Z-80 COMPUTER CORNER

Radio-Electronics

$1.00 ■ FEB. 1978

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

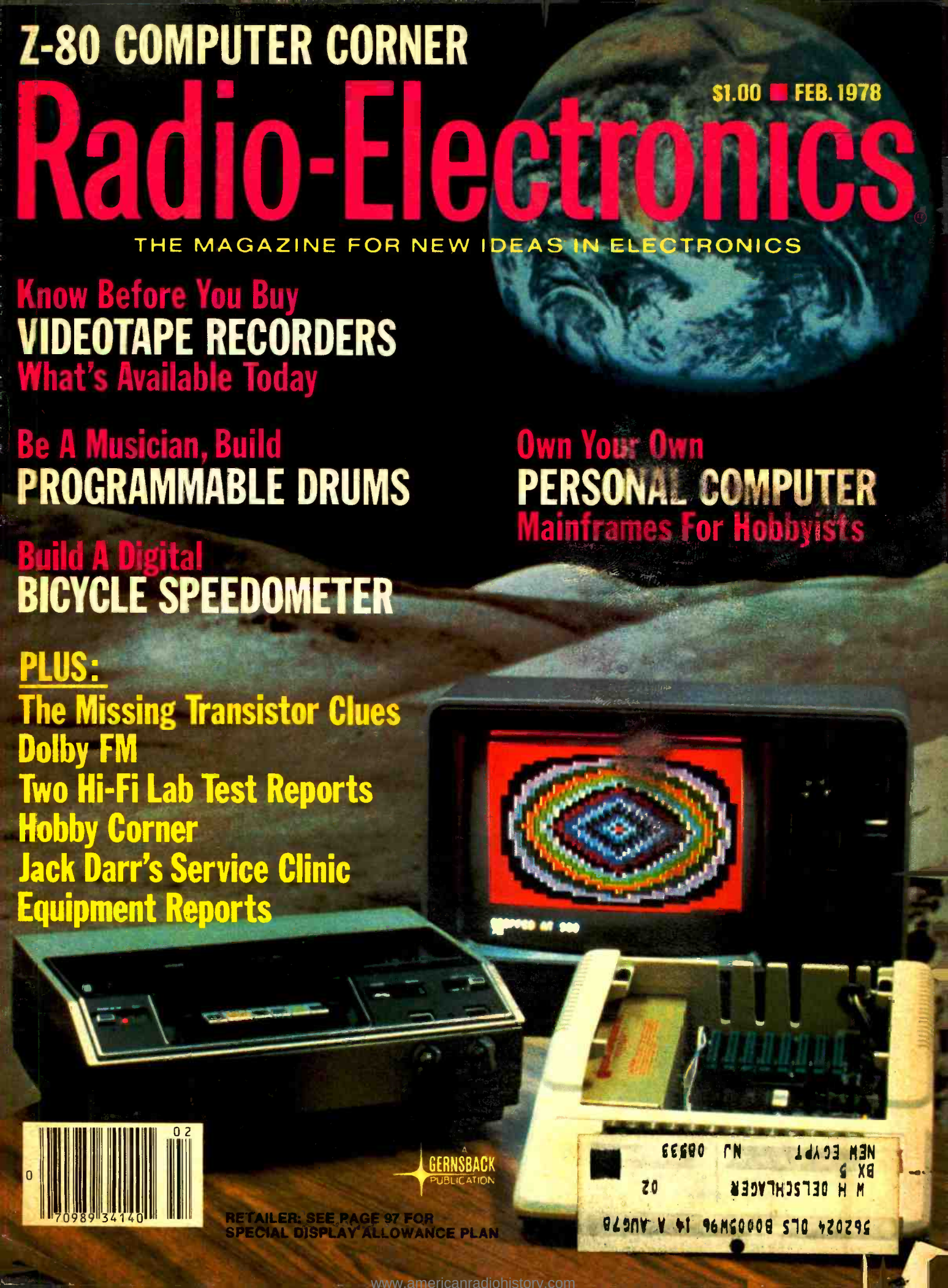
Know Before You Buy
VIDEOTAPE RECORDERS
What's Available Today

Be A Musician, Build
PROGRAMMABLE DRUMS

Own Your Own
PERSONAL COMPUTER
Mainframes For Hobbyists

Build A Digital
BICYCLE SPEEDOMETER

PLUS:



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A GERNSBACK PUBLICATION

RETAILER: SEE PAGE 97 FOR SPECIAL DISPLAY ALLOWANCE PLAN

fact: the 10 most common nuisances in PA can be cured. permanently. instantly.

These 10 problem solvers in your toolbox are like 10 new tricks up your sleeve. Or 10 hours of saved time. Or money in the bank. They tailor the sound, match the lines, smooth out the peaks, fill in the valleys, make molehills out of troubleshooting mountains. Snap one in. Out go the hassles. Without soldering, or splicing, or internal equipment modifications.

Problem:	Solution:	
Input Overload	A15A	**Microphone Attenuator** prevents input overload. Ideal where very strong signals are applied to a microphone input.
Phasing	A15PR	**Phase Reverser** reverses the phase of a balanced line without modification of equipment.
Low-Frequency Noise	A15HP	**High Pass Filter** provides a low-frequency microphone cutoff to reduce unwanted low-frequency noises and proximity effect.
High-Frequency Noise	A15LP	**Low Pass Filter** provides high-frequency cutoff to reduce objectionable high-frequency noises.
Lack of Presence	A15PA	**Presence Adapter** adds voice-range intelligibility and extra brilliance.
Sibilance	A15RS	**Response Shaper** provides excellent sibilance filtering; flattens microphone response.
Line Level to Mic Input	A15LA	**Line Input Adapter** converts balanced low-impedance microphone input to line level input.
Matching/ Bridging/Isolating	A15BT	**Bridging Transformer**, a balanced unit, matches balanced or unbalanced devices of different impedances.
Troubleshooting	A15TG	**Tone Generator** produces a continuous 700 Hz low-impedance microphone level signal — extremely useful in setting-up and troubleshooting lines. Helps check levels, connections, mixer inputs, and cables. Allows one man to do the work of two!
Microphone Impedance Matching	A95 and A97	**Series Line Transformers** make it possible to connect low-impedance lines to mid- and high-impedance inputs (or vice-versa). Completely reversible. Solves problems of excessive high-frequency loss and objectionable hum.

Shown Actual Size: 114mm (4½ in.) long x 19mm (¾ in.) diameter.

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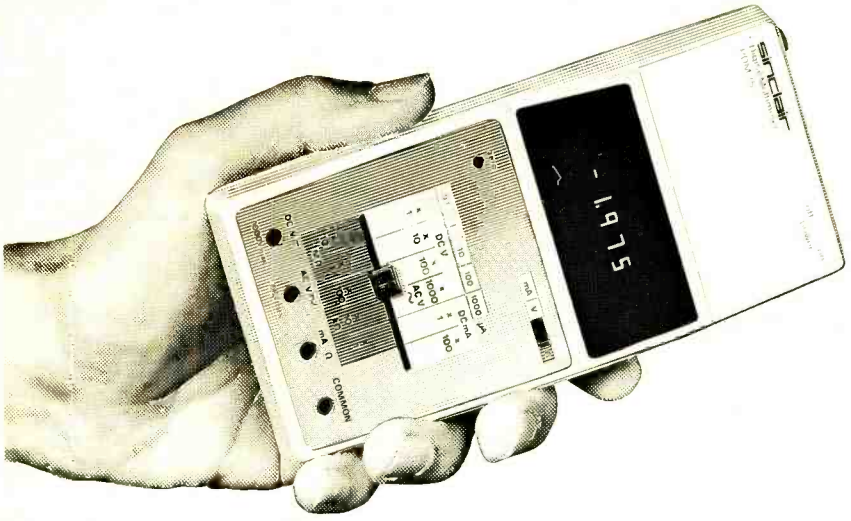
CIRCLE 46 ON FREE INFORMATION CARD

The Sinclair PDM35.
A personal digital multimeter for only $49.95



Now everyone can afford to own a digital multimeter

A digital multimeter used to mean an expensive, bulky piece of equipment.

The Sinclair PDM35 changes that. It's got all the functions and features you want in a digital multimeter, yet they're neatly packaged in a rugged but light pocket-size case, ready to go anywhere.

The Sinclair PDM35 gives you all the benefits of an ordinary digital multimeter – quick clear readings, high accuracy and resolution, high input impedence. Yet at $49.95 it costs less than you'd expect to pay for an analog meter!

The Sinclair PDM35 is tailor-made for anyone who needs to make rapid measurements. Development engineers, field service engineers, lab technicians, computer specialists, radio and electronic hobbyists will find it ideal.

With its rugged construction and battery operation, the PDM35 is perfectly suited for hand work in the field, while its angled display and optional AC power facility make it just as useful on the bench.

What you get with a PDM35

3½ digit resolution.
Sharp, bright, easily read LED display, reading to ±1.999.
Automatic polarity selection.
Resolution of 1 mV and 0.1 nA (0.0001 μA).
Direct reading of semiconductor forward voltages at 5 different currents.
Resistance measured up to 20 MΩ.
1% of reading accuracy.
Operation from replaceable battery or AC adapter.
Industry standard 10 MΩ input impedance.

Compare it with an analog meter!

The PDM 35's 1% of reading compares with 3% of full scale for a comparable analog meter. That makes it around 5 times more accurate on average.

The PDM35 will resolve 1 mV against around 10 mV for a comarable analog meter – and resolution on current is over 1000 times greater.

The PDM35's DC input impedance of 10 MΩ is 50 times higher than a 20 kΩ/volt analog meter on the 10 V range.

The PDM35 gives precise digital readings. So there's no need to interpret ambiguous scales, no parallax errors. There's no need to reverse leads for negative readings. There's no delicate meter movement to damage. And you can resolve current as low as 0.1 nA and measure transistor and diode junctions over 5 decades of current.

Technical specification

DC Volts (4 ranges)
Range: 1 mV to 1000 V.
Accuracy of reading 1.0% ± 1 count.
Note: 10 MΩ input impedance.
AC Volts (40 Hz-5 kHz)
Range: 1 V to 500 V.
Accuracy of reading: 1.0% ± 2 counts.
DC Current (6 ranges)
Range: 1 nA to 200 mA.
Accuracy of reading: 1.0% ± 1 count.
Note: Max. resolution 0.1 nA.
Resistance (5 ranges)
Range: 1Ω to 20 MΩ.
Accuracy of reading: 1.5% ± 1 count.
Also provides 5 junction-test ranges.
Dimensions: 6 in x 3 in x 1½ in.
Weight: 6½ oz.
Power supply: 9 V battery or Sinclair AC adapter.
Sockets: Standard 4 mm for resilient plugs.
Options: AC adapter for 117 V 60 Hz power. De-luxe padded carrying wallet. 30 kV probe.

The Sinclair credentials

Sinclair have pioneered a whole range of electronic world-firsts – from programmable pocket calculators to miniature TVs. The PDM35 embodies six years' experience in digital multimeter design, in which time Sinclair have become one of the world's largest producers.

Tried, tested, ready to go!

The Sinclair PDM35 comes to you fully built, tested, calibrated and guaranteed. It comes complete with leads and test prods, operating instructions and a carrying wallet. And getting one couldn't be easier. Just fill in the coupon, enclose a cheque/PO for the correct amount (usual 10-day money-back undertaking, of course), and send it to us.

We'll mail your PDM35 by return!

Sinclair Radionics Inc, Galleria, 115 East 57th Street, New York, N.Y. 10022, U.S.A.

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Please send me _____ (qty) PDM35(s) @$49.95 plus $1.05 postage and insurance each: ..... $_____
_____ (qty) De-luxe padded carrying case(s) @$4.95 each: ..... $_____
_____ (qty) AC adapter(s) @$4.95 each: ..... $_____
I enclose check/MO order made out to Sinclair Radionics Inc (indicate total order value.
Add 4% sales tax for NYS deliveries): ..... $_____
I understand that if I am not completely satisfied with my PDM35, I may return it within ten days for a full cash refund.

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TC-100/ST

TC-200/ST

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CIRCLE 31 ON FREE INFORMATION CARD

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THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

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FEBRUARY 1978 Vol. 49 No. 2

ON THE COVER

We've combined an Apple II hobby computer, an RCA Videotape machine and an RCA 19-inch color TV to put this month's cover together. We used the VTR to record the many different color displays the Apple produced. For more info on hobby computers turn to page 45. If it's the VTR you want to know about turn to page 52.

JOIN THE MASTER SUPER SLEUTH as he untangles a baffling web of clues and fixes the mysterious Oriental amplifier. Turn to page 68.

COMPUTER MAINFRAMES. For a look at who's offering what, turn to page 45.

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looking ahead

Audio revolution: Audio recording appears to be on the brink of the biggest breakthrough since Edison first preserved his words on a tin-foil cylinder. The breakthrough is the introduction of, and the eventual changeover to, digital recording. Theoretically, digital recording systems should have no distortion, no wow or flutter, practically infinite signal-to-noise ratio and a flat frequency response from DC to the top of the audible range.

The incredible thing about digital recording is that it's almost here. Although it may take a decade to spread into various consumer products, it should be available for fairly widespread sound studio use this year. Mitsubishi has already demonstrated a nine-track studio system and 3M has shown a 32-track system, the former using quarter-inch tape, the latter one-inch. Ampex has developed a special blank tape for digital recording. For advanced consumers who want to experiment with digital audio recording, both Sony and Mitsubishi (and probably others) will offer modifications for the Betamax and VHS videotape recorders to convert them to pulse-code modulation (PCM) digital audio recorders. Mitsubishi and TEAC have demonstrated PCM disc systems, both modifications of laser-scan optical videodisc devices. Upcoming new developments, such as 3M's high-coercivity Metafine tape and Hall-effect recording heads, are expected to bring digital recording closer to economical consumer use. When digital recording finally becomes an everyday reality, you can expect major efforts to develop a practical digital radio.

Latest on VTR: The videocassette recorder is now the fastest-growing new home electronic product and, naturally, new developments in that field are coming thick and fast. One of the most significant developments, that should help fuel consumer demand, is the rapid decline in prices. Although Sony pioneered home videotape recorders with the Betamax deck at a list price of $1,300 and most other manufacturers fell in line with the same price, RCA broke the ranks by introducing its Matsushita-built VHS machine at a suggested list price of $1,000 (**Radio-Electronics,** December 1977). Its competitors tried to maintain the higher price, but their ranks were soon broken by Zenith, which dropped its Beta system list price to $995. Sony followed soon after with a nominal price of $1,095 for its identical unit. Now virtually all home VTR's are at the $1,000-or-lower price in the stores, regardless of whether their suggested list is above or below that.

Several new manufacturers and marketers have joined the fold recently, and here is how the home VTR lineup stands at press time, arranged by standard, with suggested list price where available:

Two-hour or one-and-two-hour Beta format: Sony ($1,095); Sanyo (unpriced); Sears Roebuck ($995); NEC (due later in 1978); Toshiba ($1,095); Zenith ($995). **Two- and four-hour VHS format:** Panasonic ($1,095); General Electric (due this spring); Magnavox ($1,075-$1,095); Curtis Mathes ($2,900 and $4,000 in 25-inch TV-stereo combinations); Montgomery Ward (Panasonic brand at $995); RCA ($1,000); Sylvania ($995). **Two-hour VHS:** JVC (open list price); Hitachi (possibly by midyear); MGA (open price). **VX-2000:** Quasar ($995). **V-Cord II:** Sanyo ($1,050).

VTR playing time: Price is only one battlefront in home VTR. The other is record/play time. The first unit, Sony's Betamax, could record or play up to one hour on a cassette. The Japan Victor VHS had two-hour capability per cassette. Then Sony came back with the Betamax ×2, which moved the tape at half speed and extended the capacity of the former one-hour cassette to two hours. Matsushita then adapted the VHS system to a longer playing time, using the same method employed by Sony—slowing down the tape movement to half speed—to produce a machine which could cram four hours' programming on a single "two-hour" cassette. End of Round One.

Round Two. Sony announced the development of a new cassette that crammed more tape into the cassette by using a thinner tape. This extended the recording-time-per-cassette of its ×2 machine to three hours. In addition, it outlined plans to introduce a cassette changer that would permit unattended recording or playback of two cassettes. Thus, with two three-hour cassettes, the Betamax ×2 can tape six hours of programming while nobody is home. Then Japan Victor Co. (JVC) announced that it would also have a three-hour cassette for its two-hour VHS deck. However, the same cassette can be used on the Matsushita-built half-speed VHS deck to increase recording and playback time from four to six hours per cassette.

The question now arises: Who would want to record a six-hour block of programming on a single channel? Obviously, at present the extension of playing time to six hours is a good solution to a problem that doesn't exist. This long-play capacity suggests the necessity of another invention—the TV programmer-timer that will change channels unattended at preset times, so an entire evening's programming may be recorded unattended. Several manufacturers are working on such devices using microprocessors. You'll undoubtedly be hearing about them soon.

FCC studies TVI: Some 55% of the cases of CB-related television interference (TVI) in a recent FCC study was the fault of the CB, the remainder was caused by the TV set itself. Based on a study of 500 homes in six metropolitan areas, the FCC forecast that complaints of TVI from CB will climb to 105,000 in 1979 from the 1976 total of 45,210, unless the problem is attacked by improving both CB's and TV sets. The study concluded that inadequate suppression of CB transmitter harmonics and spurious radiation was the leading cause of such interference. The Commission also found that better built-in signal rejection for TV sets would eliminate at least one-third of the cases. Linear amplifiers connected to the CB were associated with 46% of all TVI cases, and in half of these the problem disappeared completely when the amplifier was removed; in the remaining cases it was substantially reduced. TV Channels 2 and 5 were the most seriously affected, followed by Channel 9. The Commission concluded that interference problem will require coordinated action by manufacturers and users of CB and TV sets and by the FCC.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

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7448	276-1816	99¢
7451	276-1825	39¢
7473	276-1803	49¢
7474	276-1818	49¢
7475	276-1806	79¢
7476	276-1813	59¢
7485	276-1826	1.19
7486	276-1827	49¢
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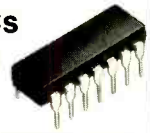

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74C192	276-2321	1.69
74C193	276-2322	1.69
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3909N	276-1705	99¢
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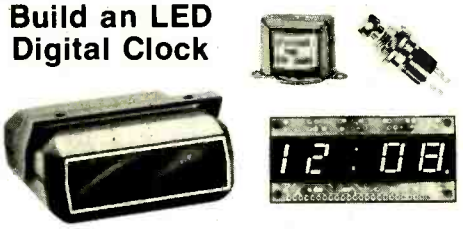

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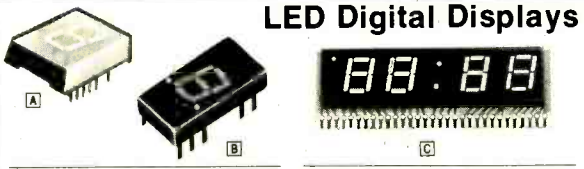

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Digits	Size	Drive	Cat. No.	ONLY
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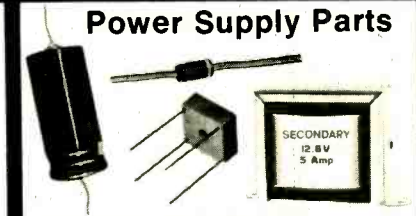

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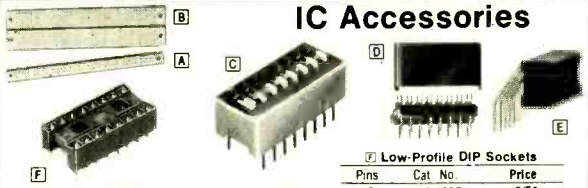

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16	276-1998	2/89¢
28	276-1997	Ea. 89¢
40	276-1996	Ea. 99¢

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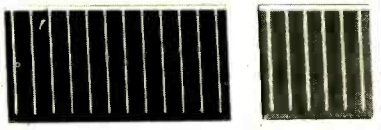

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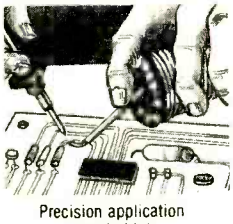

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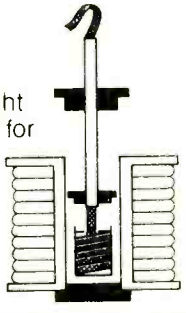

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new & timely

Pulse-modulation recorder uses laser beam system

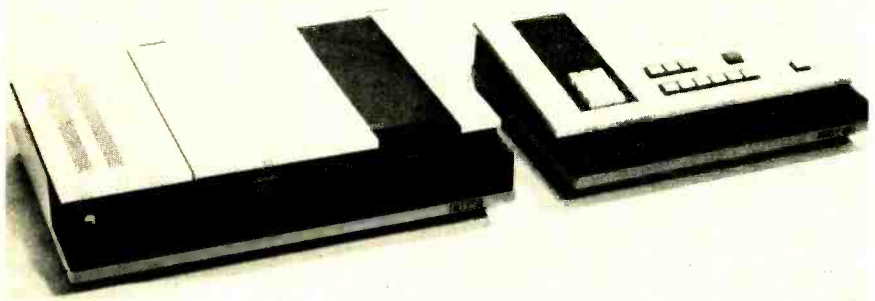
Mitsubishi Electric Corporation, TEAC Corporation and the Tokyo Denka Company have jointly developed the audio PCM (*P*ulse *C*ode *M*odulation) laser recorder—a system that projects a tiny laser beam onto a disc to record and reproduce high-fidelity sound of great purity.

The PCM system converts audio input signals into binary coded signals, modulates each signal into FM digital signals and then records them by focusing the laser beam onto the disc. During playback, four servos direct the laser optics to read out the PCM signals recorded on the disc. Decoders then convert the PCM signals back to the original audio signal. A servo motor keeps the turntable at a constant 1800 rpm. A focusing disc keeps the read-out laser beam constant. A tracking servo holds the laser beam steady over the spiral line of pits on the disc, and a radial-feed servo controls the laser optics in conjunction with the spiral line.

So far, a playing time of 30 minutes has been achieved by using a polyvinyl chloride disc. The companies involved, however, expect to extend this to two hours per disc.

Specifications for the new recorder include: negligible wow-and-flutter, a dynamic range of more than 98 dB, no crosstalk, a frequency response of 10 Hz to 20 kHz (+0.1, −0.5 dB), no distortion, no tracking error, no rumble and no surface noise. In addition, the disc is expected to last indefinitely because there is no contact between the disc and the pickup system.

Some of the possibilities envisioned for the PCM laser recorder: recording several symphonies on one disc; using the system in a juke box where dozens of songs can be selected by the system's short access time; or the possible multichanneling of music by using separate tracks for each instrument.



PCM LASER RECORDER uses laser beams to record and produce sound. Since the produced sound is not a function either of amplitude or record-groove depth, the resulting sound is of exceptional purity.

Mini-radio station can be used for disaster communications

A briefcase-sized radio station, developed by the National Aeronautics and Space Administration, could be used to speed disaster aid over long distances and in remote areas that are impossible to service via CB or police radio systems. The small battery-operated system, whose signals are transmitted via satellite, would receive on-the-scene medical advice and relay vital information about disaster victims to physicians and hospitals provided with individual radio stations.

Recently, NASA, White House and government agency officials participated in a demonstration of the unit's capabilities. Signals were transmitted from Washington, DC, to the University of Maryland's Shock Trauma Center in Baltimore. Transmission was accomplished by beaming the signals through a NASA ground station in North Carolina to a satellite high above the Pacific Ocean.

Dr. R. Adams Cowley, director of the Maryland Institute for Emergency Medical Services, hopes that a more definitive test can take place this Spring. Tentative plans call for a simulated airline collision with a fuel truck, with "burn victims" transferred to burn centers in Virginia, Pittsburgh and San Antonio, TX. Using the briefcase radio station at each location, officials could talk simultaneously with physicians at each facility to coordinate the evaluation.

Record-breaking attendance at New York hi-fi show

This past November, more than 41,000 people paid a $3 admission fee to attend the New York Hi-Fi Stereo Music Show held at the Statler Hilton. M. Robert Rogers, founder of the show (presented for the first time in New York), claims that the only other exhibit in the past ever to draw a similar attendance did not charge admission.

Visitors to the show examined the latest in hi-fi equipment, saw demonstrations and received free gifts or samples from the more than 80 exhibitors. Frosting on the cake was provided by leading figures of the entertainment world who both performed and gave out autographs. Prominent disc jockeys and radio personalities from local FM radio stations were also on hand to greet visitors.

Baltimore-Washington mobile phone system gets FCC approval

Motorola has received permission from the FCC to build its high-capacity cellular radio-telephone system in the Baltimore-Washington area. The system will provide mobile telephone service to many new business subscribers in overcongested urban areas by reusing the same channel frequencies in different areas (or cells) of each city.

While the cellular concept also attempts to control transmission levels for a more efficient use of the broadcast spectrum, frequency *reuse* is the key word. The system works like this: each base station signal can be heard by users within a specified area, or cell, that receives that signal. Each cell within a cluster of cells is assigned its own specific set of frequencies that cannot interfere with those of neighboring cells. (If cells are far apart, there is no interference problem because it is possible to use the same frequencies simultaneously.) Reducing the power transmission levels as well as the size of the cells allows the same frequencies to be used more frequently, thus enabling more subscribers to use the mobile phone service.

Motorola's hand-held portable unit can be incorporated into the company's present system, even though the present model is still somewhat too bulky. This portable unit sends a signal to a single central "sector-receive" antenna (one to each geographic cell). The sector antenna receives the signal and divides each hexagonal geographical area (cell) into six triangular regions, or wedges. The receivers then pass the transmission from wedge to wedge as the subscriber moves from area to area. The sector antenna, which is also capable of pulling in signals from as far away as 11 miles, is really the feature that enables transmission and reception of the low-power signals necessary for the system.

It is hoped that eventually the mobile phones can be dashboard-mounted. While the concept of low power plus small size is still in the drawing board stage, Motorola vice president Martin Cooper is confident that "within two years, we'll be producing a marketable product." It is predicted that this smaller unit will sell for around $2000, or $200 less than the company's present mobile instrument.

Canadian legislator discovers office is "bugged"

A device, described as a "bug," was

continued on page 14

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continued from page 12

discovered in the office telephone of Canadian Progressive Party leader Joseph Clark, thus adding fuel to the allegations of illegal bugging activities by the Royal Canadian Mounted Police, the Canadian equivalent of the FBI. The electronics expert who discovered the bug maintained that, even with the phone off the hook, the device would be able to monitor the opposition party's strategy conversations.

Later, however, Bell Canada telephone company technicians determined that the bug was in actual fact a "top hat diode," a standard part of every telephone having a bulb to show that the line is busy. From Mr. Clark's office: No comment.

Emergency alert system uses local CATV installations

Areas lacking local TV outlets for emergency broadcasts can now use a new system called C.E.A.S. (*Civil Emergency Alert System*) that can be connected to CATV installations. The system was developed by Cadco, Inc., manufacturers of cable TV antennas and equipment.

C.E.A.S. (*Civil Emergency Alert System*) enables officials to make direct emergency announcements by interrupting all cable TV channels in community. Shown is the complete system, manufactured by CADCO, Inc.

The C.E.A.S. equipment is installed in a central communications center (usually a police station) and connected to the local CATV system. The equipment blanks out all CATV channels so that voice-only emergency announcements can be made.

Here's how it works: A red telephone connected to a transmitter is tied, via leased telephone line, to an automatic modulator at the CATV head end. An assigned number is dialed, all TV screens in the area blank out, and a "warble" alert sounds. When the announcement is finished, the phone is hung up and regular CATV programming resumes.

The system costs around $3000. This amount can be partially defrayed by matching funds available through the Federal Civil Defense Act of 1950. For further information, write Phil Magers, CADCO, Inc., 2706 National Circle, Garland, TX 75041.

Bootleg videotape recordings hit all-time high

Bootleg prerecorded videocassette tapes have become big business, report federal law enforcement agencies and film industry executives. The upsurge in home videotape recorders and the increased demand for prerecorded tapes have caused an equivalent rise in pirated films, including first-run shows like "Star Wars," classic films, porno movies and network TV shows. According to a West Coast FBI source, as much as 99% of all seizures of pirated material has been in video tape, as contrasted with last year's favorite—film prints.

Prices are high. The average ½-inch home videotape copies sell anywhere from $50 to $200 and more (this for "Star Wars" and the like). Some bootlegged videotape masters go for as much as $10,000. Legitimate prerecorded videocassettes (which generally include films three years or older) can cost between $50 and $80.

Jim Bouras of the Motion Picture Association estimates that about 5% to 7% of all industry profits last year were lost due to piracy. And this doesn't take into account the actual cost of the bootlegged products themselves. Bouras added that there's no way of knowing how much of the piracy was in videotape form. However, he sees the situation getting worse: "In the past year or so, we've seen an increase in tape over film, probably due to the ease in handling the smaller cassettes, as well as more outlets available as the home videotape market begins to grow. Whatever the reason, there's no doubt about its escalation."

Foundation aids in communications-related litigation

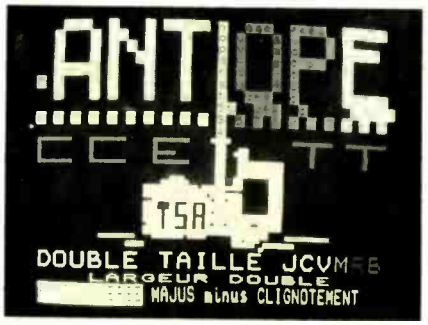
Do you have an outdoor antenna on your property? The chances are good you may be in violation of local zoning ordinances, and subject to a suit. Are you a CB'er or ham operator? If your transmitter interferes with your neighbor's TV or radio, again you may find yourself facing a suit. Litigation of this sort seems to be proliferating countrywide; however, most lawyers are unfamiliar with the technical aspects of radio, FCC regulations or prior communications cases.

To help remedy the situation, the Personal Communications Foundation was established in November, 1976. It provides attorneys with an extensive law library and research material, including court decisions, briefs and legal memoranda. Copies of such documents are available at cost not only to the legal profession but to hams, CB'ers, the communications industry and governmental agencies.

The Foundation is a membership-based organization, with four different classes of membership available. Members receive a quarterly newsletter that summarizes current legal developments and analyzes existing case law and statutes. For further information, write Personal Communications Foundation, 10960 Wilshire Blvd., Suite 1504, Los Angeles, CA 90024, or phone (213) 478-1749.

Latest TV developments—Teletext decoder and CTV receiver

Barco Electronic of Belgium (creators of the second-channel TV monitoring system described in the January 1978 issue of **Radio-Electronics**) have added two other new capabilities to their TV sets—the Teletext decoder and the "Seagull" CTV receiver.



ACTUAL DISPLAY of new teletext system. System will provide TV audience with news bulletins on command.

The Teletex decoder's unique function is to store news data transmitted during a regular TV program, which can then be read out as a Telex message on the screen. You can program the multi-standard Teletext to retain any specific type of news—general, sports, weather reports—which can then be played back on command. Another special feature of the decoder is that you can also use it to translate foreign-film subtitles!

The "Seagull" CTV receiver (originally designed for maritime use) is compatible with 7 color and 10 transmission systems; it can therefore be used worldwide. Pushbuttons control the color and transmission systems, and the decoder's modular design makes it easy to repair and maintain.

Radio pioneer passes away

D. D. Lakhanpal, whose name was synonymous with radio in India, died on October 1, 1977.

Mr. Lakhanpal, who was born in 1904, was considered one of the pioneers of the industry in his native country. During his 45 years in the business, he was responsible for spreading radio throughout India. He was also editor and publisher of the *Radio Times of India* (founded in 1946).

Mr. Lakhanpal was director of several trade associations, among them Lakhanpal National, Ltd., a joint venture company associated with Matsushita Electrical Industrial Company, Ltd. **R-E**

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letters

BIORHYTHM CLOCK

An error crept into my article on building a Biorhythm Clock (November 1977 issue). The error appears on page 37, center column, line 33. The "1927" should read "1928." There are also several omissions:

Schematic: Pin numbers were omitted for the display segments. The numbers are as follows: A is 1; B is 13; C is 10; D is 8; E is 7; F is 2; G is 11. A connection dot should be shown at the junction of the line from pin 5, IC 7 and the +5V line.

Parts layout, main board: C4 should have a "-" on the left side.

FRED BLECHMAN

MAGNETIC MACHINE

I view the magnetic machine ("Letters" Column, **Radio-Electronics,** October, 1977) with alarm. If the lines of flux are cut off by the screen, the plasma field will have less space in which to exist. This reduced space means an increase in flux density and will result in an unbalanced field. As a result of simple gravity, the field will try to flip, due to the magnetic mass being spread out and, therefore, top heavy.

Furthermore, the intrinsic coercive force (H_C) will seek release of its energy, resulting in the iron block traveling at right angles to the rapidly expanding magnetic field (remember—any ferrous material will have a residual field in the presence of another field—Br). The object will first travel in a straight line until the Br of the iron and the Bs (saturation) of the field of distance cancel (inverse of distance cubed). Then, the object will travel at a fixed tangent (⌀) to the lines of force. This change of direction may alter the hysteresis loop into its first derivative. And what happens then is terrifying to consider!

Meanwhile our object is traveling at the speed of light at right angles to the expanding field. This assumes a DC field; an AC field will cause the object to go first one way, then the other. The difference in vertical and horizontal paths will first be at right angles to the field. The angle forms when Br = Bs and to some far point; then the field will begin to reverse, pulling the object straight back until the field reverses again. The resulting trajectory will then hit the ground and be pulled back and start over.

What Mr. Fraser has done is to develop a magnetic slingshot with the energy "borrowed" from one field and "repaid" on the return pass. Thus, the law of conservation of energy is maintained.

M. ROSS DUMKE
Fort Worth, TX

2650 KEYBOARD

In Jeff Roloff's reply to a reader's question in the September 1977 issue of **Radio-Electronics,** he stated that the Radio-Shack keyboard works well in the 2650 computer system. This is not entirely correct. This keyboard is not standard ASCII, and the key functions may need to be redefined for this system.

Specifically, the PROM's recognize a 1B code for the escape function, whereas the Radio-Shack keyboard generates a 7E. Code 1B is not generated anywhere on this keyboard. A major modification would be

continued on page 22

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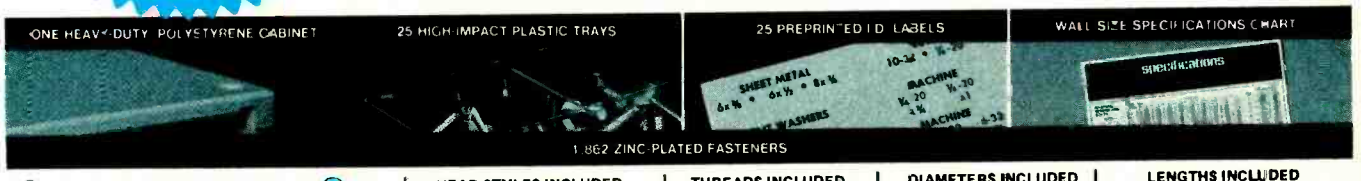

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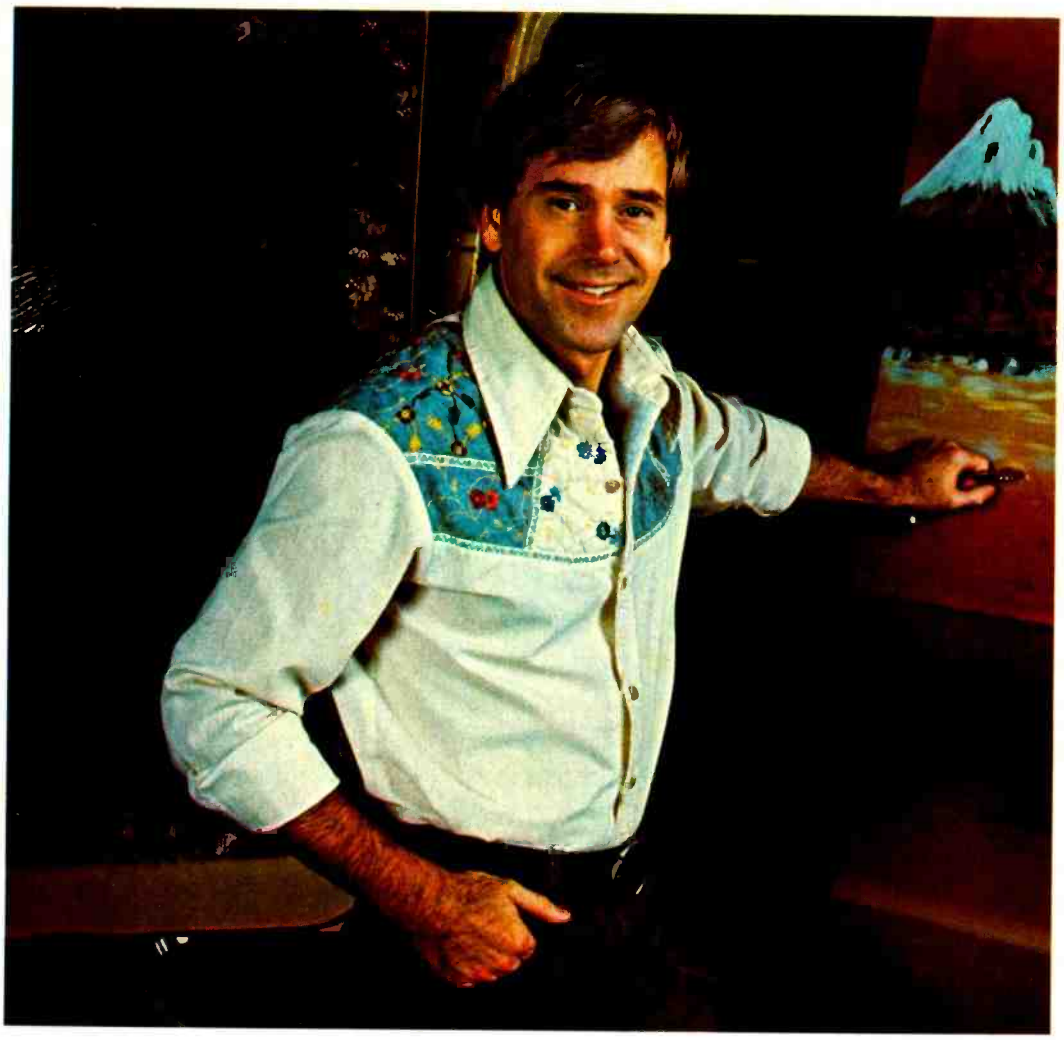


When you do, you'll probably pick CIE. You can't afford to settle for less when it comes to something like electronics training that could affect your whole life.

When you shop around for tires, you look for a bargain. After all, if it's the same brand, better price—why not save money?

Education's different. There's no such thing as "same brand." No two schools are alike. And, once you've made your choice, the training you get stays with you for the rest of your life.

So, shop around for your training. Not for the bargain. For the best. Thorough, professional training to help give you pride and confidence.

* * *

If you talked to some of our graduates, chances are you'd find a lot of them shopped around for their training. They pretty much knew what was available. And they picked CIE as number one.

Why you should shop around yourself.

We hope you'll shop around. Because, frankly, CIE isn't for everyone.

There are other options for the hobbyist. If you're the ambitious type—with serious career goals in electronics—take a close look at what we've planned for you at CIE.

What you should look for first.

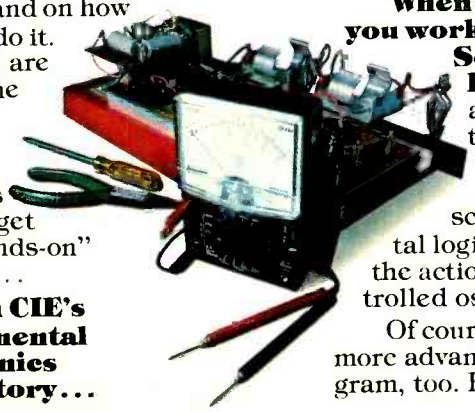
Part of what makes electronics so interesting is it's based on scientific discoveries—on ideas! So the first thing to look for is a program that starts with ideas and builds on them!

That's what happens with CIE's Auto-Programmed® Lessons. Each lesson takes one or two principles and helps you master them—before you start using them!

How practical is the training?

This is the next big important question. After all, your career will be built on what you can do—and on how well you do it.

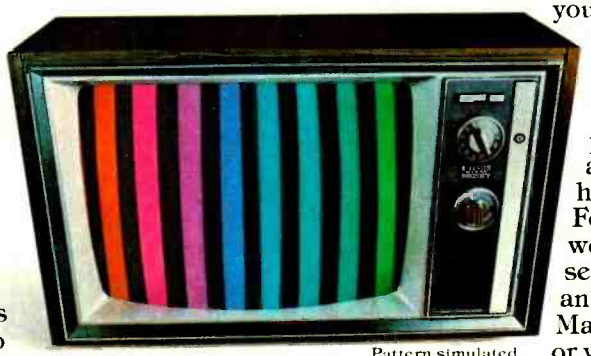
Here are ways some of CIE's troubleshooting programs help you get your "hands-on" training...



With CIE's Experimental Electronics Laboratory... you learn and review the basics—perform dozens of experiments. Plus, you use a 3-in-1 precision Multimeter to learn testing, checking, analyzing!

When you build your own 5 MHz Triggered-Sweep, Solid-State Oscilloscope you take your first real professional step. You use it as a doctor uses an X-ray machine—to "read" waveform patterns... lock them in... study, understand and interpret them!

When you get your Zenith 19-inch Diagonal Solid-State Color TV you apply your new skills to some real on-the-job-type troubleshooting! You learn to trace signal flow... locate malfunctions... restore perfect operating standards—just as with any sophisticated electronics equipment!



Pattern simulated.

When you work with a completely Solid-State Color Bar Generator—actually a TV signal transmitter—you study up to ten different patterns on your TV screen... explore digital logic circuits... observe the action of a crystal-controlled oscillator!

Of course, CIE offers a more advanced training program, too. But the main point is simply this:

All this training takes effort. But you'll enjoy it. And it's a real plus for a troubleshooting career!

Do you prepare for your FCC License?

Avoid regrets later. Check this out before you enroll in any program.

For some troubleshooting jobs, you must have your FCC License. For others, employers often consider it a mark in your favor. Either way, it's government-certified proof of specific knowledge and skills!

More than half of CIE's courses prepare you for the government-administered FCC License exam. In continuing surveys, nearly 4 out of 5 CIE graduates who take the exam get their Licenses!

Shop around... but send for CIE's free school catalog first!

Mail the card. If it's gone, cut out and mail the coupon. If you prefer to write, mention the name and date of this magazine. We'll send you a copy of CIE's FREE school catalog—plus a complete package of independent home study information! For your convenience, we'll try to have a representative contact you to answer your questions. Mail the card or coupon—or write: CIE, 1776 East 17th St., Cleveland, OH 44114.

CIE Cleveland Institute of Electronics, Inc.
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☐ **YES...** I'm shopping around for the **right** kind of career training in electronics troubleshooting—and CIE sounds well worth looking into. Please send me my FREE CIE school catalog—including details about troubleshooting courses—plus my FREE package of home study information! **RE-28**

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LETTERS

continued from page 16

required to correct this, such as the availability of a PROM that would recognize 7E as an escape. Actually, it would be better to use 00, using the BREAK key since 7E would leave a "less than" symbol on the screen after the escape function.

Another problem with this keyboard is in the control key. Instead of modifying the normal key code, this key generates a code by itself, causing problems in the editor/assembler tape. The control C code is generated with a shift C, but using HERE IS takes only one keystroke. Control P is not available, so RAM locations 2348 and 28FA should be changed from 10 to 02, and SHIFT R can be used for this function. For control O, use shift O. Change location 28EC from 15 to 05, and use shift U for control U. Carriage return is generated by shift], but it is better to use LINEFEED to get this into a single keystroke. For this, change the following locations from 0D to 0A: 2245, 2289, 22EA, 2359, 2364, 23A5, 2695, 284D, 28A5, 2921, 296C, 2D82.

One last change in the keyboard is to add a 1000-ohm resistor from pin 5 of Z11 to V_{CC}. This eliminates a floating input that may cause continuous REPEAT functions.

These may seem like a lot of changes, but the Radio-Shack keyboard is still the only easily available, inexpensive keyboard sold with a guarantee.

MIKE HERBACH
Signetics Engineering Staff
Sunnyvale, CA

Regarding the use of the Radio-Shack keyboard with my board, it would certainly appear there are many problems. I had not tried it myself—several customers just said it had worked fine with their boards.

I recommend (contrary to Mike Herbach's opinion) that people not use this type of keyboard unless they want to keep modifying all the Central Data programs—which will not be offered in Radio-Shack form. I regret ever mentioning the Radio-Shack keyboard; I should have tried it myself first.—Jeff Roloff

P.S. If you modify the keyboard you invalidate the warranty—Editor

"MAGNET CONTROVERSY" CONTINUED

Marc Scharf's letter ("Magnet Can't Solve Energy Crisis," October 1977 issue) correctly states the basic laws of science, but let's look at my 15-lb permanent magnet.

First, it will lift 600 lbs of iron. Second, it can lift its 1-lb keeper (made of soft steel) from over 3 inches away. Third, if instead of allowing the keeper to hit the permanent magnet, some springs were mounted, the keeper could put 599 lbs of tension in the springs to take the place of a sharp impact and a heat loss. Fourth, with the keeper in place, the permanent magnet will not lift even 1 lb of steel, let alone 598 lbs.

According to Mr. Scharf and the law of conservation of energy, his permanent magnet cannot do the four things mine can. My permanent magnet has been used and banged around a lot, but it is still intact and strong as ever.

JOHN W. ECKLIN
Alexandria, VA

R-E

Nobody can replace all our replacements.

When it comes to replacement tubes, nobody has as many types as Sylvania—from power amplifiers to Nuvistors.

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You'll find he's irreplaceable.

GTE SYLVANIA

equipment report

Olympic Controls, Inc., Model OCi-009 Calibrator

CIRCLE 98 ON FREE INFORMATION CARD

OLYMPIC CONTROLS, INC. OF 11246 SOUTH Post Oak Road, Houston, TX 77035 is manufacturing a new low-cost universal calibrator, the *model OCi-009*.

This instrument is primarily designed for testing and calibrating all kinds of electrical control systems that are used in industrial control and metering work. It can test transmitters, valves, transducers, sensors and all kinds of similar equipment.

The basic *model OCi-009-A1* provides highly accurate test signals in the milliampere, volt and millivolt range, showing the actual value on a 3½-digit readout.

The calibrator has dual ranges. The low range is from +1.999 VDC to −1.999 VDC; from +0.199.99 to −0.199.99 mV DC and from 0 to 0.19.99 mA DC. The high-range outputs are ±10.50 VDC, ±100.00 mV DC, and from 0 to 60 mA DC. A selector switch controls the high or low output ranges and the meter readout.

There are two variable controls—the COARSE control is a one-turn potentiometer, with zero in the center. Turning the control clockwise from zero increases the output toward positive. Turning the control counterclockwise makes the output go negative. The FINE control is a ten-turn potentiometer; turning it clockwise increases the output. All outputs are instantly displayed on the readout. The outputs are available on the front panel.

There are also two jacks labeled IN. By flipping the selector switch from OUT to IN, the readout displays whatever signal is being fed in. A range switch selects between milliamperes, volts and millivolts. The *model OCi-009* can read its own output. You can also use it to check such devices as millivolts-to-current converters, by feeding the normal input to the device and then measuring the output on the *OCi-009*'s meter.

The *model OCi-009-A2* option provides a signal frequency of up to 1.999 kHz. This feature generates test signals in this range, and you can also measure frequencies in this range by feeding it to the IN jacks. This feature can be used to check voltage-to-frequency converters: You can feed a voltage to the converter input and measure the output frequency. The same procedure works in reverse for frequency-to-voltage converters.

continued on page 26

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7404	7493
7408	74107
7410	74121
7420	74122
7430	74123
7432	74125 (DM8093)
7442	74154
7447	74161 (DM9316)
7473	74176 (DM8280)
7474	74177 (DM8281)
7475	74192
7476	74193
7485	74367 (DM8097)

Low Power TTL Schottky

74LS00	74LS83
74LS02	74LS85
74LS04	74LS86
74LS08	74LS90
74LS10	74LS109
74LS20	74LS123
74LS30	74LS136
74LS32	74LS138
74LS73	74LS151
74LS74	74LS175
74LS75	74LS367

C/MOS

4000	4029
4001	4044
4010	4046
4011	4049
4013	4050
4016	4051
4017	4069
4020	4071
4023	4081
4024	4511

LINEAR

LM301V	LM340T-15(7815)
LM307V	LM555V
LM309K	LM556N
LM311V	LM567V
LM320K-5(7905)	LM723N
LM320T-5(7905)	LM739N
LM320T-12(7912)	LM741V
LM320T-15(7915)	LM747N
LM339N	LM1458V(5558V)
LM340T-5(7805)	LM1556V
LM340T-12(7812)	LM3900N(CA3401)

MICROPROCESSOR

Z 80	2101
8080A	2102
8212	21L02
8224	7489
8228	MM5262
6800	1702A
6810	82S23
6830	2708
AY-5-1013	DM8835N
2513/2140	N8T97

DIODES

IN751	IN4148(IN914)
IN4733	IN4001
IN4734	IN4004
IN4742	IN4007
IN4744	MDA-980-3

TRANSISTORS

C106B1	2N3055
2N2222A	2N3904
2N2907A	2N3906
MJE2955	2N5129
MJE3055	2N5139

RESISTORS

ASST 1	ASST 5
ASST 2	ASST 6
ASST 3	ASST 7
ASST 4	

CAPACITORS

Aluminum Electrolytic

1mfd 50V	100mfd 50V
4.7mfd 50V	220mfd 50V
10mfd 50V	470mfd 50V
22mfd 50V	1000mfd 25V
47mfd 50V	2200mfd 16V

Ceramic Disc

10pf 50V	.001mfd 50V
47pf 50V	.0047mfd 50V
100pf 50V	.01mfd 50V
220pf 50V	.022mfd 50V
330pf 50V	.047mfd 50V
470pf 50V	.1mfd 50V

Dipped Tantalum

.1mfd 35V	2.2mfd 25V
.22mfd 35V	3.3mfd 25V
.33mfd 35V	4.7mfd 25V
.47mfd 35V	6.8mfd 25V
.68mfd 35V	10mfd 25V
1mfd 35V	15mfd 25V
1.5mfd 35V	33mfd 25V

SWITCHES

SPST 4 sta. dip	SPDT push button
SPST 8 sta. dip	SPDT push button
SPDT on-off-on toggle	SPST push button
	SPST push button
SPDT on-none-on toggle	SPST push button
	DPDT slide
DPDT on-off-on toggle	DPDT on-none-on toggle

SOCKETS

8 pin low profile	14 pin wire wrap
14 pin low profile	16 pin wire wrap
16 pin low profile	24 pin wire wrap
24 pin low profile	40 pin wire wrap
40 pin low profile	TO-3 Socket
Molex Pins	TO-5 Socket

LEDS

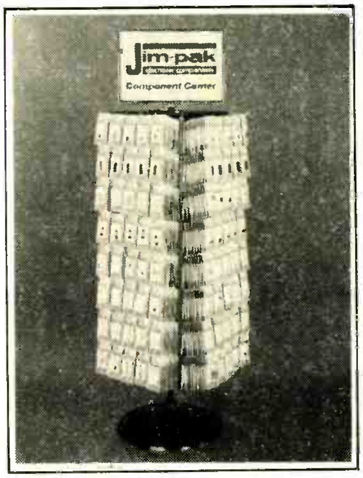
Display	Discrete
5x7 dot matrix	600 com. anode
300 com. anode	600 com. cathode
300 com. cathode	200LED Lamp red

CONNECTORS

DB 25P Plug	DB25S Socket

DATA BOOKS*

7400/74LS Data Book
CMOS/Linear Data Book
Microprocessor/LED Data Book
*JIM PAK Products only



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- *San Francisco* — *Zack Electronics*
- *San Jose* — *Quement Electronics*
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- *Vallejo* — *Zackit*
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COLORADO
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- *Steamboat Springs* — *Norm's TV & Electronics*

CONNECTICUT
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- *Orlando* — *Altair Computer Center of Orlando*
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- *Honolulu* — *Integrated Circuit Supply*

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ILLINOIS
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- *Groveland* — *Moyer Electronics*

ILLINOIS (Cont'd)
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- *Oak Park* — *Spectronics*

INDIANA
- *East Chicago* — *Acro Electronics*
- *Hammond* — *Quantum Computer Works*

KENTUCKY
- *Lexington* — *Radio-Electronic Equipment Co.*

LOUISIANA
- *Baton Rouge* — *Davis Electronics Supply*

MARYLAND
- *Baltimore* — *Computer Workshop of Baltimore*
- *Baltimore* — *Everything Electronic*
- *Rockville* — *Computer Workshop*
- *Towson* — *Computers, Etc.*

MASSACHUSETTS
- *Medford* — *Tufts Electronics*
- *North Adams* — *Electronics Supply Center*
- *Waltham* — *Computer Mart Inc.*

MICHIGAN
- *Grand Rapids* — *Micro Computer World*
- *Lansing* — *Fulton Radio Supply*

MINNESOTA
- *Duluth* — *Northwest Radio of Duluth*
- *Eagan* — *Dacom Amateur Radio Center*

MISSOURI
- *Parkville* — *Computer Workshop of Kansas City*

MONTANA
- *Billings* — *Conley Radio Supply*

NEBRASKA
- *Lincoln* — *Altair Computer Center*
- *Omaha* — *Omaha Computer Store*

NEVADA
- *Las Vegas* — *Century 23*

NEW JERSEY
- *Cherry Hill* — *Computer Systems Unlimited*
- *Hoboken* — *Hoboken Computer Works*
- *Pompton Lakes* — *Computer Corner of New Jersey*
- *Ramsey* — *Typetronic Computer Store*

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- *Albany* — *Fort Orange Electronics*
- *New York* — *The Computer Stores Inc.*
- *New York* — *Computer Mart of New York*
- *Troy* — *Trojan Electronics*
- *White Plains* — *The Computer Corner*

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OHIO
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- *Cincinnati* — *Digital Design*
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continued from page 24

Many typical applications for such units are shown in the instruction manual, along with exact hookups and control settings. The instrument is handy for industrial process-control applications. You can use its output to simulate two-wire transmitters, check the operation of 4–20-mA throttling valves, and many other things.

The accuracy of the *model OCi-009* is ±0.1% of full range, ±1 count. A detailed calibration report is included with each instrument, showing the exact readings on every function.

While I didn't have much industrial control equipment lying about my shop, I did use the instrument to check the accuracy of some of my FETVOM's and VOM's. One of the meters did need just a little tweaking, but, to my surprise, one of the oldest instruments in the shop was right on the button!

The *model OCi-009* should be a valuable instrument for anyone engaged in this line of work. It can test both ends of a control system: the generator or transducer, as well as the device controlled by it. You can use the frequency option to test turbine generators and similar units.

The basic instrument is AC-powered, but it can be used with a DC power option for portable or field work. It can also be used with any 12-volt battery. The suggested retail price of the *model OCi-009-A1* is $435. The *model OCi-009-A2* option brings the price to $570.

R-E

Hickok model 422 Mobile CB Tester

CIRCLE 99 ON FREE INFORMATION CARD

THERE ARE BENCH TESTERS AND THERE ARE field testers. The new Hickok *model 422* mobile CB tester could be called a "lap" tester. These are compact instruments that can be held on your lap in any vehicle, and will test every one of the important characteristics of the CB rig. It'll do this in an amazingly short time. This makes it very handy for initial diagnosis of any CB problem, without having to take the radio out of the vehicle. There are only three cables to hook up. One goes to the antenna input on the CB rig, the other to the CB antenna and the last plugs into the cigar lighter on the dash. There isn't even a switch; plug it in and you're ready.

The *model 422* will read frequency, RF power output, SWR and audio modulation on all 40 channels. It will also check the mike and the modulation percentage. There is a receiver test on Channel 20 that is also used to check the squelch action. It will even read the battery voltage in the vehicle, which can be very helpful in finding problems in the voltage regulator, battery, etc. There is also a confidence test: pushing the SELF-TEST button gives you a readout of the frequency of Channel 20, so that you know everything is working.

All of these tests can be made in sequence, simply by setting the front-panel controls and pressing the mike button. There are 5 pushbuttons, momentary contact except for one and a three-position lever switch. An internal dummy load is used for most tests. The load is controlled by a pushbutton switch that reconnects the CB transmitter output to the vehicle antenna for RF power and SWR testing.

There are eight separate tests. These are all numbered on the control panel. A very complete list of the test is printed on the inside of the lid; all control settings, instructions and normal readings are given. In a separate place across the bottom of the lid is a complete list of frequencies for all 40 CB channels, with high and low tolerances. If the transmitter frequency is between the high and low tolerances shown, it's OK. There is a speaker on the front panel, for use in the modulation tests. The heart of the instrument is a frequency counter with an accuracy of 10 ppm and a 6-digit 7-segment LED readout. All of the test readings are shown on this readout, including the battery voltage, which should be between 11.0

continued on page 32

FREQ. OUT.

CSC's done it again.

Broken the price and performance barriers with new MAX-100. The multimode, professional portable frequency counter that gives you more range, visibility, accuracy and versatility than any comparable unit at anywhere near its low, low price.

MAXimum performance. MAX-100 is a cinch to use. It gives you *continuous readings* from 2CHz to a *guaranteed 100MHz*, with 8-digit accuracy. Fast readings with 1/6-sec. update and 1-sec. sampling rate. Precise readings, derived from a crystal-controlled time base with 3ppm accuracy. High-sensitivity readings from signals as low as 30 mV, with diode overload protection up to 200V peaks.

Input signals over 100MHz automatically flash the most significant digit. And to indicate low-battery condition and extend remaining battery life, the *entire* display flashes at 1Hz.

MAXimum versatility. Wherever and whenever you need accurate frequency readings, MAX can do the job. Use it with clip-lead cable supplied. Mini-whip antenna. Or low-loss in-line tap with UHF connectors. For AM or FM: CB, ham, business radio and R/C transmitter or receiver alignment. Monitoring audio and RF generators. Checking computer clocks and other digital circuits. Repair of depth sounders and fish spotters. Troubleshooting ultrasonic remote controls. For these, and hundreds of other applications, you'll find it indispensable.

MAXimum visibility. MAX-100 features a big, bright 0.6" multiplexed *8-digit* LED display, with leading-zero blanking. So you don't have to squint, or work up close. And, MAX's flip-up stand is *built-in*.

MAXimum flexibility. MAX-100 operates from *four* power sources, for use in lab or field. Internal alkaline or NiCad batteries. 110 or 220V with charger/eliminator. 12V with automobile cigarette-lighter adapter/charger. And external 7.2-10V supply.

MAXimum value. With all its impressive specs, you'd expect MAX to cost a lot more than a low $134.95, complete with clip-lead cable and applications instruction manual. But that's another nice thing about MAX: though it's accurate enough for lab use, it's well within the reach of hobbyists' and CB-ers' budgets.

Try MAX for yourself at your CSC dealer—or contact us for full specs and your local dealer's name. Once you see how handy MAX is, you'll want to "freq out" too. With CSC.

Specifications.
Range: 20 Hz to 100 MHz, guaranteed. **Gatetime:** 1 sec. **Resolution:** 1 Hz. **Accuracy:** ± 1 count + time base error. **Input Impedance:** 1 MΩ/56 pF. **Coupling:** AC. **Sine Wave Sensitivity:** 30 mVRMS @ 50 MHz. **Internal Time Base Frequency:** 3.579545 MHz crystal osc. **Setability:** ± 3 ppm @ 25°C. **Temp-Stability:** Better than 0.2 ppm/°C, 0-50°C. **Max. Aging:** 10 ppm/year. **Display:** Eight .6" LED digits; anti-glare window. **Lead-zero blanking:** decimal point appears between 6th and 7th digit when input exceeds 1 MHz. **Overflow:** with signals over 99,999,999 Hz, most significant (left hand) digit flashes, allowing readings in excess of 100 MHz. **Display update:** 1/6-second plus 1 sec. gate time. **Low Battery Indicator:** When power supply falls below 6.6 VDC, all digits flash @ 1 Hz rate. Flashing display extends battery life. **Power:** 6 AA Alkaline or NiCad cells (internal); **External:** 110 or 220/VAC Eliminator/charger; Auto cigarette lighter adapter 7.2-10 VDC ext. supply; **Bat. Charging:** 12-14hr. **Size (HWD):** 1.75"x 5.63" x 7.75" (4.45 x 14.30 x 19.69 cm.) **Weight:** Less than 1.5 lb. (0.68 kg) w/batteries. **Accessories Included:** Clip-lead input cable; manual.

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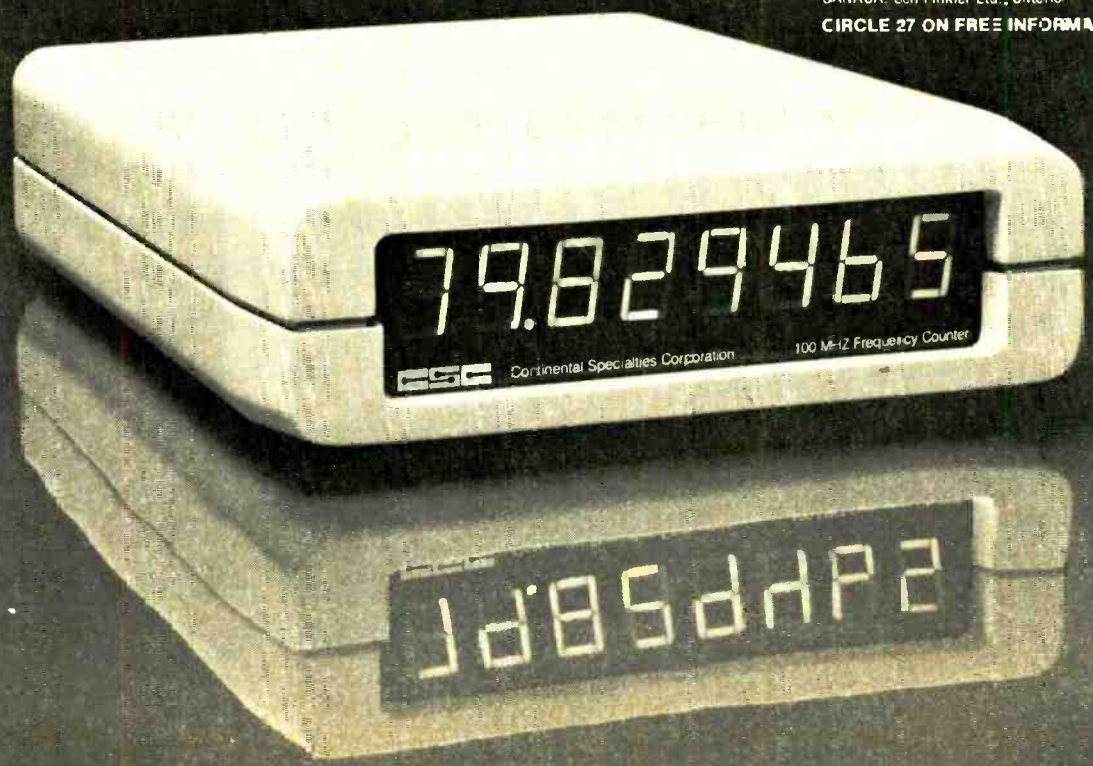
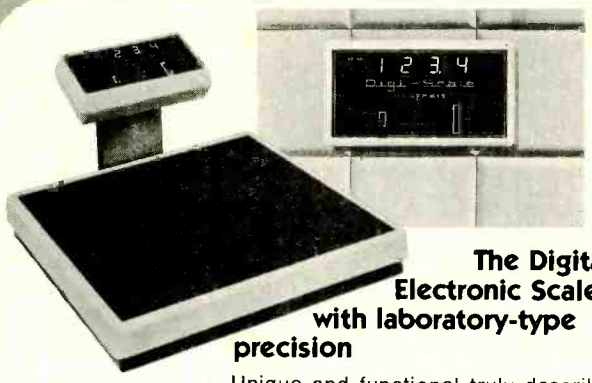


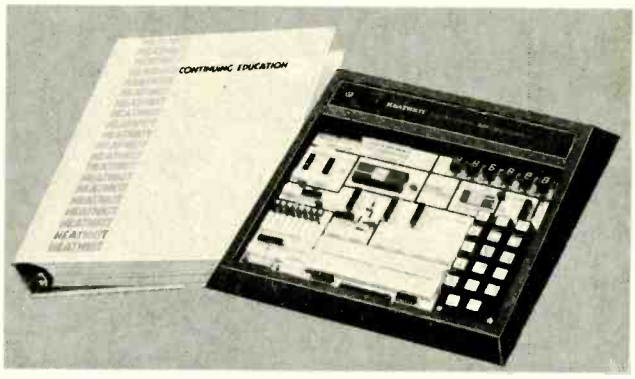
The New Heathkit Catalog has everything from Personal



The Digital Electronic Scale with laboratory-type precision

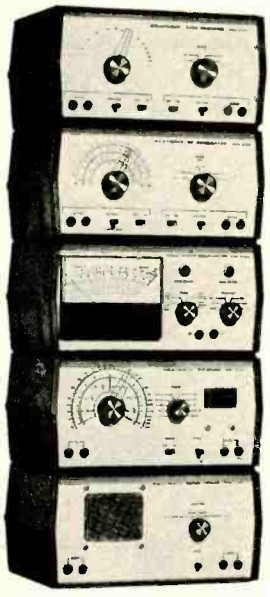
Unique and functional truly describe the new Digi-Scale electronic "weighing machine". Big, bright LED's show your weight with more precision than normal scales and there are no springs or weights to compromise performance. Unlike cheaper digital scales, this one uses a precision strain gauge for the utmost in accuracy. The digital readout may be mounted on the wall or just about anywhere.

GD-1186, only $99.95



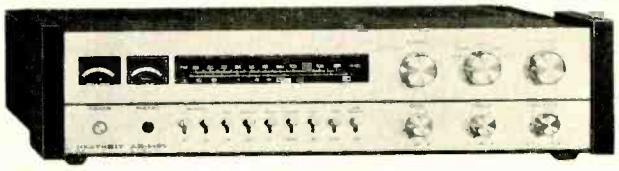
Learn all about the Microprocessor with this new Self-Instruction Course

Our EE-3401 Microprocessor Course ($89.95) is your key to learning about microprocessors. Features Heath's famous individualized learning techniques to provide you with a thorough background in microprocessor operation, interfacing and programming. Accompanying software and hardware experiments provide "hands-on" experience with the companion ET-3400 6800 Microprocessor-based trainer ($189.95).



Low-Cost Starter Series Test Bench

These five starter instruments are an economical low cost way to your first bench. They're intended for (but not limited to) the beginner and you'll be surprised at the features and performance these new instruments have to offer! There's the IG-5280 RF Oscillator with 320 kHz to 220 MHz frequency range, the IM-5284 high performance multimeter that reads volts, ohms and DC current, the IT-5283 Signal Tracer for RF, AF and logic tracing, the IB-5281 RCL Bridge for design and experimentation and the IG-5282 Audio Oscillator with a 10 Hz to 100 kHz frequency range. And to power the 5280 series, you can build the IPA-5280-1 power supply. Only $37.95 each, $24.95 for the power supply.



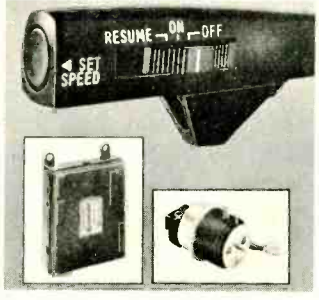
Build this new Stereo Hi-Fi Receiver for top performance and value

Experience the subtle shadings of the symphony, cool jazz, and the driving beat of rock all with this stereo performer from Heath. 35 watts, minimum RMS, per channel into 8 ohms with less than 0.1% total harmonic distortion from 20-20,000 Hz. The AR-1429 is perfect for the budget conscious stereo buff who requires a high quality system. It has all the features of a high-priced receiver and the performance too. Phono hum and noise are −65 dB. FM sensitivity is 1.8 μV. Has provision for optional Dolby™ FM module. AR-1429, only $319.95

Heathkit/Dana Electronic Speed Control Fits Most Cars

Long distance drivers will really appreciate the CS-1048. It makes the most of famous Dana Corp. technology and a crystal clear Heath instruction manual for easy installation. Electronically maintains your auto's speed uphill or downhill.

CS-1048, only $64.95



Super-Value Digital Alarm Clock

A perfect kit for the first time kitbuilder. This super-accurate timepiece has an attractive blue four-digit display that dims automatically according to ambient light. It also has the features you need in a clock; 24-hour "smart" alarm, snooze switch, alarm-on indicator and power failure indicator.

GC-1107, only $27.95

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Our most sophisticated computer, the H11, utilizes the famous DEC LSI-11 CPU for 16-bit operation. Has a 4096 x 16 read/write MOS semiconductor memory and 38 high speed data, address, control and synchronization lines. Executes and includes the powerful 400+PDP-11/40 instruction set. It also includes a complete software package for only $1295.

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and 15.7 volts. (Only the last 4 digits are lit.) RF power and SWR are displayed using only the digits needed. The control panel is well laid out to speed up operation. The switches are spaced far enough apart so that you hit only the one you want. The panel is black, with silver lettering big enough to read.

The antenna selector switch is real cute. It has an automatic no-power indicator that displays INT in red lettering on a black background when the switch is in the out position. Push the antenna selector once and the black background changes to red, the red letters disappear and it now says EXT in black!

The RF frequency tests, RF power and SWR tests are all standard. Just push the mike button and the results are displayed on the readout. In the receiver-test position, the *model 422* radiates an RF signal, on Channel 20, into the CB rig's antenna input. This is about 20 microvolts, modulated 15% by a 1000-Hz sinewave. You can check the speaker condition by listening. You can also check the squelch for proper operation; it should shut off at some point.

In the modulation test you can check the modulation of the transmitter and the mike at the same time. You can hear your own voice in the panel speaker; the *model 422* has a built-in detector that demodulates the RF carrier from the CB rig. You can also check the modulation capability of the CB rig. If you key the mike and hold it within three inches of the panel speaker, you *should* hear a feedback howl. If it doesn't, the mike may have a low output or the transmitter may not be modulating enough.

Hickok's flyer on the *model 422* says that it will give you a complete end-to-end test of any CB right in the vehicle in 5 minutes. This is the only statement in there that I can't agree with. I made a test on my daughter's CB and it didn't seem to me that it took that much time, even the first time I used it. So, I went back and did it over again, timing it this time. From the time I got the *model 422* hooked up, the full test sequence took up exactly 1 minute and 5 seconds! This could be beaten, I think; I forgot to check the squelch and had to go back and do that.

So, an instrument like this can certainly speed up in-the-car CB radio testing and preliminary diagnosis. It will pin down trouble to the correct section of the transceiver. Due to the simplified layout of the panel and the very detailed instruction always at hand, even unskilled personnel could be used for this. It would also be handy for making assurance tests after a CB installation has been completed, as well as adjusting SWR, antennas, etc. It's a compact little precision instrument, and designed to make the work a lot easier. The *model 422* sells for $325 and can be used for bench work with the bench DC power supply. **R-E**

GC Electronics Liqui-Kleen Silicone Contact Cleaner

THINGS HAVE A HABIT OF COMING IN JUST when I need them. My TV was displaying definite signs of needing a cleanup of socket contacts, controls and the tuner. Of course, I could never remember to bring some cleaner home with me. So, I was happy when I received a sample of GC Electronic's new *Liqui-Kleen* silicone contact cleaner.

CIRCLE 101 ON FREE INFORMATION CARD

I tried it and it worked. (Also very good for washing dirt off 16-year old chassis!) It's packed in a breakproof plastic bottle, which is a good thing since the first thing I did was drop it. This is not an aerosol spray; it uses a powerful pump on the top of the bottle. I say powerful; all you have to do is touch it to get a good big squirt. It has a regular spray nozzle that can be adjusted for anything from a very fine spray to a thin squirt. A 5-inch plastic extension tube is included for cleaning tuners, etc. Most of us will be using the extension tube. You can get into tight places (like my tuner) without any danger of shock.

The cleaner is a compound called 1,1,1 trichloroethane, and is nonflammable. It will not harm plastics. When it evaporates, it leaves a thin film of silicone lubricant on contacts for protection against dirt and corrosion. Since no

continued on page 34

6800/2 IS HERE

The 6800/2 uses our new A2 processor board with socket space for 8K bytes of ROM/PROM. This makes it possible to use the 6800 in applications where ROM programs are useful without purchasing an expensive PROM accessory board. The A2 board has a DIP switch selector that allows you to replace any 8K block of memory above the RAM memory that extends to 32K with memory external to the processor board itself. This lets you develop special programs that will later be put in PROM in a normal RAM memory card where it can be modified and debugged. The A2 board has a crystal controlled baud rate oscillator and a separate clock driver oscillator whose frequency may be changed with a programming resistor. The A2 processor board gives you the maximum possible flexibility in setting up a computer system.

SWTBUG® Monitor—

The 6800/2 is supplied with our new SWTBUG® monitor. This new monitor is software compatible with the earlier Mikbug® monitor used in the 6800. All major subroutine entry points are identical. SWTBUG® features a resident MF-68 Minifloppy disk boot, single level breakpoints, vectored software interrupt, generation of punch end of tape formatting and automatic interface configuring for either the MP-C control interface or MP-S serial interface.

ACIA Type Interface—

The 6800/2 uses our MP-S serial interface. This RS-232 and 20 Ma. TTY compatible interface may be configured to operate serially at the following baud rates: 110, 150, 300, 600, 1200, 2400, 4800 and 9600. Complete interrupt control is available through the user's software.

4K Static MEMORY—

The 6800/2 comes wth 4K of static RAM memory on our MP-8M board. The memory may be expanded to 8K by the addition of eight more memory chips. No additional parts are needed. Full buffering of all data, address and control lines is a standard feature. Memory expansion to 32K of continuous RAM memory and up to a 48K mixture of ROM/RAM is possible with this system.

ACCESSORY BOARDS—

Do you have a special job? Our accessory boards make it possible to use the 6800/2 for almost any type of computer application. We have our MP-T interrupt timer with software interrupt selectable output. Our MP-N calculator interface that allows you to do arithmetic functions in hardware. Our MP-R EPROM programmer that programs and verifies EPROMs right in the machine—and more coming.

6800/2 Kit . . . . . **$439.00 ppd Cont. U.S.**
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aerosol propellant is used, you won't be upsetting the environment!

Liqui-Kleen contact cleaner is GC's catalogue number 10-804 and retails for $5.27, the 16-oz refill is 10-806 and retails for $2.78. A 1-gallon can refill is also available (10-808) for $9.73. You only have to buy the pump and nozzle once; they last for a long time. These as well as other GC products are available at most local electronic parts stores. **R-E**

Triplett Model 3300 Digital VOM

THE TRIPLETT CORPORATION, BLUFFTON, OH 45817, has just introduced a new 3½-digit hand-sized DVOM, their *model 3300*, which sells for $175. This instrument reads DC and AC voltages from a low scale of 0–200 mV up to 600 VDC. It has an input impedance of 10.0 megohms when measuring AC and DC voltages. Resistance is read in six ranges, 0–200 ohms up to 0–20 megohms. Alternating and direct current can be read in three ranges from 0–2 mA up to 200 mA—22 ranges in all.

Polarity indication is automatic and the meter has automatic zeroing although this can be adjusted if necessary. All ranges are protected against overloads up to 600 volts, even on the lowest ohms range. On the lowest voltage range, the meter can read down to 1.0 mV.

One problem often found in early amplified-VOM's was AC rejection on DC voltage scales. The *model 3300* shows a CMRR (*C*ommon-*M*ode *R*ejection *R*atio) of −90 dB at 60 Hz. (I checked: On AC volts, I read the 120-volt line. When I tried the same thing set on DC volts, the meter read zero!)

The battery-powered *model 3300* uses four 1.5-volt NiCad AA batteries, and a plug-in charger is supplied. Battery life, left on continuously, is from 6 to 8 hours. To check the battery charge, just set the meter to the 20-volt DC scale and touch the red probe to a jack on the test-lead plug. A reading of about 4.4 volts shows that the batteries should be recharged.

continued on page 73

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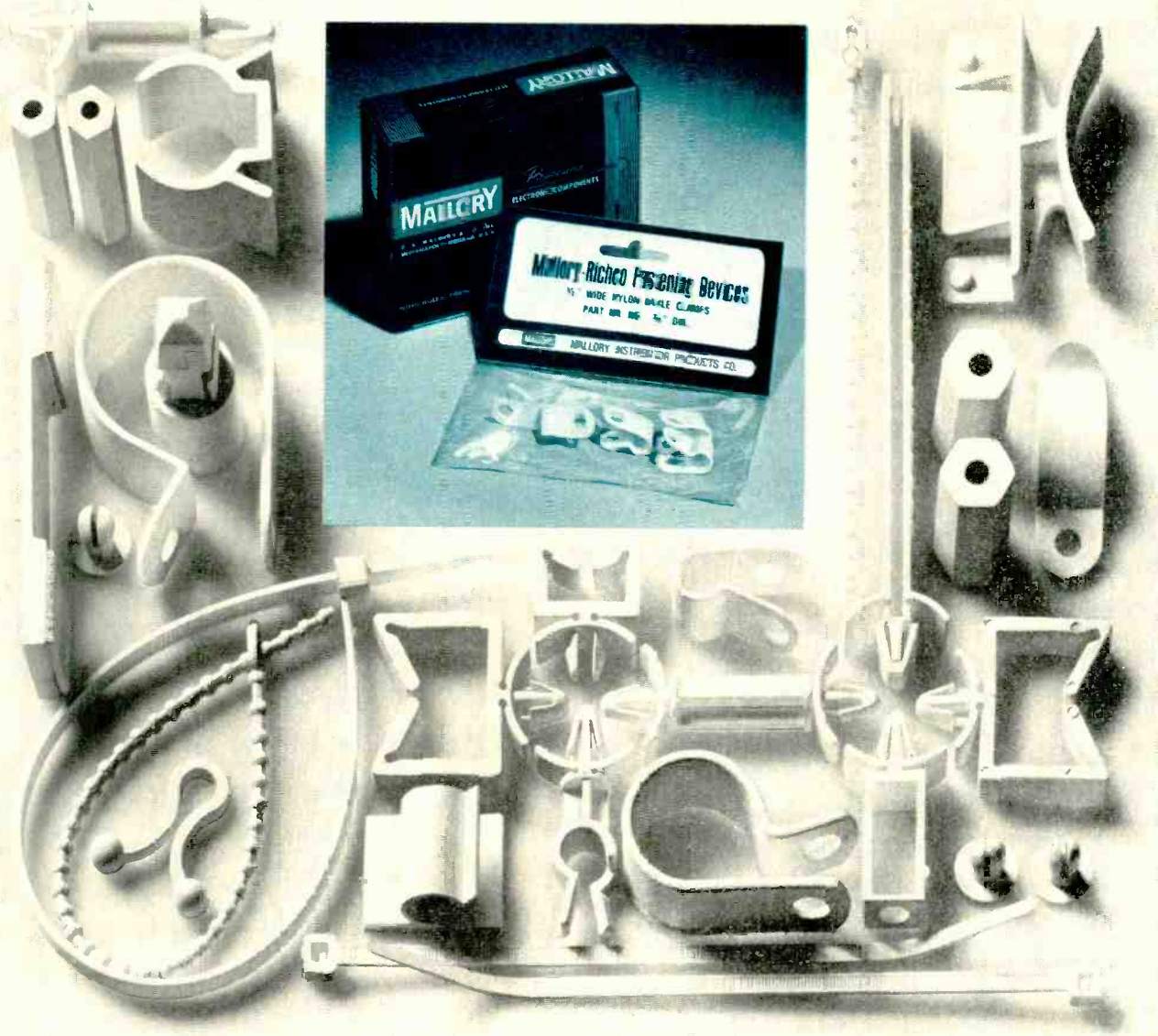

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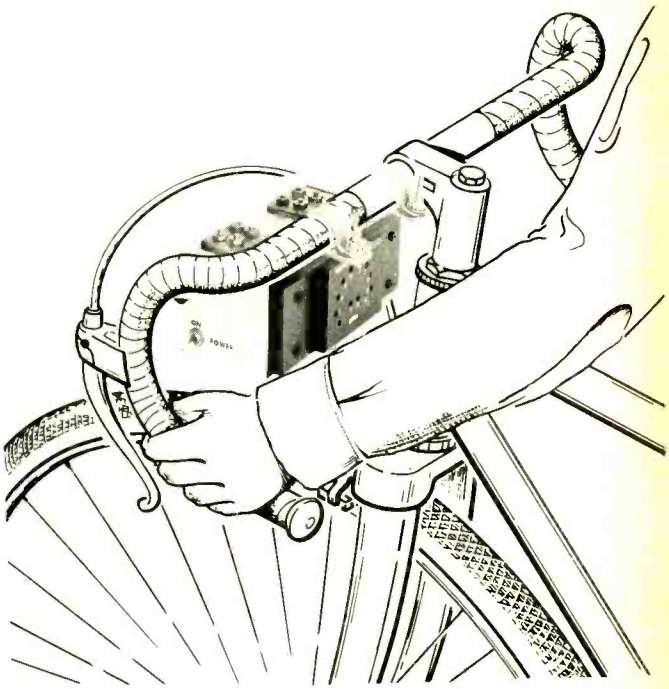
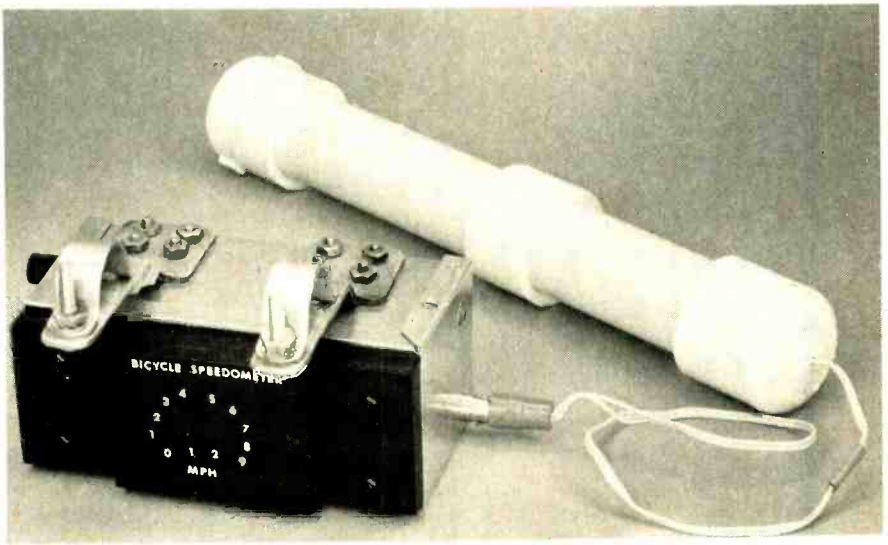
BUILD

Digital Bicycle Speedometer



An ideal gift for a young rider or an active bicyclist, this speedometer conserves battery power through the use of a motion sensor circuit.

ROBERT N. BEABER



DIGITAL BIKE SPEEDOMETER along with its plug-in battery-type power supply. PVC tubing houses the battery made by series-connecting five NiCad rechargeable cells.

BICYCLE RIDING HAS GAINED POPULARITY in recent years as a fun way to stay trim and healthy. This digital bicycle speedometer adds to that fun as well as providing an accurate indication of speed. It would make an ideal gift for that young boy in your life. Or, if you're not already an active bicyclist, you should become one. The digital bicycle speedometer uses rechargeable (NiCad) batteries and is designed to conserve power by using 12 discrete LED's as the speed indicators instead of two 7-segment LED's.

The drawings and photographs show the front panel of the speedometer. During normal operation with speeds up to 9 mph, only one LED is on at any given time. At a speed of 10 mph, both the "10" and "0" LED's are on. The "10" LED remains on and LED's "0" through "9" are on individually in the speed range of 10 to 19 mph. At 20 mph, LED's "20" and "0" are on. Above 20 mph, the rider sees LED "20" and one of the intermediate unit LED's. At 30 mph, LED's "10," "20" and "0" are on, and the counting sequence continues until the maximum of 30 mph is reached. The speedometer and speed sensing circuitry are controlled by the wheel switch. This switch consists of a magnetic reed switch on the bike frame and two magnets cemented to the wheel. This switch is S3 in the speedometer schematic in Fig. 1.

The wheel switch closes twice during each wheel revolution, and bicycle speed is indicated by the number of switch closures counted over a fixed period of time. To establish the number of switch closures per fixed period related to speed in miles per hour, we first determine the number of *one-half revolutions* the wheel makes *per mile*. For a 27-inch wheel, this is 1493.98 revolutions. At 1 mph, there is one switch closure (or one-half revolution) every 2.409 seconds. A count of 5 in 2.409 seconds equals 5 mph.

A calibration oscillator controls the fixed time interval during which wheel-switch closures are counted. The circuit is designed so that when the oscillator is adjusted correctly, closing the TEST switch causes the display to show the wheel size. For instance, the display should read "27" for a 27-inch wheel. The calibration-oscillator repetition rate is approximately 11.25 pps. This frequency was selected because it provides a simple standard for adjusting the time period to accommodate any wheel size without a calibration table or chart.

Circuit operation

The speedometer circuit (Fig. 1) consists of two 74C90 decade counters; a 74LS174 that contains six positive-edge triggered flip-flops operated as a 6-bit latch; a 7445 decimal decoder; and circuitry to strobe the latch, reset the counters and turn off the power when the wheel stops turning. Input pulses from wheel switch S3 enter at J2 and are applied to one-half of IC7, a 556 dual timer. IC7 is operated as dual one-shot multivibrators in series. The first multivibrator is a debounce circuit that conditions the wheel-switch pulses so that only one pulse is obtained each time a magnet causes the switch to close. It also triggers the second one-shot. The second circuit remains triggered as long as switch S3 is active—that is, opening and closing. When the bike stops and switch S3 no longer opens and closes, the second one-shot times-out after about 3 seconds and reverts to its stable state.

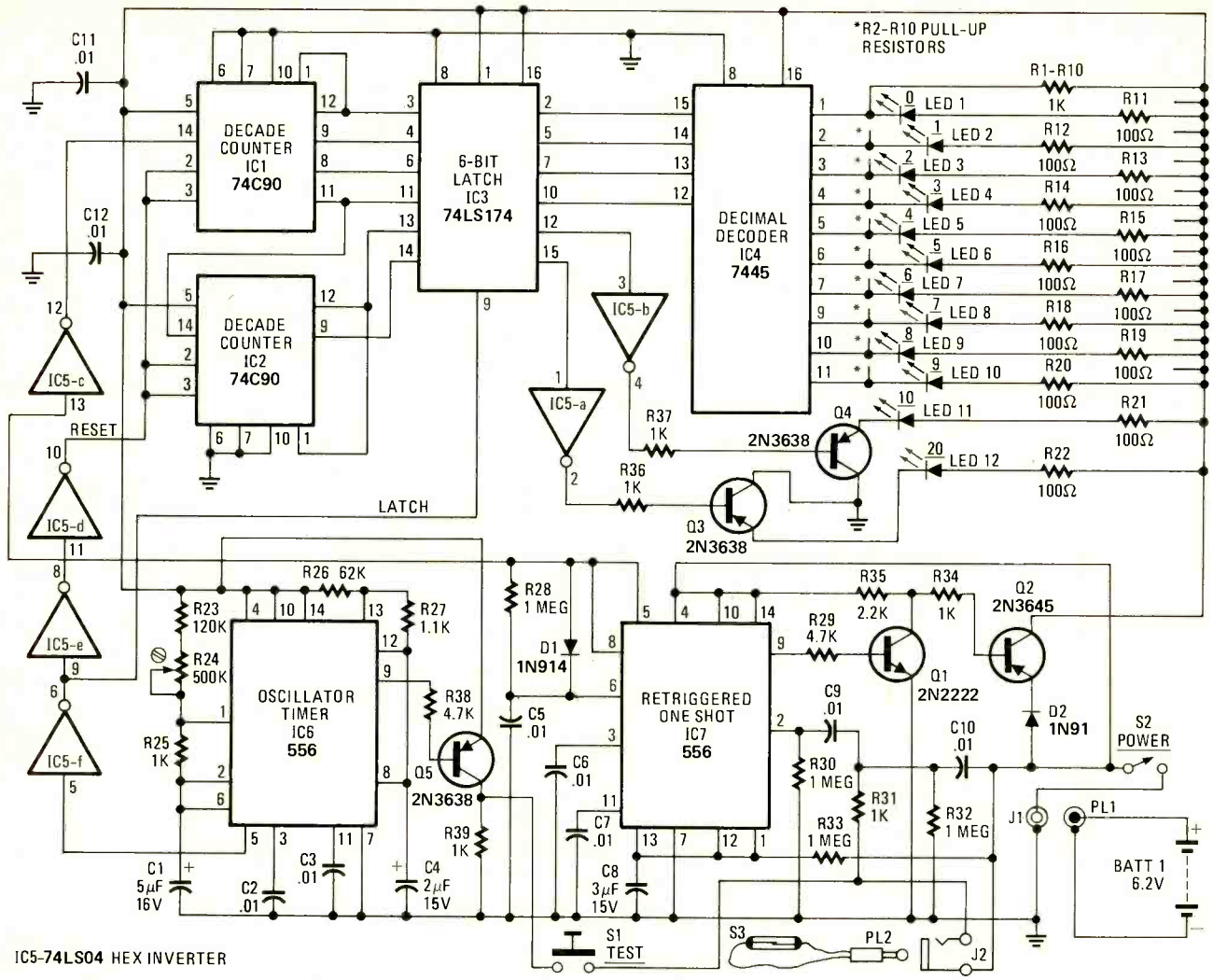


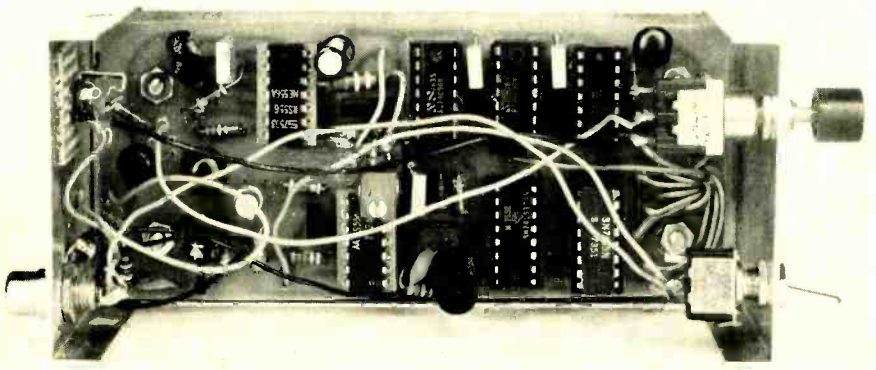
FIG. 1—BICYCLE SPEEDOMETER SCHEMATIC. Twelve miniature LED's instead of the 7-segment displays are used as the readout to minimize power drain and conserve battery life.

The output of the first one-shot, pin 5 of IC7, is inverted by IC5-a to provide the correct logical output to the first decade counter (IC1). The output of the second one-shot, pin 9 of IC7, is inverted by transistor Q1 and used to turn on Q2. Transistor Q2 is a solid-state switch that provides power to all speedometer circuitry except for IC7 and transistor Q1. Power to IC7 and Q1 is turned on and off by switch S2.

When S2 is closed, the first pulse from wheel switch S3 turns on Q2 and supplies power to the counter circuitry. Succeeding pulses are then counted by IC1 and fed to 6-bit latch IC3. The latch provides a constant output to the decoder for display during the fixed time interval. The latch is strobed at the end of the time period just prior to resetting the decade counters to zero.

The latch strobe and counter reset is provided by IC6. This dual timer IC is connected as two separate oscillators. One oscillator is slow and adjustable, delivering one pulse approximately every 2.5 seconds. The other operates at a fixed frequency and delivers 11.2 pulses per second.

The slow adjustable oscillator provides the fixed time interval for counting the pulses from S3. This output signal is from pin 5 and is inverted by IC5-f and used to strobe the latch line to pin 9 of IC3. This same signal goes through inverters IC5-e and IC5-d and is used to reset the counters. The double inversion provides an ample time delay between the strobe and reset so the output of the latch has settled before the inputs from the counter are reset to zero. If the time delay were not there, the latch output would reflect its input—which would be zero when the counter is reset to zero.



UNDER-CHASSIS VIEW of the speedometer electronics. The IC's are installed in sockets. All capacitors are vertical-mount types. Switches are miniature.

The fixed-frequency oscillator output signal is from pin 9 of IC6. It is inverted by transistor Q5 and sent through the test switch to input jack J2. The product of the number of pulses-per-second from this oscillator and the fixed time period yields a number that corresponds to the wheel size.

Decimal counter IC4 accepts the BCD output from the first 4 bits from IC3 to

PARTS LIST

All resistors ¼ watt, 5%.

R1–R10, R25, R31, R34, R36, R37, R39—1000 ohms
R11–R22—100 ohms
R23—120,000 ohms.
R24—500,000-ohm, 15-turn potentiometer (Bourns *Trimpot* or equal)
R26—62,000 ohms
R27—1100 ohms
R28, R30, R32, R33—1 megohm
R29, R38—4700 ohms
R35—1200 ohms
C1—5 μF, 16-volt electrolytic
C2,C3,C5–C7,C9–C12—.01 μF, disc
C4—4 μF, 15-volt electrolytic
C8—3 μF, 15-volt electrolytic
D1, D2—1N914
LED1–LED12—miniature red LED's, 1.6 volt, 50 mA (Radio Shack 276-026)
Q1—2N2222
Q2—2N3645
Q3–Q5—2N3638
IC1, IC2—74C90
IC3—74LS174
IC4—7445
IC6, IC7—556
J1–PL1—matching RCA-type phono plug and jack
J2–PL2—matching miniature phone jack and plug
S1—miniature, normally open pushbutton switch
S2—miniature SPST toggle switch
S3—reed switch, normally open (Radio Shack 275-035)
Misc.—Optional IC sockets; two 1-inch rectangular magnets (Radio Shack No. 64-1875); 5 × 2¼ × 2¼-in. metal utility box; handlebar clamps, assorted hardware; 2 × 5-inch PC board; 5 NiCad cells (surplus cells and batteries available from Poly-Paks and other surplus parts dealers); and rigid PVC pipe and 2 end caps.

provide a single output between 0 and 9, depending on the BCD inputs. The other 2 bits from IC3 are the resultant count from decade counter IC2. These bits are inverted by IC5-a and IC5-b and used to turn on transistors Q3 and Q4, which then turn on LED's "10" and "20."

Construction is simple

The speedometer is built on a PC board, the foil pattern is shown in Fig. 2 and components placement is shown in Fig. 3. Install the 17 jumpers as indicated in the table shown in Fig. 3. Install wire-wrap-type sockets for the IC's and then add all capacitors, resistors and other discrete components. Cut 17 lengths of No. 26 stranded hook-up wire that is approximately 6-inches long and solder them to the PC board for connection to the LED display, switches S1 and S2, and jacks J1 and J2.

Refer to Fig. 4 for the details of the faceplate in which the LED's are mounted. The faceplate is laminated from five pieces that are cut from ⅛-inch plastic to the dimensions shown. Three pieces measure 5 × 2 inches and two measure 2 × 2 inches. You can cut the

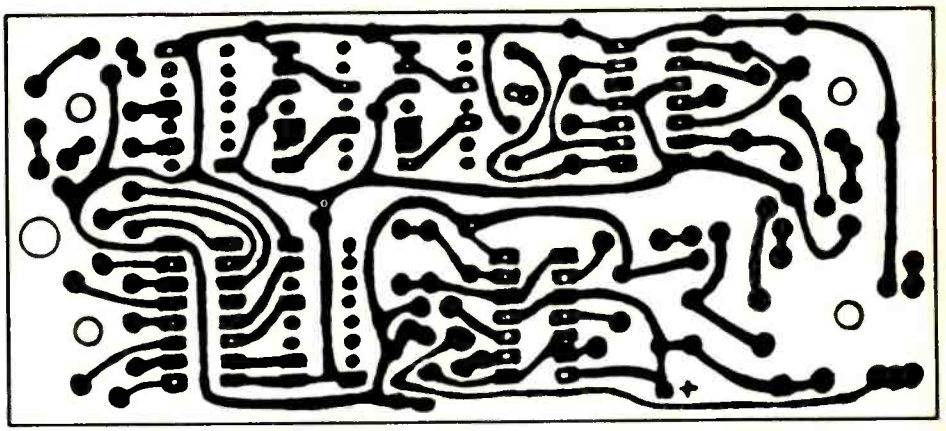
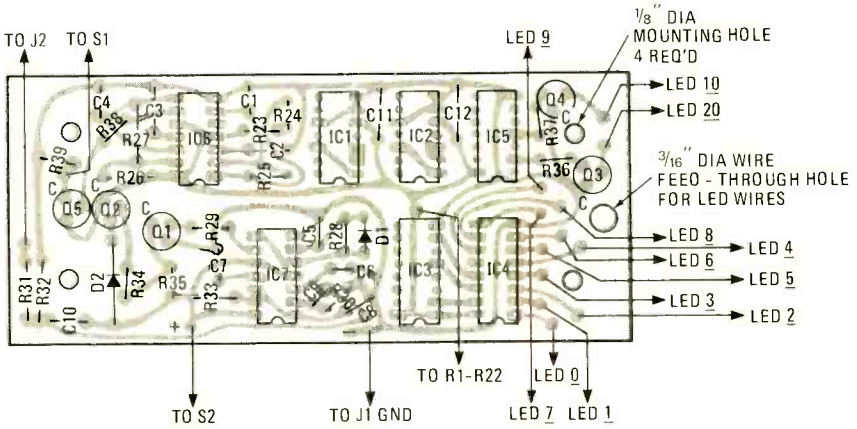


FIG. 2—FULL-SIZE FOIL PATTERN FOR PC BOARD. Use it or the drilling pattern on page 40.

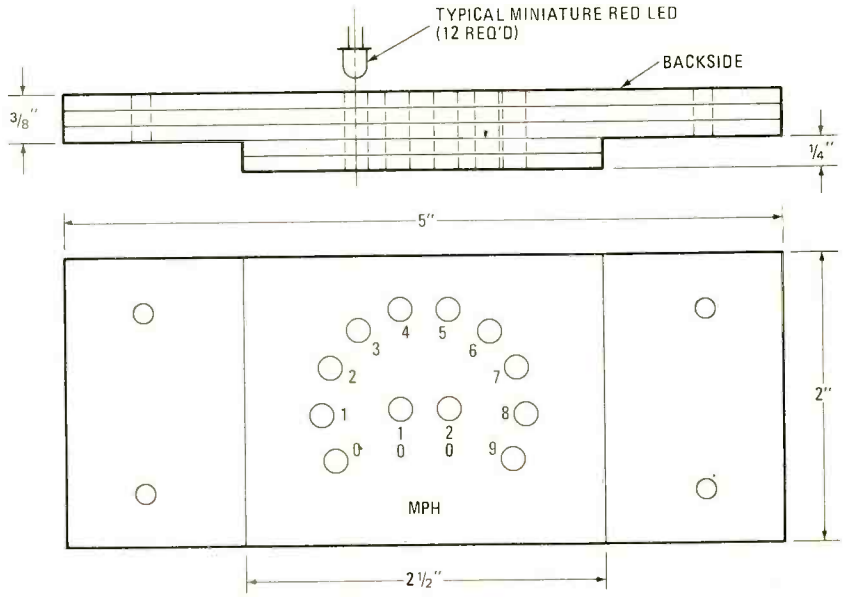


NOTE: R1 THROUGH R22 ARE ON BACK OF FACEPLATE. SEE FIG. 6

WIRE-WRAP JUMPERS

FROM	TO	FROM	TO	FROM	TO
IC5 - 1	IC3 - 15	IC5 - 10	IC2 - 2	IC2 - 14	IC1 - 11
IC5 - 3	IC3 - 12	IC2 - 3	IC1 - 3	IC1 - 11	IC3 - 11
IC5 - 5	IC6 - 5	IC5 - 13	IC7 - 5	IC1 - 8	IC3 - 6
IC5 - 6	IC5 - 9	IC5 - 12	IC1 - 14	IC1 - 9	IC3 - 4
IC5 - 9	IC3 - 9	IC2 - 9	IC3 - 14	IC1 - 12	IC3 - 3
IC5 - 8	IC5 - 11	IC2 - 12	IC3 - 13	IC4 - 12	IC3 - 10

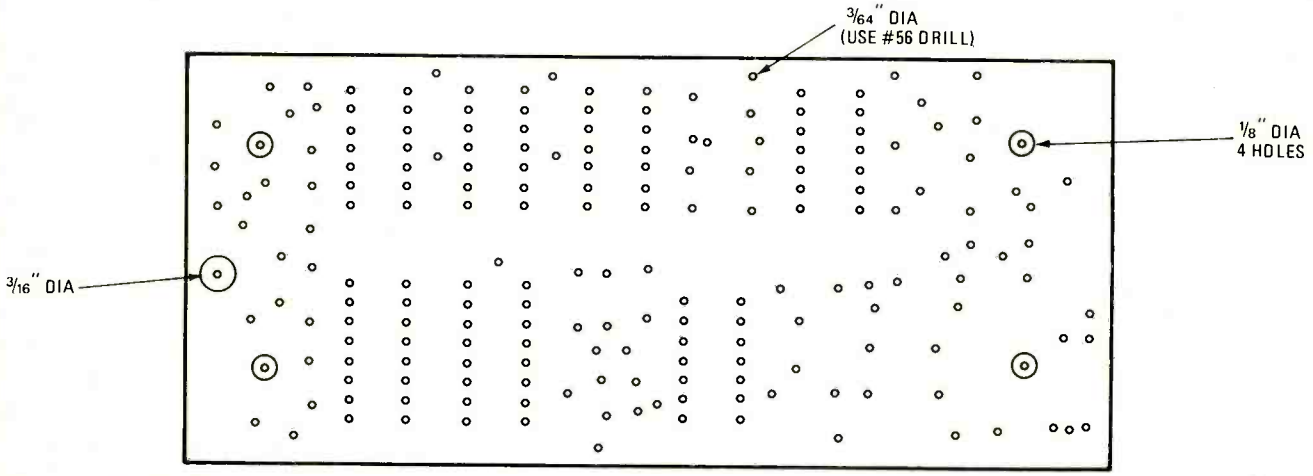
FIG. 3—PARTS LAYOUT. This drawing and the photo on preceeding page will prove helpful when constructing the bike speedometer. Add the eighteen jumpers listed in the table.



NOTE: THIS IS A TYPICAL LAYOUT. THE MATERIAL USED IS ⅛" PLASTIC. FIVE PIECES ARE LAMINATED TOGETHER USING CLEAR CEMENT FOR CHINA, GLASS, ETC. THE PLASTIC AND CEMENT CAN BE FOUND IN A HARDWARE STORE.

FIG. 4—HOW FACEPLATE IS CONSTRUCTED. Holes are drilled so LED's are snug.

ANOTHER PC BOARD CONSTRUCTION METHOD



If you don't have facilities for reproducing the PC board directly from Fig. 2, try this scheme, based on the full-size *drilling* pattern shown here.

Use carbon paper and trace the pattern or holes onto a sheet of paper. Rubber-cement this sheet onto a 2 × 5-inch PC board. With a No. 56 bit, drill a hole at each point indicated. When all holes have been drilled, use water and household cleanser to remove the paper and rubber cement residue. Burnish the copper with fine steel wool to remove all oxidation.

The next step is to draw the foil pattern on the copper surface. Use an etch-resist felt pen and Fig. 3 to make the drawing. If you start in the upper left-hand corner (that is, if you are right-handed), you can draw the connecting lines between corresponding holes without smudging them with the heel of your hand. When you finish, recheck the pattern against Fig. 3. Make sure that adjacent lines do not touch.

When the etch-resist has dried, immerse the PC board in a bath of etchant solution. Follow directions on the bottle and agitate the solution frequently. The etching process takes about 15 minutes. Inspect the board closely after removing it from the bath to make sure that all unnecessary copper has been etched away. Use nail polish remover or acetone to remove the etch-resist. Buff the copper with fine steel wool to provide a good clean surface for soldering. The board is now ready for mounting components.

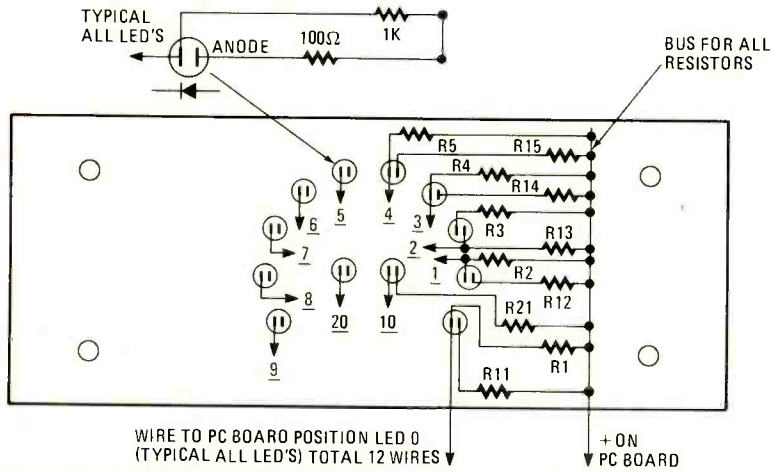


FIG. 5—HOW LED'S ARE INSTALLED along with their associated pull-up and current-limiting resistors. These parts are on rear of faceplate.

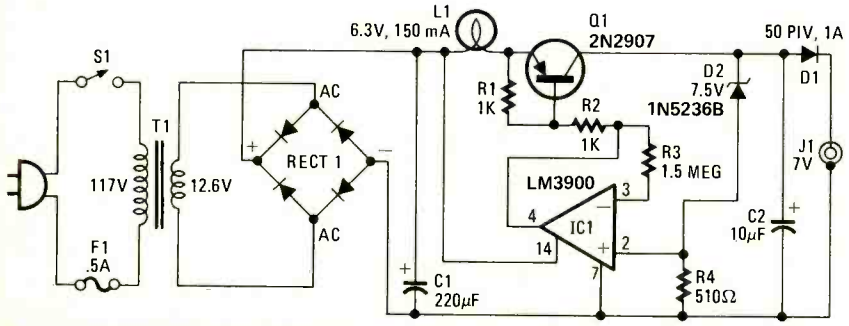


FIG. 6—BATTERY CHARGER keeps the five NiCad cells fully charged. Circuit is designed for optimum performance when charging the battery.

plastic using a fine-toothed handsaw. Cement the pieces together with a clear adhesive, and then file and sand the edges for a smooth finish.

The layout of the holes can be copied from Fig. 4 or you can use your own layout. To drill the 12 holes for the LED's, select a drill that will provide a snug fit when the LED is inserted. The four 1/8-inch-diameter mounting holes should align with the four mounting holes in the PC board. After drilling the holes, peel off the protective paper and spray the faceplate with flat black lacquer. Apply several thin coats on both sides and edges, being sure to spray the inside of each hole as well. If excess lacquer builds up on the surface, remove it with a cloth dipped in acetone. When the lacquer has dried, apply the press-on letters and numbers.

PARTS LIST
BATTERY CHARGER

R1, R2—1000 ohms, ¼ watt
R3—1.5 megohm, ¼ watt
R4—510 ohms, ¼ watt
C1—220 μF, 35-volt electrolytic
C2—10 μF, 16-volt electrolytic
D1—50 PIV, 1.0 A diode (Radio Shack 276-1101)
D2—7.5-volt, 0.5-watt Zener diode, IN5236B or equivalent
Q1—2N2907 with heat sink
IC1—LM3900 Quad Norton amplifier (Radio Shack 276-1713)
J1—Shielded phono jack, chassis mount ¼ inch (Radio Shack 276-346)
S1—SPST toggle switch, 3 A, 120 VAC
F1—½-A fuse slow blow
T1—117-volt pri. 12.6-volt sec. 300 mA (Radio Shack 273-1385)
RECT 1—50 PIV, 1.0 A full-wave bridge (Radio Shack 276-1151)
L1—6.3-volt, 150-mA lamp
Misc.—Fuse holder, case, lamp cord, PC board or perforated board

continued on page 92

BUILD

An electronic musical instrument accessory with a difference. Novel programming capabilities give you unusual time signatures along with bridges and introductions.

JOHN S. SIMONTON, JR.

THE PROGRAMMABLE DRUM UNIT described in this article is used as an add-on to your hi-fi system. It produces percussive sounds that simulate a bass, tom, conga, snare, clave and a wood block. Also, the pattern and rhythm can be stored in memory and played back. But what makes this unit different from other programmable percussion synthesizers?

In the past, percussion units have had three major failings:

1. They do the same thing again and again.
2. They do the same thing again and again.
3. They have no provision for unusual time signatures.

If you wonder why paragraphs 1 and 2 are the same, here's an explanation:

First, except for choosing very generalized and idealized "classic" rhythm patterns, you have no control over the percussion score that is generated. Every time you punch up a tango pattern it will be just like the last tango pattern. Programmability is the obvious key here so that you can produce as many different tango patterns as you wish.

Second, the same pattern repeats, at best, every couple of measures. In real music there are introductions and bridges, etc. This unit takes care of that by providing a BRIDGE key. When this control is activated, instead of repeating the same pattern again, the unit switches to a separate pattern and repeats it as long as the BRIDGE key is activated. When this key is released, the unit shifts back to the first pattern and begins playing it again. The shifting from one pattern to another happens automatically at the repeat points (the end of the pattern), but it can be "forced" to happen anytime.

Every rhythm unit plays $^2/_4$ time and $^4/_4$ time with no problems. Some can also play $^3/_4$ time or $^6/_8$ time. But none has a provision for even $^5/_4$ time, which is a pretty common time signature. This new unit can be programmed for any conceivable pattern, no matter how unusual the time signature.

All the control squares on the front panel are nonmechanical touch switches. Even the slightest touch of the finger activates them.

Drum oscillators

Figure 1 shows a schematic drawing of the five drum oscillators, the voiced noise source and buffer amplifier. All eight current differencing amplifier stages used in this circuitry are contained in two quad amplifiers, IC1 and IC2.

All drum oscillators are parallel-T filter sections, typified by the Wood Block oscillator built up around IC1-a. The parallel-T filter section, consisting of R3, R4, R5, C1, C2 and C3, has a band-reject notch characteristic which, when placed in the negative feedback loop of the amplifier, produces a bandpass filter. Activating pulses from the memory are coupled to the oscillator (filter) by C4 and R8.

The sustain characteristic of the sound produced (or how long the sound persists) is a function of the gain of the entire section. In the case of the Wood Block oscillator, the gain is set by the secondary feedback loop through C5, R6 and R7. Trimmer resistor R7 sets the amount of signal that is fed back through this loop and, consequently, the sustain characteristic of the entire stage.

The remaining Clave, Tom, Conga and Bass oscillators are built around IC1-b, IC1-c, IC1-d and IC2-c, respectively. These operate in the same manner with different component values (or sustain control settings) to produce different drum sounds. All the drum oscillators share a common bias source consisting of R1, R2 and bypass capacitor C57.

The snare sound is generated by the noise voicing circuit comprising IC2-b, IC2-a and associated circuitry. Noise is produced by the avalanching reverse-biased base-emitter junction of transistor Q1 and coupled to gating amplifier IC2-b by R44 and C26. When not activated, the output of IC2-b is held at the upper supply voltage by the current flow into the noninverting input of IC2-b through

R47, R48 and R50. Under these saturated conditions, no signal can pass through the amplifier. A negative-going pulse applied to R49 activates the Snare output by causing C29 to discharge slightly. This results in a decreased current flow through R50 into the amplifier's noninverting input and allows the amplifier to come out of saturation. When the activating pulse ends, C29 slowly charges through R47 and R48 until the amplifier returns to a saturated condition. The noise signal is coupled to the filter section consisting of IC2-a and associated components where the low-frequency components are attenuated to simulate the snare sound.

The signals from all the drum oscillators and noise source are summed together by resistors R9, R17, R25, R41 and R53 and applied to the input of the buffering amplifier IC2-d. The buffer-amplifier output is the output of the drum unit.

The power supply is shown in Fig. 2. The 6-volt supply is decoupled from the digital portion of the circuitry by R126 and C56 and applied to the drum oscillator circuits IC1 and IC2. Power to all of the logic, with the exception of the memories, passes through D40, which provides a 0.7-volt drop, leaving slightly over 5 volts to power the logic. Similarly, power to memories IC14 and IC15 passes through D41, leaving slightly over 5 volts to power these IC's. Closing the SAVE switch allows a reduced keep-alive voltage to be applied to the memory IC's by way of diodes D42–D47, while turning off power to the remainder of the circuitry.

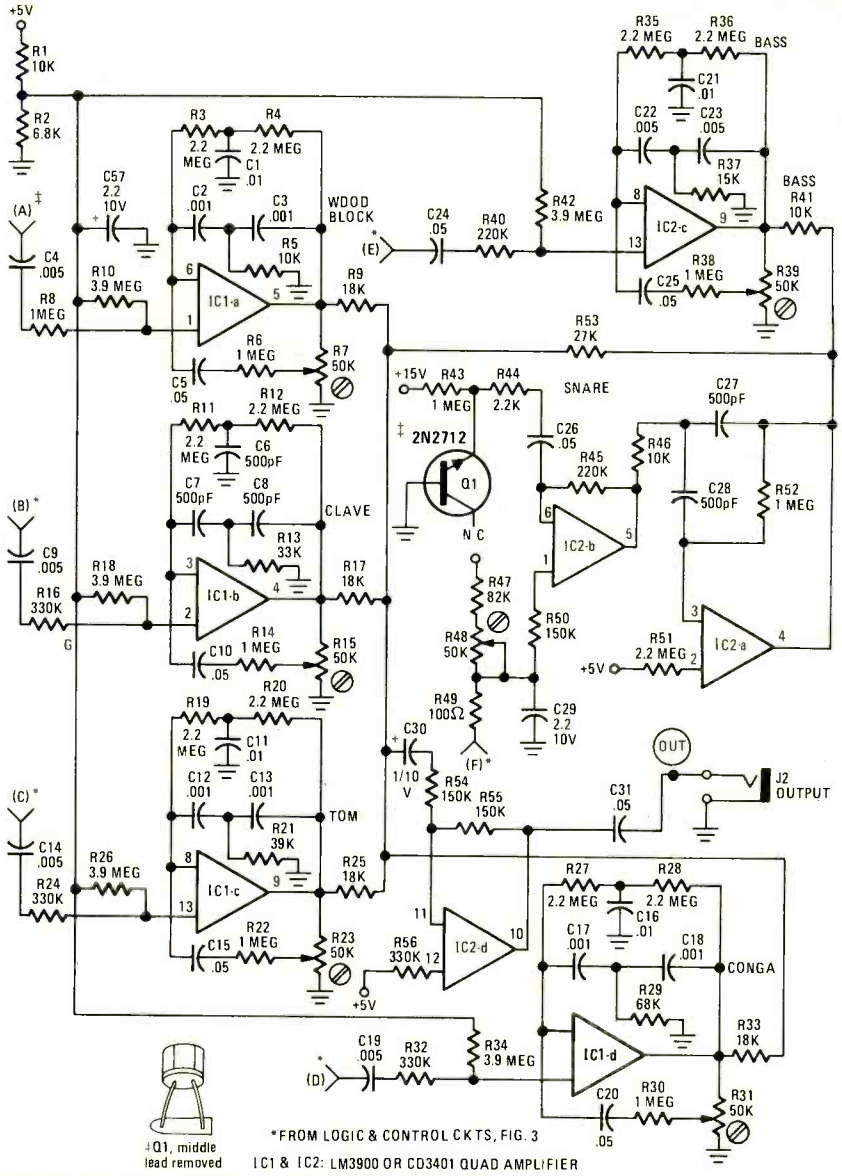


FIG. 1—DRUM OSCILLATORS. Transistor Q1 is selected for maximum noise.

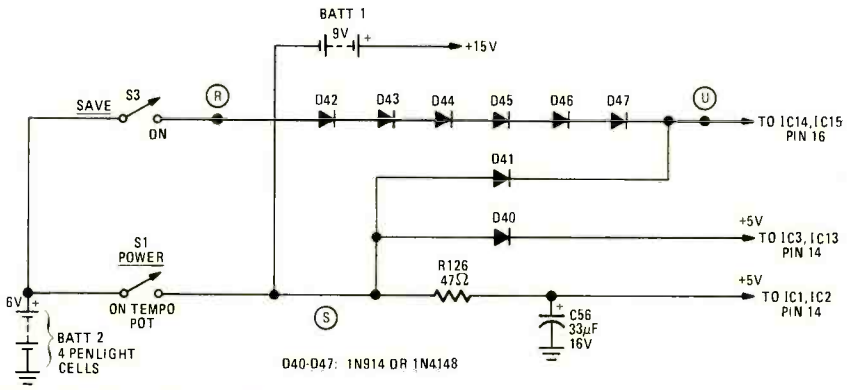


FIG. 2—POWER SUPPLY. Switch S3 permits the unit to be turned off without losing the contents of memory.

Touch switches

The bulk of the touch-switch circuitry is shown in Fig. 3. Two gates from CMOS quad NOR gate IC3 are connected together along with R68 and C34, to form an astable multivibrator that generates a 50 kHz squarewave. After being buffered by IC3-c these squarewaves serve as a common clock to all the touch-switch drivers, IC4, IC5, IC6, IC7, IC8 and IC9.

For example, when the SNARE switch is not activated, the squarewave signal from IC3-c is applied to the two inputs of gate IC8-a, which serves as an inverter. The resulting squarewave signal at the output of IC8-a charges C44 through D19. With this capacitor charged to the supply voltage, the output of inverter IC8-b is at a logic-low level—essentially ground—and the switch can be considered off.

Placing a finger on the SNARE touch pad at pin 6 of IC8 has the effect of placing a capacitor of several picofarads from this pin to ground. During the logic-high half-cycles of the squarewave clock, this capacitance is through D18, but during low half-cycles, the only discharge path for the capacitor is through R86. The net result is a charge build-up on IC8-a pin 6 that holds this pin at a logic-high level and, consequently, the output (pin 4) at a low level. With D19 now reverse-biased, C44 discharges through R87. The output of IC8-b then switches to a logic-high level. Removing your finger allows the output of IC8-a to once again switch at the clock rate, allowing C44 to charge and the IC8-b output to once again switch low.

The remaining stage of IC3 along with R69 and C35 forms a debounce circuit that momentarily turns off the clock buffer when a switch is released.

Memory-control logic

At the heart of the memory-control logic circuitry are the 2112-type memory

All resistors ½ watt, 10% or better, unless noted.

R1, R5, R41, R46, R58, R60, R62, R64, R67, R121, R127—10,000 ohms
R2, R65—6800 ohms
R3, R4, R11, R12, R19, R20, R27, R28, R35, R36, R51—2.2 megohms
R6, R8, R14, R22, R30, R38, R43, R52—1 megohm
R7, R15, R23, R31, R39, R48—50,000-ohm trimmer, PC mount
R9, R17, R25, R33—18,000 ohms
R10, R18, R26, R34, R42—3.9 megohms
R13, R108, R110, R112, R115, R117, R122-R125—33,000 ohms
R16, R24, R32, R56—330,000 ohms
R21—39,000 ohms
R29, R57, R61, R63—68,000 ohms
R37, R101-R104, R106, R107, R118—15,000 ohms
R40, R45, R114—220,000 ohms
R44, R113, R128, R129—2200 ohms
R47, R116—82,000 ohms
R49—100 ohms
R50, R54, R55, R119—150,000 ohms
R53—27,000 ohms
R66, R94-R100—47,000 ohms
R68, R105—4700 ohms
R69-R93—680,000 ohms
R109, R120—470,000 ohms
R126—47 ohms
R130—500,000-ohm log-taper potentiometer with SPST switch
C1, C11, C16, C21, C33, C48, C54, C55—.01μF, 50 volt, ceramic disc
C2, C3, C12, C13, C17, C18, C34, C52—.001μF, 50 volt, ceramic disc
C4, C9, C14, C19, C22, C23, C32, C35-C47, C49—.005μF, 50 volt, ceramic disc
C5, C10, C15, C20, C24-C26, C31—.05μF, 50 volt, ceramic disc
C6-C8, C27, C28—500 pF, 50 volt, ceramic disc
C29, C57—2.2μF, 10 volt, electrolytic
C30, C50, C51-1μF, 10 volt, electrolytic
C53-100 pF, 50 volt, ceramic disc
C56-33μF, 10 volt, electrolytic
D1-D47-1N914 or 1N4148
LED1, LED2-light-emitting diodes (Texas Instruments TIL209B or equal)
Q1-2N2712 specially selected noise transistor
Q2-Q8, Q11, Q12-2N5129
Q9, Q10-2N5139
IC1, IC2-LM3900 or CA3401
IC3-IC11-CD4001 quad NOR gate
IC12-CD4024 seven-stage counter
IC13-CD4013 dual-D flip-flop
IC14, IC15.-2112 256×4 RAM
S1-SPST switch ONR130
S2-SPST momentary-contact pushbutton
S3, S4-SPST slide switches
J1-insulated tip jack, red
J2-2-conductor phone jack
Misc.-two 9-volt battery clips, one battery holder for 4 penlight cells (Keystone type-182 or equiv.), one lug-type terminal strip (one lug grounded, two insulated).

The following are available from Paia Electronics, 1020 Wilshire, Oklahoma City, OK 73116:

Order No. 3750—Complete kit including all parts, case, step-by-step instructions. $79.95 plus $3.00 shipping.

Order No. 3750PC—Set of two etched, drilled and silkscreened circuit boards. $15.00 plus $1.00 shipping.

Oklahoma residents add state and local taxes as applicable.

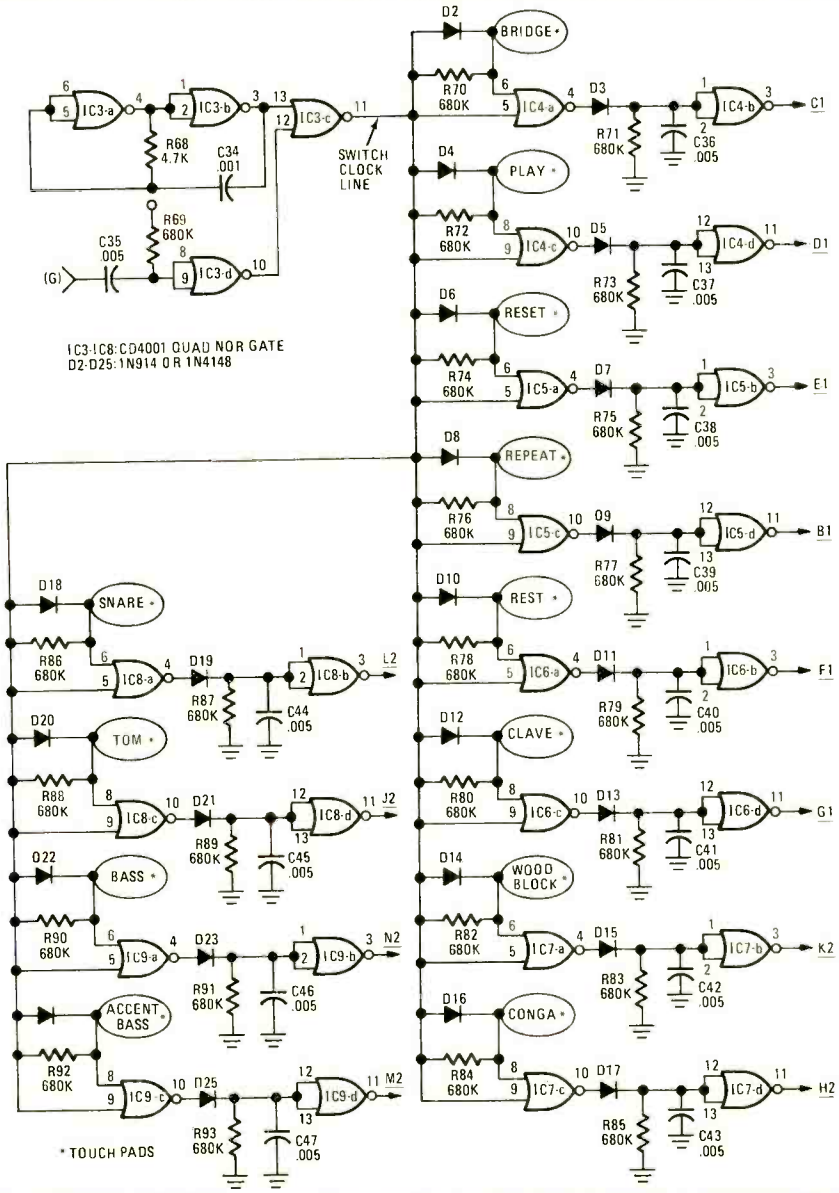


FIG. 3—TOUCH SWITCHES are capacitive sensitive. An earth ground must be provided for the unit for the switches to operate properly. This is usually provided by the shield of the output cable.

IC's 14 and 15. (See Fig. 4.) Each IC represents 1024 bits of memory organized as 256 4-bit words. The two IC's together, then, represents 256 8-bit words. Each bit in the word represents either a drum sound or a signal to reset the rest of the circuitry to the beginning of the pattern. A logic 1 stored in memory causes the corresponding drum to sound, and, if a logic 0 is written in a given memory location, then that location represents a rest.

Six address bits are supplied to the memory by counter IC12. The remaining two address bits are select lines that select one of four pages of memory. The first of these page-select lines originates at switch S4, while the second originates at bridge-select flip-flop IC13.

When the RESET pad is touched, several things happen simultaneously. The read/write (R/W) memory line goes high and the memory is in the read state. The address counter IC12 is also reset to address 000000. Flip-flop IC13-a is reset so that its $\overline{Q}$ output goes high keeping the tempo clock from running. Finally, a clocking pulse is applied to flip-flop IC13-b so that the current state of the BRIDGE-SELECT touch pad appears at the Q output of IC3-b.

Touching the PLAY pad causes the $\overline{Q}$ output of IC13-a to go low, which causes the tempo clock (IC10-a and IC10-b) to begin generating squarewaves at a rate set by TEMPO control R130. This clock signal is coupled by D38 to the input of inverter/buffer IC10-c, and in turn to address counter IC12, making it advance by one count for each cycle of the clocking waveform. Simultaneously, differentiating network R119, R120 and C52, buffered and inverted by IC10-d, produces a short pulse that activates the $\overline{CE}$ input pins of the memories. When taken to a logic-low level, these $\overline{CE}$ pins cause the data stored

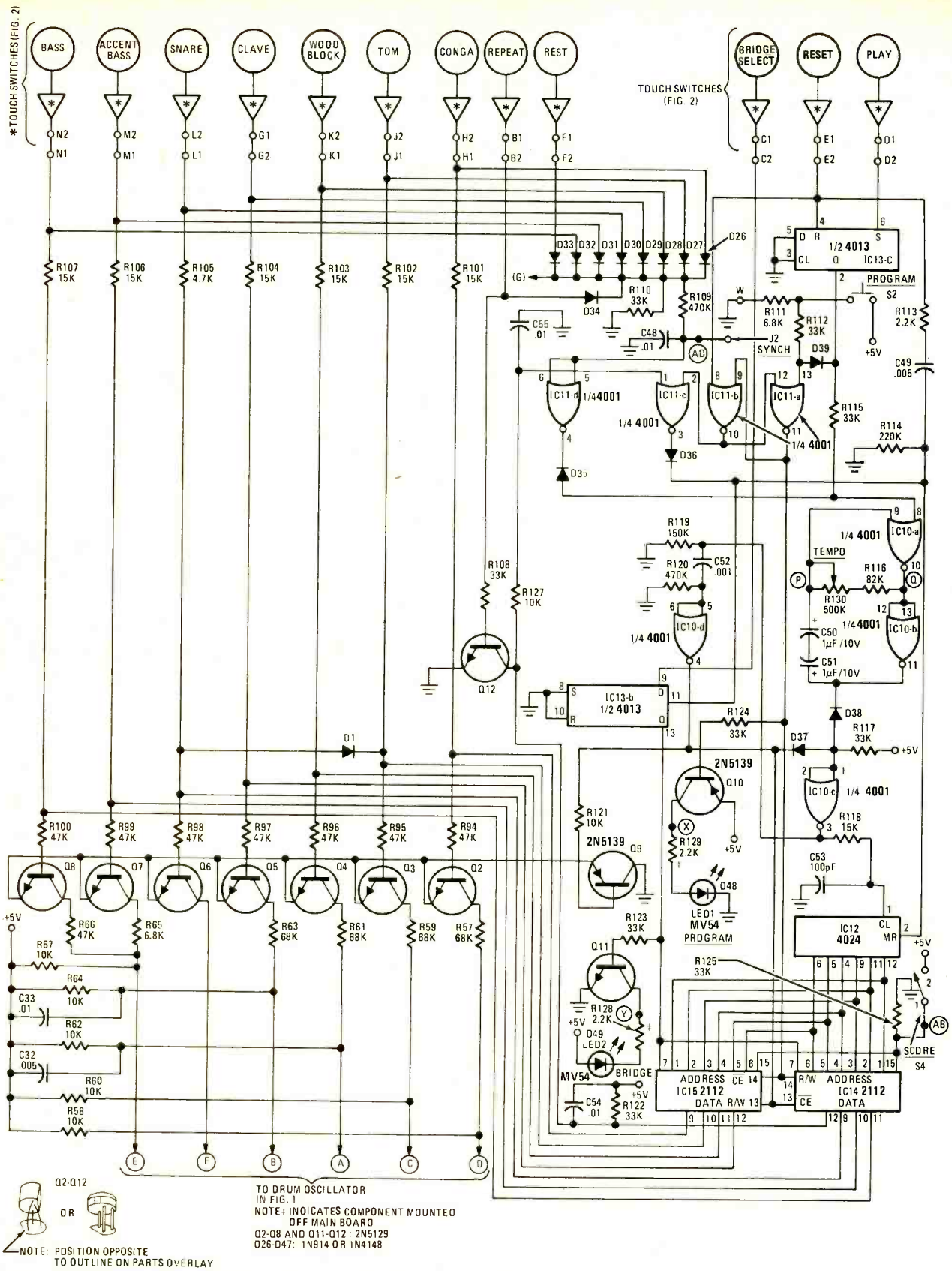


FIG. 4—LOGIC AND CONTROL circuitry. Memory is provided by two 2112-type RAM's.

in the memories at the location specified by the address lines to appear at the output of the memories and are fed to transistors Q2–Q8.

If the data stored is for a drum sound, one of the transistors Q2–Q8 is turned on, providing an activating pulse to the drum oscillators. If the data stored is a repeat, this data (a logic 0) is applied to the collector of Q12 (which will be cutoff under these conditions) and through R127 to one of the IC11-c inputs, causing this gate's output to go high. This produces the same effects as the RESET pad except that the Play flip-flop (IC13-a) is not reset.

If the BRIDGE-SELECT pad had been touched at the time the repeat data occurred, the output of bridge-select flip-flop IC13-b would have changed state, selecting the page of memory corresponding to the setting of the front-panel SCORE switch S4.

continued next month

Hobby Computer Main-Frames

main-frame/'mān-,,frām/ ***n:*** **COMPUTER;** ***esp:*** **a cabinet housing the computer itself as distinguished from peripheral devices connected with it: a cabinet containing a motherboard and power supply intended to house the CPU, memory, I/O ports, etc., that comprise the computer itself.**

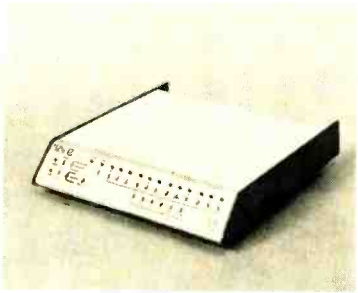
CHESTER H. LAWRENCE

IF A HOBBY COMPUTER HAS A HEART, IT MUST BE the main-frame. And when we started to assemble this story we were going to cover only main-frames. But once we got started we found that if we followed our original premise we would have to omit many popular and interesting machines and accessories. Therefore, we have taken some liberties and stretched the definition to include other devices and systems. What we have ended up with is a directory of hobby computer manufacturers and a condensed listing of items each one makes.

Wherever possible we have included model numbers and prices. In all instances we have provided the manufacturer's address. Write him for more information and when you do, tell him you read about his product in **Radio-Electronics**.

Apple Computer

Two completely assembled systems. Apple I with 4K RAM $475; with 8K RAM $575. Cassette interface board $75. Variety of tape cassette programs available. Apple II with 6502 CPU operates at 1 MHz includes 8K RAM, molded plastic case, keyboard, power supply, game paddles, carrying case, cords and cables, with 4K RAM $1298, with 8K RAM $1398; with 12K RAM $1498; with 16K RAM $1698 in steps up to maximum of 48K RAM $2638. Color graphics capability. Apple Computer Inc., 20863 Stevens Creek Blvd., Cupertino, CA 95104

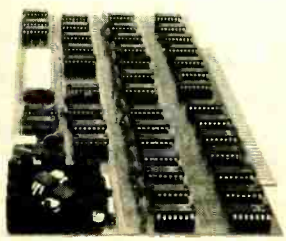


Artisan Electronics

Model 85 microcalculator for use with 8-bit microprocessors has scientific calculation capabilities for scientific, engineering, mathematical or statistical problems. When combined with microprocess a programmable scientific calculator is formed, $189. Artisan Electronics, 5 Eastmans Road, Parsippany, NJ 07054

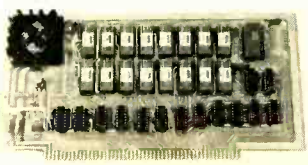
Canada Systems Inc.

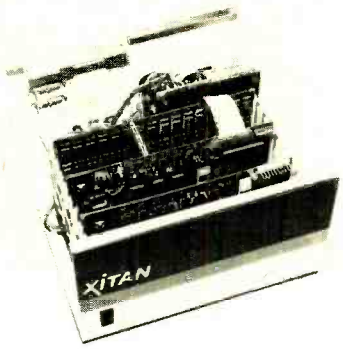
No main-frames here, but there are four S-100 compatable circuit cards. If your system needs to know what time it is try the CL2400 real-time clock board. It's a self-contained time keeping unit. No processor time is required. Kit $98, assembled $135. Then there's the PC3200 power control system that allows microcomputer control of AC power line Switching. The system has three elements; PC3202 single outlet power logic control unit kits $39.50, assembled $52; PC3216 16-channel control logic interface kit $189, assembled $240; PC3232 32-channel control logic interface, prices not available. That's Canada Systems Inc, (Formerly Comptek), 1353 1/2 Foothill Blvd., P.O. Box 516, La Canada, CA 91011



Compucolor

Makes the 8001 8-color personal computer. It consists of a stand alone CRT and microcomputer with both computation and graphics capabilities. Comes assembled only, uses Intel 8080 CPU, has 34 I/Oports and a color display with a 75-MHz bandwidth. Price $2750. Available options include light pen, floppy tape and mini disk. Compucolor Corporation, P.O. Box 569, Norcross, Georgia 30091





Computalker

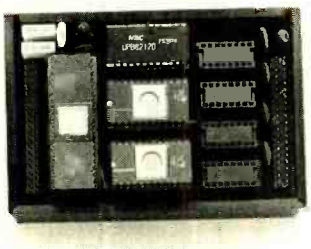
A speech synthesizer that is a high-quality voice generator designed for S-100 I/O bus configuration used in Altair, Isai and Polymorphic computers. Synthesizer is controlled by 9 acoustic phonetic parameters transmitted on the microcomputer data line. CT-1 Speech Synthesizer $395 including users manual, monitor and data tapes. Demonstration Cassette $2.95. Computalker Consultants, P.O. Box 1951, Santa Monica, CA 90406

Cromenco

Microcomputers and peripherals. Z-1 computer system uses Z-80 with a 4-MHz clock rate. S-100 bus. Comes with 8K RAM, 8K PROM, 1K resident monitor, power supply, capacity for 21 boards; assembled only $2495. Z-2 computer system; 4-MHz Z-80, 21 card slots, s-100 bus; kit $595, assembled $995. Joystick console with speaker; kit $65, assembled $95. TV Dazzler turns color TV into display system; kit $215, assembled $350. TU-ART interface has two serial I/O ports, two 8-bit parallel I/O ports and 10 independent interval timers; kit $195, assembled $295. Multichannel analog interface; kit $145, assembled $245. 16K PROM card with address anticipation and bank select; kit $145, assembled $245. Bytesaver memory board and PROM programmer; kit $145, assembled $245. 16K RAM card with bank select; kit $495, assembled $795. 4K RAM card with address anticipation and bank select; kit $195, assembled $295. Cromenco Inc., 2400 Charleston Rd., Mountain View, CA 94043

The Digital Group

Everything from software to systems. Compatible system with plug-in boards. Users choice of Z-80, 8080A, 6800 or 6502 CPU-each a plug-in board. Four board Z-80 system includes 10K memory, 12-amp power supply, standard motherboard and cabinet; kit $895, assembled $1295. Three other system packages also available. Seven system package options. If system selected with 8080A deduct $50. With 6800 deduct $50. With 6502 deduct $100. I/O card; kit $65, assembled $95. TV readout and audio cassette interface; kit $130, assembled $195. 64 X 64 color graphics interface; kit $175, assembled $225. Digital cassette storage drive $115 assembled. monitor $175 assembled. 96-column printer and interface; kit $495, assembled $595. Four power supplies, nine cabinets, assorted acessories and documentation. The Digital Group, P.O. Box 6528, Denver, CO 80206

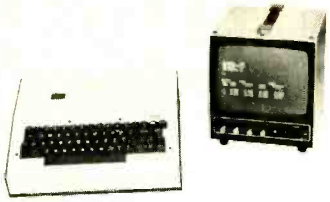


Dynabyte

Six items, all circuit boards, all assembled, all S-100 bus. There's a 16K dynamic RAM module for $399; two 16K static RAM modules – one for $555, the second for $525; two 32K static RAM modules – one for $995, the other for $925; a naked terminal module at $350 completes the line. Dynabyte Inc., 4020 Fabian Way, Palo Alto, CA 94303

Franklin Electric

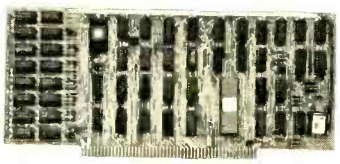
S-100 I/O interface and memory boards. I/O kit provides 3 serial, 1 parallel port; kit $150, kit with sockets $165, assembled $235, without sockets $235. 8K static RAM memory. 450-nS; kit $249, with sockets $235. Assembled $295 with sockets, $280



without. 250-nS kit $275, with sockets $289. Assembled $330, without sockets $315. Franklin Electric Company, 733 Lakefield Road, Westlake Village, CA 91361

Heath Company

Two computer families plus a substantial line of accessories. All items in kit form. H8 computer has 8080 CPU and intelligent front panel $375. Requires at least one memory board. H8-1 8K memory board supplied with 4K static RAM $140. Expansion memory kit H8-3 $95. Serial I/O and cassette interface $110. H-11 computer with LSI-11 16-bit CPU $1295. Accessories for H-11 include H11-1 4K memory expansion module $275. H11-2 parallel interface $95. H11-5 serial interface $95. H11-6 extended arithmetic chip $159. For both systems there's an H-9 video terminal $530. H-10 paper tape reader/punch $350. DEC Writer II keyboard Printer Terminal $1495. Software kits, manuals kits and cassette recorder also available. Heath Company, Benton Harbor, Michigan 49022



Infinite

Microprocessor disigned for use as training device. RCA COSMAC processor. UC1800 kit $389. Assembled with cabinet $495. Infinite Inc., 1924 Waverly Place, Melbourne, FL 32901

Info 2000

Info 2000 adapter for S-100 bus systems to interface PERSCI disc drives; $120 kit, $195 assembled. $40 optional 1K RAM. $120 optional EPROM 3K. INFO 2000 adapter for Digital Group Z-80 computers same prices. Add $90 for optional RS-232 port. Add $70 for second optional RS-232 port. INFO 2000, P.O. Box 3196, Culver City, CA 90230

IOR

VDS2K video system, S-100 compatible, circuit card. Produces 30 lines of 64 characters. Kit $399. IOR, Box 28823, Dallas, TX 75228

Kent-Moore Instrument

S-100 circuit cards. Alpha-video display module generates 16 lines of 32 characters upper and lower case, $107. Also available RAM memory boards for S-100 bus; 4K boards $107, 8K RAM $197, 8KZ (fat) RAM – 250-nS $217. Kent-Moore Instrument Company, P.O. Box 507, Industrial Avenue, Pioneer, Ohio 43554

Matrox Electronic Systems

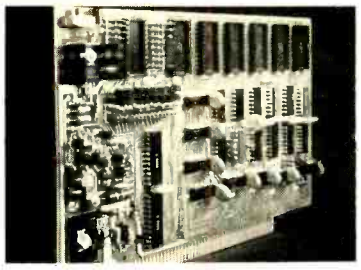
A line of S-100 peripherials includes two TV CRT controllers. The ALT-256 a 256 X 256 high resolution graphics controller $395 assembled. ALT-2480 a 24 line X 80 character alphanumeric controller $295 assembled. Matrox Electronic Systems, P.O. Box 56, Ahuntsic Stn, Montreal, Que Canada, H3L 3N5

Microtronics

Paper tape reader Byte Reader has LED data bit indicators, Lite Optimizer senses intensity of external light and adjusts sensitivity of photo transistors; kit $69.95, assembled $84.50. Microtronics, P.O. Box 7454N, Menlo Park, CA 94025

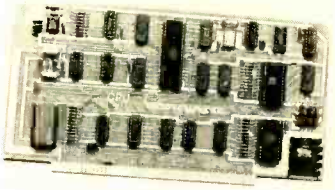
Micronics

S-100 compatible Better Bug Trap to speed software debugging. $160 assembled. Micronics Inc., P.O. Box 3514, Greenville, NC 27834



Midwest Scientific Instruments

6800 computer system. SS-50 bus compatible with SWTP 6800 system. Computer system kit including chassis and hardware, power supply, mother board and connectors, CPU board and monitor, 8K RAM memory board, interface adapter board and serial interface board; $595, assembled system $895. Additional 8K RAM; $225, assembled $335. B-100 terminal; kit $1400, assembled $1400. HSP-1 printer $1195. FD-8 floppy disk memory system single drive kit $1150. Dual drive kit $1950. Single drive floppy assembled $1395. Double drive assembled $2295. Midwest Scientific Instruments, 220 West Cedar, Olathe, KS 66061

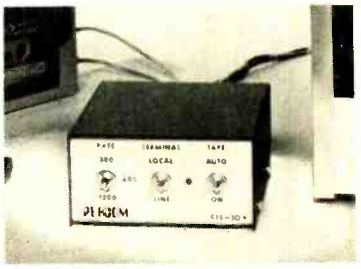


Mijobe

Altair 8800 power supply replacement kit. Just under $60. Mijobe Corp., 657 N. Benson, Upland, CA 91786

MiniTerm Associates

Merlin Video Interface system, an ASCII/Graphics video interface for S-100 bus microcomputer systems. Super dense graphics board for use with the Merlin graphics system displays up to 64,000 graphics dots in a 320H X 200V array. Keyboard interface kit, Minifloppy interface plus lots of software. Merlin; kit $269, assembled $349. Super dense; kit $39, assembled $54. Keyboard interface; kit $20. Minifloppy interface; kit $260, assembled $329. Shugart SA400 minifloppy drive $390. Dual minifloppy $499. Assorted software from $25 to $40. MiniTerm Associates Inc., Dundee Park, Andover, MA 01810



Mits Division of Pertec

This is the company that started it all by manufacturing and producing the first hobby computer. Today they offer a complete line of hobby computers, periphrals and accessories. Here are the highlights of their 14-page catalog. Main-frames: Altair 8800B includes CPU boards, interface buffer board, case power supply, fan, front panel, memory not included; kit $750, $995 and $1070 assembled. Altair 680B with CPU board, case, 1K static RAM, 256 bytes of PROM, ACIA serial interface port, front panel and power supply; kit $395, assembled $495.

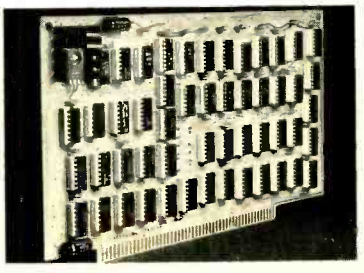
There are nine mass storage items from a disk controller and drive for $1430 kit, assembled $1750; to a hard disk controller at $7995 assembled; to a cassette interface kit at $114, assembled $195.

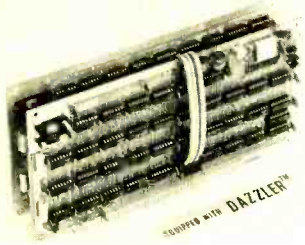
In memory there are five items from a 4K RAM board; kit $155, assembled $255; to a 16K static RAM board ; kit $680, assembled $785.

Then there are all kinds of I/O boards, terminals and printers, and software. Mits, 2450 Alamo SE, Albuquerque, NM 87106

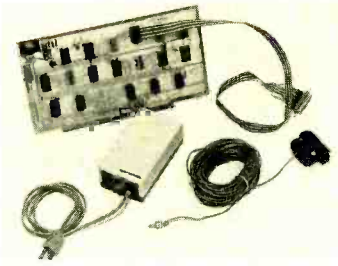
MPI

Printers are their specialty. The MP-40 is a self contained matrix printer that has a print line capacity of 40 characters at 12 characters per inch. It will crank out 75 lines a minute. $425 assembled for the parallel ASCII version. $359 for the parallel LCP and $575 for the serial SSP. Interface boards are $125, $150 and $275. In kit form a naked printer consisting of the print mechanism and interface/power





supply board and all electronic components packaged as a KP-40 is $179. A case is $89 additional. MPI, Micro Peripherals Inc., P.O. Box 22101, Salt Lake City, UT 84122.

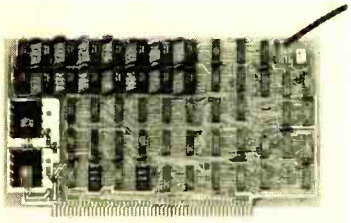


Mullen Computer Boards

Two special-purpose board kits for the S-100 bus. First an opto-isolator/relay control board kit for $117 that permits your computer to interface with all kinds of control applications – motors, alarms, lights, audio signals, etc. Second an extender board with built-in logic probe $35. Both from Mullen Computer Boards, Box 6214, Hayward, CA 94545

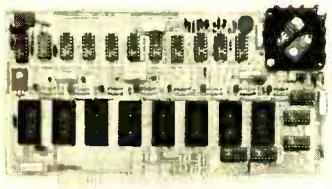
National Multiplex Corp

Universal 8, a computer main-frame with a 25-amp power supply and input port available from front panel switches. Can be used with S-100 bus or SWTP 6800 bus (SS-50). Main-frame kit, less mother board $200. Other boards for this main-frame include Z-80 MPU; kit $150, assembled $200. 8080 MPU; kit $120, assembled $170. 8085 MPU; kit $140, assembled $190. 8K RAM S-100, 250-nS mother board $35. For SWTP $40. National Multiplex Corp. 3474 Rand Avenue, Box 288, South Plainfield, NJ 07080



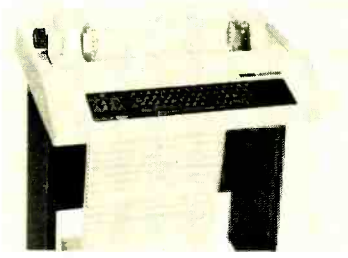
North Star Computers

Horizon-1 includes a Z-80A processor, 16K RAM, minifloppy and 12-slot S-100 mother board with serial interface; kit $1599, assembled $1899. Horizon-2 is same system with dual disk drive; kit $1995, assembled $2349. Additional S-100 boards include a hardware floating point at $259 kit, assembled $359. 16K RAM boards at $399 kit, assembled $459, with optional parity check and additional serial and parallel I/O ports at $39 kit, assembled $59. North Star Computers Inc., 2465 Fourth Street, Berkeley, CA 94710



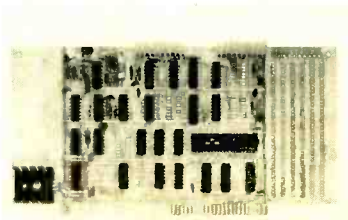
Objective Design

A programmable character generator for S-100 computers that permits the generation of any special characters required by the user. Includes keyboard interface and dual joy-stick interfaces. Magnetic tape controller for S-100 computers on a single card, available in several different versions. S-100 cardframe panel set of front and rear panels with instructions for assembly of a 12 and a 22-slot cardframe. Objective Design Inc., P.O. Box 20325, Tallahassee, FL 32304



Ohio Scientific

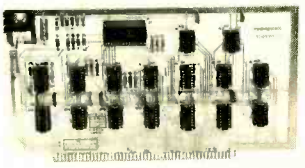
Model 500 is a 6502 running a 1 MHz with 512 bytes of PROM, 8192 bytes of ROM containing 8K basic and 4096 bytes of RAM for user programs. Boards only $298. 500-1 computer with case, power supply, reset switch and terminal connectors $429. 500-8 same board in a 8-slot case with power supply $629. Also complete Challanger computer system including main-frame with 16K RAM, serial interface, system monitor PROM and bootstrap PROM, single drive floppy, monitor and keyboard. $2599, without terminal $2099. Ohio Scientific Instruments, 11679 Hayden Street, Hiram, Ohio 44234



Oliver Audio Engineering

A line of support "tools" for 8080-based

computers. The CA-80/48 cross assembler an 8K assembler that makes it easy to compose, edit, print and store programs for 8048 computer modules. The PP-2708/16 PROM programmer for $249 kit, assembled $299. And the PP-8748 programmer $249 kit, assembled $299. Oliver Audio Engineering, 1143 North Poinsettia Drive, Los Angeles CA 90046



Parasitic Engineering

Equinox 100 kit includes power supply, front panel/CPU board, busboard, fan, cabinet, 2 edge connectors plug 2 hardware kits with handle, cord storage, tilt-up stand, hinged top panel, wiring channel and 18 edge connectors. $799. Available separately, without CPU/front panel board. Complete line of Thinkertoy Products fit and complement the Equinox main-frame. Parasitic Engineering, P.O. Box 6314, Albany CA 94706

Percom Data

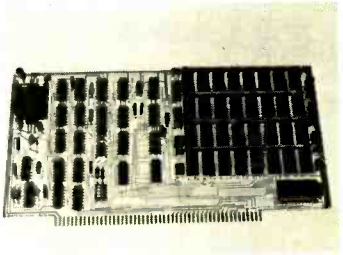
Cassette interfaces. CI-812 is both a cassette and RS-232 data terminal interface that plugs into S-100 bus. 300-baud rate can be extended to 2400-baud; kit $89.95, assembled $119.95. Another unit is made for the SWTP 6800. It's the model CIS-30; kit $69.95, assembled $89.95. Percom Data Company Inc., 4021 Windsor, Garland, TX 75042

Processor Technology

Computer systems and subsystems. Subsystem B for S-100 computer systems includes a memory module, three I/O modules, a general purpose memory and software. There is a choice of three memory modules 4K RAM, 8K RAM or 16K RAM. A VDM-1 module interfaces the computer with a TV monitor. The Computer Users Tape System module interfaces with a cassette recorder. Also available is complete SOL computer system. Processor Technology Corp., 6200 Hollis Street, Emeryville, CA 94608

Quay

Microcomputer kit for the hobbyist. Single board system is complete with Z-80 microprocessor, 2.5-Hz clock, PROM resident monitor, 1024 static RAM, parallel I/O, sockets for up to four 1024 X 8 EPROMS, EPROM programmer board, sockets, documentation; kit $450, assembled $600. Quay Corporation, P.O. Box 386, Freehold, NJ 07728

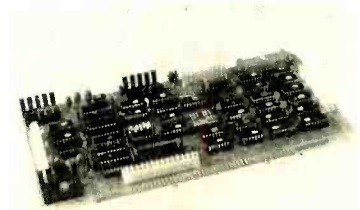


Radio-Shack

Low cost TRS-80 system available assembled only. Consists of video terminal, keyboard housing Z-80 computer main-frame with 4K memory (expandable to 16K), cassette interface, cassette recorder and power supply. $599.95. Keyboard computer alone less video display and cassette recorder $399.95. Radio-Shack, Forth Worth, TX 76107

Smoke Signal Broadcasting

A broad line of products for the SWTP SS-50 bus. An abbreviated rundown shows a BFD-68 Single Drive disk system for $795. A triple drive BFD-68-3 disk system for $1479. An 8K EPROM board for $179, a PS-1 power supply kit for $24.95. A 16K static memory system for $529. A super editor for $29. You'll want the whole catalog. Smoke Signal Broadcasting, Box 2017, Hollywood, CA 90028



continued next month

Videotape Recorders For 1978

After numerous false starts, design engineers have developed home VTR's that are viable and promising. Here's a review of what's on the market.

FRED PETRAS

IN CASE YOU HAVEN'T NOTICED, 1978 IS ON its way to being *the* year for HVTR—the *H*ome *V*ideo*T*ape *R*ecorder. Before you say, "I've heard that song before," let's say that we, too, have heard it, believed it and been disappointed. This year, however, we don't expect to be disappointed.

There seems to be plenty of evidence to support our belief in the form of actual products in the marketplace, a hefty sales base established in 1977 and a strong consumer belief in HVTR as a viable product that has finally come of age after 15 years of trial-and-error development and marketing.

Much of what has happened since our last look at HVTR (**Radio-Electronics**, June, 1976) is centered around a change in attitudes and efforts of the companies that make up the HVTR industry. These companies have come to realize that the corporate ego battles they have been fighting have cost them untold millions in wasted research and development costs and in sales that have *not* been rung up because consumers have been presented with too many forms of proprietary, incompatible equipment. They have decided not to waste any more money but rather *make* money and perhaps recoup their losses. In effect, manufacturers have stopped worrying about ego—defined as "value, standing, dignity, prestige"—and are united in putting across HVTR—even if it involves diverse approaches.

While these diverse approaches (there are six in all) still represent more incompatibility than consumers should ideally be faced with, there is strong hope, and some proof, that the new crop of systems can coexist, as, for example, in the audio field where the consumer can choose six kinds of tape (reel, cassette, cartridge, Elcaset and two forms of micromini cassette). What the consumer sees today is not just a few companies meagerly promoting *proprietary approaches* to HVTR, but nearly all the major TV/home electronics companies touting HVTR on a grand scale as the most dramatic home entertainment *concept* that has come along since the birth of television. While the consumer still has to make a choice, it is within the framework of a total concept he can now believe in since it has the backing of an entire industry, and is an industry in itself.

What has also happened since our last look at HVTR is that videotape equipment manufacturers have decided to cut

MAJOR HALF-INCH VIDEOCASSETTE SYSTEMS

Format	Brand	Suggested Price	Manufacturer
Beta 1	Sony Betamax	$1300	Sony
Beta 2	Sanyo[a]	$1000	Sanyo
	Sears[a]	$1000[b]	Sanyo
	Sony	$1300[c]	Sony
	Toshiba	$1300	Toshiba
	Zenith	$1300[d]	Sony
V-Cord Two	Sanyo	$1050	Sanyo
VHS 2	Hitachi	NA	Hitachi
	JVC	$1280[e]	JVC
	MGA	$1250	JVC
	Sharp	NA	NA
VHS 4	Magnavox	$1075–$1095	Matsushita
	Curtis Mathes[f]		Matsushita
	Panasonic	$1095	Matsushita
	RCA	$1000	Matsushita
	Sylvania	NA	Matsushita
	GE	NA	Matsushita
VX-2000	Quasar	$895	Matsushita

[a] Single-speed.
[b] Expected price.
[c] Also console with 19-inch color chassis for $1995.
[d] Also console with 25-inch color chassis for $2600.
[e] With timer.
[f] Console with 25-inch color chassis, AM/FM stereo radio, 8-track cartridge recorder/player and cassette recorder/player and 14 speakers for $3995.

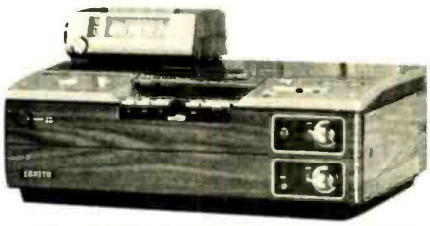
off the videodisc "at the pass," so to speak, by developing more viable, more flexible formats. Their reasoning is that if the tape formats become entrenched, the disc formats will have a tough time winning their share of the market and will exist only on a low-interest level, or fall by the wayside.

The main sales pitch of suppliers is that HVTR's offer both record and play capability, and at best, videodiscs can offer only one-hour play time while videotape offers up to six times as much. Suppliers also stress that HVTR's recording capability enables the consumer to record programs he might otherwise miss because of simultaneous scheduling and to view them any time that he, rather than a network, prefers.

The HVTR market

Having met and, in some cases, exceeded their sales projections for 1977, HVTR manufacturers are bullish about 1978 and beyond: Here's how the market looks to them:

Sony Corporation expects sales of its



ZENITH MODEL JR900W videocassette recorder has a suggested retail price of $1300.

Beta systems in the United States under its own and other brand names to be about 200,000 units, a third of its worldwide sales. Furthermore, the company predicts the industry is heading for "an estimated $1 billion in sales by 1980."

RCA says, "The home videocassette recorder market will reach the billion-dollar annual sales level in three years—by the end of August, 1980. The industry will sell 750,000 units in 1978, and well

JVC's VIDSTAR VHS SYSTEM consists of 2-hour videocassette recorder/player; Vidstar camera and color camera adapter; and videocassettes with 2-, 1- and ½-hour playing times.

over a million will be sold in 1979."

Toshiba predicts sales of 500,000 units for the industry in 1978.

Magnavox is "conservatively" predicting industry sales of half a million units in 1978.

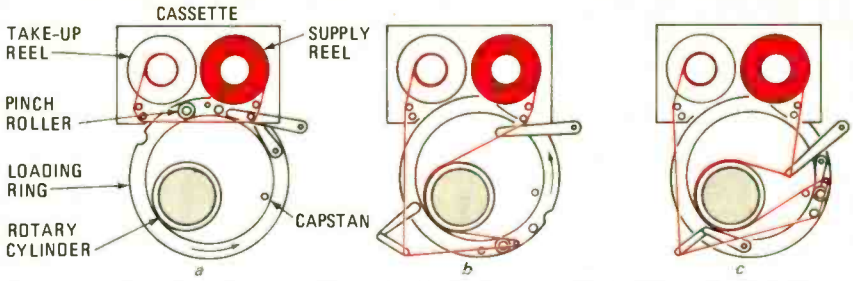
Panasonic sees the industry selling "between 500,000 and 750,000 units in 1978. In 1979 we'll see an increase—we can't say precisely how big."

JVC expects the industry to sell 400,000 units in 1978, 600,000 in 1980 and 800,000 in 1981.

Sanyo states: "Some of the predictions made by others are not realistic. HVTR will be a good, strong market in 1978, but we tend to think that overall sales will be somewhere under 200,000 units."

A Gallup survey, commissioned by Sony-Paramount and other interested parties, estimated that HVTR, at current prices, has a sales potential of 5 million homes. A consultant on the project estimated that 2 million homes would have HVTR's by 1980.

Another survey conducted by Arthur Little predicts that by 1985, movie houses will be obsolete as a result of viewers switching to projection TV's fed by HVTR's, CATV and videodises (should they actually become a viable reality). The prediction hinges on expectations that HVTR prices will drop sharply as sales increase.



BETAMAX TAPE LOADING SYSTEM. The initial starting point of the system with the cassette inserted is shown in *a*. When loading starts, the loading ring rotates counterclockwise and draws tape out of cassette and around the rotating cyclinder as shown in *b*. (Rotating cylinder contains video recording and playback heads.) When tape loading process is completed, loading ring clamps tape between capstan and pinch roller as shown in *c*.

HVTR systems

There are four basic HVTR systems in the consumer market, plus two variations, for a total of six. They are:

1. The Beta (or Betamax) format developed by Sony at a reported cost of $33 million. This format is available as *Beta 1* and *Beta 2* in several brands, the numbers originally standing for hours of record/play time.

2. The VHS formats, consisting of VHS 2 developed by JVC and VHS 4 created by the parent company Matsushita, in at least six brands, with the numbers standing for operating times.

3. The V-Cord Two, the first long-playing HVTR developed by Sanyo and marketed under that brand name, providing up to two hours of operating time.

4. The VX-2000, also known as the *Great Time Machine*, developed by Matsushita, offering up to two hours of operation and marketed in the U. S. under the Quasar name.

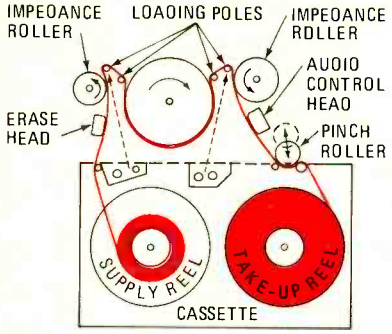
The four basic systems are mutually incompatible. But the Beta systems are compatible in the one-hour speed (with exceptions). The VHS systems are also compatible at the higher (two-hour) speed.

What helps the industry is that, in addition to having some equipment compatibility, the brand-oriented consumer has an option of brand names within the Beta and VHS formats. If he buys a Beta 1 unit bearing the Sony name, he can exchange one-hour tapes with a friend who owns a two-speed Beta 2 machine marketed under the Sony, Toshiba or Zenith brand names (but *not* the one-speed Beta 2 offered by Sanyo and Sears). Tapes made on VHS 2 machines can be played on units bearing the JVC, Hitachi, MGA and Sharp names. These same two-hour tapes can also be played on VHS 4 machines in the VHS 2 operating mode. At the moment, RCA is hedging a bit on the compatibility between its VHS 4 machines and those bearing other names. While RCA guarantees compatibility between its model and others in the two-hour mode, with respect to the four-hour mode, it says there might be "a slight degradation noticeable in interchange of tapes and machines" in that speed, and that "slight tracking errors might be possible." A spokesman for Matsushita/Panasonic stated the company "guarantees perfect compatibility between VHS 4 machines in the four-hour mode. Should there be some slight difference in picture quality, it's just a matter of adjusting the tracking control."

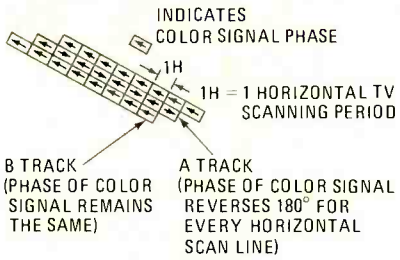
Let's take a look at some of the basic operating characteristics, specifications and features of the individual formats:

Beta 1 and Beta 2: Rotary two-head helical scan system. Video signal: EIA standard, NTSC type color. Tape speeds: 1.57 IPS for Beta 1; .79 IPS for Beta 2. Video signal-to-noise: better than 40 dB. Horizontal resolution: monochrome, more than 280; color, more than 240 lines. Uses ½-inch tape in 3¾ × 6⅛ × 1-inch cassette.

Beta units attach to TV set antenna terminals. Piano-key operating controls include eject, rewind, stop, play, fast forward, and record. Other controls and facilities include a tracking control, pause switch, power pushbutton, channel selectors, fine tuning, AFT pushbutton, memory switch, reset pushbutton for tape counter, program selector and camera input jack. Built-in or optional timers permit recording when you are not there. A key feature in the Sony *Betamax model SL-*



VHS TAPE LOADING SYSTEM. When the cassette is inserted, two sets of loading poles draw the tape out of the cassette and around the rotary cylinder. The tape is in contact with more than half the circumference of the rotary cylinder, which contains the video recording and playback heads. The impedance rollers spin as the tape is supplied to insure smooth tape travel. Simultaneously, the pinch roller shifts toward the cassette and clamps the tape against the capstan.



BETAMAX FORMAT. Tracks are recorded obliquely to the direction of tape travel. To prevent chrominance signal crosstalk between recorded tracks, each alternate track is recorded so that the phase of the chrominance signal is reversed 180-degrees for each horizontal scan line.

8200 is SNRS (*S*ony *N*oise-*R*eduction *S*ystem) to stabilize performance and retain a high-quality picture.

Beta owners can watch one program on the TV set to which the unit is attached, and simultaneously record a program from another channel via the unit's built-in tuners. Blank tape prices are about $12.45 for one-hour, and $16.95 for two-hour tapes.

VHS 2 and VHS 4: Rotary two-head helical scan system. Video signal system: EIA standard, NTSC-type color. Tape speeds: 1.32 IPS for VHS 2: .66 IPS for VHS 4. Video signal-to-noise: better than 43 dB. Horizontal resolution: more than 240 lines in color mode. Uses ½-inch tape in 4.1 × 7.4 × .98-inch cassette.

The VHS 2 and VHS 4 units attach to TV sets via their antenna terminals. The VHS 2 unit, as supplied by JVC, has eight operating controls for pause, audio dub, record, rewind, stop, play, fast forward and eject. Other features include a timer select switch, microphone jack, tracking control, search control (which lets you easily and automatically rewind tape to a predetermined point), tape counter, recording selector (selects between TV or an auxiliary program source), UHF and VHF tuners and automatic fine tuning button. There's a built-in LED clock timer for recording when you are away or occupied. A built-in tuner permits you to simultaneously record one TV program as you watch another.

The VHS 4 unit, as supplied by Matsushita for RCA, Panasonic, Magnavox, etc., is similar in basic specifications and operating features to the JVC VHS 2 unit, except for four-hour record/play capability plus switchable two-hour capability. The two formats are totally dissimilar in appearance, with the VHS 2 somewhat smaller. VHS 4 units offer a memory switch that can be set to find any particular point in a tape. They also offer a remote pause control, with a 20-foot-long cord, to delete segments of material while recording or to interrupt playback. A special feature is automatic dehumidification for humid operating conditions. Available as options are: two black-and-white cameras—one for $300 with flip-up viewfinder and one that sells for $400 with zoom lens and a through-the-lens viewfinder—and a microphone that sells for $10.95. Blank tape prices in the JVC VHS 2 format are $15.95 for one-hour tapes, and $19.95 for two-hour tapes. In the VHS 4 format, prices are $17.95 for two-hour tapes, and $24.95 for four-hour tapes.

V-Cord Two: Rotary two-head helical scan system. Video signal system: EIA/NTSC standard. Tape speed: 2.91 IPS for one-hour operation: 1.45 for two-hour operation. Video signal-to-noise ratio: better than 44 dB. Horizontal resolution: color, 250 lines; monochrome, 300 lines. Uses ½-inch tape in 4⅝ × 6⅜ × 1-inch cassette. Note: In the one-hour standard mode, the set operates as a rotary two-head helical scan, for full field recording and playback. In the two-hour long-playing mode, it operates as a rotary single-head helical scan, for skip-field recording.

The V-Cord Two attaches to antenna terminals of a TV set, or via a standard 8-pin connector to the video monitor/TV receiver for off-the-air recording. Piano-key operating controls are: audio dub, record, play, fast forward, rewind, stop and eject. Other controls and features include a power on-off switch, locking pause control (which can be used for "stop-action" capability), a source control, a speed selector, a microphone input jack, a VTR input control, digital counter with memory and automatic fine tuning. Built-in UHF and VHF tuners provide off-the-air recording independent of the TV set to which the unit is attached. Available as an option is a digital clock timer with LED readout for automatic recording while you are away. Blank tape costs $19.95 for a two-hour cassette.

VX-2000 ***Great Time Machine:*** *Alpha Scan* single-head scan system. Video signal systems: NTSC. Tape speed: 2 IPS. Video signal-to-noise ratio: better than 42 dB. Horizontal resolution: black-and-white, 240 lines; color, 220 lines. Uses ½-inch tape in 8⅜ × 5¾ × 1¾-inch cassette. Play/record time per tape: two hours.

The VX-2000 connects to TV set antenna terminals. Piano-key controls are: fast forward, rewind, play, monitor, stop, off-on. Other controls and features include: eject, auto stop, antenna selector, pause/stop level, UHF and VHF selectors, start and automatic fine tuning.

Available as a $50 option is a presettable timer for automatic recording. Also available is a remote pause/stop control for editing out commercials or other material during recording. Taping one program is possible while you view another program via a built-in tuner. A special feature is a switchable video head dehumidifier to counteract formation of moisture on the recording head under high-humidity conditions, or if the machine is moved suddenly from a cold to a warm environment. Blank tape prices are: $16.95 for one-hour tapes; $19.95 for 100-minute tapes; and $24.95 for two-hour tapes.

While most of the Beta and VHS units look quite similar, this is only temporary. Some units under contract production will be face-lifted with proprietary designs. In some cases, manufacturers will shift from contract sourcing to their own production, with individual designs. Eventually, HVTR's will look as similar or as dissimilar as audio tape recorders do today.

The same design changes will apply to features. Currently some firms are locked into machines made for them for marketing under their own brand names. As initial production problems ease up, it will be possible for those firms to obtain units made with special features that may not be offered by the OEM suppliers in their current models.

QUASAR'S GREAT TIME MACHINE features *AlphaScan* single-head video recording system. Cassettes, available at extra cost, record and playback up to two hours.

Playing times

While the operating time of the VHS 4 system obviously has an edge over that of the other systems, this advantage will be reduced to some extent in the Beta formats. Sony decided to improve its position by lengthening the operating time of its hardware through an upcoming new tape (L-750) that offers a longer record/play time. The end result is that the Beta 1 machines can function for 1½

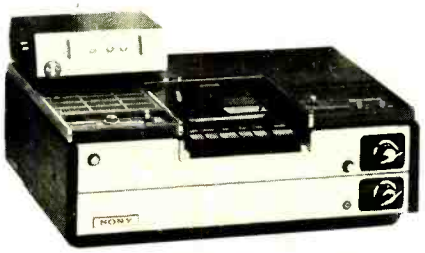
hours, and the Beta 2 machines, for three hours-per-cassette.

Simultaneously, Sony announced a $100 changer that allows two Beta cassettes to be played (or recorded) successively for up to six hours of programming. (During recording, the user loses 10 to 12 seconds of program material in the changing cycle between tapes.)

Camera equipment

While the home videocassette user has it made in terms of off-the-air color recording, his lot is not as happy in terms of do-it-yourself "live" color recording. At press time, only three color cameras that could be classified as "consumer-type" were available—at prices *higher* than those of the HVTR's they'd be used with. One color camera from JVC, priced at $1500, uses two ⅔-inch vidicon tubes and has an optical viewfinder. Another camera from Toshiba, priced at $1700, uses a single 1-inch vidicon tube with a stripe filter and has an optical viewfinder. Another version of the Toshiba model, offered under the GBC brand name, is priced at $1595.

If color is a must, you have to dig deep into your wallet. Or you can settle for black-and-white programming and use cameras in the $260-to-$400 range, as



SONY MODEL SL-8200 BETAMAX. Each cassette has a two-hour record/playback capacity.

offered by the companies supplying recorders as well as camera specialty firms.

As for recording sound, it's no-sweat proposition; the video cameras have built-in microphones. Also, some cameras connect into the remote-pause-control connection, thus enabling you to turn the HVTR on and off from the camera.

Prerecorded tapes

Beta and VHS HVTR equipment owners will not suffer a lack of prerecorded tapes. They will have a substantial variety of choices initially (over 1000 tapes in the Beta format at press time), and eventually will have a vast library from which to satisfy most tastes. Furthermore, in many instances, they need not *buy* the tapes; they can *rent* them.

The prime candidates for videocassette programming are movie films. Already available are many recent and ancient classics from several major film companies; recent hits (great and not-so-great); the mixed-bag products of secondary producers; X-rated films; travel films; comedy packages that are mainly in the public domain; sports activities; educational films; documentaries, etc.

And there's additional program potential. Sony, through independent companies, offers a service that electronically color-corrects old 8-mm home movies and 35-mm slides, and transfers them to videocassettes for Beta-format playback. One company is **S/T Videocassette Duplicating Corp., Leonia, NJ.** This company provides the service through over 200 retail store depots. Another company, **Show/Tapes, Hollywood, CA,** offers film-to-videocassette transfers of Super 8-mm home movies, at $1-per-minute plus the cost of the blank tape.

These are merely examples of what's currently available. By the time this appears in print, dozens of companies will probably be selling recorded videocassettes and offering film-to-tape transfer services.

As the HVTR industry develops, you can expect to see hundreds of specialty operations offering videocassette rentals. At this moment, it's too early to tell what rental fees will be. We'll venture to guess that initially fees will be high, but will drop markedly as competition expands. Essentially, rentals will become a viable, affordable approach to providing viewers with a variety of programs.

Pricing

The big question is "what will happen to videocassette deck pricing?" Since last July, manufacturers' original list prices have been decimated on the retail front for three reasons: (1) Anxious dealers moving merchandise just to keep their cash flow active regardless of low profits; (2) Aggressive, highly competitive dealers seeking to garner a big share of the market early on; or (3) merchants who won't let a customer walk out without buying something.

Another aspect of the pricing picture is the bottom-line reality of the marketing front. Companies are in a bind: They have to amortize millions of dollars in research and development costs for their HVTR products, and yet come up with prices that will be reasonably attractive to both dealers and consumers. RCA took the bull by the horns by list-pricing its Matsushita-made system for $95 less than Panasonic, a division of Matsushita. A spokesman for Panasonic explained: "To Matsushita, Panasonic, even as a division, was merely another customer placing an order. RCA got there first, with a big order—bigger than what we expected to place. We just couldn't list-price our sets as advantageously as RCA and give our dealers realistic profit margins." (Realistic and viable retail profit margins in the TV/electronics field are about 30%.)

Industry observers predict that HVTR pricing will settle to realistic levels eventually, enabling companies to amortize their research and development costs on a *long-range* basis by working on smaller profit margins now when the industry is just getting off the ground. By making sure that the industry establishes itself, the companies are assuring themselves of research and development amortization.

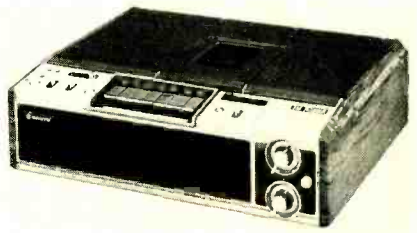
Other developments

Based on reports circulating in the industry as we go to press, you can expect the following developments:

Sony and Toshiba will manufacture single-speed two-hour Beta 2 machines at lower prices (possibly $150 less) than current two-speed models (one- and two-hour operation). These units will be smaller and lighter than two-speed models and will have built-in timers.

Toshiba will produce a lower-priced version of its $1700 color camera.

More big-name manufacturers will enter the HVTR field . . . companies like Admiral, Superscope, General Electric, Pioneer, Aiwa, Akai, plus giant retailers such as Montgomery Ward and J. C. Penney. At press time, the above firms are studying the HVTR field, along with others unwilling to tip their hands for competitive reasons. New companies are entering the field, new videotape recorders are being introduced and prices are changing, namely downward. Thus, by the time this appears in print, it is possible that some of the facts and figures given in this article will have changed.



SANYO V-CORD II, *model VTC 8200*, features 2-hour recording on single cassette.

Is videotaping illegal?

Currently pending is a suit by MCA-Universal against Sony Corporation. The suit charges that using videocassette recorders infringes on MCA-Universal's motion picture copyright position on films that are recorded from TV broadcasts, and results in unfair competition. Disney Productions is also on the side of MCA-Universal.

In the suit, MCA-Universal asks that Sony be forced to stop producing and selling Betamax recorders, and that existing tapes of copyrighted material be impounded (and presumably destroyed).

Whatever the outcome, it is expected to affect all HVTR producers. One prediction is that the suit is doomed and may never reach the courts. Another is that, should MCA-Universal win, HVTR equipment owners will have to pay a use tax on that equipment. **R-E**

Dolby FM– More than just noise reduction

A Dolby B system does more than just reduce noise in FM broadcasts, it permits stations to transmit program material with wider dynamic range. Here's how.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

MOST READERS OF RADIO-ELECTRONICS are familiar with Dolby noise-reduction or Dolby-B systems in stereo cassette tape decks. However, to review quickly, the Dolby-B circuit is a specialized compander in which high-frequency, low-level program material is progressively boosted (depending on amplitude) during encoding and symmetrically attenuated during playback.

Figure 1 shows the typical Dolby-B encoder characteristics. The decoding processor imparts converse curves (attenuating high frequencies appropriately at each level shown) so the net response for the two-part process is flat over the entire audio-frequency range. Since objectionable noise or tape hiss occurs primarily at high frequencies, the chief virtue of the Dolby-B system as applied to tape recording is its ability to reduce such high-frequency noise by as much as 10 dB. This is a substantial improvement, especially with cassette tapes, which, without such added noise reduction, can provide a maximum signal-to-noise (S/N) ratio of not much more than 55 dB (assuming that top-grade tapes are used with top-quality tape decks).

In view of the emphasis placed by tape deck users on the Dolby system's noise-reduction capability, it is not surprising that ever since this system was applied to FM and stereo FM broadcasting, most audiophiles have considered Dolby FM as simply a way of reducing background noise during weak FM reception. Indeed, if you live far from a station and have been plagued with inadequate S/N ratios, background noise is reduced significantly if the station begins using Dolby and if your tuner or receiver is equipped with the necessary modification circuitry and decoder. In most listening situations, however, such noise reduction is imperceptible.

Figure 2 show why this is so. A modern tuner or receiver can provide a maximum S/N ratio of 70 dB or more when a strong signal is fed to its antenna terminals. A strong signal is one that is greater than around 100 μV (or, in power terms, 45 dBf referred to a 300-ohm antenna input). In most listening situations (particularly if a good outdoor FM antenna is used), tuners and receivers are provided with far more signal strength than that. A 70-dB S/N ratio is better than that available in most program material (records, tapes, etc.) transmitted over FM. Thus, even if Dolby adds another 10 dB of S/N capability (at high frequencies), residual noise is still generated more by the program material than by the transmission medium. Then why do stations bother to switch to Dolby, and why do more and more tuner and receiver manufacturers incorporate some or all the Dolby circuitry in their products?

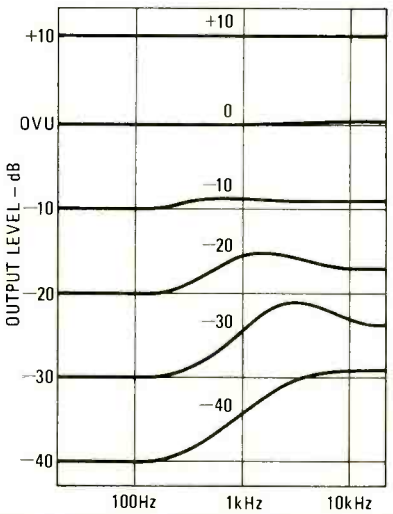


FIG. 1—DOLBY-B ENCODER characteristics show how low-level, high-frequency program material is progressively boosted according to the amplitude of the program material.

Pre-emphasis and de-emphasis

When FM broadcast standards were first established in the United States, it was realized that for the most noise-free performance, broadcast signals had to be processed in a particular way, both at the transmitting and receiving ends.

A form of treble boost, known as pre-emphasis, is used at the transmitting end. Program material is passed through a circuit that boosts high-frequency tones in accordance with the curve shown in Fig. 3. This curve is known as a 75-μs pre-emphasis curve (the R–C time constant required to produce this response). By installing the converse response at the tuner or receiver (as shown in Fig. 4), a flat musical response is restored while high-frequency hiss or background noise is reduced in much the same way as

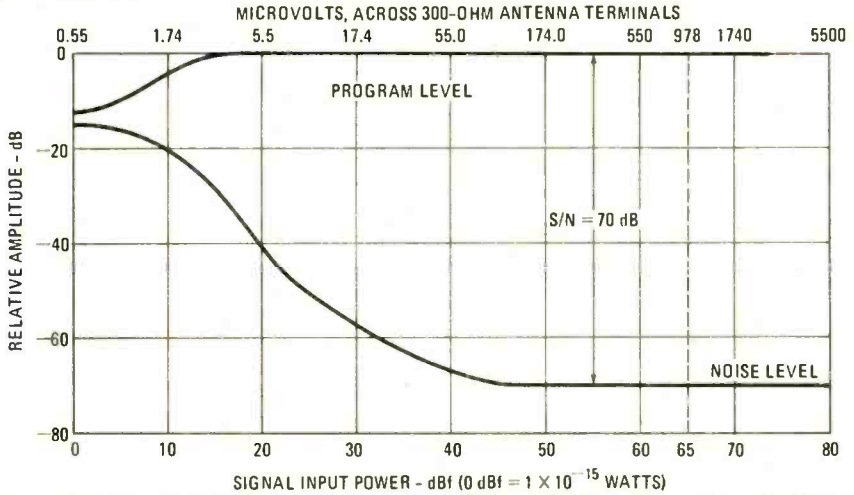


FIG. 2—MODERN FM TUNERS can typically provide a S/N ratio of 70 dB or more with a 100-μV signal from the antenna.

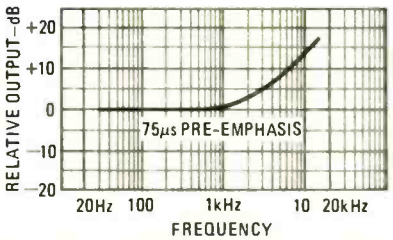


FIG. 3—75-μs PRE-EMPHASIS CHARACTERISTIC is used by non-Dolby FM broadcasters.

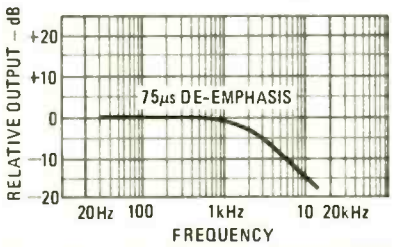


FIG. 4—75-μs DE-EMPHASIS CHARACTERISTIC restores a flat frequency response in FM tuners.

would be the case if you turned down the treble control on your amplifier, but with no attendant loss of musical highs in the program material.

Since the Federal Communications Commission limits FM modulation at any audio frequency to ±75 kHz, examine what adding pre-emphasis at the broadcast end does to the station's dynamic range capability (the ability to transmit the softest and loudest musical passages without altering their relative intensities). If you wanted to broadcast a series of tones, each modulating the transmitter to its full ±75-kHz limit, it would be necessary to *reduce* the broadcast-tone amplitude beginning at about 1 kHz. At 10 kHz, that tone's amplitude would have to be reduced by 13.66 dB; while at 15 kHz, which is the highest tone that can be transmitted over FM, the tone amplitude would have to be diminished by 17.07 dB, since the pre-emphasis (or treble boost) built into the system would raise the modulation level to the ±75 kHz maximum.

In the early FM days, programs did not have as much high-frequency content as they do today, so the 75-μs pre-emphasis and de-emphasis standard adopted by the FCC for improved S/N performance imposed no particular hardship upon broadcasters. Rarely, if ever, did high-frequency music push the modulation levels high enough to exceed ±75-kHz.

Interestingly enough, by the time European countries began FM broadcasting, program material had improved to the point where somewhat less pre-emphasis was needed if all the tones were to be transmitted without having to reduce average modulation or without having to compress musical peaks. Accordingly, the Europeans adopted a less extreme pre-emphasis/de-emphasis characteristic, known as a 50-μs pre-emphasis (or de-emphasis) curve. If a 50-μs time constant is used, the maximum boost at 15 kHz is only around 14 dB instead of 17.07 dB. However, with modern programs, this extreme treble boost at the transmitting end still poses problems. Broadcasters must limit peak modulation levels by using compression circuits, peak limiters and other devices that alter the dynamic range of the music and degrade the naturalness of the reproduced sound.

When Dr. Ray Dolby first proposed that his noise-reduction system be applied to FM broadcasting, he suggested that the pre-emphasis and de-emphasis used with Dolby be further reduced to 25 μs, as shown by the curves in Fig. 5. This suggestion was made after conducting studies of the peak levels reached in modern recorded music. To underline the importance of this change in pre-emphasis and de-emphasis, Dolby Laboratories recently published a graph (Reproduced in Fig. 6.) showing the effect of 75-μs pre-emphasis and de-emphasis on a 50-watt amplifier's *effective* power-output capability.

Superimposed on the graph in Fig. 6 (supplied through the courtesy of Dolby Laboratories, Inc.) are various power requirement points obtained by researchers (listed in Fig. 6) who have studied this matter. Note that even with modern programs, the full 50 watts of our hypothetical amplifier is not needed at high frequencies, but often *more* power is needed than is possible to achieve when we take into account the effect of 75-μs de-emphasis used in standard United States FM broadcasting.

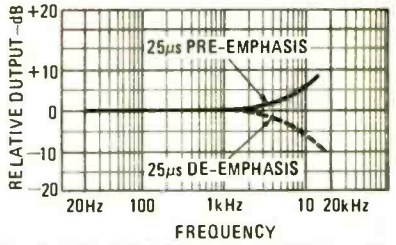


FIG. 5—DOLBY-B FM BROADCASTS use 25-μs pre-emphasis and de-emphasis.

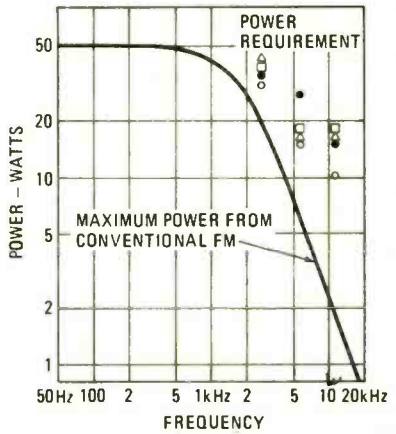


FIG. 6—EFFECT OF 75-μs PRE-EMPHASIS and de-emphasis on a 50-watt amplifier's effective power output capability.

By changing the de-emphasis and pre-emphasis characteristics during a Dolby broadcast, not only is the usual noise reduction associated with the Dolby "B" system achieved, but the broadcaster is permitted to increase average modulation levels without having to interject undesirable compression or limiting, which results in a greater and more realistic dynamic range. The increased noise level that results from the reduced pre-emphasis/de-emphasis characteristic used is more than offset by the noise-reducing properties of the Dolby-B system itself.

Compatibility

There are two levels of incompatibility between a tuner or receiver equipped with standard 75-μs de-emphasis and a

Dolby FM received program. First, the non-Dolby tuner or receiver does not have the necessary decoder to continuously and dynamically expand the high-frequency content of low-level signals. Second, a program broadcast with 25-μs pre-emphasis, when played back through a tuner or receiver equipped with a 75-μs de-emphasis network, will sound deficient in treble response since the treble frequencies are being rolled off at a greater rate than they are being boosted at the broadcast end.

Fortunately, these two effects work in opposing directions. The extra boost of *low-level* high-frequency signals controlled dynamically (depending upon level) by the Dolby encoder at the station end tends to offset the extra *fixed* treble cut introduced by the higher de-emphasis rate at the receiver. However, since one effect varies according to program level while the other effect is fixed, perfect cancellation of the two occurs only for a narrow loudness range, and Dolby FM broadcast listeners have noticed that "things are not quite right" on a conventional non-Dolby-equipped tuner or receiver.

Most FM tuners and receivers do not have either a 25-μs/75-μs de-emphasis switch or a built-in Dolby decoder. However, some new, relatively expensive tuners and receivers do come equipped with one or both of these features. If you own an older set, you must do two things in order to enjoy the full benefits of Dolby FM broadcasting. First, you must buy a *separate* Dolby decoder. However, some cassette decks permit you to use the already built-in Dolby circuitry in such a way that the output of the tuner is fed to the cassette deck (even when no recording is to be made) and heard via the deck's playback output, which has already been subjected to Dolby decoding.

Second, the de-emphasis of your current tuner or receiver must be made switchable so that the matching 25-μs de-

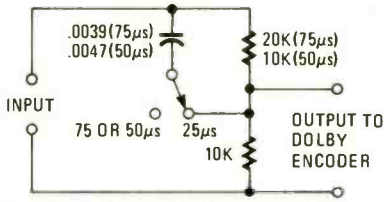


FIG. 7—DE-EMPHASIS SELECTOR circuit connects directly to the output of an FM tuner that has an output impedance less than 2,000 ohms. Component valves associated with 75-μs are for use with tuners designed for U.S. standard 75-μs de-emphasis. Component valves associated with 50-μs are for use with tuners designed for the European standard 50-μs de-emphasis.

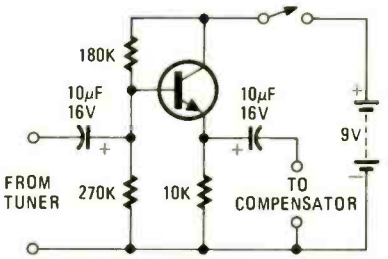
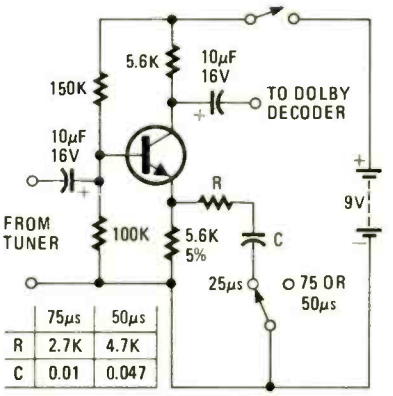


FIG. 8—BUFFER CIRCUIT connects between de-emphasis circuit shown in Fig. 7 and tuners that have an output impedance greater than 2,000 ohms.



	75μs	50μs
R	2.7K	4.7K
C	0.01	0.047

FIG. 9—ACTIVE DE-EMPHASIS SELECTOR circuit compensates for insertion loss.

emphasis characteristic can be selected. For this purpose, a small adapter made by Switchcraft (*model 621P1*) can be purchased. If you want to build it yourself, Fig. 7 shows a circuit similar to the circuit used in the Switchcraft adapter. This circuit would be suitable for use with tuners having an output impedance lower than 2,000 ohms. For tuners with a higher output impedance, an active buffer must be used between the tuner output and the input to the compensator. Figure 8 shows a suitable buffer circuit. Any low noise transistor such as a 2N3707 can be used.

Since the normal passive compensator shown in Fig. 7 introduces an insertion loss (at low frequencies) of up to 10 dB (when used to convert 75-μs de-emphasis to 25-μs de-emphasis), some tuners may not have sufficient output voltage to drive some Dolby decoders through the series-inserted compensator. In that case, an active circuit incorporating both gain and the necessary de-emphasis is required. Figure 9 shows such a circuit.

Dolby FM misuse

The advantages gained through using Dolby FM can easily be offset by poor station practices. If, for example, a station switches over to Dolby in order to transmit louder average levels, and continues to use peak limiters and compressors, then the real benefit of Dolby FM is lost and listeners are subjected to the same monotonous nondynamic music programming that prompted Dolby to suggest using his system in the first place. Although many stations do not take advantage of the added dynamic range potential afforded by Dolby, some broadcast engineers recognize the real benefits of Dolby FM and modify their studio console practices accordingly, much to the enjoyment of their listeners. If you are in an area where one or more FM stations use Dolby for all or part of their broadcast day and you believe that they are not taking proper advantage of the system, you might do them and yourself a favor by pointing it out to them. **R-E**

2-micrometer MOS devices slated for 1979

National Semiconductor states that it will have large-scale MOS integrated circuits built in 2-micrometer pattern geometrics by 1979, with the first such device being a 64K CCD memory. Most of the industry is still struggling with 4 micrometer geometrics.

Pierre Lamond, National's director of technology, says that the company has developed the electron-beam masks and projection-printing techniques necessary for the production of such 2-micrometer prototypes within the next 12 months. Along with other U.S. semiconductor manufacturers, National is emphasizing n-MOS technology in its production plans for the future.

Electronic voice system to aid vocally handicapped

A hand-held battery-operated electronic voice system called the *Phonic Mirror HandiVoice* has been developed by Votrax, a division of Federal Screw Works. Designed specifically to aid the many children and adults who are vocally afflicted as a result of disease or other causes, the device is a programmable speech synthesizer resembling a hand-held calculator.

The user enters a series of commands on the unit's keyboard; the digit combinations correspond to words that the machine will then reproduce. Up to 40 commands can be stored in memory until recalled by the TALK pushbutton. The commands are fed to the phonetic synthesizer, an analog of the human vocal system; the sounds are then articulated through a built-in 4-ohm, 400-milliwatt speaker. According to a company spokesman, the machine "has an unlimited vocabulary, since it stores the sounds that make up all words, not just a limited selection of words."

The *HandiVoice* is expected to be available in April and will sell for less than $2000.

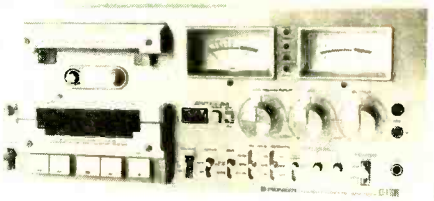
Texas department store sells microcomputers

Foley's, the Houston-based division of Federated Department Stores, is the first mass merchandiser to stock computer systems and associated software in its calculator department. Until now, all computer merchandising has been handled by small independent retailers.

According to Joseph Sternberg, Foley's divisional merchandise manager, sales of the $5000 *Altair* systems and software will be aimed at small and medium business concerns and at the home computer market. Burcon, the *Altair* distributor in the Houston area, will furnish the mini-floppy-discs for the *Altair* computer systems.

The software programs that will be available at Foley's are: a mailing list maintenance file; small business and home check-maintenance files; standard computer games (such as Star Wars); an auto log; and educational, numbers, chemistry and finance programs. **R-E**

Radio-Electronics Tests Pioneer CT-F1000 Stereo Cassette Deck



1

CIRCLE 95 ON FREE INFORMATION CARD

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

IF YOU HAVE THOUGHT OF U.S. PIONEER Electronics only as a manufacturer of stereo receivers, it may come as a surprise to you to learn that they also produce a complete line of cassette and open-reel tape decks. The cassette units initially fell into a midpriced category. As the cassettes met with increasing success in the U. S., models were added to each end of the price spectrum, front-loading models were added in all price categories and the product line continued to expand to meet different budgets and tastes.

The *model CT-F1000*, shown in Fig. 1, represents Pioneer's best and most expensive effort to date. The unique feature that places it way ahead of the next lower unit, *model CT-F9191*, is its "three-head" construction that enables you to monitor recordings as they are being made, much as you would with an open-reel deck. Furthermore, Pioneer's two-in-one head package (separate record and play coils and gaps all contained in a single head package) reduces the distance between the record and play gaps, and records can be played back with minimal time lapse.

A flip-away hinged cover protects the precision heads when the machine is not in use. Swinging the cover out of the way permits you to easily insert any standard cassette, with the tape downward, and rear illumination makes tape travel clearly visible. This simplified arrangement also permits easy access to tape heads for cleaning and maintenance. A tiny rotary PITCH CONTROL, just to the left of the cassette compartment (see Fig. 1), varies the tape speed by 6% and is used only in playback (for playing tapes that might not have been recorded at the correct speed). The POWER on-off toggle switch is located at the lower left of the panel. The piano-key transport controls are linked to solenoid-drive circuitry, which means that you can switch from one transport mode to another without having to press the STOP button. The modes provided are fast forward, fast rewind, stop, forward play and record. The latter two keys must be pressed together to record.

Twin meters at the upper right of the panel are calibrated from −40 dB to +5 dB. Between the meters are four light indicators. The uppermost indicator is an LED marked PEAK that flashes when peak levels equal or exceed a +5-dB recording level. The remaining lights indicate that the recording mode has been selected, that Dolby circuitry has been activated and that CrO_2 tape has been inserted in the cassette compartment (and the bias and equalization have been automatically selected for such tape).

To the right of the cassette compartment are a three-digit counter, RESET button and a MEMORY switch that, when depressed, automatically stops the rewind mode when the preset digit counter reaches "000." Dual, concentrically mounted microphone/DIN level, line record level and playback output level controls each have memory marker discs that can be set to remind you of preferred record and playback levels for a given recording setup. Twin microphone inputs (one for each channel) are located to the right of the output level control knobs, while just below is a headphone jack.

Lever controls along the lower section of the panel include a PAUSE switch, record LIMITER switch (useful for limiting unexpected peaks during microphone recordings), a two-position BIAS switch, a three-position equalization switch (with a setting for FeCr tape), a DOLBY switch with an extra position for Dolby FM that introduces a multiplex filter. Two Dolby calibration controls and a 400-Hz TEST tone switch are next, followed by what is perhaps the most important control on the panel—the SOURCE/TAPE switch. This switch, made possible by the three-head configuration, permits you to monitor recordings in progress, making it easy to compare recorded results with the source material being recorded.

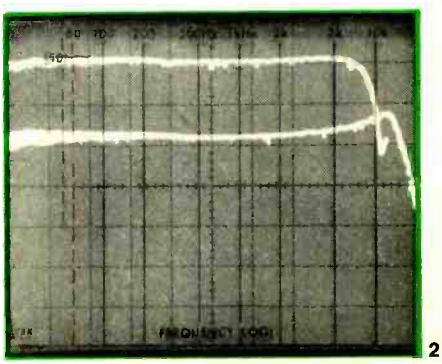
The rear panel is equipped with two sets of input jacks and two sets of output jacks. Duplication of inputs and outputs makes it easy to use for dubbing and for feeding program material to a second tape deck. A combination DIN Record/Play connector, convenience AC receptacle and a ground terminal are also located on the rear panel.

Lab measurements

Table I lists the results of our lab measurements. The three-head configuration made it possible to plot continuous frequency response curves as well as the 3-dB rolloff points shown in Table I.

We used our spectrum analyzer to make a sweep-frequency recording at 0-dB record level, using TDK Audua C-60 cassette tape, with the bias and equalization set for "standard" tape. The 0-dB record level is used primarily to gain insight into the saturation characteristics of the machine/tape combination.

The more meaningful record/play response is measured at a −20-dB recording level, and note in Fig. 2 that the lower trace shows a slight rise that peaks at



2

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Frequency Response: Standard tape, 30 Hz to 15 kHz, ±3 dB; CrO_2 tape or equivalent, 30 Hz to 17 kHz, ±3 dB. **Wow and Flutter:** 0.05% WRMS. **Harmonic Distortion:** 1.3% at 0-dB record level. **Signal-to-Noise Ratio:** Less Dolby, 54 dB. **Fast wind time:** 65 seconds. **Heads:** Combination unicrystal ferrite record and unicrystal ferrite playback plus ferrite erase. **Motors:** one electronically controlled DC motor plus one DC torque motor (reels). **Input Sensitivities.** Maximum: Microphones, 0.22 mV; Line, 60 mV. **Output Levels:** Line, 450 mV; Headphones, 62 mV into 8 ohms. **Power Requirements:** 120 VAC, 60 Hz, 45 watts. **Dimensions:** 16⁹⁄₁₆ W × 7⅜ H × 14⁹⁄₁₆ inches D. **Weight:** 26 lbs. **Suggested Nationally Advertised Value:** $600.

around 14 kHz, before it falls off to the −3-dB point at 17 kHz. All in all, these were excellent results for this high-quality standard tape.

The same measurements were made using TDK SA C-60 tape, and the scope photo of Fig. 3 shows the results for 0-dB and −20-dB record levels. The bias and equalization were reset to the CrO_2 position (although the TDK SA C-60 tape is a ferric-particle tape, it requires the same high bias and equalization settings of CrO_2 tape). These measurements show that there was no rise in response at the high end, but the −3-dB point was reached a bit sooner, at an acceptable 16 kHz. The true superiority of the "SA" tape is indicated more by the distortion and signal-to-noise results than by the slight difference in observed record/play frequency response characteristics.

Be aware that the single-reading distortion numbers measured for this or any other cassette deck are actually somewhat deceptive. An ordinary distortion analyzer combines wide-spectrum noise with actual harmonic distortion and yields one figure, in percent. For a more accurate reading of harmonic distortion products, it is preferable to use a spectrum analyzer to observe the actual harmonics separately from the noise. Figure 4 shows the results we obtained using the TDK Audua tape, and Fig. 5 shows results for the "SA" tape sample. In Fig. 4, the clearly visible dominant third-harmonic component is about 48-dB lower than the 1-kHz fundamental at center-screen. (Each vertical division is a 10-dB amplitude change.) Thus, the third-harmonic component represents barely 0.4% distortion. In the case of the "SA" tape sample, second-harmonic distortion was somewhat higher compared with third-harmonic distortion, but both were nearly 52-dB below the fundamental. Combining both distortion components results in a figure of only 0.355% or so.

Table II shows our overall evaluation and summary comments regarding the features and performance of the Pioneer *model CT-F1000* cassette deck. **R-E**

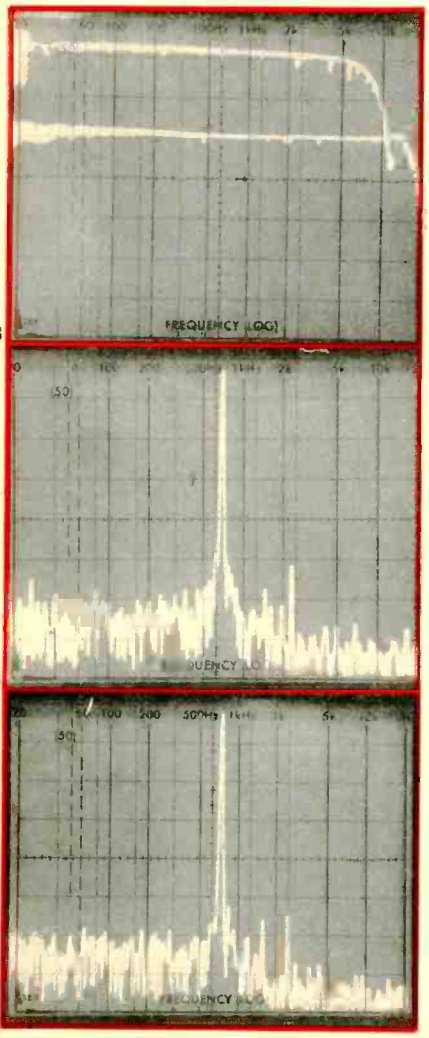


TABLE I

Manufacturer: **Pioneer** Model: **CT-F1000**

CASSETTE TAPE DECK MEASUREMENTS

	R-E Measurements	R-E Evaluation
FREQUENCY RESPONSE MEASUREMENTS		
Frequency response, standard tape (Hz-kHz ± dB)	28-17, 3	Excellent
Frequency response, CrO_2 tape (Hz-kHz ± dB)	27-16, 3	Very good
Frequency response, other (see text) (Hz-kHz ± dB)	N/A	N/A
DISTORTION MEASUREMENTS (RECORD/PLAY)	STD/TDK SA	
Harmonic distortion at −3 VU (1 kHz) (%)	1.3/1.0	Very good
Harmonic distortion at 0 VU (1 kHz) (%)	1.3/0.9	Excellent
Harmonic distortion at +3 VU (1 kHz) (%)	1.5/1.1	Excellent
Level for 3% THD (1 kHz) (dB)	+7.0/+6.5	Excellent
SIGNAL-TO-NOISE RATIO MEASUREMENTS		
Standard tape, "Dolby" off (dB)	52	Very good
Standard tape, "Dolby" on (dB)	62	Very good
"SA" tape, Dolby off (dB)	57	Excellent
"SA" tape, Dolby on (dB)	66	Excellent
MECHANICAL PERFORMANCE MEASUREMENTS		
Wow and flutter (%, WRMS)	0.06	Superb
Fast wind and rewind time, C-60 tape (seconds)	60	Good
COMPONENT MATCHING CHARACTERISTICS		
Microphone input sensitivity (mV)	0.21	
Line input sensitivity (mV)	45	
Line output level (mV)	370	
Phone output level (mV)	55	
Bias frequency (kHz)	75	
TRANSPORT MECHANISM EVALUATION		
Action of transport controls		Superb
Absence of mechanical noise		Excellent
Tape head accessibility		Excellent
Construction and internal layout		Superb
Evaluation of extra features, if any		Excellent
OVERALL TAPE DECK PERFORMANCE RATING		Excellent

TABLE II

OVERALL PRODUCT ANALYSIS

Retail price	**$600**
Price category	**Medium/high**
Price/performance ratio	**Excellent**
Styling and appearance	**Very good**
Sound quality	**Excellent**
Mechanical performance	**Superb**

Comments: The separate record and playback head, mounted in a single housing, makes the *model CT-F1000* a true three-headed cassette deck and should not be confused with lesser machines which manage to cram in a third, poor quality monitoring head that serves as a most minimal indication that recording is taking place. By separating the record and play head functions, each can be designed for optimum performance and that seems to be just what Pioneer has done. However, there is much more to the *model CT-F1000* stereo cassette deck than its three-head configuration. Tape transport is smooth and flawless, thanks in part to the dual-capstan drive that reduces erratic effects caused by less-than-perfect cassette housings. We appreciated the presence of the Dolby calibration controls; an absolute necessity if you hope to use the Dolby noise-reduction system as it was designed to be used. This feature, present on earlier machines, was dropped so as not to confuse users, but anyone who purchases a deck such as this is certainly capable of handling the calibration. There are so many hidden refinements in this deck besides the obvious front-panel control features that they can only be appreciated through extensive use of the machine. Consider the slack take-up system, for example. When a cassette is inserted, the takeup motor goes into the rewind mode for a fraction of a second, automatically, to take up the slack which might otherwise impair performance of the dual-capstan drive system. What Pioneer terms "follow-on recording" allows the user to edit electronically by going into the record mode during playback, which is similar to the "flying-start" recording commonly found in open-reel machines. The *model CT-F1000* has just about every standard feature of a top-quality deck and some that aren't so common.

Sony STR7800SD Receiver

CIRCLE 96 ON FREE INFORMATION CARD

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

LIKE OTHER RECEIVERS IN SONY'S PRODUCT line, the new *model STR-7800SD* features a completely different look; and one that is more than just a cosmetic face-lifting of earlier designs. A close examination of the front panel of this highest powered receiver from Sony will quickly cause you to take another look at more conventionally arranged panels, for Sony has really gone all out to make this one of the easiest to use and understand layouts that we have seen to date. The front panel (see Fig. 1) has a large tuning knob and a step-type calibrated master volume control in the upper right hand corner. A −20-dB audio MUTING switch (handy for lowering the volume when answering the doorbell or a phone) is logically positioned right near the volume control. A POWER pushbutton is at the upper left, and alongside it are signal-strength/multipath and center-of-channel tuning meters mounted behind a smoked plastic insert. Illuminated words that indicate stereo reception and the activation of the built-in Dolby FM circuits are located in the same general area.

The long linear FM dial scale (calibrated at every 200 kHz), the AM dial scale, TAPE dubbing selector switch, tape MONITOR switch and program selector switch are tastefully framed within a large area that extends from the center of the panel downward with the upper section of this area in a dark background color, and the lower area contains the remaining controls, jacks and switches. These include a headphone jack; a SPEAKER selector switch (up to three sets of speakers can be connected); high-cut and low-cut FILTER switches, with selectable cutoff switches for each; dual-concentric BASS and TREBLE tone controls; BALANCE control; acoustic compensator switch; MUTING, FM DOLBY and MULTIPATH push-button switches (the multipath switch changes the function of the signal-strength meter to that of a multipath indicator) and a mono/stereo switch. Also contained within this area is an external adaptor switch that acts as another circuit-interruption point for the addition of such devices as graphic equalizers, expanders, 4-channel adapters, etc. There is an auxiliary input jack which, when used to connect a tape deck or other high-level program source from the front panel, cuts out other devices already connected to the AUX terminals at the rear panel.

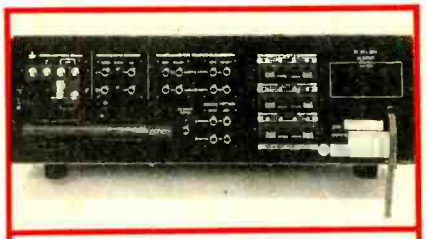
The acoustic compensator switch has three positions in addition to the OFF setting. One position introduces conventional loudness compensation, another adds bass boost only (the amount of boost is determined by VOLUME control settings) and the last position introduces a very moderate mid-frequency boost (around 3 dB centered at 1 kHz) for increased musical presence. The separate three-position tape dubbing and monitoring switches permit dubbing from one tape deck to another while listening to other program sources as well as full monitoring from either of two connected tape decks.

The rear panel contains, in addition to the usual screw-terminals for connection of external AM and 300-ohm FM antenna leads, a 75-ohm coaxial connector. Two pairs of phono input jacks, AUX, TAPE 1 and TAPE 2 input and output jacks, an FM detector output jack and external adaptor input and output jacks come next, followed by three sets of spring-loaded "piano-key" speaker wire terminals and three convenience AC receptacles. The rear panel is shown in Fig. 2.

1

Figure 3 shows the variety of components that can be connected to the *model STR-7800SD*.

The chassis contains identical power amplifier modules, including large heat sinks, that are mounted on either side of a massive toroidally wound power transformer. The FM front-end circuitry contains a MOSFET RF amplifier and mixer and an FET-buffered local oscillator. Two uniphase IF filtering stages follow, with a phase-locked-loop IC multiplex circuit for stereo decoding. An LED in the dial pointer lights up brightly when a signal has been tuned properly. When Dolby FM broadcasts are received, depressing the DOLBY FM switch on the front



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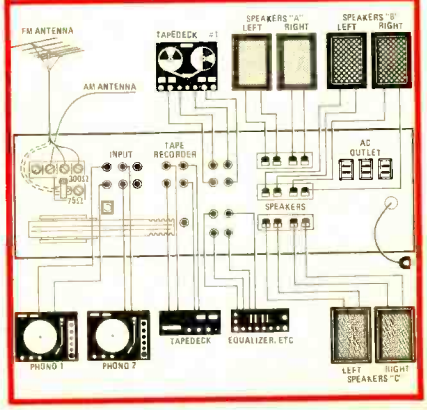

3

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

FM TUNER SECTION:
Mono Usable Sensitivity: 1.7 μV. **50-dB Quieting:** mono, 3.5 μV; stereo, 45 μV. **S/N Ratio:** mono, 73 dB; stereo, 68 dB. **Harmonic Distortion:** mono, 0.2% at 100, 1000 and 10,000 Hz; stereo, 0.3% at 100 and 1000 Hz, 0.6% at 10 kHz. **Frequency Response:** 30 Hz to 15 kHz, +0.2, −1.5 dB. **Selectivity:** 80 dB. **Capture Ratio:** 1.0 dB. **AM Suppression:** 54 dB. **Image Rejection:** 75 dB. **IF Rejection:** 100 dB. **Spurious Rejection:** 100 dB. **Subcarrier and SCA Rejection:** 60 dB. **Muting Threshold:** 5.0 μV. **Stereo Separation:** 40 dB at 1 kHz; 35 dB at 100 and 10 kHz.

AM TUNER SECTION:
Usable Sensitivity: 100 μV (external antenna). **S/N Ratio:** 50 dB. **Selectivity:** 35 dB. **Image Rejection:** 40 dB. **IF Rejection:** 35 dB. **Distortion:** 0.5%.

AMPLIFIER AND PREAMPLIFIER SECTIONS:
Power Output: 125 watts-per-channel, 8 ohms, 20 Hz to 20 kHz. **Rated Harmonic Distortion:** 0.07% **IM Distortion:** 0.07% (0.05% at 1 watt). **Damping Factor:** 40 (8 ohms). **Input Sensitivity:** phono, 2.5 mV; high level, 250 mV. **S/N Ratio:** phono, 72 dB ("A" weighting); high level, 90 dB ("A" weighting). **Frequency Response:** phono, RIAA, ±0.5 dB; high level, 10 Hz to 30 kHz, +0, −2.0 dB. **Phono Overload:** 100 mV. **Bass and Treble Range:** ± 10 dB at 100 and 10 kHz. **Low Boost & Presence:** +9 dB at 50 Hz and +3 dB at 1 kHz. **High and Low Filters:** 6 dB-per-octave at 5 kHz, or 10 kHz and 50 Hz, or 25 Hz.

GENERAL SPECIFICATIONS:
Power Requirements: 120 VAC, 60 Hz, 300 watts. **Dimensions:** 19¼ W × 6⁹⁄₁₆ H × 20⁹⁄₁₆ inches D. **Weight:** 50 lbs., 2 oz. **Suggested Retail Price:** $700.

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panel alters de-emphasis to the required 25 μs and introduces a complete Dolby decoding circuit. The phono preamplifier section uses a special transistor for low noise and high dynamic range. The power amplifier section uses a parallel-connected complementary circuit with positive and negative power supply voltages. The power amplifier is direct-coupled throughout and features a differential comparator input circuit. The receiver chassis is shown in Fig. 4.

FM measurements

Table I summarizes measurements made for the FM tuner. The results can be readily compared with manufacturer's specifications shown elsewhere in this report. Usable sensitivity fell a bit short of claims for mono signals (no usable sensitivity was given for stereo signals), but 50-dB quieting for both mono and stereo signals was as specified. The stereo 50-dB quieting figure was a bit poorer than we would have preferred, considering the circuitry used, and may indicate some slight front-end misalignment in our sample. The signal-to-noise ratio in mono was a bit better than specified, but was 1-dB short of the 68-dB figure Sony specified for stereo operation. All distortion measurements at the three test audio frequencies were considerably better than claimed, with the exception of the THD at 6 kHz in mono, which measured 0.27% instead of 0.2%. Separation was excellent at all test frequencies.

Figure 5 shows the frequency response for both de-emphasis settings of the tuner. The upper traces show the overall response of the desired outputs (with the de-emphasis included), while the lower two traces show crosstalk (stereo separation) for these two settings (the higher rolloff rates are for 75-μs de-emphasis). The sharp rolloff at 19 kHz is a result of the subcarrier product filters, which are effective in reducing carrier product output to well below the −60-dB point relative to maximum modulation. Dial calibration was accurate to within 0.2 MHz, with the greatest error observed at the low-frequency end of the FM dial. While capture ratio was a superb 1.0 dB, AM suppression was an acceptable 54 dB, as claimed. Selectivity was high enough (80 dB) to insure against interference from signals close in frequency to those of the desired station, and both spurious and IF rejection were high enough to preclude those forms of listening interference.

TABLE I

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Sony Corporation** Model: **STR-7800SD**

FM PERFORMANCE MEASUREMENTS

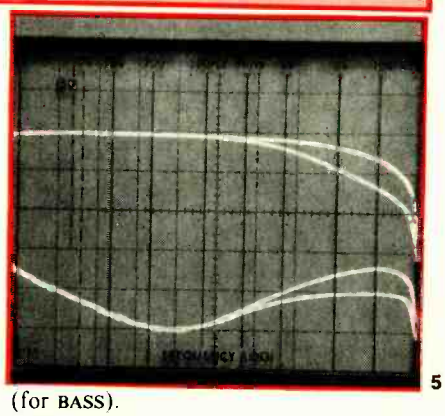
	R-E Measurement	R-E Evaluation
SENSITIVITY, NOISE AND FREEDOM FROM INTERFERENCE		
IHF sensitivity, mono (μV) (dBf)	2.4 (12.8)	Good
Sensitivity, stereo (μV) (dBf)	5.5 (20.0)	Very good
50-dB quieting signal, mono (μV) (dBf)	3.5 (16.1)	Very good
50-dB quieting signal, stereo (μV)	45.0 (38.3)	Fair
Maximum S/N ratio, mono (dB)	74	Excellent
Maximum S/N ratio, stereo (dB)	67	Good
Capture ratio (dB)	1.0	Excellent
AM suppression (dB)	54	Good
Image rejection (dB)	75	Fair
IF rejection (dB)	100	Excellent
Spurious rejection (dB)	100	Excellent
Alternate channel selectivity (dB)	80	Excellent
FIDELITY AND DISTORTION MEASUREMENTS		
Frequency response, 50 Hz to 15 kHz (±dB)	+0, −1.0	Very good
Harmonic distortion, 1 kHz, mono (%)	0.1	Excellent
Harmonic distortion, 1 kHz, stereo (%)	0.12	Excellent
Harmonic distortion, 100 Hz, mono (%)	0.1	Excellent
Harmonic distortion, 100 Hz, stereo (%)	0.27	Good
Harmonic distortion, 6 kHz, mono (%)	0.27	Good
Harmonic distortion, 6 kHz, stereo (%)	0.35	Excellent
Distortion at 50-dB quieting, mono (%)	0.7	Good
Distortion at 50-dB quieting, stereo (%)	0.36	Very good
STEREO PERFORMANCE MEASUREMENTS		
Stereo threshold (μV) (dBf)	5.5 (20.0)	Very good
Separation, 1 kHz (dB)	53	Superb
Separation, 100 Hz (dB)	44	Excellent
Separation, 10 kHz (dB)	34	Excellent
MISCELLANEOUS MEASUREMENTS		
Muting threshold (μV) (dBf)	6.5 (21.5)	Good
Dial calibration accuracy (±kHz at MHz)	0.2	Very good
EVALUATION OF CONTROLS, DESIGN AND CONSTRUCTION		
Control layout		Superb
Ease of tuning		Very good
Accuracy of meters or other tuning aids		Excellent
Usefulness of other controls		Excellent
Construction and internal layout		Very good
Ease of servicing		Fair
Evaluation of extra features, if any		Excellent
OVERALL FM PERFORMANCE RATING		Very good

4

Amplifier and preamplifier measurements

Table II shows results of measurements made on the power amplifier and preamplifier sections of the *model STR-7800SD*. Output power specifications were greater than rated for the 0.07% harmonic distortion level and, even though Sony does not offer power ratings for 4-ohm operation (when more than one pair of speakers is in use, they are connected in series to prevent too low a load impedance), we obtained 192 watts-per-channel at mid-frequencies when driving 4-ohm loads. Hum and noise measurements shown for both phono and high-level inputs are better than rated, but note that an "A" weighting network was used in these measurements since that is the way Sony chose to specify these signal-to-noise results.

The range of the BASS and TREBLE controls are shown in Fig 6. Turnover points for the controls are at approximately 2 kHz (for TREBLE) and 500 Hz (for BASS).



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The three available types of compensation provided by Sony's acoustic compensator circuitry are shown in Fig. 7. The upper traces show flat response (for reference) and the action of the loudness control at a −30 dB (from maximum) volume setting. For the sake of clarity, the scope input control was attenuated to produce displaced traces (lower two traces) for the remaining two switch positions of the compensator, which are the PRESENCE position (note the slight rise in response at mid-frequencies) and LOW-BOOST position that simply adds a

TABLE II

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Sony Corporation** Model: **STR-7800SD**

AMPLIFIER PERFORMANCE MEASUREMENTS

	R-E Measurement	R-E Evaluation
POWER OUTPUT CAPABILITY		
RMS power/channel, 8-ohms, 1 kHz (watts)	144	Excellent
RMS power/channel, 8-ohms, 20 Hz (watts)	132	Excellent
RMS power/channel, 8-ohms, 20 kHz (watts)	132	Excellent
RMS power/channel, 4-ohms, 1 kHz (watts)	192	Excellent
RMS power/channel, 4-ohms, 20 Hz (watts)	193	Superb
RMS power/channel, 4-ohms, 20 kHz (watts)	168	Not rated
Frequency limits for rated output (Hz-kHz)	10-28	Very good
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output, 1 kHz (%)	0.02	Excellent
Intermodulation distortion, rated output (%)	0.023	Excellent
Harmonic distortion at 1-watt output, 1 kHz (%)	0.015	Very good
Intermodulation distortion at 1-watt output (%)	0.035	Good
DAMPING FACTOR, AT 8 OHMS	40	Very good
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ±dB)	0.3	Excellent
Maximum input before overload (mV)	85	Poor
Hum/noise referred to full output (dB) (at rated input sensitivity)	82 ("A" weighted)	Excellent
HIGH LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ±dB)	7-30, 2.0	Very good
Hum/noise referred to full output (dB)	95 ("A" weighted)	Excellent
Residual hum/noise (minimum volume) (dB)	101	Excellent
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls	See Fig. 6	Very good
Action of secondary tone controls	See Fig. 7	Excellent
Action of low-frequency filter(s)	See Fig. 8	Excellent
Action of high-frequency filter(s)	See Fig. 8	Excellent
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	2.0/2.0	
Input sensitivity, auxiliary input(s) (mV)	200	
Input sensitivity, tape input(s) (mV)	200	
Output level, tape output(s) (mV)	200	
Output level, headphone jack(s) (V or mW)	8 ohms	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Excellent
Adequacy of input facilities		Excellent
Arrangement of controls (panel layout)		Superb
Action of controls and switches		Excellent
Design and construction		Very good
Ease of servicing		Fair
OVERALL AMPLIFIER PERFORMANCE RATING		Excellent

TABLE III

RADIO-ELECTRONICS PRODUCT TEST REPORT

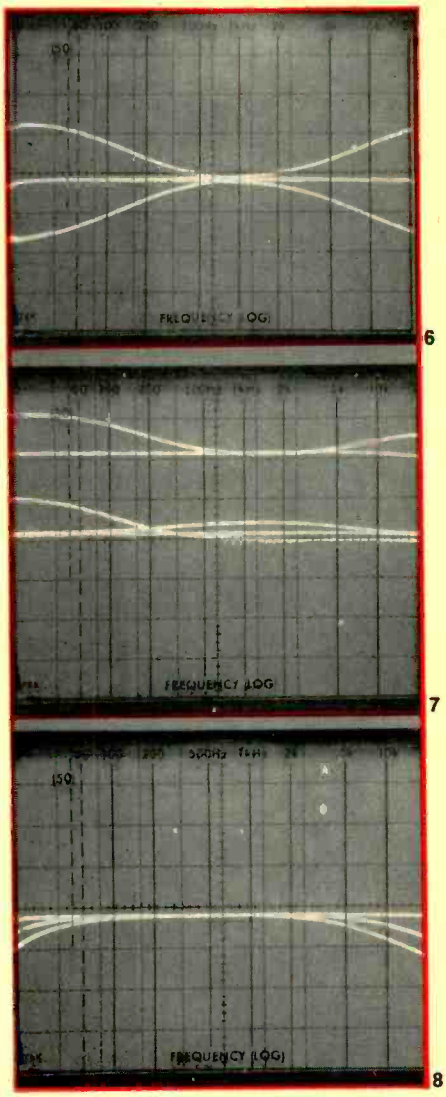
Manufacturer: **Sony** Model: **STR-7800SD**

OVERALL PRODUCT ANALYSIS

Retail price	$700
Price category	Medium-high
Price/performance ratio	Very good
Styling and appearance	Excellent
Sound quality	Very good
Mechanical performance	Excellent

Comments: Sony has carried over just about all their cleverly designed features and layout from the other three lower-powered receivers in this series. The difference between this unit and the earlier-tested *STR-6800SD* is primarily one of power output and lower distortion specifications at rated power output. Since the lower-powered *STR-6800SD* already has a great many control features (including an excellent front-panel layout), it is just as well that this model retains the same front-panel look. We would have liked to see a little better circuit design in the FM tuner section. Evidently, Sony considered that the tuner performance would satisfy most listener requirements and so, the tuner section remains essentially the same as that used in the lower-powered model.

All controls handle easily, and even though such features as variable turnover points for the BASS and TREBLE controls are missing, this deficiency is offset by the multiple-turnover filter circuits, separation of left and right BASS and TREBLE controls by means of dual concentric knobs and the useful acoustic compensator control that adds versatility to the otherwise conventional tone-control facilities. The listening quality of the *model STR-6800SD* offers particularly tight bass, a clean transparent midrange and crisp highs. We detected a slight bit of raspiness at the extreme treble end when we tried to push the receiver to its full-rated power output—a playing mode that most users would never approach unless they used extremely inefficient speakers.



fixed amount of bass boost, thus making the full range of the regular BASS-control available for other types of compensation.

Response of the high- and low-cut filters is shown in Fig. 8. Thanks to the variable cutoff provided, the filters are quite effective, despite their minimal 6-dB-per-octave slopes.

Table III contains an overall product analysis and evaluation, together with our summary comments regarding Sony's newest receiver. **R-E**

SHERLOCK HOLMES

Solves The Case Of The Missing Transistor Clues

Join the master super sleuth in his search for clues to fix the mysterious amplifier

GERRALD E. WILLIAMS

ONE GLOOMY LONDON MORNING I FOUND myself at 221 Baker Street in the company of the great detective Sherlock Holmes and his companion, Dr. John Watson.

Holmes and I were discussing the case of the chrome cuspidor—a most interesting case from a scientific point of view, but Watson had considered it of little public interest and had never written it up. Watson was less jovial than usual, being in some pain from his leg wound. Having just received in the post one of the new Oriental transistor amplifiers (after months of waiting), his humor was not improved by the fact that it would not work. Watson had taken to mumbling oaths while trying to diagnose the problem. After some time, Holmes joined Watson in solving the problem, and his remarkable solution so impressed me that I asked the good doctor to present the case to his readers. He refused adamantly in spite of Homes' insistence. After some arguments, I persuaded Holmes to let me publish the incident, and he heartily agreed.

Here then, without Watson's more exciting (but sometimes less factual) style, I shall relate the incident. Holmes entered the problem when Watson said:

"Holmes, this bloody schematic has no voltage values on it! How in the Queen's name is one to diagnose the problem?"

"Come now, Watson. I'm sure it will prove quite elementary upon reasonable examination. All that is needed is the collector current, and all else will become clear at once."

"Holmes, sometimes you infuriate me! You treat me like a dashed idiot. If I knew the collector current, the problem would be simple enough. But as you can see, it is nowhere to be found!"

"Watson, you see, but you do not perceive." Holmes tamped down his pipe, got a good light and bent over Watson's drawing. He continued:

"This is the stage in question, is it not?"

"Yes, yes, that is the culprit, I'm almost sure."

"Well then, we must find the collector current as a start."

Holmes rummaged around on the cluttered mantelpiece for a few seconds and extracted a dogeared sheet of yellow foolscap. He examined it for an instant and exclaimed:

"Ah yes, Watson, here it is, the voltage drop across the emitter resistor, 1.4 volts . . ." Watson looked down at his schematic drawing and said:

"Holmes, I see no such value here. In fact, I see no value at all. Where did you get it?"

"From this rough draft of a little monograph of mine on collector current mysteries," answered the detective. Holmes handed him the paper, a somewhat more legible version of which is presented here as Table I.

It is necessary to digress here for a moment in the narrative to explain Holmes' remarkable table. To use Table I, one must first find the ratio by performing the division:

$$\text{Ratio} = R_{b1} \div R_{b2}.$$

In the specific example,

$$R_{b1} = 18.8\text{K}, R_{b2} = 4.7\text{K}$$

$$\text{Ratio} = \frac{18.8\text{K}}{4.7\text{K}} = 4.$$

The value of V_{cc} is 10 volts. At the intersection of "4" in the *Ratio* row and 10 volts in the V_{cc} column of Table I, one will find the emitter resistor voltage drop to be 1.4 volts. The asterisks indicate conditions that, if they arise, represent a borderline design and promise trouble. The blanks indicate designs so poor that they might well work in the early morning fog, quit altogether in the noonday sun, only to work again the next morning! Or perhaps they will work only on Friday the 13th and Election Day and be on vacation the rest of the year. At least, that is what I make of Holmes' more technical explanation.

Upon examining the table, Watson exclaimed:

"Astounding! But where did you get these figures . . . I've never seen them before."

"Of course, you haven't. I have not published them as yet," answered Holmes.

"The figures are interesting enough Holmes, but I don't see how they bear on the problem at hand. Now look at this circuit and tell me what good that 1.4-volt value is."

(The circuit in question is redrawn in Fig. 1.)

"It's elementary my dear Watson. You have heard of the notorious Mr. Ohm and his law?"

"Of course Holmes, I see it now. We know that the resistance is 500 ohms and the voltage drop is 1.4, and we can calculate . . . let's see—E = I times R . . . no, no . . ." Holmes interrupted impatiently:

"I = E divided by R, or in this case, 1.4 volts divided by 500 ohms. A collector current of 2.8 milliamperes."

"Astounding Holmes! I think I have it

TABLE 1—FINDING THE VOLTAGE DROP ACROSS THE EMITTER RESISTOR

Voltage Drop Across Emitter Resistor R_{es}

Ratio (R_{b1}/R_{b2})	V_{cc} = 6	V_{cc} = 9	V_{cc} = 10	V_{cc} = 12	V_{cc} = 15	V_{cc} = 24	V_{cc} = 30
1	2.4	3.9	4.4	5.4	6.9	11.4	14.4
1.5	1.8	3.0	3.4	4.2	5.4	9.0	11.4
2	1.4	2.4	2.7	3.4	4.4	7.3	9.3
2.5	1.1	2.0	2.3	2.8	3.7	6.3	8.0
3	0.9*	1.7	1.9	2.4	3.2	5.4	6.9
4	×	1.2	1.4	1.8	2.4	4.2	5.4
5	×	0.9*	1.1	1.4	1.9	3.4	4.4
6	×	×	0.8*	1.1	1.5	2.8	3.7
7	×	×	×	0.9*	1.3	2.4	3.2
8	×	×	×	×	1.1	2.0	2.7
9	×	×	×	×	0.9*	1.8	2.4
10	×	×	×	×	×	1.6	2.1
15	×	×	×	×	×	0.9*	1.3
20	×	×	×	×	×	×	0.9*

Notes: 1. Borderline design and possible problems are indicated by an*.
2. Poor design or impossible design cases are indicated by an ×. These cases will have poor temperature stability and the replacement of transistors may be difficult, if not impossible.
3. Interpolation between integral ratios works well.
4. The table is based on the formula: $V_{Res} = \left[V_{cc} \times \frac{1}{1 + (R_{b1}/R_{b2})} \right] - 0.6.$

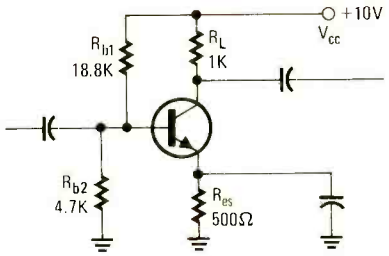


FIG. 1—SCHEMATIC DIAGRAM of the circuit as Watson traced it.

now. Appreciate the help old man . . ."

Watson's voice trailed off as he went back to work. Holmes and I resumed our discussion. We had not been engaged long when the doctor spoke up again:

"Holmes . . . I seem to have another problem."

"What is it Watson?"

"It's the voltage drop between the collector and emitter. I used Ohm's law to find the voltage drop across the collector resistor* R_L, but I don't know the collector-to-emitter resistance. Can't use Ohm's law without it you know!" (I think Watson was gloating here, having caught Holmes in a deficiency.)

"It's not necessary, Watson. Ohm's law is not needed here."

"What?"

"Kirchoff's law, man. That's what is required. We have a series circuit, Watson. We know the total voltage is 10. The voltage drop across the collector load is 2.8 and the emitter resistor voltage drop is 1.4, a total of 4.2 volts. The difference between 10 volts and 4.2 volts is your collector-to-emitter voltage."

"What?"

"10 volts minus 4.2 equals 5.8 volts. The collector-to-emitter voltage is 5.8 volts!"

"Oh . . . yes Holmes, now I see it. My thanks again."

We no sooner got back onto the case of the case of the glass spittoon[1] when Watson interrupted again:

"Right you are, Watson! Have you solved the mystery?"

"Certainly my dear fellow. The base-emitter junction voltage is about six-tenths of a volt . . . quite normal. However, the collector-to-emitter voltage is also only 0.6 volt. Ergo, a shorted transistor!"

"Right you are, Watson. *Any collector-base voltage less than 3 is certainly suspicious* in this circuit.[2] It could be a leaky coupling capacitor of course, but I lean toward your theory."

"Thanks Holmes. I was testing the transistor while you rendered your opinion, and we are correct!"

"Capital, Watson! Now I can hear my violin recordings through an adequate amplifier." *continued on page 94*

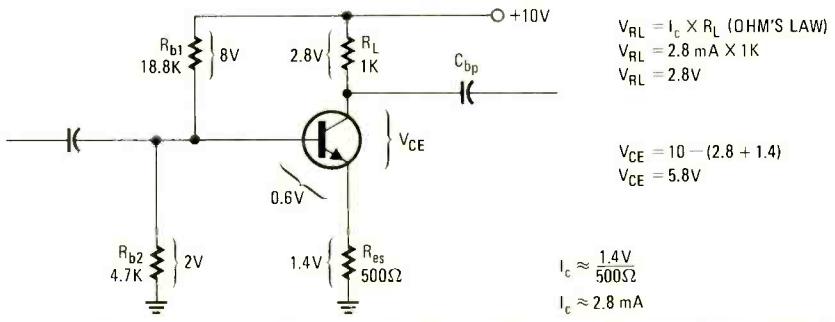


FIG. 2—SCHEMATIC DIAGRAM WITH WATSON'S VOLTAGES and collector current added. Note that for some unaccountable reason, Watson left out capacitor C_{bp}. Since this capacitor does not alter the calculations in any way, I did not take the liberty of correcting the drawing.

"Holmes, I have it. Take a look at this drawing. I have put all the proper values on it. Will you give your opinion of their correctness?" While Holmes rises from his chair, I will show you a copy of the circuit with Watson's values on it. This is presented in Fig. 2. Holmes studied the drawing for an instant and exclaimed:

*R_L = 1K and I_c = 2.8 mA: 1K × 2.8 mA = 2.8 volts.

[1] Note: Watson, in his stories about Holmes often showed a lack of consistency. It is not clear here whether the present author actually lacks consistency, or is trying to emulate Watson.

[2] Here Holmes is referring to the fact that a circuit with emitter-resistor feedback will rarely work properly with less than 2.5 to 3 volts between collector and emitter.

hobby corner

If you are planning to set up your own workbench, here's a list of basic test instruments you will need. Plus how to avoid battery troubles. **EARL "DOC" SAVAGE, K4SDS,** HOBBY EDITOR

"I PLAN TO SET UP AN ELECTRONICS WORKbench. What instruments do I need and how much will they cost?"

For those of you who have asked this question, we'll take a look at basic required test instruments and some that fit into the category of "useful and nice to have." Included will be some minimum requirements in terms of specifications or characteristics. *You* will have to make the final selection, however, so study the prices and specifications. Check ads and advertisers in **Radio-Electronics** and visit local stores. Order catalogs from several companies. Write direct to manufacturers or use the Readers Service Card in this issue.

According to an old axiom, "You get what you pay for." This is usually (but not always) the case with test equipment. More expensive items often have greater accuracy, greater range, extra features or all three. This is especially true when the price difference is large. However, study the specifications and know what you are paying for. One caution: you don't need an expensive laboratory-grade instrument to do routine work.

Then, you must make another decision. Many instruments can be purchased either in kit form or wired and ready to use. Frequently, the same make and model is available in both forms. You can save money if you do the work yourself.

Type of work

Here are some instruments you should consider for your workbench. Your selection will be determined in part by the type of work you plan to do. Accordingly, these instruments are broken down into five categories: **General** (needed by just about everyone); **Radio** (for those interested in tuners, receivers and/or transmitters); **Audio** (for the amplifier and hi-fi buff); **IC's** (analog and digital); and **Nice to have** (for those who can afford them). Within each group, the instruments are listed in order from the most needed to the least needed, together with estimated prices.

General

1. **Volt-Ohm-Milliammeter** (VOM)—this *basic* instrument is needed by even the occasional dabbler in electricity or electronics. Without a VOM, you are working blind. For greatest usefulness try to find one with at least a 20,000-ohms-per-volt input impedance on the DC voltage ranges. ($16 and up.)
2. **Signal injector**—with just one switch and one probe, this simple instrument provides RF, IF and AF signals for quickly checking tuners, amplifiers and receivers. ($7 and up.)
3. **Signal tracer**—another instrument for quick checks similar to the signal injector. The tracer is used from the opposite end of the circuit. Some people prefer the injector and some, the tracer. On occasion, it is handy to have both. The tracer should have AF and RF inputs and a volume control. ($14 and up.)
4. **Transistor checker**—transistors can be given a basic checkout with a VOM, but an in-circuit/out-of-circuit checker is most useful. ($13 and up.)
5. **Bench power supplies**—every hobbyist needs one or more power supplies. These days, one supply should have a 0–15 VDC capability at 500 mA. Fixed supplies are quite useful (5 VDC, 12 VDC). If much work is to be done with tubes, you should consider a variable high-voltage supply. You can build the power supplies or buy them assembled. ($12 and up.)
6. **Capacitor checker**—although this instrument is not essential, it can be most useful. It should be able to measure both capacitance and leakage. ($38 and up.)
7. **Resistance and capacitance substitution boxes**—these items can save a lot of time. ($10 and up.)

Radio

In addition to the instruments listed above, the radio hobbyist will need the following:

8. **A sensitive voltmeter.** This can be any one of three types:

8-a. **Vacuum-tube voltmeter** (VTVM)—this device features high input impedance on DC ranges, usually 11 megohms. This means you can make measurements in low-signal and other sensitive circuits without loading them down and getting distorted readings. Since some VTVM's cannot measure current, they cannot replace a VOM. ($35 and up.)

8-b. **Field-effect transistor VOM** (FETVOM)—this VOM has an FET input stage that raises its impedance to the VTVM category. ($35 and up.)

8-c. **Digital multimeter** (DMM)—most DMM's have an input impedance comparable to that of a VTVM. Furthermore, most have a high order of accuracy. ($60 and up.)

9. **Signal generator**—it is impossible to align a receiver without a signal generator. The suggested minimum range is 400 kHz to 25 or 30 MHz. This instrument can replace the signal injector described above. ($50 and up.)
10. **Grid dip meter**—this unconventional instrument is so useful that it almost went on the general list. With a grid-dip meter you can measure capacitors, coils, tuned circuits and antennas. It can be used as a signal generator within its tuning range. ($60 and up.)

If you work on transmitters as well as tuners, receivers, etc., you should add the following instruments, which can be found individually or in various combinations:

11. **Field strength meter**—$12 up.
12. **Standing-wave ratio meter** (SWR)—$15 up.
13. **Dummy load**—$5 up.

Audio

In addition to items 1 through 10, the audio hobbyist should also consider purchasing an

14. **Audio generator** or oscillator—$80 and up.

IC's and transistors

Hobbyists should have instruments 1 through 10 and the following:

15. **Breadboard**—indispensable for analog or digital circuits and for transistors. You can quickly build up circuits for testing or design purposes. ($15 and up.)
16. **Logic probe**—essential for digital work. This instrument should be able to detect pulses of very short duration as well as simple on/off states. ($10 and up.)
17. **Pulse generator**—extremely useful with digital circuits. I have not found an inexpensive commercially made basic pulse generator. However, you can build one for about $5, or purchase a nice multifunction generator for $50 and up.

Nice to have

These are instruments that the hobbyist can do very well without for about 99% of the time. However, they are quite useful and can occasionally save a bundle of time. If your finances can stand the strain, consider the following:

18. **Tube checker**—this is of less and less use as tubes gradually disappear from the scene. A few years ago, it would have been placed on the general list. Now, it just saves you an occasional trip to the self-service tester at your local electronics dealer. ($40 and up.)
19. **Oscilloscope**—sometimes you really need to see what a voltage or other signal looks like—not just know it's there. ($120 and up.)
20. **Frequency counter**—for precise measurement of frequencies. ($60 and up.)
21. **Digital IC tester**—can be worthwhile if you do a lot of work in this area. ($75 and up.)

So, there you have what I call the basic list of instruments plus a few extra. Obviously, some instruments are more difficult to do without than others. You certainly don't have to have all of them at first. You can add them as your knowledge and the complexity of your work increase. Also, if finances pinch too hard, there are three ways you can ease the strain:

First, check the ads for sales. You can often obtain discontinued or overstocked models at a savings.

Second, you can build your own instruments in many cases—I mean build from scratch (as opposed to kits) by collecting the parts yourself. Several instruments on this list are quite simple to construct and others are just a little more difficult. Note especially items 2–5, 7, 10-13, 16 and 17. Check back issues of **Radio-Electronics,** other magazines and handbooks. Not only does building from scratch or from kits save you money, but it is good experience.

The last, but not least, possibility for saving is to purchase used or previously owned equipment. Be sure to check carefully the specifications, price, condition and guarantee, if any. You can obtain used gear from commercial establishments and/or from individuals. Don't overlook the possibility of trading equipment for what you need.

In any case, do not despair and do not hesitate, jump in and get started. Whether you work on tubes, transistors or IC gear, you can do a lot of repairing, modifying and building with just a VOM!

Avoiding battery troubles

We all own more and more battery-operated equipment, a convenience that is just one of the advantages in these days of transistors and IC's.

But how often have you started to use an instrument only to find the battery dead? Have you ever gone inside the equipment to replace a battery and discovered that it has leaked so that you have to spend hours cleaning up and replacing corroded parts? Even if you are sure to use the leak-proof variety, they still leak. The time and annoyance of replacing batteries depends upon the construction of the device case.

In addition, these devices use a bewil-

continued on page 96

computer corner

Z-80 *A look at the nine addressing modes included in the Z-80 instruction set.*

WILLIAM BARDEN, JR.

LAST MONTH, WE DISCUSSED THE Z-80 INstruction set. This month, we will take a look at the various addressing modes available to the Z-80 programmer.

There are nine types of addressing included in the Z-80 instruction set, seven of these are included in the 8080 instruction set. The 8080 addressing types include the following:

1. Register Addressing
2. Implied Addressing
3. Register Indirect Addressing
4. Extended Addressing
5. Immediate Addressing
6. Immediate Extended Addressing
7. Modified Page Zero Addressing

The additional types of Z-80 addressing are:

8. Relative Addressing
9. Indexed Addressing

A register addressing type instruction specifies which CPU registers will be used in the instruction. The INC R instruction increments the contents of the specified register by one, for example. In this example, the C register is specified by the programmer.

Mnemonic	Instruction Configuration
INC C	00001100 001 specifies register C 000 register B, etc.

Implied addressing is used on any instruction in which the use of one or more CPU registers is implied. An example of this would be the one-byte instruction ADD B which adds the contents of the B register to the A register and places the result in the A register. Use of the A register is implied.

Mnemonic	Instruction Configuration
ADD B	10000000 000 specifies register B 001 register C, etc.

Register indirect addressing type instructions generally use the H,L register pair as a pointer to memory, although pairs B,C and D,E are also employed. The Z-80 block instructions for moves, searches and I/O are of this type, in addition to the more standard 8080 instructions. Here the instruction is a one-byte instruction and the H,L register pair holds the address of the operand in memory. If the H,L register pair held 2000_{10}, for example, the following instruction would add the contents of location 2000_{10} and the A register, and put the results in the A register.

Mnemonic	Instruction Configuration
ADD (HL)	10000110

Extended addressing is also used in the 8080. Here the instruction is three bytes long with the first byte specifying the operation code and the next two bytes specifying a 16-bit memory address of an operand *or* a jump location. The 8080 JMP instruction becomes JP in the Z-80.

Mnemonic	Instruction Configuration
JP 200H	11000011 00000000 00000010 byte 1 byte 2 byte 3, 200_{16}

Immediate addressing and immediate extended addressing are 8080-type addressing modes. In the first, the second byte of the two-byte instruction specifies an 8-bit operand to be used in the instruction. In the second type, the immediate operand to be used is 16-bits, or two bytes.

Mnemonic	Instruction Configuration
AND 7	11000110 00000111 byte 1 byte 2 The contents of the A register is logically AND'ed with 7 and the result placed in the A register.
LD BC,200H	00000001 00000000 00000010 byte 1 byte 2 byte 3, 200_{16} 200_{16} is loaded into register pair B,C.

Modified page zero addressing in the Z-80, as in the 8080, is a special CALL instruction of one byte. The instruction is designated a *restart*, and causes a transfer to a page 0 location. It is used for commonly used subroutines or (usually) for interrupt processing for multi-interrupt capability. Page 0 is defined as locations 0 through FF_{16}.

Mnemonic	Instruction Configuration
RST 6	11110111 110=6 The contents of the program counter is pushed into the stack and the CPU jumps to page 0 location 6 × 8 or 48_{10}.

Relative addressing is not found in the 8080. The Z-80 uses this addressing mode only in jump type instructions. Here, the second byte of the two-byte instruction specifies an 8-bit signed *displacement* that is added to the current contents of the program counter to produce the jump address. Since the displacement may be +127 to −128, a relative jump can conditionally or unconditionally jump back −126 or forward +129 from the jump instruction (program counter points to next instruction after the jump). Since many jumps in a program are within this range, this instruction can be used to save one byte over an extended-type JP, and of course, to execute in a shorter time than a JP.

Mnemonic	Instruction Configuration
JR NC,10FOH	00110000 11101110 byte 1 byte 2 JR instruction is at location 1000_{16}. A jump is executed if carry flag = 1. The jump address is 1002_{16} (program counter contents) + EE_2 or $10FO_{16}$.

In indexed addressing, one of the two index registers IX or IY is used. The contents of the specified index register is added to an 8-bit displacement in the third byte of the three-byte instruction. The result is the memory address to be used. This is a very powerful type of addressing not found in the 8080.

Mnemonic	Instruction Configuration
ADD (IX + 20H)	11011101 10000110 00100000 byte 1 byte 2, byte3, op code displacement If register IX held 2000H, the contents of location 2020H would be added to the contents of register A and the result would be placed in register B.

Many of the instruction types already discussed use several types of addressing modes. In general, the addressing types to be used for a given instruction should be the one that produces the shortest instruction to optimize both the number of bytes required to store the instruction and the time to execute it. **R-E**

continued from page 34

The four NiCad batteries are housed in a snap-in *Battery-Pak*. A spare *Pak* may be obtained and carried along, fully charged. To change the *Pak*, just pop the old one out and the new one in. The charger socket on the *Pak* allows the charger to be used on the instrument itself or on the spare *Pak*. In an emergency, stock AA batteries may be used.

The case is made of high-impact plastic, with no exposed metal parts. The test leads are connected to a flat polarized plug with a locking latch that fits into a socket on the top end of the case. You can't pull it out accidentally; the release button must be pushed.

The red test probe is a unique design. Rather chubby, it has a safety ring halfway down the probe body. Housed in the probe body are two fuses—a 1-amp fast-blow fuse for protection against ordinary overloads and, at the very tip, a special 2-amp, 1000-volt fuse to protect against catastrophic arcing. To change fuses, just unscrew the tip of the probe and they pop out into your hand.

The *model 3300* is small, really hand-sized. And because it weighs only 10 ounces, it's easy to manipulate. You can hold the case and the negative probe in one hand, leaving the other hand free for doing the work. You can also tie a loop in the negative test lead and hang the meter up so that both hands are free; the lock on the test-lead plug holds it easily.

The instruction manual contains details on how to use the instrument, how to check batteries, etc., together with instructions on recalibration adjustments. **R-E**

state of solid state

A new CMOS smoke detector IC, an A/D converter for 8080 microprocessors, frequency synthesizers and a touch-switch matrix

KARL SAVON, SEMICONDUCTOR EDITOR.

SMOKE DETECTORS ARE BECOMING A VERY popular consumer item. Specialized integrated circuits that improve their performance and reliability are being released by the IC manufacturers. One of these devices, the MD4301 CMOS alarm circuit, has been developed by Mitel, a Canadian semiconductor company that specializes in CMOS and I^2L integrated circuits.

The main circuit elements of the Mitel IC are shown in the block diagram of Fig. 1. Input sense amplifier A1 is a comparator that switches when the input voltage on pin 2 rises 150 mV above the voltage on the bias input terminal (pin 3). The input threshold or trigger point can be adjusted by connecting a potentiometer between the internal voltage reference on pin 1 and the reference input on pin 3.

The circuit's main function is to trigger an audible alarm through the horn output terminal when the circuit itself is triggered. Trace the signal path through gate G1, inverter I2, gates G2 and G5, inverter I4 and N-channel transistor Q1 to the horn output pin. There are an even number of signal inversions from the input pin to the transistor gate. A positive input swing, therefore, produces a positive change on the gate of the transistor to turn it on.

The MD4301 has a number of versatile options: Either a DC or an AC output signal can be generated. An additional signal path starting at the oscillator and continuing through gates G3 and G4 and into gate G5. Gate G5 selectively adds the oscillator signal to the DC alarm signal. The combined AC and DC output signal is used to drive a horn. To select the horn mode, pin 9 is grounded. In this mode, gate G4 passes the oscillator signal to gate G5. For a DC alarm output, pin 9 is switched to a logic high level so that gate G4 blocks the oscillator signal, leaving only the DC path through gate G5. Audio tone inverter I5 is tied directly to gate G3's output, so that audio output triggered by A1 appears on pin 10.

An LED output is provided for localizing the alarm in a system that uses more than one MD4301. A signal path from sense amplifier A1 feeds the indicator latch circuit, which remains on even after the alarm input condition is cleared. The output transistor that lights an external LED is rated for a 300-mA collector current. The latch-reset input terminal (pin 5) must be switched to a logic high level to clear the indicator latch and turn off the LED.

Besides adding an extra component, a constantly illuminated pilot light would be a heavy battery drain. The LED output is designed to give a unique power-on indication. Power-on signals originate from a counter that is clocked by a two-phase signal from the audio oscillator. The counter is a polynomial counter constructed with shift register stages and EXCLUSIVE OR gates. The division ratio of this counter can be altered by a factor mask option. The standard version sends out one 50-ms pulse-per-minute.

The polynomial-counter output pulse feeds inverter I3, and the inverted pulse connects to gate G7 where it combines with the indicator output. This short once-per-minute visual blip indicates that the circuit has power and is functional. There is no need for a test pushbutton or pilot lamp.

The path from the polynomial counter through inverter I3 has a different purpose. Even though power-on indication has been provided, a reliable design should also warn of impending battery failure. When the 9-volt battery supply drops to between 7.5 and 8.0 volts, the low-battery sense circuit turns on gate G6. Battery-voltage falloff triggers the audio and horn outputs at the once-per-minute rate. The distinctive pulsed audio output signal cannot be mistaken for the sustained alarm condition. The low-battery condition triggers the alarm via gates G6 and G2. As an aid to understanding the circuit functions, Gate G2 was drawn as an OR gate with inverted inputs rather than as a schematically simpler but equivalent NAND gate. Gate 2 sums the signals from the battery-sense circuit and the sense amplifier and passes either of the abnormal conditions. If gate G2 had been drawn as a NAND gate, its function would be less obvious and would erroneously suggest that both inputs must be high to produce an output.

The output of gate G6 does not combine with the output of the indicator latch, so the LED is not affected by a low-battery condition. Gate G2 feeds the

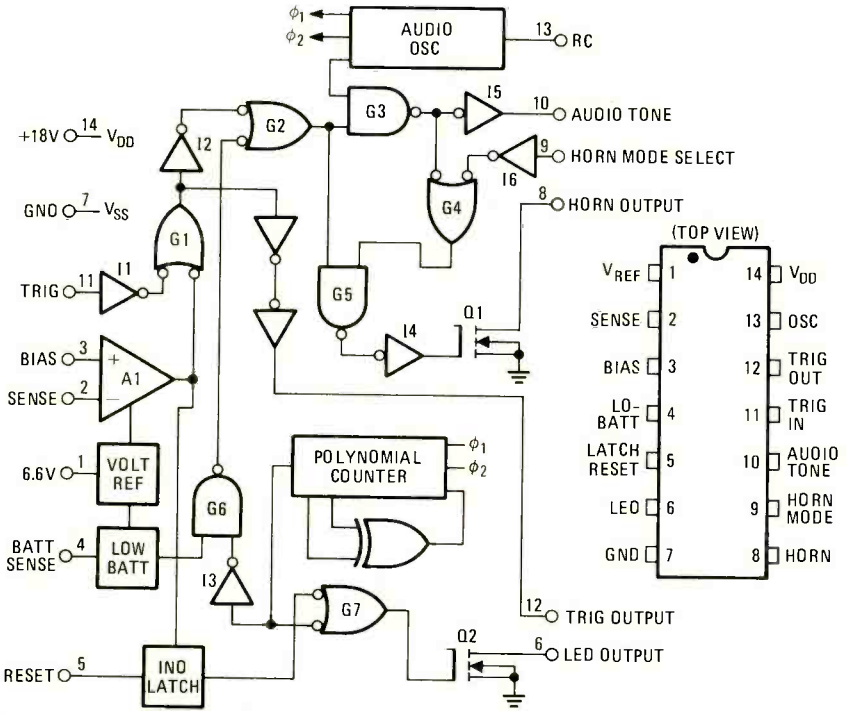


FIG. 1—MD4301 ALARM CIRCUIT designed for ion-chamber type smoke detectors. Low-battery sensor pulses audio and horn outputs at one-per-minute rate.

audio and horn output circuits and both are affected by the low-battery sense circuitry.

The trigger input terminal is used to form a multiple MD4301 system by cascoding the trigger output of one MD4301 through the trigger input of the next. Figure 2 shows the cascoded arrangement, where any alarm-sense condition

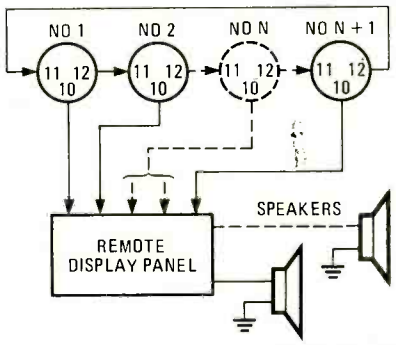


FIG. 2—CASCODED ALARM CIRCUITS. The MD4301 can be cascoded for detecting more than one alarm condition.

triggers all audio and horn outputs, but only activates the LED associated with the particular triggered circuit. A bank of LED indicators provides a visual trace of the sensor points that originate the alarms.

The trigger input is routed through inverter I1 and is combined with the sense-amplifier output in gate G1. Therefore, the trigger input and sense-amplifier output produce the same results, except that the LED output is driven only from the sense amplifier.

For additional information, write Mitel Semiconductor Incorporated, 18 Airport Boulevard, Bromont, Quebec, Canada J0E 1L0.

A/D conversion

To feed digital data into a microprocessor from an external source of parallel binary data, the data is applied to the data bus and a read operation is performed. On the other hand, if the input is an analog signal, an A/D converter must be used. Precision Monolithics (in *Application Note AN-22*) shows a system approach to digitizing analog inputs using an 8080 microprocessor, a DAC-08E digital-to-analog converter and a CMP-01C comparator. Figure 3 shows the block diagram.

The successive approximation method is used, in which the binary output is determined beginning with the most significant bit and finishing with the least significant bit. The first step in the approximation process is to determine if the voltage being measured is in the top or bottom half of the converter range and the most significant bit of the output data is either set or reset, respectively. Then, each successive step in the process narrows down the input voltage to one-half of the last selected range and sets or resets the appropriate bit.

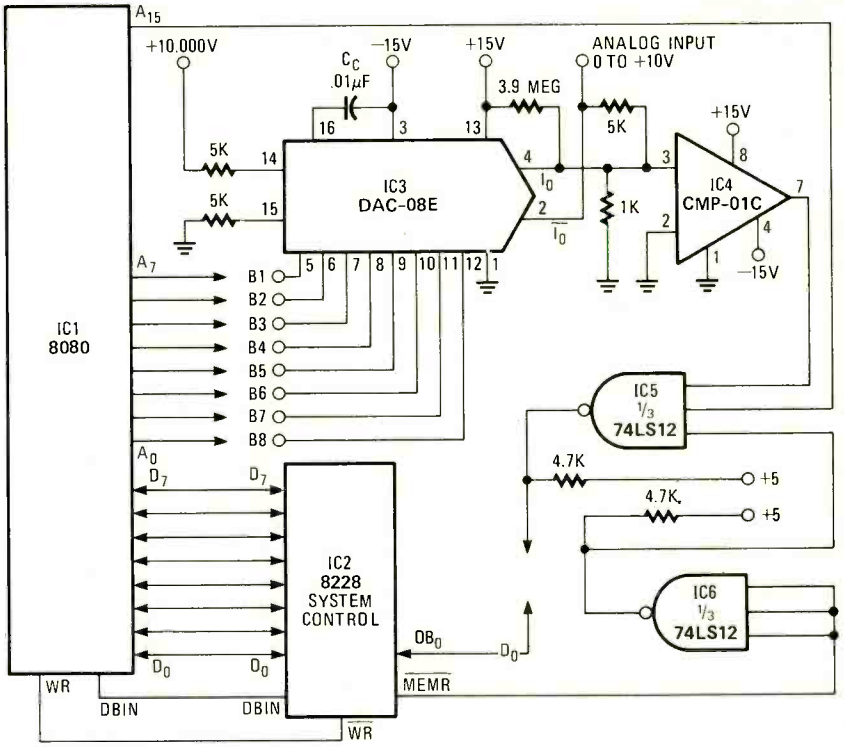


FIG. 3—D/A CONVERSION using an 8080 microprocessor.

Table 1 lists the 16 instruction 8080 assembly language program. First, the system sets the H pointer to 80_{16} in preparation for testing the most significant bit. All addresses above 8000 (1000 0000 0000 0000 binary) address the D/A converter since line A15 feeds enable gate

turn page

IC5. (See Fig. 3.) Register C is initially set to 0 and is used to store the intermediate and final values of the conversion. At the point labeled TEST in Table I, the program OR's the value of register C with the next bit to be tested. This new value is sent to the D/A converter so that its equivalent voltage can be compared with the actual input voltage.

The first time around, register C is 0 and is OR'ed with 80_{16} (1000 0000 binary)

TABLE I

```
START:  LXI  B,08000H ;LOAD MSB IN
                       B,CLEAR C
        MOV A,B       ;MSB TO ACC
        MOV H,A       ;SET MEM/MAP
                       I/O
TEST:   ORA C         ;ADD LAST TEST
                       VALUE
        MOV L,A       ;MOVE PRESENT
                       TEST TO L
        MOV A,M       ;GET COMP
                       OUTPUT
        ANA A         ;SET FLAGS
        JPO TOOHI     ;DISCARD
                       PRESENT
                       TEST BIT
        MOV A,B       ;GET PRESENT
                       TEST BIT
        ORA C         ;ADD TOTAL SO
                       FAR
        MOV C,A       ;SAVE TOTAL
TOOHI:  MOV A,B       ;GET LAST TEST
                       BIT
        RAR           ;ROTATE
                       TOWARD LSB
        MOV B,A       ;SAVE NEW
                       TEST BIT
        JNC TEST      ;JUMP IF NOT
                       FINISH
        END           ;FINAL VALUE IS
                       IN C
```

to test the first bit. At step MOV L, A (transfer accumulator to L), the test word in the accumulator is sent out onto the address lines. Next, MOV A,M (transfer memory addressed by H,L to the accumulator) reads the comparator output and places it in the accumulator.

System control circuit IC2 reads the comparator output through IC5, and places it on the data bus as D0. All other data bits are unused and are 0. The program tests the accumulator with the ANA A instruction (the 8080 does not automatically set the flags on a read operation). If the comparator output is 0, the value measured is less than the digitized value and the program jumps to TOOHI.

If the test result is positive, the bit corresponding to the test bit is set by adding the test bit with register C and storing the updated result back in register C. The test bit is shifted to the right in preparation for the next test. Starting with 80_{16}, register B proceeds through 40, 20, 10, 08, 04, 02 and 01, each value containing a single binary 1 in the test-bit position. When the last shift is made, the bit from 01 is shifted into the carry flag. The carry test at the end of the program detects this condition. A set carry bit signals the end of the conversion and the program reaches the END instruction or else branches back to TEST to determine the next least significant bit.

For a copy of *Application Note AN-22*, write Precision Monolithics Incorporated, 1500 Space Park Drive, Santa Clara, CA 95050.

MOS frequency synthesizers

The new 40-channel CB regulations are largely responsible for the current popularity of the synthesizer. Actually, synthesizers have been used for quite a while in commercial communication and navigation equipment. The integrated circuit has added significantly to their appeal.

Siemen's S187 MOS synthesizer tunes receivers up to 800 MHz with the help of a prescaler. An eight-stage divider follows the crystal oscillator that operates at a maximum frequency of 6.5 MHz. The outputs of the divider's four lowest stages are selected by a multiplexer and then divided by either 8 or 10, for a selection of 16 reference frequencies for the phase comparator.

The receiver's external VCO (*V*oltage-*C*ontrolled *O*scillator) is scaled by a divide-by-10 and divide-by 10/11 prescaler that feeds PROM-controlled synchronous dividers that drive the other phase-comparator input.

The S187 synthesizer generates up to 500,000 channels. The PROM can be controlled from a matrix of switches for pushbutton channel selection. Write Components Div., Siemens Corp., 186 Wood Ave. South Iselin, NJ 08030.

The MN6040 frequency synthesizer from Energy Electronic Products has a 0–256 programmable counter to divide down an external VCO. The counter works to 2.55 MHz. A divide-by-1024 circuit divides down an external 10.24-MHz reference crystal oscillator to a 10-kHz reference frequency. Information is available from Energy Electronic Products, 6060 Manchester Avenue, Los Angeles, CA 90045.

Microcomputers

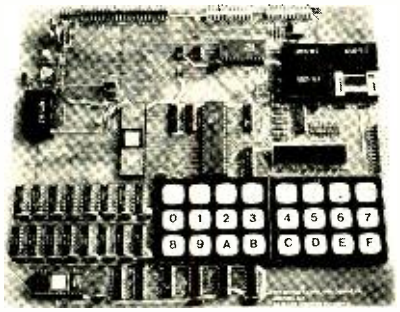
Signetics' 3000KT8080SK emulator kit uses Schottky LSI (*L*arge *S*cale *I*ntegration) parts to operate as an 8080A microcomputer at speeds from two to nine times faster. Instruction cycle time and RAM access time are 150 ns. New instructions can be added by programming the microcontrol store for the 12 instruction codes not used in the 8080. The kit has fully static operation, a single 5-volt power supply, hardware multiply-and-divide and fully vectored interrupts to anywhere in 64K of memory. The unit price is $299 from Signetics, 811 East Arques Avenue, Sunnyvale, CA 94086.

Motorola has 1.5- and 2-MHz versions of their M6800 microprocessor family circuits. There is a 50% to 100% increase in throughput potential, and power dissi-

pation has been lowered by about 20%. The part Nos. for the 1.5-MHz units have an MC68A prefix and the 2-MHz circuits have an MC68B prefix.

The 25-99 price of the MC68A00P microprocessor is $25, and the MC68B00P costs $30. Other parts available in plastic are MCM68A10P and MCM68B10P 128 × 8 static RAM's, MC68A21P and MC68B21P peripheral interface adapters and MC68A50P and MC68B50P asynchronous communications interface adapters. Information is available from Motorola, Inc., P.O. Box 20294, Phoenix, AZ 85036.

Texas Instruments' S481 bipolar microcomputer set uses Schottky TTL microprogrammable blocks for up to 10 times conventional microprocessor speed. Intended for minicomputers and fast controllers, it allows existing instruction sets to be emulated. The IC set is based around 4-bit slice processors, 4-bit slice controllers, field-programmable logic arrays, PROM's and RAM's. For more information, write Texas Instruments Incorporated, P.O. Box 5012, Dallas, TX 75222.

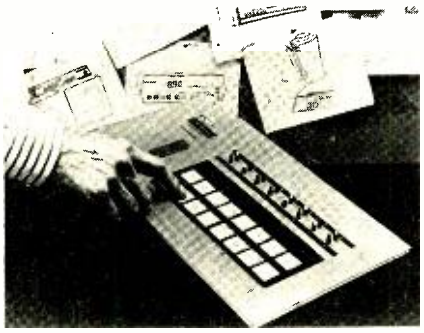


IMSAI MICROCOMPUTER is 8048-based and is designed for control applications.

IMSAI Manufacturing is proud of their new 8048, the world's first single-board control computer designed for electric tools, instruments and appliances that can be controlled without any intervening hardware.

The IMSAI Megabyte MICRO also allows up to 1-million byte capacity in a standard IMSAI chassis. The RAM-16, RAM-32 and RAM-65 are 16K- to 65K-byte low-power dynamic memory boards. Combined with the IMM (*I*ntelligent *M*emory *M*anager) interrupt controller board, these memories provide for expansion up to 1 megabyte, write protection for each 1K of extended space, read protection, fully vectored interrupts, time of day and real-time clocks. IMSAI Manufacturing Corporation, 14860 Wicks Boulevard, San Leandro, CA 94577.

American Microsystems offers a *TouchControl* IC that operates up to 32



AMI TCK-100 *TouchControl* evaluation kit.

touch switches for toy, game, electronic music, computer, keyboard, appliance and tool applications.

The *TCK100* evaluation kit is available for $29.95 from AMI distributors with a prewired control panel, the AMI S9263 IC with 16 touch switches and an instruction package.

American Microsystems, Incorporated, 3800 Homestead Road, Santa Clara, CA 95051. **R-E**

EIA proposes new CB standards to cut TVI

The Citizens Radio Section of the Electronic Industry Association has proposed to the FCC that new standards be adopted to eliminate much of the annoying TVI caused by CB signals. Specifically, it was recommended that CB *harmonic* emissions be kept 75-dB below the present 4-watt power limit.

Harmonics, although nonessential in CB communications, have a way of interfering with some TV channels. If a CB set is properly adjusted and operated, the chances are its signals won't interfere with TV reception. However, occasional interference does occur in high-density areas. The proposed EIA standards would cover such contingencies. Inexpensive filters can be used to relieve exceptional cases of TVI.

EIA spokesmen have also asked that firm action be taken against illegal power amplifiers, known as "linears," in order to significantly reduce the TVI experienced from CB sets. The FCC has proposed action in this area.

Other causes of poor TV reception have been laid at the door of automobile ignitions, household appliances, fluorescent lights, etc. One EIA study found that from 60 to 100 devices are capable of such TV and radio interference in the average home.

Advanced microcomputer seminar held on cruise ship

The Virginia Polytechnic Institute and State University of Blacksburg, VA, has announced an advanced microcomputer Interfacing and Programming Workshop that will be held aboard a cruise ship, the TSS "Carnivale," in the Carribean on June 17-24, 1978.

Featured in the five-day floating workshop will be a hands-on course using the 8080 and 8085 microprocessors. Some of the topics covered will be the use of programmable interface IC's, data acquisition modules, programming techniques and future trends in the field. For more information, contact Dr. Norris Bell, V.P.I. and S.U. Continuing Education Center, Blacksburg, VA 24061. Telephone: (703) 951-6208.

service clinic

How tuned horizontal output circuits work and how to troubleshoot them. **JACK DARR,** SERVICE EDITOR

IN ORDER TO FIX THE FAULTS ELECTRONIC technicians find, you *have* to understand the failure mechanism, not only what happened but why.

Technical writers also must first understand a product or problem thoroughly, so that readers can understand what's being described. For instance, there's one circuit I haven't written anything about until now simply because I didn't understand it. I knew what it was doing, but I couldn't find out what was causing the problem.

I am referring to the horizontal-output circuit, used in a great many solid-state color TV sets. This is the circuit with the famous four-legged capacitors across the horizontal-output transistor. Whenever these capacitors go bad, the high voltage rises to tremendous levels and creates all kinds of weird damage. The suggested remedy is to "replace the capacitor!" (This reminds me of a juke-box service manual I read once, in which, for a certain problem, the recommended cure was a curt "find cause and repair!")

All things come to him who waits, however, and I finally found an explanation in the Admiral manual, *Circuit Description and Troubleshooting* for their series *M45* units. The manual contains a highly detailed and crystal-clear explanation of just exactly how this type of circuit works.

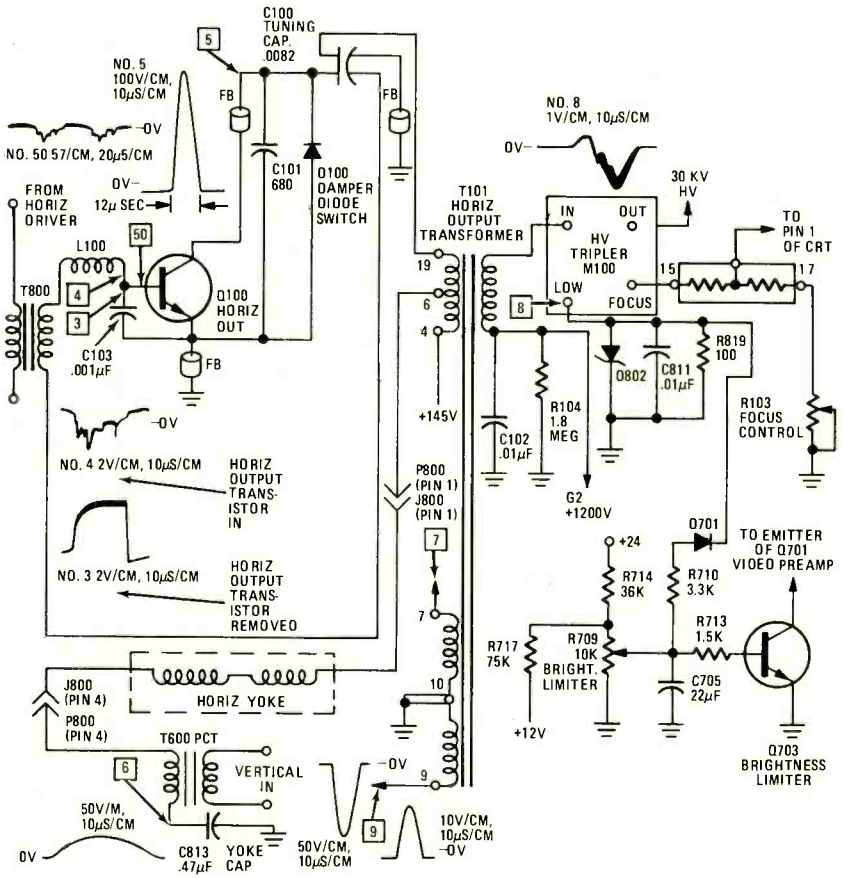


FIG. 1

Figure 1 shows the horizontal-sweep circuit of the *model M45* chassis. As in most conventional designs, the transistor drives the flyback transformer and yoke. The current pulse is stepped up to create the high voltage. Everything is normal so far; however, Admiral continues by explaining that this circuit is designed on a "dual-frequency" concept. The *scan* portion of the horizontal sweep is rated at roughly 10 kHz. The retrace portion (flyback pulse) is 40 kHz. These two frequencies have no real relation to the 15.75-kHz line frequency, except that each frequency goes through exactly *one half-cycle* during each period of the scan line. As long as the *total time* period of these two half-cycles adds up to the standard 63.5-μs scan time, everything is all right. The key frequency is the 40-kHz retrace, and the half-cycle concept must be kept in mind.

Therefore, in this circuit, there are *two* resonant circuits—the 10-kHz scan and the 40-kHz retrace. The actual scan is similar to that in tube-type TV sets: the horizontal yoke winding is fully charged, and the beam is on the left side of the screen. The damper diode conducts due to the polarity of the voltage developed by the collapse of the magnetic field in the yoke. This voltage sweeps the beam to the center of the screen. At this point, the yoke is discharged and the horizontal-output transistor turns on and recharges it, sweeping the beam the rest of the way across. (It's the familiar concept of "damper sweeps left half, output sweeps right half.") Because of the *time,* this action takes a total of 52 μs, which is equivalent to one half-cycle at about 10 kHz.

Now the fun begins. During scan, the damper diode and the horizontal-output transistor, which are connected from terminal No. 19 of the flyback transformer to ground in parallel, act as "switches." First one is on, then the other. The first of the two resonant circuits comprises the yoke winding and its 0.47-μF series capacitor, C813. The few turns on the flyback transformer and a small winding on the pincushion transformer play a minor role due to their size. The yoke and capacitor form a series-resonant circuit at about 10 kHz for maximum efficiency.

Note that in the retrace period, the .0082-μF capacitor is connected from terminal No. 19 on the flyback transformer to ground. During scan, either the damper diode or output transistor are on, thereby shorting this capacitor. (At the center of the sweep, both the damper diode and output transistor are open, but there is no energy in the yoke.) At the end of the scan, the output transistor is

quickly turned off by the rapid falltime of its base drive pulse, as shown by waveform No. 3 in Fig. 1. The yoke is fully charged and the instant the drive is removed, the magnetic field collapses.

With both switches off the *tuning capacitor* is now in-circuit. A sudden burst of energy is pumped into the *second* resonant circuit that consists of the yoke and the tuning capacitor. Yoke capacitor C813 has a very low impedance. Therefore, it is charged and serves only as a source of electrons. This resonant circuit is tuned to 40 kHz. If a pulse is sent into the circuit, it rings. The circuit then develops a high-voltage pulse because it is of very short duration—the current *changes* much more rapidly, causing a rise in the voltage.

When this high-voltage pulse reaches its peak, the current stops increasing and falls. These two changes develop a current in the yoke that moves the beam all the way back to the left side of the screen, and also recharges the yoke winding. This is a 40-kHz *one half-cycle* of energy and it takes place in about 12 μs. Adding this and the 52-μs scan time results in the necessary 63.5-μs total time for a scan line. (Don't argue with me about the missing half-μs; I said "about," which should take care of it!)

High voltage increase

Now, to get down to the nitty-gritty about why the high voltage rises if something happens to capacitor C813. Figure 1 shows that during scan, capacitor C813 is shorted-out by one of the two switches; therefore, an open capacitor would not affect the scan at all. However, with the capacitor open, during *retrace* all that energy that was pumped into the yoke is being pumped into a resonant circuit. Now, because there are only the yoke inductance and its own distributed capacitance, the resonant frequency goes way up. Instead of only *one* half-cycle, several develop during the same 12-μs period. Since these half-cycles are all shorter in duration than the correct frequency, what happens? Each half-cycle has a much faster risetime than it should. As a result, the flyback transformer tries to develop a much greater pulse, since the voltage developed by the changing current is proportional to the *rate of current change*. Since the yoke series capacitor is still in-circuit, each pulse charges the series capacitor. The pulses will still be positive-going pulses, since the damper diode will cut off the negative-going halves.

This excessive pulse height will make the high-voltage winding develop tremendous high-voltage values. Field engineers have reported rises of up to 60,000 volts. (The reading might have been higher, but 60,000 volts was the limit of their meters!) It is important to note that this increase in frequency is *not* related to the

continued on page 84

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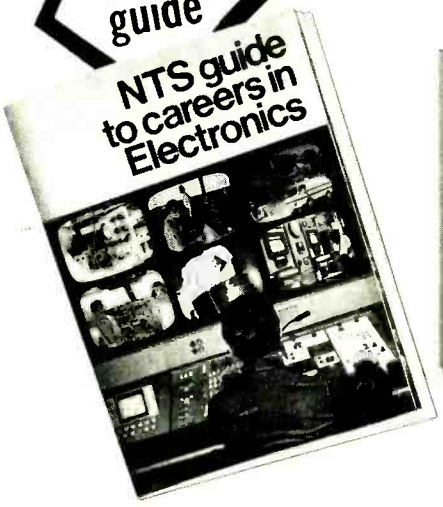

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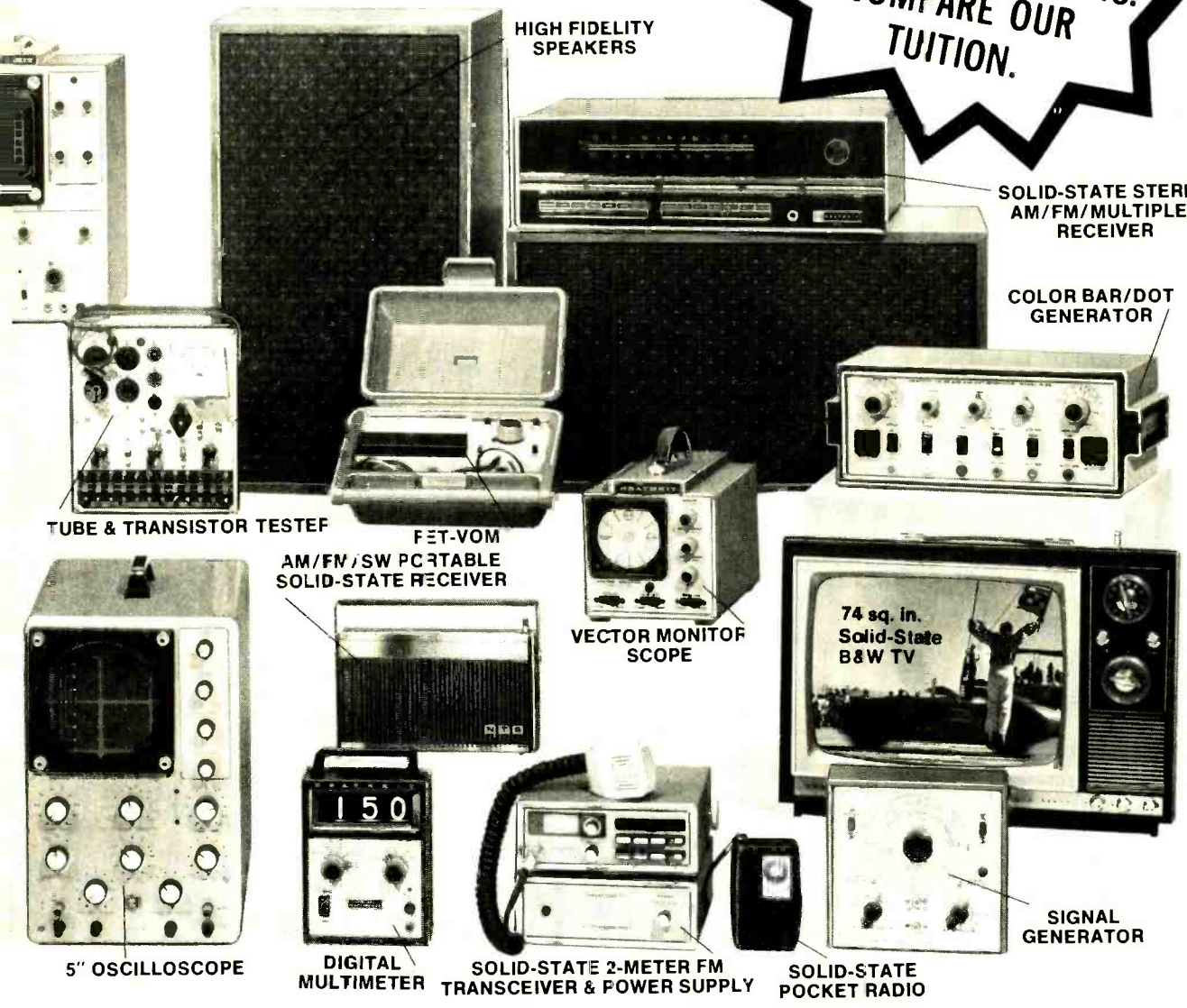

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SERVICE CLINIC
continued from page 79

horizontal-drive frequency, which stays the same; the change is entirely in the "retrace frequency."

This rise in retrace frequency seems to be due, in the vast majority of cases, to an open tuning capacitor. If the horizontal yoke winding opens, it is not able to store enough energy to develop the high pulse; the same thing applies to the larger series capacitor. This usually kills the horizontal sweep, leaving a thin, bright *vertical* line. The high voltage does not usually rise except for a small amount due to the reduced beam current needed to scan only one bright line.

It is necessary to use specially designed reliable capacitors that can handle high RF current. This leads to what should be an unnecessary warning—*never* replace these capacitors with an ordinary capacitor. The ones used here seem to be polypropylene or polycarbonate dielectric with high voltage ratings. However, the best substitute is always the set-maker's suggested replacement type.

The Admiral manual describes one good test—scoping the pulse on the horizontal-output transistor collector. The pulse should be about 850 volts peak, but, more important, the pulse width must be very close to 12 μs. A triggered sweep

scope set to a speed of 10 μs-per-cm should show one full-scale division and about 0.2 of the next division, as shown in waveform No. 5 in Fig. 1. If your scope probe won't take an 850-volt pulse, just hold it near enough to the circuit to get a pickup waveform; the width will be accurate. **R-E**

service questions

TUNABLE HUM BAR

Here's a curio for you. This Sylvania DO-5 chassis had what looked like a bright, single hum bar that tended to break up along with a static-like noise in the sound. This effect was most distinct on UHF and high VHF. Below Channel 11, it wasn't evident.

I checked for heater-cathode shorts in tubes; nothing. I let them heat up to see if this was a hot short. While tapping tubes and watching the picture, I noticed that the UHF pilot light was flickering like a Christmas-tree blinker lamp, right along with the blinking hum bar! The pilot lights are NE-2H neon lamps, each with a 30K dropping resistor.

New pilot light, no hum bar! I'm sending you this lamp for your collection.

(Thanks very much to A. C. O'Neal, San Diego, CA, for this curiosity.)

SCOPE CALIBRATION OFF

I'm working over an Eico 460 scope that I picked up. I get a very funny waveform in the CALIBRATE position! Instead of a 60-Hz sinewave, it looks like this (see diagram). I've checked all the tubes, no help. Please advise.—L.M., Coraopolis, PA

It looks as if there's something wrong in the sweep. It doesn't start until it reaches that point, then suddenly jumps up to normal amplitude. This means there's an unbalance somewhere. Check all of the resistors in the vertical and horizontal sweep and output stages. Some of them may have gone way off. This is a common problem in the older scopes.

(Feedback: "Bingo! I remembered that the person I got the scope from said that he'd built it. Evidently he was color blind! He interchanged R10 (grid peaking resistor, vertical input stage—Ed.), which should be 220K for R36 (plate supply resistor for push-pull vertical output stage—Ed.), which should be 22K. I swapped 'em back, and it works.")

VOLUME OUT OF CONTROL

I have a peculiar problem with an RCA VCR-243 AM/FM stereo. When the set has warmed up, the volume starts to go up slowly, and the volume control won't cut it down. This is intermittent and can happen any time after it's warmed up. The volume control has been replaced. Everything else is normal. What causes this?—W.F., Marysville, KS

The crystal ball says your ground is not grounded, on the bottom of the volume control! Like all stock volume-control circuits, this one is actually an "audio signal voltage divider." The slider varies the amplitude of the signal fed to the audio input. To reduce this level, it must go to a good *ground*—a point equal to zero signal level. If the ground is imperfect, there will still be too much audio getting through. I suggest you run a jumper from a known ground over to the volume control's bottom terminal.

I had a case like this not long ago. It turned out that the bottom of the volume control wasn't "DC-grounded", but it certainly was for audio. A 20-μf electrolytic bypass capacitor from the bottom of the control to ground was open.

In either case, you can verify this quite easily by simply scoping the bottom terminal of the control. This should show absolutely *no signal* at any time.

FAULTY ROTATOR

I ran into a Channel-Master 9524C rotator that won't rotate. I don't have any data on this, and not much experience with rotators. Do you know how to test these?—K.S., Bellingham, WA

Check the cable up to the rotor for continuity and correct resistance. If this is OK, then see if you get 20 volts AC at each of the secondary windings of the transformer. If you do, and the motor hums but won't run, the phasing capacitor C is probably open.

Capacitor C is a 110–120 μf *nonpolarized* electrolytic; either a Sprague AM-510 or equivalent. Note that each half of the motor can be switched so that the capacitor is in series with it, while the other one goes directly to the transformer. This gives you the phase shift needed to make the motor start and run.

PICTURE/COLOR PROBLEMS

I have an unstable picture in a Zenith 19EC45. It falls out of horizontal sync and also rolls vertically. At the same time, the color goes bad. It goes out of sync, or shifts in hue. Can you help?—C.S., Vergennes, IL

All these troubles can probably be fixed at once. Just get the horizontal sync problem fixed up. Try running a horizontal-oscillator setup, and check the AFC diodes. These are separate in this chassis; try replacing both of them at once.

If your horizontal oscillator is unstable, this causes keying-pulse instability, which can upset not only the vertical sync, but the automatic gain control, color and everything else.

Note: Check the 330-ohm resistor in the emitter of the sawtooth shaper on the 9-90 board; if it's risen in value this has caused problems.

(Feedback: "Got it!")

FAULTY SWITCH CAUSES TV TROUBLES

I've a batch of problems in this Sears 528.427-11012! It was serviced; worked for 24 hours; then blooie. I found six tubes shorted. I replaced them. The set now had vertical, sound, RF, but very little horizontal. I found a 30KD6 in the horizontal output. This should be a 40KD6. Now there's lots of color, plenty of sweep, but no RF or audio! Now what?—J.R., Newark, OH

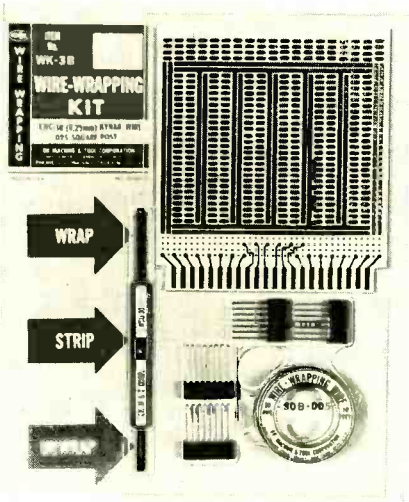
(I wrote him suggesting checking for video, since he seemed to have color but no black-and-white picture, etc. Later, he answered:)

I checked all the things you suggested; no dice. The problem turned out to be strange but simple. It was the *on-off switch!* This set uses a triple switch, which is supposed to turn on the heaters and the B+; two of the switches were shorted. I was getting only about half the B+ voltage plus other things. I replaced the switch with a factory duplicate, and now it works.

new products

More information on new products is available from manufacturers of items identified by a Free Information number. Free Information Card follows page 122.

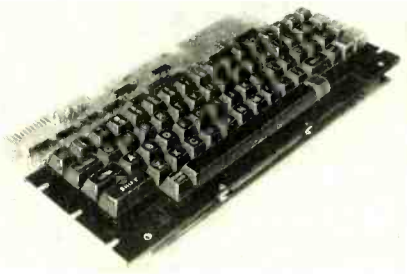
WIRE-WRAPPING KIT, *model WK-3B,* contains wire-wrapping tool (*model WSU-30*) that wraps and unwraps AWG No. 30 wire on .025 square pins and has built-in wire stripper. Kit also includes 50-ft roll of insulated silver-plated copper wire, two 16-pin wire-wrap DIP sockets and two 14-pin wire-wrap DIP sockets. Also included is new 4 × 4¼-in. PC board, *model H-PCB-1,* made of glass-epoxy laminate with solder-coated copper pads.—**OK Machine and Tool Corp.,** 3455 Conner St., Bronx, NY 10475.



CIRCLE 102 ON FREE INFORMATION CARD

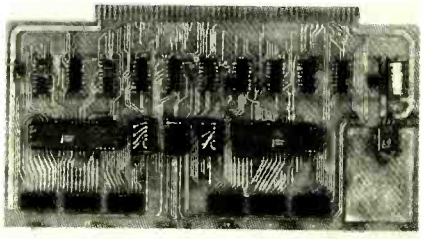
COMPUTER KEYBOARD, *PRO,* has alphanumeric lock key for changing outputs from typewriter to teletype code and 5 unassigned (nondedicated) relegendable keys; unit can easily piggyback a daughterboard and lends itself to do-it-yourself customizing.

Alterable customizing options include negative logic or tri-state positive logic (accomplished via simple IC substitution); a high-voltage, CMOS-compatible output; encoded or nonencoded outputs; flexible key assignments; card connector on PC board for auxiliary keyboard; automatic repeat function; optional parity bit; varied strobe pulsewidth; output latch with auxiliary circuit and optional shift-control mode. Key array includes full 128-character ASCII output code, four modes (lower case, upper case, control case and teletype alpha-lock), TTL and DTL-compatible outputs, a +5-volt supply at 325-mA maximum. Unit price: $135 prepaid. Free brochure available.—**Cherry Electrical Products Corp.,** Frank Amendola, Box 718, Waukegan, IL 60085.



CIRCLE 103 ON FREE INFORMATION CARD

I/O CONTROLLER, *model PIO4800,* is a 6-port programmable device. This 5 × 10-in. S-100 bus-compatible PC board can interface computers to any parallel device with or without handshaking. Two channels, three different modes per channel, can be programmed for up to three 8-bit ports which can be operated simultaneously. Whether a port is to be an input, output or bidirectional port is determined by a single control word. This control word determines the mode of each port, direction, strobes and interrupt capabilities. Price: $149.—**I O R,** Box 28823 (Dept. D-200), Dallas, TX 75228.



CIRCLE 104 ON FREE INFORMATION CARD

HEAVY-DUTY POWER SUPPLY, *model PS-5,* is rated at 13.6 volts, 5 amperes continuous, making it suitable for CB 40-channel AM and SSB radios. The unit features short-circuit protection, a rugged heavy-gauge aluminum case and a one-year warranty. List price: $49.95.—**Communications Power, Inc.,** 2407 Charleston Rd., Mountain View, CA 94043.

CIRCLE 105 ON FREE INFORMATION CARD

FREQUENCY-RESPONSE RECORDER, *model LFR-5600,* uses an audio sweep oscillator and pen recorder to measure and graphically record

frequency response, wow and flutter, drift, voltage and temperature readings for high-fidelity audio equipment. Among unit's features are automatic start to simplify tape recorder response measurements; 1-kHz and 333-Hz standard signal frequencies for reel-to-reel or cassette recorders; 25-dB, 50-dB or linear scales; higher sensitivity measurement capability; slow speed range to permit long-term drift measurements.

Meter can also be used as a sweep-frequency indicator for easy voltage calibration.

Applications include measurements of audio amplifier frequency response and S/N ratio, low frequency response of speaker systems and amplifiers, tape recorder frequency response and S/N ratio, phonograph cartridge frequency response, filter design tests, reel-to-reel and cassette recorder wow, flutter and drift measurements. Priced at under $3000.—**Leader Instruments Corp.**, 151 Dupont St., Plainview, NY 11803.

CIRCLE 106 ON FREE INFORMATION CARD

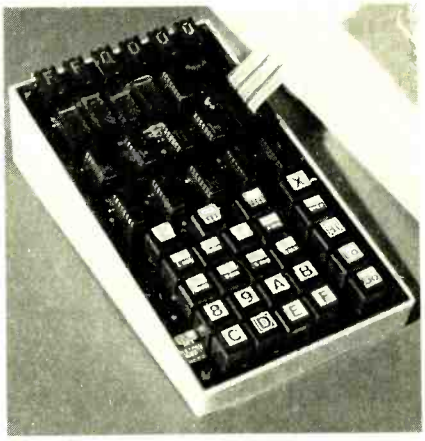
HOME PINBALL MACHINE, *Fireball* kit contains all solid-state electronics. Bright red LED's display scores, up to four players, automatically (individual scores are stored in memory); musical synthesizer plays tunes for bonuses and extra

scores. Bonus balls are awarded automatically. Unit can be programmed for beginner or advanced skill levels. Large playfield contains player-controlled flippers and "thumper bumpers" and "sling shots." Kit price: $699.95.—**Heath Co.**, Dept. 350-480, Benton Harbor, MI 49022.

CIRCLE 107 ON FREE INFORMATION CARD

HEXADECIMAL KEYPADS, *models MMD/HEX-1* and *MMD/HEX-2*, are designed as accessories to E&L Instruments' *model MMD-1* Mini-Micro Designer training and development computer. Calculator-type 16-key array has 8 additional function keys that permit the user to execute programs, modify or examine contents of memory and registers and monitor programs performance.

Factory-programmed HEX L/D PROM for hex conversion replaces original HEX PROM in the *model MMD-1*. The *model MMD/HEX-2* is provided with one pair of 0.3-in.-high LED hexadecimal displays; 2 additional displays are optional (displays can also be added to the *model MMD/HEX-1*). Both keypads come with conversion PROM, integrated circuits, interconnection cable



and instruction manual. Both measure 7¾ × ⅜ × 3 in., and weigh about 1 lb. Prices for the *model MMD/HEX-1*, assembled: $125; kit: $105. The *model MMD/HEX-2* costs $185 assembled; kit, $155 (including display pair).—**E&L Instruments, Inc.**, 61 First St., Derby, CT 06418.

CIRCLE 108 ON FREE INFORMATION CARD

HANDS-FREE TELEPHONE AMPLIFIER lets you conduct a conversation while typing, filling, preparing dinner or even taking a bath. System amplifies all parties' voices through speaker unit and can be used at high volumes without feedback whistle or other distortion. Just place phone handset on amplifier unit; pressure-activated switch turns unit on and off automatically. Comes with 56-inch cord and operates on 9-volt battery.

Amplifier base measures 4 × 8 inches; speaker base measures 3½ × 4¼ inches. Net weight: 15 oz; gross weight: 24 oz. Suggested retail price,

$19.95.—**Saxton Products, Inc.**, 215 N. Rt. 303, Congers, NY 10920.

CIRCLE 109 ON FREE INFORMATION CARD

CB ANTENNA KIT, *Readywhip model 18-2065,* contains a 48-in. top-loaded fiber glass antenna. Special process distributes power to coil for optimum performance and the VSWR is 1:5:1 or less across entire 40-channel band. Kit comes

with trunk mount, coax cable, hardware and installation manual.—**GC Electronics,** 400 S. Wyman, Rockford, IL 61101.

CIRCLE 110 ON FREE INFORMATION CARD

DIRECT DRIVE TURNTABLE, *model 6150,* has brushless low-voltage DC servo-controlled motor system to minimize vibration. Two separate controls (33 rpm and 45 rpm) allow for ±3% speed variation. Precision tone arm is resonance-free

throughout audible range and features a viscous damped cue control. Wow and flutter is specified to be less than .045%. Built-in strobe light provides speed indication. Suggested retail price is $169.95.—**Marantz Co., Inc.**, 20525 Nordhoff St., Chatsworth, CA 91311.

CIRCLE 111 ON FREE INFORMATION CARD

FREQUENCY MULTICOUNTERS, *models 1912A and 1925A,* provide overall versatility of operation for use in industrial, communications and computer fields. Following the company's introduction of the *models 1910A and 1911A,* both these counters offer period, period-average and totalize modes. The *model 1912A* (shown) provides a range of 5 Hz to 520 MHz on a 7-digit LED readout. A trigger level control and attenuator allow you to measure in the presence of noise. Input impedance on the *model 1912A* is 1 megohm from 5 Hz to 125 MHz and 50 ohms from 50 MHz to 520 MHz. Sensitivity is rated at 15 mV across the major portion of the input bandwidth. Unit can be ordered with either 2 ppm or .5 ppm TCXO at 0° to 50°C; aging rate on both is .3 ppm.

External timebase allows counter to be used with 10-MHz frequency standard. Optional internal rechargeable battery pack provides up to 4 hours continuous operation. Unit features autoranging, autoreset, manually selected gate times and self-check function.

The *model 1915A* provides a 5-Hz to 125-MHz range on a 9-digit LED display, and also available is a 520-MHz, 50-ohm option. (Must be ordered at time of purchase.) Unit is especially designed to meet major portion of military RFI-EMI specification MIL STD 461. A 2 ppm TCXO is standard. An optional 1×10^{-7} ovenized timebase is also available. Price of the *model 1912A*: $620; *model 1925A*: $750.—**John Fluke Mfg. Co., Inc.,** Box 43210, Mountlake Terrace, WA 98043.

CIRCLE 112 ON FREE INFORMATION CARD

COMPUTER TERMINAL KIT, *model CT-64,* contains everything needed for a complete terminal compatible with MODEMS and ASCII computer systems. Terminal features 16 lines of 32 or 64 characters per line, scrolling or page mode, upper and lower case characters, reversed character printing, control character printing, cursor

control and control character decoding. Comes with power supply, keyboard, serial interface, beeper, assembly instructions, chassis and cover. Optional *model CT-VM* video monitor available assembled. Prices: *model CT-64,* $325 postpaid; *model CT-VM,* $175.—**Southwest Technical Products Corp.,** 219 W. Rhapsody, San Antonio, TX 78216.

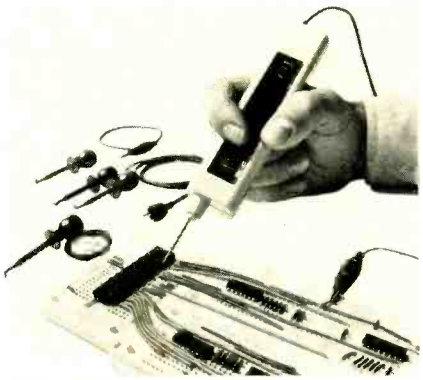
CIRCLE 113 ON FREE INFORMATION CARD

DIGITAL PULSER, *model DP-1,* handheld pulse generator is short circuit and overload protected, which permits fast, easy circuit tests. Single-pulse or 100 pulse-per-second testing is accomplished via pushbutton selection of single-shot or continuous modes. LED indicator flashes once for single pulse or continuously for pulse trains.

After connecting the clipleads to positive and

negative power supply points, the user touches the *DP-1* probe to the desired circuit point. The *DP-1* automatically senses the circuit condition—high or low state—and produces an opposite-state pulse. Permits rapid stimulus-response troubleshooting in TTL, DTL, CMOS and other popular logic families.

Selectable pulse width accomodates CMOS (10 μs ±30%) or TTL/DTL (1.5 μs ±30%). Pro-



vides CMOS circuits with 50-mA source to logic 1, and a sink to logic 0. For TTL/DTL circuits, the *model DP-1* can be used as 100-mA source to 3.5V and a sink to .6V for up to 60 loads. Risetime in CMOS is 100 ns, falltime, 8 μs for a 100,000-ohm load. Instrument measures 5.8 × 1.0 × 0.7 in., weighs 3 oz., and can accommodate a variety of test leads. Price: $74.95.—**Continental Specialties Corp.,** 44 Kendall St., Box 1942, New Haven, CT 06509.

CIRCLE 114 ON FREE INFORMATION CARD

RMS DISTORTION ANALYZER/OSCILLATOR, *model 339A,* is a lightweight, flexible bench-measurement instrument that, when used as a distortion analyzer, can measure THD from 0.01% to 100% full-scale in nine ranges. Fundamental frequency range is from 10 Hz to 110 kHz, and harmonics can be read to 330 kHz. The voltmeter function measures input levels over a 1.0-mV to 300-volt range full-scale on a 10-hz to 110-kHz frequency range. Used as a distortion oscillator,

instrument delivers a variable output level from <1 mV to <3 volts RMS into a 600-ohm load. The THD is as low as −95 dB or 0.0018%.

The *model 339A* is simple to use because of its automatic tuning and set-level features. Built-in tracking oscillator lets you save time; the automatic set-level allows you to measure distortion as a function of level. Other features include an AM detector, 30-kHz low-pass filter and switchable VU meter ballistics. Unit weighs 18 lbs. Price: $1900.—**Hewlett-Packard,** Inquiries Manager, 1501 Page Mill Rd., Palo Alto, CA 94304.

CIRCLE 115 ON FREE INFORMATION CARD

new lit

More information on new lit is available from the manufacturers of items identified by a Reader Service number. Use the Free Information Card following page 122.

SURPLUS CATALOG, *This Month,* 32-page catalog lists hundreds of industrial, electronic, scientific and electromechanical products. Kits, computer components, test equipment, switches, holograms and parts cabinets are just some of the items described. Handy order form is included.—**Herbach & Rademan, Inc.,** 401 E. Erie Ave., Philadelphia, PA 19134.

CIRCLE 116 ON FREE INFORMATION CARD

MAGAZINE INDEX, *Periodicals For Craftsmen, Collectors, Hobbyists And Science Enthusiasts,* 42 pages listing more than 470 different magazines, covering the entire hobby spectrum from Art to Writing (as a craft). Eleven pages of publications devoted to science and science-related topics. Listed are address, description of the magazine and subscription price. Cost of the directory: $2.00.—**Hersey Publications,** Box 515, Stewartstown, PA 17363.

ELECTRONICS CATALOG, *No. 1977B,* contains 14 illustrated pages of kits and preassembled units, as well as many standard electronic components. The booklet features four pages of digital clock kits. Other items include a prescaler, a frequency counter and an assortment of mini-kits.—**Ramsay Electronics,** Box 4072, Rochester, NY 14610.

CIRCLE 117 ON FREE INFORMATION CARD

COMPUTER INDEX, *Periodical Guide For Computerists, January-June, 1977,* is a handy 32-page index of over a thousand articles, book reviews, editorials and reader correspondence from 22 hobby and professional computer magazines. All material is indexed by subject matter under 90 different categories. Available for $3.00 postpaid.—**E. Berg Publications,** 1360 S.W. 199th Court, Aloha, OR 97005.

ELECTRONICS CATALOG, *Super Buys,* contains 32 pages of discounted electronic items, from simple (and not-so-simple) components to speaker kits, CB gear, TV, hi-fi and tape equipment, test instruments, etc. There is a handy mail-order form in the back of the booklet.—**ETCO Electronics,** 183G Hymus Blvd., Pointe Claire, Quebec H9R 1E9.

CIRCLE 118 ON FREE INFORMATION CARD

new books

ACTIVE NETWORK DESIGN, by Claude S. Lindquist. Steward & Sons, Box 15282, Long Beach, CA 90815. 749 pp. 7 × 10 in. Softcover, $21.95; in California, $23.27.

This guide describing filter design and applications is helpful for engineers, technicians and hobbyists who must understand signal processing and filtering, and adapt, specify or design filters for their own use.

The book is divided into two sections: Part I deals with general concepts and analysis; Part II is concerned with design specifics. The book includes many designs and tables; problems and solutions; references and original and unpublished research results; and a complete cross-referenced index.

ILLUSTRATED HANDBOOK OF ELECTRONIC TABLES, SYMBOLS, MEASUREMENTS AND VALUES, by Raymond H. Ludwig. Parker Publishing Co., Inc., West Nyack, NY 10994. 352 pp. 7¼ × 10 in. Hardcover $17.95.

Technicians, engineers, instructors, experimenters and hobbyists will find much vital technical information in this easy-to-use reference guide that covers a broad range of the most used electronic data. Many helpful formulas, values, symbols, measurements, etc., are included along with a complete collection of troubleshooting techniques and shortcuts. In addition, the book takes you through a step-by-step examination of many specialized electronic areas, such as digital circuits, microwave characteristics, semiconductors and industrial applications. Equally useful to the engineer and hobbyist.

HOME COMPUTERS: 2^{10} QUESTIONS AND ANSWERS, VOLUME 1: HARDWARE, edited by Rich Didday. dilithium Press, Box 92, Forest Grove, OR 97116. 225 pp. 5½ × 9 in. Softcover $7.95.

HOME COMPUTERS: 2^{10} QUESTIONS AND ANSWERS, VOLUME 2: SOFTWARE, edited by Rich Didday. dilithium Press, Box 92, Forest Grove, OR 97116. 175 pp. 5½ × 9 in. Softcover $6.95.

The series gets its title from the fact that there are 2^{10} or 1024 questions and answers in the two volumes. These two volumes are written in easy-to-follow question-and-answer format to help the average reader with little or no computer knowledge not only to operate his own computer but become more knowledgeable generally in both home computing *and* programming. The material is presented in the form of a dialogue, in clear informal style. The material covered progresses in an orderly structured fashion from basics of hardware and software to details of special microprocessors. The book's format also lends itself to leisurely browsing. Instruction sets and a bibliography form part of the extensive appendices.

PROGRAMMING MICROPROCESSORS, by M. W. Mcmurran. Tab Books, Blue Ridge Summit, PA 17214. 279 pp. 5¼ × 8¼ in. Hardcover $9.95.

This book is intended to give a basic understanding of microprocessor design and functions and to allow the reader to prepare workable computer programs with relative ease. Topics discussed are hardware and software, fundamentals of processor arithmetic, numerical conversion, scaling techniques for magnitude control of fixed-point processor data, floating-point arithmetic, and how to use and store data efficiently. The text is illustrated with pictures, schematics and tables. Conversion tables, an AMP instruction set and a RAM work sheet are contained in the back of the book.

HANDBOOK OF ADVANCED SOLID-STATE TROUBLESHOOTING, by Miles Ritter-Sanders, Jr. Reston Publishing Co., Inc., Div. of Prentice-Hall Co., Reston, VA 22090. 255 pp. 6 × 9 in. Hardcover $15.95.

This book presents a comprehensive overview of practical solid-state troubleshooting techniques. It outlines preliminary analyses of symptoms as well as pinpointing procedures and malfunctions. The material is aimed at those with some experience in the electronics field. The instruments necessary for troubleshooting—such as multimeters, voltmeters, DMM's, pulse generators, among others—are described with their various applications in troubleshooting solid-state stereo systems, audio amplifier testing and troubleshooting, FM receivers, color TV and advanced semiconductor tests and measurements. The text is illustrated with diagrams, schematics, charts and pictures. **R-E**

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BIKE SPEEDOMETER

continued from page 40

Figure 5 shows you how the LED's are installed. The 100-ohm resistors should be connected to the anode, and the 1000-ohm resistors to the LED cathodes. Wire them close together and trim the leads short since they will extend into the utility box used as the case. Otherwise, you can mount the resistors parallel to and against the back surface of the faceplate. In this case, cut a large hole in the front surface of the metal box so as to clear the resistors when the faceplate is installed.

Whether to mount the resistors parallel to or at right angles to the faceplate is up to you. Your choice, however, may be dictated by the amount of space available once the PC board is mounted inside the box. The limiting factor is the size of adjusting potentiometer R24. I used a 15-turn, ¾-inch-long Bourns *Trimpot* and cemented it to the component side of the board. When the PC board is in place in the case, the adjusting screw comes close to the back of the case.

The case has two sections. Use the part with the lips on the front and end surfaces to mount all electrical components. Start by locating and drilling the four mounting holes for the faceplate and PC board. Use a full-size foil pattern of Fig. 4 to locate the mounting holes. Next, cut a rectangular hole in the front of the box to clear the resistors when the faceplate is mounted.

Drill the mounting holes for the two switches and two jacks. Place the switches on one end and the jacks on the other end. The holes are ¾-inch from the back of the box and approximately 1-inch apart. The important thing is to position the holes so that the switches and jacks do not touch the PC board.

Use special care when mounting the jacks. They must be insulated from the chassis because its outer housing or shell is connected to the positive side of the battery. Use shoulder-type insulating washers or, as I did, mount J2 on a small piece of plastic and cement the plastic behind an oversized hole. Do not

install the switches and J2 at this time. The handlebar clamps are mounted on the back section of the box, using No. 6-32 flathead machine screws. The screw heads go inside the box.

Begin final assembly by attaching the faceplate to the box with four 6-32 × 1¼-inch machine screws. Next, solder the wires from the PC board to the corresponding LED's. Place ½- or ¾-inch spacers over the screws and mount the PC board on top, anchoring the board securely with four nuts and lock washers. Mount the switches and J1. Make the necessary connections to the switches and jacks. These are:

From	To
PC board B+ line	S2 arm contact
J1 center post	S2 fixed contact
PC board B− line	Shell of J1
Q5 collector	One S1 contract
J2 center post	Second S1 contact
Point J2 on PC board	J2 tip contact
J2 shell contact	S2 arm contact

Battery pack

The battery pack consists of five NiCad C cells connected in series. Solder four short pieces of wire to the positive and negative terminals and connect the cells in series. Wrap electrical tape around the cells to form a fairly rigid cylindrical package. Solder a 12-inch lead to the negative terminal and a 3-inch lead to the positive terminal. Cut a piece of 1-inch PVC plastic pipe approximately 12-inches long. Cement a pipe cap to one end and slip the battery inside the pipe, letting the two wires extend from the open end.

Drill a small hole for the two power leads in the end of the remaining pipe cap. A 12-inch piece of 24-gauge 2-conductor speaker cable is used for the power leads. Solder plug PL1 to one end of the cable and feed the other end through the hole in the end cap. Solder these wires to the battery leads and insulate

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SHERLOCK HOLMES

continued from page 69

"I'm afraid not yet, Holmes. There is still one little problem."

"What sort of problem?"

"There is no number on this transistor. None at all! And there is no number on the schematic drawing. I swear Holmes! I shall swear off unknown goods! Dash it all!"

"Come, come, Watson. No need to swear at all sir. You must have a thousand assorted transistors in that box. Certainly one, or perhaps any one of them will do."

"But which one, Holmes? How shall I select the proper one?"

"I suspect it is quite elementary, but let me check my latest monograph on transistor substitution." Holmes went to the mantel and rummaged through a stack of papers. He mumbled to himself:

"I really must get these published one day . . . Ah, here is what I was looking for." Holmes read silently for a while. Watson waited, knowing that nothing could be gained by interrupting. Finally, Holmes said:

"Yes Watson, I knew the answer was here. Examine this, it provides your solution."

Watson took the tattered piece of paper and read it. He then did a surprising thing. He put his hand over his eyes, reached into the box and, as in a lottery drawing, selected a transistor. Without a word, he soldered the "lottery" transistor into the circuit and turned it on. The "New Unknown Amplifier" *worked*, and with amazing clarity.

"By jove Holmes, you have done it again!"

Watson had made my statement for me. I was flabbergasted. Upon reading the page that had seemingly caused Watson's strange lottery drawing, I read the following:

"If the voltage drop across R_{es} is greater than 1, and R_{b2} is less than 10 times the value of the emitter resistor, almost any transistor will serve adequately as a replacement. That is, if:

E_{Res} is greater than 1 volt

and

R_{b2} = 1 to 10 (but not greater than 10) times R_{es} (on ohms),

transistor substitution should be easy. If the voltage drop across the emitter resistor is greater than 2 and R_{b2} is equal to R_{es}, it will be difficult to find a transistor (assuming it is not defective) that will not work as a replacement."

It seems that perhaps Watson was more certain of Holmes' theories than Holmes himself. However, my subsequent laboratory investigations lead me to believe that Doctor Watson was right and Holmes a little conservative in a practical situation. From my numerous laboratory experiments, I can wholeheartedly recommend Holmes' methods for use if you are ever confronted with these two problems.

In his monograph, Holmes also mentioned that a substitute transistor should have a maximum collector voltage rating at least that of the value of V_{cc}, a beta figure of 100 or greater in the replacement device (50 for a power transistor) and the calculated collector current should not be greater than 40% of the replacement's maximum rated collector current.

Meanwhile, Holmes and I returned to our discussion of the crystal expectorant container case, and had been at it for nearly an hour when Doctor Watson broke in:

"I say, Holmes, isn't your monograph a little incomplete? I find here several circuits to which your method does not seem to apply!"

"Perhaps, Watson, but it applies to all circuits of its class, and, as for the others, I have also written some insignificant monographs. I will go into more detail later about those. At the moment, I *do* have a guest and we are both deeply involved in the case of the silver saliva slopper. Later, doctor, later!" **R-E**

BIKE SPEEDOMETER
continued from page 93

the connections. Make sure that the positive battery lead goes to the center pin of PL1.

Wheel-switch assembly

Next, cement the reed switch to a ¾ × 2-inch piece of plastic. Recess the switch in a shallow groove made with a small round file. Use Elmer's clear adhesive intended for glass and china or epoxy cement to anchor the switch to the plastic. Look through the glass envelope and note the two flat metal strips that make up the switch. These strips must lie parallel to the surface of the plastic when the switch is cemented in the groove. Solder a piece of No. 24, 2-conductor speaker cable about 20-inches long to the two leads of the reed switch. Connect the other end of this cable to plug PL2.

Testing the speedometer

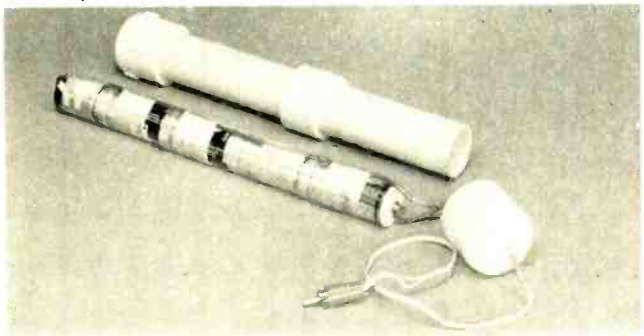
Charge the battery and plug it into J1. Plug reed switch S3 into J2. Turn on the power and see if any of the LED's light up. If they do, then depress the TEST switch and hold it for at least 5 seconds. The 5-second delay insures that the signal pulses from IC6 are counted for at least one fixed time period.

At this point, connect a temporary jumper across the S1 terminals. This leaves both your hands free to hold the speedometer while you adjust potentiometer R24. Adjust R24 until the LED display reads the diameter of the bike's front wheel.

When you are satisfied that the display is stable, remove the jumper lead and observe the LED display. The LED's should go dark after about 3 seconds. Next, check the operation of reed switch S3 by bringing a magnet close to it—the "0" LED should light up. Simulate wheel movement by moving the magnet rapidly back and forth, opening and closing switch S3. The number displayed will change, but don't expect a display of "10" or more. Your hand isn't fast enough.

If the speedometer passes this test, assemble the case and fasten the halves together with sheet metal screws. Unplug the battery and wheel switch. Use epoxy cement to mount each of the two magnets on a piece of ¾ × 2-inch plastic. Mount the magnets temporarily on the front-wheel metal rim of the bike between the spokes. The magnets should be diametrically opposite each other so that as the wheel turns, one magnet activates the reed switch every one-half revolution.

Now, place the reed switch on the inside of the fork in a position where a gap of ¼ to ⅜ inch exists between it and the magnets. Adjust the switch and magnet positions to get proper switch action. Use a good bonding cement such as *Eastman 910* or *Krazy Glue* to fasten the magnets and the switch.



BATTERY POWER SUPPLY. NiCad "C" cells form power supply for speedometer.

Next, make sure that the battery is fully charged (you can use the battery charger shown in Fig. 6 for this purpose) and then mount the battery pack under the bicycle crossbars.

Plug in the battery pack and wheel switch. Close power switch S2 and press TEST switch S1. In approximately 5 seconds, the speedometer will read out the bicycle's wheel diameter. Release the pushbutton and the speedometer is ready for a trial run. **R-E**

HOBBY CORNER

continued from page 71

dering variety of voltages: 3, 4.5, 6, 7.5, 9, etc. You probably also own several AC adapters, each with a different output. Have you ever plugged in the wrong one? (Well, I hope it was a lower voltage rather than a higher voltage, or, at least, that you burned out only a $3 AM radio!)

I find both the battery and the adapter problems particularly annoying. Usually frustration and annoyance lead to changes; mine did and so can yours.

I use *external* batteries, especially on seldom-used gear. In fact, several recently constructed projects don't even have compartments for internal batteries.

First, to avoid using the wrong voltages, devise a connector plan. There are many shapes and sizes of jacks and plugs. Select one for 3 volts, another for 4.5 volts, one for 5 volts, and so on. It doesn't matter which you choose for any given voltage; just be consistent.

Next, change the plugs on each of your AC adapters to match their voltages to your connectors. Make adapters that you can use with your bench power supplies.

The next step is to make up battery packs. I use regular battery holders of various sizes; each one has leads and the appropriate plug attached.

The final step is to modify your battery-operated equipment. The power jack of those devices having one must be changed to the proper type to fit your scheme. Add appropriate jacks to those devices lacking them by simply wiring them to the internal batteries.

Now you are in business. When you get ready to use a piece of gear, just plug in a bench supply, AC adapter or a battery pack. The system is quick and convenient and you have to work at it to apply the wrong voltage. (Your devices can still be used in the normal way when you want the compactness and convenience of internal batteries.)

As for batteries, they are easily replaced. There are not a large number sitting around expiring of old age; and if they should leak, it won't happen inside your good equipment!

(Please remember that we want this to be *your* column as much as possible. Send us any suggestions and ideas you would like to see explored. Let us know what you are working on, and, especially, send along any circuits that you would like to share with other readers. See you next month. *73, Doc*) **R-E**

WATCH FOR IT

Next month, **Radio-Electronics** will feature a construction article on a portable DMM. The meter is built around a digital panel meter with a "front end" that provides the necessary ranges.

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CD4025BE	.16	CD4512BE	.69
CD4026BE	1.39	CD4514BE	2.50
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CD4043BE	.45	CD4539BE	1.20
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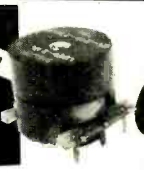

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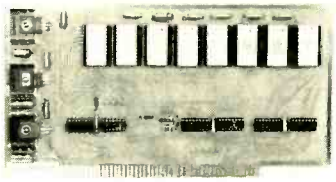

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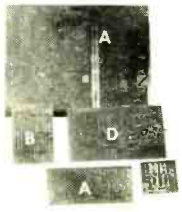

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4006A	1.35	4022A	.94	4071A	.26
4007A	.26	4023A	.25	4072A	.35
4008A	1.52	4024A	.89	4073A	.39
4009A	.57	4025A	.25	4075A	.39
4010A	.54	4027A	.59	4078A	.39
4011A	.29	4028A	.98	4082A	.35
4012A	.25	4030A	.44	4518A	1.56
4013A	.45	4035A	1.27	4528A	1.56
4014A	1.27	4040A	1.39	4585A	2.10
4015A	1.27	4042A	1.47		
4016A	.48	4049A	.59		
4017A	1.01	4050A	.59		

IC SOCKETS
Solder Tail - low profile

8 pin	$ .17	24 pin	.42
14 pin	.20	28 pin	.59
16 pin	.22	40 pin	.69
18 pin	.29		

CERAMIC DISC CAPACITORS

1pf 50V	56pf 50V	270pf 50V	01uf 1000V
5pf 50V	68pf 50V	390pf 50V	022uf 50V
7pf 50V	82pf 50V	470pf 50V	030uf 50V
10pf 50V	100pf 50V	600pf 50V	050uf 50V
22pf 50V	120pf 50V	820pf 50V	1uf 50
27pf 50V	150pf 50V	001uf 50V	
33pf 50V	180pf 50V	0047uf 50V	
47pf 50V	220pf 50V	01uf 50V	

(each) (Minimum 10 per value)

0-100	$.10 ea	$.05 ea
100-		$.04 ea

SPECIAL SALE

Jumbo LED'S
green - yellow
amber - clear 16¢ ea.

ZENER DIODE — 400MW
3.6V 5.1V 6.8V 15V
4.7V 5.5V 10V **$.15 EA.**
8/$1.00 ANY MIX

LED'S

MAN 72	.99
NSN 74R	.99
DL702	.99
FND 359	.59
MV10B	
6/$1.00	

TTL BARGAINS

7416	$ .19
7420	.13
7432	.19
7437	.19
7440	.13
7442	.29
7460	.13
7495	.59
74141	.68
74145	.59
74151	.59
74165	.79

SIGNAL DIODES — 400 MW
20/$1.00

SHIFT REGISTERS

2510	$ .75
2511	.95
2518	2.50
2522	.95
2532	2.29
5016	.89

CERAMIC DISC CAPACITOR PACKAGE

10 EA. OF FOLLOWING VALUES — 50 VOLT

1pf	33pf	82pf	220pf	820pf	.022uf
5pf	47pf	100pf	270pf	.001uf	.030uf
10pf	56pf	150pf	470pf	.0047uf	.050uf
22pf	68pf	180pf	600pf	.01uf	.1uf

240 CAPACITORS **$10.95**
SUPPLIED IN 60 DRAWER CABINET . **$24.50**

LINEAR SPECIALS

LM301	mini dip	$ .20
LM308	TO-5	.65
LM311	mini dip	.65
LM340T	6V	.89
LM565	dip	.89
LM567	mini dip	1.09
LM747	dip	.50
LM1458	mini dip	.50
CA3046	dip	.75

CALC. KIT ONLY **$7.95**
ADAPTER -60Hz **$3.95**

REGULATED POWER SUPPLY KIT

PLUS & MINUS 5, 12 & 15 VOLT USES 3 LM340T AND 3 LM320T REGULATORS. 115V/29VCT TRANSFORMER PLUS PC BOARD, CAPACITORS & DIODES + 5V PROVIDED WITH SINK TO SUPPLY 1 AMP. WITH ALL PARTS, SCHEMATIC AND INSTRUCTIONS — PS-29 ... **$11.95**
SHIPPING $1.00

MM 5330
4½ DIGIT DVM LOGIC **$ 4.95**

CALCULATOR KIT

LITRONIX 1502 MEMORY

- **FULL ACCUMULATING MEMORY** — STORES AND RECALLS SUBTOTALS
- **%** KEY — PERFORMS ALL PERCENTAGE FUNCTIONS INCLUDING ADD-ONS, DISCOUNTS, MARKUPS AND YIELDS
- **ARITHMETIC LOGIC** — LETS YOU ENTER PROBLEMS IN ADDING MACHINE MODE
- **FLOATING DECIMAL SYSTEM** — AUTOMATIC DECIMAL POINT POSITIONING FOR FULL 8 DIGIT ACCURACY
- **OVERFLOW SAVE** — IN CASE OF OVERFLOW IN DISPLAY, THIS CLEARS THE CONDITION AND ALLOWS CALCULATOR TO CONTINUE USING THE OVERFLOWED RESULTS DIVIDED BY 10
- **AUTOMATIC TIMEOUT TO SAVE BATTERIES**

PRECISION RESISTOR PACKAGE

METAL FILM ± 1% ¼ WATT — 240 RESISTORS **$21.95**
4 EA. OF FOLLOWING VALUES — SUPPLIED IN 60 DRAWER CABINET **$39.50**

10.5	100	499	1.65K	4.53K	7.50K	13.0K	22.1K	44.2K	80.6K
20.0	130	604	2.00K	5.11K	8.45K	14.0K	24.9K	48.7K	90.9K
30.1	162	750	2.49K	5.49K	9.09K	15.0K	27.4K	52.3K	100K
49.9	200	1.0K	3.01K	6.04K	10.0K	16.2K	30.1K	57.6K	147K
60.4	301	1.21K	3.48K	6.49K	11.0K	17.8K	34.0K	63.4K	210K
76.8	402	1.40K	4.02K	6.98K	12.1K	20.0K	40.2K	69.8K	464K

2708
FULL SPEED EROM
$10.95

5314 6 DIGIT CLOCK CHIP
$2.95

170.2A
$ 4.75

74S200
256 BIT RAM TRI-STATE
$3.25

8080A, 8008
$11.95

UART
AY51013A
$6.95

LD110, LD111
3½ DIGIT A/D CONVERTER SET
$24.75

2513
CHARACTER GEN
64 x 8 x 5 ASCII
$6.95

82S23
256 BIT PROM
$2.95

MM5369 Divider mDIP 2.49
Crystal 3.58 MHZ color TV 1.75
Crystal 2.010 MHZ 3.95

RESISTOR PACKAGE

CARBON FILM ± 5% ¼ or ½ W
15 EA. OF THE FOLLOWING VALUES
100, 220, 470, 1K, 1.5K, 3.3K,
4.7K, 6.8K, 10K, 33K, 100K, 1M
180 RESISTORS **$5.45**

MINIATURE SOLID STATE ELECTRONIC BUZZER

LONG LIFE — HIGH RELIABILITY
LOW CURRENT DRAIN
NO MOVING CONTACTS
78 dB min AT 1 FT. — 450 Hz

				EA
EB-106	6V	15mA	4-9 VDC	$1.99
EB-112	12V	15mA	8-20 VDC	1.99

6 Digit Clock Kit

MM5314 with 6 NS71 .27" displays 2 P.C. boards — Display board may be remote. Internal or wall transformer can be used. 50-60 Hz, 12-24 hour. Includes all necessary transistors, resistors, capacitors, diodes, 3 switches and complete assembly instructions.

CK6-3 ..... **$14.95**

KEYBOARD

20 KEYS
2 SLIDE SW
3 x 3 $ .99

CALCULATOR DISPLAY

9 MAN 3 M
ON PC BOARD
99¢

ELECTRONIC DOOR CHIME KIT

WITH TI TMS 1000 MICROPROCESSOR CHIP PROGRAMMED TO PLAY 24 DIFFERENT TUNES

INTERNATIONAL ELEVATOR — PLAYS NATIONAL ANTHEMS OF U.S., BRITAIN, FRANCE AND WEST GERMANY PLUS 3 OTHER TUNES. CLASSICAL AND TRADITIONAL SELECTIONS

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- USES 29V TRANSISTOR BATTERIES (NOT SUPPLIED)
- LOW POWER CONSUMPTION
- INTERNAL SELECTION OF TUNE, VOLUME, TEMPO AND TIMING FUNCTIONS
- PROGRAMMED MATHEMATICALLY TO PLAY IN PERFECT PITCH PERMANENTLY
- EXTERNAL DOOR CASE CONVENIENT WALL MOUNT

$39.50 SHIPPING $1.00

TANTALUM CAPACITORS

Solid dipped +20%

.1 mfd	35V	$ .25	10 mfd	16V	$ .40
.33 mfd	35V	.25	10 mfd	25V	.45
1 mfd	35V	.25	15 mfd	10V	.40
2.2 mfd	20V	.25	15 mfd	20V	.45
2.2 mfd	35V	.30	22 mfd	16V	.45
3.3 mfd	35V	.30	33 mfd	10V	.40
4.7 mfd	16V	.30	47 mfd	6V	.40
6.8 mfd	6V	.30	56 mfd	6V	.45
6.8 mfd	50V	.40	150 mfd	15V	.50

CALCULATOR CHIPS

CT5002	12 digit, 4 function fixed decimal battery operation — 40 pin	1.95
CT5005	12 digit, 4 function plus memory, fixed decimal — 20 pin	2.49
MM5725	8 digit, 4 function, floating decimal 18 pin	1.98
MM5736	6 digit, 4 function, 9V battery operation — 18 pin	2.95
MM5738	8 digit, 5 function plus memory and constant floating decimal, 9V battery operation — 24 pin	3.95
MM5739	9 digit, 4 function, 9V battery operation — 22 pin	3.95

CLOCK CHIPS

MM5314	6 digit multiplexed 12-24 Hr, 50-60 Hz 24 pin	4.45
MM5316	4 digit, 12-24 Hr, 50-60 Hz, alarm 40 pin	4.95
5375AA	4-6 digit, 12 hour, 60 Hz snooze alarm brightness control capability, alarm tone output — 24 pin	4.95
CT7001	6 digit, 12-24 Hr, 50-60 Hz, alarm, timer and date circuits — 28 pin	6.95

DISCRETE LED'S

			EACH
ME4	INFRARED CLEAR DOME	.170"	.29
MV10B	CLEAR DOME	.170"	.25
MV50	CLEAR — AXIAL	.09"	.12
MV50	RED — AXIAL	.09"	.12
NSL100	RED	.19"	.12
RL209	RED DIFF. SUBMINIATURE	.12"	.12
RLT-T1-03	WHITE DIFF. SUBMINIATURE NO FLANGE	.124"	.15
RLC-200	RED DIFF. CURRENT REG., CONST. BRIGHTNESS 4.5-12.5V	.190"	.25
RLC-201	RED DIFF. CURRENT REG., CONST. BRIGHTNESS 4.5-	.190"	.25
RL-4403	RED DIFF. FULL FLOOD	.190"	.15
GREEN	SPOT	.190"	.18
CLEAR	POINT	.190"	.15

LEDS

		EA.
DL10A	RED CA .27" LHD	$1.89
DL 707	RED CA .30" RHD	1.49
DL 507	RED CA .50" RHD	1.49
FND 359	RED CC .375" RHD	.89
DL 702	RED CC .30" LHD	1.39
NSN 74R	RED CC .30" RHD	1.49
DL 500	RED CC .50" RHD	1.49
MAN5	GREEN CA .27" LHD	1.39
MAN8	YELLOW CA .27" LHD	1.39
MAN82	YELLOW CA .3" LHD	1.89
MAN66	RED CA .6" LHD	2.19
DL747	RED CA .6" LHD	2.39

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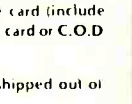
Accommodates 5 16 pin IC's with additional interconnection holes. 1/16" phenolic with silver plated copper circuits. 2 5/16" x 6 9/16" **$1.80 ea.**

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



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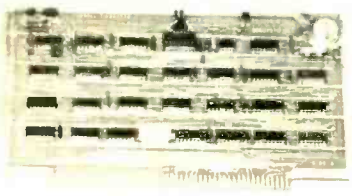

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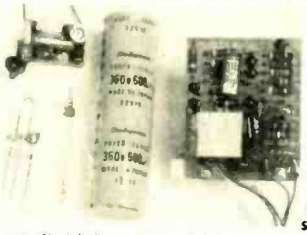
CIRCLE 26 ON FREE INFORMATION CARD

MAKE YOUR OWN AUTOMATIC STROBE KIT



We have all the parts to custom design your own automatic photo graphic strobe. These individual modules may be put together in several different ways, depending on how powerfull, or whether you want automatic shut off. We have a DC to DC power supply, that raises the output of 4 NICADs from 4.8 volts, to 320 volts. We have the trigger coil, to fire the flash tube.We have 2 flash tubes, a straight tube 2" long, and a horse-shoe tube 1½" long. a small, high voltage, high capacity capacitor, rated at 360 V, 600 mfd. 38 watt seconds., an electronic cut off device that shuts of the flash tube when the exposure is correct. You may make up your own kit by choosing the parts you wish. We list the price of each part, but when 3 or more parts are chosen, you may deduct 10% from the total. We suggest that only one capacitor be used if the the straight flash tube is used. With the horseshoe tube, 2 capacitors may be used for greater output. Use of the cut off module is optional. We provide circuitry for the entire system.

	STOCK NO.	
DC to DC power supply	5528R	$4.95
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Capacitor	2675R	$2.00
Horseshoe flash tube	9941R	$3.00
Straight flash tube	9244R	$2.50
Cut-off module	6423R	$2.50

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VIDEOCUBE is a self contained RF oscillator-modulator, allowing easy interface with any video output device to a standard TV set. We provide a reprint of article from RADIO-ELECTRONICS. Approved by FCC.

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- Very Low Output Ripple
- Fiberglass PC Board Mounts All Components
- Assemble in about One Hour
- Makes a Great Bench or Lab Power Supply
- Includes All Components except Case and Meters

ADD $1.25 FOR POSTAGE/HANDLING

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2N3904	NPN Amp/Switch @100 40V 200mA	8/$1
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2N4888	150 Volt PNP Transistor for Keyer	2/$1
E112	N-Channel FET VHF RF Amp	3/$1
TIS74	N-Channel FET High-Speed Switch 40Ω	3/$1
TO-220	Mounting Kit-Mica insulator & bushing	10/$1

LM308H	Low Bias Current Op Amp-Super 709		$0.84
LM309K	5 Volt Regulator	TO-3	.84
LM317K	Adjustable Voltage Regulator	2-37V	3.50
LM380N	2 Watt Audio Power Amplifier	DIP	.94
NE565A	Phase Locked Loop	DIP	.94
LM723CN	Precision Voltage Regulator	DIP	3/$1
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2102	1024-Bit Static RAM (1024 x 1)	DIP	$1.75
2740DE	FET-Input Op Amp- like NE 536/μA740		1.95
CA3018A	4-Transistor Array/Darlington		.99
CA3028A	RF/IF Amplifier DC to 120MHz		1.45
CA3075E	FM IF Amp/Limiter/Detector	DIP	1.45
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These easy to-assemble kits include all components, complete detailed instructions and plated fiberglass PC boards. Power supply kits do not include case or meters. Add $1.25 per kit for postage and handling.

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2N718	.24	2N4092	$0.75
2N720	.48	2N4121	3/$1
2N918	3/$1	2N4122	3/$1
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2N1711	.29	2N4248	5/$1
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2N3644	4/$1	2N5126 to 2N5135	6/$1
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2N3919	$5.00	2N5432	1.90
2N3922	5.00	2N5457	3/$1
2N3954	3.20	2N5458	$0.38
2N3958	1.15	2N5484	3/$1
2N3970	1.00	2N5486	2/$1
		2N5543	$3.00
		2N5544	2.50
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TRANSISTORS

2N5638	2/$1
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CP643	$4.00
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CP651	$4.00
E100	4/$1
E101	3/$1
E102	3/$1
E175	3/$1
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MPF104	
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MM5738N	$2.95
SN7400N	.16
SN7410N	.16
SN7420N	.16
SN7440N	.16
SN7451N	.18
SN7473N	.36
SN7475N	.48
SN7476N	.35
SN7490N	.44

LINEAR IC's

LM100H	$7.50
LM301AN	.27
LM307H	.27
LM308N	.88
LM309K	.94
LM311N	.90
LM320K-5	1.35
LM320K-12	1.35
LM320K-15	1.35

LINEAR IC's

LM340K-5	$1.20
LM340T-5	1.20
LM340T-6	1.20
LM340T-12	1.20
LM340T-15	1.20
LM3401-24	1.20
LM376N*	.55
LM377N	2.50
LM380N	1.29
NE555V*	2/$1
NE556A	$0.90
LM709CH	.29
LM709CN	.29
LM723H	2/$1
LM723N*	3/$1
LM739N	$1.00
LM741CH	3/$1
LM741CN*	4/$1
LM741CN14	.34
LM747CN	.65
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749CJ DIP	1.00
844CP mDIP	.80
LM1304N	1.15
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XR2556CP	1.55
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RC4194TK*	2.50
RC4195DN*	1.25
RC4195TK*	2.25
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N5558V	.50
μA7805UC	1.25
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2N2907	PNP Transistor 6/$1	LM723 2-37V Reg DIP	3/$1
2N3055	Power Xistor 10A $0.75	LM741 Comp Op Amp mDIP	6/$1
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2N3906	PNP Amp/Sw @100 6/$1	CA3086 5 Trans Array DIP	.62
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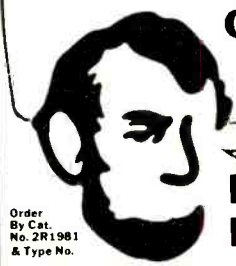

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SN7414	.65	.66
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SN7417	.35	.36
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SN7426	.25	.26
SN7427	.25	.26
SN7430	.29	.30
SN7432	.25	.26
SN7437	.25	.26
SN7438	.29	.30
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SN7443	.69	.70
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SN7448	1.35	1.36
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SN7451	.19	.20
SN7453	.19	.20
SN7454	.19	.20
SN7455	.19	.20
SN7460	.19	.20
SN7462	.19	.20
SN7464	.19	.20
SN7465	.19	.20
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SN7471	.25	.26
SN7472	.25	.26
SN7473	.55	.56
SN7474	.29	.30
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SN7476	.59	.60
SN7478	.59	.60
SN7480	.29	.30
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SN7490	.69	.70
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SN7492	.45	.46
SN7493	.49	.50
SN7494	.69	.70
SN7495	.69	.70
SN7496	.69	.70
SN7498	.69	.70
SN74100	1.49	1.50
SN74107	.39	.40
SN74112	.25	.26
SN74113	.19	.20
SN74114	.25	.26
SN74121	.49	.50
SN74123	.69	.70
SN74125	.59	.60
SN74126	.39	.40
SN74132	1.25	1.26
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SN74145	1.25	1.26
SN74148	1.75	1.76
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SN74151	.99	1.00
SN74153	.99	1.00
SN74154	1.75	1.76
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SN74157	.99	1.00
SN74158	.99	1.00
SN74160	1.25	1.26
SN74161	1.25	1.26
SN74163	1.25	1.26
SN74164	.99	1.00
SN74165	1.25	1.26
SN74166	1.25	1.26
SN74173	1.25	1.26
SN74174	1.49	1.50
SN74175	.99	1.00
SN74177	.79	.80
SN74179	1.49	1.50
SN74180	.49	.50
SN74182	.69	.70
SN74190	1.49	1.50
SN74191	1.75	1.76
SN74192	.85	.86
SN74193	.85	.86
SN74194	1.25	1.26
SN74195	.49	.50
SN74197	.75	.76
SN74199	1.75	1.76
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SN74285	4.25	4.26

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LM307V-N	.45	.46
LM308V-H	.79	.80
LM309K	1.79	1.80
LM311H-V	.79	.80
LM318V	1.29	1.30
LM320H-5, 12, 15	1.19	1.20
LM320K-12, 15	1.19	1.20
LM320T-6, 15, 24	1.19	1.20
LM322N	1.19	1.20
LM324N	1.75	1.76
LM339N	1.09	1.10
LM340K-5, 6, 8, 12, 15, 18, 24V	1.19	1.20
LM340T-5, 6, 8, 12, 15, 18, 24	1.19	1.20
LM350N	.59	.60
LM370N-H	1.29	1.30
LM374H	1.79	1.80
LM376V	.29	.30
LM377N	2.25	2.26
LM378V	7.95	7.96
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LM387V	1.19	1.20
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LM704H	.29	.30
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LM1458V	.69	.70
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LM75453	.39	.40
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2R3814	6.3V	1A	Open frame	$2.49	$2.50
2R3412	12V	300ma	Open frame	$1.95	$1.96
2R4029	12V	1A	Open frame	$2.49	$2.50
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2R3323	24VCT	300ma	Open frame	$1.95	$1.96
2R3937	24V	1A	Open frame	$1.95	$1.96
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2R2379	1N4003	200	10 for .85	20 for .86
2R2380	1N4004	400	10 for .99	20 for 1.00
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2102-L1	1.69
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2112	2.49
2708	19.95
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MM5202	6.95
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74LS04	.35	74LS139	1.24
74LS08	.32	74LS151	1.25
74LS10	.32	74LS153	1.25
74LS11	.32	74LS155	1.25
74LS13	.64	74LS160	1.47
74LS20	.32	74LS161	1.47
74LS21	.32	74LS162	1.47
74LS22	.32	74LS163	1.47
74LS27	.39	74LS168	1.68
74LS30	.32	74LS169	1.68
74LS32	.39	74LS173	1.68
74LS37	.45	74LS174	1.05
74LS38	.45	74LS190	1.77
74LS42	1.19	74LS191	1.75
74LS47	.99	74LS192	1.75
74LS74	.49	74LS193	1.75
74LS90	.89	74LS195	1.25
74LS92	.89	74LS197	1.25
74LS93	.89	74LS257	1.35
74LS109	.58	74LS266	.54
74LS112	.58	74LS366	.66
74LS113	.58	74LS368	.69
74LS114	.49	74LS390	2.95

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CD4002	.29	CD4024	.79
CD4006	1.19	CD4025	.34
CD4007	.29	CD4027	.69
CD4008	.79	CD4028	.89
CD4009	.59	CD4029	1.19
CD4010	.59	CD4030	.49
CD4011	.29	CD4033	1.60
CD4012	.29	CD4035	.99
CD4013	.69	CD4040	1.19
CD4015	1.19	CD4041	1.25
CD4016	.49	CD4042	.88
CD4017	1.19	CD4046	1.79
CD4018	1.19	CD4049	.49
CD4019	.49	CD4066	.79
CD4020	.99	C04071	.29
CD4021	1.29		

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2SA 101	.59	2SA 839	2.15	2SC 454	.59	2SC 898	4.40	2SC 1451	1.60	2SD 382	1.40
2SA 102	.59	2SA 841	.59	2SC 458	.59	2SC 900	.59	2SC 1475	1.40	2SD 388	3.40
2SA 234	.59	2SA 847	.59	2SC 460	.59	2SC 929	.59	2SC 1475S	.70	2SD 424	8.50
2SA 342	.90	2SA 850	.70	2SC 461	.59	2SC 930	.59	2SC 1509	1.10	2SD 427	2.80
2SA 353	.70	2SA 872A	.59	2SC 481	1.60	2SC 943	1.20	2SC 1584	8.50	2SD 525	1.60
2SA 377	2.00	2SA 908	11.00	2SC 482	1.50	2SC 945	.59	2SC 1586	6.60	2SD 526	1.10
2SA 440	.90	2SB 54	.59	2SC 485	1.60	2SC 959	1.50	2SC 1624	1.30	2SD 555A	6.60
2SA 483	3.00	2SB 55	1.10	2SC 486	1.60	2SC 971	1.00	2SC 1626	1.10	2SD 610	1.90
2SA 484	2.50	2SB 75	.59	2SC 493	3.90	2SC 983	1.00	2SC 1628	1.30		
2SA 485	2.00	2SB 77	.59	2SC 495	1.00	2SC 984	.90	2SC 1647	.59	FET	
2SA 489	1.60	2SB 186	.59	2SC 497	1.60	2SC 1000BL	.59	2SC 1669	1.60	2SK 19	1.60
2SA 496	.70	2SB 187	.59	2SC 509	.90	2SC 1014	1.20	2SC 1674	.59	2SK 30	.90
2SA 496	1.10	2SB 202	1.60	2SC 517	3.95	2SC 1017	1.40	2SC 1675	.59	2SK 33	1.10
2SA 497	1.60	2SB 220	.70	2SC 535	.70	2SC 1018	1.20	2SC 1678	2.25	2SK 34	1.10
2SA 509	.70	2SB 303	.59	2SC 536	.59	2SC 1030C	2.80	2SC 1682	.45	2SK 40	.70
2SA 525	2.50	2SB 324	.70	2SC 537	.59	2SC 1047	.70	2SC 1684	.59	2SK 49	1.30
2SA 537	2.25	2SB 337	1.60	2SC 538A	.70	2SC 1060	2.25	2SC 1708	.59	2SK 55	1.30
2SA 539	.70	2SB 367	1.50	2SC 562	2.15	2SC 1061	1.40	2SC 1728	2.00	2SK 68	1.30
2SA 561	.59	2SB 368B	2.15	2SC 563	1.10	2SC 1080	4.40	2SC 1760	2.00	3SK 22	2.55
2SA 562	.59	2SB 379	1.10	2SC 619	.59	2SC 1096	1.00	2SC 1775	.45	3SK 35	2.25
2SA 564A	.59	2SB 400	.59	2SC 620	.59	2SC 1111	3.40	2SC 1816	4.25	3SK 39	2.25
2SA 565	1.10	2SB 405	.70	2SC 632A	.70	2SC 1115	3.40	2SC 1885	.70	3SK 40	2.25
2SA 566	3.40	2SB 407	1.40	2SC 644	.59	2SC 1116	4.40	2SC 1908	.59	3SK 41	2.50
2SA 606	1.90	2SB 415	.70	2SC 645	.70	2SC 1116A	4.90	2SC 1909	4.40	3SK 45	2.50
2SA 624	1.10	2SB 434	1.20	2SC 650	1.30	2SC 1124	1.30	2SC 1951	1.10	MK 10	2.00
2SA 627	3.60	2SB 440	.70	2SC 668	.59	2SC 1162	1.10	2SC 1957	1.20		
2SA 628	.59	2SB 463	1.50	2SC 680	2.80	2SC 1166	.59	2SC 1969	4.90	IC	
2SA 634	.90	2SB 471	1.60	2SC 684	1.40	2SC 1173	.90	2SC 1973	1.10	AN 214Q	3.40
2SA 640	.59	2SB 472	2.80	2SC 693B	.59	2SC 1175	.90	2SC 1975	4.40	AN 315	3.70
2SA 643	.70	2SB 474	1.20	2SC 696	1.95	2SC 1177	14.00	2SC 2028	.90	BA 511	3.40
2SA 659	.59	2SB 492	1.00	2SC 708A	1.90	2SC 1189	1.40	2SC 2029	3.90	BA 521	3.70
2SA 663	4.90	2SB 507	1.60	2SC 710	.59	2SC 1211D	.70	2SC 2091	3.60	HA 1151	3.70
2SA 666	.70	2SB 509	1.90	2SC 711	.59	2SC 1213	.70	2SC 2092	3.90	LA 4400	3.70
2SA 672	.70	2SB 514	1.90	2SC 712	.59	2SC 1222	.45	2SC 2098	3.90	TA 7045M	3.00
2SA 673	.70	2SB 526C	1.30	2SC 717	.59	2SC 1226	1.00	2SD 28	2.80	SN 7400	.19
2SA 678	.70	2SB 527	1.90	2SC 730	4.40	2SC 1237	4.25	2SD 75	1.10	SN 7490	.80
2SA 683	.70	2SB 528D	1.60	2SC 732	.59	2SC 1239	3.50	2SD 90	1.60	TA 7055P	3.00
2SA 684	.70	2SB 536	1.60	2SC 733	.59	2SC 1279	.70	2SD 91	1.60	TA 7060P	1.60
2SA 695	.70	2SB 539	4.90	2SC 734	.59	2SC 1306	4.40	2SD 92	1.50	TA 7061AP	1.90
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2SA 720	.70	2SB 595	1.90	2SC 773	.70	2SC 1318	.59	2SD 178	1.40	PLL 02A	8.80
2SA 721	.70	2SB 600A	7.00	2SC 774	1.60	2SC 1327	.59	2SD 180	2.50		
2SA 725	.59	2SC 183	.59	2SC 776	2.65	2SC 1330	1.50	2SD 187	.59	DIODES	
2SA 726	.59	2SC 184	.59	2SC 778	3.60	2SC 1342	.59	2SD 188	3.00	1S 84	1.00
2SA 733	.59	2SC 281	.59	2SC 781	2.65	2SC 1344	.59	2SD 205	1.40	1S 188	.45
2SA 740	2.65	2SC 284	1.40	2SC 783R	3.60	2SC 1345D	.59	2SD 217	4.40	1S 332	.45
2SA 744	3.70	2SC 367	.90	2SC 784	.59	2SC 1359	1.40	2SD 223	1.90	1S 953	.45
2SA 745R	4.40	2SC 369	.70	2SC 785	.70	2SC 1360	1.00	2SD 224	1.90	1S 1007	.45
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2SA 756	3.40	2SC 373	.59	2SC 799	3.60	2SC 1377	4.90	2SD 235	1.00	1S 1555	.32
2SA 758	5.80	2SC 374	.59	2SC 815	.59	2SC 1383	.59	2SD 287	3.70	1S 1588	.32
2SA 774	.59	2SC 380	.59	2SC 828	.59	2SC 1400	.59	2SD 313	1.10	1S 1885	.45
2SA 777	1.10	2SC 381	.59	2SC 829	.59	2SC 1402	3.70	2SD 315	1.20	1S 2076	.45
2SA 798	.70	2SC 382	.59	2SC 838	.59	2SC 1403	3.70	2SD 325	1.10	1S 2093	.45
2SA 814	1.90	2SC 387	.59	2SC 839	.59	2SC 1419	1.10	2SD 356D	1.10	1S 2473	.45
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Each kit contains 300 wires in various sizes and colors. Lengths range from 1.2" to 9". Each wire is stripped both ends. solid tinned 24 gauge with PVC insulation.

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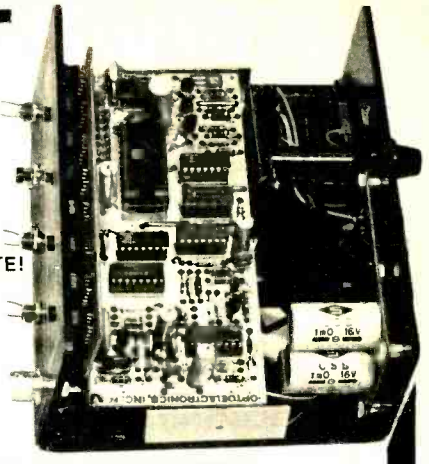
MODEL #FC-50WT ..... 60 MHZ COUNTER WIRED, TESTED & CAL. 165.95
MODEL #FC-50/600 WT .. 600 MHZ COUNTER WIRED, TESTED & CAL. 199.95

SIZE:
3" High
6" Wide
5½" Deep



FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
PRESCALER WILL FIT INSIDE COUNTER CABINET
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ, 20 MV RMS TO 60 MHZ TYP.
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION.]
ACCURACY: ± 1 PPM [± .0001%]; AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5 V DC REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED.

PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

CABINET I 3"H,6¼"W,5½"D
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RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
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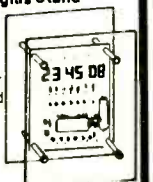
SEE THE WORKS Clock Kit
Clear Plexiglas Stand

- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included



Plexiglas is Pre-cut & drilled
Kit #850-4 CP
Size: 6"H, 4½"W, 3"D
Assembled
$23.50 ea. **2/$45.** **$29.95**

60 HZ. XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC. 1"x2" PC Board
Power Req: 5-15V (2.5 MA. TYP.)
Easy 3 wire hookup
Accuracy: ± 2PPM
#TB-1 (Adjustable)
Complete Kit **$4.95**
Wir & Cal $9.95

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1000 AND OVER **$1.29** ea.

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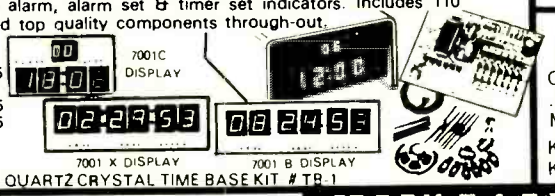
FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM. SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.



KIT - 7001B WITH 6 - .5" DIGITS $39.95
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
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KITS ARE COMPLETE (LESS CABINET)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT #TB-1

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.
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JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer, Line Cord, Switches and all Parts. Ideal Fit in Cabinet II
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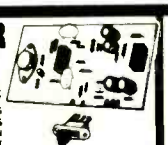
Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.
Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

AUTO BURGLAR ALARM KIT



AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND KEYLESS ALARM HAS PROVISION FOR POS & GROUNDING SWITCHES OR SENSORS WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT ENTRY & ALARM PERIOD UNIT MOUNTS UNDER DASH - REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED CMOS RELIABILITY RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND INSTRUCTIONS OR AVAILABLE WIRED AND TESTED

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
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- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (Less TRANSFORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

MOBILE LED CLOCK

12/24 HR .4" DIGITS!

MODEL #2001 12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
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- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT **$27.95** EA. 3 OR MORE **$25.95** ea. 115 VAC Power Pack #AC-1 **$2.50** EA.

ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] Wired for 12-Hr. Op. if not otherwise specified. **$37.95** EA. 3 OR MORE **$35.95** ea.

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- Kit includes all components
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- One hour assembly

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Same as above but with a 1 Amp output, also with case
ONLY $13.95

This model will power a 5 watt transistorized CB Radio

LOOK AT THIS SPECIAL FROM RADIO HUT

- Power Supply Kit: 5V1 amp reg.
- Line regulation .005%
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Kit includes components, PC board, transformer, fuse and pilot light. Line cord not included.

Only $6.50

60 Hz. Crystal Time Base for Digital Clocks

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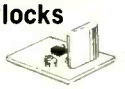

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7400	.11	7430	.13	7480	.31	74153	.61
7401	.13	7432	.23	7481	.55	74154	.98
7402	.13	7433	.26	7482	.57	74155	.89
7403	.13	7437	.23	7483	.67	74156	.89
7404	.15	7438	.23	7485	.89	74157	.55
74L04	.29	7440	.13	7489	1.25	74160	.55
74S04	.44	7441	.76	7490	.65	74161	.65
7405	.13	7442	.47	7491	.61	74163	.65
7406	.16	7443	.59	7492	.43	74164	.85
7407	.16	7444	.59	7493	.43	74165	.89
7408	.19	7446	.68	7494	.67	74174	.85
7409	.19	7447	.68	7495	.67	74175	.85
7410	.13	7448	.71	7496	.67	74180	.67
7411	.18	7450	.13	74100	.30	74181	1.93
7412	.26	7451	.13	74104	.49	74182	.68
7413	.37	7453	.13	74107	.28	74191	.98
7416	.15	7454	.13	74109	.31	74192	.79
7420	.13	7460	.19	74121	.29	74193	.81
7421	.13	7470	.27	74123	.48	74194	.81
7423	.25	7472	.25	74132	.99	74195	.69
7425	.29	7473	.29	74136	.99	9316	.85
7426	.24	7474	.29	74S138	1.95	9601	3/$1
7427	.19	7475	.47	74141	.75	9L04	.35
7428	.26	7476	.31	74151	.61		

74LS00 LOW POWER SCHOTTKY

74LS00	.21	74LS47	.73	74LS136	.37	74LS258	.71
74LS02	.21	74LS51	.26	74LS138	.71	74LS260	.26
74LS03	.21	74LS54	.26	74LS139	.71	74LS266	.26
74LS04	.28	74LS55	.26	74LS145	1.00	74LS279	.55
74LS05	.28	74LS73	.35	74LS151	.70	74LS290	.75
74LS08	.21	74LS74	.35	74LS153	.70	74LS293	.61
74LS09	.28	74LS76	.49	74LS155	.69	74LS295	.95
74LS10	.21	74LS83	.73	74LS156	.70	74LS298	.95
74LS11	.21	74LS85	1.35	74LS157	.75	74LS365	.55
74LS13	.45	74LS86	.36	74LS158	.71	74LS366	.55
74LS14	.99	74LS90	.55	74LS160	.85	74LS367	.55
74LS15	.26	74LS92	.55	74LS161	.85	74LS368	.55
74LS20	.24	74LS93	.55	74LS162	.85	74LS390	1.75
74LS21	.28	74LS109	.38	74LS163	.85	74LS393	1.45
74LS22	.28	74LS112	.38	74LS164	1.49	74LS670	2.30
74LS26	.32	74LS113	.38	74LS168	.85	74LS192	.95
74LS27	.32	74LS114	.38	74LS169	.85	74LS193	.95
74LS30	.26	74LS122	.49	74LS170	1.69	74LS194	.95
74LS32	.32	74LS124	.99	74LS173	1.10	74LS195	.85
74LS37	.32	74LS125	.47	74LS174	1.00	74LS196	.85
74LS38	.32	74LS126	.47	74LS175	.81	74LS197	.85
74LS40	.26	74LS132	.79	74LS190	.95	74LS251	.85
74LS42	.65	74LS133	.35	74LS191	.95	74LS253	.81
						74LS257	.71

74H SERIES TTL

74H00	.18	74H21	.29	74H53	.29	74H73	.39
74H05	.29	74H40	.29	74H61	.25	74H74	.39
74H20	.29	74H50	.20	74H72	.45		

CMOS

CD400	.19	CD4017	.95	CD4040	1.00	CD4071	.19
CD4001	.19	CD4018	.95	CD4041	.69	CD4081	.19
CD4002	.19	CD4019	.19	CD4042	.69	CD4507	.35
CD4006	1.20	CD4020	.97	CD4043	.60	CD4508	2.80
CD4007	.19	CD4021	.97	CD4044	.60	CD4510	1.00
CD4009	.47	CD4022	.97	CD4046	1.39	CD4512	1.10
CD4010	.39	CD4023	.19	CD4047	1.50	CD4516	.79
CD4011	.19	CD4024	.75	CD4049	.35	CD4518	1.10
CD4012	.29	CD4025	.19	CD4050	.39	CD4520	.69
CD4013	.32	CD4027	.39	CD4051	1.19	CD4528	.85
CD4014	.78	CD4028	.85	CD4053	1.19	74C02	.45
CD4015	.78	CD4029	.99	CD4056	1.15	74C04	.32
CD4016	.32	CD4030	.35	CD4066	.78	74C107	.79

ITT HIGH LEVEL LOGIC

301	Dual 5 Input NAND Gate	.15
302	Quad 2 Input Buffer open collector	.18
303	Quad 2 Input NAND Buffer	.15
311	Master Slave F/F	.18
312	Dual JK Flip Flop	.18
321	Quad 2 Input NAND Gate	.18
322	Dual 5 Input NAND Gate	.15
323	Quad 2 Input NAND Gate	.18
324	Quad 2 Input NAND Gate	.18
325	Dual 2 Dual 3 Input NAND Gate	.13
326	Dual 2 Dual 3 Input NAND Gate	.13
331	Dual 5 Input Expander	.13
332	Hex Inverter	.18
333	Hex Inverter	.18
334	Hex Inverter	.18
335	Hex Inverter	.18
342	Dual One Shot Multivibrator	.25
343	Dual 4 Bit Comparator	.22
370	Quad D Flip Flop	.22
371	Decode Counter	.30
372	Quad Ripple Counter	.39
380	BCE to Decimal Decoder	.39
381	BCD to Decimal Decoder	.39

ITT MOS TO LED DRIVERS

ITT 501	Quad Seg. Dr.	.35
ITT 502	Hex Digit Dr.	.49
ITT 503	Quad Seg. Dr.	.49
ITT 506	Hex Digit Dr.	.49
ITT 508	8 Digit Dr.	.49
ITT 509	8 Seg. Dr.	.49
ITT 511	Quad Seg. Dr.	.55
ITT 514	8 Digit Dr.	.59

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9007/7430	10/1.00	
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9300/74195	3/1.00	

9000 series parts prime from ITT. Pin for Pin compatible with 7400 series.

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941 One Shot Multivibrator	5/$1
945 JK F/F	8/$1
946 Quad 11 Input Gate NAND/NOR	8/$1
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9094 Dual JK F/F	8/$1
9097 Dual JK F/F	8/$1
9099 Dual JK F/F	8/$1
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9112 Hex Inverter	7/$1
9601 One Shot	3/$1
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7404 10/1.00 7438 6/1.00
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7420 10/1.00 are ordering 74153 3/1.00
House Number TTL.

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3.57945 1.25

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MM5316	Clock Chip	3.75
MK50250	Alarm Clock	3.75
MK50380	Alarm Chip	2.95
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- 16 Pin Low Profile .25
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470 MFD 16V	4/$1	1000 MFD 35V PC Leads	4/$1
500 MFD 35V	5/$1		
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330 PFd 50V .02 MFd 200V
.001 UFd500V 3.3 PF 500V
.0015 UFd500V 4.7 PF 500V
.005 UFd500V 8.2 PF 500V
100 PF 500V

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HOUSE # ZENER

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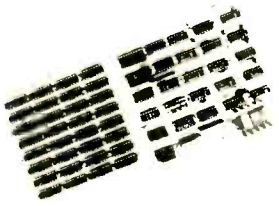

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FEATURES:

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C. On board precision crystal time base.
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F. PC board and all parts (less case) inc.

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AC XFMR — $1.50

$16.95

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$44.95

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DL 721 8 C.A. DL 727 - C.A.
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The timers can be used independently or coupled. The timer can be set to 59 minutes 59.9 seconds at 0.1 intervals. Kit includes all necessary parts and an attractive woodgrain case.

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MK50250 Alarm clock	4.99
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8228 Sys. Controller	8.20
8251 Prog. comm. interface	10.95
8255 Prog. perp. interface	13.50
8820 Dual Line Recr	1.75
8830 Dual Line Dr.	1.75
2513 Char. Gen.	7.50
8838 Quad Bus. Recvr	2.00
74LS138N — 1/8 decoder	.99
8T97-Hex Tri-State Buffer	1.25
1488/1489 RS232	1.50
TR 1602B Uart	3.95

Z-80 PROGRAMMING MANUAL

IN DEPTH DETAIL OF THE Z-80 CPU MICRO-COMPUTER

S.D. Sales Special $9.95

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CIRCLE 45 ON FREE INFORMATION CARD

MINI-KITS

FM WIRELESS MIKE KIT
FM-1 $2.95
Transmit up to 300' to any FM radio. Sensitive mike input requires dynamic, crystal or ceramic mike. Runs on 3 to 9 volts

TONE DECODER KIT
A complete tone decoder on a single PC Board. Features .400 to 5000 Hz adjustable frequency range, voltage regulation. 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.
Complete Kit, TD-1 ..... $4.95

LED BLINKY KIT
A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons or warning type panel lights

Complete Kit, BL-1 ..... $2.95

SUPER-SNOOP AMPLIFIER
A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker
Complete Kit, BN-9 ..... $4.95

MUSIC LIGHTS KIT
See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable and drives up to 300 watts. Great for parties, band music, nite clubs and more
Complete Kit, ML-1 ..... $7.95

SIREN KIT
Produces upward and downward wail characteristic of police siren. 200ma audio output, runs on 3-9 volts, uses 8-45 ohm speaker
Complete Kit, SM-3 ..... $2.95

CODE OSCILLATOR KIT
Powerful 1 watt audio oscillator of approx. 1 kHz, good for many uses. Great for warning alarm, battery checker, voltage indicator and code oscillator
Complete Kit, CPO-1 ..... $2.50

POWER SUPPLY KIT
Complete triple regulated power supply provides variable @5 volts at 200ma and +5 volts at 1 amp. 50mv load regulation, good filtering and small size. Kit less transformers. Requires 6.8V at 1 amp and 18 to 30VCT
Complete Kit, PS-3LT $6.95

DECADE COUNTER PARTS KIT
Includes 7490A 33 MHz counter, 7475 latch, 7447 LED driver, LED readout, current limit resistors, hook up details and instructions on how to build an easy low cost freq. counter
Kit of Parts, DCU-1 ..... $3.50

NEW

Frequency Counter
$79.95 KIT

You've requested it, and now it's here! The CT-50 Frequency Counter Kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, It runs equally as well on 12 VDC as it does on 110 VAC. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $79.95. Order yours today!

CT-50, 60MHz Counter Kit $79.95
CT-50WT, 60 MHz counter, wired and tested $159.95
CT-600, 600 MHz prescaler option for CT-50, add .. $29.95

UTILIZES NEW MOS-LSI CIRCUITRY

SPECIFICATIONS

Sensitivity: less than 25MV
Frequency range: 5Hz to 60MHz, typically 65MHz
Gate time: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 10 ppm, .001 ppm with TV time base!
Input: BNC, 1 meg ohm direct, 50 ohm with prescale option
Power: 110 VAC 5 watts or 12 VDC @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case
Color burst adapter for .001 ppm accuracy available in 6 weeks. CB-1, Kit $14.95

VIDEO TERMINAL KIT $149.95

A compact 5 x 10-inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard-operated cursor and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block-type see-thru cursor. Keyboard/computer control backspaces, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit $149.95
TH3216, Assembled and Tested $239.95
VD-1, Video to RF Modulator Kit ..... $ 6.95

600 mHz Prescaler

Fully assembled and tested.
Extend the range of your counter to 10 times higher in frequency. Works with any counter. High sensitivity input with built-in on-chip pre-amp
PS-1B,—10 ..... $59.95

SIX DIGIT 12/24 HR CLOCK KIT

Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits. Polaroid lens filter, extruded aliminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, blue and bronze (specify).

Clock Kit, DC-5 ..... $22.95
Alarm Clock, DC-8, 12 hr. only $24.95
DC-5 with 10 min. ID timer $25.95
Mobile Version, DC-7 ..... $25.95
Assembled and tested clocks available, add $10.00 to kit price

741 MINI DIP, house marked ..... 10/$2.00

Phone orders welcome
Minimum order $8.00

Satisfaction guaranteed or money refunded. Orders under $10 add 75c. COD add $1.00. NY add 7% sales tax.

CAR CLOCK KIT $27.95

12/24-Hour 12-Volt AC or DC
- High Accuracy (1 minute/month)
- 6 jumbo 4" LED readouts
- Easy, no-polarity hookup
- Display blanks with ignition
- Case, mounting bracket included
- Super instructions

Complete Kit, DC-11 ..... $27.95

AUTO DIMMER $2.50
Automatically adjusts display brightness according to ambient light level. For DC-11 Car Clock

LINEAR		REGS		TRANSISTORS	
555	.50	309K	.99	NPN 2N3904 type	10/$1.00
556	.75	340K-12	.99	PNP 2N3906 type	10/$1.00
566	1.49	7805	.99	NPN Power Tab 40W	3/$1.00
567	1.49	7812	.99	PNP Power Tab 40W	3/$1.00
324	1.49	7815	.99	FET MPF-102 type	3/$2.00
1458	.49	78MG	1.50	UJT 2N2646 type	3/$2.00
380	1.49	723	.49	2N3055 NPN Power	.75

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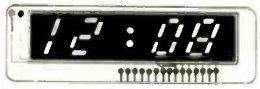
CIRCLE 38 ON FREE INFORMATION CARD

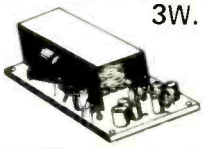
JUMBO LED READOUT ARRAY



$1.95 LIMITED STOCK

By Bowmar. .5 in. character common cathode. Designed for use with multiplexed clock chips 4 digits in 1 pack!

3W. AUDIO AMP



$3.95
2¼x3"

Assembled & tested. Not a kit. Has tapped output for either 4, 8 or 16 OHMS. With schematic.

CABLE TIES!

Most popular size. 3¾ inches overall for a ¾" bundle. Ty-wrap style. Nylon Self-locking.
100 for $1.00 $8. for 1,000

FILTER CAP

Mini Size. Axial. 1,000 MFD. 16 WVDC. 4/$1.00

RED LED READOUT FILTER

Very handy. Can be used with our calculator displays. 2¼x½" 6/$1.

2708 1KX8 EPROMS 2708

Prime new units from a major mfg. 450 N.S. access time. Equivalent to 4-1702 A's in 1 package! 450 ns
$15.75 each

MOTOROLA 7805R Voltage Regulator

Same as standard 7805 except 750 MA output. TO—220. 5VDC output.
44c each 10/$3.95

4K STATIC RAM'S

2114. The new industry standard. Arranged as 1K x 4. Equivalent to 4-21 L02's in 1 package! 18 pin DIP. 2 chips give 1Kx8.
2 for $24. 8 for $85.

OPCOA LED READOUT

SLA-1 Common Anode. .33 inch character size. The original high efficiency LED display.
75c ea. 4/$2.50

TRANSFORMER

12 Vac. 600 MA. PRI-115 VAC 60 HZ. Perfect for clocks or power supplies! Small Size.
$1.95

1 AMP RECTIFIERS

House numbered. Factory marked units. All meet 200 PIV minimum. Many up to 1,000 PIV. Full leads.
30 for $1.00

741C OP AMPS

Mini Dip. Prime new units. Has computer Mfg's house number.
12/$2. 100 for $15.

DISC CAPACITORS

.1 MFD 16V. P.C. leads. Most popular value! By Sprague.
20 for $1.00

HEAVY DUTY!

Full Wave Bridge 25 AMP 50 PIV
$1.25

TANTALUM CAPACITOR

1 MFD. .35 V. By Kemet. Axial Lead Best Value! 10/$1.

2N3904-House No.

TO—92. NPN. VCEO-45. HFE 100 to 300
10 for $1.00

Jumbo Red Leds

New by G.E. Like MV5024. Number SSL-22.
6/$1. 25/$3.75

TO-92 Voltage Regulators

Rated 100 MA output Small size. 78L05-5 VDC.78L15-15VDC
Your choice 3/$1.

TI POWER TRANSISTORS

TO—220. VCEO-60V. 30W.
TIP29A-NPN 44c
TIP30A-PNP 44c

CMOS QUAD Bilateral Switch

CM4116. By Solitron. An improved CD4016. 3/$1.

TI Keyboard $2.95 ea.

Used in desk topprinting calculators by TI. Brand new, mfg. for TI by Digitran. Patented design. Perfect for experimenters.

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CIRCLE 89 ON FREE INFORMATION CARD

DIODES/ZENERS

1N914	100v	10mA	.05
1N4005	600v	1A	.08
1N4007	1000v	1A	.15
1N4148	75v	10mA	.05
1N753A	6.2v	z	.25
1N758A	10v	z	.25
1N759A	12v	z	.25
1N4733	5.1v	z	.25
1N5243	13v	z	.25
1N5244B	14v	z	.25
1N5245B	15v	z	.25

SOCKETS/BRIDGES

8-pin	pcb	.25	ww	.45
14-pin	pcb	.25	ww	.40
16-pin	pcb	.25	ww	.40
18-pin	pcb	.25	ww	.75
22-pin	pcb	.45	ww	1.25
24-pin	pcb	.35	ww	1.10
28-pin	pcb	.35	ww	1.45
40-pin	pcb	.50	ww	1.25

Molex pins .01	To-3 Sockets	.45
2 Amp Bridge	100-prv	1.20
25 Amp Bridge	200-prv	1.95

TRANSISTORS, LEDS, etc.

2N2222	NPN	(Plastic .10)	.15
2N2907	PNP		.15
2N3906	PNP		.10
2N3054	NPN		.35
2N3055	NPN 15A 60v		.50
T1P125	PNP Darlington		.35
LED Green, Red, Clear			.15
D.L.747	7 seg 5/8" high com-anode		1.95
XAN72	7 seg com-anode		1.50
FND 359	Red 7 seg com-cathode		1.25

C MOS

4000	.15
4001	.20
4002	.20
4004	3.95
4006	1.20
4007	.35
4008	.95
4009	.30
4010	.45
4011	.20
4012	.20
4013	.40
4014	1.10
4015	.95
4016	.35
4017	1.10
4018	1.10
4019	.60
4020	.85
4021	1.35
4022	.95
4023	.25
4024	.75
4025	.35
4026	1.95
4027	.50
4028	.95
4030	.35
4033	1.50
4034	2.45
4035	1.25
4040	1.35
4041	.69
4042	.95
4043	.95
4044	.95
4046	1.75
4049	.70
4050	.50
4066	.95
4069	.40
4071	.35
4081	.70
4082	.45

– T T L –

7400	.15	7473	.25	74176	1.25	74H72	.55
7401	.15	7474	.35	74180	.85	74H101	.75
7402	.20	7475	.35	74181	2.25	74H103	.75
7403	.20	7476	.30	74182	.95	74H106	.95
7404	.15	7480	.55	74190	1.75		
7405	.25	7481	.75	74191	1.35	74L00	.35
7406	.35	7483	.95	74192	1.65	74L02	.35
7407	.55	7485	.95	74193	.85	74L03	.30
7408	.25	7486	.30	74194	1.25	74L04	.35
7409	.15	7489	1.35	74195	.95	74L10	.35
7410	.10	7490	.55	74196	1.25	74L20	.35
7411	.25	7491	.95	74197	1.25	74L30	.45
7412	.30	7492	.95	74198	2.35	74L47	1.95
7413	.45	7493	.40	74221	1.00	74L51	.45
7414	1.10	7494	1.25	74367	.85	74L55	.65
7416	.25	7495	.60			74L72	.45
7417	.40	7496	.80	75108A	.35	74L73	.40
7420	.15	74100	1.85	75110	.35	74L74	.45
7426	.30	74107	.35	75491	.50	74L75	.55
7427	.45	74121	.35	75492	.50	74L93	.55
7430	.15	74122	.55			74L123	.55
7432	.30	74123	.55	74H00	.25		
7437	.35	74125	.45	74H01	.25	74S00	.55
7438	.35	74126	.35	74H04	.25	74S02	.55
7440	.25	74132	1.35	74H05	.25	74S03	.30
7441	1.15	74141	1.00	74H08	.35	74S04	.35
7442	.45	74150	.85	74H10	.35	74S05	.35
7443	.85	74151	.75	74H11	.25	74S08	.35
7444	.45	74153	.95	74H15	.30	74S10	.35
7445	.65	74154	1.05	74H20	.30	74S11	.35
7446	.95	74156	.95	74H21	.25	74S20	.35
7447	.95	74157	.65	74H22	.40	74S40	.25
7448	.70	74161	.85	74H30	.25	74S50	.25
7450	.25	74163	.95	74H40	.25	74S51	.45
7451	.25	74164	.60	74H50	.25	74S64	.25
7453	.20	74165	1.50	74H51	.25	74S74	.40
7454	.25	74166	1.35	74H52	.15	74S112	.90
7460	.40	74175	.80	74H53J	.25	74S114	1.30
7470	.45			74H55	.25		
7472	.40						

74S133	.45	74LS133	.45
74S140	.75	74LS140	.75
74S151	.35	74LS151	.35
74S153	.35	74LS153	.35
74S157	.80	74LS157	.80
74S158	.35	74LS158	.35
74S194	1.05	74LS194	1.05
74S257 (8123)	.25	74LS257 (8123)	.25
		74LS00	.35
		74LS01	.35
		74LS02	.35
		74LS04	.35
		74LS05	.45
		74LS08	.35
		74LS09	.35
		74LS10	.35
		74LS11	.35
		74LS20	.35
		74LS21	.25
		74LS22	.25
		74LS32	.40
		74LS37	.35
		74LS40	.45
		74LS42	1.10
		74LS51	.50
		74LS74	.65
		74LS86	.65
		74LS90	.95
		74LS93	.95
		74LS107	.85
		74LS123	1.00
		74LS151	.95
		74LS153	1.20
		74LS157	.85
		74LS164	1.90
		74LS367	.85
		74LS368	.85

LINEARS, REGULATORS, etc.

8266	.35	LM320K5 (7905)	1.65	LM340T24	.95	LM723	.50
MCT2	.95	LM320K12	1.65	LM340K12	2.15	LM725	1.75
8038	3.95	LM320T5	1.65	LM340K15	1.25	LM739	1.50
LM201	.75	LM320T12	1.65	LM340K18	1.25	LM741 (8-14)	.25
LM301	.25	LM320T15	1.65	LM340K24	.95	LM747	1.10
LM308 (Mini)	.75	LM339	.95	LM373	2.95	LM1307	1.25
LM309H	.65	7805 (340T5)	.95	LM380	.95	LM1458	.95
LM309K (340K-5)	.85	LM340T12	1.00	LM709 (8,14 PIN)	.25	LM3900	.50
LM310	1.15	LM340T15	1.00	LM711	.45	LM75451	.65
LM311D (Mini)	.75	LM340T18	1.00			NE555	.50
LM318 (Mini)	.65					NE556	.95
						NE565	.95
						NE566	1.75
						NE567	1.35

9000 SERIES

9301	.85
9309	.35
9322	.85
95H03	.55
9601	.75
9602	.50

MEMORY CLOCKS

74S188 (8223)	3.00
1702A	6.95
MM5314	3.00
MM5316	3.50
2102-1	1.75
2102L-1	1.95
TR 1602B/ TMS 6011	6.95
8080AD	15.00
8T13	1.50
8T23	1.50
8T24	2.00
2107B-4	4.95

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Total Order	Deduct
$35 - $99	5%
$100 - $300	10%
$301 - $1000	15%
$1000 - Up	20%

BREAD BOARD JUMPER WIRE KIT

Each kit contains 350 wires cut to 14 different lengths from 0.1" to 5.0". Each wire is stripped and the leads are bent 90° for easy insertion. Wire length is classified by color coding. All wire is solid tinned 22 gauge with PVC insulation. The wires come packed in a convenient plastic box.

JK1 . . . . $10.00 / kit

SOCKET JUMPERS

Mates with two rows of .025" sq. or dia. posts on patterns of .100" centers and shielded receptacles. Probe access holes in back. Choice of 6" or 18" length.

Part No.	No. of Contacts	Length	Price
924003-18R	26	18"	$ 5.38 ea.
924003-06R	26	6"	4.78 ea.
924005-18R	40	18"	8.27 ea.
924005-06R	40	6"	7.33 ea.
924006-18R	50	18"	10.31 ea.
924006-06R	50	6"	9.15 ea.

JUMPER HEADERS

Solder to PC boards for instant plug-in access via socket-connector jumpers. .025" sq. posts. Choice of straight or right angle.

Part No.	No. of Posts	Angle	Price
923863-R	26	straight	$1.28 ea.
923873-R	26	right angle	1.52 ea.
923865-R	40	straight	1.94 ea.
923875-R	40	right angle	2.30 ea.
923866-R	50	straight	2.36 ea.
923876-R	50	right angle	2.82 ea.

INTRA-CONNECTOR

Provides both straight and right angle functions. Mates with standard .10" x .10" dual row connectors (i.e. 3m, Ainsley, etc.) Permits quick testing of inaccessible lines.

Part No.: 922576-26 **No. of contacts:** 26 **Price** $6.90 ea.

INTRA-SWITCH

Permits instant line-by-line switching for diagnostic or QA testing. Switches actuated with pencil or probe tip. Mates with standard .10" x .10" dual-row connectors. Low profile design. Switch buttons recessed to eliminate accidental switching.

Part No.: IS-26 **No. of contacts:** 26 **Price** $13.80 ea.

CRYSTALS

THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33/U	$5.95
CY2A	2.000 MHz	HC33/U	$5.95
CY2.01	2.010 MHz	HC33/U	$1.95
CY3A	4.000 MHz	HC18/U	$4.95
CY7A	5.000 MHz	HC18/U	$4.95
CY12A	10.000 MHz	HC18/U	$4.95
CY14A	14.31818 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

CONNECTORS

PRINTED CIRCUIT EDGE-CARD

156 Spacing-Tin-Double Read-Out

Bifurcated Contacts — Fits .054 to .070 P.C. Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100	PINS (Wire Wrap)	$6.95
50/100A (.100 Spacing)	PINS (Wire Wrap)	$6.95

25 PIN-D SUBMINATURE (RS232)

DB25P	PLUG	$3.25
DB25S	SOCKET	$4.95

HEAT SINKS

680-.75A		205-CB
205-CB	Beryllium Copper w-black finish for TO-5	$ .25
291-.36H	Aluminum for TO-220 Transistors & Regulators	$ .25
680-.75A	Black Anodized Aluminum for TO-3	$1.60
Dude 4	Black Anodized Aluminum — predrilled mounting holes for TO-3 — 4¾ x 1¼ x 2"	$1.75

Etching Kits

(cannot be shipped via air)

32 X A-1	P.C. Etch Materials Kit enough for 5 circuit boards	$29.95 ea.
27 X A-1	Etched Circuit Kit	$ 9.95 ea.

Plugboards — Complete kit — only add water

3662	6.5 X 4.5 X 1.16 Epoxy Glass P-Pattern-44 P.C. Tabs-spaced .156"	$ 6.95 ea.
22/44	Mating connector for plugboard — 22 pin double readout	$ 2.95 ea.
8800V	Universal Microcomputer/Processor plugboard — Epoxy Glass — complete with heatsink and mounting hardware 5.313 X 10 X 1/16 copper clad	$19.95 ea.

Vector

1/16 VECTOR BOARD

	0.1" Hole Spacing Part No	P-Pattern L	W	Price 1-9	10 up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062WE	4.50	6.50	2.07	1.86
	84P44 062WE	4.50	8.50	2.56	2.31
	169P44 062WE	4.50	17.00	5.04	4.53
	169P84 062WE	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062WEC1	4.50	17.00	6.80	6.12

INSTRUMENT/ CLOCK CASE

Injection molded unit. Complete with red bezel. 4½" x 4" x 1-9/16".

$3.95 ea.

MICROPROCESSOR COMPONENTS

8080A	CPU	$16.00	CDP1802	CPU	$19.95
8212	8 Bit Input/Output	4.95	MC6800	8 Bit MPU	24.95
8214	Priority Interrupt Control	15.95	MC6820	Periph. Interface Adapter	15.00
8216	Bi-Directional Bus Driver	6.95	MC6810AP1	128 x 8 Static RAM	6.00
8224	Clock Generator/Driver	9.95	MC6830L8	1024 x 8 Bit ROM	15.00
8228	System Controller Bus Driver	10.95	Z80	CPU	29.95

CPU'S

8080A	Super 8008	16.00
2650	8 Bit MPU	26.50
P8085	CPU	29.95

SR'S

2504	1024 Dynamic	$ 3.95
2518	Hex 32 BIT	7.00
2519	Hex 40 BIT	7.00
2522	Dual 132 Bit SSR	2.95
2524	512 Dynamic	1.95
2525	1024 Dynamic	3.00
2527	Dual 256 BIT	3.95
2529	Dual 512 BIT	3.00
2532	Quad 80 BIT	3.95
2533	1024 Static	5.95
3341	Fifo	6.95
74LS670	16 x 4 Reg	3.95

UART'S

AY-5-1013	30K Baud	$5.95

ROM'S

2513(2140)	Char Gen -upper case	$ 9.95
2513(3021)	Char Gen -lower case	9.95
2516	Char Gen	10.95
MM5230	2048 BIT (512 x 4 on 256 x 8)	1.95

RAM'S

1101	256 x 1	Static	$ 1.49
2101	256 x 4	Static	5.95
2102	1024 x 1	Static	1.75
2107/5280	4096 x 1	Dynamic	4.95
2111	256 x 4	Static	6.95
7489	16 x 4	Static	2.49
8101	256 x 4	Static	5.95
8111	256 x 4	Static	6.95
8599	16 x 4	Static	3.49
21L02/91L02	1024 x 1	Static	2.25
5280	256 x 1	Static	5.95
93421	256 x 1	Static	2.95
MM5262	25 x 1	Dynamic	2 for 1.00
UPD414(2104)4K		Dynamic 16 Pin	5.95

PROMS

1702A	2048	Famos	$ 9.95
5203	2048	Famos	14.95
82S23	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	5.00
74S287	1024	Static	7.95
3601	256 x 4	Fast	3.95
2708	8K	Eprom	19.95
2716	16K	Eprom	34.95
6301-1	1024	Tri-State Bipolar	3.49
6330-1	256	Open Collector Bipolar	2.95

SPECIAL REQUESTED ITEMS

FCM3817	$5.00	11C90	19.95	7205	19.95	9368	3.95
AY-3-8500-1	8.95	4N33	3.95	ICM7045	24.95	LD110/111	25.00/set
AY-5-9100	17.50	8T20	7.50	ICM7207	7.50	95H90	11.95
AY-5-9200	14.95	8T97	2.00	ICM7208	22.00	MC3061P	3.50
AY-5-9500	4.95	HD0165	7.95	ICM7209	7.50	MC4016 (74416)	7.50
AY-5-2376	14.95	MCM6571	13.50	MK50240	17.50	MC1408L7	8.95
9374	1.95	MCM6574	13.50	DS0026CH	3.75	MC1408L8	9.95
82S115	25.00	MCM6575	13.50	TIL308	10.50		

CLOCK CHIPS

MM5309	$9.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5841	9.95
CT7001	5.95

PARATRONICS

Featured on February's Front Cover of Popular Electronics

Logic Analyzer Kit Model 100A

$229.00/kit

Model 100A assembled $295.00

Model 100A Model 10

- Analyzes any type of digital system
- Checks data rates in excess of 8 million words per second
- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
- Displays 16 logic states up to 8 digits wide
- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

(Model 100A Manual - $4.95)

- Some applications are:
  - Troubleshooting microprocessor address, instruction, and data flow
  - Examine contents of ROMS
  - Tracing operation of control logic
  - Checking counter and shift register operation
  - Monitoring I/O sequences
  - Verifying proper system operations during testing

PARATRONICS TRIGGER EXPANDER - Model 10

Adds 16 additional bits. Provides digital delay and qualification of input clock and 24-bit trigger word. — Connects direct to Model 100A for integrated unit).

Model 10 Kit — $229.00
Model 10 Assembled — $295.00
Baseplate — $9.95
Model 10 Manual — $4.95

B&K PRECISION

3½-Digit Portable DMM

- Overload Protected
- .3" high LED Display
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- Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution
- Overange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage 0-1000V/ AC Voltage 0-1000V
Freq. Response 50-400 HZ
DC/AC Current: 0-100mA
Resistance 0-10 meg ohm
Size 6.4" x 3.4" x 2"

Model 2800
$99.95

Comes with test leads, operating manual and spare fuse.

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CSC

100 MHz 8-Digit Counter

- 20 Hz-100 MHz Range
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- Fully Automatic
- Portable — completely self-contained
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MAX-100 $134.95

ACCESSORIES FOR MAX 100:
Mobile Charger Elliminator use power from car battery **Model 100 — CLA $3.95**
Charger/Elliminator use 110 V AC **Model 100 — CAI $9.95**

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(6" long X 4" wide)

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PB102 - 7" x 4.5"	39.95
PB103 - 9" x 6"	59.95
PB104 - 9.5" x 8"	79.95
PB203 - 9.75 x 6½ x 2¾	80.00
PB203A - 9.75 x 6½ x 2¾ (includes power supply)	129.95

PROTO CLIPS

14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

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DM1 - Circuit Designer $69.95
DM2 - Function Generator $74.95
DM3 - RC Bridge $74.95

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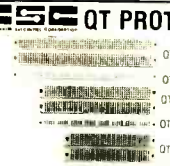
CSC QT PROTO STRIPS



	QT type	# holes	price
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QT-47S	QT-47S	470	10.00
QT-47B	QT-47B	bus strip	2.25
QT-35S	QT-35S	350	8.50
QT-35B	QT-35B	bus strip	2.00
QT-18S	QT-18S	180	4.75
QT-12S	QT-12S	120	3.75
QT-8S	QT-8S	80	3.25
QT-7S	QT-7S	70	3.00
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Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character)
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark
Transmit Channel Frequencies	Switch selectable Low (normal) — 1070 space 1270 mark High — 025 space, 2225 mark
Receive Sensitivity	-46 dbm accoustically coupled
Transmit Level	-15 dbm nominal. Adjustable from -6 dbm to -20 dbm
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase, 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

NEW! BULB-ENERGY SAVER

Bulb lasts 3 or more times longer. Fits Standard Socket 6 watts to 200 watts

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BES-1 1-9 $1.50 ea. 10+ 1.25 ea.

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- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One Times Single Event — Split & Taylor
- Size 4.5" x 2.15" x .90" (4½ ounces)
- Uses 3 Penlite Cells

Kit — $39.95
Assembled — $49.95
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Stop Watch Chip Only (7205) $19.95

iMC 3½ DIGIT DPM KIT

- New Bipolar Unit
- Auto Zeroing
- .5" LED
- Auto Polarity
- Low Power
- Single IC Unit

Model KB500 DPM Kit $49.00
Model 311D-5C-5V Power Kit $17.50

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 KIT ONLY **$16.95**

HEXADECIMAL ENCODER 19-KEY PAD

- 1 - 0
- ABCDEF
- Shift Key
- 2 Optional Keys

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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), (LOW), (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

T²L 5V 1A Supply

This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware, for only.

$9.95 Per Kit

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SN7430N	25	SN74121N	.39	SN74191N	1.25
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LM340K-12	1.35	LM709N	.29	7545ACN	.39
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74LS00 TTL

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74LS03	.29	74LS83	1.75	74LS160	1.95
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74LS13	.69	74LS93	.89	74LS190	2.49
74LS14	1.75	74LS95	1.50	74LS191	2.49
74LS20	.29	74LS96	1.89	74LS192	2.49
74LS26	.39	74LS107	.59	74LS193	2.49
74LS27	.39	74LS109	.59	74LS194	1.89
74LS28	.39	74LS112	.59	74LS195	1.89
74LS30	.29	74LS123	1.25	74LS253	1.75
74LS32	.39	74LS132	1.25	74LS257	1.75
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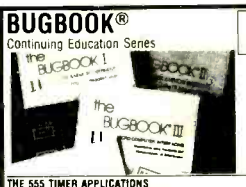

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Here is the book that puts it all together. Besides having much valuable text there are a series of experiments in which the reader completely explores the 8080 chip pin by pin and introduces you to the Mark 80 microcomputer, a unique easily interfaced system. It is recommended that you have the background on the BUGBOOKS I & II before proceeding with BUGBOOK III.

BUGBOOK V and VI — $19.00 per set
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Experiments in digital electronics 8080A microcomputer programming and 8080A microcomputer interfacing. An integrated approach to self-instructed basic digital electronics, breadboarding and 8080A interfacing/programming. Bugbook VI integrates the digital concepts of Bugbook V into a treatment of 8080A microcomputer programming and interfacing. Details & laboratory experiments included with each book.

CMOS-M — DESIGNERS PRIMER AND HANDBOOK — $6.00
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XC22	Yellow	4/$1							INFRA RED LED		
XC22	Orange	4/$1							Flat		5/$1.00
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MAN 74	Common Cathode-red	.300	1.50
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MAN 3630	Common Anode-orange ±1	.300	1.35
MAN 3640	Common Cathode-orange	.300	1.75
MAN 4610	Common Anode-orange	.300	1.00
MAN 4640	Common Cathode-orange	.400	1.00
MAN 4710	Common Anode-red ±1	.400	1.00
MAN 4730	Common Anode-red	.400	1.00
MAN 4740	Common Cathode-red	.400	1.00
MAN 4810	Common Anode-yellow	.400	1.00
MAN 8610	Common Anode-orange-D.D	.560	1.25
MAN 6630	Common Anode-orange	.560	1.25
MAN 6640	Common Cathode-orange-D.D	.560	1.25
MAN 6650	Common Cathode-orange ±1	.560	1.25
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MAN 6680	Common Cathode-orange	.560	1.25
MAN 6710	Common Anode-red-D.D	.560	1.25
MAN 6730	Common Anode-red ±1	.560	1.25
MAN 6740	Common Cathode-red-D.D	.560	1.25
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14 pin	.35	32	29
16 pin	.38	35	32
18 pin	.52	47	43
8 pin	$.40	.38	35
10 pin	.45	41	37
14 pin	.39	.38	37
16 pin	.43	.42	41
18 pin	.75	.68	62

	1-24	25-49	50-100
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1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	8/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N455	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
1N485A	180	10m	6/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.50
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2N2369	5/$1.00	2N3705	5/$1.00	2N5086	4/$1.00
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22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

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.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

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15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
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1.0/35V	.28	.23	.17	15/25V	.60	.50	.40

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1.0/50V	.16	.14	.11	47/50V	.16	.14	.11
3.3/50V	.15	.13	.10	1.0/16V	.15	.13	.10
4.7/25V	.16	.14	.12	1.0/25V	.16	.14	.11
10/25V	.15	.13	.10	1.0/50V	.16	.14	.11
10/50V	.16	.14	.12	4.7/16V	.15	.13	.10
22/25V	.17	.15	.12	4.7/25V	.15	.13	.10
22/50V	.24	.20	.18	4.7/50V	.16	.14	.11
47/25V	.19	.17	.15	10/16V	.14	.12	.09
47/50V	.25	.21	.19	10/25V	.15	.13	.10
100/25V	.24	.20	.18	10/50V	.16	.14	.12
100/50V	.35	.30	.28	47/50V	.24	.21	.19
220/25V	.32	.28	.25	100/16V	.19	.15	.14
220/50V	.45	.41	.38	100/25V	.24	.20	.18
470/25V	.33	.29	.27	100/50V	.35	.30	.28
1000/16V	.55	.50	.45	220/16V	.23	.17	.16
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

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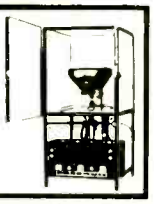

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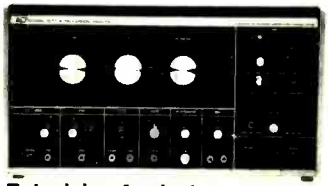

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7400	.21
7401	.21
7402	.21
7403	.21
7404	.21
7405	.21
7406	.25
7407	.25
7408	.21
7409	.21
7410	.21
7411	.21
7412	.21
7413	.25
7414	.89
7416	.25
7417	.25
7420	.21
7421	.25
7423	.35
7425	.35
7426	.25
7427	.33
7428	.28
7430	.21
7432	.25
7433	.30
7437	.25
7438	.25
7439	.50
7440	.21
7442	.53
7445	.70
7446	.70
7447	.70
7448	.70
7450	.21
7451	.21
7453	.21
7454	.21
7460	.21
7470	.30
7472	.30
7473	.30
7474	.30
7475	.49
7476	.32
7480	.70
7483	.70
7485	.89
7486	.28
7489	2.19
7490	.44
7491	.70
7492	.44
7493	.44
7494	.70
7495	.70
7496	.70
74100	1.28
74107	.30
74109	.33
74116	1.26
74121	.35
74122	.44
74123	.61
74125	.40
74126	.40
74128	.48
74132	.70
74141	.88
74145	.70
74147	1.63
74148	1.30
74150	1.16
74151	.70
74153	.65
74154	1.03
74155	.70
74156	.70
74157	.70
74160	.88
74161	.88
74162	.88
74163	.88
74164	.96
74165	1.15
74166	1.15
74170	2.64
74174	.98
74175	.93
74176	.79
74177	.79
74180	.70
74180	.70
74181	2.15
74182	.79
74184	2.15
74185	2.19
74189	3.50
74190	1.23
74191	1.23
74192	.88
74193	.88
74194	.88
74195	.88
74196	.88
74197	.88
74198	1.49
74199	1.49
74221	.86
74251	1.09
74279	.55
74298	.94
74365	.67
74366	.67
74367	.67
74368	.67

74LS00

74LS00	.28
74LS01	.28
74LS02	.28
74LS03	.28
74LS04	.29
74LS05	.29
74LS08	.29
74LS09	.29
74LS10	.28
74LS11	.28
74LS12	.28
74LS13	.47
74LS14	1.02
74LS15	.28
74LS20	.28
74LS21	.28
74LS22	.28
74LS26	.33
74LS27	.33
74LS28	.33
74LS30	.28
74LS32	.33
74LS33	.33
74LS37	.33
74LS38	.33
74LS40	.28
74LS42	.67
74LS47	.79
74LS48	.77
74LS51	.28
74LS54	.28
74LS55	.28
74LS73	.39
74LS74	.39
74LS74	.39
74LS75	.53
74LS76	.39
74LS78	.39
74LS83	.79
74LS85	.49
74LS86	.39
74LS90	.57
74LS92	.57
74LS93	.57
74LS95	.88
74LS96	.88
74LS107	.39
74LS109	.39
74LS112	.39
74LS113	.39
74LS114	.39
74LS125	.49
74LS126	.49
74LS132	.81
74LS136	.39
74LS138	.73
74LS139	.73
74LS151	.75
74LS153	.75
74LS154	1.10
74LS155	.75
74LS156	.75
74LS157	.75
74LS158	.75
74LS160	1.02
74LS161	1.02
74LS163	1.02
74LS164	1.02
74LS168	1.14
74LS169	1.14
74LS170	1.73
74LS173	1.34
74LS174	1.06
74LS175	.84
74LS181	2.50
74LS190	1.18
74LS191	1.18
74LS192	.98
74LS193	1.06
74LS194	.88
74LS195	.86
74LS196	.86
74LS197	.86
74LS197	.86
74LS221	1.06
74LS240	1.90
74LS241	1.90
74LS242	1.70
74LS243	1.70
74LS244	1.70
74LS247	.79
74LS248	.79
74LS249	.79
74LS251	.84
74LS253	.84
74LS257	.75
74LS258	.75
74LS260	.34
74LS261	2.00
74LS266	.39
74LS273	1.28
74LS279	.62
74LS283	.79
74LS290	.65
74LS293	.65
74LS295	1.12
74LS298	1.30
74LS365	.67
74LS366	.67
74LS367	.67
74LS368	.67
74LS377	1.50
74LS386	.39
74LS395	1.74
74LS670	2.34
81LS95	.77
81LS96	.77
81LS97	.77
81LS98	.77

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8093	.40
8094	.40
8095	.67
8096	.67
8097	.67
8098	.67
75450	.88
75451	.61
75452	.61
75453	.61
75454	.61
75491	.81
75492	.84
75493	1.09
75494	1.19
MC1488N	.90
MC1489N	.90

4000 CMOS

4000	.23
4001	.23
4002	.23
4006	1.23
4007	.23
4008	.79
4009	.44
4010	.44
4011	.23
4012	.23
4013	.40
4014	.96
4015	.96
4016	.40
4017	1.05
4018	1.05
4019	.23
4020	1.14
4021	1.14
4022	.96
4023	.23
4024	.84
4025	.23
4026	1.68
4027	.40
4028	.89
4029	1.14
4030	.23
4033	1.51
4034	3.50
4035	1.14
4040	1.14
4041	.79
4042	.79
4043	.70
4044	.70
4046	1.86
4049	.40
4050	.40
4051	1.26
4052	1.26
4053	1.26
4060	1.58
4066	.79
4071	.23
4072	.23
4073	.23
4075	.23
4081	.23
4082	.23
4502	.79
4510	1.14
4511	1.05
4514	2.80
4515	2.80
4516	1.23
4518	1.14
4520	1.14
4527	1.68
4528	.88
4585	1.23
74C00	.23

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CA3046	.75
CA3086	.50
LF351N	.76
LF356N	1.20
LF357N	1.20
LF13741	.76
LM301AN	.44
LM307N	.64
LM308N	1.00
LM309K	1.80
LM311N	.90
LM317T	3.00
LM317MP	1.90
LM318N	2.70
LM320MP-5	1.30
LM320MP-6	1.30
LM320MP-8	1.30
LM320MP-9	1.30
LM320MP-12	1.30
LM320MP-15	1.30
LM320MP-18	1.30
LM320MP-18	1.30
LM320MP-24	1.30
LM323K	7.50
LM324N	.72
LM325N	2.70
LM326N	2.70
LM327N	2.70
LM339N	1.15
LM340T-5	1.25
LM340T-6	1.25
LM340T-8	1.25
LM340T-10	1.25
LM340T-12	1.25
LM240T-15	1.25
LM340T-18	1.25
LM340T-24	1.25
LM341P-5	.98
LM341P-6	.98
LM341P-8	.98
LM341P-10	.98
LM341P-12	.98
LM341P-15	.98
LM341P-18	.98
LM341P-24	.98
LM348N	1.60
LM349N	1.60
LM358N	.72
LM1310N	.84
LM1800N	.94
LM1801N	1.70
LM1812N	4.80
LM1830N	1.30
LM1889N	2.00
LM2111N	1.25
LM2907N	1.50
LM2917N	1.50
LM3089N	1.30
LM3900N	.88
LM3900N	.88
LM3905N	1.40
LM3909N	.69
LM3911N	1.50
MC1456V	1.00
MC1458V	.53
MC1496N	.70
MC3302P	1.15
NE536T	2.50
NE540L	2.04
NE555V	.48
NE556A	.88
NE558N	2.40
NE559N	2.40
NE560B	2.50
NE561B	2.50
NE562B	2.50
NE565A	1.25
NE566V	1.28
NE567V	1.36
UA709CV	.44
UA710CA	.44
UA711CA	.53
UA723CA	.60
UA733CA	.75
UA741CV	.44
UA747CA	.70
UA748CV	.49
UA7805CU	1.25
UA7806CU	1.25
UA7808CU	1.25
UA7812CU	1.25
UA7812CU	1.25
UA7815CU	1.25
UA7818CU	1.25
UA7824CU	1.25
UA78L05ACZ	.40
UA78L06ACZ	.40
UA78L08ACZ	.40
UA78L1oACZ	.40
UA78L12ACZ	.40
UA78L15ACZ	.40
UA78L18ACZ	.40
UA78L24ACZ	.40
UA7905CU	1.70
UA7906CU	1.70
UA7908CU	1.70
UA7909CU	1.70
UA7912CU	1.70
UA7915CU	1.70
UA7918CU	1.70
UA7924CU	1.70

MISC IC

MM5314N	3.75

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20 PIN SOLDER	.30	2.85/10	25.25/C
22 PIN SOLDER	.33	3.15/10	27.75/C
24 PIN SOLDER	.38	3.60/10	32.25/C
28 PIN SOLDER	.45	4.25/10	38.25/C
40 PIN SOLDER	.63	6.00/10	53.50/C
8 PIN W-W	.24	2.30/10	20.50/C
14 PIN W-W	.26	2.50/10	22.00/C
16 PIN W-W	.30	2.85/10	25.50/C
18 PIN W-W	.60	5.70/10	51.00/C
20 PIN W-W	.70	6.65/10	59.50/C
22 PIN W-W	.84	8.00/10	71.50/C
24 PIN W-W	.96	9.10/10	81.50/C
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.0047	.14	1.15/10	9.00/C
.0068	.14	1.15/10	9.00/C
.01	.14	1.15/10	9.00/C
.022	.15	1.25/10	10.00/C
.033	.15	1.25/10	10.00/C
.047	.15	1.25/10	10.00/C
.068	.15	1.25/10	10.00/C
.1	.17	1.35/10	11.00/C
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.47	.36	3.00/10	24.00/C

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VALUE	RADIAL LEADS			AXIAL LEADS		
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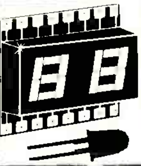
1/50V	.08	.65/10	5.41/C	.11	.90/10	7.65/C
2.2/50V	.08	.65/10	5.41/C	.12	.90/10	7.82/C
3.3/50V	.08	.65/10	5.41/C	.12	1.00/10	8.31/C
4.7/35V	.08	.65/10	5.41/C	.12	.95/10	7.91/C
4.7/50V	.08	.68/10	5.75/C	.12	1.00/10	8.31/C
10/16V	.08	.65/10	5.41/C	.11	.90/10	7.65/C
10/25V	.08	.65/10	5.66/C	.12	1.00/10	8.31/C
10/35V	.09	.70/10	6.12/C	.13	1.10/10	8.94/C
10/50V	.10	.75/10	6.58/C	.14	1.15/10	9.56/C
22/16V	.08	.67/10	5.66/C	.12	1.00/10	8.31/C
22/25V	.09	.70/10	6.09/C	.13	1.05/10	8.74/C
22/35V	.11	.85/10	7.29/C	.15	1.19/10	9.98/C
22/50V	.12	1.00/10	8.48/C	.17	1.32/10	11.22/C
33/16V	.09	.75/10	6.90/C	.12	1.00/10	8.48/C
33/25V	.10	.81/10	7.50/C	.14	1.15/10	9.56/C
33/35V	.13	1.05/10	9.65/C	.17	1.34/10	11.23/C
33/50V	.14	1.13/10	10.41/C	.19	1.52/10	12.89/C
47/10V	.09	.71/10	6.52/C	.13	1.04/10	9.50/C
47/16V	.10	.81/10	7.47/C	.14	1.15/10	9.56/C
47/25V	.13	1.05/10	9.65/C	.17	1.30/10	11.22/C
47/35V	.14	1.13/10	10.41/C	.19	1.51/10	12.89/C
47/50V	.15	1.21/10	11.16/C	.21	1.71/10	14.55/C
100/10V	.10	.77/10	6.58/C	.14	1.13/10	9.56/C
100/16V	.11	.85/10	7.28/C	.17	1.30/10	11.22/C
100/25V	.13	1.10/10	9.15/C	.20	1.55/10	13.30/C
100/35V	.17	1.41/10	11.85/C	.25	1.93/10	16.50/C
100/50V	.21	1.71/10	14.55/C	.29	2.30/10	19.70/C
220/10V	.13	1.08/10	9.15/C	.18	1.42/10	12.05/C
220/16V	.15	1.16/10	9.86/C	.20	1.55/10	[illegible]
220/25V	.21	1.71/10	14.55/C	.29	2.35/10	19.96/C
220/35V	.25	2.03/10	17.26/C	.35	2.79/10	23.70/C
220/50V	.29	2.35/10	19.96/C	.40	3.23/10	27.44/C
330/6V	.14	1.12/10	9.50/C	.19	1.48/10	13.71/C
330/10V	.15	1.16/10	9.83/C	.21	1.64/10	15.13/C
330/16V	.21	1.66/10	14.14/C	.31	2.45/10	22.70/C
330/25V	.23	1.86/10	15.79/C	.38	3.07/10	28.38/C
330/35V	.33	2.66/10	24.59/C	.43	3.43/10	31.68/C
330/50V	.54	4.30/10	39.73/C	.60	4.81/10	44.45/C
470/6V	.15	1.21/10	11.16/C	.20	1.64/10	15.13/C
470/10V	.21	1.71/10	14.55/C	.31	2.45/10	22.70/C
470/16V	.23	1.81/10	15.39/C	.33	2.66/10	24.59/C
470/25V	.29	2.35/10	19.96/C	.43	3.43/10	31.68/C
470/35V	.41	3.27/10	30.26/C	.47	3.78/10	34.99/C
470/50V	.54	4.30/10	39.73/C	.75	6.03/10	55.80/C
1000/6V	.22	1.90/10	16.50/C	.35	2.76/10	25.54/C
1000/10V	.24	1.96/10	16.62/C	.38	3.07/100	28.38/C
1000/16V	.29	2.35/10	19.96/C	.43	3.43/10	31.68/C
1000/25V	.42	3.33/10	28.27/C	.68	5.42/10	50.13/C
1000/35V	.60	4.81/10	44.45/C	.75	6.03/10	55.81/C
2200/6V	.36	2.86/10	26.48/C	.43	3.43/10	31.68/C
2200/10V	.42	3.33/10	28.27/C	.60	4.81/10	44.45/C
2200/16V	.54	4.30/10	36.58/C	.68	5.42/10	50.13/C

LED DIGITS AND LAMPS



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NSN374 .3" Dual Digits, CA, Red	2.20
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NSN584 .5" Dual Digits, CA, Red	2.60
NSN783 .7" Dual Digits, CC, Red	3.00
NSN784 .7" Dual Digits, CA, Red	3.00
NSL5053 Dif Red T-1¾ Lamp w Mtg Hdwe $1.80/10	$16.00/100
NSL5056 Dif Narrow Angle Red T-1¾ Lamp w Mtg Hdwe $1.80/10	$16.00/100

5% CARBON FILM RESISTORS

¼ WATT RESISTOR ASSORTMENTS

Catalog Number	Description	PRICE
RS125	Set of 5 each of the 73 standard 5% ¼ watt carbon film resistors in the series 1.0, 1.2, 1.5, 1.8, 2.2, etc. through 1.0 meghom (365 total pcs.)	$9.90
RS225	Set of 5 each of the 72 standard 5% ¼ watt carbon film resistors in the series 1.1, 1.3, 1.6, 2.0, 2.4, etc. through 910 kilohm (360 total pcs.)	$9.90

½ WATT RESISTOR ASSORTMENTS

Catalog Number	Description	PRICE
RS150	Set of 5 each of the 73 standard 5% ½ watt carbon film resistors in the series 1.0, 1.2, 1.5, 1.8, 2.2, etc. through 1.0 meghohm (365 total pcs.)	$9.90
RS250	Set of 5 each of the 72 standard 5% ½ watt carbon film resistors in the series 1.1, 1.3, 1.6, 2.0, 2.4, etc. through 910 kilohm (360 total pcs.)	$9.90

Bishop Graphics 5"x6" 1X Scale PC Design Template

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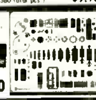

CLOCK MODULES

The MA1002 and MA1010 series clock modules by National Semiconductor are fully assembled and tested clocks using a 4 digit LED display and an MOS integrated circuit on the same board. Simply connect switches and our special transformer and you have a fully functioning clock.

The MA1003 clock module is a fully assembled and tested 12 hour clock using a high brilliance green flourescent display and crystal time base making it perfect for car, boat or other portable use. It operates directly from 12 volts DC so no transformer is needed. Our price includes three push button switches for setting the time.

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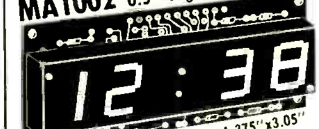
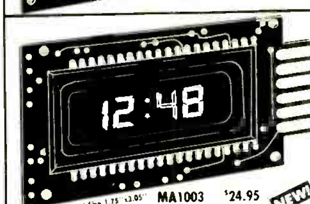
MA1002 0.5" High Digits



Actual Size: 1.375"x3.05"

MA1010 0.84" High Digits

Actual size: 1.75"x3.75"



0.3" Digits Actual Size 1.75"x3.05" **MA1003** $24.95 NEW!

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1N5229B	4.3V	1N5245B	15V
1N5230B	4.7V	1N5246B	16V
1N5231B	5.1V	1N5247B	17V
1N5232B	5.6V	1N5248B	18V
1N5233B	6.0V	1N5249B	19V
1N5234B	6.2V	1N5250B	20V
1N5235B	6.8V	1N5251B	22V
1N5236B	7.5V	1N5252B	24V
1N5237B	8.2V	1N5253B	25V
1N5238B	8.7V	1N5254B	27V
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MPS3565	.16	1.55/10	13.60/C	130.00/M
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2N3904	.16	1.55/10	13.60/C	130.00/M
2N3906	.16	1.55/10	13.60/C	130.00/M
2N4124	.16	1.55/10	13.60/C	130.00/M
2N4126	.16	1.55/10	13.60/C	130.00/M
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2N4403	.16	1.55/10	13.60/C	130.00/M
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74C175N	1.16
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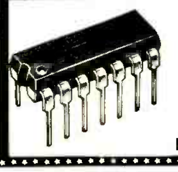

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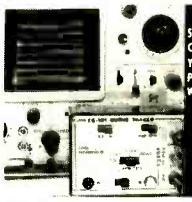

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7447N	.60	74LS136N	.35	LM723HN	.50	CD4016	.36	74C42	.75	**CLOCKS**					
7448N	.69	74LS151N	.67	LM733N	.67	CD4017	.94	74C76	1.40	MM5309	3.00				
7450N	.17	74LS155N	.67	LM741CH	.35	CD4018	.94	74C90	1.15	MM5311	3.60				
7474N	.29	74LS157N	.67	LM741N	.25	CD4019	.21	74C93	1.40	MM5312	3.60				
7475N	.49	74LS162N	.91	LM747H N	.62	CD4020	1.02	74C154	3.00	MM5313	5.00				
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7489N	2.00	74LS174N	.95	LM1303N	.82	CD4022	.86	74C175	2.00	MM5369	2.10				
7490N	.43	74LS190N	1.06	LM1304	1.10	CD4023	.21	74C192	2.40	MM5841	10.50				
7492N	.43	74LS221N	1.95	LM1305	1.27	CD4024	.75	74C221	2.75	MM5865	9.00				
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74154N	1.00	LN3014N AH	.35	LM3909N	.61	CD4044	.63	**IC SOCKETS**							
74157N	.69	LM305H	.87	MC1458V	.50	CD4046	1.67	8097	.65	**Solder Tin Low Profile**					
74161N	.87	LM307N	.35	NE540L	2.89	CD4049	.36	8098	.65	**PIN** 1 UP	**PIN** 1UP				
74162N	.87	LM308N	.89	NE550N	.65	CD4050	.36	8 .15	.24	20 .36					
74163N	.87	LM309H	1.15	NE555V	.61	CD4051	1.13	14 .18	.28	24 .43					
74174N	.96	LM309N	.95	NE556A	.79	CD4060	1.42	8T10	4.50	16 .20	.36	.58			
74175N	.90	NE565A	1.00	CD4066	.71	8T20	5.50	18 .27	.40	.61					
74190N	1.15	LM311H/N	.90	NE566V	1.15	CD4068	.40	8T23	3.10	22 .33					
74192N	.87	LM317T/K	2.92	NE567V	1.20	CD4069	.40	8T24	3.50	3 level wire wrap gold					
74193N	.85	LM320K 5	1.20	78L05	.60	CD4070	.40	8T25	3.20	14 pin .35 16 pin .38					
74221N	.55	LM323K-5	6.95	79L05	.70	CD4071	.21	8T26	1.69	**MICROPROCESSOR**					
74298N	1.65	LM320K-12	1.35	78M05	.85	CD4072	.21	8T97	1.69	8800	24.50				
74365N	.66	LM320K 15	1.35	79M05	.85	CD4073	.21	8T98	1.69	8080A with data	11.50				
74366N	.66	LM320T 5	1.75	78M12	1.75	CD4075	.21	Z80	29.95	6.5536 MHz	4.50				
74367N	.66	LM320T-12	1.60	75491CN	.50	CD4076	1.75	8212	3.50	14.31818 MHz	4.25				
74LS00 TTL		LM320T-15	1.50	75492CN	.55	CD4078	.40	**MOS/MEMORY RAM**		18.432 MHz	4.50				
74LS00N	.25	LM320T-15	1.60	75494CN	.89	CD4081	.21	8214	8.00	22.1184 MHz	4.50				
74LS02N	.25	**A to D CONVERTER**		CD4082	.21	8216	3.85								
74LS03N	.25	LM324N	1.15	8700CJ	13.95	CD4116	1.30	8224	3.50						
74LS04N	.25	LM339N	1.55	8701CN	22.00	CD4490	5.50	8228	6.25	**CONNECTORS**					
74LS05N	.25	LM340K-5	1.10	8750CJ	13.95	CD4507	1.00	8251	11.50	22 pin edge	2.00				
74LS08N	.25	LM340K-8	1.10	LD130	9.95	CD4508	4.25	2111-1	7.00	100 pin edge	4.50				
74LS10N	.25	LM340K-12	1.10			CD4510	1.02	2114-A-4	4.95	100 pin edge WW	5.25				
74LS13N	.40	LM340K-15	1.10	9400CJ		CD4511	.94	2102-1	1.80	**TRANSISTORS**					
74LS14N	.90	LM340K-24	1.10	V to F	7.40	CD4513	2.52	MK4116 48.00		CDP1802CD	25.00				
74LS20N	.25	LM340T-5	1.10	**CMOS**		CD4514	1.90	25138	8.75	CDP1861	12.95				
74LS22N	.25	LM340T-8	1.10	CD3401 Pair	.50	CD4516	1.10	MM5262	.50	6820	12.00				
74LS28N	.41	LM340T-12	1.10	CD4000	.16	CD4518	1.02	MM5320	5.95	6850	15.00				
										6502	24.50				

UART/FIFO			
AY5-1013	5.50		
3341	6.95		
PROM			
1702A	5.95		
100 per type .015	2.95		
KEYBOARDS 63 Key Keyboards $26.95			
Hex keyboard $10.95. Fully encoded w/PC board, parts and instructs. $29.95			
53 key ASCII keyboard kit	55.00		
Fully assembled 65.00 Enclosure 14.95			
LEDS			
Red T01¾	.15		
Green, Orange Yellow T01¾	.20		
Jumbo Red	.20		
Green Orange Yellow Jumbo	.25		
Cliplite LED Mounting Clips 6/$1.25			
(specify red, amber, green, yellow, clear)			
CONTINENTAL SPECIALTIES $128.95			
Complete line of breadboard test equip			
MAX-100 8 digit Frequency Counter			
DX WIRE WRAP TOOLS AVAILABLE			
Portable Multimeter $18.00			
TRANSFORMERS			
12 Volt 300 ma transformer	1.25		
12.6V CT 600 ma	3.75		
12V 250 ma wall plug	2.95		
12V CT 250 ma wall plug	3.50		
24V CT 400 ma	3.95		
2 01100 ma	3.25		
COMPUTER BOARD KITS			
8K RAM Board Kit	175.00		
16K EPROM Kit	119.95		
I/O Board Kit	44.50		
Extender Board w/connector	12.50		
Video interface board kit	143.50		
16K EPROM board kit w/o PROMS	85.00		
16K Static RAM board kit	495.00		
North Star Floppy Disk Kit	$665.00		
Additional Drive Kit	415.00		
DIGITAL THERMOMETER $48.50			
Batt. oper. General purpose or medical			
32°–230°F. Disposable probe cover. ±2°			
accuracy. Comp assy. in compact case			
5 function digital DC Calendar clock			
4" green LED display, auto dim			
Pedestal mounts 2.7" by 2.7"			
Beautiful case	$54.95		

SPECIAL PRODUCTS			
MM5865 Stopwatch Timer	9.00		
PC board	7.50		
Switches Mom. Pushbutton	.27		
3 pos. slide	.25		
Encoder HD0165-5	6.95		
3 Digit Universal Counter Board Kit			
Operates 5–18 Volt DC to 5 MHz typ. 125" LED display	19.50		
Voice activated switch	.50		
CLOCK MODULES			
Complete alarm clocks ready to hook up with transformer and switches. Very compact with .50" and .54" digits			
MA1002A, C or E .50	8.95		
102P3 Transformer	2.25		
MA1010A, C or E .84	11.95		
102P2 Transformer	2.25		
Special transformer and six switches when purchased w/module	2.95		
MA1003 car module .3 green fluor. display	17.50		
Fair MOS 6300 .53	9.95		
DISPLAY LEDS			
MAN1	CA 270	2.90	
MAN3	CC 125	.30	
MAN7/2-74	CA/CA 300	1.00	
DL704	CC 300	1.25	
DL707/DL707R	CA 300	1.90	
DL727/728	CA/CC 500	1.90	
DL747/750	CA/CC 600	1.95	
DL759	CC 600	1.95	
FND359	CC 357	.70	
FND500-507	CC/CA 500	1.35	
FND503-510	CC/CA 500	1.35	
FND800-807	CC/CA 800	2.20	
3 digit Bubble		60	
4 digit bubble		80	
DG8 Fluorescent		1.75	
DG10 Fluorescent		1.75	
3 digit 14 pin display		1.00	
NSN33M 3 digit 8 pin		.39	
NSN69 9 digit display		.60	
7520 Clarex photocells		.39	
TIL311 Hex		9.50	
Motorola MEK 6800 D2 Kit			
All parts including hex keyboard			
minus 5V power supply	235.00		

Sinclair 3½ Digit Multimeter
Batt. oper. 1mV and .1NA resolution. Resistance to 20 meg. 1% accuracy. Small, portable, completely assem. in case. 1 yr. guarantee. Best value ever! **$59.95**

Not a Cheap Clock Kit $14.95
Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions. **Same clock kit with .80" displays. $21.95**

Digital Temperature Meter Kit
Indoor and outdoor. Automatically switches back and forth. Beautiful .50" LED readouts. Nothing like it available. Needs no additional parts for complete, full operation. Will measure −100° to +200°F, air or liquid. Very accurate. Complete instructions. **$39.95**

Clock Calendar Kit $19.95
CT7015 direct drive chip displays date and time on .6" LEDS with AM-PM indicator. Alarm/doze feature includes buzzer. Complete with all parts, power supply and instructions, less case.

1977 IC Update Master Manual
Final 1977 closeout **$15.00** while they last. 1978 Master available late Jan. 1978 **$30.00.** Complete IC data selector, 1234 pg. master ref. guide, 17,000 cross references. Free update for 1977. Domestic postage $2.00. Foreign $6.00

60 Hz Crystal Time Base Kit $4.75 Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

New Cosmac Super "ELF"
RCA CMOS expandable microcomputer w/HEX keypad input and video output for graphics. Just turn on and start loading your program using the resident monitor on ROM. Pushbutton selection of all four CPU modes. LED indicators of current CPU mode and four CPU states. Single step op. for program debug. Built in pwr. supply, 256 Bytes of RAM, audio amp. & spkr. Detailed assy. man. w/PC board & all parts. Comp. Kit **$106.95** Custom hardwood cab.; drilled front panel **19.75** Nicad Battery Backup Kit w/all parts **4.95** Fully wired and tested in cabinet **151.70** 1802 software xchng. club; write for info.

RCA Cosmac VIP Kit 275.00
Video computer with games and graphics.

Original Cosmac "ELF" kit
with PC board, monitor, power supply plus all parts and instructs. **$89.50**
Board only **14.95**

4½ Digit DMM kit $85.00
Volts—ohms—milliameter accuracy ±1 count. Ranges: Volts—2, 20, 200. Ohms—2K, 2meg, 20 meg. Ma—200, 2000. .4" display. Variable update rate. Comp. w/parts, PC boards, instructs., less case.

Paratronics 100A Logic Analyzer Kit $199.00
Converts an oscilloscope into a digital tester and analyzer. Trace computer program flow, monitor I/O sequences, etc. Trouble shoot all digital, CMOS and MOS families. 128 bit truth table (8 by 16 bits). Complete with case, parts and instructs. Model 10 Trigger Expander Kit expands Model 100A to 24 bits **$229.00.** Model 150 Bus Grabber Kit **$369.00,** a one board logic analyzer for S-100 bus applications. Instant access to 56 S-100 bus signals. Complete kit with all parts and instructs.

2.5 MHz Frequency Counter Kit Complete kit less case **$37.50**
30 MHz Frequency Counter Kit Complete kit less case **$47.75**
Prescaler Kit to 350 MHz **$19.95**

Stopwatch Kit $26.95
Full six digit battery operated. 2–5 volts. 3.2768 MHz crystal accuracy. Times to 59 min., 59 sec., 99 1/100 sec. Times std., split and Taylor. 7205 chip, all components minus case. Full instruc. White or black plexiglass case. **$5.00**

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DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

TERMS: $5.00 min. order U.S. Funds. Calif residents add 6% tax. BankAmericard and Master Charge accepted. Shipping charges will be added on charge cards.

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The MT1 is the Ultimate Digital Timepiece. 17 digits continuously read out the month, date, time, alarm setting, and timer. The MT1 operates on 110 VAC, with battery backup in case of power failure, or off 12 VDC for operation in a car or boat.
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The MT1 is designed for custom installation. Several partial or full displays can be run from one master clock unit. Easily interfaced to a computer for real time applications.
MT1-C kit, less case $109.00

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PINK NOISE GENERATOR KIT
Inexpensive unit allows proper set up of graphic equalizer in a stereo system. Easy to use.
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MINIMUM ORDER $10.00

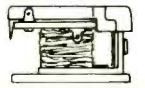
GIANT CATALOG

The best bargain on this page !!! —Our brand new 1977 giant catalog packed with dozens and dozens of super buys on electronic components. Contains such unique components as: Pneumatic switches, electric motors, Caps, wire, resistors, diodes, switches, LED's, transformers, transistors, and much, much more. Perhaps we have just the item you've been looking for !!

REED RELAY

High quality, ultra-sensitive 5VDC SPST reed relay. Use in a variety of applications where transistors or SCR's are not quite suitable. May be driven directly from TTL. RRY-510 $1.50

12V RELAY



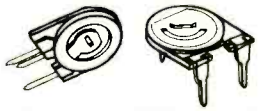
Brand new 12VDC relay by Cornell-Dubilier. Has N.O. and N.C. contacts. Measures appx. 1 x 1¼" CRY-012 $1.50

DIGITAL READOUTS

Hewlett-Packard prime units HP #7730, .3" character(RED)

Common Anode.....$1.70
4 for $4.95

P.C. TRIMMER POTS

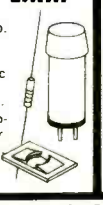


TYPE	PART NO.	PRICE
470 ohm, vertical	PCV-471	.25
1K ohm, vertical	PCV-102	.20
2.5K ohm, vertical	PCV-252	.20
5K ohm, vertical	PCV-502	.20
10K ohm, vertical	PCV-103	.25
22K ohm, horizontal	PCV-223	.25
50K ohm, vertical	PCV-503	.20
470K ohm, horizontal	PCV-473	.25

FAN MOTOR

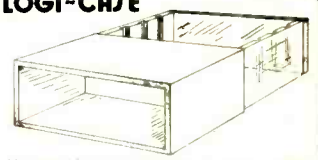
117VAC fan motor for use in cooling insides of test equipment, operating models, cooling yourself off, etc. A fantastic buy at this price ! MOT-115 $2.25

PANEL LAMP



110VAC panel lamp. Neon lamp inside with white plastic outer lens assembly. Includes dropping resistor & mtng clip. NEL-110 29¢

LOGI-CASE



Universal instrument enclosure with a wide variety of applications. Unique interior flexiglass rack assembly will hold up to 6—1.5" by 4" PC boards. Great for packing a lot of components into a very small space. Adds a very professional touch to any project. Made from 1/8" thick anodized, extruded aluminum. So tough that you can run over it without damaging it !!!! The Logi-Case comes with a reversible front filter allowing you to choose between transparent red or smoke grey. Now available in two popular sizes:

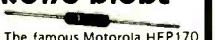
Small: 4½L x 3¼D x 1¾H.
Large: 6L x 4½D x 2H.

SMALL (LCS-100) $7.95
LARGE (LCS-200) 9.95

4N27 OPTO ISOLATOR

NPN phototransistor & PN infrared light emitting diode. 1500 volt isolation. 3ma coll output current. Excellent frequency response to 300 khz. Brand new Motorola 6 pin DIP with full specs & data. POI-427 $1.00 10 for $9

R0170 DIODE



The famous Motorola HEP170 universal replacement diode. Rated 1000 PIV @ 2.5 Amps. HEP-170 ..... 20 cents ea. 100 for only $14.50

STROBE TUBE

Experimenter's delight ! New xenon strobe tube & trigger transformer. Tube op. from 150-300V FFT-100 1.75

TELEPHONE WIRE

26 AWG Telephone Hook-up wire; single strand, twisted pair & 20 pair. Single Cond. 100ft/90¢ 1 pr-100/1.40 20pr-1ft/20¢

TRANSFORMER

Mini transformers for clocks, etc. Outputs 8V @ 500ma or 12V @ 190ma. With specs. CMX-812 $1.50

HEAT SHRINK

Much easier to use than electrical tape. Slip over solder joint & heat. Tube will shrink to form tight seal. 12—6" peices, assorted sizes. HST-120 $1.45

1-3pf TRIM CAP

Mini trim cap. Great for crystal circuits, hand probes, etc. Measures 3/16" diameter. PCT-130 95¢ 5 for $3.50

V.O.X.

Solid state Voice Operated switch. Complete w/ all parts and completely assembled. SCR output. W/ schematic. VOX-900. ..... $1.50

100K MINI-POT

New by IRC, PC-mount trimpot. ¼" H by ½" diameter. PCT-104 50¢

.1uf, 6000V CAP

New by Sprague. Great for experimenting w/ high voltage. AXC-160. ..... .70¢

2N3055

The king of audio power transistors now at an unbeleivable price !!! Brand new BNC-055 ..... .50¢

TOGGLE SWITCH

Heavy duty, SPST high quality. Rated 15A @ 125 VDC. TSW-111 95¢

POWER RELAY

Potter & Brumfeild 120V. SPDT, 25 Amp. CRY-012 $4.00

SNAP SWITCH

Mini SPDT snap switch by Cherry. Rated 5 amps, 125—250 VAC. MSW-523. 65¢

RIBBON CABLE

Cond.	Part No.	1'	10'
6	RIB-006	.25	2.00
12	RIB-012	.45	3.95
24	RIB-024	.85	7.95

WIERD SWITCH

Strange, but useful reverse—action snap switch w/ lever. NC & NO connection LSW-100 ..... .75¢

WIRE SPECIAL

22 ga. magnet wire. Unique solder-thru insulation. Buy by the poung and save! (Appx. 500 feet). LBW-220 $2.50

RUBBER FEET

Molded, adhesive back rubber feet in peel-off sheets from 3M.

Round: (RRF-120) 12 for 75¢
Square: (SRF-120) 12 for 55¢

POT w/ SWITCH

New by Allen-Bradley. 100K mini 1/8" shaft, ¼" mount. with SPST switch. QVR-104 65¢

MICRO SWITCH

Miniature SPDT momentary contact pushbutton. Rated 5 amps @ 125VAC MSP-111 95¢

TTL DATA BOOK

TDB-254 $4.95

The newest edition of the TTL data book for design engineers. Detailed specs on over 900 TTL devices including standard and high-technology Schottky Clamped TTL. Pin assignment drawings of all TTL types. The most complete book ever written on TTL. —By Texas Instruments.

VACUUM SWITCH

SPST pneumatic switch. Enclosed diaphram activates with vacuum or pressure. Extremely sensitive. Brand new. VPS-195 ..... $1.95

10a POWER CORD

High quality power cord. New from Beldon, 10a, 125v 3 connector, approx. 5ft. 75¢

5 MEG H.V. POTS

High voltage pots w/ insulated shaft for protection against high voltage.
1/8" shaft—Small (QVR-505) 45¢
1/4" shaft—Large (TVR-505) 75¢

1.5V DC MOTOR

Great for toys, experimenting, etc. 6" leads, 1/16" shaft.

MOT-015. ..... .50¢
10 for only $4.00

MINI-SWITCH

Brand new by C & K. Very high quality SPDT toggle, rated 5Amps @ 125 VAC. MST-111 $1.10

RUBBER EDGEING

Protection from unsightly metal edges. Contours to any shape... For mat'l up to 1/16" thick.

10' for $1.60 100' for $12

PHOTOFLASH CAP

Brand new Rubycon. 600 uf at 360 volt. Use with our flash tube & trigger transformer to make a very high quality strobe light !!! PFC-360 $1.95

Switch

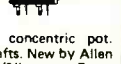
SPDT momentary, center off (on—off—on). Rated 15A @ 125VAC, 10A @ 250VAC. New Units. 55¢

COMPUTER CAPS

Quality computer grade caps.

12000mf @ 25VDC CGC-122	3.95
5900mf @ 60VDC CGC-596	2.50
5000mf @ 30VDC CGC-503	1.95
2700mf @ 25VDC CGC-272	1.75

MOD-POT



High quality dual concentric pot. 1/8 and 1/4 inch shafts. New by Allen Bradley. Measures 5/8" square. Front pot is 25K linear, rear pot is 50K log. MVR-255 $1.75

CLOCK CHIP

Most popular clock chip on the market. National MM5314. 12/24 hour, 50 or 60 hz, 6 digit. MME-314 $4.95

IN4448

Case AA, 75v,,high speed diode. New from Texas Instruments.

12 for $1.00

SLIDE SWITCH

Standard DPDT Long shaft for deep panel mounting. 3A @ 125VDC. SSW-221 25¢

POT NUTS

Standard size pot hex nuts. 2 sizes:
3/8" PTN-380
1/4" PTN-140
your choice, 25 for 1.00

FELT FEET

3/8" diameter. Comes in peel-off strips of 25 felt feet per strip. FFT-015 25¢ strip

.01uf DISC

.01 uf disc ceramic capacitor. We have thousands !!! Buy while they last DCP-010 5¢

10K POT

Brand new Clarostat, 1/4" shaft standard pot. TVR-103 90¢

10K POT

New from CTS mini 1/8" shaft, ¼" mounting dia. QVR-103 65¢

DIXIE BELL

Enclosed, aluminized signal bell. 6-8VAC or 3-6V DV. New units. DBL-720 $2.00

.02uf DISC

.02 uf disc ceramic capacitor. We have thousands !!! Buy while they last DCP-020 5¢/20 for 80¢

12AU7 TUBE

We somehow managed to get ahold of hundreds of these. Very popular number for replacement in radios, TV's, etc. New and unused. AUT-127 50¢

STAND-OFF

Insulated stand off terminal. ¼" dia., 5/8" long. With ¼" mounting screw. SOT-210 10/$1.49

CONNECTOR

Female UHF to BNC male connector. Plated, new. ADP-239 $1.95

COMPONENT CARRIER

Molded plastic with hole drilled in center. 7/16" I.D. CLP-050 10/25¢

.1/50V CAP

TRW dipped mylar capacitor. .1 uf at 50 VDC. DCP-150 15¢

ROCKER SW.

PC mount, 2 pole 3 position. Used, but in very good condition. RSW-231 25¢

BARRIER BLOK

Black molded bakelite barrier block, 5 position. BTS-250 25¢

5uf, 150V

5 uf, 150VDC cap. Great for audio crossover networks. Non-polarized. NPC-515 60¢

5200uf CAP

New by STM. 5200 uf at 25 VDC, PC leads. PCL-522 75¢

1800uf CAP

1800 uf at 40VDC. Brand new. PCL-184 55¢

8200uf CAP

8200 uf at 15 VDC. Brand new by Mallory. AXC-821 75¢

TERMINAL

Single solder terminal strip. Bakelite mount. STS-010 6 for ..... 25¢

.01uf MINI CAP

Ultra-miniature .01 uf ceramic chip capacitor, axial lead. Appx. ¼" long. High quality. DCP-015 15¢

47pf MINI CAP

Ultra-miniature ceramic capacitor for crystal circuits, etc. UMC-047 10¢

TYPE MKM 20¢

Extremely stable mettalized polycarbonate. .01 uf at 150 VDC. .4" lead spacing. MKM-010

760 HC COMPARATOR

New Fairchild type 760HC single voltage comparator. TTL compatible. 8 lead TO-5 case. CMP-760 50¢

60 AMP(!)

Power terminator strip. Sells new for over $11.00. Mfg. by Curtiss. PTS-060 $4.00

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Numeric Display
¼" Single Digit GaAsP LED

FND 70

COMMON CATHODE WITH RH DECIMAL
COMPACT - 10 DIGITS IN 3" PANEL WIDTH
HIGHLY LEGIBLE - BRIGHT RED ¼" CHARACTER EASILY READ WITHIN 10 FEET OVER A WIDE VIEWING ANGLE (140°)
LOW POWER - 125 mW PER DIGIT AT TYPICAL BRIGHTNESS

65¢ ea 10-$4

RESISTOR ASSORTMENT
with metal cabinet

100ea 1/4W 5%

5.9	6.8	12	18	27	39
56	82	120	180	270	390
560	820	1.2K	1.8K	2.7K	3.9K
5.6K	8.2K	12K	18K	27K	39K
56K	68K	100K	180K	270K	
390K	560K	820K	1.5M	1.8M	2.7M

$44.95

COUNTER DISPLAY KIT

Ideal module for home built counter projects. Includes 7490 decade counter 7475 latch, 7447 driver, and RCA .6" NUMITRON display. PCB with plated thru hole and instructions supplied.....
KITS SUPPLIED FROM ONE TO TEN DIGITS PER BOARD (all interconnects plated)..

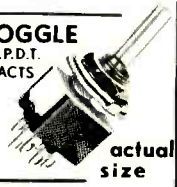
$5.89 per digit

-SWITCHES-

RED PUSH BUTTON N.O. MOMENTARY CONTACT

30¢ each
8 $ 2
100 22
1000 210
actual size

MINI MINI TOGGLE
EXTRA SMALL D.P.D.T.
3A 125VAC CONTACTS



each $1.50
8 — 10.
100 — 95.
actual size

JBT MR1-223 5 AMP DPDT ROCKER SWITCH WITH PANEL MOUNTING HARDWARE.....

79¢ea.
ten $6
$49/c

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Type KHP Relay
4 PDT 3A Contacts
24VDC COIL
650 ohms
120VAC
10.5MA

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360MFD. 600VDC PHOTO FLASH CAP.	.90
1702A 2K, lus, EPROM	7.95
SP425 SPERRY 9 digit ¼" HV multiplexed 7 seg.	1.25
MM5369 time base osc. chip	1.75
T.V. crystal for above.....	1.75
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93410 256 x 1 45NS RAM . . .	.85
75451 peripheral driver . .	.40
7402 TTL nor gate	.16
7430 TTL nand gate	.14
CERAMIC FILTER 10.7 MHz. . .	1.20
MM5058 1024 bit static SR . .	1.50
UA715 60MHz. op-amp	1.20
74S206 256 x 1 45NS RAM . . .	.90
78L2.6 2.6V TO92 .1A +regul.	.29
78L05 5.0V " " "	.29
78L6.2 6.2V " " "	.29
78L12 12V " " "	.29
78L15 15V " " "	.29
78M05 5V tab .5A + regul.	.59
78MG 4 term. adj. .5A + reg.	1.29
79MG " " " " - reg.	1.39
7805T tab 1A 5v regul	.89
7812 to-3 1A +12V regul.	.59

SUPER LED's

This family of LED's are mounted on a TO-5 header with a 6/32 threaded stud to secure to a heat sink.. TWO AMPERES max. continuous current rating (with heat sink). LED's can be pulsed at up to 25A with low duty cycle. Data supplied w/order.

ME2 Infra Red w/low lens
ME5 Infra Red w/high lens
MV4 Visible Red with low lens
MV4H Visible Red with high lens

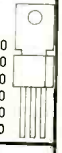
$2.99 ea.

DIP TRIMMER

12 TURN, ¼"x¼"x¼"
5K or 200K only
mfg. DALE
$.50 TEN FOR $4

TRANSISTORS

2N5559B (HEP707)	NPN SI TO-3	400V	10A	125W	EA.	2.50	10/22.50
TIP31A (HEP245)	NPN SI TAB	60	3	40		.30	2.50
2N6101 (S5004)	NPN SI TAB	80	10	75		.65	5.00
D41D1	PNP SI TAB	30	1	6		.25	2.00
MPS5172(HEP56)	NPN S TO-92	25	.1	.2		.12	1.00
C106D1	SCR TAB	4A-400V	.2MA	GATE		.65	5.00



Hal's Goodies

Hal's computer really popped it's stack on these prices. We cannot allow any quantity discounts or bonus credits on these items. Quantities are limited and at these prices- order now.....

2708	8K EPROM Sig.,Nat., Intel prime 450NS	ea.$14.95	8/$120
2504T	Sig. 1024 bit dyn. shift register TO-99	ea. $.75	10/$6.
93410	Fairchild 256x1 RAM bipolar 45NS DIP	ea. .75	10/$6
TR1602B	5V Wesern Digital UART 40 pin DIP	ea. 3.00	
7402	Nat. quad 2 in NOR gate marked DEC7402	10/$1.50	100/$12
	40 pin gold solder tail IC socket,Augut	ea. .55	
Capacitor-	.01mf 50V monolithic ceramic, sealed in glass DO-7 diode package	10/$.90	100/$8
1/8W carbon comp. resistors ten each of 2.4, 390,1.8K,3.9K,6.8K,11K,43K,68K,240K,ohms		90/$4.	

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Money back guarantee - $5 minimum order. we pay post on orders for $10 or more. All payment must be in U.S. funds. Foreign orders must include post. BAC & MC are not prepaid orders and shipping is added

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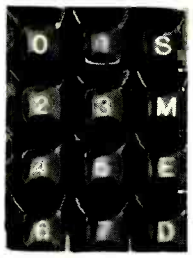
CIRCLE 60 ON FREE INFORMATION CARD

The Keyed-Up 8080™



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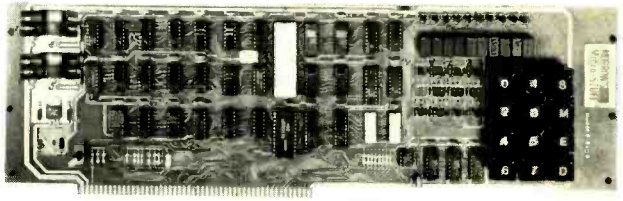

Have your local computer store order it for you. Or place BAC/MC orders to 415-527-7548

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Why buy wire on rolls?

PRECUT & STRIPPED WIRE IS:

- Fast - No more cutting & stripping by hand
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- Economical - Cheaper than using bulk wire

Precut Wire	Bulk Wire
100 pcs of 3" at $.82 = 3½¢/ft.	50 ft. roll at $1.99 = 4¢/ft.
100 pcs of 6" at 1.06 = 2¢/ft.	100 ft. roll at 2.95 = 3¢/ft.
Wire Kit 1 at $6.95 = 2 1/3¢/ft.	

30 Kynar stripped 1" on each end. Lengths are overall
Colors: Red,Blue,Green,Yellow,Black,Orange,White
Wire packaged in plastic bags. Add 25¢/length for tubes.

	100	500	1000	5000
2½ in.	.78	2.40	4.30/K	3.89/K
3 in.	.82	2.60	4.71/K	4.22/K
3½ in.	.86	2.80	5.12/K	4.55/K
4 in.	.90	3.00	5.52/K	4.88/K
4½ in.	.94	3.21	5.93/K	5.21/K
5 in.	.98	3.42	6.34/K	5.52/K
5½ in.	1.02	3.65	6.75/K	5.86/K
6 in.	1.06	3.85	7.16/K	6.19/K
6½ in.	1.15	4.05	7.57/K	6.52/K
7 in.	1.20	4.25	7.98/K	6.85/K
7½ in.	1.25	4.45	8.39/K	7.18/K
8 in.	1.29	4.65	8.80/K	7.53/K
8½ in.	1.32	4.85	9.21/K	7.84/K
9 in.	1.36	5.05	9.62/K	8.17/K
9½ in.	1.40	5.25	10.03/K	8.50/K
10 in.	1.45	5.51	10.44/K	8.83/K
Addl. in.	.10	.41	82/K	.66/K

WIRE WRAP SOCKETS

	1-9	10-24	25-99	100-249	250-999	1K-5K
8 pin *	.41	.38	.35	.31	.29	.27
14 pin *	.42	.39	.36	.32	.29	.27
16 pin *	.46	.43	.39	.35	.32	.30
18 pin *	.63	.58	.54	.47	.44	.41
20 pin	.84	.78	.71	.63	.59	.54
22 pin *	1.30	1.20	1.10	.95	.90	.84
24 pin	.91	.84	.78	.68	.64	.59
28 pin	1.25	1.15	1.08	.95	.89	.82
40 pin	1.65	1.55	1.42	1.25	1.15	1.09

Gold 3-level Closed Entry Sockets
End & Side Stackable — All prices include gold
Tin sockets and 2-level sockets available

WIRE WRAP TOOLS

$34.95

HOBBY WRAP
Model BW 630
With Free Wire Kit 1
($6.95 Value)

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WSU 30 Hand Wrap-Unwrap Strip Tool	5.95
WSU 30M, for Modified Wrap	6.95
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WIRE KITS

# 1 $6.95				# 2 $19.95			
250	3"	100	4½"	250	2½"	250	4½"	250	6"
250	3½"	100	5"	500	3"	250	5"	100	6½"
100	4"	100	6"	500	3½"	100	5½"	100	7"
				500	4"	1 250 ft. Roll Bulk			

Choose One Color or Assortment

INTERCONNECT CABLES

Ribbon cable connectors for connecting boards to front panels, or board to board.

	SINGLE ENDED			DOUBLE ENDED		
	14 pin	16 pin	24 pin	14 pin	16 pin	24 pin
6"	1.24	1.34	2.05	2.24	2.45	3.37
12"	1.33	1.44	2.24	2.33	2.55	3.92
24"	1.52	1.65	2.63	2.52	2.76	4.31
48"	1.91	2.06	3.40	2.91	3.17	5.08

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AUGAT ROUND TEFLON SOCKETS
HI-TEMP GOLD
TO-5 3 PIN 39c
TO-99 8 PIN 49c
TO-100 10 PIN 59c

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LOW NOISE
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uA 723
VARIABLE 2V to 37v
PLASTIC 39c
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ALL BOARDS ARE G-10 GLASS EPOXY, have Vcc AND GROUND PLANES, PLATED THROUGH HOLES, AND HAVE GOLD-PLATED EDGE CONNECTORS.

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1700+ holes
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Leading computer manufacturer's "in-house"
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for sockets, pins, or wire wrap socket strips.
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A MUST for trouble-shooting your Computer boards
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THERMISTOR
I.D.'ed to .01%
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SET OF 4 CLOSELY MATCHED
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ideal display for pocket-sized instruments
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PRECUT & STRIPPED
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No. 30 Kynar available in red, blue, yellow, orange, green, black, white. Length is overall with 1" strip on each end.

AT THESE PRICES A GUY HAS TO BE NUTS TO DO IT BY HAND!

	100pcs		100pcs		100pcs		100pcs
2-1/2	$1.00	4-1/2"	$1.27	6-1/2"	$1.57	8-1/2"	$1.88
3"	1.08	5"	1.35	7"	1.63	9"	1.97
3-1/2"	1.15	5-1/2"	1.41	7-1/2"	1.68	9-1/2"	2.08
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100 PIECES OF EACH LENGTH $22.00
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20 KV at 100mA
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1/10" CENTERS
STACKABLE...
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741
OP AMP
12c

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ULTRA HIGH SPEED .5NS RISE TIME
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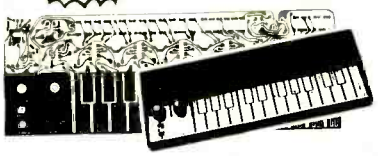
BUSINESS OPPORTUNITIES

CIRCLE 85 ON FREE INFORMATION CARD

NEW! ELECTRONIC TOUCH ORGAN KIT



Fantastic new design uses CMOS I.C. and a total of 39 semi-conductors to give a touch control keyboard, all the electronic parts in one PC Board. This organ is easy to build, yet has features like a full two-octave range touch keyboard, variable tremolo; two voices; built-in I.C. amplifier with volume control, complete with speaker and a specially designed plexi-glass case.

BATTERIES NOT INCLUDED *Ideal kit for beginner or gift for children **$24.50 ea.**

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Take advantage of this new state-of-the-art counter featuring the many benefits of custom LSI circuitry. This new technology approach to instrumentation yields enhanced performance, smaller physical size, drastically reduced power consumption (portable battery operation is now practical), dependability, easy assembly and revolutionary lower pricing!

Only $59.50

Includes all parts, PC Board and Transformer

Model 250-30A

- 0.5" red LED 6 digits display
- Resolution: 1 Hz at 1 sec. 10 Hz at 1/10 sec.
- Sensitivity: 10 Mv RMS to 30 Hz
- Internal power supply: 5.2V at 1 amp regulated
- Input connector: BNC type
- Input power required: 117V AC 50/60 Hz
- Diode protected for over voltage input

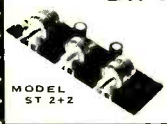
CALCULATOR with STOPWATCH

6 Functions with % and memory
8 Digits big green display
*Built-in X'tal controlled stop watch count to 1/10 of a second.
Special Price Only
$16.50 Ea.
BATTERIES NOT INCLUDED

1Watt AUDIO AMP

All parts are pre assembled on a mini PC Board
Supply Voltage 6~9V D.C.
SPECIAL PRICE $1.95 ea.

2W + 2W STEREO AMP



MODEL ST 2+2

All parts completed on a PC Board
2 LM380 I.C., volume, bass, treble control included
Supply voltage 9~15V D.C.
Sensitivity: 100Mv for full output
Total harmonic distortion 1% @ 1 KHz @ 1.5 watt
Output is short circuit protected
ONLY $5.75 ea.

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Supply 6~18V DC
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Time Controlled from 1-100sec.
Ideal to be used as time delay unit for burglar alarm, photo service, and other purposes. Max. loading 110V, 2 AMP. Supply voltage 12-18V D.C.
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COMPLETE UNIT
Ideal for use as an Alarm Unit, or hookup to your car back up to make a reverse indicator
Light Output up to 130 dB.
Voltage Supply 6~12V $7.50
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19 KEY HEXADECIMAL KEY PAD

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- ABCDEF
- ←→Key

SPECIAL $10.50 ea.

Low Cost Hexadecimal 16 Key Pad

Designed for Calculator, Can be used for Computer, Data Entry Pad or Digital Lock
All key tops blank with super good touch feeling $0.95 ea.

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$6.50 ea. CMOS I.C. IN CIRCUIT
for auto ignition, entry door, burglar, alarm, etc
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400Ω RELAY AND KEY PAD NOT INCLUDED

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Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts.
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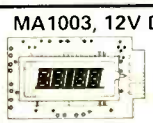
MA1003, 12V DC CLOCK MODULE



Built in X'TAL controlled time base. Protected against automotive volt transients. Automatic brightness control with 0.3" green color display. Display turnoff with ignition "OFF".
$19.50

MECHANICAL DIGITAL CLOCK

WITH DAY AND DATE OF THE WEEK
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Supply Voltage 110V AC. limited quantity $15.50 ea.

QUARTZ CRYSTALS

1 MHZ	$4.95
2 MHZ	$5.25
4 MHZ	$5.25
10 MHZ	$5.25
3.579 MHZ Color TV Type	$1.25

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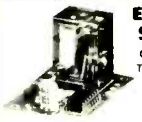

CONDENSER TYPE
Touch on Touch Off use 7473 I.C. and 12V relay
$5.50 each

VHF MODULATOR

For TV Game or Computer
This unit converts the Video Signal to RF Signal
Video Input 1VDC RF Output 1.5 MV
61.25 MHZ (channel 3)
Frq. Adjustable + 3 MHZ
ONLY $4.50

TI 1955

Alternative AY3 8500 1 6 Game (28 Pin Dip) TV Game Chip with Data Tennis Squash hockey, practice & 2 shooting.
Special Only $6.50
PC Board for TV Game with Data $2.50 ea.
Switch Box between Game & TV $1.25 ea.

RCA STEREO AM-FM MUX TUNER AMP

5 Watt Per Channel RMS With 8 Track Tape Player Built In
Manufactured by RCA, maker of Quality Systems. All Solid State Circuitry with Beautifully detailed panel. Limited Quantity.
ONLY $53.50 ea.

ON-SCREEN TV CLOCK KIT

Same one as in July Radio Electronics. Kit includes PC Board, MM5318 and MM5841 chip. All other electronic parts with transformer.
ONLY $21.00

BIPOLAR LED

Jumbo Size red/green change color when reverse polarity of voltage. Ideal for go/nogo indicator.
Two for $1.00

I.C. TEST CLIPS

Same as the E-Z clips With 20" Long Leads In Black and Red Colors
$2.75 per pair

TV Games

Direct Sales Only
$19.50
FEATURES:
- 4 Games—Tennis, Hockey, Racquet Handball and Single Handball.
- Auto counter display on the screen.

WIRE WRAPPING TOOL

$29.50

NEW
Battery wire wrapping tool
COMPLETE WITH BIT AND SLEEVE

Wire Wrapping In Bulk
100' $2.00
500' $8.50

Sub Mini Size PANEL METER

500 UA
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MJE3055 NPN
10 AMP, 60 VOLT, 90 WATTS
$2.25 PER PAIR

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ALL 117 VOLT INPUT

30V	at 1.5 amp	$30.00 ea.
36V CT	at 3 amp	$ 4.50 ea.
50V CT	at 2.5amp	$ 4.50 ea.
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AC POWER SUPPLY

Adapter Type Transformer
12V AC Output 200 MA
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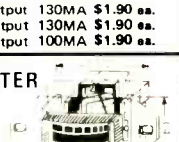

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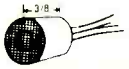

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2SA497	1.44	2SC517	3.60	2SC1239	3.50	2SD188	2.70
2SA634	1.00	2SC634A	.60	2SC1306	3.50	2SD234	.85
2SA636	1.25	2SC710	.49	2SC1307	4.75	2SD235	.85
2SA673	.70	2SC711	.49	2SC1377	4.80	2SD313	1.05
2SA678	.65	2SC735	.49	2SC1383	.50	2SD314	1.50
2SA682	1.49	2SC756A	2.40	2SC1448	1.00	2SD315	1.20
2SA683	.60	2SC778	3.50	2SC1449	.85	2SD358	1.10
2SA699	1.30	2SC781	2.50	2SC1678	2.00	2SD360	1.05
2SA699A	1.45	2SC789	1.00	2SC1728	1.85	2SD427	2.55
2SA733	.49	2SC798	3.95	2SC1760	1.60	2SD525	1.50
2SA777	.99	2SC799	3.25	2SC1816	3.50	2SK19	1.25
2SB54	.49	2SC1000	.49	2SC1908	.49	2SK30A	.75
2SB56	.95	2SC1013	.95	2SC1909	3.75	2SK33	.90
2SB186	.49	2SC1014	.95	2SC1957	1.00	2SK55	1.00
2SB187	.55	2SC1017	1.20	2SC1973	.90		
2SB324	.60	2SC1018	1.00	2SC1975	3.50	3SK22Y	2.20
2SB370	.65	2SC1061	1.25	2SC2028	.80	3SK40	2.00
2SB405	.60	2SC1079	3.95	2SC2029	3.40	3SK45	2.20
2SB415	.65	2SC1096	.80	2SC2091	2.50	3SK49	2.20
2SB461	1.60	2SC1098	1.00	2SC2092	3.25		
2SB463	1.40	2SC1115	3.00				
2SB507	1.40	2SC1170B	4.95	2SD72	.80	4004	3.00
2SC371	.49	2SC1172	5.25	2SD77	1.50	4005	3.00
2SC372	.49	2SC1173	.75	2SD88	4.80	40081	1.50
2SC481	1.50	2SC1209	.75	2SD118	3.00	40082	3.00

JAPANESE CIRCUITS

AN136	2.90	LA4400FS	3.40	TA7055P	3.00	UPC20C	3.75
AN214	3.35	LA4400FR	3.40	TA7060P	1.40	UPC41C	2.80
AN239	6.50	LD3120	2.40	TA7061P	1.50	UPC563H2	8.00
AN241	2.40	M5115PR	7.80	TA7063P	1.50	UPC566H	1.25
AN315	3.50	PLL01A	13.50	TA7075P	3.75	UPC575C	2.60
BA511	3.00	PLL02A	8.50	TA7089P	2.90	UPC595C	2.95
BA521	3.40	PLL02A-G	8.50	TA7120P	1.50	UPC1001H2	3.50
HA1202	2.20	SG613	6.75	TA7150P	3.75	UPC1008C	5.75
HA1306	4.90	STK011	7.50	TA7153P	6.90	UPC1020H	3.25
HA1308	4.50	STK015	6.50	TA7203P	4.25	UPC1025H	3.50
HA1322	4.20	STK032	14.20	TA7204P	3.70	UPC1156H	4.50
LA1201	4.25	STK050	24.50	TA7205P	3.60	UPD277C	4.50
LA4031P	3.20	STK056	11.35	UH1C003	6.50	UPD857C	15.50
LA4032P	4.20	STK415	8.50	UH1C004	6.50	UPD858C	9.50
LA4051P	3.20	TA7045M	3.25	UPC16C	2.50	UPD861C	18.50

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LM340K-6	1.70
LM340K-8	1.70
LM340K-12	1.70
LM340K-15	1.70
LM340K-18	1.70
LM340K-24	1.70
LM340T-5	1.50
LM340T-6	1.50
LM340T-8	1.50
LM340T-12	1.50
LM340T-15	1.50
LM340T-18	1.50
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5473	1.50
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7400	.18	7442	1.08	74107	.49
7401	.21	7448	1.15	74121	.55
7402	.21	7450	.26	74122	.49
7404	.21	7451	.27	74123	1.05
7405	.24	7453	.27	74125	.60
7407	.45	7454	.41	74126	.81
7408	.25	7460	.22	74132	3.00
7409	.25	7472	.39	74141	1.15
7410	.20	7473	.45	74150	1.10
7411	.30	7474	.45	74151	1.25
7413	.85	7475	.80	74153	1.35
7416	.43	7482	1.75	74154	1.54
7417	.43	7483	1.15	74157	1.30
7420	.21	7485	1.12	74161	1.45
7422	1.50	7486	.45	74164	1.65
7425	.43	7489	2.49	74165	1.65
7427	.37	7490	.69	74166	1.70
7428	.35	7491	1.20	74174	1.95
7430	.26	7492	.82	74175	1.95
7432	.31	7493	.82	74180	1.05
7437	.47	7494	.91	74181	3.55
7438	.40	7495	.91	74191	1.50
7440	.21	7496	.91	74195	1.00
7441	1.10	74100	1.25	74197	1.00

OEM SPECIALS

1N34	.25	2N2905A	.30	2N3903	.16
1N60	.25	2N2906	.25	2N3904	.16
		2N2906A	.30	2N3905	.16
1N270	.25	2N2907	.25	2N3906	.16
1N914	.10	2N2907A	.30	2N3954A	3.75
2N173	1.75	2N2913	.75	2N3955	2.45
2N404	.75	2N2914	1.20	2N3957	1.25
2N443	2.50	2N3019	1.00	2N3958	1.20
2N508A	.45	2N3053	.30	2N4037	.60
2N718	.25	2N3054	.70	2N4093	.85
2N930	.25	2N3055	.75	2N4124	.16
2N956	.30	2N3227	1.00	2N4126	.16
2N1302	1.25	2N3247	3.40	2N4141	.20
2N1305	.75	2N3250	.50	2N4142	.20
2N1540	.90	2N3393	.20	2N4143	.20
2N1544	.80	2N3394	.17	2N4220A	.45
2N1560	2.80	2N3414	.17	2N4234	.95
2N1605	1.75	2N3415	.18	2N4400	.16
2N1613	.50	2N3416	.19	2N4401	.16
2N1711	.50	2N3417	.20	2N4402	.16
2N2102	.70	2N3442	1.85	2N4403	.20
2N2160	.70	2N3553	1.50	2N4409	.16
2N2218	.25	2N3563	.20	2N4410	.16
2N2218A	.30	2N3565	.20	2N4441	1.00
2N2219	.25	2N3638	.20	2N4442	1.15
2N2219A	.30	2N3642	.20	2N4443	1.35
2N2221	.25	2N3643	.20	2N4852	.55
2N2221A	.30	2N3645	.20	2N5061	.30
2N2222	.25	2N3646	.14	2N5064	.50
2N2222A	.30	2N3731	3.75	2N5130	.20
2N2270	.40	2N3740	1.00	2N5138	.15
2N2369	.25	2N3771	1.75	2N5296	.50
2N2484	.32	2N3772	1.90	2N5306	.20
2N2712	.18	2N3773	3.00	2N5400	.40
2N2904	.25	2N3819	.40	2N5401	.50
2N2904A	.30	2N3823	.70	2N5457	.35
2N2905	.25	2N3866	1.25	2N5458	.30

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4001	.22	4015	.95	4025	.22	4050	.40
4002	.22	4016	.10	4027	.40	4055	1.50
4006	1.20	4017	1.05	4028	.88	4066	.80
4007	.22	4018	1.00	4029	1.10	4071	.27
4009	.42	4019	.25	4030	.22	4076	1.05
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2N4898 PNP TO 66	$ .60
2N404 PNP GE TO 5	5 $ 1.00
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2N3055 NPN Si TO 3	$ .60
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2N3906 PNP Si TO-92	5 $ 1.00
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7404	.20	7450	.15	74157	.65
7405	.20	7472	.32	74161	.85
7406	.25	7473	.32	74163	.80
7407	.25	7474	.32	74164	.95
7408	.20	7475	.45	74165	1.05
7409	.20	7476	.30	74170	2.25
7410	.16	7480	.45	74173	1.35
7411	.20	7483	.70	74174	.95
7412	.20	7485	.87	74175	.90
7413	.39	7486	.30	74176	.75
7414	.85	7490	.45	74177	.75
7416	.25	7491	.65	74180	.65
7417	.25	7492	.43	74181	2.00
7420	.16	7493	.45	74190	1.20
7425	.25	7494	.70	74191	1.20
7426	.25	7495	.65	74192	.83
7427	.25	7496	.65	74193	.83
7430	.16	74107	.28	74194	.85
7432	.25	74121	.33	74195	.85
7437	.24	74122	.38	74196	.86
7438	.24	74123	.40	74279	.87
7440	.16	74125	.40	75491	.50
7441	.70	74126	.40		
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74LS00	.26	74LS126	.65	LM 101	.75
74LS02	.26	74LS132	.80	LM 301/748	.29
74LS03	.26	74LS136	.39	LM307	.90
74LS04	.28	74LS138	.72	LM 308	.75
74LS05	.28	74LS139	.72	LM 311	.75
74LS08	.28	74LS151	.98	LM 318	1.20
74LS09	.28	74LS153	.93	LM 319	.95
74LS10	.26	74LS155	2.00	LM 324	1.05
74LS11	.26	74LS156	.95	LM 339	1.10
74LS13	.50	74LS157	.98	LM 358	1.40
74LS15	.28	74LS160	1.02	LM 370	1.15
74LS20	.26	74LS161	1.02	LM 377	2.50
74LS21	.26	74LS162	1.02	LM 380	.95
74LS22	.26	74LS163	1.02	LM 381	1.25
74LS26	.33	74LS168	1.10	LM 382	1.25
74LS27	.33	74LS169	1.10	LM 537	2.50
74LS30	.26	74LS170	1.72	LM 553	2.50
74LS32	.33	74LS173	1.39	LM 555	.39
74LS37	.37	74LS174	1.05	LM556	.85
74LS38	.37	74LS175	1.22	NE540L	2.75
74LS40	.27	74LS190	1.50	560	2.00
74LS42	.88	74LS191	1.50	565	.95
74LS47	.79	74LS192	1.75	566	1.25
74LS51	.26	74LS193	1.75	567	1.30
74LS54	.26	74LS195	1.25	703	.90
74LS90	.95	74LS196	.99	709	.95
74LS73	.40	74LS197	.99	710	.35
74LS74	.40	74LS221	1.25	741C or V	.31
74LS76	.40	74LS257	1.35	747	.65
74LS90	.89	74LS258	1.38	LM 1310	2.50
74LS92	.85	74LS279	.75	1456	.95
74LS93	.85	74LS365	.66	1458	.50
74LS109	.43	74LS366	.66	CA3046	.75
74LS112	.43	74LS368	.66	3900	.49
74LS113	.43	74LS390	1.95	8038CC	3.90
74LS114	.43			UA791P5	1.95

TRIACS

PRV	1A	10A	25A
100	.40	.70	1.30
200	.70	1.10	1.75
400	1.10	1.60	2.60
600	1.70	2.30	3.60

SCR'S

1.5A	6A	35A
.40	.50	1.20
.60	.70	1.60
1.00	1.20	2.20
	1.50	3.00

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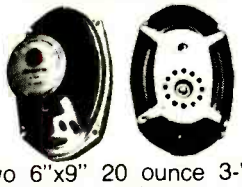

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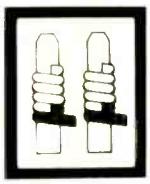

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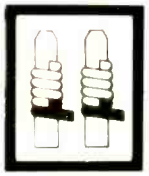

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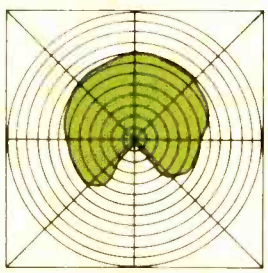
A 40 db+ rejection means that if a signal is coming in at a certain strength and the ASTRO BEAM is turned around so that the back is toward the signal, the signal will drop 40 db or more*.



*The Actual Astro Beam Polar Plot Shows Signal at 41 db Power Level Reduced to Almost 0 db on Back of Antenna. Think of how you can cut out unwanted signals with this kind of rejection.

Forward gain of 11 db over an isotropic source is a means of rating the antenna's ability to increase, receive, and transmit signals. The point here is that the ASTRO BEAM has about 1 db more than the best 3 element beam currently on the market. This gain has the equivalent of multiplying your power about 12.5 times.

SPECIFICATIONS

Rejection — 40 db+ front-to-back
Forward Gain — 11 db over an isotropic source
Impedance — 50-52 ohms
Boom Length — 10½ feet, Weight — 14 lbs.
Mode — Vertical Beam Wind Load Area — 2.6 sq. ft.
Light to Medium duty rotor needed
Turning Radius — 63 inches Power Multiplication — 12.6x
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