitter that causes double images, and a vertical jitter at the same time. This is affected by both brightness and contrast controls. Horizontal sync range on hold control very small. Why?—J.M., Hatfield, AR.***

After you check the horizontal AFC diodes and so on, try checking the plate load resistor of the horizontal oscillator! This is R40, and should be 220K. In one known case, this dropped to about 40K and caused the same symptoms you have. Oddly enough, there was plenty of sweep and high voltage, but it was very unstable. Apparently the horizontal oscillator was hunting very rapidly and upsetting the sync keying pulses, etc. Quick-check; horizontal oscillator plate voltage will be very high, almost 400 volts instead of normal +225 volts.

### UHF SNIVETS

***I've got a couple of oddball problems in this Quasar TS-934. There are severe snivets on UHF, clean on VHF. The UHF picture and sound go out shortly after turn-on. The other one: I replaced the Z-panel DC regulator. After taking the UHF tuner out, I checked the 20-volt source and it was only 12 volts. I adjusted it to 20 volts as instructed, and the video and sound went out! Are these connected?—J.L., Fairfield, CA.***

Your snivets could be caused by corona to the metal ring around the 6LF6 tube. This has happened. Move the ring so that it's nearer the bottom of this tube.

Voltage problem: it is possible that raising the 20 volt line to normal could have caused the AGC to cut off the IF. Run this voltage up to the normal level and then reset the IF and RF AGC controls. That ought to do it.

### TUNER DRIFT

***This Admiral 3L36 has a very severe tuner drift. After it warms up it may drift one whole channel. Tuner tubes checked and replaced, no help. Where to look?—M.W., El Cajon, CA.***

"Drift" is something that changes the tuner oscillator frequency. (Fine basic statement!) Not apt to be a coil, but very apt to be a capacitor. In this tuner, they use a transistor with one terminal clipped, apparently as a varactor diode. This would be a very good "suspect"; try warming it up or cooling it off and see if this won't show up something.

### DISAPPEARING DIODE!

***I can't find the 22-volt Zener diode, Y404, in this G-E 19QA chassis! It's not on the power-supply board, although the symbol is there. In the photo of this board in Sams 1388-3, it's also gone. Shows it on the schematic, though. The 22.7 volt source shows a very low resistance. Help!—L.C., Mena, AR.***

It's still in the circuit, but not where you'd expect. Follow the line from the power-supply board down to a terminal strip on the back of the flyback cage; right under the sticker saying "19QA Chassis." It's underneath this board! Also, it's probably shorted if you're reading a low resistance on the 22.7-volt line.

### WINDOW-SHADE PROBLEM

***I have an odd brightness problem in this Zenith 20X1C38. Everything is normal except that the picture is dark at the top and bottom is too bright. When the brightness control is turned, the picture gets dark from the top down, like pulling a window shade down. Any assistance will be appreciated! —R.S., Aurora, CO.***

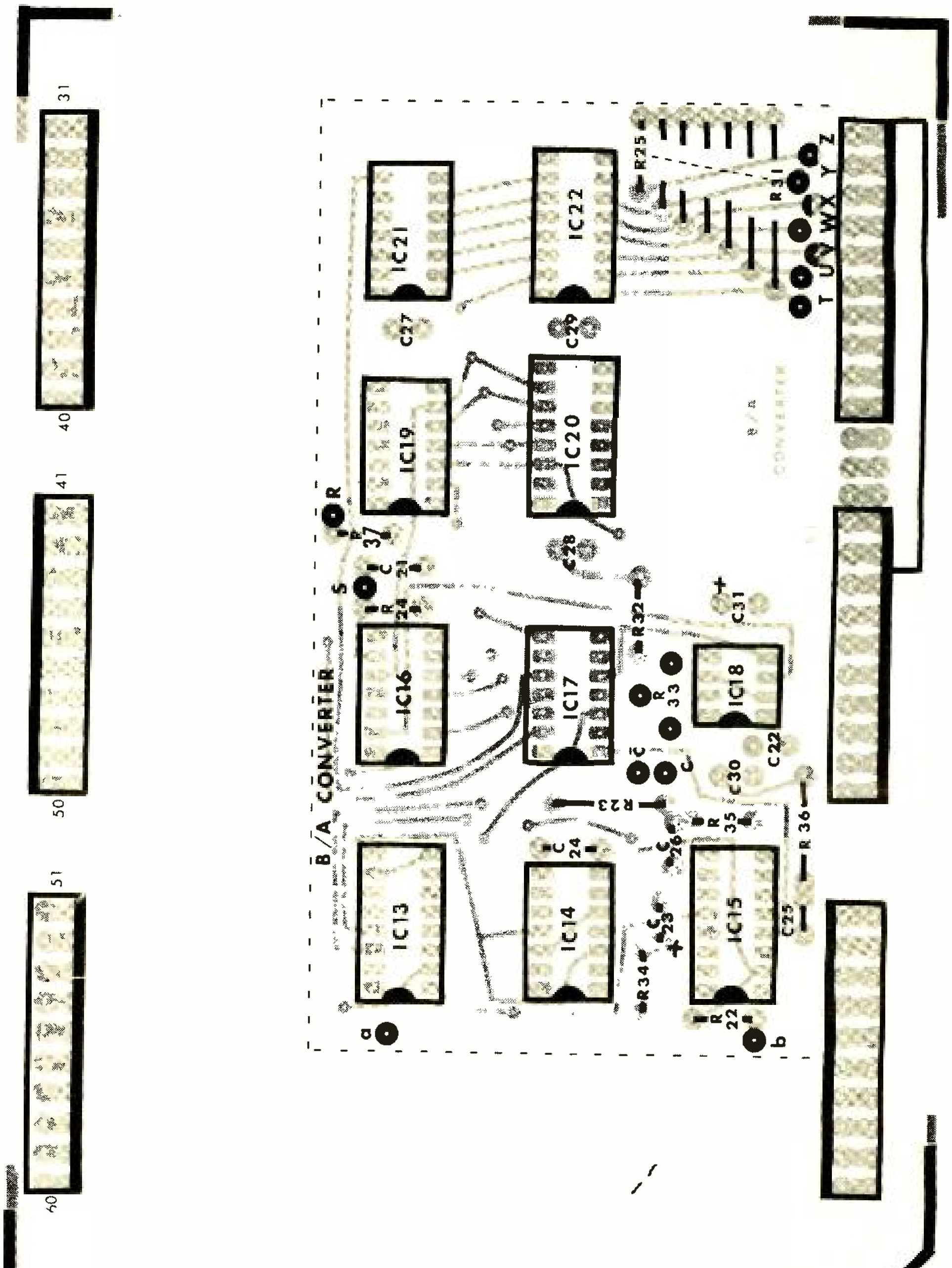
You've got it; you've even got the right name for it. This is a classic case of "window-shade." It's caused by a shorted blanking diode in the vertical blanking circuitry. This will probably be the one connected to the green-white wire from the secondary of the vertical output transformer to the emitter of the 1st video amplifier transistor. There are two more to the same point; check them all for luck.

### DIODE BLOWING

***This Sears 528.40720320 color set came in with the horizontal output transistor, vertical output transistor and diode***

*(continued on page 87)*

**BAUDOT TO ASCII**
*(continued from page 83)*




**COMPONENT LAYOUT of BAUDOT to ASCII converter board.**

## AN INTERMITTENT FLYBACK!

The reader wrote that he had two symptoms; a vertical shrink and roll, and then the raster went black. Since these aren't normally from the same cause, I investigated. In this chassis the vertical oscillator is fed from boost. So, I suggested checking the boost. If this dropped, it could cause these two symptoms.

He wrote back, and said "Since this showed up only at the customer's house, I figured he had excessive line voltage that was causing the flyback to break down. So, I raised the line voltage, on the bench, and out it went. Cool it off and it came back!

"I replaced the flyback, and cured the trouble. First intermittent I ever saw like this, in a flyback!" (Thanks to Jack Mandik, Evanston, IL.)

Thanks, Jack. Me too.

## FLAT-TOPPING OF GRID-DRIVE

(Reader had previously written about problems in his scope. These were solved, then he wrote;) "Thanks for detailed suggestions regarding problems in Silvertone 7174. I used the scope, and sure enough, the grid-drive waveform on the 31JS6 tube flattened very decidedly when the trouble showed up. Replacing this tube cleared up the problem." **R-E**

## READER QUESTIONS

*(continued from page 85)*

***D773 shorted. Replaced all of these, plus the fuse, and everything worked well. Current through 1.5-A fuse 800 mA. Then diode D773 shorted again! Took it out and fed the vertical module from a 20 volt DC power supply. Current drain of vertical section is 550 mA, and it played for hours.***

***Tried another diode, and it overheated. Tried feeding 60 Hz AC through it, and it overheated again! Something is odd here. What's going on?—F.A., Orlando, FL.***

The crystal ball says that the vertical module is all right; not overloading the power supply. Since it will work "for hours" on an outboard DC power supply, and draw what sounds like about normal current, this much ought to be OK.

From the schematic (Sams 1443-2) this diode and the 3300-$\mu$F filter-capacitor provide the +21.6 volt *source* that drives the vertical module. However, the drive waveform is 15,750 Hz! So, feeding the circuit with 60 Hz AC might keep the diode on too long and make it overheat. (Guess!)

More derating of this diode would be one way of helping. Try something like an RCA SK-3081, 1000 volts at 2.0 A. Alternate, do what several manufacturers have done in similar cases; parallel two diodes to raise the current handling ability. Won't take long to find out!

### FOCUS VOLTAGE DROPS TO ZERO

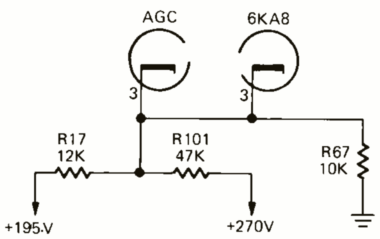
***If I disconnect the lead from the tube-base, pin 9, the focus voltage reads OK. If I reconnect the lead, the focus voltage drops to zero. Raster goes dark. Is the picture tube shorted? If so, can it be repaired?—B.C., Thurmont, MD.***

The chances are that you do have a short in the focus electrode! With zero focus-voltage, the raster will go out. You might try this; disconnect the focus lead from the tube —leave the other leads and the high-voltage connected. Turn the set on and see what voltage, if any, you read on the open pin-9 lead. This might tell you something about where the short is. For instance, if you get about 750-800 volts, the focus would be shorted to one of the screens. You might blow the short out by discharging an electrolytic capacitor between the base pins. No guarantee on this, of course!

### SYNC PROBLEM

***I've got what looks like a sync problem in this RCA KCS-141 chassis. The voltages around the sync-separator seem to be pretty close. Changed the tube and checked capacitors. The voltage on the plate of the AGC keyer goes off now and then; sometimes to +15 volts. I could use some ideas!—L.P., Houston, TX.***

There is one problem that I've run across on several occasions in this chassis. Check the voltage divider made up of R17 (12K, 2-watt) and R101 (47K, 2-watt) between the




+195 volt and +270 volt lines. This sets the *cathode voltage* on both the AGC keyer and sync separator stages. If either one of these resistors opens or changes in value, it'll cause trouble in both AGC and sync. You'll have to break the circuit to get a valid reading of either one of these. Wouldn't hurt to check R67 (10K) to ground from this point as well.

*(continued on page 95)*

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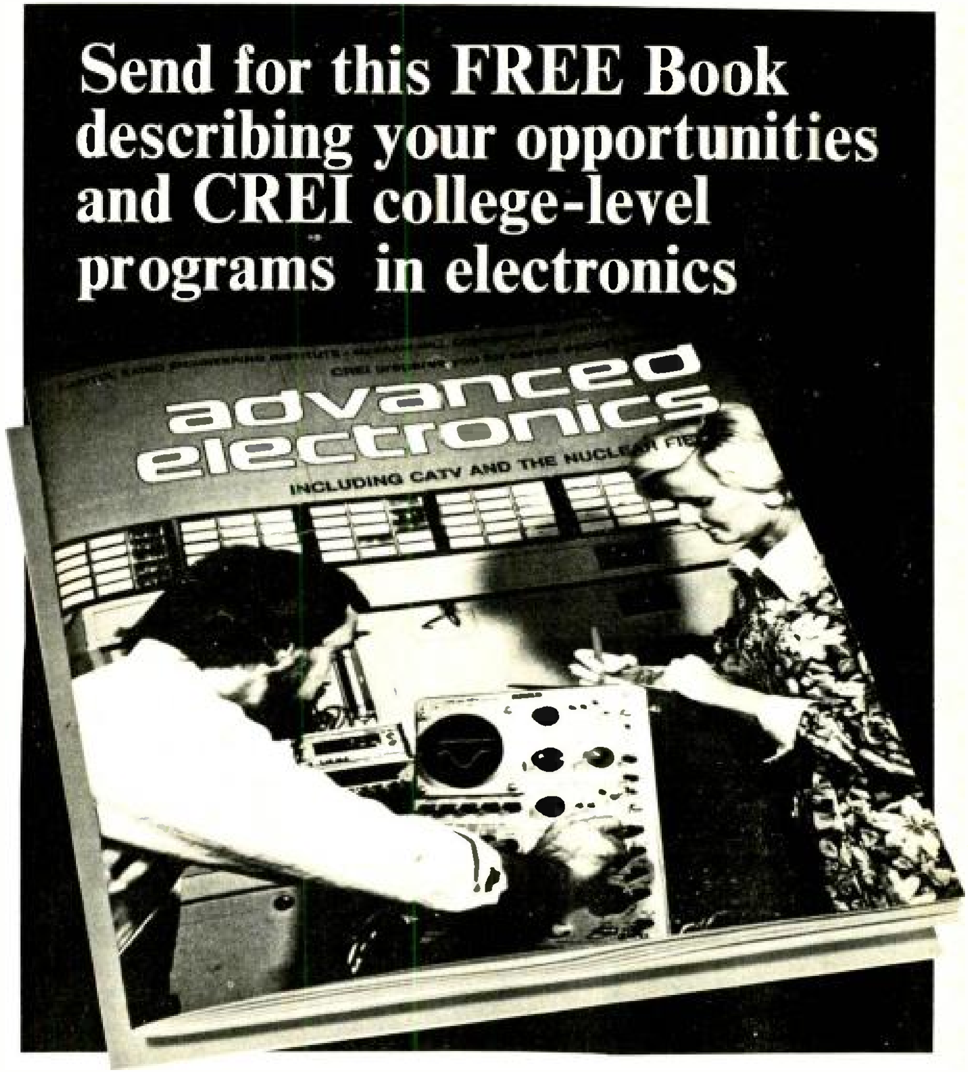


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## GARAGE DOOR OPENER

*(Continued from page 52)*

Now that many families are two-car families, the first accessory that comes to mind is an extra transmitter. Since manufacturers generally include only one transmitter per unit, the convenience and need for an extra transmitter for the second car cannot be overstated.

Another item in demand is an outdoor key-switch control. The key-switch installs in the garage door and allows the homeowner to unlock and open the garage door with a key instead of having to use the transmitter. Suppose the homeowner is outside and the car is in the garage. With the key switch the homeowner can easily open the garage door. This is particularly important if the garage is a main access route to the home.

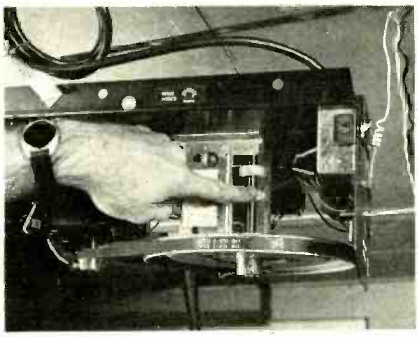
A third accessory is a wall button for operating the garage door from a second location, such as the kitchen. This allows the homeowner to open and close the garage door without having to use the transmitter or walk into the garage to operate the switch on the receiver.

### Service is easy

Servicing the garage door opener is usually easier than installing it. Most manufacturers use solid-state radio controls to provide years of service without worrying about vacuum tubes burning out. The greatest number of reported problems (inadequate distance or failure to operate) are corrected by replacing the battery in the transmitter.

The only regular maintenance the garage door opener requires is lubrication of the rail. This is done only once a year with a light, spray lubricant.

Door force and opener-limit adjustments are usually made at the factory, but because garage doors vary, extra adjustment may have to be made after the opener is installed. If the door reverses itself at any point in travel, the door force must be adjusted.



**If the door does not open fully,** the opener limits need adjustment. Slide the power head chassis-cover forward. Adjustments are made by turning the large plastic limit nuts up or down a threaded shaft located just behind the motor. One complete revolution of the limit nut equals three inches of trolley travel. All adjustments require complete turns.

There are other minor problems that occasionally develop and these are usually attributable to even more minor causes, many requiring only minor electrical adjustments. For example:

- If the power head completely stops, check the electrical supply. Specifically, check for loose plugs, a blown fuse or circuit breaker and power shutoff.
- If the garage-door operates from the wall switch but not from the transmitter, it is most likely because the battery in the transmitter is dead.
- If the unit turns on but does not lift the door, the door may have been accidentally locked. All locks should be deactivated.
- If the garage light does not turn on when the door opens, check the bulb, socket and socket wires.

Installing garage-door openers are easy, lucrative and does not require a large capital investment in inventory. Don't overlook this possibility to expand your business. **R-E**

# next month

## MAY 1976

■ **Build An 8080 Computer**

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## COMPUTER TERMINAL SPEAKS JAPANESE

**JAPANESE TEACHERS AND STUDENTS inspect a new computer terminal that prints out information in Japanese characters, it is being demonstrated for them by Frank Taylor of the Raytheon Data Systems plant in Norwood, MA. The audience is part of a 36-person delegation sent by the Japanese Institute for Cultural Studies, who are on a month-long cultural exchange as guests of Boston University. Half the group are teachers of English and business in the Japanese public school system; others are Japanese college students who are continuing their education in the United States.**

## Newest equatorial satellite will study communications

The Communications Technology Satellite (CTS) launched from Cape Canaveral, January 13, is the focal point of an international venture into the study of space communications, in which NASA and three American universities are involved.

Besides communications research, CTS will carry out a variety of education, health-care and community service demonstrations in remote areas.

Research of millimeter reception is one of the main projects for the satellite, according to information from the News Bureau of Ohio State University, one of the schools taking part in the study. (The other two are the Virginia Polytechnic Institute and the University of Texas.) The millimeter band offers great advantages, among them being inexpensive receivers, compact antennas and a fantastic signal capacity.

A second important objective of the project is a quantitative study of scintillation—the atmospheric turbulance that causes stars to twinkle. An understanding of scintilllation might be useful in studying a number of not entirely understood effects on communication, such as some types of fading and possibly the sunrise effect—that sudden change in signal strength at sunrise or sunset.

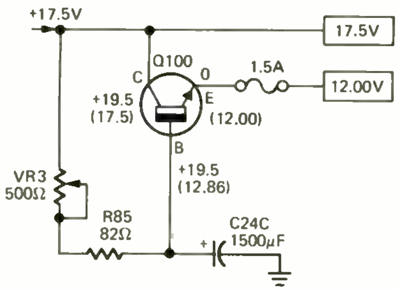
Ohio State University is receiving the signals from the satellite with the antenna consisting of four dishes in a "self-phased" array. Each dish measures only a meter in diameter. Although the satellite is "fixed" in position above the equator at 116° west longitude, its position varies slightly because of variations in the earth's rotational pattern. The ground station tracks the satellite by measuring the difference in signal strength as received by each of the dishes and using the result to "phase" the antenna to aim it at the satellite. The physical array remains stationary—all the tracking is accomplished electronically. **R-E**

*(continued from page 87)*

### POWER FILTER OUT

***I can't get anything through the active power-filter circuit in this Philco B311 TV. The collector voltage is 19.5, the base voltage also 19.5, and the emitter voltage is zero. If I connect an external 12-volt supply to the emitter, the set works fine. I've changed the transistor, the resistor and the capacitor, but nothing helps. Why isn't the transistor turning on?—D.R., Rockwood, MI.***

You're right; that's wrong! The transistor is definitely not conducting at all. The base circuit here is from the $V_{cc}$ supply, through VR3,R85 and the base-emitter junction of Q100. Since you have (wisely) tried a new transistor and




NOTE: PART NUMBERS ARE FROM SAMS 1334-3.

parts, that clears that much up. The emitter circuit returns through the load circuits. The load circuits are clear because they'll work with an external power supply.

So! This leaves us with only one good suspect; the transistor socket, the wiring, and so on. Take your DC voltage readings right on the pins of the transistor itself, and see if you get something open!

### NO TINT CONTROL

***Due to an accidental short while plugging in some controls, the tint control, transformer, and a couple of resistors blew up in this Penncrest 2890. These were replaced. Now I have good color, flesh tones, and so on, but the tint control has no effect at all! What do you think?—A.T., Benton, IL.***

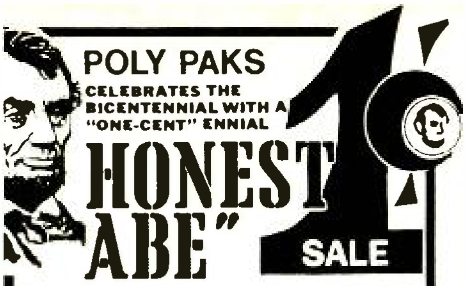
I think you still have something wrong in or around the tint control circuit itself. Since the control and the transformer were replaced, this would leave only the cable from chassis to control. This is probably one of those tiny coax cables we see so often of late. The initial short may have blown the center conductor open or caused the coax to short. Disconnect it and check. Check the tiny choke marked L503; this may have been burnt when the short hit.

### GEAR TOOTH JITTER

***This Wards Airline GEN-17148B has a problem with horizontal stability. Vertical lines are "rippled" (the old "gear-tooth" effect) and the horizontal hold control has very little hold-range. The picture won't jump to a double image, though. I've bridged electrolytic filters without any luck. Where to go now?—M.R., Gregory, MI.***

Try grounding the pin-2 grid of the 6FQ7 horizontal oscillator tube, and see if you can juggle the hold control to make a single picture without the gear-tooth effect. If you can, this trouble is in one of two places. It may be a badly unbalanced AFC diode unit or a loss of the horizontal sync pulse feeding the diodes. You have the typical symptoms—narrow hold range, etc.

If the gear-tooth effect isn't cleared up by this, check the anti-hunt network capacitors (below the AFC diode unit on the schematic; Sams Photofact SED in 1288.) One of these parts may be open. **R-E**



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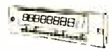

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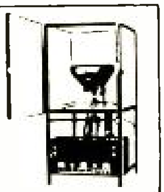

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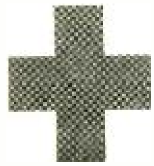

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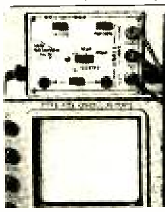

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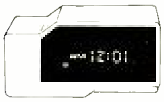

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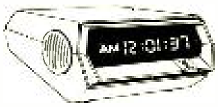

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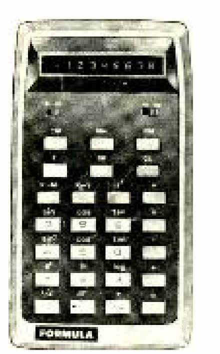

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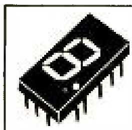

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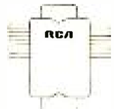

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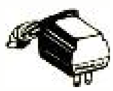

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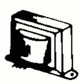

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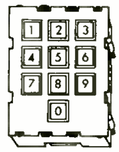

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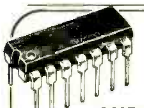

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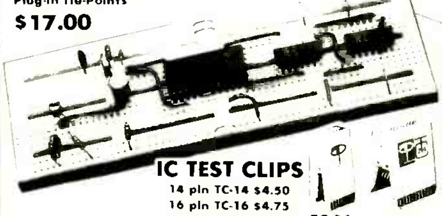

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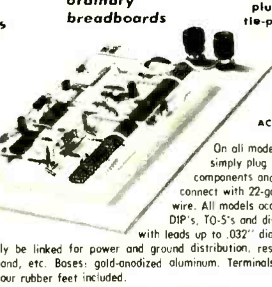

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| 218 (assem.) | 1760 | 18 (14's) | 10 | 2 | 6-1/2x7-1/8 | 46.95 |
| 227 (assem.) | 2712 | 27 (14's) | 28 | 4 | 8x9-1/4 | 59.95 |
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| 28 Pin Solder Tab | .45 |
| 40 Pin Solder Tab | .63 |
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| 14 Pin Wire-Wrap | .26 |
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| 3.3uf/50v | .08 | .65/10 |
| 4.7uf/25v | .08 | .65/10 |
| 4.7uf/50v | .08 | .70/10 |
| 10uf/25v | .08 | .65/10 |
| 10uf/50v | .10 | .75/10 |
| 22uf/25v | .09 | .70/10 |
| 22uf/50v | .12 | 1.00/10 |
| 100uf/6.3v | .09 | .75/10 |
| 100uf/16v | .11 | .85/10 |
| 100uf/25v | .13 | 1.10/10 |

— Axial Lead —

| | | |
|---|---|---|
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| 2.2uf/50v | .12 | .90/10 |
| 3.3uf/35v | .12 | .95/10 |
| 3.3uf/50v | .12 | 1.00/10 |
| 4.7uf/25v | .11 | .90/10 |
| 4.7uf/35v | .12 | .95/10 |
| 10uf/16v | .11 | .90/10 |
| 10uf/25v | .12 | 1.00/10 |
| 10uf/50v | .14 | 1.15/10 |
| 22uf/16v | .12 | 1.00/10 |
| 22uf/25v | .13 | 1.05/10 |
| 33uf/16v | .12 | 1.00/10 |
| 33uf/25v | .14 | 1.15/10 |
| 47uf/16v | .14 | 1.15/10 |

— Axial Lead —

| | | |
|---|---|---|
| 47uf/25v | .17 | 1.30/10 |
| 100uf/16v | .17 | 1.30/10 |
| 100uf/25v | .20 | 1.55/10 |
| 100uf/50v | .29 | 2.30/10 |
| 220uf/16v | .20 | 1.55/10 |
| 220uf/25v | .29 | 2.35/10 |
| 330uf/16v | .29 | 2.35/10 |
| 330uf/25v | .32 | 2.55/10 |
| 470uf/16v | .32 | 2.55/10 |
| 470uf/25v | .37 | 3.00/10 |
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| 6-32 ½ Screw | .75/C | 4.85/M |
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| 6-32 Hex Nut | .60/C | 4.00/M |
| 8-32 Hex Nut | .60/C | 4.15/M |
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| 4700pf/500v | .04 | .32/10 |
| .01ufd/500v | .06 | .50/10 |
| .01ufd/50v | .03 | .24/10 |
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**6 DIGIT LED CLOCK KIT**
INCLUDES:
MM314 clock circuit
6 FND70 LED displays (.250" red 7 segment)
All necessary transistors, resistors & capacitors
1 double sided PC board accommodates LED's & clock circuitry
Schematic & instructions
Does not include 12V-300 ma transformer, switches & case **$11.95**

**CLOCK CHIPS WITH LED's**
CT7001 4-6 digit, 12-24 hour clock with alarm, timer & date circuits plus 4 MAN 66 .6" LED display **$14.95**
above items plus 2 MAN 1 for date **$17.95**

MM5314 clock chip 12-24 hour 4-6 digits
Plus choice of 6 MAN 5 green 7 SEG LED .27"
6 MAN 7 red 7 SEG LED .27"
6 MAN 8 yellow 7 SEG LED .27"
**$9.95**

**UNIVERSAL BREADBOARD**
Silver plated copper circuit board 3-3/16" x 5-1/16". 2 rows of 27 holes for DIP IC's - space for transistors, resistors & capacitors. Versatile and simple for breadboarding IC circuitry **$1.50 ea.**
50 pcs. **1.00 ea.**

**UV ERASABLE PROM**
1702A — 2048 bit static PROM 256x8 elect programmable & erasable TTL/DTL comp. **$14.95**

## TTL

| | | | | | |
|---|---|---|---|---|---|
| | | 7451 | .17 | 74154 | 1.25 |
| 7400 | $ .14 | 7453 | .17 | 74155 | 1.07 |
| 7401 | .16 | 7454 | .17 | 74156 | 1.07 |
| 7402 | .15 | 7460 | .17 | 74157 | .99 |
| 7403 | .16 | 7464 | .35 | 74158 | 1.79 |
| 7404 | .19 | 7465 | .35 | 74160 | 1.39 |
| 7405 | .19 | 7470 | .30 | 74161 | 1.25 |
| 7406 | .35 | 7472 | .30 | 74162 | 1.49 |
| 7407 | .35 | 7473 | .35 | 74163 | 1.39 |
| 7408 | .18 | 7474 | .35 | 74164 | 1.59 |
| 7409 | .19 | 7475 | .57 | 74165 | 1.59 |
| 7410 | .16 | 7476 | .39 | 74166 | 1.49 |
| 7411 | .25 | 7483 | .79 | 74170 | 2.30 |
| 7413 | .55 | 7485 | 1.10 | 74173 | 1.49 |
| 7416 | .35 | 7486 | .40 | 74174 | 1.62 |
| 7417 | .35 | 7489 | 2.48 | 74175 | 1.39 |
| 7420 | .16 | 7490 | .59 | 74176 | .89 |
| 7422 | .26 | 7491 | .97 | 74177 | .84 |
| 7423 | .29 | 7492 | .71 | 74180 | .90 |
| 7425 | .27 | 7493 | .60 | 74181 | 2.98 |
| 7426 | .26 | 7494 | .94 | 74182 | .79 |
| 7427 | .29 | 7495 | .79 | 74184 | 2.29 |
| 7430 | .20 | 7496 | .79 | 74185 | 2.29 |
| 7432 | .23 | 74100 | 1.30 | 74187 | 5.95 |
| 7437 | .35 | 74105 | .44 | 74190 | 1.35 |
| 7438 | .35 | 74107 | .40 | 74191 | 1.35 |
| 7440 | .17 | 74121 | .42 | 74192 | 1.25 |
| 7441 | .98 | 74122 | .45 | 74193 | 1.19 |
| 7442 | .77 | 74123 | .85 | 74194 | 1.25 |
| 7443 | .87 | 74125 | .54 | 74195 | .89 |
| 7444 | .87 | 74126 | .63 | 74196 | 1.25 |
| 7445 | .89 | 74141 | 1.04 | 74197 | .89 |
| 7446 | .93 | 74145 | 1.04 | 74198 | 1.79 |
| 7447 | .89 | 74150 | .97 | 74199 | 1.79 |
| 7448 | 1.04 | 74151 | .79 | 74200 | 5.90 |
| 7450 | .17 | 74153 | .99 | | |

## LOW POWER TTL

| | | | | | |
|---|---|---|---|---|---|
| 74L00 | $ .25 | 74L51 | $ .29 | 75L90 | $1.49 |
| 74L02 | .25 | 74L55 | .33 | 74L91 | 1.45 |
| 74L03 | .25 | 74L71 | .25 | 74L93 | 1.69 |
| 74L04 | .25 | 74L72 | .39 | 74L95 | 1.69 |
| 74L06 | .25 | 74L73 | .49 | 74L98 | 2.79 |
| 74L10 | .25 | 74L74 | .49 | 74L164 | 2.79 |
| 74L20 | .33 | 74L78 | .79 | 74L165 | 2.79 |
| 74L30 | .33 | 74L85 | 1.25 | | |
| 74L42 | 1.49 | 74L86 | .69 | | |

## HIGH SPEED TTL

| | | | | | |
|---|---|---|---|---|---|
| 74H00 | $ .25 | 74H21 | $ .25 | 74H55 | $ .25 |
| 74H01 | .25 | 74H22 | .25 | 74H60 | .25 |
| 74H04 | .25 | 74H30 | .25 | 74H61 | .25 |
| 74H08 | .25 | 74H40 | .25 | 74H62 | .25 |
| 74H10 | .25 | 74H50 | .25 | 74H72 | .39 |
| 74H11 | .25 | 74H52 | .25 | 74H74 | .39 |
| 74H20 | .25 | 74H53 | .25 | 74H76 | .49 |

## 8000 SERIES

| | | | | | |
|---|---|---|---|---|---|
| 8091 | $ .53 | 8214 | $1.49 | 8811 | $ .59 |
| 8092 | .53 | 8220 | 1.49 | 8812 | .89 |
| 8095 | 1.25 | 8230 | 2.19 | 8822 | 2.19 |
| 8121 | .80 | 8520 | 1.16 | 8830 | 2.19 |
| 8123 | 1.43 | 8551 | 1.39 | 8831 | 2.19 |
| 8130 | 1.97 | 8552 | 2.19 | 8836 | .25 |
| 8200 | 2.33 | 8554 | 2.19 | 8880 | 1.19 |
| 8210 | 2.79 | 8810 | .69 | 8263 | 5.79 |
| | | | | 8267 | 2.59 |

## 9000 SERIES

| | | | | | |
|---|---|---|---|---|---|
| 9002 | $ .35 | 9309 | $ .79 | 9601 | $ .89 |
| 9301 | 1.03 | 9312 | .79 | 9602 | .79 |

## CMOS

| | | | | | |
|---|---|---|---|---|---|
| | | 4016A | .56 | 4050A | .59 |
| 4000A | $ .26 | 4017A | 1.19 | 4066A | .89 |
| 4001A | .25 | 4020A | 1.49 | 4068A | .44 |
| 4002A | .25 | 4021A | 1.39 | 4069A | .44 |
| 4006A | 1.35 | 4022A | 1.10 | 4071A | .26 |
| 4007A | .26 | 4023A | .25 | 4072A | .35 |
| 4008A | 1.79 | 4024A | .89 | 4073A | .39 |
| 4009A | .57 | 4025A | .25 | 4075A | .39 |
| 4010A | .54 | 4027A | .59 | 4078A | .39 |
| 4011A | .29 | 4028A | .98 | 4081A | .26 |
| 4012A | .25 | 4030A | .44 | 4082A | .35 |
| 4013A | .45 | 4035A | 1.27 | 4528A | 1.60 |
| 4014A | 1.49 | 4042A | 1.47 | 4585A | 2.10 |
| 4015A | 1.49 | 4049A | .59 | | |

| | | | | | |
|---|---|---|---|---|---|
| 74C00 | $ .22 | 74C74 | $1.04 | 74C162 | $2.93 |
| 74C02 | .26 | 74C76 | 1.34 | 74C163 | 2.66 |
| 74C04 | .44 | 74C107 | 1.13 | 74C164 | 2.66 |
| 74C08 | .68 | 74C151 | 2.61 | 74C173 | 2.61 |
| 74C10 | .35 | 74C154 | 3.15 | 74C195 | 2.66 |
| 74C20 | .35 | 74C157 | 1.76 | 80C95 | 1.35 |
| 74C42 | 1.61 | 74C160 | 2.48 | 80C97 | 1.13 |
| 74C73 | 1.04 | 74C161 | 2.93 | | |

**TTL**

| | |
|---|---|
| 74132 | $ .89 |
| 74H101 | .58 |
| 74H102 | .58 |
| 74H103 | .63 |
| 74H106 | .63 |
| 74H108 | .63 |

**SCHOTTKY**

| | |
|---|---|
| 74S00 | $ .38 |
| 74S02 | .45 |
| 74S03 | .38 |
| 74S04 | .45 |
| 74S08 | .52 |
| 74S10 | .38 |
| 74S20 | .38 |
| 74S22 | .38 |
| 74S32 | .52 |
| 74S74 | .38 |

**LOW POWER SCHOTTKY**

| | |
|---|---|
| 74LS00 | $ .36 |
| 74LS02 | .36 |
| 74LS04 | .36 |
| 74LS08 | .38 |
| 74LS10 | .36 |
| 74LS20 | .36 |
| 74LS32 | .38 |
| 74LS40 | .45 |
| 74LS74 | .59 |
| 74LS90 | 1.30 |
| 74LS93 | 1.30 |
| 74LS95 | 2.09 |
| 74LS107 | .59 |
| 74LS164 | 2.20 |
| 74LS193 | 2.50 |

**LINEARS**

| | | |
|---|---|---|
| 546 | AM radio receiver subst. DIP | $ .75 |
| 733 | Diff. video AMPL TO-5 | .89 |
| 5556/ MC1456 | Int. compensated Op Amp mDIP | 1.59 |
| 7525 | Dual core mem. sense AMPL DIP | .98 |
| CA3046 | Transistor array 14 pin DIP | .89 |

**METAL FILM RESISTORS**
±1% ¼ WATT

| QTY | PRICE EACH | PRICE MINIMUM 10 PER VALUE | PRICE MINIMUM 100 PER VALUE |
|---|---|---|---|
| 0 - 10 | $.20 | | |
| 10 - 100 | .20 | $.15 | |
| 100 - 1000 | | .10 | $.09 |
| 1000 - | | .10 | .08 |

**RESISTANCE (OHMS)**

| | | | | | |
|---|---|---|---|---|---|
| 22.6 | 71.5 | 182 | 887 | 11.8K | 40.2K |
| 23.7 | 78.7 | 187 | 1.15K | 13.0K | 45.3K |
| 25.5 | 84.5 | 191 | 1.5 K | 15.0K | 48.7K |
| 30.9 | 105 | 205 | 2.49K | 18.2K | 54.9K |
| 34.8 | 110 | 232 | 3.57K | 19.1K | 60.4K |
| 40.2 | 115 | 243 | 4.75K | 19.6K | 64.9K |
| 45.3 | 137 | 499 | 5.49K | 22.6K | 69.8K |
| 51.1 | 147 | 604 | 6.04K | 24.9K | 84.5K |
| 61.9 | 158 | 715 | 7.15K | 28.0K | |
| 64.9 | 178 | 806 | 8.25K | 37.4K | |

**MISC. DEVICES**

| | | |
|---|---|---|
| 2513 | 64 x 8 x 5 character generator | $11.00 |
| 2602 | 1024-bit static RAM, N-channel DTL/TTL compatible | 3.95 |
| F93410 | 256 bit RAM | 2.19 |
| MV5020 | Jumbo green | .22 |
| XC209-R | .125" red LED | .15 |
| L100 | Red LED | .15 |
| L101 | Red LED | .15 |

Data sheets on request. With order add $.30 for items less than $1.00 ea.

**LINEAR CIRCUITS**

| | | |
|---|---|---|
| 300 | Pos V Reg (super 723) TO-5 | $ .71 |
| 301 | Hi Perf Op Amp mDIP TO-5 | .29 |
| 302 | Volt follower TO-5 | .53 |
| 304 | Neg V Reg TO-5 | .80 |
| 305 | Pos V Reg TO-5 | .71 |
| 307 | Op AMP (super 741) mDIP TO-5 | .26 |
| 308 | Mciro Pwr Op Amp mDIP TO-5 | .89 |
| 309K | 5V 1A regulator TO-3 | 1.35 |
| 310 | V Follower Op Amp mDIP | 1.07 |
| 311 | Hi perf V Comp mDIP TO-5 | .95 |
| 319 | Hi Speed Dual Comp DIP | 1.13 |
| 320T | Neg Reg 5, 12, 15, TO-3 | $1.39 |
| 320K | Neg Reg 5.2, 12 TO-3 | 1.39 |
| 322 | Precision Timer DIP | 1.70 |
| 324 | Quad Op Amp DIP | 1.52 |
| 339 | Quad Comparator DIP | 1.58 |
| 340K | Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-3 | 1.69 |
| 340T | Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220 | 1.49 |
| 372 | AF-IF Strip detector DIP | 2.93 |
| 376 | Pos V Reg mDIP | 2.42 |
| 380 | 2w Audio Amp DIP | 1.13 |
| 380-8 | .6w Audio Amp mDIP | 1.52 |
| 381 | Lo Noise Dual preamp DIP | 1.52 |
| 382 | Lo Noise Dual preamp DIP | .71 |
| 550 | Prec V Reg DIP | .89 |
| 555 | Timer mDIP | .89 |
| 556A | Dual 555 Timer DIP | 1.49 |
| 560 | Phase Locked Loop DIP | 3.95 |
| 562 | Phase Locked Loop DIP | 3.95 |
| 565 | Phase Locked Loop DIP TO-5 | 2.38 |
| 566 | Function Gen mDIP TO-5 | 2.25 |
| 567 | Tone Decoder mDIP | 2.66 |
| 709 | Operational AMP TO-5 or DIP | .26 |
| 710 | Hi Speed Volt Comp DIP | .35 |
| 711 | Dual Difference Compar DIP | .26 |
| 723 | V Reg DIP | .62 |
| 739 | Dual Hi Perf Op Amp DIP | 1.07 |
| 741 | Comp Op Amp mDIP TO-5 | .32 |
| 747 | 741 Dual Op Amp DIP or TO-5 | .71 |
| 748 | Freq Adj 741 mDIP | .35 |
| 1304 | FM Mulpx Stereo Demod DIP | 1.07 |
| 1307 | FM Mulpx Stereo Demod DIP | .74 |
| 1458 | Dual Comp Op Amp mDIP | .62 |
| 1800 | Stereo multiplexer DIP | 2.48 |
| LH2111 | Dual LM 211 V Comp DIP | 1.70 |
| 3900 | Quad Amplifier DIP | .35 |
| 7524 | Core Mem Sense AMPL DIP | .71 |
| 8038 | Voltage contr. osc. DIP | 4.25 |
| 8864 | 9 DIG Led Cath Drvr DIP | 2.25 |
| 75150 | Dual Line Driver DIP | 1.75 |
| 75451 | Dual Perepheral Driver mDIP | .35 |
| 75452 | Dual Peripheral Driver mDIP | .35 |
| 75453 | (351) Dual Periph Driver mDIP | .35 |
| 75491 | Quad Seq Driver for LED DIP | .71 |
| 75492 | Hex Digit driver DIP | .80 |

**LED's**

| | | |
|---|---|---|
| MV10B | Red TO 18 | $ .22 |
| MV50 | Axial leads | .18 |
| MV5020 | Jumbo Vis. Red (Red Dome) | .22 |
| | Jumbo Vis. Red (Clear Dome) | .22 |
| ME4 | Infra red diff. dome | .54 |
| MAN1 | Red 7 seg. .270" | 2.19 |
| MAN2 | Red alpha num .32" | 4.39 |
| MAN4 | Red 7 seg. .190" | 1.95 |
| MAN5 | Green 7 seg. .270" | 3.45 |
| MAN6 | .6" high solid seg. | 4.25 |
| MAN7 | Red 7 seg. .270" | 1.19 |
| MAN3 | Red 7 seg. .127" straight pins | .29 |
| MAN8 | Yellow 7 seg. .270" | 3.45 |
| MAN66 | .6" high spaced seg. | 3.75 |
| MCT2 | Opto-iso transistor | .61 |

**MEMORIES**

| | | |
|---|---|---|
| 1101 | 256 bit RAM MOS | $ 1.50 |
| 1103 | 1024 bit RAM MOS | 3.95 |
| 1702A | 2048 bit static PROM UV eras. | 17.95 |
| 2102-2 | 1024 bit static RAM | 4.25 |
| 5203 | 2048 bit UV eras PROM | 17.95 |
| 5260 | 1024 bit RAM | 2.49 |
| 5261 | 1024 bit RAM | 2.69 |
| 5262 | 2048 bit RAM | 5.95 |
| 7489 | 64 bit ROM TTL | 2.48 |
| 82523 | Programmable ROM | 3.69 |
| 74200 | 256 bit RAM tri-state | 5.90 |

**MULTIPLE DISPLAYS**

| | | |
|---|---|---|
| NSN33 | 3 digit .12" red led 12 pin fits IC skt. | $1.79 |
| HP45082 7405 | 5 digit .11 led magn. lens com. cath | 3.49 |
| HP5082 7414 | 4 digit .11 LED magn. lens comm. cath. | 3.25 |
| FNA37 | 9 digit 7 seg led RH dec clr. magn. lens | 4.95 |
| SP-425-09 | 9 digit .25" neon direct interface with MOS/LSI, 180 VDC, 7 seg. | 1.79 |

**CALCULATOR & CLOCK CHIPS**

| | | |
|---|---|---|
| 5001 | 12 DIG 4 funct fix dec | $2.49 |
| 5002 | Same as 5001 exc btry power | 2.79 |
| 5005 | 12 DIG 4 fuct w/mem | 2.99 |
| MM5725 | 8 DIG 4 funct chain & dec | 1.98 |
| MM5736 | 18 pin 6 DIG 4 funct | 4.45 |
| MM5738 | 8 DIG 5 funct K & mem | 5.35 |
| MM5739 | 9 DIG 4 funct (btry sur) | 5.35 |
| MM5311 | 28 pin BCD 6 dig mux | 4.45 |
| MM5312 | 24 pin 1 pps BCD 4 dig mux | 3.95 |
| MM5313 | 28 pin 1 pps BCD 6 dig mux | 4.45 |
| MM5314 | 24 pin 6 dig mux | 4.45 |
| MM5316 | 40 pin alarm 4 dig | 5.39 |

**SHIFT REGISTERS**

| | | |
|---|---|---|
| MM5013 | 1024 bit accum. dynamic mDIP | $1.75 |
| MM5016 | 500/512 bit dynamic mDIP | 1.59 |
| SL5-4025 | QUAD 25 bit | 1.29 |

**DTL**

| | | | | | |
|---|---|---|---|---|---|
| 930 | $ .15 | 937 | .15 | 949 | .15 |
| 932 | .15 | 944 | .15 | 962 | .15 |
| 936 | .15 | 946 | .15 | 963 | .15 |

Satisfaction guaranteed. Shipment will be made via first class mail in U.S., Canada and Mexico within 5 days from receipt of order. Add $.50 to cover shipping and handling for orders under $25.00. Minimum order $5.00. California residents add sales tax.

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P.O. BOX 1708/ MONTEREY, CA. 93940 USA
PHONE (408) 659-3171



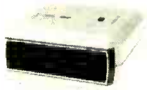
*Circle 92 on reader service card*

# CRYSTALS

| Part # | Frequency | Case Style | Price |
|---|---|---|---|
| CY1A | 1 000 MHz | HC33/U | $4 95 |
| CY2A | 2 000 MHz | HC33/U | $4 95 |
| CY3A | 4 000 MHz | HC18/U | $4 95 |
| CY7A | 5 000 MHz | HC18/U | $4 95 |
| CY12A | 10 000 MHz | HC18/U | $4 95 |
| CY19A | 18 000 MHz | HC18/U | $4 95 |
| CY22A | 20 000 MHz | HC18/U | $4 95 |
| CY30B | 32 000 MHz | HC18/U | $4 95 |

— AVAILABLE IN THESE FREQUENCIES ONLY —

## CLOCK CASES



Nicely styled cases complete with red bezel for use in such applications as desk clocks, car clocks, alarm clocks, instrument cases
DIMENSIONS W-4", L 4½ H-2"
$5.95

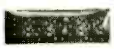
## 64 Key Keyboard

$24.95

This keyboard is composed of 64 Magnetic Reed Switches, in one molded unit. It is unencoded with each SPST switch brought out to two pins

HD0165 Keyboard Encoder ROM $7.95

## DIGITAL WATCH READOUT



FOR USE WITH WATCHES, DVMS, COUNTERS ETC $1.95

## MOS LSI DEVICES

### CLOCK CHIPS

| | | |
|---|---|---|
| MM5309 | 6 Digit BCD Outputs, Reset PIN. | $5.95 |
| MM5311 | 6 Digit, BCD Outputs, 12 or 24 Hour | 4.95 |
| MM5312 | 4 Digit, BCD Outputs, 1 PPS Output | 4.95 |
| MM5313 | 6 Digit, BCD Outputs, 1PPS Output | 4.95 |
| MM5314 | 6 Digit, 12 or 24 Hour, 50 or 60 Hz | 4.95 |
| MM5316 | 4 Digit, Alarm, 1PPS Output | 6.95 |
| MM5318 | Video Clock Chip, For Use With MM5841 | 9.95 |
| CT7001 | 6 Digit, Calander, Alarm, 12 or 24 Hour | 6.95 |

### CALCULATOR CHIPS

| | | |
|---|---|---|
| MM5725 | 6 Digit, Four Function, Less Decimal | $2.95 |
| MM5738 | 8 Digit, 5 Function, +, −, ×, ÷, % | 2.95 |
| MM5739 | 8 Digit, 4 Function, Floating Decimal | 2.95 |
| CT5001 | 12 digit 4 Function | 3.95 |
| CT5005 | 12 digit 4 Function with Memory | 5.95 |
| CT5030 | 12 digit 4 Function and% | 7.95 |

### MISC. MOS

| | | |
|---|---|---|
| MK5007 | Complete 4 Digit Counter | $10.95 |
| LD110/LD111 | 3½ Digital Voltmeter Chip Set | $25 00 |
| MC1408L7 | 7 Bit Digital To Analog Conv | 9.95 |
| MM5320 | TV Camera Sync Generator | 19.95 |
| MM5841 | Video Generator For MM5318 | 18 00 |

## DL728

The DL728 is a dual 0.5" common cathode red display. It is ideal for use with clock chips, as segments are already multiplexed. $2.95

## 1¼" x 1½" XFMERS — P.C. Mount

That were designed for clock type applications 110 Vac primary @ 60 Hz.
Secondaries 8-10 Vac @ 30 mA-50 mA
50 Vac @ 30 mA-50 mA
Excellent for miniature power supplies & gas discharge displays

SPECIAL $.79

## 1/16 VECTOR BOARD

0.1" Hole Spacing P-Pattern

| | Part No. | Length | Width | Price 1-19 | Price 20-49 |
|---|---|---|---|---|---|
| PHENOLIC | 64P44 062XXXP | 4.50 | 6 50 | 1 72 | 1 54 |
| | 169P44 02XXXP | 4 50 | 17 00 | 3 69 | 3 32 |
| EPOXY GLASS | 64P44 062 | 4 50 | 6.50 | 2 07 | 1 86 |
| | 84P44 062 | 4.50 | 8 50 | 2 56 | 2 31 |
| | 169P44 062 | 4 50 | 17 00 | 5 04 | 4 53 |
| | 169P84 062 | 8 50 | 17 00 | 9 23 | 8 26 |
| EPOXY GLASS COPPER CLAD | 169P44 062C1 | 4.50 | 17 00 | 6 80 | 6 12 |

## VECTOR WIRING PENCIL

Vector Wiring Pencil P173 consists of a hand held featherweight (under one ounce) tool which is used to guide and wrap insulated wire, fed off a self-contained replaceable bobbin, onto component leads or terminals installed on pre-punched "P" Pattern Vectorbord®. Connections between the wrapped wire and component leads, pads or terminals are made by soldering. Complete with 250 FT of red wire.

Special $7.95

### REPLACEMENT WIRE — BOBBINS FOR WIRING PENCIL

| | | |
|---|---|---|
| W36-3-A-Pkg. 3 | 250 ft. 36 AWG GREEN | $2.40 |
| W36-3-B-Pkg. 3 | 250 ft. 36 AWG RED | $2.40 |
| W36-3-C-Pkg. 3 | 250 ft. 36 AWG CLEAR | $2.40 |
| W36-3-D-Pkg. 3 | 250 ft. 36 AWG BLUE | $2.40 |

## 9V BATTERY CLIP

STANDARD CLIP FOR USE WITH 9V TRANSISTOR BATTERIES WITH 4" LEADS 9/.99

## TERMINAL STRIPS

THREE TERMINAL STRIPS, WITH CENTER TERMINAL USED FOR MOUNTING 15/$1.00

## MOLEX PINS

PINS USED AS INEXPENSIVE SUBSTITUTE FOR SOCKETS
SPECIAL 100/1.49
SPECIAL 1000/12.00

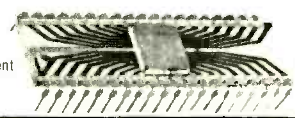
# MICROPROCESSOR COMPONENTS

### CENTRAL PROCESSOR UNITS

Each processor feature a 2μs instruction cycle, and are brand new from the manufacturer. The 8080 is a 2nd generation processor and the 8080A is a 2½ generation microprocessor

**8080 $24.95** — Direct Replacement For Intel C8080

**8080A $39.95** — Direct Replacement For Intel C8080A



| CPU'S | | | RAM'S | | | |
|---|---|---|---|---|---|---|
| 8008 | 8 Bit CPU | $19 95 | 1101 | 256X1 | STATIC | $2 25 |
| 8080 | Super 8008 | $24 95 | 1103 | 1024X1 | DYNAMIC | 2.95 |
| 8080A | Super 8008 | $39 95 | 2101 | 256X1 | STATIC | 6 95 |
| | | | 2102 | 1024X1 | STATIC | 2 49 |
| SR'S | | | 2107 | 4096X1 | DYNAMIC | 19 95 |
| 2504 | 1024 DYNAMIC | $9 00 | 2111 | 256X4 | STATIC | 7 95 |
| 2518 | HEX 32 BIT | 7.00 | 7010 | 1024X1 | MNOS | 29 95 |
| 2519 | HEX 40 BIT | 4 00 | 7489 | 16X4 | STATIC | 2 49 |
| 2524 | 512 DYNAMIC | 2.95 | 8101 | 256X4 | STATIC | 7 95 |
| 2525 | 1024 DYNAMIC | 6.00 | 8111 | 256X4 | STATIC | 7 95 |
| 2527 | DUAL 256 BIT | 3 95 | 8599 | 16X4 | STATIC | 3 49 |
| 2529 | DUAL 512 BIT | 4 00 | 91L02 | 1024X1 | STATIC | 2.75 |
| 2532 | QUAD 80 BIT | 3.95 | 74200 | 256X1 | STATIC | 6.95 |
| 2533 | 1024 STATIC | 7.95 | 93410 | 256X1 | STATIC | 1 75 |
| 3341 | FIFO | 6 95 | 5262 | 2048X1 | DYNAMIC | 2 95 |
| 74LS670 | 16X4 REG | 3 95 | | | | |
| UART'S | | | PROMS | | | |
| AY-5-1013 | 20K BAUD | $6.95 | 1702A | 2048 | FAMOS | 15 95 |
| ROM'S | | | 5203 | 2048 | FAMOS | 14 95 |
| 2513 | CHAR GEN | 11 00 | 82S23 | 32X8 | OPEN C. | 5.00 |
| 7488 | RANDOM BITS | 3 50 | 82S123 | 32X8 | TRISTATE | 5.00 |

## 2K RAM SPECIAL

MM5262 Fully decoded 2Kx1 dynamic RAM. All inputs except clocks are TTL compatible. Provides a 635 n s minimum access time, and requires a +5, +8.5, and −15V power supply. Low power provides non volatile memory using battery back up.
$0.99 ea (0.05 cents per bit)

## BUILD YOUR OWN JOLT MICROCOMPUTER IN JUST 3 HOURS OR LESS FOR $159.95.

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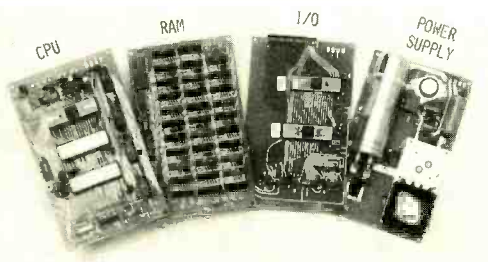


### JOLT ACCESSORY KITS

**JOLT RAM Card** — Fully static 4,096 bytes of RAM with 1 microsecond access time and on-board decoding. **$199.95**

**JOLT I/O Card (Peripheral Interface Adapter)** — 2 PIA LSI chips, 32 I/O lines, four interrupt lines, on-board decoding and standard TTL drive. Fully programmable. **$95.50**

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**JOLT Resident Assembler** — Fully symbolic, single pass resident assembler, all mnemonics compatible with timesharing assemblers. Delivered on four 1702A PROMs, ready for plugging into JOLT PROM card. **$149.95**

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| 30 AWG | BLUE | 2.10 | 2 75 | 3 50 | 24 00 |
| 30 AWG | BLACK | 2 10 | 2.75 | 3 50 | 24 00 |

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| 20 | .59 | .49 | .45 | .43 |
| 26 | .69 | 59 | .55 | .52 |

## 6' 2 CONDUCTOR POWER CORDS 125V @ 5A

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| 17237 | 6 | 18(41x35) | 253 | 1250W 10A-125V | GREY | 1.25 |
| 17238 | 8 | 18(41X34) | 265 | 1250W 10A-125V | BLACK Special | .99 ea |
| 17239 | 8 | 18(41X34) | 253 | 1250W 10A-125V | GREY | 1 30 |
| 17000 | 4 | 18(41X34) | 253 | 1250W 10A-125V | BLACK | .59 |

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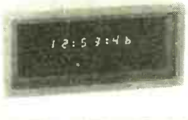
# JE SERIES KITS

## JE700 CLOCK



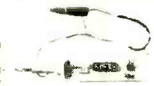
The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6" x 2½" x 1". It utilizes a MAN72 high brightness readout and the MM5314 clock chip

12 or 24 Hour

115 VAC—

**$17.95**

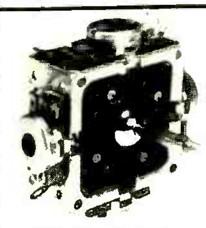
## JE803 PROBE



The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols (H) - 1 (LOW) - 0 (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result

**$9.95 Per Kit**
printed circuit board

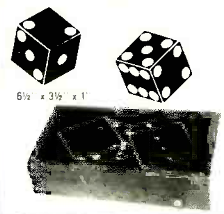
## JOYSTICK



These joysticks feature four 100K potentiometers, that vary resistance proportional to the angle of the stick. Sturdy metal construction with plastics components only at the movable joint. Perfect for electronic games and instrumentation.

**$9.95 ea**

## ELECTRONIC CRAPS

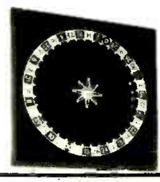


6½" x 3½" x 1"

Electronic craps is an entirely electronic game featuring a dice "roll down". 14 LED's form two dice that roll when activated by a push botton. Dimensions are 6½" x 3½" x 1½".

$19.95

## ELECTRONIC ROULETTE



This kit comes complete with all components, including the case and line cord. Electronic Roulette, is entirely electronic, and features 32 LED's that form a wheel, that is activated, by a push botton switch. Dimensions are 6½" x 6½" x 1½"

$29.95

## Semiconductor Specials

2N2222 - NPN Si, High Frequency switching transistor (typically 250 MHz) 0 5W. HFe = 100, Vceo 30V — 7/$1.00

MJ3055 - Same as TO3 CAN 2N3055 except that base and emmitter leads have solder lugs — $.59

1N4308 - Excellent signal diode for uses in digital switching circuits 80 PRV @ 200 mA. — 20/$1.00

MCT2E - NPN Opto Isolator which provides 2500 VDC isolation. — $2 95

2N4123 - NPN Si high frequency switching transistor. With an HFE = 120, it is ideally suited for most digital applications — 8/$1.00

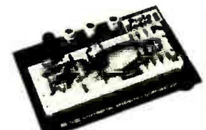
RL4403 - Red 2" LED with 2 piece plastic mounting — 3/$1.00

74S287 - Outstanding 256 x 4 TTL PROM. Tristate outputs provide easy bussing. Access time of 40 ns — $7.95

CA3081 - Common Emitter H.V. 7 transistors in a 16 PIN package. Ideal for segment drivers — $1.75

CA3082 - Common Collector H.V. NPN transistor array, packaged 7 transistors to each D.I.P. Excellent in uses with incandescent displays. — $2.00.

# Continental Specialties



### PROTO BOARD 6

The PB-6 lets the user test and build circuits without soldering or patch cords, all interconnections between components are made with common #22 AWG hook-up wire. This quality breadboarding kit includes 630 component tie points at less than 2.5c each. It measures 6" long by 4" wide. Designed specially to Breadboard Microprocessor Circuits.

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### FEATURE

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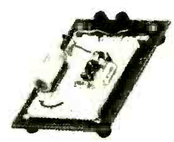

SPECIAL $17.95



Circle 93 on reader service card

Circle 94 on reader service card

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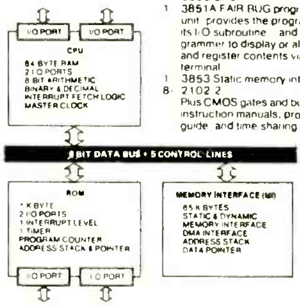
- 1 - 3853 Static memory interface
- 8 - 2102 2

Plus CMOS gates and buffers PC card, instruction manuals, programming guide and time sharing guide

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| 8008 8 BIT MICRO PROCESSING CHIP (with Data Book) | $19.00 |
| 2102-2 1024 BT RAM | $ 2.95 |
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| 400 | .09 | .25 | .50 | 1.40 | 6.50 |
| 600 | .11 | .30 | .70 | 1.80 | 8.50 |
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| 7410— | .15 | 74107— | .34 |
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| PRV | 2A | 6A | 25A |
|---|---|---|---|
| 200 | .95 | 1.25 | 2.00 |
| 400 | 1.15 | 1.50 | 3.00 |
| 600 | 1.35 | 1.75 | 4.00 |

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**TRIACS / SCR'S**

| PRV | 1A | 10A | 25A | 1.5A | 6A | 35A |
|---|---|---|---|---|---|---|
| 100 | .40 | .70 | 1.30 | .40 | .50 | 1.20 |
| 200 | .70 | 1.10 | 1.75 | .60 | .70 | 1.60 |
| 400 | 1.10 | 1.60 | 2.60 | 1.00 | 1.20 | 2.20 |
| 600 | 1.70 | 2.30 | 3.60 | | 1.50 | 3.00 |

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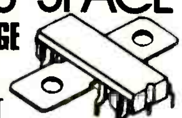

TCA 940
10 WATT

| Type | Supply Voltage Range (V) | Pout (THD=10%) (W) | @RL (Ω) | &Vcc (V) | Closed-Loop Gain Range (dB) | Key Features | Price |
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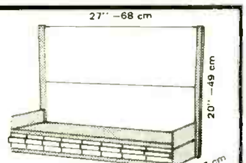


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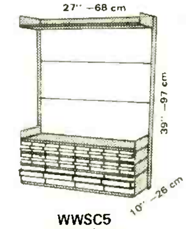


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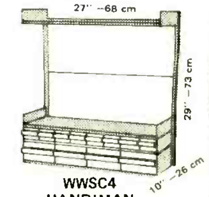


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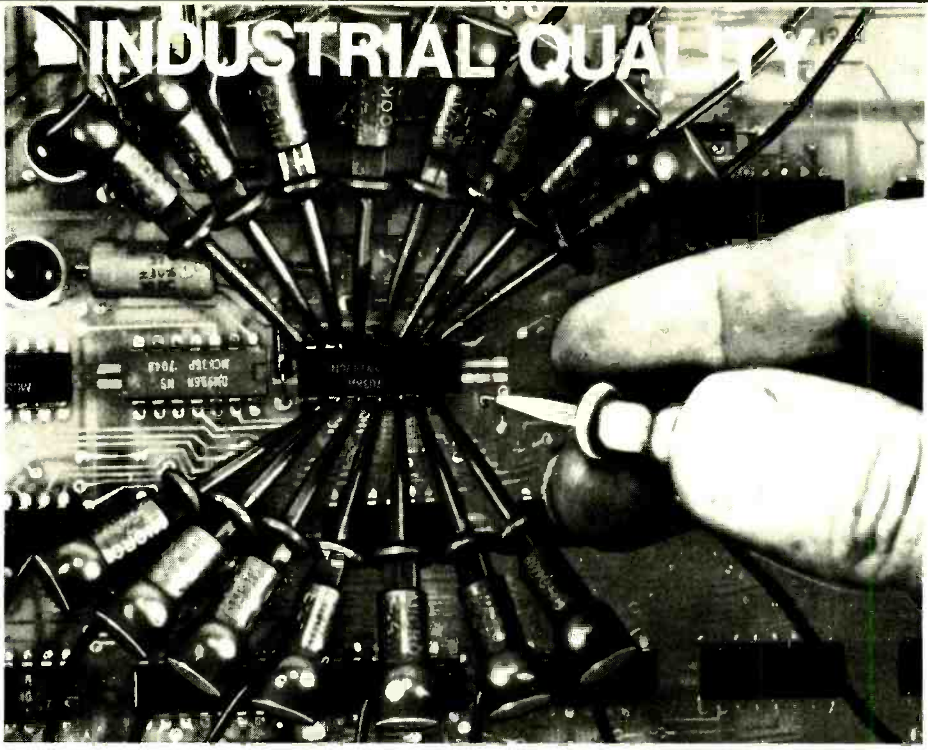


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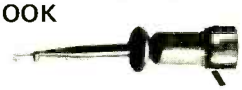
## MICRO HOOK



XM Micro Hook (1.75" long, <1 gram) for difficult IC Testing. Permits hookups to delicate wires where weight and leverage may damage component. **$.80 ea.**

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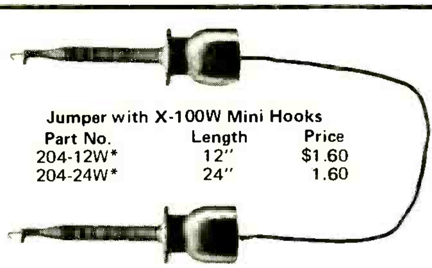

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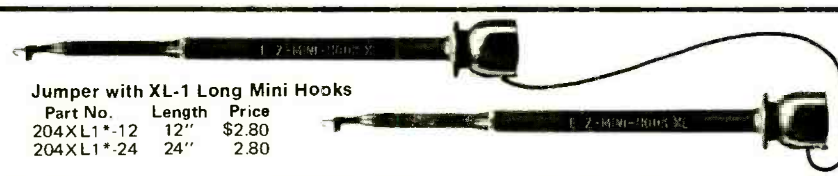

**Jumper with XL-1 Long Mini Hooks**

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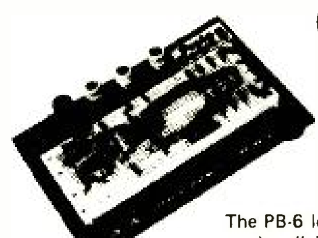
| .22 | 35 | 30 | 25 | 20 | 6.8 | 35 | 40 | 32 | 26 |
| .33 | 35 | 30 | 25 | 20 | 10.0 | 16 | 38 | 30 | 24 |
| .47 | 35 | 30 | 25 | 20 | 10.0 | 35 | 40 | 32 | 26 |
| .68 | 35 | 30 | 25 | 20 | 15.0 | 35 | 95 | 64 | 56 |
| 1.0 | 35 | 30 | 25 | 20 | 22.0 | 16 | 40 | 32 | 26 |
| 1.5 | 35 | 35 | 28 | 23 | 33.0 | 20 | 95 | 64 | 56 |
| 2.2 | 20 | 30 | 25 | 20 | 47.0 | 20 | 1.40 | 1.05 | 90 |
| 3.3 | 35 | 38 | 30 | 24 | 68.0 | 16 | 1.40 | 1.05 | 90 |



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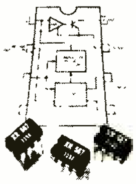

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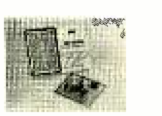

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| 2N3506 | 7.40 | 2N3663 | .44 | 2N3796 | 3.00 | 2N3955A | 3.20 | 2N4237 | 1.20 |
| 2N3554 | 3.90 | 2N3684 | 1.20 | 2N3799 | 3.15 | 2N3956 | 2.90 | 2N4238 | 1.30 |
| 2N3546 | 2.90 | 2N3685 | 1.35 | 2N3804 | 8.00 | 2N3957 | 1.45 | 2N4248 | .17 |
| 2N3553 | 1.80 | 2N3685A | 1.75 | 2N3805 | 10.40 | 2N3958 | 1.45 | 2N4249 | .20 |
| 2N3563 | .16 | 2N3686 | 1.50 | 2N3819 | .30 | 2N3964 | 1.09 | 2N4250 | .22 |
| 2N3564 | .14 | 2N3687 | 1.60 | 2N3821 | 1.35 | 2N3970 | 1.20 | 2N4256 | .28 |
| 2N3565 | .18 | 2N3692 | .20 | 2N3822 | 1.40 | 2N3971 | 1.00 | 2N4258 | .34 |
| 2N3567 | .26 | 2N3693 | .21 | 2N3823 | .69 | 2N3972 | 1.39 | 2N4289 | .40 |
| 2N3568 | .28 | 2N3694 | .22 | 2N3824 | 1.00 | 2N4012 | 10.40 | 2N4291 | .35 |
| 2N3569 | .19 | 2N3702 | .30 | 2N3851 | 7.40 | 2N4032 | 1.90 | 2N5157 | 9.85 |

| | | | | | |
|---|---|---|---|---|---|
| 2N4293 | .50 | 2N5172 | .14 | 2N5592 | 1.00 |
| 2N4303 | .30 | 2N5190 | .95 | 2N5637 | 26.90 |
| 2N4341 | 1.35 | 2N5191 | 1.00 | 2N5644 | 7.10 |
| 2N4347 | 1.60 | 2N5198 | 4.25 | 2N5655 | .95 |
| 2N4348 | 2.10 | 2N5210 | .22 | 2N5657 | 1.20 |
| 2N4352 | 2.00 | 2N5219 | .16 | 2N5679 | 1.39 |
| 2N4395 | 1.25 | 2N5220 | .28 | 2N5742 | 35.00 |
| 2N4400 | .29 | 2N5221 | .30 | 2N5777 | .50 |
| 2N4401 | .33 | 2N5222 | .16 | 2N5778 | .54 |
| 2N4402 | .35 | 2N5223 | .16 | 2N5779 | .80 |
| 2N4409 | .30 | 2N5224 | .22 | 2N5780 | .85 |
| 2N4416 | .89 | 2N5225 | .30 | 2N5810 | .34 |
| 2N4424 | .35 | 2N5226 | .26 | 2N5811 | .38 |
| 2N4425 | .40 | 2N5227 | .16 | 2N5812 | .36 |
| 2N4427 | 1.30 | 2N5232 | .22 | 2N5813 | .42 |
| 2N4441 | 1.30 | 2N5232A | .24 | 2N5815 | .36 |
| 2N4443 | 1.40 | 2N5249 | .30 | 2N5816 | .38 |
| 2N4852 | .85 | 2N5249A | .31 | 2N5817 | .38 |
| 2N4858 | 1.10 | 2N5294 | .75 | 2N5818 | .40 |
| 2N4859 | 1.20 | 2N5295 | .60 | 2N5819 | .42 |
| 2N4863 | 5.45 | 2N5296 | .95 | 2N5821 | .60 |
| 2N4870 | .60 | 2N5298 | 1.00 | 2N5822 | .56 |
| 2N4878 | 3.85 | 2N5306 | .26 | 2N5823 | .66 |
| 2N4890 | .95 | 2N5306A | .40 | 2N5824 | .24 |
| 2N4898 | 1.10 | 2N5307 | .40 | 2N5825 | .26 |
| 2N4901 | 2.70 | 2N5308 | .44 | 2N5826 | .28 |
| 2N4902 | 3.00 | 2N5309 | .36 | 2N5827 | .30 |
| 2N4903 | 3.90 | 2N5310 | .40 | 2N5828 | .32 |
| 2N4904 | 2.90 | 2N5311 | .44 | 2N5828A | .38 |
| 2N4905 | 4.10 | 2N5322 | .70 | 2N6000 | .50 |
| 2N4906 | 4.30 | 2N5323 | .66 | 2N6001 | .52 |
| 2N4918 | 1.30 | 2N5354 | .35 | 2N6002 | .54 |
| 2N4919 | 1.35 | 2N5355 | .35 | 2N6004 | .54 |
| 2N4921 | 1.30 | 2N5365 | .40 | 2N6010 | .62 |
| 2N4922 | 1.00 | 2N5366 | .40 | 2N6011 | .64 |
| 2N4923 | 1.05 | 2N5367 | .42 | 2N6014 | .66 |
| 2N4983 | .80 | 2N5368 | .24 | 2N6015 | .68 |
| 2N4984 | 1.10 | 2N5369 | .25 | 2N6027 | .50 |
| 2N4985 | 1.90 | 2N5370 | .26 | 2N6028 | .64 |
| 2N4986 | .95 | 2N5371 | .22 | 2N6076 | .16 |
| 2N4987 | .65 | 2N5373 | .26 | 2N6099 | 1.00 |
| 2N4988 | .95 | 2N5375 | .25 | 2N6101 | .95 |
| 2N4989 | 1.40 | 2N5380 | .50 | 2N6103 | .98 |
| 2N4990 | .75 | 2N5381 | .56 | 2N6107 | 1.90 |
| 2N4991 | .75 | 2N5382 | .50 | 2N6109 | 2.30 |
| 2N4992 | 1.10 | 2N5383 | .56 | 2N6111 | 2.60 |
| 2N4993 | 1.60 | 2N5397 | 2.90 | 2N6114 | 4.50 |
| 2N4994 | .25 | 2N5407 | 28.90 | 2N6115 | 2.10 |
| 2N4995 | .26 | 2N5409 | 31.90 | 2N6218 | .60 |
| 2N5016 | 12.70 | 2N5418 | .30 | 2N6219 | .59 |
| 2N5036 | 1.17 | 2N5419 | .34 | 2N6220 | .58 |
| 2N5064 | .90 | 2N5420 | .40 | 2N5221 | .52 |
| 2N5088 | .45 | 2N5447 | .26 | 2N6222 | .28 |
| 2N5089 | .80 | 2N5448 | .27 | 2N6223 | .30 |
| 2N5105 | 3.05 | 2N5449 | .26 | 2N6224 | .32 |
| 2N5109 | 2.40 | 2N5450 | .24 | 2N6225 | .34 |
| 2N5127 | .16 | 2N5451 | .24 | 3N81 | 3.60 |
| 2N5130 | .20 | 2N5453 | 5.35 | 3N82 | 5.00 |
| 2N5131 | .20 | 2N5457 | .65 | 3N83 | 1.70 |
| 2N5133 | .17 | 2N5458 | .50 | 3N84 | 1.68 |
| 2N5134 | .18 | 2N5490 | 1.40 | 3N85 | 3.30 |
| 2N5135 | .16 | 2N5491 | .80 | 3N86 | 6.10 |
| 2N5137 | .26 | 2N5492 | 1.45 | 3N153 | 1.05 |
| 2N5138 | .24 | 2N5494 | 1.70 | 3N189 | 4.10 |
| 2N5154 | 7.05 | 2N5496 | 1.90 | 40290 | 1.70 |
| 2N5155 | 3.20 | 2N5562 | 12.40 | 40319 | 1.00 |
| 2N5161 | 2.60 | 2N5563 | 8.90 | 40346 | .70 |

Prices effective through April 30, 1976

Minimum order $10.00. Add $1.00 to cover postage and handling. California residents add 6% sales tax.

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Visit our Electronic Shop: 11080 Jefferson Blvd., Culver City, CA
(Studio Village Shopping Center)
Prices may vary at over-the-counter locations.

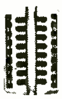
*Circle 104 on reader service card*

## CONTINENTAL SPECIALTIES

### PROTO BOARDS

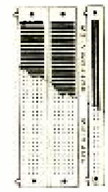
Build & test circuits as fast as you think!

| | | |
|---|---|---|
| PB100 | 10 IC cap breadboard kit, 4.5 x 6.0 x 1.35" | $19.95 |
| PB101 | 10 14-DIP cap, 5-way post, 940 solderless tie points, 5.8 x 4.5" | $29.95 |
| PB102 | 12 14-DIP cap., like PB101 with 1,240 tie points, 7.0 x 4.5" | $39.95 |
| PB103 | 24 14-DIP cap., 4 5-way posts, 2,250 tie points, 6.0 x 9.0" | $59.95 |
| PB104 | 32 14-DIP cap., 3060 solderless tie points, 8.0 x 9.76" | $79.95 |



**LOGIC MONITOR**
Simultaneously displays static and dynamic logic states of DTL, TTL, HTL or CMOS DIP ICs. Pocket size. $84.95.

**PROTO-CLIP**
For power on/hands-off signal tracing. Bring IC leads up from PC board surface for fast trouble-shooting.
PC14 14-pin $4.50
PC16 16-pin 4.75



### SOCKETS & BUS STRIPS

Plug-in, wire, test, modify or expand without patch cords or solder. Snap together to form breadboard needed.

| PN/Description | L. | Hole-to-Hole | Term'ls | Price |
|---|---|---|---|---|
| QT59S Socket | 6.5" | 6.2" | 118 | $12.50 |
| QT59B Bus | 6.5" | 6.2" | 20 | 2.50 |
| QT47S Socket | 5.3" | 5.0" | 94 | 10.00 |
| QT478 Bus | 5.3" | 5.0" | 16 | 2.25 |
| QT35S Socket | 4.1" | 3.8" | 70 | 8.50 |
| QT35B Bus | 4.1" | 3.8" | 12 | 2.00 |
| QT18S Socket | 2.4" | 2.1" | 36 | 4.75 |
| QT12S Socket | 1.8" | 1.5" | 24 | 3.75 |
| QT8S Socket | 1.4" | 1.1" | 16 | 3.25 |
| QT7S Socket | 1.3:: | 1.0" | 14 | 3.00 |

## 7400N TTL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7400N | $.12 | 7442N | .58 | 7497N | 5.00 | 74164N | 1.10 |
| 7401N | .15 | 7443N | .77 | 74100N | 1.00 | 74165N | 1.10 |
| 7402N | .14 | 7444N | .77 | 74104N | 1.20 | 74166N | 1.28 |
| 7403N | .15 | 7445N | .77 | 74105N | .50 | 74170N | 2.05 |
| 7404N | .16 | 7446N | .83 | 74107N | .33 | 74173N | 1.34 |
| 7405N | .19 | 7447N | .72 | 74109N | .74 | 74174N | 1.25 |
| 7406N | 29 | 7448N | .80 | 74110N | .72 | 74175N | .94 |
| 7407N | .29 | 7450N | .14 | 74111N | 1.20 | 74176N | .90 |
| 7408N | .18 | 7451N | .14 | 74116N | 2.00 | 74177N | .90 |
| 7409N | .20 | 7453N | .14 | 74121N | .36 | 74178N | .90 |
| 7410N | .16 | 7454N | .14 | 74122N | .38 | 74179N | 2.50 |
| 7411N | .24 | 7459N | .20 | 74123N | .70 | 74180N | .80 |
| 7412N | .33 | 7460N | .14 | 74125N | .47 | 74181N | 2.39 |
| 7413N | .44 | 7470N | .26 | 74126N | .53 | 74182N | .70 |
| 7414N | .95 | 7472N | .26 | 74128N | .84 | 74184N | 1.84 |
| 7416N | .30 | 7473N | .37 | 74132N | 1.10 | 74185N | 2.20 |
| 7417N | .33 | 7474N | 32 | 74136N | .95 | 7418BN | 4.75 |
| 7418N | .25 | 7475N | .50 | 74141N | 1.20 | 74190N | 1.20 |
| 7420N | .13 | 7476N | .32 | 74145N | .91 | 74191N | 1.20 |
| 7421N | .33 | 7480N | .48 | 74147N | 2.40 | 74192N | .96 |
| 7422N | .50 | 7481N | 1.30 | 74148N | 2.00 | 74193N | .95 |
| 7423N | .37 | 7482N | .98 | 74150N | 1.00 | 74194N | 1.10 |
| 7425N | .23 | 7483N | .70 | 74151N | .80 | 74195N | .74 |
| 7426N | .23 | 7484N | 3.00 | 74152N | 1.40 | 74196N | .99 |
| 7427N | .25 | 7485N | .90 | 74153N | .79 | 74197N | .78 |
| 7428N | .33 | 7486N | .34 | 74154N | 1.40 | 74198N | 1.60 |
| 7430N | .20 | 7489N | 2.20 | 74155N | .97 | 74199N | 1.60 |
| 7432N | .24 | 7490N | .48 | 74156N | .95 | 74200N | 5.60 |
| 7433N | .36 | 7491N | .78 | 74157N | .74 | 74221N | 1.50 |
| 7437N | .29 | 7492N | .49 | 74158N | 1.60 | 74251N | 1.75 |
| 7438N | .29 | 7493N | .49 | 74160N | 1.24 | 74278N | 2.45 |
| 7439N | .38 | 7494N | .72 | 74161N | .99 | 74279N | .94 |
| 7440N | .16 | 7495N | .80 | 74162N | 1.25 | 74293N | 1.00 |
| 7441N | .87 | 7496N | .70 | 74163N | .99 | 74298N | 1.98 |

### HIGH SPEED TTL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 74H00N | .33 | 74H20N | .33 | 74H52N | .36 | 74H73N | .80 |
| 74H01N | .25 | 74H21N | .33 | 74H53N | .36 | 74H74N | .80 |
| 74H04N | .33 | 74H22N | .33 | 74H54N | .36 | 74H76N | .75 |
| 74H05N | .33 | 74H30N | .33 | 74H55N | .36 | 74H102N | .75 |
| 74H08N | .40 | 74H40N | .36 | 74H60N | .36 | 74H103N | .90 |
| 74H10N | .33 | 74H50N | .36 | 74H71N | .75 | 74H106N | .95 |
| 74H11N | .33 | 74H51N | .36 | 74H72N | .75 | | |

### LOW POWER TTL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 74L00N | .24 | 74L10N | .24 | 74L51N | .34 | 74L90N | 1.62 |
| 74L02N | .24 | 74L20N | .33 | 74L73N | .43 | 74L93N | 1.51 |
| 74L03N | .39 | 74L42N | 1.33 | 74L74N | .90 | 74L95N | 1.62 |
| 74L04N | .33 | | | | | | |

### 74LS00

| | 1-9 | 10up | | 1-9 | 10up | | 1-9 | 10up |
|---|---|---|---|---|---|---|---|---|
| 74LS00 | .38 | .35 | 74LS54 | .55 | .54 | 74LS160 | 3.00 | 2.90 |
| 74LS01 | .50 | .49 | 74LS55 | .39 | .38 | 74LS161 | 3.00 | 2.90 |
| 74LS02 | .39 | .38 | 74LS73 | .65 | .64 | 74LS162 | 2.25 | 2.20 |
| 74LS03 | .39 | .38 | 74LS74 | .65 | .64 | 74LS163 | 2.25 | 2.20 |
| 74LS04 | .45 | .44 | 74LS76 | .65 | .64 | 74LS170 | 5.80 | 5.70 |
| 74LS05 | .45 | .44 | 74LS78 | .92 | .91 | 74LS174 | 2.20 | 2.15 |
| 74LS08 | .39 | .38 | 74LS95 | 2.19 | 2.10 | 74LS175 | 2.40 | 2.35 |
| 74LS09 | .45 | .44 | 74LS107 | .65 | .64 | 74LS181 | 3.69 | 3.65 |
| 74LS10 | .39 | .38 | 74LS109 | .65 | .64 | 74LS190 | 2.85 | 2.80 |
| 74LS11 | .42 | .41 | 74LS112 | .65 | .64 | 74LS191 | 2.85 | 2.80 |
| 74LS15 | .57 | .56 | 74LS113 | .92 | .90 | 74LS193 | 2.85 | 2.80 |
| 74LS20 | .39 | .38 | 74LS114 | .92 | .90 | 74LS194 | 2.25 | 2.20 |
| 74LS21 | .56 | .55 | 74LS123 | 1.30 | 1.29 | 74LS195 | 2.25 | 2.20 |
| 74LS22 | .60 | .59 | 74LS138 | 1.89 | 1.85 | 74LS251 | 2.06 | 2.00 |
| 74LS27 | .45 | .44 | 74LS139 | 2.00 | 1.95 | 74LS253 | 2.42 | 2.40 |
| 74LS30 | .39 | .38 | 74LS151 | 1.55 | 1.50 | 74LS257 | 1.89 | 1.85 |
| 74LS32 | .45 | .44 | 74LS153 | 1.89 | 1.85 | 74LS258 | 2.06 | 2.00 |
| 74LS38 | .53 | .52 | 74LS157 | 1.55 | 1.50 | 74LS260 | .50 | .44 |
| 74LS51 | .39 | .38 | 74LS158 | 1.68 | 1.60 | | | |

### SCHOTTKY TTL

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 74S00 | .44 | 74S32 | .80 | 74S113 | 1.50 | 74S174 | 3.30 |
| 74S01 | .76 | 74S40 | .65 | 74S114 | 1.20 | 74S175 | 2.90 |
| 74S02 | .60 | 74S50 | .76 | 74S133 | .80 | 74S181 | 6.00 |
| 74S03 | .75 | 74S51 | .80 | 74S138 | 2.20 | 74S189 | 4.40 |
| 74S04 | .55 | 74S60 | .80 | 74S139 | 2.20 | 74S194 | 3.30 |
| 74S05 | .76 | 74S64 | .80 | 74S140 | .80 | 74S195 | 3.30 |
| 74S08 | .80 | 74S65 | .80 | 74S151 | 2.20 | 74S251 | 2.20 |
| 74S09 | .76 | 74S74 | .90 | 74S153 | 3.40 | 74S253 | 2.40 |
| 74S10 | .55 | 74S76 | 1.15 | 74S157 | 2.40 | 74S257 | 2.40 |
| 74S11 | .65 | 74S78 | 1.16 | 74S158 | 2.00 | 74S258 | 2.40 |
| 74S15 | .76 | 74S85 | 6.10 | 74S160 | 3.90 | 74S260 | 1.20 |
| 74S20 | .65 | 74S86 | 2.50 | 74S161 | 4.70 | 74S280 | 5.70 |
| 74S21 | .76 | 74S112 | 1.00 | 74S172 | 6.00 | 74S289 | 4.00 |
| 74S30 | .80 | | | | | | |

### 9300 SERIES

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9300PC | $1.00 | 9318PC | 2.30 | 9366PC | 1.75 | 93L18 | 3.50 |
| 9301PC | 1.20 | 9321PC | 1.20 | 93L00 | 1.50 | 93L21 | 1.50 |
| 9304PC | 1.50 | 9322PC | 1.30 | 93L01 | 1.60 | 93L22 | 1.80 |
| 9306PC | 6.90 | 9324PC | 2.00 | 93L08 | 3.20 | 93L24 | 2.80 |
| 9308PC | 2.50 | 9328PC | 2.50 | 93L09 | 1.80 | 93L28 | 3.70 |
| 9309PC | 1.60 | 9334PC | 2.95 | 93L10 | 2.80 | 93L34 | 4.00 |
| 9310PC | 1.50 | 9338PC | 3.30 | 93L11 | 4.20 | 93L38 | 4.20 |
| 9311PC | 2.30 | 9340PC | 5.00 | 93L12 | 1.80 | 93L40 | 6.50 |
| 9312PC | 1.20 | 9341PC | 4.10 | 93L14 | 1.70 | 93L41 | 6.50 |
| 9314PC | 1.30 | 9342PC | 1.15 | 93L16 | 3.20 | 93L60 | 3.00 |
| 9316PC | 1.50 | 9360PC | 1.75 | 93L18 | 3.50 | 93L66 | 2.70 |

## LINEAR IC's

H=TO-5 N=DIP M=MINI-DIP D=CER-DIP K=TO-3

| | | | | | |
|---|---|---|---|---|---|
| LM105H | 3.90 | LM311H | 1.20 | LM710CH | .90 |
| LM108H | 4.90 | LM311D | .90 | LM710CN | .90 |
| LM114H | 3.00 | LM311M | 1.75 | LM711CH | .90 |
| LM300H | 1.20 | LM312N | 1.75 | LM711CN | .90 |
| LM300N | 1.20 | LM318H | 1.50 | LM715CH | 3.50 |
| LM301AH | .50 | LM318M | 2.40 | LM715CD | 4.60 |
| LM301AM | .80 | LM324N | 1.90 | LM723CH | .60 |
| LM301AN | 1.10 | LM331N | 1.25 | LM723CN | .65 |
| LM301M | .95 | LM336K | 2.40 | LM725CH | 1.50 |
| LM302N | 1.30 | LM339N | 2.20 | LM725CD | 5.00 |
| LM302H | 1.40 | LM320-5K | 2.90 | LM733CH | 1.40 |
| LM304H | 1.20 | LM320-5T | 2.50 | LM733CD | 3.50 |
| LM305H | .85 | LM320-12K | 2.90 | LM733CN | 1.30 |
| LM305AH | 1.05 | LM320-12T | 2.50 | LM741CH | .40 |
| LM305N | 1.00 | LM340-5K | 2.60 | LM741CD | 1.25 |
| LM306N | .95 | LM340-6K | 2.60 | LM741CM | .39 |
| LM307H | .60 | LM340-8K | 2.60 | LM747CH | .75 |
| LM307M | 1.50 | LM340-12K | 2.60 | LM747CN | .90 |
| LM308H | .85 | LM340-15K | 2.60 | LM748CM | .55 |
| LM308AH | 5.00 | LM340-18K | 2.60 | LM777CH | 2.15 |
| LM308D | 2.25 | LM340-24K | 2.60 | LM777CM | 2.10 |
| LM308M | 1.00 | LM555CM | .70 | LM3046CN | .95 |
| LM309H | 1.75 | LM556CM | 1.30 | LM3054CN | 1.50 |
| LM309K | 1.50 | LM567CM | 1.70 | SG4501T | 2.40 |
| LM310H | 1.50 | LM709CH | .75 | SG4501N | 2.40 |
| LM310M | 1.80 | LM709CN | .75 | LM5000K | 7.50 |

### C-MOS

| P/N | 1-9 | 10up | P/N | 1-9 | 10up | P/N | 1-9 | 10up |
|---|---|---|---|---|---|---|---|---|
| 4000AE | .24 | .23 | 4027AE | .55 | .53 | 4070AE | .60 | .59 |
| 4001AE | .24 | .22 | 4028AE | .95 | .88 | 4071AE | .25 | .23 |
| 4002AE | .24 | .22 | 4029AE | 1.25 | 1.22 | 4072AE | .34 | .31 |
| 4004AE | 4.00 | 3.99 | 4030AE | .44 | .40 | 4073AE | .38 | .35 |
| 4006AE | 1.30 | 1.20 | 4033AE | 2.00 | 1.94 | 4075AE | .38 | .35 |
| 4007AE | .24 | .23 | 4035AE | 1.25 | 1.14 | 4076AE | 1.24 | 1.22 |
| 4008AE | 1.79 | 1.65 | 4040AE | 1.58 | 1.50 | 4077AE | .70 | .69 |
| 4009AE | .59 | .51 | 4041AE | 1.82 | 1.75 | 4078AE | .38 | .35 |
| 4010AE | .50 | .49 | 4042AE | .78 | .75 | 4081AE | .25 | .23 |
| 4011AE | .24 | .23 | 4043AE | .85 | .80 | 4082AE | .34 | .31 |
| 4012AE | .24 | .22 | 4044AE | .80 | .75 | 4095AE | 2.00 | 1.99 |
| 4013AE | .45 | .40 | 4047AE | 2.75 | 2.70 | 4098AE | 1.30 | 1.29 |
| 4014AE | 1.45 | 1.34 | 4048AE | 1.43 | 1.42 | 4099AE | 2.90 | 2.89 |
| 4015AE | 1.24 | 1.23 | 4049AE | .58 | .53 | 4507AE | .60 | .55 |
| 4016AE | .50 | .49 | 4050AE | .58 | .53 | 4508AE | 2.20 | 2.19 |
| 4017AE | 1.15 | 1.07 | 4051AE | 1.49 | 1.48 | 4510AE | 1.45 | 1.44 |
| 4018AE | 1.24 | 1.23 | 4052AE | 1.49 | 1.48 | 4514AE | 5.00 | 4.99 |
| 4019AE | .50 | .49 | 4053AE | 1.49 | 1.48 | 4515AE | 5.00 | 4.99 |
| 4020AE | 1.45 | 1.34 | 4055AE | 1.95 | 1.94 | 4516AE | 1.75 | 1.74 |
| 4021AE | 1.38 | 1.25 | 4056AE | 1.99 | 1.98 | 4518AE | 1.28 | .98 |
| 4022AE | 1.05 | .99 | 4063AE | 2.50 | 2.49 | 4520AE | 1.28 | .98 |
| 4023AE | .24 | .22 | 4066AE | 1.10 | 1.09 | 4528AE | 1.59 | 1.45 |
| 4024AE | .88 | .80 | 4068AE | .50 | .49 | 4585AE | 2.05 | 1.89 |
| 4025AE | .24 | .22 | 4069AE | .44 | .43 | 4901AE | .43 | .36 |
| | | | | | | 4911AE | .43 | .36 |

# INDUSTRIAL QUALITY COMPONENTS

We've been buying and selling top quality components for nearly ten years. Our annual volume exceeds $3 million. We handle only original parts, from the world's leading manufacturers and our customers include some of the largest and most quality-conscious companies. Now you can take advantage of our component buying skills and power and select from a broad range of advanced circuits.


# MICROPROCESSOR SPECIAL

# 8080A $38.50

### INTERSIL 8038 PRECISION WAVEFORM GENERATOR & VCO

For simultaneous sine, square and triangular waveforms <.001 Hz to 1MHz.

| Part No. | 1-9 | 10 up |
|---|---|---|
| 8038CCPD | $3.90 | $3.70 |

### 1-AMP RECTIFIERS

| | 10 | 100 | 1000 |
|---|---|---|---|
| 1N4001 | 1.00 | 7.00 | 60.00 |
| 1N4002 | 1.10 | 8.00 | 70.00 |
| 1N4003 | 1.20 | 9.00 | 80.00 |
| 1N4004 | 1.30 | 10.00 | 90.00 |
| 1N4005 | 1.40 | 11.00 | 100.00 |
| 1N4006 | 1.50 | 12.00 | 110.00 |
| 1N4007 | 1.60 | 13.00 | 120.00 |

### HYBRID POWER AMPLIFIERS

| | | |
|---|---|---|
| SI-1010G | 10W | $6.40 |
| SI-1020G | 20W | 9.90 |
| SI-1030G | 30W | 18.70 |
| SI-1050E | 50W | 24.90 |
| SI-1050G | 50W | 24.90 |

### HIGH VOLTAGE TRANSISTORS

| | | | |
|---|---|---|---|
| BU204 | 3A | 1300V | $4.14 |
| BU205 | 3A | 1500V | 4.95 |
| BU206 | 3A | 1700V | 5.94 |
| BU207 | 6A | 1300V | 5.85 |
| BU208 | 6A | 1500V | 6.93 |
| BU209 | 6A | 1700V | 8.64 |

### PICO-PAC

**THE SMALLEST AC/DC POWER SUPPLY EVER!**
Only 1.70"x1.00" x 0.85", output preset ±5%, 9 models:

| | |
|---|---|
| 5 | 140 |
| 8 | 115 |
| 10 | 100 |
| 12 | 90 |
| 15 | 70 |
| 18 | 50 |
| 20 | 35 |
| 22 | 25 |
| 24 | 15 |

$39.80 each

### POWER SUPPLIES

ADTECH

| Model No. | Output Vdc | Output Amps | 1-4 | 5 up |
|---|---|---|---|---|
| APS5-3 | 5 | 3.0 | $29.95 | $28.60 |
| APS12-1.6 | 12 | 1.6 | | |
| APS15-1.5 | 15 | 1.5 | | |
| APS24-1 | 24 | 1.0 | | |
| APS28-0.8 | 28 | 0.8 | | |
| APS5-6 | 5 | 6 | $48.45 | $46.05 |
| APS12 4 | 12 | 4 | | |
| APS15-3 | 15 | 3 | | |
| APS24-2.2 | 24 | 2.2 | | |
| APS28-2 | 28 | 2 | | |
| APS5-10 | 5 | 10 | $72.25 | $68.65 |
| APS12-7 | 12 | 7 | | |
| APS15-6 | 15 | 6 | | |
| APS24-5 | 24 | 5 | | |
| APS28-4 | 28 | 4 | | |

## MICROPROCESSORS & LSI

| | 1-9 | 10 up |
|---|---|---|
| P1101A | 2.20 | 2.10 |
| P1101A1 | 3.50 | 3.30 |
| P2102-1 | 3.90 | 3.00 |
| 91L02 | 3.90 | 3.20 |
| 91L02-1 | 3.90 | 3.20 |
| 8080A | | 38.50 |

| | |
|---|---|
| 1702 | 17.00 |
| P8101 | 5.50 |
| P8101-2 | 6.00 |
| P8102 | 4.00 |
| P8102-2 | 4.00 |
| P8111 | 5.60 |
| P8111-2 | 6.00 |
| 9102PC | 4.00 |

### COMPUTER INTERFACE

| | |
|---|---|
| DM8820N | 2.40 |
| DM8820AN | 6.90 |
| DM8830N | 2.40 |
| DM8831N | 5.20 |
| DM8832N | 6.00 |
| N8T268 | 4.40 |
| 9600PC | 1.30 |
| 9601PC | 1.20 |
| 9602PC | 1.95 |
| 9614PC | 2.30 |
| 9615PC | 2.40 |
| 9616PC | 5.00 |
| 9617PC | 3.50 |
| 9620PC | 4.00 |
| 9621PC | 4.00 |

**75107**

| | |
|---|---|
| 75107BN | 2.60 |
| 75108BN | 2.30 |
| 75109N | 2.20 |
| 75110N | 2.20 |
| 75115N | 2.25 |
| 75138N | 2.95 |
| 75150N | 3.10 |
| 75154N | 4.10 |
| 75208N | 2.70 |
| 75234N | 2.50 |
| 75450N | 1.25 |
| 75451N | 1.00 |
| 75452N | 1.00 |
| 75453N | 1.00 |

**7520 SERIES SENSE AMPS**

| | |
|---|---|
| 7520N | 4.00 |
| 7521N | 2.00 |
| 7522N | 4.25 |
| 7523N | 1.75 |
| 7524N | 2.00 |
| 7525N | 4.50 |

**TWO-PHASE MOS CLOCK DRIVER**
MH0026CN 5.50

**DECODED READ/WRITE RAM**
P1103 5.90

**2524V Recirculating 512 Bit Dynamic Shift Register**
1 24 2.40
25 uP 2.30

### BIPOLAR MEMORY

| | |
|---|---|
| C3101 | 6.50 |
| P3101 | 4.90 |
| C3101A | 7.30 |
| P3101A | 5.80 |
| IM5501CDE | 7.30 |
| IM5501CPE | 5.80 |
| MM5560D | 7.30 |
| MM5560N | 5.80 |
| DM8599N | 5.80 |
| 93403PC | 5.80 |

**1024-BIT N-Channel RAM**

| | |
|---|---|
| C2102 | 5.00 |
| P-2102 | 2.85 |
| C2102-1 | 5.00 |
| P-2102-1 | 3.90 |
| C2102-2 | 6.00 |
| P-2102-2 | 3.00 |
| P-2102A | 8.00 |
| P-2102A-2 | 9.50 |
| P-2102A-4 | 6.00 |
| 2601-1 | 4.00 |
| 2601-21 | 11.40 |
| 26028 | 3.80 |
| 2602-18 | 4.40 |
| 2602-2B | 4.00 |
| MK4102P | 11.40 |
| 7552-1CPE | 6.00 |
| 7552-2CPE | 6.00 |
| TMS4033JL | 9.00 |
| TMS4033NL | 4.20 |
| TMS4034JL | 9.00 |
| TMS4034NL | 4.20 |
| TMS4035JL | 9.00 |
| TMS4035NL | 4.20 |

**MM**

| | |
|---|---|
| MM404H | 12.00 |
| MM405H | 23.00 |
| MM406H | 6.50 |
| MM407H | 6.50 |
| MM451H | 11.40 |
| MM454F | 18.00 |
| MM500H | 2.00 |
| MM506H | 3.20 |
| MM507H | 3.20 |
| MM550H | 5.90 |
| MM551H | 5.60 |
| MM555H | 5.60 |

### MOS-LSI

| | |
|---|---|
| 1402AN | 3.80 |
| 1403AH | 4.00 |
| 1403AN | 3.80 |
| 1404AH | 4.50 |
| 1404AN | 2.90 |
| 1405A | 4.00 |
| 1406 | 8.40 |
| 1407 | 8.40 |
| 1506 | 3.00 |
| 1507 | 3.00 |
| 1602 | 33.00 |
| P2101 | 5.00 |
| P2101-1 | 5.50 |
| P2101-2 | 4.90 |
| P2111 | 5.80 |
| P2111-1 | 6.00 |
| P2111-2 | 5.90 |
| P2112 | 5.00 |
| P2112-2 | 5.90 |
| P2401 | 9.90 |
| P2405 | 9.70 |
| 2505K | 3.30 |
| 2512K | 4.00 |
| 2521V | 2.50 |
| 2525V | 3.50 |
| 2533V | 7.90 |
| 2803PC | 4.00 |
| 2804PC | 4.00 |
| 2807PC | 2.70 |
| 2808PC | 4.00 |
| TMS3114J | 9.40 |
| TMS3120JC | 7.00 |
| TMS3120NC | 6.00 |
| TMS3133NC | 7.50 |
| 3341ADC | 8.00 |
| 3341APC | 7.00 |
| 3347DC | 5.80 |
| 3347PC | 4.60 |
| 4102 | 4.95 |
| 7552 | 4.95 |
| 7552-1 | 5.40 |
| 7552-2 | 5.50 |
| MM4055D | 12.00 |
| MM4056H | 9.70 |
| MM4057D | 13.00 |
| MM5025N | 20.00 |
| MM5026N | 20.00 |
| MM5027N | 20.00 |
| MM5055N | 5.50 |
| MM5056N | 5.50 |
| MM5057N | 5.50 |
| MM5058N | 5.50 |

### IC SOCKETS

SOLDER-TIN DIP

| PIN | 1-24 | 25 | 100 |
|---|---|---|---|
| 8 | .21 | .19 | .17 |
| 14 | .25 | .22 | .20 |
| 16 | .28 | .25 | .23 |
| 24 | .67 | .61 | .55 |
| 28 | .88 | .80 | .72 |
| 36 | 1.09 | .98 | .89 |
| 40 | 1.24 | 1.12 | .92 |

WIRE-WRAP GOLD

| PIN | 1-24 | 25 | 100 |
|---|---|---|---|
| 14 | .45 | .41 | .37 |
| 16 | .54 | .49 | .44 |

SOLDER - GOLD DIP

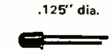
| | | | |
|---|---|---|---|
| 14 | .34 | .31 | .28 |
| 16 | .37 | .34 | .31 |

TEFLON TO-5

| | |
|---|---|
| 3 PIN | .55 EA |
| 4 PIN | .65 EA |
| 6 PIN | .90 EA |
| 8 PIN | 1.10 EA |
| 10 PIN | 1.40 EA |

### LEDs

.125" dia.

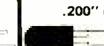


| | | |
|---|---|---|
| 209 | RED | $.25 |
| 209 | YELLOW | .35 |
| 209 | GREEN | .35 |

.160" dia.

| | | |
|---|---|---|
| 216 | RED | $.25 |
| 216 | YELLOW | .30 |
| 216 | GREEN | .30 |

.200" dia.



| | | |
|---|---|---|
| 220 | RED | $.25 |
| 220 | YELLOW | .30 |
| 220 | GREEN | .30 |

LOW PROFILE

.200" dia.

| | | |
|---|---|---|
| 226 | RED | $ 25 |
| 226 | YELLOW | .30 |
| 226 | GREEN | .30 |
| 226 | ORANGE | .30 |

.200" dia.

| | | |
|---|---|---|
| 5053 | RED | $.35 |
| 5053 | YELLOW | .40 |
| 5053 | GREEN | .40 |
| 5053 | ORANGE | .40 |

MV50 RED $.30

*216 = MV5024*
*5053 = MV5053*

### DISPLAYS

OPCOA

| | | |
|---|---|---|
| SLA1 | RED | 2.25 |
| SLA11 | GREEN | 3.50 |

XCITON

| | | |
|---|---|---|
| XAN72 | RED | 2.00 |
| XAN52 | GREEN | 2.00 |

LITRONIX

| | | |
|---|---|---|
| DL80 | RED | 6.00 |
| DL81 | RED | 6.00 |
| DL10 | RED | 6.00 |
| DL10A | RED | 4.00 |
| DL101 | RED | 4.90 |
| DL57 | RED | 9.90 |
| DL61 | RED | 12.00 |
| DL33 | RED | 4.00 |

| | | |
|---|---|---|
| DL44 | RED | 6.00 |
| DL402 | RED | 4.00 |
| DL701 | RED | 3.40 |
| DL704 | RED | 2.25 |
| DL707 | RED | 2.35 |
| DL747 | RED | 2.50 |

| | | 1-9 | 10 up |
|---|---|---|---|
| DL747 | RED | 2.50 | 2.40 |

### CARBON FILM RESISTORS

¼ WATT 5%

150 STANDARD VALUES . . . . . . . . . . . . . . $1.69 per 100
10 ohm to 10 megohms . . . .Only in multiples of 100 per value

**EP 9125 9-DIGIT DISPLAY**
$7.90
1/8" Character Ht. Compact, Thin PC Pkg., Wide Viewing Angle

### ELECTRONIC ARRAYS

EA1500AJ

| | |
|---|---|
| 1-24 | $21 00 |
| 25 | 16 80 |
| 100 | 14 00 |

EA 1500ASJ

| | |
|---|---|
| 1-24 | $16.00 |
| 25 | 14.40 |
| 100 | 12.00 |

### OPTOISOLATORS

MONSANTO
MCT2 1.35

LITRONIX

| | | | |
|---|---|---|---|
| IL1 | 1.30 | IL74 | 1.35 |
| IL12 | 1.40 | ILD74 | 1.75 |
| IL16 | 1.80 | ILQ74 | 3.40 |

### WAVEFORM GENERATOR KIT

**EXAR XR205K . . . . . . . . $25.00**

Here's a highly versatile lab instrument at a fraction of the cost of conventional unit. Kit includes 2 XR205 IC's, data & applications, PC board (etched and drilled, ready for assembly) and detailed instructions.

Prices effective through April 30, 1976.
Minimum order: $10.00. Add $1.00 to cover postage and handling. California residents add 6% sales tax

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Visit our Electronic Shop: 11080 Jefferson Blvd., Culver City, CA
(Studio Village Shopping Center)
Prices may vary at over-the-counter locations.

### STANDARD MICROSYSTEMS

| | 1-9 | 10 up |
|---|---|---|
| COM2502 | $13.20 | $10.60 |
| COM2502P | 8.00 | 6.85 |
| COM2017 | 13.20 | 10.60 |
| COM2017P | 8.00 | 6.85 |
| COM2502H | 25.00 | 20.00 |
| COM2017H | 25.00 | 20.00 |
| COM2601 | 30.00 | 24.00 |
| COM5016 | 12.00 | 9.60 |
| KR2376-ST | 20.00 | 17.50 |
| KR3600-ST | 20.00 | 17.50 |
| NMX5010 | 12.00 | 9.60 |
| CAL1022 | 60.00 | 52.00 |

# Spring-Pac super SALE! Each pac only $1.98

All pacs are first quality (no fallout), tested and guaranteed.

**Memory pac** — 4 MM5016 MOS TO-5 512 BIT shift registers from NATIONAL - with data **$1.98**

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**Comparator pac** — 5 assorted DIP's-- LM311, 710, 711, with data **$1.98**

**TTL Gates** — 15 assorted DIP's 7400 series-7420, 7430, 7440, etc...All prime, marked parts, with data **$1.98**

**LED pac** — 10 assorted discrete LED's-green, red, and infra-red, with data. **$1.98**

**Transistor pac** — 40 assorted TO-92 plastic transistors-- PNP's and NPN's, mostly Fairchild house marked. **$1.98**

**Regulators** — 4 LM723 DIP variable regulators, 2-40V, with data **$1.98**

**Diodes** — 100 Germanium computer signal diodes with leads trimmed for PCB mounting. **$1.98**

**Resistors** — 100 ¼ watt 5% resistors of any single standard value from 2.7 ohm to 1M ohm **$1.98**

**Linear pac** — 8 assorted linears in mini-DIP or TO-5*741 op amp, LM307 op amp, LM 703 RF-IF amp, with data and circuits **$1.98**

**DIP RC Network** — 50 assorted 14 and 16 pin IC packages containing precision resistors and capacitors-no data available **$1.98**

**Switches** — 8 SPST momentary contact push button N.O. Red button fits in approx. ½" panel, with lock washer and mounting nut. **$1.98**

**LED Display pac** — 2 DL33 - 3 digits each, approximately .1" magnified digits in a 12 pin DIP, with data **$1.98**

Buy 5 pacs for $9.90 and pic-a-pac for 10¢

The above are special offerings from Babylon Electronics, and will be shipped third class. See bottom of ad for ordering instructions.

## Specials

**DIP TRIMMER**

-12 turn trimpots which plug into a DIP socket
-5K and 200K
-½" x ¼" x ¼"
-4 leads spaced .3" x .2"

Each $.65 10 for $4.95

**25K Trimmer**

Printed Circuit Board Type
Each $.20
10 for $1.50

**TRANSISTOR**

2N3904 - HEP736
TO92 PLASTIC - NPN
300 MW - 60V - β100-300
NEW - FAIRCHILD - MARKED
EACH $ .15 10 FOR $1.00

**1 AMP RECTIFIER**

1N4007 SALE EACH $ .13 10/ $1.00

**NPN TO3 POWER TRANSISTORS**

2N3055: PD-115W; VCE-60V; HFE-50; FT-30K.
Each $ .90 10 for $6.95
410 (RCA) 200V-10A
2N3772 70V-30A (max.)
Each $1.75 10 for $15.00

## CMOS

| | | | |
|---|---|---|---|
| CD4001 | $ .29 | CD4023 | .29 |
| CD4002 | .29 | CD4024 | 1.50 |
| CD4009 | .59 | CD4025 | .34 |
| CD4010 | .59 | CD4030 | .65 |
| CD4011 | .29 | 74C20 | .65 |
| CD4013 | .69 | 74C42 | 2.00 |
| CD4015 | 1.98 | 74C157 | 2.50 |
| CD4016 | .69 | 74C195 | 1.00 |
| CD4019 | .69 | | |

**2102-2 MOS 1024 BIT MEMORY**

14 PIN DIP ON CARRIERS
Each $3.00 10 for $27.00

**1 Amp OP AMP**

Similar to National LH0021. General purpose operational amplifier in a TO-3 package. Capable of large output currents.

$6.95 ea. 5/$30.00

**More Memories**

93410-256x1 RAM, fully decoded, high speed (40 ns) open collector output. 16 pin DIP with data.
ONLY $2.25 10/$18.95

1702-2048 BIT PROM. 2K static units. Ultraviolet light erasable.
EACH $9.95

## TTL

| | | | |
|---|---|---|---|
| 7400 | $ .20 | 7453 | $ .10 |
| 74H00 | .25 | 7454 | .20 |
| 7401 | .14 | 74L54 | .25 |
| 74H01 | .25 | 74L55 | .25 |
| 7402 | .25 | 7460 | .16 |
| 7404 | .25 | 74L71 | .20 |
| 74H04 | .30 | 7472 | .40 |
| 7405 | .30 | 74L72 | .60 |
| 7406 | .40 | 7473 | .35 |
| 7408 | .30 | 74L73 | .75 |
| 7410 | .12 | 7474 | .45 |
| 7413 | .75 | 74H74 | .75 |
| 7417 | .40 | 7475 | .80 |
| 7420 | .12 | 7476 | .35 |
| 74L20 | .25 | 74L78 | .70 |
| 74H20 | .18 | 7480 | .50 |
| 74H22 | .30 | 7483 | .70 |
| 7430 | .10 | 7489 | 2.00 |
| 74H30 | .30 | 7490 | .70 |
| 74L30 | .30 | 7492 | .35 |
| 7440 | .10 | 7493 | 1.00 |
| 74H40 | .22 | 7495 | .65 |
| 7442 | 1.00 | 74L95 | 1.00 |
| 7447 | 1.50 | 74107 | .25 |
| 7450 | .10 | 74145 | 1.25 |
| 74H50 | .30 | 74155 | .90 |
| 7451 | .10 | 74174 | 1.00 |
| 74H51 | .25 | 74180 | 1.00 |
| 75492 | 1.00 | 74193 | 1.50 |

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| PRV | PRICE | PRV | PRICE |
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| 50.. | $.08 | 600.. | $.23 |
| 100.. | .10 | 800.. | .30 |
| 200.. | .15 | 1000. | .40 |
| 400.. | .18 | 1200. | .50 |

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Instructions & parts - 12 or 24 hour format.
Four digit clock kit includes all parts for complete clock: 3½"x 2":
-FND 70 readouts
-MM5314 clock chip & all transistors, etc.
-extruded aluminum case
-cord with transformer plug

**$16.95**

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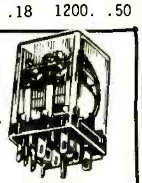
Type KHP Relay
4 PDT 3A Contacts



120V AC (10.5 MA coil)
**$1.75**

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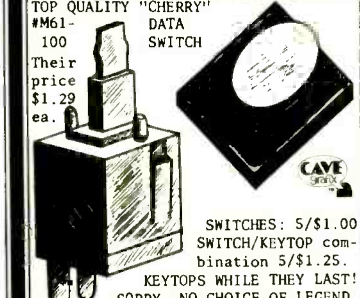
8 Actual size

A DIGITAL CLOCK IN YOUR VEHICLE---AT A SPECIAL COMBINATION PRICE! The clock features .3 inch readouts, bright digits, sockets for readouts and IC, choice of display modes, and so on. Our time base provides stable 60 Hz timing pulses: just the thing to free your clock from its dependence on the AC line. It's a miser with power consumption, and accurate to within .01% or better. Our data shows how to run your clock & time base from a 12 volt battery, blanking the readouts when not in use, remoting readouts, and more.

TOP QUALITY "CHERRY" #M61-100 DATA SWITCH
Their price $1.29 ea.

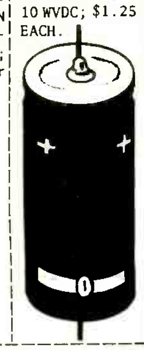


SWITCHES: 5/$1.00
SWITCH/KEYTOP combination 5/$1.25.
KEYTOPS WHILE THEY LAST!
SORRY, NO CHOICE OF LEGEND.

**39µf Tantalum** 10V 4/$1.00

SPST PUSHBUTTON SWITCHES, momentary contact; many uses. 4 for $1.00.

**10,000 µf** PERFECT TONIC FOR SUPPLIES WITH A FARAD DEFICIENCY. 10 WVDC; $1.25 EACH.



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ANOTHER "WHILE-THEY-LAST" SPECIAL: LOW POWER NMOS 1K RAMS!

**5V 5A microprocessor power supply**

Also +12V @ ½A and -12V @ ½A, plus an adjustable negative bias supply. Crowbar overvoltage protected; fold back current limiting; 5V regulation 1% or better. TOP QUALITY COMPUTER SUPPLY KIT, W/ HARDWARE & CHASSIS--less line cord. $44.95 + 8 lbs shpng.

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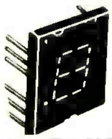

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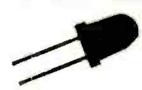

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