BACK-TO-SCHOOL SECTION – DIGITAL TROUBLESHOOTING

$1.25 ■ NOV 1978

Radio-Electronics®

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

DIGITAL WIPER DELAY

Build it and add it to your car. Provides intermittent windshield wiper operation and is programmed automatically. Turn to page 60.

AUDIO BREAKTHROUGH

New metal-particle tape for recording promises ultra-performance in the near future. For the complete story, turn to page 49.

VIDEO TANK GAME

Use your cannon to destroy your opponent first but watch out for the barriers. Construction starts on page 52.

CAPACITANCE METER

Part 2: 4-digit display reads out between 1 pF and 9999 μF. Turn to page 67.

COVER STORY
UNUSUAL TELEPHONE

Built into a stylish handset is a complete telephone and amplifier. To see how it's done, turn to page 37.

PLUS

- ★ Digital Crib Sheets
- ★ Computer Corner
- ★ Hobby Corner
- ★ Service Clinic

600 MHZ. FREQUENCY COUNTER
±0.1 PPM TCXO

OPTO-8000.1

This new instrument has taken a giant step in front of the multitude of counters now available. The Opto-8000.1 boasts a combination of features and specifications not found in units costing several times its price. Accuracy of ±0.1 PPM or better — *Guaranteed* — with a factory-adjusted, sealed TCXO (Temperature Compensated Xtal Oscillator). **Even kits require no adjustment for guaranteed accuracy!** Built-in, selectable-step attenuator, rugged and attractive, black anodized aluminum case (.090" thick aluminum) with tilt bail. 50 Ohm and 1 Megohm inputs, both with amplifier circuits for super sensitivity and both diode/overload protected. Front panel includes "Lead Zero Blanking Control" and a gate period indicator LED. AC and DC power cords with plugs included.

SPECIFICATIONS:
Time Base—TCXO ±0.1 PPM GUARANTEED!
Frequency Range—10 Hz to 600 MHz
Resolution—1 Hz to 60 MHz; 10 Hz to 600 MHz
Decimal Point—Automatic
All IC's socketed (kits and factory-wired)
Display—8 digit LED
Gate Times—1 second and 1/10 second
Selectable Input Attenuation—X1, X10, X100
Input Connectors Type —BNC
Approximate Size—3"h x 7½"w x 6½"d
Approximate Weight—2½ pounds
Cabinet—black anodized aluminum (.090" thickness)
Input Power—9-15 VDC, 115 VAC 50/60 Hz
or internal batteries

OPTO-8000.1 Factory Wired **$299.95**
OPTO-8000.1K Kit **$249.95**

ACCESSORIES:
Battery-Pack Option—Internal Ni-Cad Batteries and charging unit **$19.95**

Probes: P-100—DC Probe, may also be used with scope **$13.95**
P-101—LO-Pass Probe, very useful at audio frequencies **$16.95**
P-102—High Impedence Probe, ideal general purpose usage **$16.95**

VHF RF Pick-Up Antenna-Rubber Duck w/BNC #Duck-4H **$12.50**
Right Angle BNC adapter #RA-BNC **$ 2.95**

FC-50 — Opto-8000 Conversion Kits:
Owners of FC-50 counters with #PSL-650 Prescaler can use this kit to convert their units to the Opto-8000 style case, including most of the features.

FC-50 — Opto-8000 **Kit $59.95**
*FC-50 — Opto-8000F **Factory Update $99.95**
FC-50 — Opto-8000.1 (w/TCXO) **Kit $109.95**
*FC-50 — Opto-8000.1F **Factory Update $149.95**
*Units returned for factory update must be completely assembled and operational

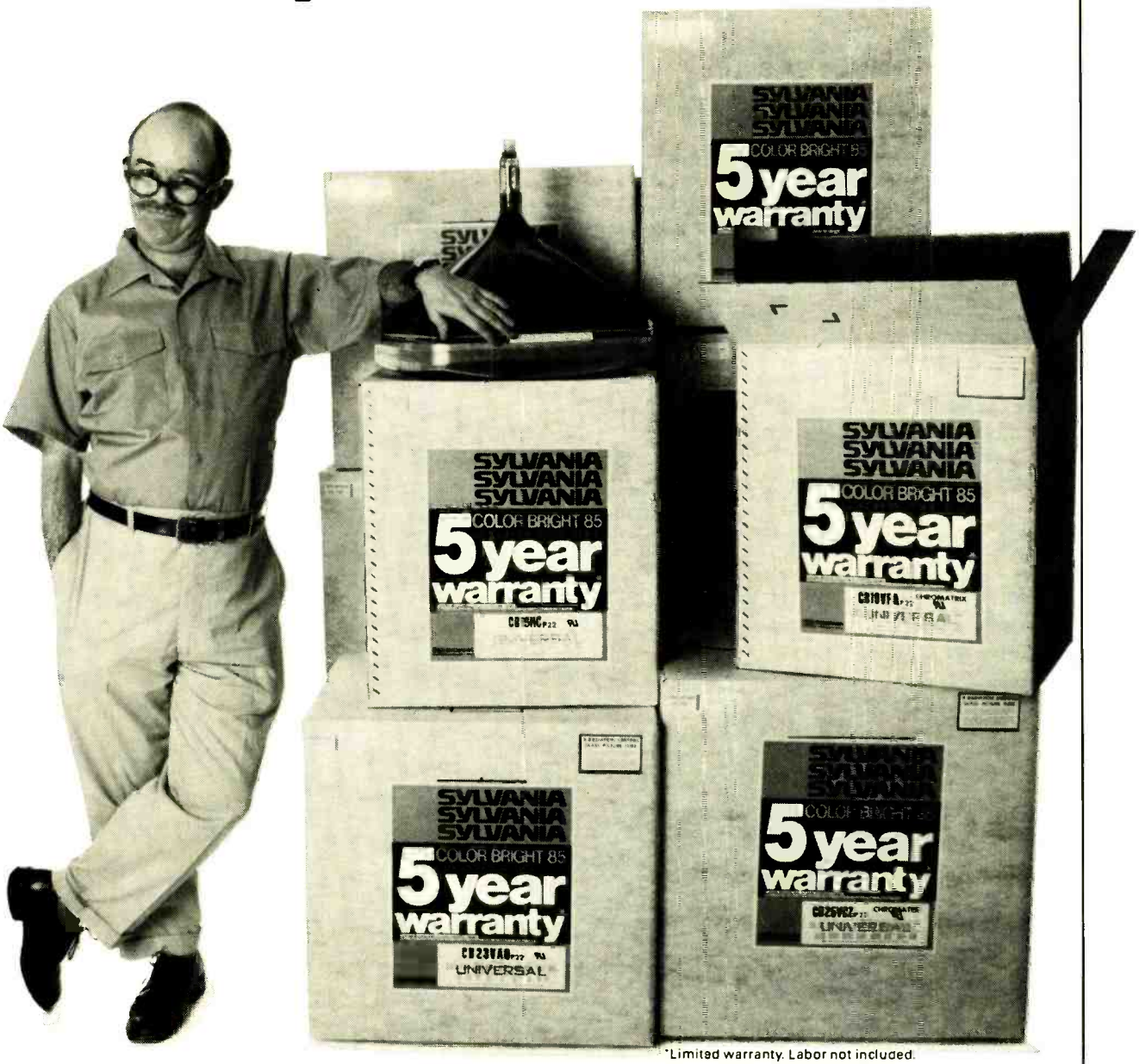
OPTOELECTRONICS, INC.
5821 NE 14 Avenue
Ft. Lauderdale, FL 33334
Phones: (305) 771-2050 771-2051
Phone orders accepted 6 days, until 7 p.m.

master charge
BANKAMERICARD

TERMS: Orders to U.S. and Canada, add 5% to maximum of $10.00 per order for shipping, handling and insurance. To all other countries, add 10% of total order. Florida residents add 4% state tax. C.O.D. fee: $1.00. Personal checks must clear before merchandise is shipped.

CIRCLE 18 ON FREE INFORMATION CARD

Only eight TV tubes can make a warehouse out of your backroom.



*Limited warranty. Labor not included.

To offer fast replacement for 385 different TV tubes, you'd have to open a warehouse. Or, you could open eight Sylvania picture tube cartons.

Our eight Universal Color Bright tubes are designed as direct replacements for 385 bonded safety plate picture tubes. And they're designed so well that they're offered with a five-year limited warranty.*

Call your Sylvania distributor to stock up on Color Bright tubes. Then, you won't have to wait days for your customer's new tube to be delivered.

You can order a Color Bright for immediate delivery right from your own backroom.

SYLVANIA

Electronic Components

GTE

CIRCLE 68 ON FREE INFORMATION CARD

We didn't have to make a better 2 track than our RS-1500. So we made a 4 track. Introducing the RS-1506.

Ingenuity is truly rare. Repeated ingenuity is true genius. Like the Technics 4-track RS-1506. It offers twice the program time of our 2-track RS-1500.

It also offers the award-winning RS-1500's "Isolated Loop" tape transport with a quartz-locked, phase-controlled, direct-drive capstan.

By isolating the tape from external influences we minimized tape tension to a constant 80 mgs. Providing extremely stable tape transport and low head wear. While reducing modulation noise and wow and flutter to a point where they are barely measurable on conventional laboratory equipment.

Electronically, too, Technics RS-1506 provides the same level of professional control as its predecessor. A separate microphone amplifier. Mixing amplifier. And separate three-position bias/equalization switches. While IC full-logic function permits absolute freedom in switching modes. Also available is an optional full-feature infrared wireless remote control (RP-070). It lets you operate all transport functions and record from up to 20 feet.

For the same performance as the RS-1506 with the convenience of auto reverse, there's the RS-1700.

Compare specifications. Even with the best 2-track decks. TRACK SYSTEM: 4-track, 2-channel recording, playback and erase. 2-track 2-channel playback 4-head system. FREQ. RESP.: 30-30,000Hz, ±3dB (—10dB rec. level) at 15ips. WOW & FLUTTER: 0.018% WRMS at 15ips. S/N RATIO: 57dB (NAB weighted) at 15 ips. SEPARATION: Greater than 50dB. RISE TIME: 0.7 secs. SPEED DEVIATION: ± 0.1% with 1.0 or 1.5mil tape at 15ips. SPEED FLUCT.: 0.05% with 1.0 or 1.5mil tape at 15ips. PITCH CONTROL: ±6%.

Technics 4-track RS-1506 and auto-reverse RS-1700. A rare combination of audio technology. A new standard of audio excellence.

Technics
Professional Series

CIRCLE 57 ON FREE INFORMATION CARD

Radio-Electronics®

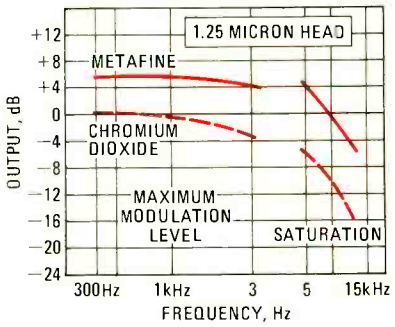
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

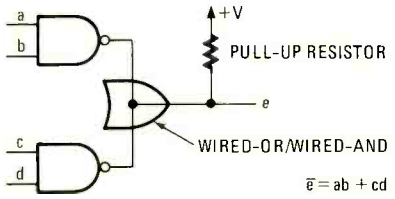
NOVEMBER 1978 Vol. 49 No. 11

ON THE COVER

That brick wall is made up of a large number of very special telephones. Take a look at the circuitry and how it works. Just turn to page 37.



NEW METAL-PARTICLE TAPE promises higher output levels with lower distortion. Story starts on page 49 and presents full details.



WIRED-OR/WIRED-AND is just one kind of digital circuit covered in digital troubleshooting story on page 41.

Radio-Electronics, Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Phone: 212-777-6400. Second-class postage paid at New York, NY and additional mailing offices. One-year subscription rate: U.S.A. and U.S. possessions, $9.98, Canada, $12.98. Other countries, $14.98. Single copies $1.25.

Subscription Service: Mail all subscription orders, changes, correspondence and Postmaster Notices of undelivered copies (Form 3579) to Radio-Electronics Subscription Service, Box 2520, Boulder, CO 80322.

A stamped self-addressed envelope must accompany all submitted manuscripts and/or artwork or photographs if their return is desired should they be rejected. We disclaim any responsibility for the loss or damage of manuscripts and/or artwork or photographs while in our possession or otherwise.

looking ahead

Projection TV: Three-tube projection TV is now in the lines of several major-brand TV manufacturers. Advent's new Model 760 has a 72-inch screen and a horizontal in-line-tube arrangement permitting a long, low projector which does added duty as a cocktail table. (Please don't spill your drinks on the electronics.) Panasonic and Quasar both have different versions of 60-inch one-piece sets—the optics are the same but electronics and furniture are different. Mitsubishi (MGA) has a two-piece 72-inch projection system and a one-piece 50-inch system. Sharp has a 72-inch two-piece system similar to Mitsubishi's. Sony has two one-piece units, with 50- and 70-inch screens, each with three tubes and two lenses. GE has the rear-view unit described in the July 1978 issue of **Radio-Electronics.** All the three-tube major-brand systems sell for more than $3,000. The GE single-tube unit is $2,800.

New feud? Remember hand wiring vs. printed circuits? We may be getting ready for a new RCA-vs.-Zenith dispute over set construction, but this one is much tougher to call. In introducing its 1979 color TV models, RCA quietly inaugurated a new chassis in two high-end 19-inch sets, and company spokesmen indicated that this indeed is RCA's chassis of the future. What's so special about it? Well, it's all one piece—not modular. RCA officials explain that the modular chassis has performed its function by introducing technicians to solid-state TV circuits. They said that 20% of modules returned to RCA for servicing have tested good, with no defects, and presumably the problem was in the connections. The new chassis reduces physical connections by 75% (to 30), wires from 150 to 40, hand-solder joints from 200 to 75. RCA concedes that it might cost a little more to repair the new set than its modular predecessors, but says repairs should be required less frequently.

So the very next week, what does Zenith do? Why, it introduces a brand spanking-new modular chassis, that's what. Well, the chassis has been quietly in use for some months, but now it's got a name (*Triple-Plus*). It has eight modules and low-cost Zenith-developed connectors that are claimed to compare favorably with military specs. Zenith's argument for modular: "The cost saving of the unitized chassis is not enough to give up the service advantages . . . This 100% modular chassis permits virtually 100% in-home repair."

More metal tapes: Although criticized by some competitors, 3M's introduction of its revolutionary metal-alloy audio tape (see **Radio-Electronics,** September 1978) may have established a standard of sorts. Fuji already has announced it will be next on the market with a metal tape, and company spokesmen indicated that it would be compatible with the 3M *Metafine* tape. Next to come in line has been BASF, which announced it had distributed samples to Japanese equipment manufacturers, with coercivity levels of both 950 and 1,100 oersteds. However, BASF suggested that any industry coercivity standard not exceed 1,000 oersteds. TDK also has a metal-particle tape and has provided samples to hardware manufacturers.

Videodisc boxscore: As the time draws nearer for the first U.S. consumer marketing of home videodiscs and players (at press time it was still scheduled for December or January in three or four introductory cities), more new systems are showing up. For the record, here's a summary of what has surfaced to date: **Ted**—developed by German Telefunken, British Decca and a joint subsidiary called Teldec, this mechanical system uses a flexible one-sided 8¾-inch discs which play for up to 10 minutes each. It has been marketed in Germany and Japan, is now principally used for education and training purposes. **Philips/MCA**—an optical system which will be marketed to consumers initially by Magnavox, later also by Universal-Pioneer of Japan. It uses 12-inch reflective double-sided discs. These play for up to 30 minutes-per-side and revolve at 1800 rpm while longer-playing discs (up to 60 minutes-per-side) revolve at a speed varying from 600 to 1800 rpm. The pick-up never touches the disc. **RCA**—this is a capacitance needle-in-groove system that plays for up to one hour-per-side of each two-sided disc, revolving at 450 rpm. RCA hasn't yet made a commitment for marketing. **Thomson-CSF**—this French system, like Philips/MCA, is a laser-read optical system, but the discs are transparent rather than reflective. Two-sided discs are possible. Discs demonstrated have played for up to 30 minutes-per-side. The disc revolves at 1500 rpm for the PAL color system, 1800 rpm for NTSC.

A few units are being produced for demonstration and industrial-institutional uses. **MDR**—Magnetic disc recorder, originated in Germany and demonstrated in various forms, both records and plays back using an oxide-coated plastic disc. **Visc**—Mechanical system developed by Matsushita, playing 30 minutes or 60 minutes-per-side of a 12-inch disc, depending on version used, revolving at 450 rpm. Smaller seven-minute disc is the size of a 45-rpm audio disc and revolves at 720 rpm. No announced plans for commercialization. **Sony**—Reflective optical disc, laser-read, similar to the Philips/MCA development except that it revolves at 900 rpm. Provides up to one hour-per-side of two-sided 12-inch disc. No announced plans for commercialization. **JVC**—Capacitance system using ungrooved disc revolving at 900 rpm, claimed to have many advantages of optical systems but lower costs because of elimination of necessity to use laser pickup. No known plans for commercialization.

Color, China and USSR: The U.S. may be officially tilting toward China in its foreign policy, but in color TV technology it's dealing more closely with the Soviet Union. RCA, Owens-Illinois Glass and several Japanese firms have received contracts, estimated to total more than $100 million, to provide the USSR with color tube manufacturing equipment and technology. Meanwhile, Hitachi and Toshiba are understood to have negotiated contracts with China to build a color tube plant and an IC development and manufacturing facility, respectively, with a total value of about $245 million.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

new & timely

Bell Labs designs communications system for the disabled

Bell Laboratories, together with the Telephone Pioneers of America (a voluntary industrial organization), has designed *Unix*, an experimental computer-based communications system for severely handicapped persons, such as cerebral palsy victims.

BELL LABS COMMUNICATIONS SYSTEM, *Unix*, contains a large keyboard with recessed keys that can be used by severely handicapped persons. Here a cerebral-palsied child uses a cap pointer to type a message on the keyboard.

The *Unix* system uses a special oversized keyboard coupled to a computer that is connected to a TV set and a page printer. The keys are large recessed pushbuttons that can be pressed either by a finger or by a pointer attached to a cap worn by the user that is controlled by head motion. Pressing the buttons with the pointer causes the "typed" message to appear immediately on the screen; two other pushbuttons can be pressed for a copy of the message.

For simplicity and to reduce the amount of typing to a minimum, abbreviations are used for words, word endings and phrases. For example, "GH" stands for "I want to go home," and "gb" means "goodbye." A standard list of abbreviations has been preprogrammed by Bell, and instructions for adding more abbreviations are being developed.

The *Unix* system is designed so that up to three persons can share it; it also lets the computer perform store, retrieve, process and control tasks simultaneously.

Best record of 1978 receive audio awards

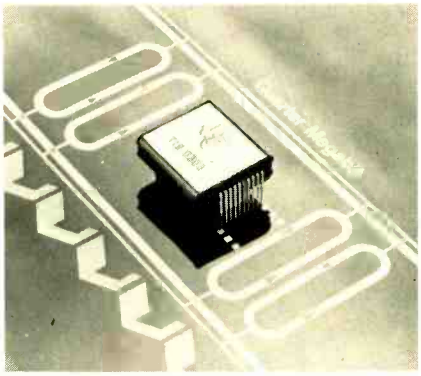
The 1978 Audio Excellence Record Awards were recently presented by Audio-Technica U.S., Inc., for discs in three categories: classical music, rock/pop and special-interest recordings.

The winner in the classical music category is a British recording of Tchaikovsky's Six Symphonies and Manfred performed by the London Philharmonic conducted by Mstislav Rostropovich (EMI ELS 5099) and produced by David Mottley. For rock/pop, the top record was Steely Dan's "Aja," produced by Gary Katz (ABC AA 1006). In the special-disc category, the award was given to a direct-to-disc recording by Harry James and His Big Band, produced by Doug Sax and Lincoln Mayorga (Sheffield Lab 6).

TI's quarter-million-bit magnetic bubble memory due in late '78

Some time in the last quarter of 1978, TI will release its new quarter-million-bit magnetic bubble memory IC, the TIB0303, with a family of interface and control circuits available in 1979.

The bubble IC is composed of a gadolinium-gallium garnet substrate on top of which is superimposed a layer of magnetic epitaxial film. Permalloy metal patterns placed on the film determine the way the 3-micron-diameter bubble domains move when they are exposed to a rotating magnetic field, provided by two orthogonal coils. When the magnetic field rotates, the bubble domains move under the permalloy patterns similar to shift registers.



TI'S MAGNETIC BUBBLE MEMORY is a quarter-million-bit device. The advantages of bubble memory technology include storage density and nonvolatile characteristics.

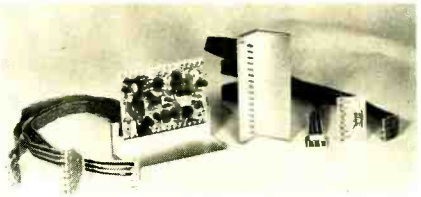
The TIB0303 has a 7.2-ms average access time (for the first bit of the 224-bit page), a 0.9-watt power consumption, a read-data rate of 100K bits-per-second, and an operating temperature of 0° to 50°C. It comes in a 20-pin dual-in-line package and measures 1.2 × 1.2 × 0.4 inches; the package includes the IC, the magnetic coils, a permanent magnet set and magnetic shielding, and costs $500.

Connecticut to receive first off-track betting/entertainment center

By the fall of 1979, New Haven, CT, will be the site of Teletrack, the very first off-track betting and entertainment center in a theatre environment. The center will use a closed-circuit TV system to provide betting customers with on-track events and paddock activities as they occur.

Teletrack was developed by General Instrument Corporation, manufacturer of electronic systems and components, and built by AmTote, a subsidiary of the company, as part of the state's off-track betting system. Microwave transmissions will bring the track events into the betting center, where they will be displayed on giant 24-foot by 32-foot screens, as well as on strategically placed monitor screens. Customers will place their bets through TIM 300 ticket-issuing machines, insuring the efficiency of the betting operations.

TV MODULE SERVICING AIDS



GTE-SYLVANIA CHEK-A-BOARD CABLE kits make it possible for technicians to service solid-state TV sets without removing the chassis. The *Chek-A-Board* kits, designed for use with RCA and Zenith modular sets, contain cables with female connectors on one end for modules, and mating chassis connectors on the other end. The two-foot cables, composed of stranded multilead ribbon wire, feature plated-alloy conductors on acrylic plastic PC boards. The side of each cable bears a different color for ease in orientation.

1978 mid-year VTR sales to dealers exceed 1977 figures

According to the Marketing Services Department of EIA, total U.S. market sales of home videotape recorders to dealers increased in June 1978, and showed an upward trend in the first six months of the year—in contrast to sales for a similar period in 1977. During the first 26 weeks of 1978 VTR sales to dealers amounted to 142,490 units and the June VTR sales came to 31,339.

Fotomat offers new film-to-videotape service

Fotomat Corporation is now offering a special service at all its 3400 stores in the U.S.: it will transfer your film and/or slide photography to a videotape cassette.

How it works is this: You take your film (either 8-mm or Super 8-mm) and/or 35-mm or 126-mm color slides to your Fotomat dealer who will transfer the material to either ½-inch Beta or VHS-format videotape. All you have to do is inform Fotomat what type of VTR you own so that the correct cassette format can be chosen.

continued on page 12

We've done the impossible again!
A versatile and superior frequency counter kit for only $89.95

Now you can forget about price/performance trade-offs when you select a frequency counter. In Sabtronics' Model 8100 you get features you once expected to pay several hundreds of dollars for. But you pay only our low, low price of $89.95!

Dare to Compare. This frequency counter, using LSI technology, has the performance and input characteristics you demand. Note the specifications: You will see that the frequency range is guaranteed all the way to 100 MHz; and a high or low input impedance allows you to select for high-frequency operation. And you'll see a sensitivity that holds well over the frequency range; convenient selectable gate-time for best resolution; and selectable attenuation; and even an optional pre-scaler. Note the highly accurate time base, and its excellent ageing and temperature characteristics. And a full 8-digit LED display with floating decimal point, leading zero suppression, and overflow indicator.

You would expect to find all these features together only on a much higher-priced instrument. But Sabtronics' advanced digital technology combines with your own skill — you assemble this kit from our easy-to-follow instructions — to make it possible for you to have this fine frequency counter at a fraction of what you would otherwise expect to pay.

Free 10-day trial
Examine the 8100 Frequency Counter Kit for 10 days. If not completely satisfied, return unassembled for full refund of $89.95 purchase price.

Brief Specifications
• Frequency Range: 20 Hz to 100 MHz guaranteed (10 Hz to 120 MHz typical) • Sensitivity: 25 mV RMS, 20 Hz to 70 MHz (20 mV typical); 45 mV RMS, 70 MHz to 120 MHz (30 mV typical) • Selectable Impedance: 1 MΩ at 25 pF, or 50 Ω • Selectable Attenuation: X1, X10, or X100 • Accuracy: ± 1 Hz plus time-base accuracy • Ageing rate: ± 5 ppm/yr • Temperature stability: ± 10 ppm, 0° to 50°C • Selectable Gate-time: 0.1 sec, 1 sec., or 10 sec. • 8-digit LED display with floating D.P., overflow indication • Input: 9-15 VDC, 350 mA (550 mA with optional prescaler) • Input protection: 150 V RMS, 20 Hz to 10 kHz; 30 V RMS to 2 MHz; and 3 V RMS to 100 MHz • Optional prescaler extends frequency range to 650 MHz. (Available soon)

To: Sabtronics International, Inc. RE-11
13426 Floyd Circle, Dallas, TX 75243

Please send me____Sabtronics Model 8100
Frequency Counter Kit(s) at $89.95 each $_____
Texas Residents add Sales Tax $_____
Shipping and handling, $5.00 per unit (USA only)* $_____
Payment enclosed ☐ $_____
Charge my Master Charge ☐
Visa ☐
Account No. _____ Exp. Date_____
Name _____
Street _____
City _____
State _____ Zip _____
*Canada $6.50. All other countries $19.00 Airmail.

sabtronics INTERNATIONAL INC.
13426 Floyd Circle · Dallas, Texas 75243
Telephone 214/783-0994

Now NRI makes it TV/Audio home

Side-by-side equipment comparison of NRI and two other leading schools shows what you get for what you pay. When you have to pay as much as $985 more for another school's course, you should carefully consider your tuition investment.

When you sit down and try to pick out the school that's best for you, it gets to be a problem. Catalogs are radically different and some are not too clear as to what you actually get for your money. So NRI has done a lot of the work for you. And put the prices right up front so you can make your own judgment.

Of course, we can't compare everything. Lesson clarity and content vary. What one covers here, another covers there...or not at all. The material one school breaks down into eight lessons may be four at another. And the qualifications and abilities of instructors are another question.

	NRI	SCHOOL A	SCHOOL B
COURSE TITLE	Master Course in TV, Audio, and Video System Servicing	Master Course in Color TV Servicing	Electronics Technology and Advanced Troubleshooting I & II
CASH PRICE (terms available)	$1295	$1539	$2280
TV SET	NRI designed-for-learning kit. Dual speaker 25" (diagonal) color TV with cabinet	Heathkit GR-2001 25" (diagonal) color TV (cabinet extra)	Zenith model G4020W 19" (diagonal) color TV (fully assembled)
OSCILLOSCOPE	NRI designed-for-learning kit. 5" (8 x 10 cm) triggered sweep	Heathkit IO-4541 5" (8 x 10 cm) triggered sweep (not given until after graduation)	Heathkit IO-4541 5" (8 x 10 cm) triggered sweep
COLOR BAR GENERATOR	NRI designed-for-learning kit. 10 patterns	Elenco SG-200 (kit) 10 patterns	Elenco SG-200 (fully assembled) 10 patterns
FREQUENCY COUNTER	NRI designed-for-learning kit. Complimentary metal oxide semiconductor digital type		
METER	NRI designed-for-learning kit. Transistorized AC/DC volt-ohm meter	Heathkit (part of TV kit) DC only; IK Ohm/volt	Private label multimeter
AUDIO	NRI designed-for-learning kit. Four-channel high-fidelity AM/FM tuner with speakers	Private label pocket transistor AM radio kit and AM-FM-SW solid-state portable radio kit	
TRAINER	NRI Discovery Lab	Breadboard	Experimental Electronics Lab
MISCELLANEOUS EQUIPMENT		EICO Digital Logic Probe	

All data as shown in each school's catalog as of September 1, 1978.

One Million Students, Over 60 Years' Experience

So we can only tell you what NRI has to offer. We've been in education since 1914, starting as a radio school six years before commercial broadcasting was even on the scene. Since then, we've kept right up with the times, improving techniques, adding material, creating new courses to help people improve their skills and income.

Early on, we learned to keep our lessons compact...thoroughly covering a subject, but not so much that students would be overwhelmed. We call them "bite-size" lessons because they're easy to digest.

Learn by Doing with "Hands-on" Training

And, we pioneered the concept of "hands-on" training. NRI goes far beyond theory and textbooks to give our students actual bench experience and prepare them for the realities of electronic servicing. Every piece of equipment in our Master Course in TV and Audio Servicing is designed for learning. As you assemble the kits we supply, you build a highest-quality, up-to-date 25" (diagonal) color TV, a 4-channel amplifier and tuner with speakers, your own oscilloscope,

Learn as you build with "hands-on" training.

easy to compare study courses.

digital frequency counter, and other instruments you'll use in your course, use later to earn good money as a TV/Audio technician.

The point is, none of this equipment is hobby-kit or commercial assembly line units with lessons "retro-fitted" to what was at hand. NRI has designed each so you get invaluable training and experience you just can't get any other way. As you build, you study operation of circuitry, see how sections interact, perform "power-on" experiments only possible with NRI. This total training is exclusive with NRI...no other school, home study or resident, offers it.

Instructors Who Know Their Business

NRI instructors are thoroughly qualified, with both technical and educational experience. Most of them helped develop NRI courses, lessons, and equipment, so they really know what they're talking about. They're interested in their students, always ready to help with a question, a problem...give good advice to help you reach your goals.

It's instructors and training like this that have made NRI the choice of professional TV servicemen who have taken home study courses. As a national survey shows (summary on request), they recommend NRI by a majority of three to one over any other school.

So how does NRI give you all this and still cost so little? We keep costs down by designing our own training kits, eliminating the middleman's profit on hobby kits or commercial units. And by offering our training by mail only. We have no sales force, no commissions to pay. You make up your mind in your own time, without pressure, let the facts speak for themselves. We pass these savings on to you in the form of lower tuitions, more equipment, carefully designed courses and effective lessons.

Send for Free Catalog, No Salesman Will Call

Send for our free catalog today and get all the details. See every piece of equipment and kit you get...a complete listing of fully described lessons...explanations of each and every experiment you perform. Read about NRI's background and qualifications...career opportunities ...what NRI graduates say about their training...costs and monthly payment plans for the courses that interest you. Then compare NRI value and results and make your decision. Like the million that have gone before you, we think you'll choose NRI. Send the card today.

Build and keep 2-meter transceiver, test equipment for a communications career.

Or check out NRI value-training in Computer or Communications/CB Equipment Servicing.

If you're interested in learning how to service and maintain digital computers, check out our NRI course. You learn at home, in your spare time, and actually build a programmable, integrated circuit, digital computer with expanded memory. Or maybe your interest is CB or the expanding world of communications... mobile radio, microwave, TV broadcasting, and much more. NRI can help you there, too, as you build and experiment with your own digitally synthesized 2-meter transceiver. For these and other NRI home study courses, just check the postage-paid card and mail today. If card is missing, write to:

NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, D.C. 20016

new & timely

continued from page 6

It is expected that this new service will benefit most those with an enormous backlog of already developed but rarely viewed movies and slides, as well as in the development and creation of new film and slide libraries. Sound narration or music to accompany a previously transferred movie or slide can be added by merely plugging in a mike or an audio input into the jack on the front of a VTR. In addition to home applications, Fotomat also sees possible future use for the new service in business, medical and educational fields.

The videotape cassette offered in Fotomat stores as an adjunct to the new service will cost the same as those presently being offered in the Fotomat drive-in stores. The cost of transferring a 400-foot roll of Super 8-mm film, plus the videotape cassette, is $14.95 (for the 1-hour format).

NESDA/ISCET INSPECTS AND RATES RCA CHASSIS

In Las Vegas recently, a NESDA/ISCET inspection team looked over and rated three RCA TV chassis: the CT 92A, CTC 93D and CTC 88AC. The CT 92A was rated as "good," and the CTC 93D and CTC 88AC were each given an "excellent." The inspection forms used were developed by the serviceability committee from information supplied by manufacturers and from the service industry. Shown from left to right are CET members Don Winchel, Dean Mock, Jack Lang, R. E. Eddy, Hal Robbins, Frank Grabiec (ISCET vice-chairman) and Edward Burroughs.

NRBA approves proposed law to deregulate radio

The National Radio Broadcasters Association (NRBA) has approved proposed new legislation to deregulate the radio industry. The Communications Act *(HR 13015)* has as one of its primary objectives the release of radio from government restrictions. While not all the Act's proposals received the NRBA blessing, the association believes it will insure the continued growth and diversity of the radio industry in a competitive free marketplace, and that this will best serve the public interest. It is hoped that there will be enough input to the subcommittee from industry representatives and private individuals that the proposed legislation will be passed, or at the very least that appropriate amendments will be made to the Communications Act of 1934.

Service-profits rise revealed by retail association survey

The National Association of Retail Dealers of America (NARDA) has published a cost-of-doing-business Survey that reveals that in 1977 service operations showed a 5.8% net profit (as against total sales) plus a 4.7% after-taxes profit.

Referring to a 9.5% increase in overall sales, John Gooley, manager of the NARDA service division, cautioned that "it should be kept in mind that the increase is among actual participants in the survey," and adds that the service industry volume may have declined due to a corresponding decline in the incidence of failure (in equipment). Labor income, however, was greater than parts income—the result of the gross margin on labor income being greater than that on parts. The Survey also indicates that inventories continued to rise during 1977, with 18.5% more inventory on hand at the end of the year than at the beginning.

The figures listed in the Survey are all percentages, making it possible to compare them with data from earlier years. The Survey costs $25 ($10 to NARDA members), and can be obtained from NARDA, 2 North Riverside Plaza, Chicago, IL 60606.

Programmable VCR provides up to 4-hour recording capability

RCA has designed a programmable video cassette recorder, the *SelectaVision 400 (model VCT400)*, that can be preprogrammed to record up to four TV shows simultaneously on different channels over a seven-day period. The unit is microprocessor-based, has a varactor tuner and two switch-selectable speeds: the long play setting provides a four-hour-per-cassette recording time; the standard play setting provides a two-hour-per-cassette recording time.

PROGRAMMABLE VCR can be preprogrammed to record up to four TV programs on different channels over a seven day period. In addition, the RCA VCT-400 has a 14-channel varactor tuner and a program indexing feature that lets you find the starting point of a recorded program.

To preset the VCR to record up to a full week's programs in advance, all that's needed is to store into memory the day, time, length and channel of the program you want taped. Other features include an electronic indexing capability, tape counter with memory switch, remote pause control, a tracking control (to correct distortions) and 14 channel selector switches that receive all UHF/VHF channels in any desired sequence. The *SelectaVision 400* carries a suggested retail price of $1275.

IHF installs hi-fi systems in the White House

The Institute of High Fidelity, Inc. (IHF) was instrumental in selecting and assembling two complete high-fidelity systems for the White House—one for the President's living quarters, the other for the White House solarium.

Leonard Feldman, IHF technical director, selected the components and accessories from a list of IHF member companies whose names, in turn, had been drawn by Chip Carter.

Mr. Feldman said that the IHF intent in selecting the individual components for both systems was that they be representative of typical hi-fi equipment enjoyed by American families. The 14 manufacturers chosen to supply the White House are U.S. Pioneer, JVC America, Shure, Kenwood, Koss Corporation, Altec, Sony, Jensen Sound Labs, TDK Electronics, Sansui, B.I.C./ Avnet, Pickering & Company, TEAC Corporation of America, and Maxell. The Institute also has the responsibility of reviewing the systems and replacing the components with new, more technologically up-to-date units as the need warrants.

TI awarded Japanese patent for miniature calculator

In August 1978, over the objections of several Japanese calculator companies, the Japanese Patent Office issued a patent to Texas Instruments covering the manufacture of practically all minicalculators incorporating their circuitry in a single IC. The Japanese patent is based on U.S. patent 3,819,921 originally filed in 1967 and granted TI in 1974.

The calculator described in the 1967 patent was the first to provide the computational capability of larger machines. The heart of the TI minicalculator was an integrated circuit that performed four basic arithmetic functions. It measured 4¼ × 6⅛ × 1¾ inches, and featured a small 18-pushbutton keyboard and a thermal printer to display up to 12 digits.

Nineteen other countries to date have issued patents to TI for manufacturing minicalculators. **R-E**

BEARCAT® SCANNERS ANNOUNCE AMERICA'S ONLY 50-CHANNEL, MICRO PROCESSOR CONTROLLED SCANNER. IT SEARCHES, STORES, REMEMBERS AND ALL BUT THINKS FOR YOU.

The new *Bearcat* 250.
An unbelievable advancement
in no-crystal scanning.

Bearcat's new, 250 is fully synthesized
for punch-in programming. It searches,
stores, and recalls every bit of programming,
on a vast, 50-channel spectrum.
Automatically.
Unbelievable? Read and
believe.

CRYSTAL-LESS. Micro processor controlled. Brings in every local frequency, automatically, without a crystal.

50 CHANNELS. Scans up to 50 channels in banks of 10 each. Scans any combination of banks at the touch of a button.

SEARCH/STORE. Seeks out and stores up to 64 active local public service frequencies automatically.

SEARCH/RECALL. Retrieves stored frequencies for simple entry into scan program.

PRIORITY CHANNEL. Samples a designated priority frequency on channel 1 every two seconds.

DIGITAL CLOCK. A genuine, LED quartz crystal digital clock. Shows hours, minutes, seconds.

5-BAND COVERAGE. Low, high, UHF, UHF-T. Plus 2 meter amateur ham band, and other UHF frequencies.

COUNT. Transmissions on each frequency counted automatically to determine which are most active.

SCAN/SEARCH LOCKOUT. A unique feature. Not only locks out channels while scanning, it also eliminates unwanted frequencies while searching.

AND MUCH MORE! Selective Scan Delay. Direct Channel Selection. Scan Speed Control. Automatic Squelch. Track Tuning Circuitry. Front-Mounted Speaker. Decimal Display. Quality Construction. AC/DC. UL listed. FCC Certified.

THE INCREDIBLE, NEW BEARCAT® 250 SCANNER.

LEADING THE WAY TO REAL EXCITEMENT.

CIRCLE 36 ON FREE INFORMATION CARD

guest editorial

SCIENCE FOR JOURNALISTS

Journalism students often explain their choice of profession by saying that they want to write. One caustic observer noted that this statement is tantamount to a medical student wanting to study surgery so that he can operate.

The point is that the surgeon's goal is not to cut but to cure. Likewise, the aim of the journalist should not be to "write" but rather to communicate. And there is much evidence that journalists are not communicating well.

The reason, according to some experts, is that journalism graduates today simply are not well educated. Whether dealing with history, economics, government, or science, they often demonstrate a poor grasp of principles, confusion over issues, or an inability to weigh the significance of events.

Science, in particular, gets apathetic coverage by the press. Shortly after NASA placed a probe on the surface of Mars, a poll by the *Indianapolis News* indicated that its readers regarded the event as one of the top ten news stories of the year. Surprisingly, a poll of the editors of that newspaper failed to place the Mars landing on the list. Editors subordinated this outstanding achievement to such events as a Korean border conflict and the outbreak of Legionnaires' disease.

Other cases demonstrate befuddlement of technical concepts, sometimes with an amusing twist. When the roof of the Hartford Civic Center collapsed last winter, *Newsweek* magazine reported that the structure had been "designed by a computer." A perceptive reader noted that a statement such as that could appear only in an article written by a typewriter.

Even some of the most respected periodicals downplay important technical aspects of a story. When Chrysler introduced its Omni and Horizon automobiles, the event was covered extensively in *The Wall Street Journal*. The report dwelt at length on the price of the cars and their competitive posture with respect to other compact automobiles. Only in the last sentence did it mention what is perhaps the most significant facet of the introduction—that the cars are the first U.S. built compacts with front-wheel drive.

All of this would amount to mere nit-picking if it were not for a worrisome aspect. The public, which relies heavily on the consumer press for information, is increasingly asked to support political decisions on technical matters ranging from the energy crisis to the neutron bomb. Journalists who are either confused by or indifferent to technology can hardly be counted on to provide meaningful information.

We don't have a ready solution to the problem. But it is encouraging to note that one liberal arts college has recently required its students to take courses in mathematics. The purpose, according to the college provost, "is to emphasize quantitative and logical ways of thinking."

Perhaps that avenue, or some other form of "science-appreciation" curriculum, should also be considered by journalism schools.

RON KHOL
Managing Editor
Machine Design

Reprinted from MACHINE DESIGN, July 6, 1978.

Radio-Electronics®

Hugo Gernsback (1884-1967) founder

M. Harvey Gernsback, editor-in-chief and publisher

Larry Steckler, KTX-3644, CET, editor

Arthur Kleiman, KTZ-3288, managing editor

Robert F. Scott, CET, W2PWG, KXK-8533, technical editor

Sonia Greenbaum, copy editor

Jack Darr, CET service editor

Leonard Feldman contributing high-fidelity editor

Karl Savon, semiconductor editor

David Lachenbruch, contributing editor

Earl "Doc" Savage, K4SDS, hobby editor

Vincent P. Cicenia, production manager

Ellen Celnik, production assistant

Harriet I. Matysko, circulation director

Sheila Wertling, circulation assistant

Arline R. Bailey, advertising coordinator

Cover design by Louis G. Rubsamen
Cover photo by Mel Small

Radio Electronics is a member of the *Institute of High Fidelity* and is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature.*

Gernsback Publications, Inc.
200 Park Ave. S., New York, NY 10003
(212) 777-6400
President: M. Harvey Gernsback
Vice President: Larry Steckler
Treasurer: Carol A. Gernsback
Secretary: Bertina Baer

ADVERTISING SALES
Paul McGinnis
Director of Marketing

EAST
Stanley Levitan
Radio-Electronics
200 Park Ave. South
New York, NY 10003
(212) 777-6400

MIDWEST/Texas/Arkansas/Okla.
Ralph Bergen
The Ralph Bergen Co.
540 Frontage Road—Suite 361-A
Northfield, Illinois 60093
(312) 446-1444

PACIFIC COAST
Mountain States
Jay Eisenberg
J.E. Publishers Representative Co.,
8732 Sunset Blvd.,
4th Floor,
Los Angeles, CA 90069
(213) 659-3810
Sales Mart Building
1485 Bayshore Blvd., Box 140
San Francisco, CA 94124
(415) 467-0125

SOUTHEAST
J.E. Publishers Representative Co.,
214-387-2424

How to listen to Moscow, Russia... Moscow, Idaho and your good buddy, Max Moscow.

Panasonic introduces the Command Series.™

Tune in. Sit back. And travel the world with Panasonic's short wave radios—the Command Series. Set your itinerary by simply setting the dial. Stop off in London for a concert with the London Philharmonic. Be in Peking when they announce the new pecking order. Or visit old friends in the old country. Any old country. Even the good ol' U.S.A.

There are thousands of overseas and domestic short wave transmissions* you can tune in. And with an optional outside antenna, you'll get incredible accuracy with the RF-2800 (shown above). Because Panasonic's LED Digital Frequency Display is so precise, it's accurate to within 1 kHz. That's the kind of tuning that used to cost twice the price. That was up until the Panasonic RF-2800.

And if you want to hear more than short wave, the RF-2800 gives you more. Like SSB (single sideband) amateur radio. All 40 CB channels. Ship to shore. Even Morse communications. And, of course there's AM and FM.

And like more expensive short wave receivers, the RF-2800 has an RF-Gain Control to enhance weak, distant stations or to prevent overload distortion from overstrong stations.

The Command Series from Panasonic. Now you can travel the world without ever leaving home.

*Short wave reception will vary with weather conditions, operator's geographic location and other factors.

Panasonic®
just slightly ahead of our time.

CIRCLE 19 ON FREE INFORMATION CARD

letters

CRYSTAL OSCILLATOR PROJECT

The Hobby Corner article in the July 1978 issue states it is often desirable to change the frequency coverage of a receiver with a converter, the main part of which is a crystal oscillator.

The next paragraph is disappointing in that it does not explain how to use the oscillator to change receiver frequency, or a typical converter circuit.

I found the remainder of the article very clear and interesting. Was a paragraph left out; does **R-E** plan a follow-up article; could you send instructions on using the oscillator to change receiver frequency?

H. WOODS
Brentwood, NY

No, a paragraph was not omitted. There was no intention to go into further detail on frequency converters at that time.

Often the topic of a Hobby Corner column is some basic circuit that has many uses. In such cases, it is quite impossible to delve into all the possible applications. Only a limited number can be discussed in the space available. Other uses can only be mentioned in passing.

It is our hope that readers will be stimulated to look further into circuit applications. I am indeed glad that the converter idea aroused your interest. Perhaps in the future such applications can be discussed in Hobby Corner, but I am sure you will not want to wait that long.

So that you can follow up on your interest, here are a couple of references:

ARRL Radio Amateur's Handbook, *and* Solid State Design for the Radio Amateur, *published by the American Radio Relay League, Newington, CT 06111. Each publication has sections on frequency converters plus a great deal more. You can probably obtain them from the publishers or from the public library.*

EARL "DOC" SAVAGE

TRS-80 PROGRAM ERROR

Congratulations to your typesetter for being so accurate in exactly copying my TRS-80 Investment Evaluation Program listing (August 1978 issue). He even copied an error I made in the manuscript I sent you! In line 170, instead of the PRINT statement (P.) at the beginning of the line, it should be INPUT (IN.). It must have been another typesetter that mispelled my name in the byline.

FRED BLECHMAN

COSMAC NEWSLETTER

Readers of **Radio-Electronics** may be interested to know that a new RCA COSMAC 1802 computer newsletter has been published by Quest Electronics, entitled *Questdata*. Owners of Elf, Super Elf, Elf II, COSMAC VIP, COSMAC Development System or Homebrew 1802 systems will find programs, applications and experiments supporting their RCA 1802 COSMAC. The newsletter will feature complete instruction sets; how to set up programs for graphics, control, games, and business applications; plus sections on Tiny BASIC, Elf expansion possibilities, light pens, reader

questions and music programs. The subscription cost is $12; foreign subscriptions are $18 (to cover postage). Write *Questdata*, P.O. Box 4430, Santa Clara, CA 95054.
BILL HASLACHER
Editor
Santa Clara, CA

DeFOREST NOT EDISON

I've been a reader since the early Thirties when I subscribed to *Radio-Craft*.

You pulled a boo-boo in your September issue. In the article on "Pioneers in Radio," you show a picture of Lee DeForest holding the audion tube which, because of the added *grid* to the diode, started radio broadcasting. And he is not even mentioned in the article—you named him Thomas Alva Edison!
JOE BERO
Newark, DE

Boo-boo is right! The picture on page 46 of the September issue indeed shows Lee DeForest and not Thomas Alva Edison. The editorial staff of ***Radio-Electronics*** *extends their deepest apology for this most unfortunate and careless error*—Editor.

HOME COMPUTERS

You've done it again! First, you want to know where all the designers have gone (June 1978 editorial); now you want to know where the home computers are coming from (August 1978 editorial).

It seems that pretty much for the 20 years I've been working with computers, the computer has been a solution looking for a problem.

But, suppose the computer has utility as a home appliance, where will that utility emerge? Let me suggest the three E's: Entertainment, Education and Economics. (A fourth E, Environment, can be identified separately or included under the Economics category.)

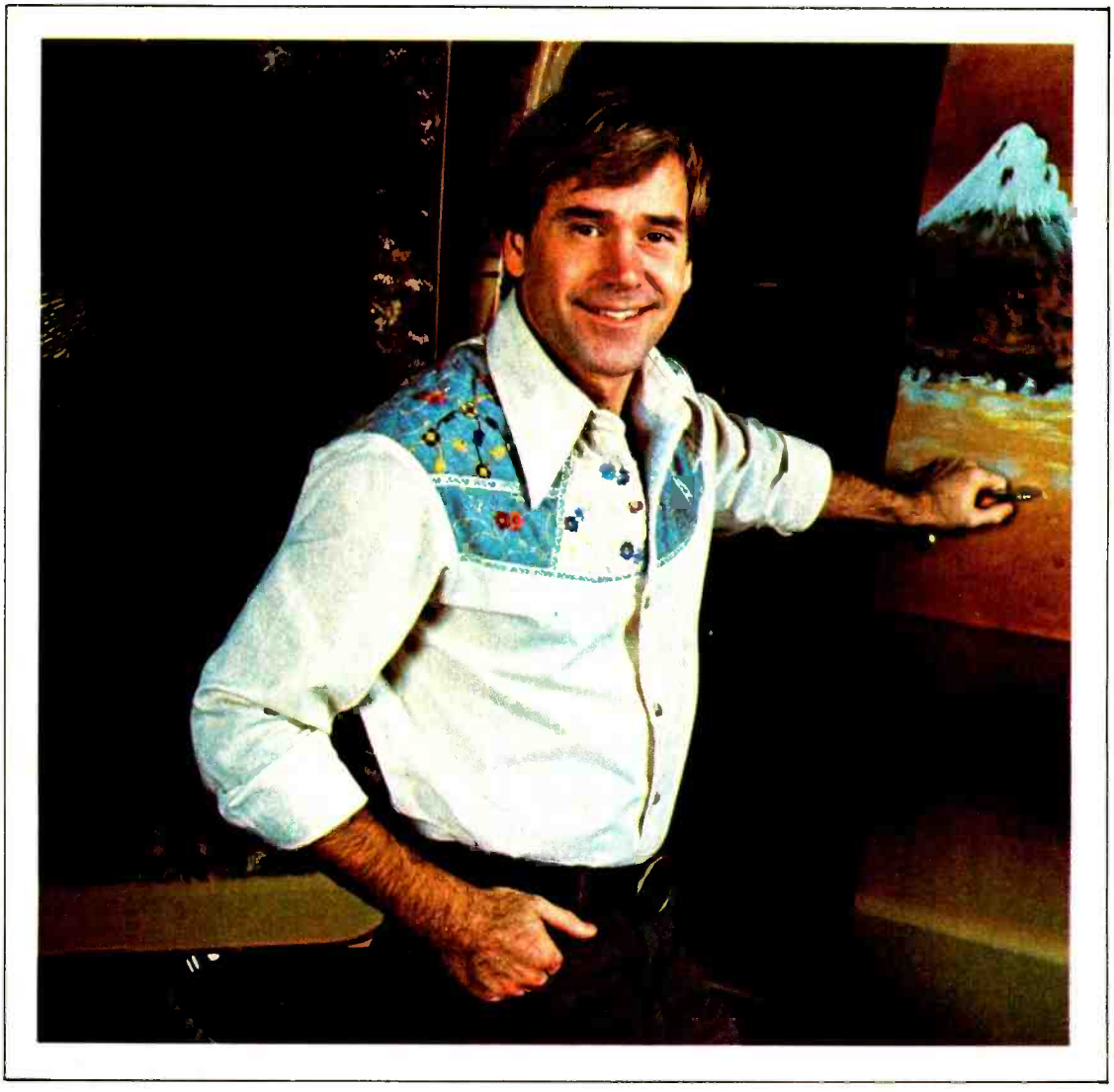
Using home computers in entertainment and education applications should be self-explanatory. By economics, I mean supporting the household as an economic unit. This leads to a peculiar wrinkle: the value of a computer as an education and economics instrument only makes sense to households that are already pretty self-reliant in those areas. It is foolish, I agree, to expect a family to use a computer for things that no one's already eager to do. Given existing motivation, the computer operates as an amplifying device. But you can't amplify what isn't there.

With that viewpoint, I can see a market for the home computer but certainly not one comparable to that for, say, color television. Even by sneaking a computer into the house for entertainment purposes, a way of opening up the other possibilities, I don't see how that market can be substantially increased. We need another 15–20 years.

I do not believe that the foreseeable home computer market is inconsequential. I do believe that present computer systems are inadequate, with no immediate solution to compatibility and software problems. The *convenience* of computing just isn't there yet. The purchaser also need strong protection from obsolescence. System upgrading instead of replacement seems indispensable.

continued on page 22

You gotta shop around.



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.
1776 East 17th Street, Cleveland, Ohio 44114
Accredited Member National Home Study Council

☐ **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-48**

Print Name _____

Address _____ Apt. _____

City _____

State _____ Zip _____

Age _____ Phone _____
(area code)

Check box for G.I. Bill information:
☐ Veteran ☐ Active Duty

Mail today!

LETTERS

continued from page 17

That these problems can be solved is practically an article of faith among computer buffs. *Whether* these problems will be resolved, and when, remains to be seen. I hardly dare suggest that it will take more than five years, although it's hard to see how it might happen sooner.

In the meantime, digital processing will cover the Earth in microprocessor chips and a few of our neighbors will become BASIC freaks.

DENNIS E. HAMILTON
System Design Consultant
Penfield, NY

Your editorial certainly hit the mark. I, too, see little use for a *home computer.* Even as one of the people who helped start the spread of hobby computers, I don't expect to have one at home doing bookkeeping, inventory or burglar alarming.

The home computer can be used to teach programming and have fun with, but my wife can keep track of the foods we need better than a computer. Who expects a housewife to "key-in" each item she uses just so she can have a computer-output shopping list? It's easier to keep this information in your head.

Simple controllers can be used to manage energy use, air conditioning, swimming pool heating, etc. Home computers just aren't needed.

This all reminds me of the tunnel diode, which was touted as the answer to many, many electronic problems. It's still the answer, it's just that no one has any questions.

JONATHAN A. TITUS
Tychon, Inc.
Blacksburg, VA

WHERE ARE THE ELECTRONIC DESIGNERS?

In your June 1978 editorial, you speak of design as if hooking up IC's is not design. Where do you draw the line? Any new device is designed (even if you modify your Heathkit). You may be an expert in capacitors but not know how to use them to couple IF stages. You may understand the quantum mechanics of PN junctions but not how to build a good FM tuner. We are all extremely specialized . . . some persons are good at designing corporate organizations, though ignorant of the skills and knowledge of those they organize.

The advent of IC's has lightened the burden for us all, and, yes, it has allowed some of us to design with devices we do not understand fully. How many engineers who use a calculator could design one (or even a slide rule)? The history of technical progress is marked with mechanisms that allow the designer to move to higher levels without worrying about details and trivia.

Yes, making a device smaller and less expensive is not the same as making a novel device. However, remember that the cost and performance of devices has traditionally been more important than their novelty. For instance, who would have bought a TV set in 1950 when the cost was so high? Mass production and production engineering are important fields. Design is where you find it and the injection of human energy with a foundation of education more often than not comprises the creation of things that are new, different, cheaper, etc.

One final word on the state of electronics: There are few colleges or universities which can keep faculty that is knowledgeable about the latest advances in such a fast-moving field as electronics. As you'd expect, the persons who have the latest information are out making a lot of money using that knowledge. Most of the latest data comes to us via the media (such as **Radio-Electronics**). It is an important service that you render and a contribution to technical progress.

DION L. JOHNSON
Santa Cruz, CA

SHOT-PUT EXPERIMENT

Were W. Cochran and **Radio-Electronics** promoting a religious revival in the June 1978 issue (see "Free Energy," Letters, p. 22)? None of the laws I ever alluded to can be found in my Bible.

Also, where did we come by this lossless spring and who needs it? If you place a shot-put on top of a helical car spring and push down on the shot-put until there is 600 lb of tension in the spring, the shot will receive much more kinetic, potential and heat energy when released than any heat loss in the spring. Caution: Do not attempt this experiment indoors unless you have a very high ceiling.

JOHN ECKLIN
Alexandria, VA

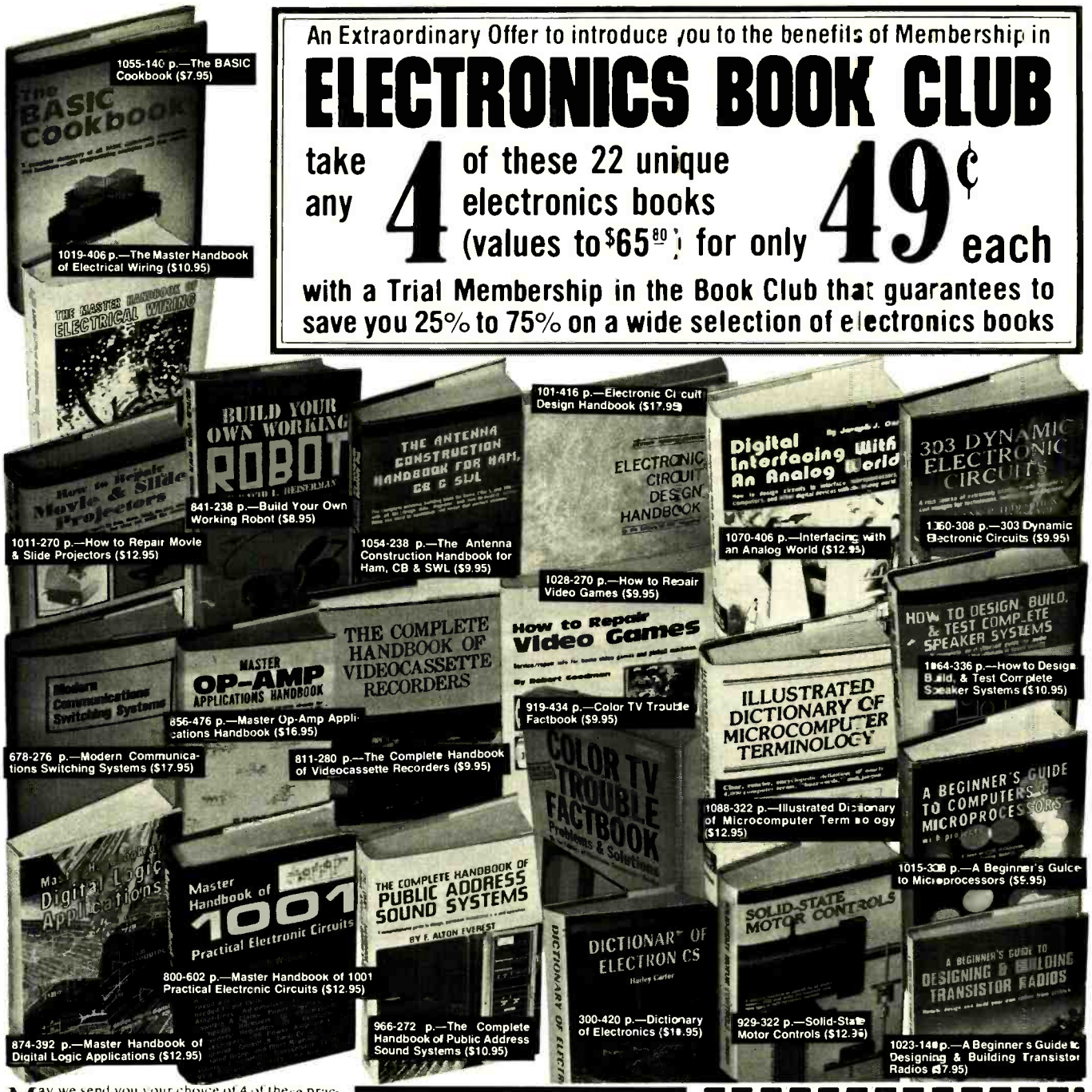
R-E

An Extraordinary Offer to introduce you to the benefits of Membership in

ELECTRONICS BOOK CLUB

take any **4** of these 22 unique electronics books (values to $65.80) for only **49¢** each

with a Trial Membership in the Book Club that guarantees to save you 25% to 75% on a wide selection of electronics books



May we send you your choice of 4 of these practical time-and-money-saving books as part of an unusual offer of a Trial Membership in Electronics Book Club?

Here are quality hardbound volumes, each especially designed to help you increase your know-how, earning power, and enjoyment of electronics. Whatever your interest in electronics, you'll find Electronics Book Club offers practical, quality books that you can put to immediate use and benefit.

This extraordinary offer is intended to prove to you through your own experience, that these very real advantages can be yours...that it is possible to keep up with the literature published in your areas of interest, and to save substantially while so doing. As part of your Trial Membership, you need purchase as few as four books during the coming 12 months. You would probably buy at least this many anyway, without the substantial savings offered through Club Membership.

To start your Membership on these attractive terms, simply fill out and mail the coupon today. You will receive the 4 books of your choice for 10-day inspection. YOU NEED SEND NO MONEY. If you're not delighted, return the books within 10 days and your Trial Membership will be cancelled without cost or obligation.

ELECTRONICS BOOK CLUB, Blue Ridge Summit, Pa. 17214

Facts About Club Membership

- The 4 introductory books of your choice carry publisher's retail prices of up to $65.80. They are yours for only 49¢ each (plus postage/handling) with your Trial Membership.
- You will receive the Club **News**, describing the current Selection, Alternates, and other books, every 4 weeks (13x a year).
- If you want the Selection, do nothing; it will be sent to you automatically. If you do not wish to receive the Selection, or if you want to order one of the many Alternates offered, you simply give instructions on the reply form (and in the envelope) provided, and return it to us by the date specified. This date allows you at least 10 days in which to return the form. If, because of late mail delivery, you do not have 10 days to make a decision and so receive an unwanted Selection, you may return it at Club expense.
- To complete your Trial Membership, you need buy only four additional monthly Selections or Alternates during the next 12 months. You may cancel your Membership anytime after you purchase these four books.
- All books—including the Introductory Offer—are fully returnable after 10 days if you're not completely satisfied.
- All books are offered at low Member prices, plus a small postage and handling charge.
- **Continuing Bonus:** If you continue after this Trial Membership, you will earn a Dividend Certificate for every book you purchase. Three Certificates plus payment of the nominal sum of $1.99 will entitle you to a valuable Book Dividend of your choice which you may choose from a list provided Members.

ELECTRONICS BOOK CLUB

Blue Ridge Summit, Pa. 17214

Please open my Trial Membership in ELECTRONICS BOOK CLUB and send me the 4 books circled below. I understand the cost of the books I have selected is only 49¢ each, plus a small shipping charge. If not delighted, I may return the books within 10 days and owe nothing, and have my Trial Membership cancelled. I agree to purchase at least four additional books during the next 12 months, after which I may cancel my membership at any time.

101 300 678 800 811 841 856 874
919 929 966 1011 1015 1019 1023
1028 1054 1055 1060 1064 1070 1088

Name _____ Phone _____

Address _____

City _____

State _____ Zip _____

(Valid for new Members only. Foreign and Canada add 10%) RE-118

CIRCLE 29 ON FREE INFORMATION CARD

PHILIPS HICKOK FLUKE®

DORIC

NLS Non-Linear Systems

C-Meter: MODEL 130

A precision, autoranging, capacitance meter

Autoranging
10 ranges are automatically selected from full scale values of 200 picofarads to 200,000 microfarads, with a maximum resolution of 0.1 picofarads.

Accurate
The C-meter achieves 0.3%(±1 count) up to 200 microfarads and 1% from 200 microfarads to 2000 microfarads. It is accurate on all ranges at temperatures from 15° to 35°C. (59° to 95°F).

DORIC **$325.**

FLUKE DIGITAL MULTIMETERS

- Measures AC/DC Volts, Current and Resistance
- True RMS on all AC Functions
- Diode Test
- In-Circuit Resistance Measurement
- Overload Protection on all Functions
- Functional Self Check

8010A

Model 8030A is a 3½ digit, six-function hand-held multimeter with features that qualify it as an excellent field service and troubleshooting instrument. Measurement functions include ac volts, dc volts, ac current, dc current, resistance and diode test. Each function, with the exception of diode test, has five selectable ranges for a total of 29 ranges (one range for diode test).

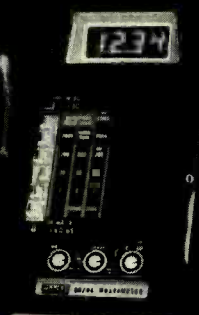
True RMS conversion techniques offer high accuracy for noise and other distorted waveforms. AC coupling rejects dc bias during AC voltage measurements. DC coupling is used on the ac current ranges to provide the ac and dc capability necessary for measuring power supply and SCR regulator currents.

In-circuit resistance measurements can be made using the normal resistance ranges. Parallel semi-conductor junctions are ignored by impressing less than 200 mV across the unknown resistance.

SPECIFICATIONS

	DC Volts	AC Volts	DC Current	AC Current	Ohms	Diode Test
Range	0.7-1000V	0.2-750V	200μA-2A	200μA-2A	700Ω-7000MΩ	0-2000 mV
Resolution	100 μV	100 μV	100 nA	100 nA	1 Ω	1 mV
Accuracy*	(0.1 + 1)	(0.5 + 2)*	(0.35 + 1)	(1 + 2)*	(0.2 + 1)	(0.2 + 1)

8010A $239.



8020A

- 26 Ranges—5 Functions plus New Conductance Function for up to 10,000 MΩ Leakage Measurements
- Extensive Overload and Transient Protection
- Rugged Construction—1 Year Warranty
- Hi/Lo Power Ohms for In-circuit Resistance and Diode Testing
- 10 MΩ AC/DC Input Impedance Doesn't Load Circuit
- 200 Hour, 9V-Battery Life—Low Battery Indicator
- Large LCD Readout—2000 Counts
- 1 Year Calibration Cycle—Only 3 Adjustments
- One Hand Operation
- Complete with Battery and Test Leads

The 8020A has been designed with the user in mind and features exclusive one hand operation. For harsh service environments, the 8020A has a ruggedized case and extensive overload/transient protection backed up by a 1-year warranty. Long term stability (1 year calibration cycle) is excellent with only three cal adjustments. Up to 200 hours of continuous operation can be expected from a single 9V alkaline battery.

BASIC SPECIFICATIONS

	DC Volts	AC Volts	DC Current	AC Current	Ohms	Conductance
Range	0.2-1000V	0.2-750V	0.002-2A	0.002-2A	200Ω-20 MΩ	200 nS, 2 mS
Resolution	100 μV	100 μV	1 μA	1 μA	0.1Ω	0.1 nS
Accuracy	(0.25 + 1)	(0.75 + 2)*	(0.75 + 1)	(1.5 + 2)*	(0.2 + 1)*	(0.1 + 1)*

8020A $169.

New Low Distortion Function Generator

MODEL
3010

- Generates sine, square and triangle waveforms
- Variable amplitude and fixed TTL square-wave outputs
- 0.1 Hz to 1MHz in six ranges
- Push button range and function selection
- Typical sine wave distortion under 0.8% from 0.1 Hz to 100 kHz
- Variable DC offset for engineering applications
- VCO external input for sweep-frequency tests

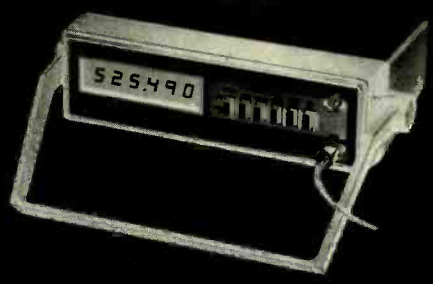
$144.95

Regular price $175.

B&K PRECISION

B&K PRECISION

520 MHz Frequency Counter



MODEL
1850

- 5Hz to 520 MHz reading guaranteed — 600 MHz typical
- Gate time from 10ms to 10 seconds
- Full period measurement capability
- 50 mV input sensitivity at 520MHz
- Operates from 115 or 230 VAC, or 12 VDC
- Well protected input circuitry
- Temperature compensated crystal oscillator (TCXO)

$379.95

Regular price $450.

FLUKE®

MULTIFUNCTION COUNTERS

DISTINCTIVE PERFORMANCE FEATURES YOU CAN USE

The 1910A, 911A And 1912A Family

Precise, rapid determination of frequency, period and period-average, coupled with totalize capability, represent superior versatility and performance in the Fluke 1910A, 1911A and 1912A multicounters. Here are the features and benefits that distinguish these hard working counters from all others in their price range.

Multifunction

The army does the work of counters costing much more. They measure frequencies to 125 MHz (1910A), 250 MHz (1911A), and 520 MHz (1912A); period of signal frequencies to 2 MHz.

Autorange

Full autoranging is supplemented by selectable four-range manual operation. In autorange, the display is automatically filled to a maximum 7-digit readout.

Input Signal Conditioning

All three counters offer trigger level and attenuator controls which operate over the dynamic range of the input to permit *accurate readings in the presence of noise.*

Automatic Clean Dropout

The 1911A and 1912A Channel B input has a circuit which automatically monitors the input and gives you instant warning in the form of zero readout whenever your input signal level falls below the sensitivity threshold of the trigger circuit. When the signal level returns to a acceptable level, the counter locks on for a correct reading. *When you get a reading, you know it's right.*

Sensitivity

A basic sensitivity of 15 mV, backed by Fluke's conservative design margin, guarantees you we'll get reliable, solid readings every time. In practice, a typical sensitivity of 10 mV will be experienced.

Autoreset

This automatic feature is activated every time you select a new range or function, which means you never have to wait for a second reading, the first one in the new measurement sequence is always correct. *Autoreset saves time and reduces errors.*

SPECIFICATIONS

Input Characteristics

Model	Channel	Operating Range: Frequency	Operating Range: Period	Sensitivity
1910A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz; 25 mV rms, 100 MHz - 125 MHz
1911A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz; 25 mV rms, 100 MHz - 125 MHz
	B	50 MHz - 250 MHz		15 mV rms, 50 MHz - 175 MHz; 30 mV rms, 175 MHz - 250 MHz
1912A	A	5 Hz - 125 MHz	500 ns - 0.2s (5 Hz - 2 MHz)	15 mV rms, 5 Hz - 100 MHz; 25 mV rms, 100 MHz - 125 MHz
	B	50 MHz - 520 MHz		25 mV rms, 50 MHz - 520 MHz

FLUKE	125 MHz	1910A $395
	250 MHz	1911A $495
	520 MHz	1912A $620

LEADER Instruments Corp.

LCR-740
Transistorized LCR Bridge

- Highly accurate 3 digit readout.
- Measures Inductance (L), Capacitance (C) and Resistance (R), within ±0.5% accuracy.
- Range expandable — built-in 10% over range.
- Loss Factor scale (D).
- Battery, or AC adapter operation.

$279.95

Regular price $319.

LEADER Instruments Corp.

LCG-395 SOLID STATE VIDEO COLOR SIGNAL SOURCE

- Provides staircase, window, convergence and white purity adjustments.
- Multi-purpose applications for CATV, MATV, CCTV, VTR and NTSC testing.
- Segment display information provides data details for every color check requirement.
- Exclusive convergence check facility gives hz11 and vert'l lines and dots within 80% safety margin.
- 5-step staircase signal for checking modulation levels in 20% segments from 0 (black) to 100% (white).
- Window and noiseless white raster position.
- 10 gated rainbows, plus 3 gated color bars; plus overall rainbow pattern.
- Return trace blanking for vert/hztl signals.
- 2 switch selectable RF chan. frequencies.

$199.95 $299.95 Regular price

Simpson

B&K PRECISION

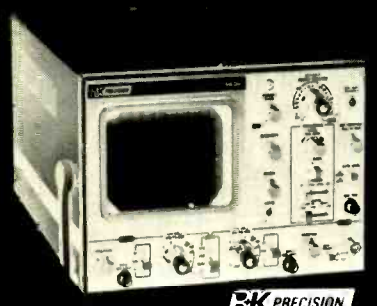
LEADER

TRIPLETT

VIZ formerly RCA

DATA PRECISION

Dual-Trace 5" 30MHz Triggered Scope...



MODEL
1474

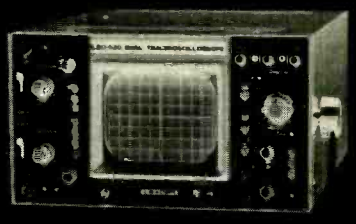
- Rise time 11.7 nS or less
- Built-in signal delay line permits view of leading edge of fast-frequency pulse display
- Triggers on signals up to 50 MHz
- 5mV/cm vertical sensitivity
- Mode automatically shifts between CHOP and ALTERNATE as you change sweep time
- Checks most digital logic circuitry, including ECL
- High accuracy ten-position vertical input attenuator
- Flat response with smooth rolloff past 30 MHz
- P24 CRT with P31 phosphor
- Built-in high- and low-pass filters
- Maintains calibration accuracy from over 105-130 VAC and 200-260 VAC
- 20 calibrated sweeps—.5 µS/cm to .5 S/cm

$729.95

B&K PRECISION

Probes not included in price

LBO-520
30MHz, Fixed Delay



LEADER Instruments Corp.

- Dual trace, 30MHz bandwidth.
- 5mV/cm Vertical Sensitivity.
- Fixed delay facilitates hi-speed readings of the leading edge of a pulse or pulse train.
- Add, subtract, alternate selection, chopped, and front panel X-Y modes broaden areas of application.
- TV-V and TV-H sync. for both CH-1 & 2.

$849.95

Regular price $1,050.

Model 517 Dual-Trace 15 MHz Triggered Oscilloscope

HICKOK

$589.95

Regular price $695.

15 MHz response flat within 3dB for all signal levels. Excellent pulse response minimizes overshoot and ringing.
5mV/cm sensitivity, useful for solid-state work.
Positive triggering to 27 MHz (30 MHz typical).
X-Y operation for vectorscope measurements.
Bright 8 cm x 10 cm display.
Auto mode triggering provides baseline for recurrent sweep operation. CHOP and ALTERNATE mode automatically selected as sweep time is changed for easier setup.

- Algebraic sum and difference capability.
- Differential input capability.
- Digital logic circuit capability, including CMOS.
- Analyze A & B AM and SSB waveforms.
- TV sync separators built in.
- Regulated power supply maintains amplifier gain with changes in line voltage from 105 to 125 volts.

LBO-508
20MHz, Dual Trace

LEADER Instruments Corp.

- Add, subtract modes on CH-1 & CH-2 facilitate easy check-out for simultaneous pulses, signal levels, distortion & noise cancelling.
- Front panel X-Y operation useful for phase shift measuring, sweep alignment, vector scope service.
- 17.5nSec rise time.
- Automatic chop and alternate selection for low and high frequency checks.
- Automatic trigger for CH-1 or 2 includes TV sync.
- 10mV p-p 2CV/cm Vertical Sensitivity 11 steps.
- 0.5µS/cm to 200mS/cm sweep speed; 18 steps; X5 magnification.

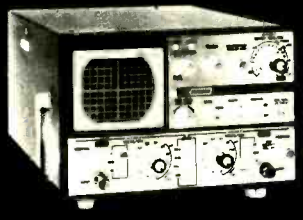
$614.95

Regular price $769.

SUPER SPECIALS

Shipping not included in prices Sale ends Dec. 31, 1978

New 15MHz portable 3" dual-trace scope



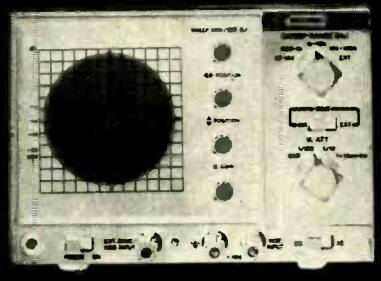
MODEL
1432

- 15MHz bandwidth with smooth roll-off; usable response extends beyond 30MHz
- 2mV/div. vertical sensitivity
- Operates on 117VAC, 234 VAC, 12VDC or optional internal battery pack
- Fully regulated high- and low-voltage supplies
- Algebraic addition and subtraction of Channel A and B input signals
- Nineteen calibrated sweep ranges cover 0.5 microseconds/cm to 0.5 second
- TTL Compatible X-axis input
- Compact size; measures only 8.5 x 5.25 x 11.5"
- Includes two slim-bod. 10:1 direct probes and accessory clips
- Built-in sync separator

B&K PRECISION

$629.95

Regular price $780.



5MHz Solid State 3" Oscilloscope

MODEL
1403A

B&K PRECISION

- 5 MHz with high sensitivity
- For production lines, schools, field service work, hobbyists
- CB modulation monitor
- Ultra-compact and lightweight; goes anywhere!
- Use the 1403A to replace more expensive scopes from monitoring applications
- Vertical sensitivity of 10mV/division.
- High brightness CRT and smoked-glass graticule

$209.95

Regular price $250.

3-1/2 Digit DMM with .5% Accuracy

B&K PRECISION

MODEL
2810

$109.95

Regular price $130.

- 3½ digit easy to read LED display
- 0.5% DC accuracy typical
- 100µ... 5 resolution
- 10 ... ranges and control to zero lead resistance
- Selectable High-Low power ohms on four ranges
- Auto-ranging
- Completely overload protected on all 29 ranges
- 100% overrange reading to 2000 counts full scale
- Protected against RF interference
- Completely portable

THE TEST EQUIPMENT SPECIALISTS

TOLL FREE HOT LINE
800-223-0474

54 West 45 Street, New York, N.Y. 10036 212-687-2224

ADVANCE ELECTRONICS

equipment reports

Data Precision Corp. Model 1350 DMM

CIRCLE 106 ON FREE INFORMATION CARD

THE DATA PRECISION CORP. (AUDUBON ROAD, Wakefield MA 01880) specializes in digital multimeters and they have introduced a new one. They call it a General Purpose Multimeter, and it is. It's designed for any kind of electronic/electrical work. It is a 3.5-digit instrument and has a basic accuracy of 0.1%. It has a tough plastic case with a handle that doubles as a bench rest. The readouts are LED's, large enough (0.43 in.) to see quite a way off.

DC voltages can be read from ± 100 μV to a full 1200 volts. AC volts from 100 μV to 1000 volts RMS. The input impedance is 10.0 megohms on all ranges. Six pushbuttons are used for range switching on all functions—volts, ohms and mA. The ranges are set up in the simple 1–10–100–1000 sequence (the lowest range is 100 μV) and all but the top range have 100% overrange capability. With 100% overrange, a 0–10 range will read up to 19.9. If the 100% overrange capability is exceeded, it is indicated by the display being blanked except the left-hand digit that displays a "1" and the decimal point. Resistance ranges start at 0–100 ohms, and go up to a 10.0-megohm range. Same overrange as the others; the 10.0 megohm will actually read 19.99 megohms. Either high-ohms with 2.8 volts on the prods or low ohms with only 300 mV can be selected on all resistance ranges by a pushbutton.

The panel is plain and simple. The functions are chosen by 4 pushbuttons and ranges by 6 pushbuttons, all along the bottom of the panel. Input jacks are at the right side, out of the way. A separate jack is used for current readings only. I like this approach better; it eliminates the chance of accidentally connecting the meter across a voltage with the switch on mA!

Early DMM's suffered from overload accidents. The *model 1350* is well protected on every range. It will take 1200 volts on any range, including resistance, and it will handle a 6000-volt spike on any voltage input for 500 ns, with no damage. The current ranges are protected by 2A 250-volt fuses. The AC frequency response is specified up to 10 kHz, except for the two highest current ranges that are specified up to 2 kHz.

The *model 1350* is all IC's with the exception of a couple of transistors used as voltage regulators. Even the DC power supply uses an IC regulator. The basic circuitry has the beauty of simplicity. A couple of op-amps and an

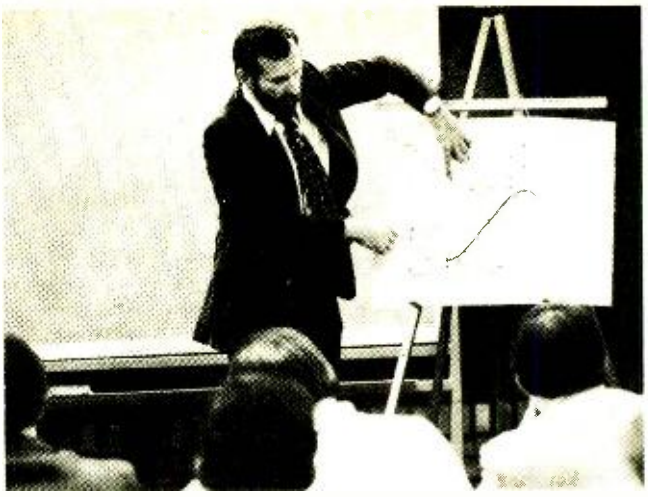
continued on page 32

NEW for Professional Technicians

Forest Belt's
TRAINING WORKSHOPS 1978

- THREE-DAY
- INTENSIVE
- UP-TO-DATE
- PERSONAL
- UNIQUE

- Includes lodging
- Breakfasts, lunches, and coffee breaks during WORKSHOPS
- Grand AWARDS BANQUET
- FREE Extra SEMINAR



ADVANCED
VIDEO SERVICING

Featuring VCRs, Digital Controls, VIR . . . and much more

Intensive Forest Belt teaching techniques and exclusive, proven training aids bring you right up-to-date in the troubleshooting and repair of today's video equipment for home or industry.

Special emphasis on solid-state and integrated circuits. See new IF and color alignment methods you probably never thought of. Learn about Vertical Interval Reference (VIR) automatic color control in newly introduced TV receivers. Understand digital and solid-state tuning systems. Participate in live equipment demonstrations. Sit in on the industry's first look at practical, **Easi-Way™** repair of video cassette recorders.

DON'T BE LEFT BEHIND in your own industry! Be the one technician in your region who not only keeps up but stays AHEAD of new technology and servicing methods. ENROLL NOW to be sure you do not miss this vital and unique Advanced Video Servicing WORKSHOP.

FREE Price and Profit SEMINAR Tuesday evening.

September
11-13 (Communications)
or 18-20 (Video)

Hospitality Inn East
Interstate 70 at Post Road
Indianapolis, INDIANA

Centrally placed for convenient travel from anywhere in the mainland U.S. Also timed earlier in the year, in case you should not be away from your shop during the pre-Christmas season. You can attend in time to prepare you for the year-end service rush and the new sets being sold.

Comfortable, pleasant accommodations: two people to a room (two beds). Indoor pool. Shopping downtown by freeway. Bring your spouse if you wish, at the nominal No-WORKSHOP fee (she joins the WORKSHOP group for breakfasts and lunches). If you prefer to room with a specific other WORKSHOP attendee, tell us.

Enrollments close August 4, 1978, or when capacity is reached.

Per Workshop $495

ADVANCED
COMMUNICATIONS SERVICING

Featuring FM Two-Way, PLL, Single Sideband . . . and much more

Here, too, intensive Forest Belt teaching methods and exclusive, tested learning aids assure you up-to-the-minute training troubleshooting and maintaining communications systems.

Special emphasis on solid-state and integrated circuits. Observe professional alignment and tuneup methods. Deal profitably with Business and Land Mobile Radio—and the growing General Mobile Radio on UHF wavelengths. Learn of new developments in Marine and Aircraft Radio. Study the latest phase-locked loops, including their digital programming. Take part in live equipment demonstrations. See **Easi-Way™** techniques applied to communications.

GROW AS A REAL EXPERT in your specialty. Grab this exceptional opportunity to polish up your diagnosis and repair skills. Become familiar with new technology and money-saving instruments. ENROLL NOW in Advanced Communications . . . a giant step beyond our popular CB Servicing WORKSHOPS.

FREE Math and Formulas SEMINAR Tuesday evening.

November
6-10 (Communications)
or 13-17 (Video)

South Seas Plantation
Captiva Island, FLORIDA
(near Sanibel and Ft. Myers)

For technicians who could use a bit of get-away time as part of this unique training package. Two days of consulting or on-your-own follow each WORKSHOP. Make your own airline reservations, well in advance; but we take care of placing you in our luxury cottage lodging.

Exceptional resort accommodations: four people (two bedrooms, four beds, two baths) or six people (three bedrooms, six beds, three baths) in fancy beach cottages. Bring your spouse, if you wish, at the nominal No-WORKSHOP fee (she joins the WORKSHOP group for breakfasts and lunches). If you prefer to share a room with a specific other WORKSHOP attendee, tell us. Cottages have kitchen facilities. An unusual winter-season bargain.

Enrollments close Sept. 15, 1978, or when capacity is reached.

Per Workshop $595

FIRST COME, FIRST SERVED — ENROLLMENT DEADLINES ABOVE

Yes, enroll me promptly for TRAINING WORKSHOP at right.

☐ Advanced Communications Servicing
☐ Advanced Video Servicing

I enclose check or money order for $_____ U.S. dollars.

☐ $495 per WORKSHOP in Indianapolis
☐ $595 per WORKSHOP in Florida

☐ $175 for spouse
☐ $250 for spouse (includes lodging, same meals as for WORKSHOP enrollee)

☐ $475 for CB Service WORKSHOP (same as 1977, and includes lodging) at Indianapolis August 21-23, 1978.

Name _____ Age _____

Company _____

Address _____ Phone _____

City _____ State _____ Zip _____

NOTE: You need 2 years electronics training or experience to gain proper benefit from these Advanced TRAINING WORKSHOPS. NOT FOR BEGINNERS.

Mail to: Forest Belt's TRAINING WORKSHOPS, Box 68120, Indianapolis IN 46268

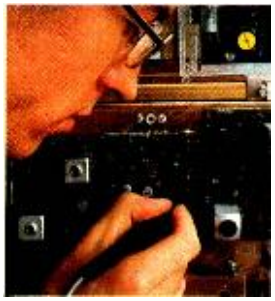
CIRCLE 85 ON FREE INFORMATION CARD

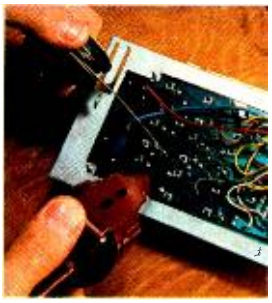
The whole team wondered what Ron Brown was up to in his basement.

Word has it he was up to something mighty special. And when he didn't show up for bowling practice one Wednesday night, the Lucky Strikers (that was the name of his neighborhood team) began to wonder, too.

So it was that a bunch of the boys decided to pay their "star" a visit, and talk him out of his secret project and back into action. It didn't happen that way, though.

Matter of fact, it was Ron Brown who talked the Lucky Strikers out of their bowling night and down into his workshop. What was it ...what could be exciting enough to keep a bunch of ten-pin tigers from their favorite pastime? One of the most fascinating learn-at-home programs in the world, that's what!





Actually build and experiment with a new big-screen color TV in ASI's fascinating learn-at-home program. It will help you develop new skills as an electronics troubleshooter.

You'll set up your own electronics laboratory to discover first-hand the technology behind the most exciting innovations in the world of home entertainment electronics.

In fact, as part of the program, you'll actually build and experiment with a beautiful, integrated circuit 100% solid state color TV.

But most important of all will be the new skills you'll develop all along the way...the kind of skills that could lead you in exciting new directions. For example, like many of ASI's 140,000 graduates, once you complete the program you could use your training:

1. To provide part-time income
2. To start a business of your own
3. To seek out a job in the electronics industry
4. To upgrade your current job
5. As a foundation for advanced programs in electronics

Go exploring at home, in your spare time. No traveling to class. No lectures. No one breathing down your neck.

ASI wants to make it easy for you to get to know the exciting world of home entertainment electronics. You'll be able to develop new skills in your own home on whatever days and hours you choose. So you don't have to give up your present job or paycheck just because you want to prepare yourself for some future opportunities.

What's more, we believe that when you're exploring a field as fascinating as home entertainment electronics, reading about it is just not enough. That's why you'll get lots of "hands on" training experience with some of the most impressive electronic training tools you've ever seen!

No Electronics Background Necessary

That's one of the advantages of this program. We start you off with the basics and help you work your way up, one step at a time. You'll start right off using your hands as well as your head. That's because ASI firmly believes that one of the best ways to develop skills is the exciting "hands on" way.

Each time you receive new materials you will assemble and experiment with the kind of fascinating electronic equipment that will guide you with tests and experiments and will help you become familiar with operations and applications. With ASI you BUILD, EXPERIMENT, and KEEP:

- Signal Generator—This important tool helps you explore AM alignment and signal injection. This is a source of modulated or unmodulated signals. It provides a wide range of frequencies for use in AM, FM, TV, LW and SW broadcast bands.
- Transistorized Radio Receiver—Build your radio in a spread out format directly on a large schematic diagram. You will learn how transistors, capacitors, resistors and other parts work together to receive radio signals and convert them into sound.
- VTVM (Vacuum Tube Voltmeter)—Build and troubleshoot measurements of DC+, DC−, AC rms and peak-to-peak voltages.
- Solid State Triggered Sweep Oscilloscope—See the heartbeats of tiny integrated circuits with one of the most universal of all testers. You'll experiment with displays of voltage waveforms found in audio devices, television receivers, transmitters and other electronic equipment.
- Vectorscope—Patterns for converging, adjusting and troubleshooting color television receivers. Solid state circuitry and integrated circuits are used for accuracy, stability and reliability since this will be a key instrument for troubleshooting and servicing color television receivers.
- Color Television Set—As you build, you explore automatic fine tuning, plug-in circuit boards, the cathode ray tube and all the components and circuitry used in the late model color receivers.

Besides these, you will also receive a pre-wired and assembled multi-tester plus a professional quality set of electronic hand tools and tool box.

And Only ASI Offers Audio/Visual Aids Too!

You will receive a filmstrip projector, filmstrips and records that SHOW and TELL you the proper way to perform some of the fascinating tests and experiments you'll do in the program. Only ASI offers this exciting way to combine theory with practice...and our graduates tell us that these aids are some of the most helpful and interesting parts of the program.

We try to give more personal attention than other learn-at-home programs.

1. Toll-free phone-in assistance. Should you ever run into a rough spot, we'll be there to help. While many schools make you mail in your questions, we have a toll-free line for questions that can't wait.

2. Every student is assigned a Personal Technical Advisor. He'll follow your progress and be available whenever you want to "talk shop" or bounce around an idea or two.

Send for free details today—for a more secure tomorrow.

Whether your goal is higher-paid job skills...extra income from part-time work...being your own boss in your own business...or simply to become your own electronics expert and experience the comfortable confidence that comes with having another marketable skill to fall back on, in case of hard times...ASI can help you reach it.

Mail postpaid card today for free course outline and sample lesson.

No cost or obligation of any kind.

APPROVED FOR VETERANS BENEFITS WHEN TAKEN FOR VOCATIONAL PURPOSES.

If card has been removed—write to:

asi **advance schools, inc.**

5900 NORTHWEST HIGHWAY • CHICAGO, ILLINOIS 60631

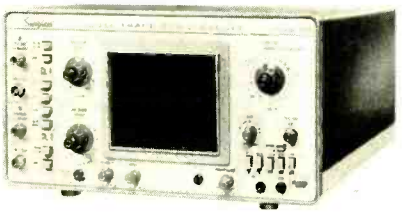
101

A/D converter do all of the work.

The instrument carries a full one-year warranty, and you get a certificate of conformance that traces its accuracy to NBS Standards. Calibration is needed only at one-year intervals. When calibration is necessary, only two adjustments are required.

An attractive feature of the *model 1350* is its price—$169.00 complete with test leads, operating manual, certificate and even a spare fuse. This is getting it down to the point where the typical shop can have instruments of laboratory accuracy and stability that are also rugged enough for everyday use. **R-E**

Simpson Model 452 Dual-Trace Oscilloscope



CIRCLE 107 ON FREE INFORMATION CARD

THE SIMPSON ELECTRIC COMPANY, 853 DUNDEE Avenue, Elgin, IL 60120, has been making high-quality test instruments for a long time. Their latest introduction, the *model 452* dual-trace triggered-sweep oscilloscope, is an all-solid-state unit with many applications: lab work, production-line testing, design, or any kind of consumer electronics work. It is especially useful for color TV applications of any kind.

The *model 452* has all the regular features. Its two channels are identical: DC to 15 MHz and AC from 2 Hz to 15 MHz. The high-impedance inputs are 1.0 megohm shunted by 25 Pf, and handle a maximum input of 500 volts DC plus AC peak.

Calibrated vertical step attenuators give a deflection sensitivity from 5 mV-per-centimeter (.005 volt) up to 10 volts-per-centimeter with a direct probe. The attenuator switch uses the 1-2-5 sequence. A continuously variable control allows fine adjustment if needed; simply turn the control fully clockwise for calibration. The inputs can be switched to AC or DC. A total of 11 positions are used for the volts-per-centimeter selector switch.

Channel selection and other functions are handled by well-spaced push-push controls that lock in on the first push and release on the second. All pushbuttons are very plainly marked so that you know where you are all the time. Channel A or Channel B can each be used by itself if you want a single trace. Just press the Channel A button, leaving Channel B off; or move the Channel B trace up off the screen using the vertical position control. For a dual trace, the sweep is automatically chopped, at a rate of 200 kHz, for sweeps from 1 ms-per-centimeter and slower. For all higher speeds, the two traces are scanned alternately. There is no perceptible flicker in either one.

Other pushbuttons allow other types of testing: One adds the signals in Channel A and Channel B and then displays the sum waveform. Another pushbutton inverts the Channel

continued on page 34

continued from page 32

B waveform. This control performs all kinds of tricks. For instance, when you make the standard input-output tests on any amplifier stage, the output waveform is inverted. You can press the Channel B INVERT pushbutton, adjust the traces to the same amplitude, and then superimpose one trace on the other. This will display instantly any significant differences, phase shifts and distortion.

By pressing the Channel B INVERT and ADD pushbuttons, you can *subtract* Channel A from Channel B. This test is used for comparing differential voltages between two points in a circuit, etc.

The *model 452* dual-trace scope is indispensable for testing digital circuitry. Since we're going to be dragged kicking and screaming into digital work (at least *I* am!) we might as well have the right tools for it. Timing relationships are vital; pulses must arrive at the right place at exactly the right time (and *exactly* means just that!).

The *model 452* manual shows a good typical example using a set of waveforms produced by the Simpson *model 7016* frequency counter to show the exact timing. In only one case, the reset pulse, using its negative edge, triggers a control flip-flop. By hooking the scope up to observe the reset pulse on one channel and the flip-flop output on the other, this can be checked with the greatest of ease! This applies to any other type of digital circuitry.

The *model 452* manual gives a very complete description of how to take phase readings on any kind of signal—sinewave, pulse, squarewave, etc. After a simple calibration, the phase angle is very easy to read. After setup, just push the ×5 magnification switch and the display expands (the sweep speed goes up). If the original resolution was, say, 40°-per-division, pressing this switch brings it to only 8°-per-division, which can easily be read to a close tolerance. You can also make Lissajous figures, which are shown in the manual.

In hi-fi audio applications, you can use the scope to read the phasing of the inverse feedback. If the phase is off far enough, it can cause the feedback to become regenerative instead of degenerative, and force the amplifier into violent oscillation. In color TV, you can easily check to make sure that the gating pulse and color burst are in precisely the correct phase (timing) relation. If the pulse arrives too soon or too late, the burst finds the gate slammed in its face!

Five trigger selector switches are on the right-hand side of the panel below the trigger-level control. These switches let you select Channel A, Channel B or external trigger signals using either positive or negative going slopes; and also switch to normal or auto (to display a trace on the screen without triggering if you need it). The last switch changes the Channel B input so that it becomes the horizontal amplifier. This feature is used in sweep alignment, vectorscope display, Lissajous figures, etc. The Channel B gain controls adjust the trace horizontally.

Vertical interval test signals (VITS) are very handy for quick IF/RF response and alignment tests. However, since the patterns are broadcast on only two lines of the vertical blanking interval, they are not very easy to pick out and lock on to. (I know, I've tried it!)

The *model 452* TIME/CM selector switch has three extra positions: TVV, TVH and VITS. The instruction manual shows a simple method for picking the VITS signal out of the video, locking onto it, then displaying it. Again, just press the ×5 magnification switch, and the display opens up so that the VITS signal is easy to observe. All you do is *look* at the multiburst part of the VITS signal, which consists of several short bursts of video at a gradually increasing frequency.

If the IR/RF stages are working properly, these burst frequencies will all be amplified equally, and the top of the multiburst will be flat. If it slopes in either direction (becomes wedge-shaped) this indicates there is either a loss of high-frequency or low-frequency response somewhere ahead of the video detector. If a good flat top is displayed, just dig into the video stages to locate the source of your trouble.

The test probes used with the *model 452* are 10:1 divider types; they use the popular miniature spring--loaded hook design. Special tips can be pushed on for testing IC's and several other types of components.

The DC power supply is regulated to within an inch of its life. I counted *seven* separate voltage regulators, and I may have missed one or two. The patterns are therefore very stable and the calibration remains accurate during variations of the AC line voltage.

The *model 452* is a lot of instrument, and its price($635) is well within the ballpark for an instrument of its capabilities and construction.

continued on next page

Radio Shack Model TRS-80 Computer

CIRCLE 110 ON FREE INFORMATION CARD

SPECIFICATIONS

Z-80 based CPU; 4K bytes RAM; BASIC in 4K ROM; integrated 53-key ASCII keyboard; 500 baud cassette interface; 12-inch monitor displays 16 lines × 64 characters (32 characters selectable); interspersed graphics (128 horizontal by 48 vertical); 21 general commands with 14 functions, plus special commands including array and strings. Price: $599.95.

THE TANDY CORPORATION (1400 ONE TANDY Center, Fort Worth, TX 76102) appears to have become a serious competitor in the field of small computer systems. The Radio Shack *model TRS-80* (based on the popular Z-80 microprocessor) is rapidly becoming a standard item in homes and offices. Educators are also finding it both affordable and practical for instructing students in basic computer programming.

The *model TRS-80* is available either with Level 1 BASIC with 4K RAM ($599.95), or with Level 2 BASIC and 16K RAM ($789). Included are such accessories as a 12-inch video monitor, cassette recorder and an easy-to-follow user's manual. A game tape (*Blackjack* and *Backgammon*) is also included.

The operator's manual itself is impressive—the style is witty, comprehensive, informative, and an excellent introduction to the world of computer programming.

Although the complete three-piece *model TRS-80* package is recommended as a system, the keyboard terminal alone is available for $400. Its video output can be fed to any video monitor (even a simply converted TV set), and data can be transferred into a good-quality portable cassette recorder. The video display provides 16 lines of 64 characters each.

The modular construction of the *model TRS-80* system allows for future expansion as peripheral equipment becomes available. The keyboard terminal circuit board is designed to accomodate 16K RAM and Level 2 BASIC to handle more involved computer requirements, such as advanced string manipulation and peripheral control.

In the home, the Level 1 BASIC system would be ideal for recipes, bookkeeping, filing and even games (many already available from other sources). For educators, the system's applications could include keeping records of grades, familiarizing students with how a computer operates and for visual instruction.

Small business applications for the *model TRS-80* include record- and inventory-keeping.

With Level 2 BASIC, data exchange with the cassette is faster, and the system provides for more flexible software for alphanumeric data handling and improved graphics. Level 2 BASIC is required for such peripheral equipment as a printer or floppy-disc recorder.

Using the TRS-80

As uncrated from the box, the *model TRS-80* Level 1 system is ready-to-go in minutes. The three units (keyboard, video monitor and cassette player) are interconnected with cables (provided), and initial starting and testing instructions are simple to follow.

By following the instructions, it soon became apparent that the sample system was in excellent working order. The keyboard is especially responsive and comfortable.

The 16-line, 64-character-per-line video display is bright and sharply defined. The 12-inch video monitor makes the characters quite readable even at a considerable distance, an advantage for classroom instruction.

After an extended period of familiarization, we developed an involved program to test the computer: It performed flawlessly. Occasionally, in the interval between commanding the computer to transfer data to the cassette and commanding the cassette to return the data to memory, a small glitch developed—the information did not always return. This usually caused no particular problem, however, since a blinking video signal constantly alerts you as to the status of the data transfer. If the blinking stops, this means a bit error has occurred and the transfer must be repeated.

If the error occurs during a data transfer from the terminal to the tape, you will not realize it until you attempt to reload the cassette data back into memory; this process will also erase the program presently in the memory. Thus, it is advisable to record the data on two or three tapes first before reloading the computer memory to check the tape. This routine precautionary step will prevent much anguish later if for any reason (including power-line spikes, incorrect cassette volume-control playback settings, loose connections, or operator error) the data did not transfer.

All things considered, the Level 1 *model TRS-80* appears to be an excellent computer system; and, as system needs grow, the *model TRS-80* can grow with them. **R-E**

Electra Bearcat model 250 Programmable Scanner

CIRCLE 111 ON FREE INFORMATION CARD

THE *MODEL BC-250 BEARCAT* IS THE LATEST addition to the programmable, frequency-

continued on page 36

$AVE $9

AND RECEIVE 3 YEARS OF RADIO-ELECTRONICS AT HOME.

The option is yours! You can have the next 12, 24 or 36 excitement-packed issues of Radio-Electronics delivered to your door each month, and save up to $9 of the newsstand price while enjoying the convenience of home delivery. And you'll enjoy all the news of electronics you get in Radio-Electronics: projects to build, new-equipment test reports, computer technology, servicing tips, and all your favorite columnists on solid state, hobbies, hi-fi, servicing and computers. Check out the money-saving subscription offers on the coupon below, and check off the one that suits you best. It's the best move you can make today, or for the next three years.

Mail to: Radio Electronics
SUBSCRIPTION DEPT., P.O. BOX 2520
BOULDER, COLO. 80323

(please print)

Name

Address

City State ZIP

Indicate the offer you prefer:

☐ **1 Year—12 issues ONLY $9.98**
(You save $2.02 off newsstand price.)

☐ **2 Years—24 issues ONLY $19.00**
(Save More! $5.00 off newsstand price.)

☐ **3 Years—36 issues ONLY $27.00**
(Save Even More! Save $9.00 off newsstand price.)

☐ Payment enclosed (Send one extra issue)

☐ Bill me

☐ Check here if this is a new subscription.

☐ Check here if you are extending or renewing your subscription.

Extra Shipping: Canada $3.00 per year, all other countries $5.00 per year. 40L8

CIRCLE 86 ON FREE INFORMATION CARD

EQUIPMENT REPORTS

continued from page 34

synthesized VHF/UHF scanners already on the market. It is manufactured by Electra Company (300 South on East County Line Rd., Cumberland, IN 46229) the pioneer of scanning receivers.

At first glance, the BC-250 looks nearly identical to the popular *model BC-210*, but a closer look at the keyboard reveals the differences.

A custom-designed microprocessor IC greatly expands the flexibility of this scanner: It has 50-channel scanning capability; it counts the number of times any (or all) of the 50 channels have been heard in use while scanning; and it can search through any of its frequency ranges for unknown frequencies (up to 64) and store them for later display during recall.

The nonvolatile memory retains its frequency and instruction programming even if the unit is unplugged while it is operating, or if a power failure occurs; there is no battery to replace every few months.

The 50 channels are programmed into the scanner by a keyboard and stored in five banks of 10 channels each. The banks can be individually or collectively selected in or out of the scanning sequence. Thus, the frequency blocks of such agencies as fire and police departments, ambulances, etc., can be selected in and out of scanning at will.

The squelch control can be adjusted manually or rotated to an automatic position at which it is activated only when a received signal exceeds a preset level above the background noise. Plus any one of the 50 channels can be manually selected at random without having to step in sequence through the scanning order.

A delay feature places a two-second hold on any channels after a signal is received before scanning or searching is resumed. This feature allows you to hear a reply to an intercepted transmission from a simplex operation. The delay feature is not necessary for monitoring repeaters, since they have their own built-in delay for incoming signals.

Both scanning speed and search speed can be slowed down or speeded up at the touch of a button (a choice of 5 or 15 channels-per-second). The unit has a lockout feature which when activated, prevents unwanted signals from stopping the scan or search sequence.

A priority channel is also provided; no matter what function the monitor is presently executing, the priority channel overrides it and can be heard when it is active. In addition, an automatic 12-hour clock display appears when the receiver is switched off, and can also be read with the receiver on without disabling any receiving function.

The rear apron of the *model BC-250* provides an audio output for an external speaker or recorder, plus a control circuit to activate an external device such as a tape recorder. The quality of the audio sound is voice-tapered . . . crisp and clean.

Specifications

The manufacturer's specifications for the *model BC-250* show a noticeable improvement over those of earlier scanners. Naturally, published specifications are average, and will vary somewhat among individual receivers.

SPECIFICATIONS

Frequency range: 32–50, 146–174, 420–512 MHz
Sensitivity (12-dB SINAD): .6 μV, low and high band; .9 μV UHF
Adjacent-channel rejection: better than 50 dB
Audio output: 1.5 watts
Power requirements: 120 VAC or 13.5 VDC
Size: 10⅝ W × 3 H × 7⅝ inches D
Weight: 5 lb

Lab tests

To avoid strong signal overload in metropolitan area monitoring, Electra recommends the use of the small telescoping antenna provided with the *model BC-250*. We couldn't resist using a rooftop monitoring antenna. Distant weak signals came in surprisingly well, and problems with intermodulation and images were less than expected. A major metropolitan area is a beehive of signal activity, and only the better receivers can endure the signal overload presented by an outside antenna! Still, with the internal antenna provided, distant signals were very readable due to the model BC-250's improved sensitivity.

The automatic search feature, with search-lockout for unwanted signals, is a pleasure to use. The ability to recall active channels discovered during search, and the automatic capability to count transmissions intercepted on scan are very handy. A modest spectrum study of active channels in an area can be quickly accomplished using the *BC-250*.

Expected delivery for the new scanner was tentatively set for mid-summer, 1978, at a suggested retail price of $399.95. **R-E**

New All-In-One Speaker-phone

It's a standard telephone and speakerphone housed in a compact ultra-modern package. Here's a look at the circuitry and how it works.

HANS R. CAMENZIND*

IF YOU HAVE EVER USED A SPEAKERPHONE, OR IF YOU HAVE ever talked to somebody who was using a speakerphone, it is immediately apparent because it sounds as if the call is being made from inside a large wine barrel, a quite annoying phenomenon. Also, all except some of the most expensive speakerphones ($300 and up) tend to drop off a word or a syllable here or there. And, if you happen to have a bad connection with much background noise, your speakerphone may not work at all. For all these reasons, speakerphones are almost exclusively used for group conversations. The much-advertised "hands-free" feature is really more of a nuisance than a valuable asset.

In attempting to design a speakerphone that eliminated, or at least greatly reduced, these shortcomings, the first and most serious problem encountered was the barrel sound that is caused by room acoustics. For example, if you place a tape recorder microphone in the middle of a room and speak into it from a few feet away, the sound bounces off the walls and you get a noticeable echo effect. In a face-to-face conversation, you do not notice this echo at all because your ears are stereophonic and the brain does a marvelous job of signal processing.

When you move a microphone to within about 18 inches from your mouth, the echo starts disappearing. At this distance, or even shorter distances, the direct sound becomes so much stronger than the reflected sound that the echo is no longer a factor.

There is at present no electronic solution to the echo problem. It is possible to process the signal so that the gain is reduced for a period of time after a sound peaks. This method works well for tone bursts, but it makes a conversation less intelligible. In addition, the time it takes for the echo to arrive at the microphone varies with room size. This means that the suppression time would have to be adjusted for each room.

The best solution to this problem is to design the speakerphone so small and light that the person using it would naturally move it closer. This design choice was influenced by the electronic calculator: When you use a calculator you draw it close to you because it is small and handy.

A calculator-sized speakerphone also solves the problem of the noise interference on the line. If the connection is very bad, you simply pick the speakerphone up and hold it to your ear. The Tridar speakerphone contains a mercury switch that senses the angle at which the phone is being held. When it is tilted more than 45°, the gain is automatically reduced, and the speakerphone becomes a normal telephone.

This latter feature also has another advantage. Suppose you have been holding a hands-free conversation. Somebody walks into your office and you would rather continue the conversation privately. You simply pick up the phone.

Two other features are built into the Tridar speakerphone. One is a volume control to adjust the varying amplitude on the phone line and to make the speakerphone useful for a group conversation as well. The other control is a HOLD pushbutton to shut off the microphone so that the group can speak in private, or allow you to leave temporarily.

The most difficult problem to solve in the circuit design was the delay, which can chop off a part of the speech. Unlike a regular telephone, the microphone and the speaker in the speakerphone cannot be on simultaneously; otherwise the speaker feeds into the microphone, the signal is amplified and a portion of it returns to the speaker, creating the howling sound sometimes heard in public address systems.

The simplest solution here is to sense the microphone level. When the level exceeds a preset threshold, the speaker is turned off. However, since this threshold cannot be set very low (otherwise it would be triggered by room noise, e.g., a typewriter clicking), part of the first syllable is lost. To minimize the effect, typical low-cost speakerphones turn the speaker on with a delay of about 1 second so that the microphone channel is held on continuously for the entire sentence.

*Tridar Corporation.

But such relatively unsophisticated circuitry used in low-cost speakerphones has the disadvantage that comments interjected by the conversation partner can be missed. Especially if the other party in the conversation is long-winded, it becomes impossible to get a word in edgewise!

To avoid this delay a rather complex voice-level sensing scheme was designed. This is the main reason that high-performance speakerphones are rather bulky and heavy. Therefore, to provide this complexity in a small and light package, custom-designed integrated circuits were used. In fact, using custom IC's not only allowed the Tridar phone to be designed in a very small package, it reduced the cost to less than that of a design using components and standard IC's.

There is a great deal of misconception about custom IC's. Most designers feel that a custom IC is only economically feasible for very large quantities because of the enormous tooling cost and that you should design a product with standard, off-the-shelf components first. However, neither of these assumptions is quite true.

Semicustom IC's require little extra expense or added time for the development. And, especially for this speakerphone, a design using off-the-shelf components would have made no sense at all, since the end product would have been of the size of a normal telephone and weighed at least two pounds.

Basic design

Figure 1 shows the block diagram of the Tridar speakerphone. The most important feature that is responsible for the high performance of the speakerphone is the peak detector/comparator circuit. Its design represents a drastic departure from older speakerphone designs.

The most difficult task in designing a speakerphone is to devise a circuit that decides who is talking at any given moment. You cannot simply assume that if there is a signal in the microphone channel, it is the person at the speakerphone end that is talking. What makes this assumption wrong is the fact that the speakerphone's speaker also talks into the microphone.

At the other end—the telephone line—the distinction between the voices of the two parties is also unclear. On the telephone line itself the two signals are completely mixed and, supposedly, of equal amplitude so you cannot distinguish between the two. The connection to the phone line is usually made through a hybrid transformer, in which the two directions can be separated somewhat. In the Tridar speakerphone, the hybrid circuit is an active circuit to reduce space and weight.

The separation of the two signals in even the best hybrid circuits is only about 10 dB, the reason being the telephone line impedance. If the impedance were 600 ohms, as specified, the hybrid circuit could be matched to the line and a separation of at least 30 dB would be possible. In reality, both impedance and phase vary wildly between 300 Hz and 3 kHz and depend on the length of the line.

How then can you tell which channel should be open? The information is there but just barely. The signal from the phone line coming from the hybrid circuit is slightly stronger even after the limited separation afforded by the hybrid circuit.

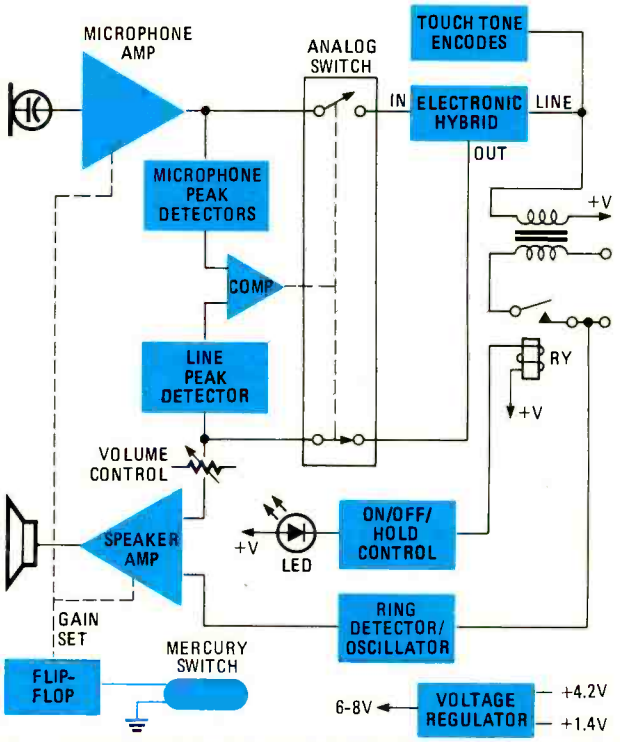


FIG. 1—PEAK DETECTORS AND COMPARATOR determine which party is talking. This represents a drastic departure from earlier designs.

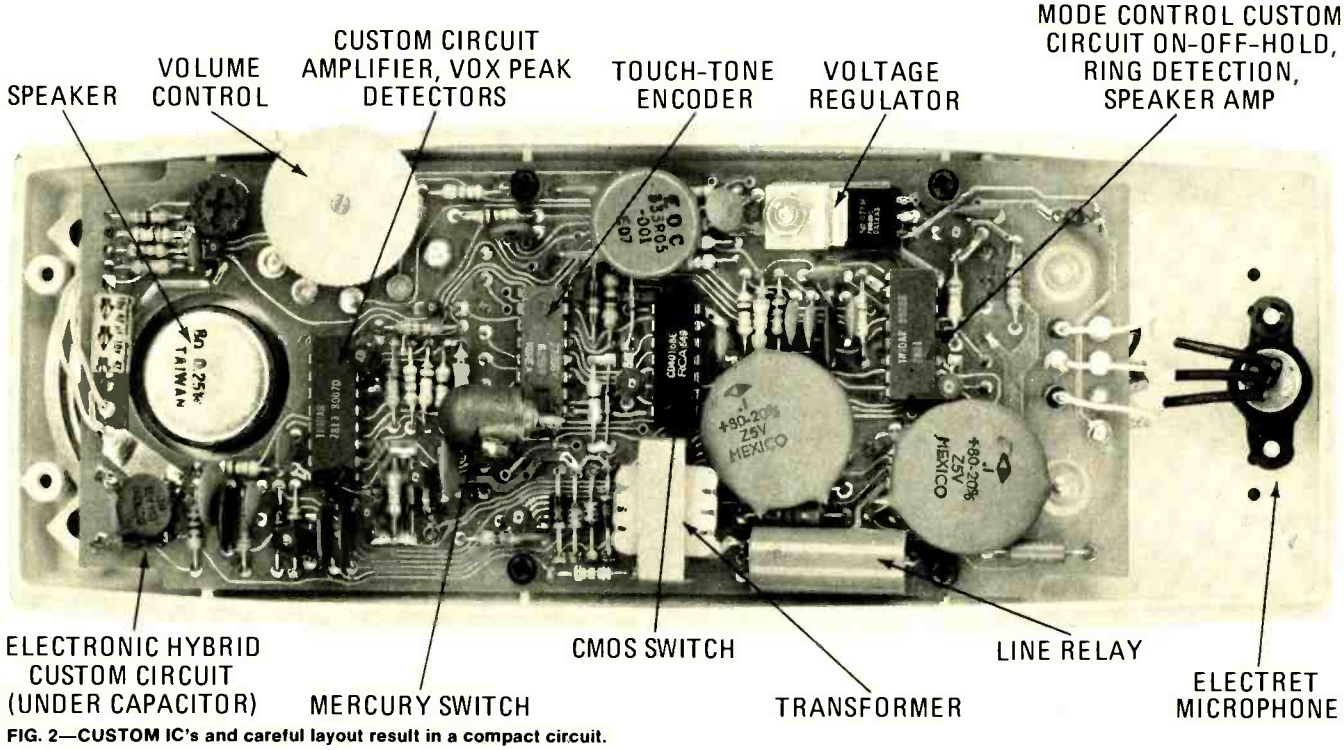


FIG. 2—CUSTOM IC's and careful layout result in a compact circuit.

Speaking directly into the microphone does result in a slightly larger amplitude than the indirect sound produced by the loudspeaker if the microphone is pointed away from the loudspeaker. In the Tridar design, the amplitudes of these two signals are converted into DC voltages in the peak detectors and then compared (see Fig. 1). If the microphone channel is louder, the upper section of the analog switch is closed and the lower one is opened; thus, the microphone sound will go to the line and the speaker channel is cut off.

During each pause in the microphone signal—even between words—the comparison is made again, i.e., the signal from the line is connected. To allow this, the time constant of the microphone peak detector is quite short.

Two factors help here. First, when you are talking, you cannot really hear anything. You shut off the other person's voice in your brain. You may be aware that he or she wants to say something, but you cannot understand it. Second, even segments of the other person's voice in this instance tell you what you need to know, namely that you are about to be interrupted and that you had better stop talking and start listening.

This is precisely what was built into this design. During each pause in the microphone signal, however short, the speaker channel is opened up. Thus, if the other person has been talking, a part of his speech is heard on the speakerphone.

If the user of the speakerphone continues to talk (despite the fact that sound is coming through) another effect takes place. The other person automatically raises his voice. This increases the level of the line peak detector, and the line signal begins to outweigh the microphone signal, thus opening the speaker and shutting off the microphone.

The entire speakerphone contains 465 components, of which 410 are contained in three custom IC's (not counting the touch-tone encoder, which is a standard, off-the-shelf IC). Figure 2 shows a view of the PC board. Here are some highlights of some of the important circuit blocks.

The hybrid circuit

The function of the hybrid circuit is to separate the two signals on the telephone line. In an ordinary telephone, this is accomplished with a rather bulky differential transformer. In the Tridar speakerphone, this function is duplicated in one of the custom IC's.

Figure 3 is the schematic diagram of the hybrid circuit. The

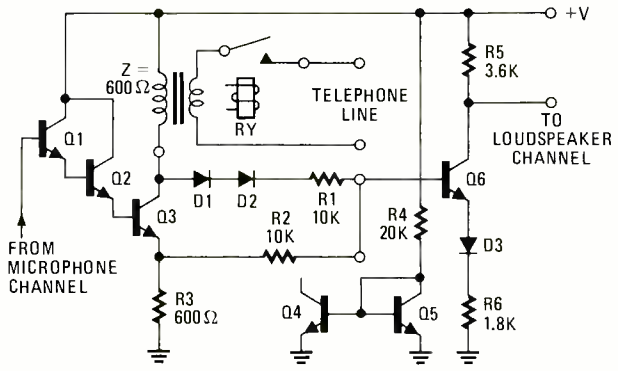


FIG. 3—ELECTRONIC HYBRID CIRCUIT duplicates function of bulky transformer used in ordinary telephone.

telephone line is connected to the phone through a small simple transformer to meet the FCC's 2000-volt isolation specification. The signal is then obtained at the secondary and arrives at the base of Q6 through D1, D2 and R1. Note that the signal cannot go through Q3 because transistor Q2 blocks the signal applied to Q3's base.

A signal coming from the microphone is buffered by Q1, Q2 and Q3. The impedance of the telephone line is nominally 600 ohms, and with a 1:1 ratio in the transformer, the collector load impedance of Q3 is the same as its emitter resistance. Thus, the signal going into the transformer has the same amplitude as the signal at the emitter of Q3, but the opposite phase. These two signals are summed at the junction of R1 and R2. Since R1 and R2 are equal, the microphone signal cancels exactly at the base of Q6 so that only the line signal appears at this point. This, however, is true only if the line impedance is, in fact, 600 ohms. In reality, the line impedance can vary considerably and the cancellation at the base of Q6 is about 10 dB. This performance is identical to that of a hybrid transformer.

Diodes D1, D2 and D3 are used for DC level-shifting only; their influence on the gain and cancellation is minimal.

Mike amplifier and peak detectors

Figure 4 shows the diagram of the microphone amplifier. The

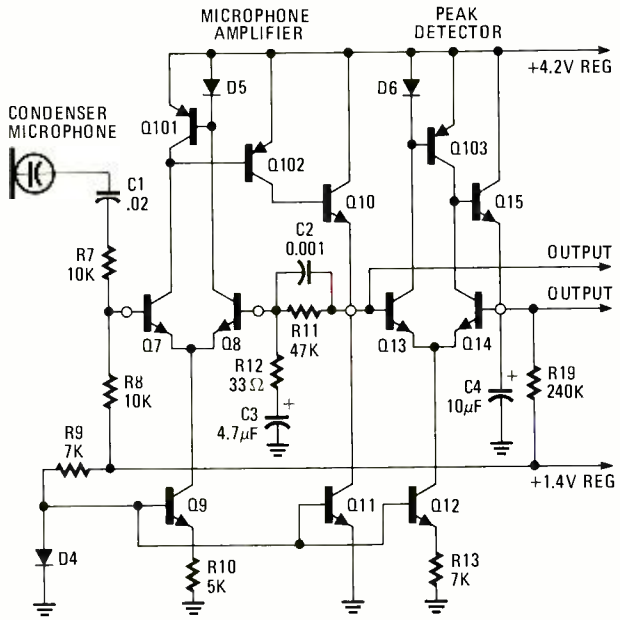


FIG. 4—MICROPHONE AMPLIFIER and peak detector features a differential input stage.

input is biased at 1.4 volts through R8. Transistors Q7 and Q8 form a differential pair with an active load D5/Q101. This active load is a diode-biased current source. The collector current of Q8 flows into D5. The internal base-emitter diode of Q101 is connected across D5. Therefore, as the current through D5 increases, the collector current of Q101 increases by the same amount. At the collectors of Q7 and Q101 there is a push-pull effect: When, with a signal at the input, one collector current increases, the other decreases by the same amount, resulting in a large amount of gain. Note, however, that this configuration can only be used in IC's since it requires a near perfect matching of the components.

The signal is then further amplified in Q102 and buffered by Q10. At this point there is an open-loop gain of several thousand that is then reduced to 140 with feedback resistors R11 and R12.

The operating current of the differential stage and the output is derived from D4. Diode D4 and the base-emitter diode of Q11 are identical in size; therefore, the collector current of Q11 will be similar to that of D4, or 100 μA. The current of Q9 and Q12 is reduced by emitter resistors.

The microphone-amplifier output is fed into both the analog switch (CMOS) and the peak detectors. The configuration of the peak detector is almost identical to the amplifier. However, there is no load current at the emitter of Q15. The positive peaks of the signal charge up capacitor C4 at the output. The only discharge path for C4 is R19. These two elements then set the time constant of the peak detectors.

Loudspeaker amplifier

Approximately 250 mW of audio power is required for a speakerphone, which can easily be integrated on a bipolar IC chip. The loudspeaker amplifier uses two of the four high-current (200-mA) NPN transistors contained in a linear IC.

Figure 5 is the schematic of the speaker amplifier. Coming from the volume control, the telephone line signal is first amplified in a differential pair with an active load. A diode string (D9–D11) and resistor R21 are biased through D8/Q107 at a

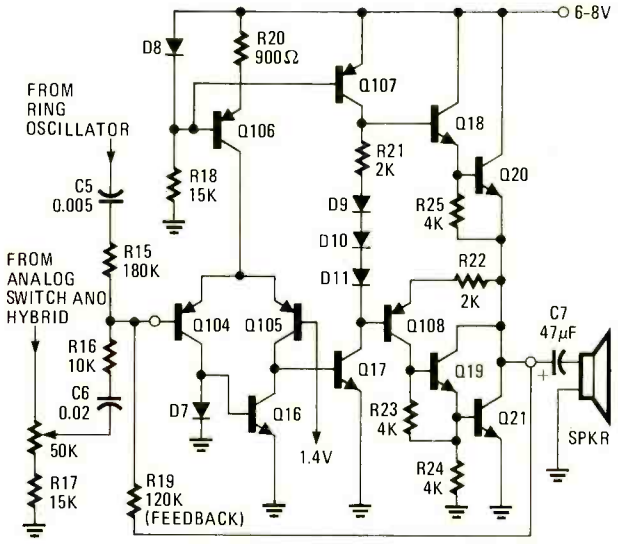


FIG. 5—SPEAKER AMPLIFIER circuit generates 250 mW of power.

current of 500 μA. These four elements match the internal base-emitter diodes of Q18/Q20 and Q108/R22, so that the idling current of the output stage Q is also 500 μA. The signal is fed into the diode string through Q17 and is amplified in the output stage. The closed-loop gain is set at approximately 5 by R19 and the input impedance.

Ring detectors and oscillators

The final circuit causes a ringing sound in the loudspeaker

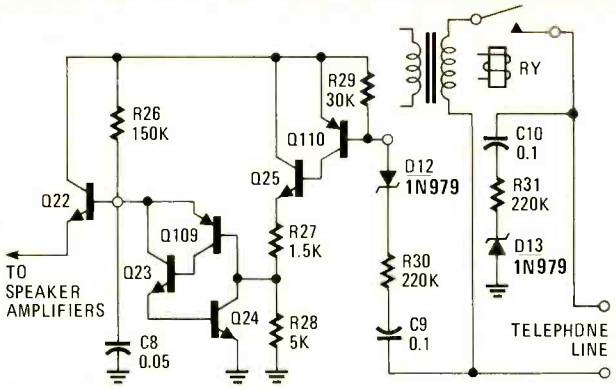


FIG. 6—RING DETECTOR AND OSCILLATOR generates a 1-kHz tone that varies between 60 and 150 volts P-P at a 20-Hz rate.

that eliminates the need for the bell. As shown in Fig. 6, the ring signal is picked up directly at the telephone line through a combination of Zener diodes, capacitors and resistors. In direct contrast to the voice signal, the ring signal has a very large amplitude that varies between 60 and 150 volts peak-to-peak at 20 Hz.

When the negative peak of the ring signal exceeds the Zener diode breakdown, Q110 and Q25 turn on. This powers up the relaxation oscillator made up of Q23/Q24 and Q109 through voltage divider R27/R28. The frequency of the relaxation oscillator is set by R26 and C8 at 1 kHz. The 1-kHz sound signal, which is modulated by 20 Hz, is fed into the speaker amplifier.

One large custom IC contains three of the four circuits discussed plus part of the control circuitry. As a result of using this type of IC, the Tridar speakerphone is smaller than the smallest telephone now offered and and weighs less than the handset of a desk telephone. The custom integrated circuit is making its presence felt in consumer electronics. **R-E**

Oscilloscopes gaining worldwide acceptance in computer field

As the mechanical design, layout and circuitry of oscilloscopes have improved so has their worldwide marketability. Hans Toorens, oscilloscope product manager for Philips Test & Measuring Instruments, Inc., believes that the broader range of applications and functions for an oscilloscope in computer servicing, as well as in other areas, has caused the market to expand both in the U.S. and abroad. He also believes oscilloscopes are destined to become the "workhorse" of the computer-service industry.

Purchasers of test equipment such as oscilloscopes have become increasingly sophisticated in their requirements—they use more precise parameters in judging an oscilloscope, looking for electronic measurement capability, cost reliability and its effectiveness both on the bench and in the field.

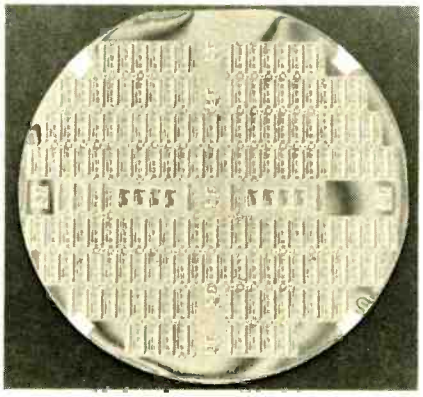
Connecticut judge dismisses radar-detector case

The city of Waterbury, CT, has probably experienced its last arrest for possession of a radar detector. This past June, Judge Norman Buzaid dismissed charges against Dr. Howard Rofsky who had been arrested for possession of a detector. Judge Buzaid termed the 1962 state ruling against radar detectors "ridiculous."

Most Connecticut courts have been reluctant to prosecute such cases, and Dr. Rofsky's case was only one of several lesser-known incidents. However, the Connecticut decision came only days after the Supreme Court of the State of Virginia struck down a portion of that state's anti-radar law, declaring that a presumption of guilt in the statute was unconstitutional. The law will still be on the books, but police will now have a hard time proving the detector in the car was being used illegally. Virginia is the only state in the country to have a law against radar detectors.

The charge-coupled device, an idea come of age

In 1969 Bell Labs scientists Willard S. Boyle and George E. Smith devised the charge-coupled device (CCD), an invention that since then has inspired a great many technical papers but has now finally come of age.



CCD WAFER has a 3-inch diameter and contains 169 CCD devices.

Scientists Boyle and Smith arrived at the idea for the CCD almost accidentally. They were looking for a semiconductor device that could control and handle data similar to magnetic bubble devices. (Bubbles store data in a very small space, making possible high-density data storage.) While at that time bubbles were fairly new devices, the semiconductor was well-known; the resulting invention was the CCD—a result of applying the principles of bubble devices to a semiconductor.

The CCD has three layers—one layer made of metallic electrodes, another of silicon crystal, and an insulating layer of silicon dioxide. Standard MOS processing techniques can be used to manufacture a CCD, which can then be used to perform many electronic functions now performed by larger, more complicated IC's.

Negatively charged electrons in the CCD can be moved about. The information (in the form of electrical charge packets) is stored in small areas or "wells" on the surface. Applying the desired voltage results in data transfer from one well to another. Since the amount of charge in a well can be varied continuously, this makes the CCD an analog device that can be used in analog communications transmissions. When the charge packets are digitized (i.e., the wells are either empty or full), the CCD can be used as a digital memory. If the charge packets are introduced *optically*, instead of electronically, with an image focused on the silicon surface, an imaging device results. It can then be used as an image sensor in an all solid-state television camera. **R-E**

How To Troubleshoot Digital Circuits

Isolating a fault in a digital circuit can be both difficult and time consuming if you don't know how to go about it. Here's an in-depth look at the faults, the right troubleshooting procedures and the test equipment to make it easier.

L. STEVEN CHEAIRS

MOST PROTOTYPE INSTRUMENTS HAVE A few design or fabrication bugs, and any system can malfunction due to a defective component. Unfortunately, these problems do not generally announce themselves in a way that makes them easy to identify. This is because a defect in the system can affect many other components and produce a number of secondary faults. This article will try to present a method that the average hobbyist can use to debug his own prototype or to repair malfunctioning logic circuits.

A list of digital troubleshooting equipment will be included. For each unit, we will try to outline when and where it should be used, noting its limitations. The reader will be led step-by-step through a few typical problems and we'll show various methods of obtaining the data required to pinpoint the fault. Since most of you only come into contact with TTL, CMOS and MOS devices, only these technologies will be covered.

Test equipment

Traditionally, when the individual components of a circuit were accessible, you could perform relatively simple tests to verify proper operation of each component by using a signal generator, voltmeter, ohmmeter, diode tester, transistor tester, tube tester, or an oscilloscope. All this equipment is defined as traditional troubleshooting equipment.

Now that a circuit element must be viewed as a little "black box," where the components are not accessible, a new troubleshooting philosophy must be adopted. Simply the IC must be tested for a complete circuit operation rather than just for a few characteristics such as capacitance, inductance, resistance and turn-on voltages. Note also that now we must observe complex digital signals, rather than simple circuit characteristics, to determine if the IC is functioning correctly. Complicating the situation further, you must consider a large number of inputs and outputs and compare the relationship of incoming signals to outgoing signals. This requires an intricate knowledge of many complex circuits. However, I am not trying to scare you off but just trying to show why a new variety of test equipment was developed.

Multimeter and oscilloscope

The only two pieces of traditional test equipment that you will find some use for in digital troubleshooting are your *multimeter* and *oscilloscope*. With the multimeter you can check the power-supply voltage of a malfunctioning circuit. An oscilloscope can also find much use, especially if it is a dual-trace unit with triggered sweep. However, the older scopes will be next to useless because both time and frequency measurements cannot be made, and the amplitude, the Y-axis, is not generally calibrated, therefore preventing threshold measurements.

When viewing logic levels, absolute amplitudes are unimportant. A digital signal has three states. Only two of these states are used to convey information; they are logic 1 and logic 0 (the third state is designated as undefined). These states are defined by the threshold levels of the logic family; for TTL (*T*ransistor-*T*ransistor *L*ogic) the low threshold is 0.4 volt and the high threshold is 2.4 volts. When the amplitude of the signal is less than 0.4 volt, it is considered to be at a logic 0 level; when it is above 2.4 volts it is at a logic 1 level; and when the amplitude is between 0.4 volt and 2.4 volts, the output is undefined. *Therefore, when you use an oscilloscope, all signals must be checked in order to determine if the data is at a valid logic level!* I have seen technicians spend days troubleshooting a circuit only to discover a problem that had been staring at them all along because they were only looking at waveforms and not logic levels.

Logic clip and probe

Two logic test instruments that almost anyone who works with logic has become familiar with are the *logic clip* and *logic probe*—both overcome the oscilloscope problem. When observing static or low-frequency data, the logic clip and logic probe function quite well; many units have a pulse stretcher and/or memory to enable short pulses to be observed. The clip is simply piggybacked onto the IC; it will find its own power. If pin-to-pin contact is good, then the LED's will indicate the logic levels (where LED on = logic 1 and LED off = logic 0).

To use the logic probe, connect the two wires that exit from the end opposite the tip to the power supply (the red wire is positive and the black is negative). Some probes only have one indicator light; thus, a lit indicator is a logic 1 and an unlit indicator is a logic 0. Other probes may have two or more indicator lights; for instance, a light for the logic 1 state, another for the logic 0 state, and yet another light connected to a pulse stretch circuit or memory. To use the probe, simply touch a PC card run or the pin of one of the IC's and observe the indicators. The logic probe can detect pulses of short duration that have low repetition rates; these pulses would be difficult for an oscilloscope to detect. The probe should be used in one of two ways: First, you can let the circuit operate at its normal clock rate and monitor only key signal lines. Second, you can slow the system clock down using a low-frequency clock source so the logic changes are slow enough for the probe (or clip) to be useful.

Unfortunately, when you slow the clock down, the circuit will probably react differently—due to propagation delay. Many design problems that occur are due to the delaying of parallel signals; the glitches produced by propagation delays in two or more logic paths; or because of PC track inductance and capacitance (both of these are frequency sensitive).

The solution to these problems was provided by two instruments, the *logic comparator* and the *logic analyzer*. The logic comparator is a small hand-held unit having a cord protruding from one end, a 16-LED display and a cradle for a reference IC. The end of the cord contains an IC clip. The instrument has two modes of operation: First, connecting the IC clip to an IC and observing the LED provides you with a simple logic clip (when no reference IC is used and the mode switch is set to the clip position); second, insert-

ing the known good reference IC and setting the mode switch to the comparator position gives you a tester that will detect operational differences in the two IC's.

Since the reference IC is known to be good, it is assumed that any fault must be due to a bad IC; however, this is not always the case. Problems can occur when say a flip-flop or counter is being tested and the two IC's are not synchronized. The solution here is to use a logic pulser to reset the devices before testing. When testing memories or shift registers, attach the comparator for a long enough period for both IC's to acquire the same data.

The comparator does have some serious problems, however; it will not function properly with IC's that have a TTL input and a non-TTL output. Sometimes it will detect a problem that may not be caused by the test IC but by another IC, a bad clip connection, or a faulty circuit board. The worst problem the comparator has, and it shares this problem with all the other logic tools (with the exception of the current tracer), is that it cannot test any wired-OR/wired-AND connections. Thus, the whole set of open-collector IC's are untestable.

The logic analyzer is probably one of the most useful digital test instruments. Very simply, it monitors one or more signal lines until it observes a preprogrammed qualifier that is user-programmed. After detecting the qualifier, it loads its internal memory at a sample rate that is also user-determined; the rate may be synchronous or asynchronous to the data lines. It is also possible to wait a predetermined number of clock pulses (or amount of time) before or after the qualifier. The data is then displayed on a CRT screen as waveforms or truth tables. The logic analyzer also has difficulties testing wired-OR/wired-AND configurations.

The best solution to the wired-OR/wired-AND problem (as well as shorts and opens in the PC card) is to use a current tracer. This probe can be obtained in two forms. The first resembles a logic probe; one end has power leads and the other has a tip. The tip is not used to make electrical contact as with the logic probe; instead it contains a magnetic sensor used to monitor the field produced by current flow. Also, the probe can only detect low-impedance faults.

To detect a wired-OR/wired-AND fault, simply place the probe near the pull-up resistor and adjust the gain control until the indicator lamp lights up (see Fig. 1). Next, place the probe to each output pin of the open-collector gates—only the defective gate will cause the indicator to light up. Also, when a low-impedance fault exists between two gates, the current tracer and a logic pulser can be used as quick diagnostic tools (the logic pulser should be used on all faults responsible for abnormal current flow if the current flow does not provide enough stimulation to use the current tracer). If a signal line between IC's is shorted to ground, place the logic pulser on the foil trace midway between the IC's. Next, use the current

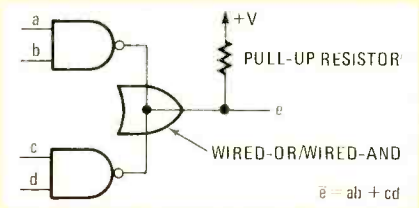


FIG. 1—WIRED-OR/WIRED-AND configuration is formed by connecting the outputs from open-collector gates and connecting a pull-up resistor.

tracer to follow the current to the defective component. A solder bridge may also be detected using the current tracer. Start with the gate that is sourcing the current and follow the current flow until you find the short. Another useful application is when a buffer is driving numerous inputs and one input is shorted to ground. Adjust the current tracer at the output of the buffer and then touch the probe to each input; the one that causes the indicator to light is the defective gate.

Logic pulser

A *logic pulser* is simply a pulse generator that provides either a single-pulse or a continuous-pulse stream. To use a logic pulser, place the tip of the pulser to the input of the suspected logic element. Next, press the trigger button and the logic element will be forced into its opposite logic state. With most conventional signal generators, either circuit components have to be unsoldered and/or the foil trace has to be cut. Most pulsers will provide around 700 mA of current, which is more than sufficient to force the IC to change states. The pulser must generate a very narrow pulse to prevent any IC damage that might be caused by applying too much current. The pulser, as should all other test equipment, should have a high-impedance input to prevent adversely affecting normal circuit operation while using it.

Beyond this collection of equipment all you need is a set of IC test clips and jumper wires. It should also be emphasized that all the equipment described above will be required in any single application. The scope is a general-purpose instrument that can be used in almost any application, whereas the voltmeter may find use only in specific cases—such as checking the power supply. The logic clip should only be used for checking static or low-frequency signals. The logic probe also works best at low-frequency levels, but can be used on higher-frequency circuits if it is used just to monitor key control lines. The IC comparator is useful only for testing a restricted number of the available IC types (because of the need for a reference IC). Both the pulser and current tracer are very valuable troubleshooting tools. The logic analyzer is unquestionably a valuable tool—especially when used with systems that have parallel information, such as synchronous counter strings, address buses, data buses, etc.

IC technologies

To troubleshoot effectively, a knowledge of the individual IC's and the logic

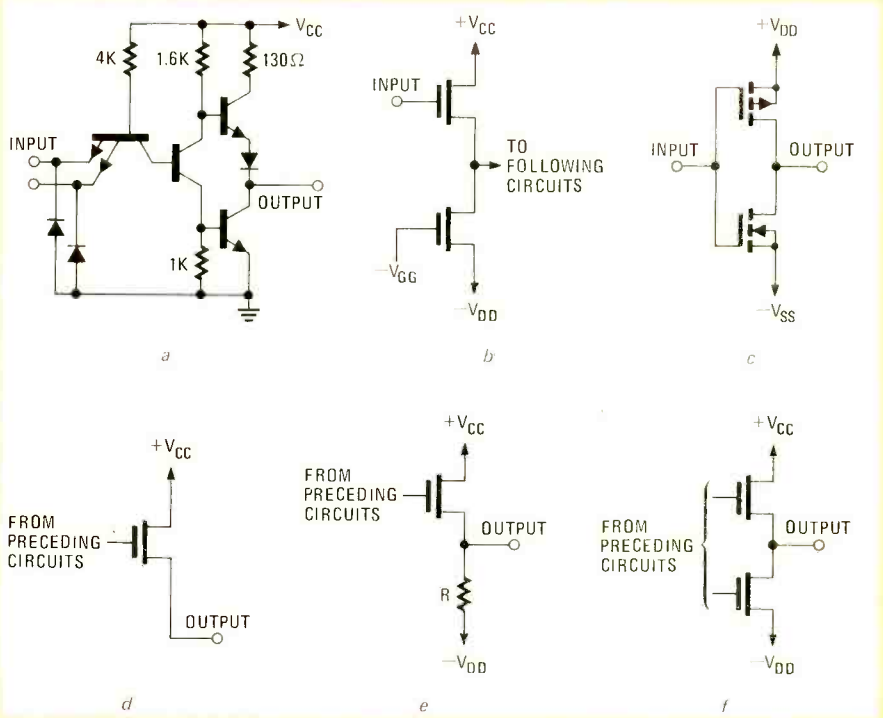


FIG. 2—INPUT AND OUTPUT CIRCUITRY FOR TTL, PMOS, CMOS and MOS logic families. Input circuitry for a 2-input TTL NAND gate is shown in *a*. Input of PMOS gate is shown in *b*. Circuit of a CMOS inverter is shown in *c*. Open-drain MOS output circuit is shown in *d*. Resistor pull-down MOS output circuit is shown in *e*. Push-pull MOS output circuit is shown in *f*.

family associated with them is required. Thus, the troubleshooter must have a library containing the pinouts and functional truth tables for all the common IC's, plus some not so common ones. Also, a firm understanding of the IC's input and output characteristics for the logic family is required. Figure 2 shows the input and output circuitry associated with TTL, CMOS and MOS logic families.

This article will not discuss such design characteristics as propagation delays, set-up times, power supplies, filtering, bypassing, fan-in/fan-out, etc. When discussing specific logic families, only threshold levels and failure modes will be examined. Furthermore, emphasis will be placed upon poor PC layout, with less emphasis on defective components. This is because more than 90% of the problems are a result of design and fabrication failures and less than 10% a result of faulty components. Of course, the exception to this rule is the digital circuit that experiences a logic failure after proving itself in operation for an extended period. In this case, the odds are in favor of a defective component.

I will assume that you have access to IC pinout information and description of all the IC functions. If not, such information is available from many sources. The most common IC's used by hobbyists are of the MOS, CMOS, or TTL technologies. For the MOS types—NMOS and PMOS—you should consult the individual components data sheet for switching-threshold levels. For most MOS/CMOS IC's that are TTL-compatible, the maximum low-level output, V_{OL}, with no noise at the input and assuming only capacitive loading, is given as $V_{OL} = V_{SS} + 0.01$ volts. The minimum high-level output, V_{OH}, for the same conditions, is given as $V_{OH} = V_{DD} - 0.01$ volts. For optimum performance, the high-level input should equal V_{DD} and the low-level should equal V_{SS}. Due to the high DC noise immunity of MOS/CMOS devices, an acceptable logic 1 is $V_{DD} - 0.3(V_{DD})$ and a logic 0 is $V_{SS} + 0.3(V_{DD})$. Therefore, as a worst case, V_H may equal 3.5 volts, and V_L may equal 1.5 volts, using a 5-volt power supply. Also, variations in the power-supply potential, V_{DD}, will directly affect the threshold point.

Transistor-Transistor Logic (TTL or T^2L) can be subdivided into five families—regular, low-power, low-power Schottky, Schottky and high-speed. Table 1 shows threshold-level comparisons of each type. In this table, both the absolute and typical levels are shown; when testing use only the absolute levels. Thus, for standard TTL the low-level threshold is 0.4 volt and the high-level threshold is 2.4 volts (the area between 0.4 volt and 2.4 volts is undefined).

The failure modes for these logic families are similar, although some logic families may be more prone to one particular type of failure. Basically, there are only five kinds of failure: (1) failure of the internal logic; (2) the input/output is shorted to ground; (3) the input/output is shorted to V_{CC}; (4) the input/output is open; and (5) there is a short between two or more of the IC pins.

The first failure, that of internal logic, results in erratic circuit operation. Therefore, the output of the IC will not be predictable. This failure will block normal signal flow and most assuredly has a catastrophic effect upon circuit operation.

The second and third failure modes, the input/output being shorted to ground or to V_{CC}, do not qualify as catastrophic failures since in many cases normal curcuit operation continues with only occasional circuit malfunctions. In most cases, however, some expected system operations will not exist and thus can manifest themselves as catastrophic failures. The actual effect of this type of fault is that an input/output will be held high or low, depending upon the failure, and thus prevent normal circuit operation.

The fourth failure, open input/output, generally will be due to a bad internal wire bond between the IC pin and the silicon wafer. When the problem is due to an open input bond, then no signal will be delivered to the silicon wafer. Thus, the input will float at some undefined level. Note also that there will be no effect upon the signal source driving this input. An open bond on an output will cause the IC inputs being driven by that output to float (high in the case of TTL). For both TTL and DTL, a floating input drifts to about 1.4 volts to 1.5 volts. Therefore, an open bond on an output (for TTL or DTL) forces all corresponding inputs to a logic 1 level (even though this is below the valid logic 1 level).

The final failure, a short between two pins, is one of the harder cases to analyze. When two pins are shorted, two outputs that drive those lines are placed in opposition; i.e., they both will attempt to pull the other high or low. These outputs may be on the bad IC (when two outputs are shorted) or external to the IC (when two inputs are shorted), or there may be only one output on the IC (when an output and input are shorted together). In the case where one output attempts to go high and the other tries to go low, excessive current will be drawn through both outputs. The end result is that the short will pull both outputs to a low state. Therefore, when both outputs are driven low or high simultaneously, the circuit will perform normally, but when they are driven into alternate states, the output will go low. Note that since the outputs must dissipate more power under these conditions, at some point a catastrophic failure may occur due to excessive heat buildup.

TABLE 1—THRESHOLD LEVELS for TTL logic families. Values are given in volts.

	Logic Level	7400	74L00	74LS00	74S00	74H00
V_L	Typical	0.2	0.2	0.35	0.35	0.2
	Maximum	0.4	0.4	0.5	0.5	0.4
V_H	Typical	3.4	3.2	3.4	3.4	3.4
	Minimum	2.4	2.4	2.7	2.7	2.4

A troubleshooting example

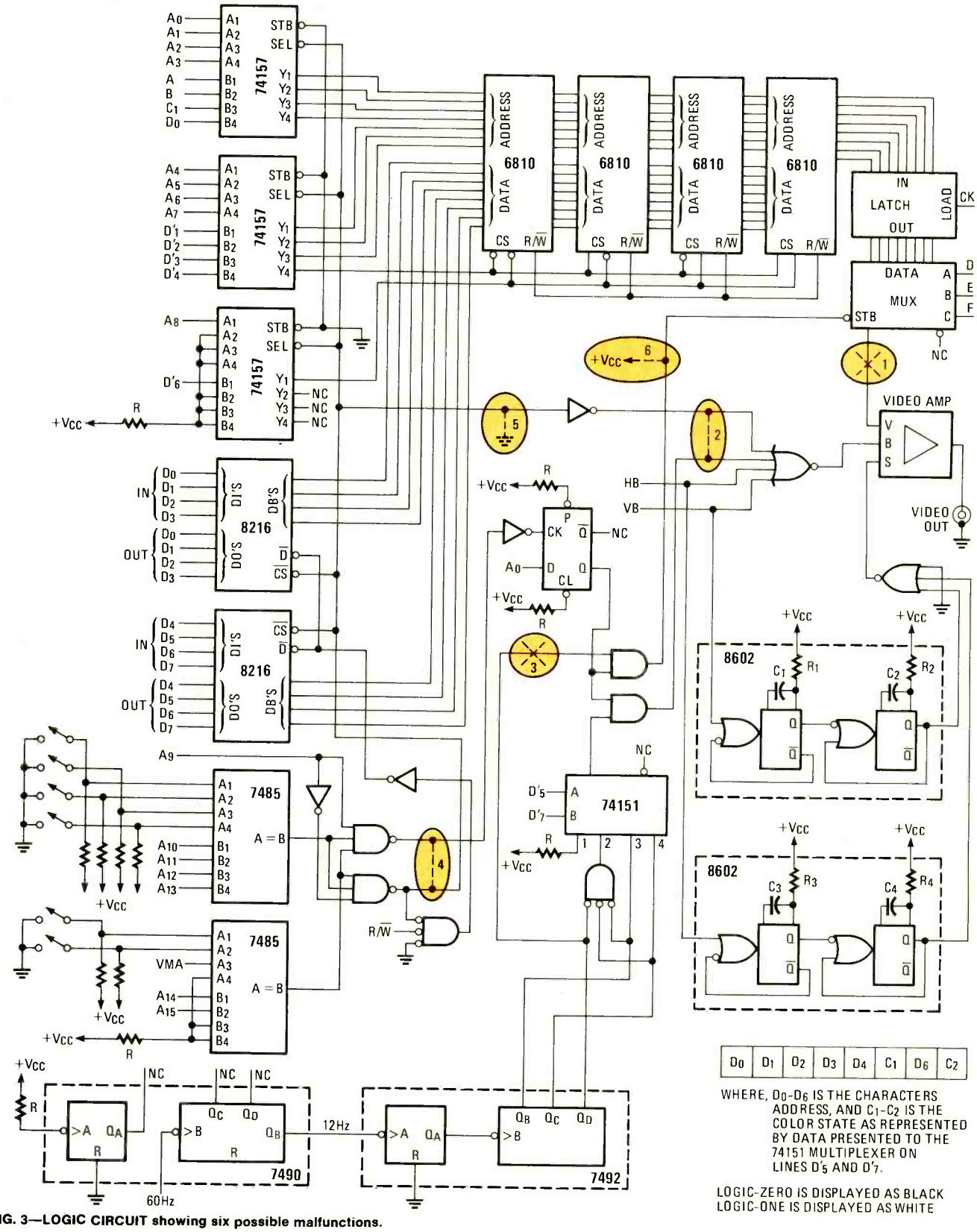
Whenever you troubleshoot, it is mandatory to narrow the problem down as much as possible by observing the symptoms. By using the controls and displays provided on the front panel of the malfunctioning equipment, isolate the problem to as few circuits as possible. Obtain all the written information available, such as service manuals, operator's manuals and schematics. *Look and think before touching!* Remember you have enough problems now, do not create any more by hasty actions. A well-written service manual can provide information about key signals that may aid in isolating the failure to a single circuit.

When troubleshooting a complex system, such as a computer that contains hundreds of IC's, the first step is to isolate the malfunction to as few IC's as possible. Most of your time will be spent searching for the problem, not fixing it. Next, by using key signals and the proper test equipment, zero in on the faulty IC.

Let's look at a typical circuit containing a few problems. To enhance your skills for both general-purpose repair work and prototype testing, two separate troubleshooting paths will be followed: The first is to assume that the circuit has only one failure at a time and it will be due to a faulty component (this is basically what we see when a proven circuit fails); second, in order to simulate design, layout and fabrication problems, several concurrent problems are shown to exist.

The circuit is shown in Fig. 3 This circuit is one-half of the logic used in building a limited graphic terminal that uses subjective color. Subjective color, unlike standard color, can be displayed on a black-and-white monitor screen—if you stay within its limitations. The circuit board contains the video-output amplifier, sync generation circuits, composite blanking circuit, character generator, subjective color circuits, and the computer I/O circuits.

The schematic (see Fig. 3) shows six circuit failures. The first is an open circuit at the output of the video multiplexer. The symptom observed on the monitor is: No picture, with a white raster being displayed. This immediately



D_0	D_1	D_2	D_3	D_4	C_1	D_6	C_2

WHERE, D_0-D_6 IS THE CHARACTERS ADDRESS, AND C_1-C_2 IS THE COLOR STATE AS REPRESENTED BY DATA PRESENTED TO THE 74151 MULTIPLEXER ON LINES D'5 AND D'7.

LOGIC-ZERO IS DISPLAYED AS BLACK
LOGIC-ONE IS DISPLAYED AS WHITE

FIG. 3—LOGIC CIRCUIT showing six possible malfunctions.

suggests you should check the signal path between the video amplifier and the multiplexer, because both blanking and sync seem to be working. Since this is a high-frequency signal with only one line, use the oscilloscope. If there is no signal on that line, check the strobe input using a logic probe (this input should be a logic 0 or be checked at a low frequency). Since this input checks OK, next use the logic analyzer or oscilloscope to verify that the 8-bit data lines and 3-bit control lines are active—they should be. After verifying these inputs, the only possible problem could be an open bond inside the multiplexer on the output.

The second fault is between two input pins of the composite summing circuit; this fault causes the color-blanking and computer-access blanking outputs to be tied together. The symptoms of this failure are (1) the color cannot be observed, and (2) erratic images are displayed during computer access. During normal non-color operation when the computer is not loading a new character pattern into the

continued on page 87

CUT ALONG DOTTED LINE

Digital Reference Charts

NUMBER SYSTEM

Our present number system (decimal) uses base 10 to perform all necessary arithmetic operations. Example: $312 = 3 \times 10^2 + 1 \times 10^1 + 2 \times 10^0$. Binary number system uses combinations of 0's and 1's to represent and perform all arithmetic operations that are possible in the decimal system. Binary number system uses base 2:

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1

Table progresses to the left indefinitely as 2^n, where n = 0, 1, 2, 3, 4, . . . To change any binary number to base 10, write binary number underneath table and add decimal equivalent where 1's appear. Example, change 11000100 to decimal:

2^7	2^6	2^5	2^4	2^3	2^2	2^1	2^0
128	64	32	16	8	4	2	1
1	1	0	0	0	1	0	0

$2^7 + 2^6 + 2^2 = 128 + 64 + 4 = 196$. The number then is 196.

To change decimal to binary: Divide number by 2 and keep remainder that will always give 1 or 0. Example: 196.

	Remainder
196 ÷ 2 = 98	0
98 ÷ 2 = 49	0
49 ÷ 2 = 24	1
24 ÷ 2 = 12	0
12 ÷ 2 = 6	0
6 ÷ 2 = 3	0
3 ÷ 2 = 1	1
1 ÷ 2 = 0	1

To write binary number from decimal begin at bottom row of remainder table and write the digits from left to right. Example: 196 = 11000100

BINARY WORDS

A bit is a digit in binary language. A digit can be either a 1 or 0. Binary numbers are also known as binary *words*. Consequently a *5 bit* binary number is referred as a *5 bit* word. The longer the word the greater the decimal number that can be represented. Example: A 5 bit word can represent 32 different combinations. A 2 bit word can represent 4 different combinations. By the equation: combinations = 2^n where n is the number of bits in the digital word. Example: Represent the maximum number of combinations with a 2 bit word. Combinations = $2^n = 4$. See table.

Decimal	Binary
0	00
1	01
2	10
3	11

The highest decimal number that can be expressed for a given word is the total number of combinations minus one. Equation: Decimal Number = $2^n - 1$. Example: What is the highest decimal number that can be expressed by a 2 bit word. The total decimal number is $2^n - 1 = 2^2 - 1 = 3$.

ADDITION

Binary addition is manipulated the same as decimal addition but keep in mind that 1 + 1 = 0 and 1 carries over.

Carry 1
Carry 1
Carry 1

```
  1 1 1
  1 1 1
1 0 1 0
```

Addition table	
	Carry
0 + 0 = 0	0
0 + 1 = 1	0
1 + 0 = 1	0
1 + 1 = 0	1

Examples:

```
Add  101011        Add  10000
   + 111001           + 00100
  1100100            10100
```

SUBTRACTION

Reversed procedure from addition remembering to borrow one from the left column.

```
  1001
- 100
  0101
```

Here borrow one from the left which makes the next number 1 – 1 = 0

Subtraction table	
	Borrow
0 – 0 = 0	0
1 – 0 = 1	0
1 – 1 = 0	0
0 – 1 = 1	1

MULTIPLICATION

Proceed as arithmetic multiplication.

Example:

```
  10011
X   101
  10011
 00000
10011
1011111
```

TABLE
0 X 0 = 0
1 X 0 = 0
0 X 1 = 0
1 X 1 = 1

DIVISION

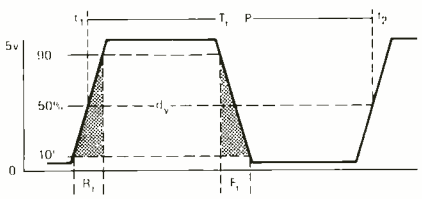
Binary division: proceed as arithmetic division.

```
    1100
10 ) 11000
     10
     010
     10
     0000
```

Division Table
0 ÷ 1 = 0
1 ÷ 1 = 0

DIGITAL PULSES

In digital logic, pulses are defined as voltage transitions that occur during a determined lapse of time. Timing pulses are usually generated by a circuit called a clock. A set of digital pulses is known as a train of pulses. The duration and length of the pulses can be changed to fit the needed application. A pulse is an abrupt change in a voltage level.



For the pulse shown in the figure: the maximum amplitude is 5 volts; the reference level is 0 or ground. The total time duration is from t_2 to $t_1 = t_{total}$. If the pulse occurs 1 time in one second, the frequency is one pulse per second. The period = 1/f. The duty cycle = d_y/P.

P = 1/frequency

The left-hand side of the pulse is called the leading edge. The right-hand side of the pulse is called the trailing edge. The width of the dotted area under the leading edge is known as the pulse risetime. The width of the dotted area under the trailing or decay edge is known as the falltime. Digital pulses are fast pulses with very sharp leading edges and very sharp trailing edges. *Positive logic* equates the maximum amplitude of the pulse as the digital number 1 and the ground or zero level as digital logic zero. *Negative logic* equates the maximum amplitude of the pulse as the digital number 0 and the ground or zero level as digital 1.

OCTAL NUMBER SYSTEM

Number system widely used in computer language. The octal system is a simpler way to store and recall values stored in computer memory banks. The binary numbers to be stored are converted to octal saving considerable time and possible errors. The octal number system has a base of 8. The symbol to represent the numbers are: 0, 1, 2, 3, 4, 5, 6 & 7. Notice the absence of the number 8. The conversion from decimal to octal follows the same procedure as the decimal to binary, but the base is 8.

8^4	8^3	8^2	8^1	8^0
4096	512	64	8	1

The table progresses indefinitely to the left as 8^n; where n = 0, 1, 2, 3, 4 . . . .

Convert the octal number 421_8 to decimal.

8^4	8^3	8^2	8^1	8^0
4096	512	64	8	1
		$4X8^2$	$2X8^1$	$1X8^0$
		256	16	1

Add the powers of 8 to get the decimal number. Example: 421 octal = $4 \times 8^2 + 2 \times 8^1 + 1 \times 8^1 = 273_{10}$ (decimal). To convert decimal number to octal, divide decimal number by 8 and keep remainder that will give octal number.

	Remainder
273 ÷ 8 = 34	1
34 ÷ 8 = 2	2
4 ÷ 8 = 0	4

To write octal number begin at the bottom row or last digit of the remainder and write octal number from left to right. Example: 421_8 (octal) = 273_{10} (decimal). The conversion of a binary digit to octal is accomplished by grouping the binary number into groups of 3 digits. Then proceed to evaluate the octal number in each group of 3 digits. Example: Change binary number 111100111110 to octal. Separate from right to left in groups of 3. Example: 111-100-111-110 = 7476_8. Change each group of 3 digits to octal converting binary to decimal. 111 = 7_8; 100 = 4_8; 110 = 6_8.

CUT ALONG DOTTED LINE

BOOLEAN ALGEBRA RULES

▲ symbol indicates a logic variable. This can be either a logic 0 or a logic 1 level.

1	$0 + ▲ = ▲$
2	$1 + ▲ = 1$
3	$▲ + ▲ = ▲$
4	$▲ + \overline{▲} = 1$
5	$0 \cdot ▲ = 0$
6	$1 \cdot ▲ = ▲$
7	$▲ \cdot ▲ = ▲$
8	$▲ \cdot \overline{▲} = 0$
9	$\overline{(\overline{▲})} = ▲$
10	$▲ + Y = Y + ▲$
11	$▲ \cdot Y = Y \cdot ▲$
12	$▲ + (Y + Z) = (▲ + Y) + Z$
13	$▲ (YZ) = (▲Y) Z$
14	$▲ (Y + Z) = ▲Y + ▲Z$
15	$▲ + ▲Z = ▲$
16	$▲ (▲ + Y) = ▲$
17	$(▲ + Y) (▲ + Z) = X + YZ$
18	$▲ + \overline{▲}Y = ▲ + Y$

BOOLEAN SIMPLIFICATION

Simplify $P + X + \overline{X}$. Using Rule 4 from above table, $P + X + \overline{X}$ reduced to $P + 1$. Using Rule 2 reduced $P + 1$ to 1. Therefore, $P + \overline{X} + X$ is always equal to a logic 1.

Simplify $PQ\overline{Q}L$. By Rule 8 of above table, $Q \cdot \overline{Q} = 0$. Therefore, $PQ\overline{Q}L = P \cdot Q \cdot L$. By Rule 5, $P \cdot Q \cdot L = 0$. Therefore, $PQ\overline{Q}L = 0$.

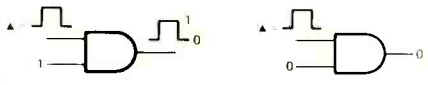
Simplify: $\overline{M} + C\overline{S}C + F$. Use Rule 8: $C\overline{S}C$; $C\overline{C} = 0$. Use Rule 5: $0 \cdot S = 0$. Expression becomes $\overline{M} + 0 + F$, which reduces to $\overline{M} + F$. Note we should not apply Rule 4 of boolean table $\overline{M} + F$ because variables are not identical. The answer is $\overline{M} + F$ or an OR gate with inputs $\overline{M}$ and F.

LAW OF PRODUCTS

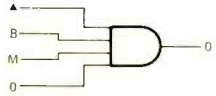
The law of *Products* is also called the law of *Intersection.* This law explains the behavior of an AND gate. It follows Rules 5 and 6 from the above table.

According to Rule 6 ($1 \cdot ▲ = ▲$), if we apply a logic 1 and the variable ▲ to the input of an AND gate, the output will be equal to the variable ▲. According to Rule 5 ($0 \cdot ▲ = 0$), if we set the variable ▲ equal to a binary 1, the output of an AND gate is still 0.

For a pulsed input:

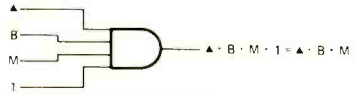


Consequently for a four input AND gate, applying Rule 5 of the boolean angebra table:



$▲ \cdot B \cdot M \cdot 0 = 0$. It is obvious that in the preceding AND gate expression if any of the variables is a logic 1 level, but either of the inputs is zero, the output will be 0.

If the input 0 becomes 1, then:



THE LAW OF UNIONS

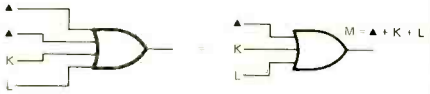
This law pertains to the OR gate and is related to Rule 1 and 2 of the boolean table.

According to Rule 1 ($0 + ▲ = ▲$), if one of the inputs of an OR gate is 0 and we apply the variable ▲ to the other input, the output will be the variable ▲. According to Rule 2 ($1 + ▲ = 1$),

if we apply a 1 and the variable ▲ to the inputs of an OR gate, the output will be 1.

LAW OF TAUTOLOGY

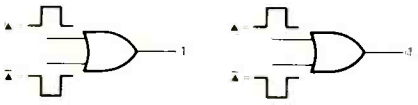
The known *Law of Tautology* applies to Rules 3 and 7 of the boolean table. Rules 3 and 7 apply to AND gates and OR gates. Using this law, simplification of long algebraic expressions becomes simple. The rules merely state that equal variables in an equation should be omitted. Example: Simplify the equation ($M = ▲ + ▲ + K + L$). It is obvious that the variable ▲ repeats twice. By Rule 3, the equation simplifies to $M = ▲ + K + L$.



THE LAW OF COMPLEMENTS

If a logic signal and the complement of this logic signal is applied to a logic gate the resulting output is 1 or 0 depending on the logic gate being used. The law of the complement is stated in Rules 4 and 8 of the boolean table. Let's apply this rule to an OR gate.

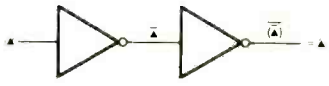
According to Rule 4 ($▲ + \overline{▲} = 1$), if one of the inputs of the OR gate is logic ($1 = ▲$) and the other input is ($0 = \overline{▲}$) the output will be 1. Example: Pulsed



According to Rule 8 ($▲ + ▲ = 0$), if one input to an AND gate is variable ▲ and the other input is 0, the output of the gate will be 0.

THE LAW OF DOUBLE NEGATION

The Law of Double Negation is expressed by Rule 9 of the boolean algebra table. This law states that feeding the negation of a variable through an inverter produces the original variable.



Complementing a signal an even number of times produces the original signal.

FLIP-FLOPS

A digital logic circuit able to memorize by storing logic levels. A flip-flop has two stable states: It will remain in either set or reset state until its state is changed by external signals. The data stored in a flip-flop can be quickly checked by using an oscilloscope or meter to detect the state of its output. There are three basic types of flip-flops.

1 The RS
2 The D type
3 The JK

The logic symbol for an RS flip-flop is

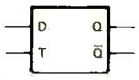
The inputs are S and R. The outputs are Q and $\overline{Q}$. Application of a logic 1 level on the S input will make the Q output go to a logic 1 level and the $\overline{Q}$ output go to a logic 0 level. If the logic 1 level is applied to the R input, the output levels are reversed. The unused input must be held at a logic 0 level.

RS FLIP-FLOP LOGIC TABLE

INPUTS		OUTPUTS	
R	S	Q	$\overline{Q}$
High	Low	Low	High
Low	High	High	Low
Low	Low	Unchanged	
High	High	Not Permitted	

When the S input is 1 and the R is 0 the flip-flop is reset. When the S is 0 and R is 1, it is set. All the other input combinations produce ambiguous or race states.

The D-type flip-flop logic symbol.

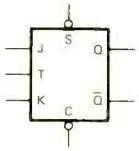


The D-type flip-flop generally behaves like the RS flip-flop but the main difference is that a low-to-high transition must be applied to the T input for the D flip-flop to toggle and store information.

D-TYPE FLIP-FLOP LOGIC TABLE

INPUT		OUTPUT	
D	T	Q	$\overline{Q}$
Low	Low	Previous state	
Low	High	Low	High
High	Low	Previous state	
High	High	High	Low

The JK flip-flop symbol

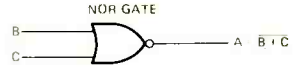


The S and C inputs presets the JK flip-flop to a desired state before another operation is begun. The S and C inputs are referred to as asynchronous inputs because they don't require a transition on the T input. The J and K inputs only affect the Q and $\overline{Q}$ outputs when a transition occurs on the T or clock input. If the J input is 1 and the K input is 1, the flip-flop will reset from the previous state in the presence of a low-to-high transition on the T input. To set the JK flip-flop, apply a 1 to the J input and a 0 to the K input, then apply a low-to-high transition (clock pulse) to the T input. This operation is referred as synchronous with the clock operation.

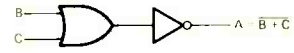
CUT ALONG DOTTED LINE

THE NOR GATE

A logic circuit with two or more input capable of resolving the equation $A = \overline{C + B}$. The NOR gate is a combination of an OR logic gate followed by an inverter.



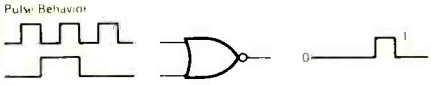
The NOR gate could be constructed using an OR gate followed by an inverter.



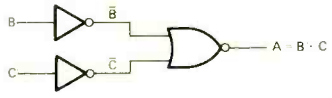
The operation of a *NOR* gate is represented in the following truth table.

Input		Output
B	C	$A = \overline{B + C}$
0	0	1
0	1	0
1	0	0
1	1	0

Notice that the NOR table is the exact opposite or complement of the OR truth table. Summary: The 2 input NOR gate produces an output when both of the inputs are logic 0 level. If either of the inputs is 1, the output is always a logic 0 level.



A NOR gate using inverters in the input will act as an AND gate.



Truth Table for inverted input NOR gate shown above.

B	C	$\overline{B}$	$\overline{C}$	A
1	0	0	1	0
0	1	1	0	0
0	0	1	1	0
1	1	0	0	1

DUALITY OF LOGIC GATES

Gates can provide different functions depending on the assumed reference logic level applied to the input. There are two widely used types of combinational logic levels used in present logic circuits. These are known as *positive logic* and *negative logic*.

POSITIVE LOGIC LEVELS

Input	Output
Logic 1 = +5 volts	+5 volts
Logic 0 = 0 volts to +0.2 volts	0 volts to +0.2

The logic 0 is relatively close to the 0 or ground reference level but in practical gate design the 0 reference is usually a few tenths of a volt above ground level.

NEGATIVE LOGIC LEVELS

Input	Output
Logic 1 = 0 volts to +0.2 volts	0 volts to +0.2 volts
Logic 0 = +5 volts	+5 volts

Truth Table for Positive Logic 2-input AND gate

Voltage Table

Input		Output
B	C	A
0 V	0 V	0 V
0 V	+5 V	0 V
+5 V	0 V	0 V
+5 V	+5 V	+5 V

Truth Table

Input		Output
B	C	A
0	0	0
0	1	0
1	0	0
1	1	1

Compare above Truth Table with Truth Table below for a negative logic 2-input AND gate.

Negative Logic AND gate.

Voltage Table

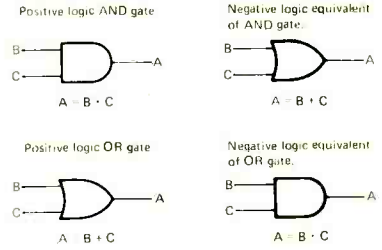
Input		Output
B	C	A
0V	0V	0V
+5V	0V	0V
0V	+5V	0V
+5V	+5V	+5V

Truth Table

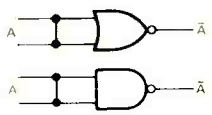
Input		Output
B	C	A
1	1	1
0	1	1
1	0	1
0	0	0

Notice that the Truth Table for the negative logic AND gate is exactly opposite to the Truth Table for the positive logic AND gate. The negative logic AND gate acts as a positive logic OR gate.

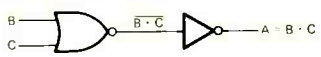
Consequently an AND gate can provide the OR function and an OR gate can provide the AND function by selecting positive or negative logic level assignments.



Flexibility in implementation of the basic gate functions. NOR gates and NAND gates can be used to implement any of three basic logic functions. Example: By connecting all the inputs of a NOR or NAND gate together we can implement an inverter.



By connecting an inverter in the output of a NOR gate, we can implement an OR gate. (Same applies for a NAND gate.)

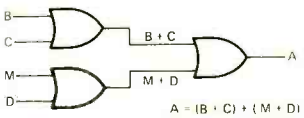


BOOLEAN ALGEBRA

Is the mathematical method of analyzing logic circuits. Boolean equations describe the operation and provides the mathematical tool for the manipulation of logic circuits. For example, draw the logic circuit that solves the boolean equation A = (B+C) + (M+D): The expression indicates that there are two OR gates being OR'ed by another single OR gate: Analysis: Draw the sumbol for the first member of the equation. (B+C):

Then draw the symbol for the second member of the equation (M+D).

Use a single OR gate to combine the two OR gate outputs as required by the indicated + symbol.

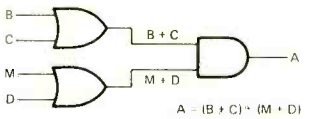


Draw symbol for the second term of the equation (M+D).

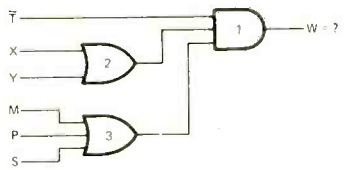
Draw the logic circuit to solve the boolean equation A = (B+C) · (M+D).

The first term (B+C) of the equation indicates an OR gate with inputs B and C.

Combine the two OR gate outputs using a single AND gate as required by the multiplication.



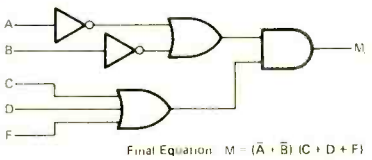
Write the boolean algebraic expression from the given logic circuit.



First write the expression describing the output of gate 2. This is an OR gate, therefore, the expression is X+Y. Secondly write the output equation for gate 3. This is another OR gate, so the expression is M + P + S. Notice that the algebraic expressions are being AND'ed by gate 1. Consequently the output expression so far is (X+Y) · (M+P+S). Input T could have been included anywhere in the equation because it is being AND'ed by gate 1 with the other two equations. The complete output equation is:

$$W = (X + Y)(M + P + S)\,\overline{T}.$$

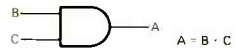
Write the boolean equation for the logic diagram.



CUT ALONG DOTTED LINE

AND GATE

Logic circuits with two or more inputs and a single output capable of resolving an output with combinations of input variables. The two-input AND gate resolves the equation A = BC. The output (A) is expressed in terms of the two variables (B) and (C). The expression A = BC does not imply multiplication but rather (A) is the result of quantity (B) *AND* quantity (C) presented at the input. AND gate symbol



The operation of the AND gate is better represented by the use of a Truth Table that indicates the output for the various input combinations.

Truth Table for 2-input AND gate:

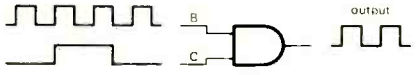
IN		OUT
B	C	A
0	0	0
1	0	0
0	1	0
1	1	1

The AND gate performs binary multiplication.

MULTIPLICATION TABLE
0 X 0 = 0
1 X 0 = 0
0 X 1 = 0
1 X 1 = 1

The total number of possible input combinations for a gate with an even number of inputs is given as (inputs)^2 = outputs. For a two input AND gate; $2^2 = 4$. The truth table then contains 4 possible input combinations. Summary: A two-input AND gate gives an output only when both inputs are logic 1.

For a pulse input.



Notice that the AND gate produces 2 output pulses out of 4 input pulses arriving at the B input because the duration of pulse C is exactly twice the total duration of input pulses B.

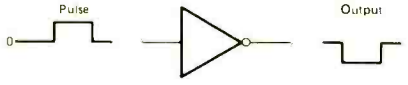
Algebraic equations. Example: For A = W · TX · MPS. Using AND gate

THE INVERTER

A digital gate that inverts the input signal. It is also known as a complementary gate because the output is inverted in relation to the input. The inverted output is written with a bar over the inverted variable.

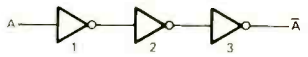
The inverter has only one input connection and one output connection.

For a pulse input:



CASCADED INVERTERS

If an odd number of inverters are connected in series, the output will always be the negation of complement or the input variable.



If an even number of inverters are connected in series, the output will be the same as the input with no inversion.

THE OR GATE

Logic circuit with two or more inputs that provides an output when any input is a logic (1). The two input OR gate resolves the equation A = B + C. The output is expressed in terms of either variable B or C acting on the input. The expression A = B + C does not imply addition but rather A is the result of either B or C acting on the input.

The operation of the OR gate is better represented by the use of a Truth Table that indicates the output when the inputs are modified by (1) or (0):

2 INPUT OR GATE

INPUT		OUTPUT
B	C	A
0	0	0
0	1	1
1	0	1
1	1	1

Below is a 3-input OR gate Truth Table.

INPUT			OUTPUT
A	B	C	D
0	0	0	0
1	0	0	1
1	1	0	1
1	1	1	1
0	0	1	1
0	1	1	1
0	1	0	1
1	0	1	1

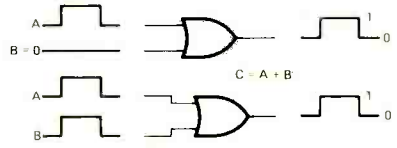
The number of inputs determines the number of combinations in the same manner as for the AND gate: input = combinations − 1. Example: $3^2 - 1 = 8$.

Note: The equation; inputs^2 = combinations − 1; is for an ODD number of inputs. Use inputs^2 = combinations for an EVEN number of inputs. Example: An OR gate with 2 inputs has $2^2 = 4$ possible input combinations. An OR gate with 5 inputs has $5^2 = 25 - 1 = 24$ possible input combinations.

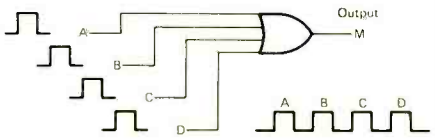
The OR gate equation satisfies the rule of binary addition.

LOGICAL ADDITION TABLE
0 + 0 = 0
1 + 0 = 1
0 + 1 = 1
1 + 1 = 1

Note: Binary addition and logical addition are not EQUAL. Summary: The OR gate gives an output when any input is a logic one. Output is zero when all inputs are zero.



The OR GATE preserves the individual characteristics of pulses arriving at the input.

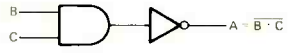


Note: Each output pulse has the same time interval at the output as it had in the input. If there is time coincidence at the input, the output pulse will be equivalent to the longest pulse at the input. Example:

THE NAND GATE

The NAND (NOT-AND) gate is the combination of an AND gate and inverter. The operation of a NAND gate is represented by the equation $A = \overline{B \cdot C}$ and is read A is the result of B and C operating at the input of the NAND gate but inverted at the output. The solid bar over B · C means inversion.

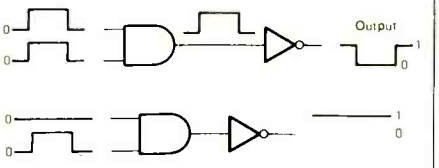
The NAND gate could be constructed by using an AND gate followed by an inverter.



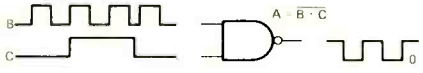
The operation of a 2-input NAND gate is easily represented by a truth table form.

INPUT		OUTPUT
C	B	$A = \overline{B \cdot C}$
0	0	1
1	0	1
0	1	1
1	1	0

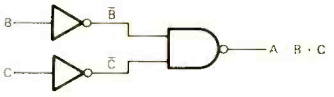
Note: The NAND gate truth table is the complement of the AND gate truth table. Both inputs must be at a logic 1 level to produce a logic 0 output. Pulse behavior:



Non-coincident input pulses have no effect on the output of a NAND gate. The output always stays at logic 1 level. Coincidence at input of logic 1 level pulses produces a negative going pulse at the output.



A NAND gate with inverters connected to the inputs will act as an OR gate.



New Breakthrough In Audio Tape

New metal particle tape for recording provides increased output level, reduced distortion, added high-frequency response and improved S/N ratio.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

THE HISTORY OF CASSETTE TAPE RECORDING has been marked by many minor and a few major technological breakthroughs. When the cassette format was originally introduced in 1964 by the Philips Company of the Netherlands, it was not much more than a tape recording medium suitable for low-fi voice recording. Over the years, there have been improvements both in tape hardware (i.e., better electronics, more efficient tape heads, smaller tape-head gaps and such noise-reduction techniques as Dolby and dbx) and, equally significantly, in tape software.

Initially all tapes used ferric-oxide particles suspended in a binder and coated onto a plastic base material. Later on, chromium dioxide (CrO_2) and other particles (such as cobalt-doped ferric oxide) appeared. These formulations primarily improved high-frequency performance, but also the signal-to-noise capability of the cassette recording medium, since they could produce higher maximum-output levels at high frequencies before reaching magnetic saturation.

To understand how these improved tapes worked, it is necessary to examine a typical hysteresis loop associated with magnetic recording. Figure 1 shows such a hysteresis loop. Coercivity, plotted along the horizontal axis, demonstrates how difficult it is to magnetize (or demagnetize) a given tape formulation. Remanent magnetization (also known as remanence) indicates how strong such a magnetization can be. The area shown in the upper-left quadrant of Fig. 1 helps us in judging any particular tape formulation.

If the area in the upper-left quadrant is redrawn with what magnetic tape engineers call "frequency load lines," two things become apparent (see Figs. 2 and 3). In Fig. 2 typical load lines were drawn for 20 kHz and 200 Hz. The lower partial hysteresis curve might be considered typical of ferric-oxide-particle tape; the upper curve could typify the characteristics of chrome tape or one of the treated ferric compounds. Note that increasing the remanent magnetization has a profound effect upon high-frequency performance but little effect upon performance at lower frequencies.

Conversely, Fig. 3 shows that if the coercivity of a given formulation is improved compared with a reference tape, the tape's low-frequency performance is improved significantly while its high-frequency performance remains virtually the same. Clearly, then, an ideal tape is

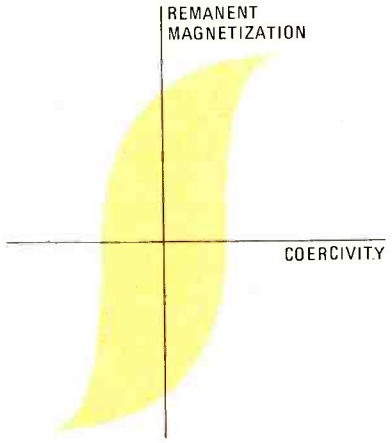


FIG. 1—HYSTERESIS LOOP is obtained by plotting remanence versus coercivity.

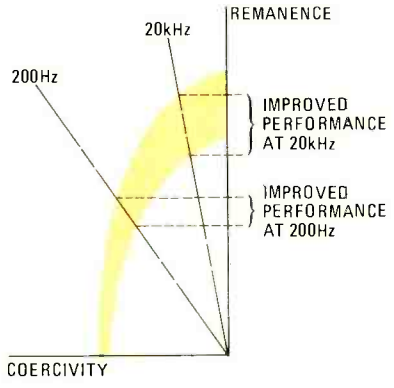


FIG. 2—INCREASING REMANENCE improves high-frequency performance.

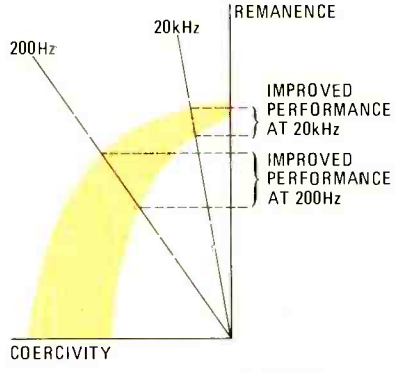


FIG. 3—INCREASING COERCIVITY improves low-frequency performance.

one in which both the remanence and the coercivity are greater than in any of the standard tapes.

Thirteen years of research

In 1965, barely more than a year after the cassette tape format was introduced commercially, the 3M Company, a leading magnetic tape manufacturer, began a long-term research project in search of a better magnetic tape medium. The project centered around using fine metal particles as the magnetizing medium rather than metal-oxide particles. Seven years later, in 1972, samples of a tape then known as XRM-4 were distributed to several tape equipment manufacturers. Between 1972 and 1976, the performance capabilities of the new tape were verified by many manufacturers, but problems related to its economical mass production prevented it's being marketed. There were also other problems. Available state-of-the-art tape recorders could not take full advantage of the new tape's capabilities. Existing record and erase tape heads were incapable of recording program material onto the new tape.

By 1976, 3M Company licked some of the production problems, and became convinced that the metal-particle tape had economic possibilities. At that point, the name of the tape was changed to *Metafine*, a name that is 3M's own registered trademark for the new tape. In 1977, adequate recording and erase heads were developed for use with Metafine tape, and recording heads became commercially available by the end of the year. By late 1977 and early 1978, equipment manufacturers were able to build prototype tape decks to fully demonstrate the capabilities of Metafine tape.

By the end of 1978, at least one tape-deck manufacturer (Tandberg of America, Inc.), and quite possibly several others, will be marketing stereo cassette decks that can handle both conventional oxide-particle tapes as well as the new metal-particle tapes.

There are indications that many other tape manufacturers have the capability for making pure metal-particle tapes. Fuji, for example, recently announced that they had come up with a metal-particle tape and would be able to produce it if they perceive a demand and greater availability of machines that can use the tape. Though TDK has not officially announced marketing dates for any metal-particle tape, they are quick to admit that they, too, know how to make the tape and could bring it to dealers' shelves just as soon as they saw a demand for it. Maxell, on the other hand, has indicated that they have no plans to market a metal-particle tape at this time. They maintain that the looming digital tape recording techniques would more than offset any advantages in the use of metal-particle tape. BASF is also in no rush to introduce metal-particle tape (though a spokesman for the company says that the technology for producing such tape is well within the skills and experience of this German-based company), citing lack of standardization as one of the reasons for their reticence.

Indeed, lack of standardization may well be one of the things which impedes the proliferation of metal-particle tape. While 3M has proposed that 70-microsecond playback equalization be used for the new tape, others feel that a 50-microsecond standard would take best advantage of the new tape's capabilities. Nor is there complete agreement regarding the other parameters, such as coercivity and retentivity. Unless manufacturers of tape, worldwide, can agree upon standards for the new tape (and thereby enable tape deck manufacturers to proceed in an orderly development of equipment suitable for use with the new tape), metal-particle tape may run into the same sort of resistance that consumers showed with respect to the multiplicity of 4-channel recording systems that were popular just a few years ago. The 3M Company must nevertheless be credited with being first to announce the availability of metal-particle tape for use in cassette tape recording. The tape packaging will be similar to that used in 3M's other popular cassette tape formulations (see Fig. 4), and tape lengths will be in the popular C-60 and C-90 packages.

FIG. 4—METAFINE TAPE will be packed in C-60 and C-90 cassettes.

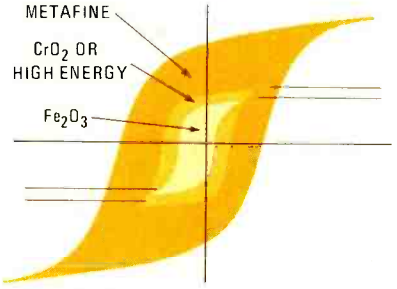


FIG. 5—HYSTERESIS CURVES for Metafine, chromium-dioxide, and ferric-oxide tapes are superimposed.

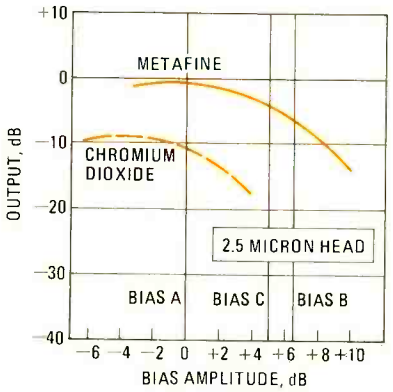


FIG. 6—OUTPUT LEVEL of Metafine versus chromium-dioxide tape.

Comparing Figs. 2 and 3 with Fig. 5 gives you some idea of Metafine tape's tremendous improvement in performance and output levels. Figure 5 shows three hysteresis curves; the curve for Metafine tape is superimposed on that for chromium-dioxide or "high-energy" oxide tapes, as well as on a smaller curve representing the practical limits of earlier ferric-oxide tapes. The dramatic increase in the upper-left quadrant area of Fig. 5 indicates the performance capabilities of Metafine tape. Note that both coercivity and a remanent magnetization have been widely increased, indicating that both low-frequency and high-frequency output can be much higher than that obtained from any previous tape formulation.

According to 3M, in typical applications the Metafine cassettes delivered maximum outputs of 5 dB to 10 dB greater than typical chromium-dioxide tapes and 3 dB to 7 dB greater than 3M's own premium *Scotch Master II* cassettes. This means that the maximum output was double that of the other tapes or

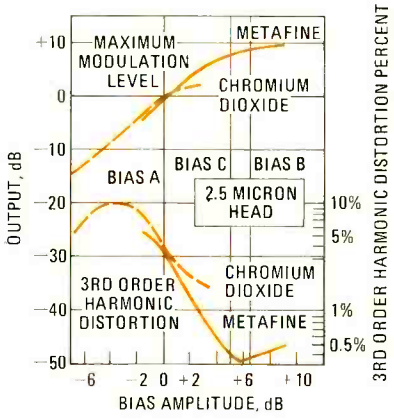


FIG. 7—MAXIMUM MODULATION level and harmonic distortion of Metafine versus chromium dioxide.

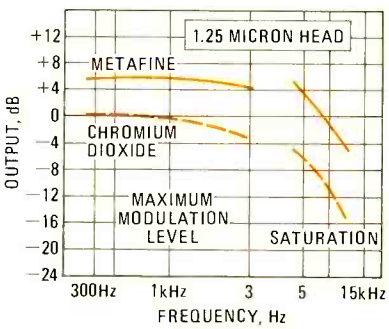


FIG. 8—OUTPUT versus frequency of Metafine and chromium-dioxide tape. For mid-frequencies, the maximum modulation level takes into account distortion. For high frequencies, saturation limits output.

more, depending upon the frequency.

Exact increases in performance characteristics will depend, in part, upon the benefits that home recording equipment manufacturers build into future tape recorders. Lower distortion, added high-frequency response, improved signal-to-noise ratio, increased maximum recorded output, etc., are all benefits that the new generation of recorders can provide (in various degrees) with the new metal-particle tapes.

Figure 6 shows the comparative output levels for Metafine and chromium-dioxide tape. Maximum output level (saturation) at 12.5 kHz is approximately 7-dB higher for the Metafine tape when each tape is biased optimally. (Bias A is the optimum bias level for chromium dioxide, Bias B is set for minimum distortion for Metafine, while Bias C is set for the flattest frequency response.) Note, however, that optimum bias for the Metafine tape is between 5 dB and 6.5 dB greater than for chromium-dioxide tapes whose bias is already several dB greater than that required for ferric-oxide tapes. This is one of the problems of compatibility.

Figure 7 shows the maximum modulation and harmonic-distortion level as a function of bias for Scotch Metafine tape and for chromium-dioxide tape. Maximum modulation level (the recording level that produces 3% third-order harmonic distortion at a 333-Hz test frequency) is up to 9-dB higher for the metal-particle tape. Distortion for the Metafine tape is more than 20-dB lower (when optimally biased) compared with optimally biased chromium-dioxide tape.

Both Figs. 6 and 7 show results for a record head having a 2.5-micron gap. Such a wide gap is typical of that used in three-head cassette tape decks, since the record head and play head can be optimized separately and the record-head gap will be more efficient at this width. Less expensive cassette decks generally use record-play combination heads, however, in which the gap must be made narrower for high-frequency reproduction.

Figure 8 shows the maximum output (at optimal bias) plotted against frequency for *Scotch Master II* chromium-dioxide tape, and the new Scotch Metafine tape, using a two-head tape deck in which the combination record-play head has a 1.25-micron gap. Under these conditions, the Metafine tape had a consistently higher output.

Compatibility/incompatibility

Present audio cassette decks having 70-μs equalization (now required for playing back chromium-dioxide and treated ferric tapes such as *Scotch Master II*, TDK-SA, Maxell UD-XL-II and others) can play prerecorded cassette tapes without requiring any modifications in the playback electronics or the tape heads. However, most stereo cassette deck owners are more interested in being able to record their own programs from records, tapes, FM radio or live program sources. In this respect, present-day recorders are incapable of handling the new metal-particle tapes. Bias-current requirements are much higher for Metafine tape than for previously available cassettes. Erase current applied to the erase head must also be considerably higher. Many present-day record and erase heads cannot handle such high erase and bias currents. On the other hand, such tape head types as *Sendust* or *Sen-Alloy* are able to handle the necessary increased current providing that suitable electronic changes are made in cassette decks using these heads.

Almost coincident with 3M's announcement of the availability of Metafine tape, Tandberg of America, Inc., announced its *model TCD-340-AM* cassette recorder, which is claimed to be the first production cassette deck offered for use with the new metal-particle tapes. The new deck is shown in Fig. 9. Undoubtedly, a tape-technology improvement such as metal-particle tape won't be allowed to flounder while the industry becomes involved in a "chicken-or-egg" debate.

Summary

Table 1 summarizes the values obtained from 3M Company's tests of Metafine tape and compares them with those of chromium dioxide and *Scotch Master II* tape. In the case of chromium-dioxide tape, 0-dB reference values were used for the parameters. These comparisons show that the Metafine tape clearly wins out in every single instance. Comparisons of typical tape specifications are given in Table 2. **R-E**

TABLE 1—PERFORMANCE SPECIFICATIONS

Recording Head Gap		1.25 Micron (2-head type)		2.5 Micron (3-head type)		
Tape	Chrome	Master II	Metafine	Master II	Metafine	
Bias reference point	0	0	+6	+1.3	+6½[1]	+5[2]
Sensitivity, dB						
S_L-333 Hz	0	+3	+2½	+3	+3	+3
S_H-12.5 kHz	0	+2½	+2½	+2	+½	+3
Maximum Modulation Level (MML) at 333 Hz, in dB	0	+2½	+5½	+5½	+10	+9
Maximum Output Level (MO_H) at 12.5 kHz, in dB	0	+4	+11	+3	+5	+7
Distortion Level (HDL_3), in dB	0	−6½	−10	−11½	−23½	−21

1. Biased for minimum distortion ("B" on graph).
2. Biased for flat-frequency response ("C").

TABLE 2—TAPE SPECIFICATION COMPARISONS

	Typical Chrome	Scotch Master II	Metafine
Retentivity (gauss)	1400	1500	3400
Remanence (lines-per-¼ inch)	0.43	0.60	0.8
Coercivity (Oersteds)	550	550	1000

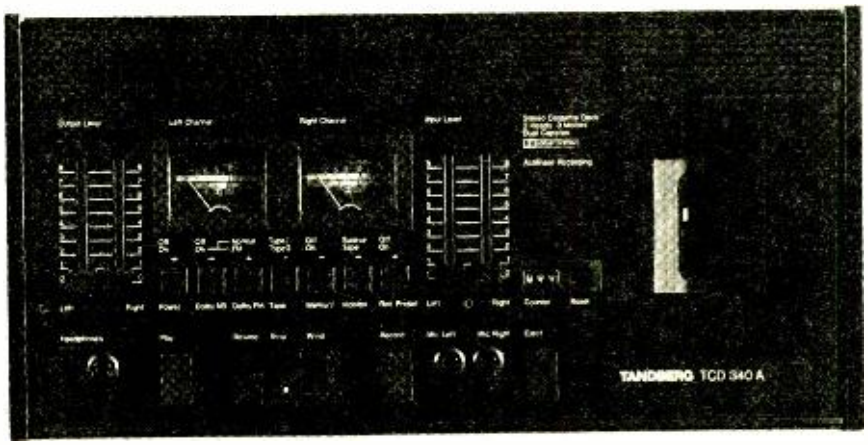
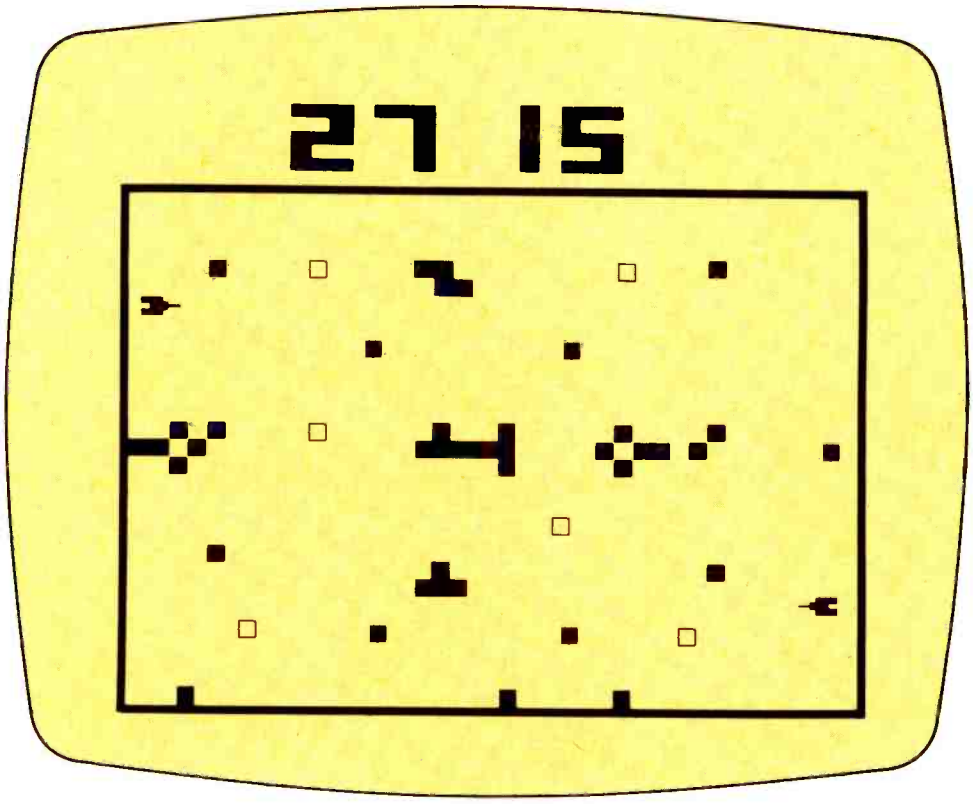


FIG. 9—TANDBERG MODEL TCD-340-AM cassette recorder can handle the new Metafine tape.



TANK

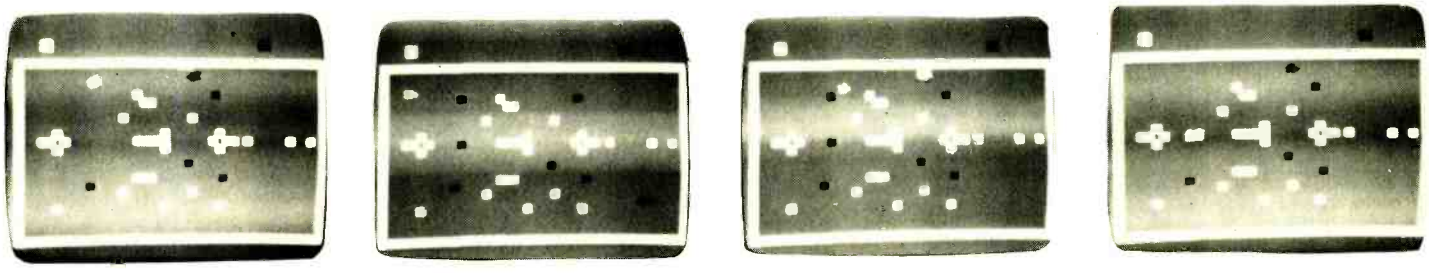
arcade quality TV game

Part 1. The object is to use your cannon to destroy your opponent first, but watch out for the land mines and anti-tank barriers. The circuit provides a composite video signal to your TV set and produces realistic sound effects.

L. STEVEN CHEAIRS

A FEW YEARS AGO I WAS AFFILIATED WITH a small repair company that specialized in video games. After the arcade pong-type games were retired from the market, they were replaced by road race and tank games. At that time, a pong game filled a 10-inch by 14-inch printed circuit board, with about 80 to 100 TTL, SSI and MSI IC's. The road race, baseball and tank games used two or three cards of that size and composition.

In the last few years, the arcade units have been improved by using newer LSI IC's; and the older pong games are now produced on a single LSI IC for home use, with a television set used as a display. It is interesting to note that many of the first arcade games used a converted black-and-white TV set as a monitor. In fact, the prototype of the game described in this article was tested on a TV set that was removed from a retired arcade pong game. Although the monolithic game IC's have permitted these games to be played at home, the quality has always been inferior to the arcade games. Now with the newer LSI IC's, the quality of the games has improved dramatically.



The leader in home monolithic game IC's is General Instruments Corporation's Microelectronics Group. This company is now producing an arcade-level single IC tank game. This single IC, the AY-3-8710-1, replaces the set of PC boards traditionally used in the arcade-type game that contained a couple of hundred TTL logic circuits and read-only memories (ROM's). This undoubtedly represents the start of a new generation of dedicated home video games.

To start the two-player tank game, you simply press the reset pushbutton. Two tanks, one white and one black, suddenly materialize in a battlefield of antitank barriers and mines. Realistic engine sounds, provided for each tank, help create the illusion of combat; four distinct sounds are produced, one for each of the motor speeds and one for the stationary condition. Next comes the sound of gunfire, coupled with shell bursts and tank explosions—the illusion of battle is complete.

Playing the game

The game was designed to work into a standard domestic 525-line black-and-white receiver.

When the game is reset, the scores are cleared (to 0), all the mines reappear and the tanks are placed in their corners. The tanks remain in a stationary state until the control sticks are manipulated. These control sticks are single-pole double-throw (SPDT) center-off, momentary-contact-type switches. When the player pulls the control sticks toward himself the tank advances at a slow speed. If the control sticks are held back for another ½ second, then the speed increases to medium. If the sticks are again held for another ½ second, the tank switches to high speed. When the sticks are released, the tank remains at the selected speed.

If the control sticks are now momentarily pushed in the opposite direction, the tank will stop. When the sticks are pushed forward, the tank backs up. Again, the speed increases for each ½ second the switches are closed, for a total of three speeds.

The tanks can be rotated by pushing one control stick forward and the other back. Rotation in the opposite direction occurs when the control sticks are reversed. Rotation may occur during all seven motion states—stationary, three speeds forward and three speeds backward. Rotation stops when the controls are returned to the normal standby position. A total of 32 rotation angles are provided.

The main gun is fired by pressing the SPST normally open pushbutton switch. A shell exits from the gun barrel and traverses the screen, unless it hits the enemy's tank or a barrier. The gun's range, if it is fired along the horizontal axis is about two-thirds of the TV screen; the range for the other directions varies with the angle. The switch must be depressed for each firing; only one shot every four seconds is possible. The shell explodes when it hits an object or reaches the end of its range. If a shot is fired during a tank rotation, the shell follows a curved trajectory—in the direction of the tank rotation.

Twenty-two fixed-terrain antitank barriers are provided. These barriers can retard or help your progress in the game. They stop shells and tanks if the BARRIER INTERACTION switch is closed—for the AY-3-8710-1 IC only. This switch is not included in the prototype model designed around the AY-3-8700-1. Also, six mines are distributed over the battlefield area. When a tank hits one of these mines—the tank explodes and fragments momentarially, as it does when hit by a shell. When the tank image returns, it is stationary and the gun is inactive for about 2 to 4 seconds. The mine that was hit vanishes for the rest of the game. If you hit a mine a point is scored for the enemy's tank.

Scoring is automatic. When a tank is hit by gunfire or it hits a mine, this increments the opponent's score. The game ends when a player's score indicates a total of 16 points; the score then flashes at a 1-Hz rate and no further points are recorded. Of course, the object of the game is to maximize your score while minimizing your opponent's score.

The audio output is provided on five lines—one for each tank motor (plus bearing and track squeak), a gunfire envelope, an explosion envelope and a noise source. Figure 1 shows a typical waveform observed on the prototype tank game. In a typical system the tank motor sounds are summed. The noise and gunfire envelopes are gated with the noise output. These signals are summed with the motor noise. The composite audio signal then drives an audio-output amplifier that drives the speakers.

The circuit

The circuit described in this article is a modification of one shown in *Application Note Bulletin 104* developed by M. S. Sellars III, senior design engineer, Gen-

Train with NTS for the

MicroComputers, digital the first name

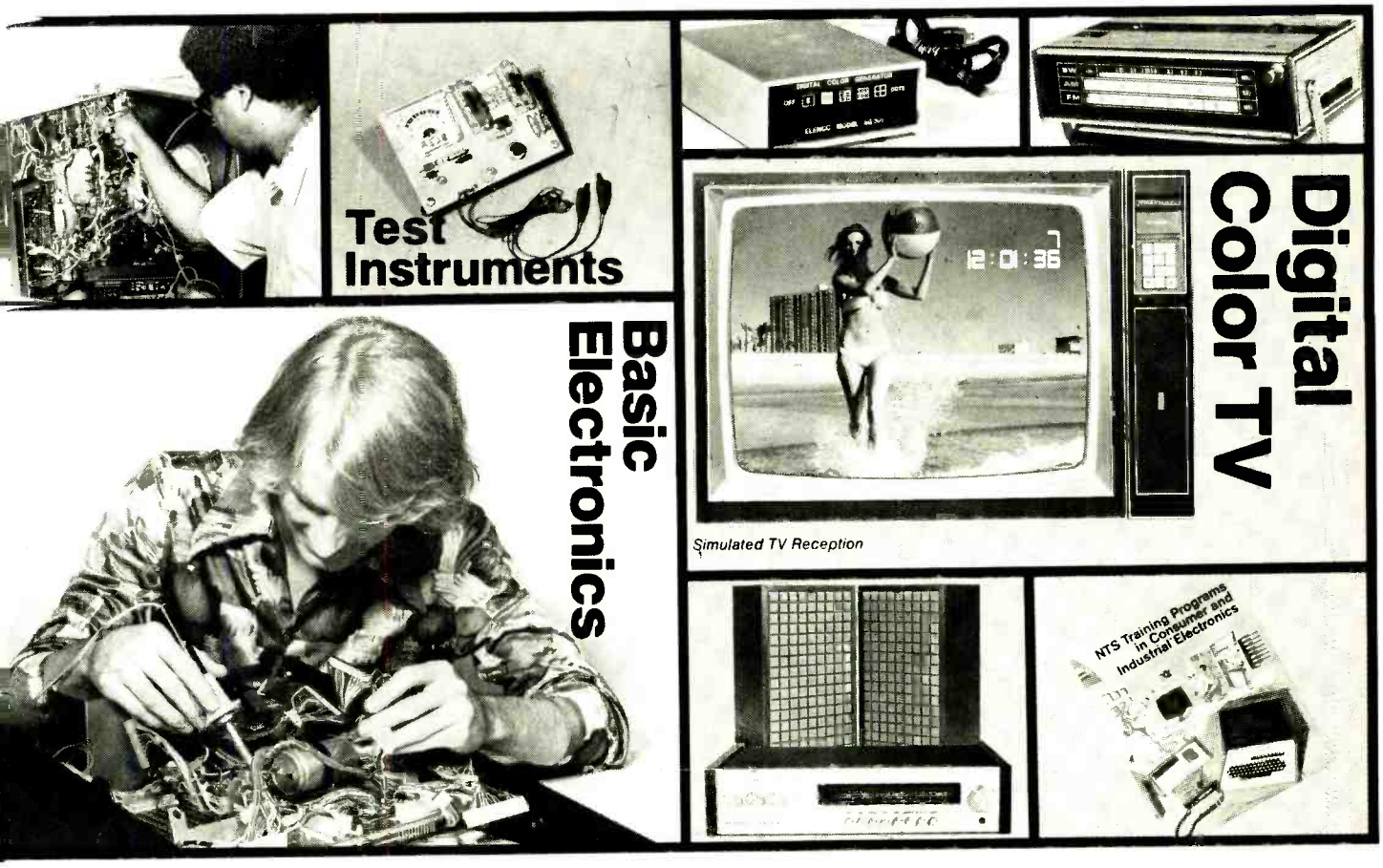
The world of electronics is daily becoming more challenging. Technology is growing more specialized, and the importance of digital systems increases every day. Test instruments, home entertainment units and industrial control systems are all going digital. And now, NTS training programs include a wider choice of solid-state and digital equipment than ever before offered in any home study course: Advanced NTS/Heath digital color TV (25" diagonal with optional programming capability), NTS/Heath microcomputer, digital test equipment, digital stereo receiver (70 watts per channel), NTS compu-trainer, plus much more state-of-the-art equipment to make your training exciting and relevant.

The equipment you receive with NTS training programs is selected to provide you with a solid background in electronic systems. Kits and lessons are designed to work together to demonstrate electronic principles and applications. The kit-building not only shows you how electronic hardware functions, but how various circuit designs accomplish different purposes. Your lessons guide you through any number of experiments associated with many projects. This is the Project-Method, and it works. Step-by-step, you learn how and why digital electronics has become a part of our world, and the even bigger role it is sure to play in the future.

Whether you are looking for training in Consumer, Commercial, or Industrial electronics, NTS offers fourteen courses, some basic, many advanced, in several areas of electronics. An all-new full-color NTS catalog shows you what each course covers,

electronics of the future.

systems and more...from in home study.



and every piece of equipment included.

Send for it today, and see for yourself what's really happening in electronics training technology at NTS. Find out how much has changed, and what new directions the field is taking. You'll probably want to be a part of it.

It's free. Just mail the card or coupon. Today.

NO OBLIGATION. NO SALESMAN WILL CALL.
APPROVED FOR VETERAN TRAINING.

NATIONAL TECHNICAL SCHOOLS

TECHNICAL-TRADE TRAINING SINCE 1905
Resident and Home-Study Schools
4000 South Figueroa St., Los Angeles, Calif. 90037

NATIONAL TECHNICAL SCHOOLS Dept. 206-118
4000 South Figueroa Street, Los Angeles, California 90037

Please send FREE Color Catalog and Sample Lesson.

- ☐ Color TV Servicing
- ☐ B & W TV and Radio Servicing
- ☐ FCC License Course
- ☐ Electronic Communications
- ☐ Electronics Technology
- ☐ Audio Electronics Servicing
- ☐ Digital Electronics
- ☐ MicroComputers/MicroProcessors

Name _____

Address _____

Apartment Number _____ Age _____

City _____

State _____ Zip _____

☐Check if interested in G.I. Bill information.
☐Check if interested ONLY in classroom training in Los Angeles.

PARTS LIST

All resistors are ¼ watt, 5%.
R1—180 ohms
R2—510 ohms
R3—470 ohms
R4—1800 ohms
R5—1000 ohms
R6—270 ohms
R7, R16, R19, R20, R23, R28—10,000 ohms
R8—1600 ohms
R9—2400 ohms
R10—12 megohms
R11—220 ohms
R12—5000-ohm, PC-type potentiometer
R13—2.2 megohms
R14—2200 ohms
R15, R21, R26—20 megohms
R17, R22—3.9 megohms
R18—22,000 ohms
R24, R25—10 megohms
R27—30,000 ohms
R29—15 ohms
C1, C2—100μF, 50-volt electrolytic
C3—2.7-μF tantalum
C4—C6, C13, C14—0.1-μF disc
C7, C8—30-pF disc
C9, C10—0.01-μF disc
C11, C12—0.22μF
C15, C16, C20—5 μF
C17—0.47 μF
C18—200 pF disc
C19—100-pF disc
C21—220-μF, 15-volt electrolytic
D1-D10—1N4148 or similar
D11-D14—1N4005 or similar
Q1—Q3—2N3904 or similar
IC1—AY-3-8700-1 or AY-3-8710-1 LSI game
IC2, IC3—4001, CMOS quad NOR gates
IC4—78M05, 5-volt regulator
J1—miniature open-circuit jack
S1—S4—SPDT center-off, momentary-contact toggle switches
S5—S7—SPST normally open pushbutton switch
S8—SPST switch
S9—SPST toggle switch
T1—12VAC, 1A secondary transformer
XTAL—4.090900-MHz crystal
SPKR—8 ohms
MISC.—12 × 7 × 3-inch aluminum chassis, line cord, hook-up wire, four 1½ inch stand-off busings.

The following parts are available from Questar Engineering Company, McDonald Street, Mesa, AZ 85202: PC board, $12.95; AY-3-8700-1 or AY-3-8710-1 (please specify), $29.00; crystal, $5.50; set of all switches, $12.25. Kit of all parts, $63.95.

eral Instruments Corporation, Microelectronics Group.

Figure 2 shows a block diagram of the tank game system and Fig. 3 is the schematic diagram. Block one is the game IC, which, it is claimed, is more complex than most microprocessors. There are also two IC's, the AY-3-8700-1 and AY-8710-1. The two circuits are identical with the exception of one input pin: The AY-3-8710-1 has a barrier interaction select input, pin 22. If the pin is left floating, the two IC's function identically. On the other hand, if the input pin is brought to the system ground potential, then the tanks cannot drive over the barricades.

Block two in Fig. 2 is a crystal-controlled clock. One inverter is used along with two resistors, two capacitors and a crystal to form a 4.0909-MHz oscil-

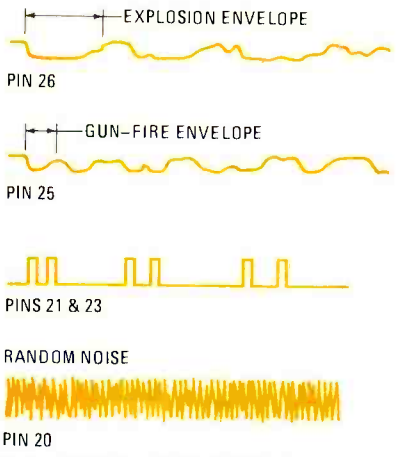


FIG. 1—TYPICAL AUDIO SIGNALS as they appear at the pins of the pins of the game IC.

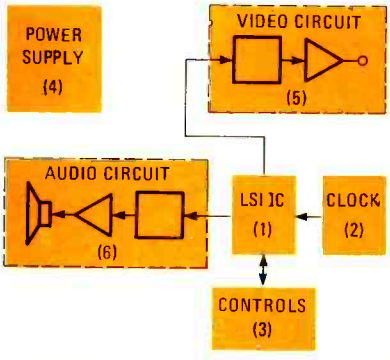
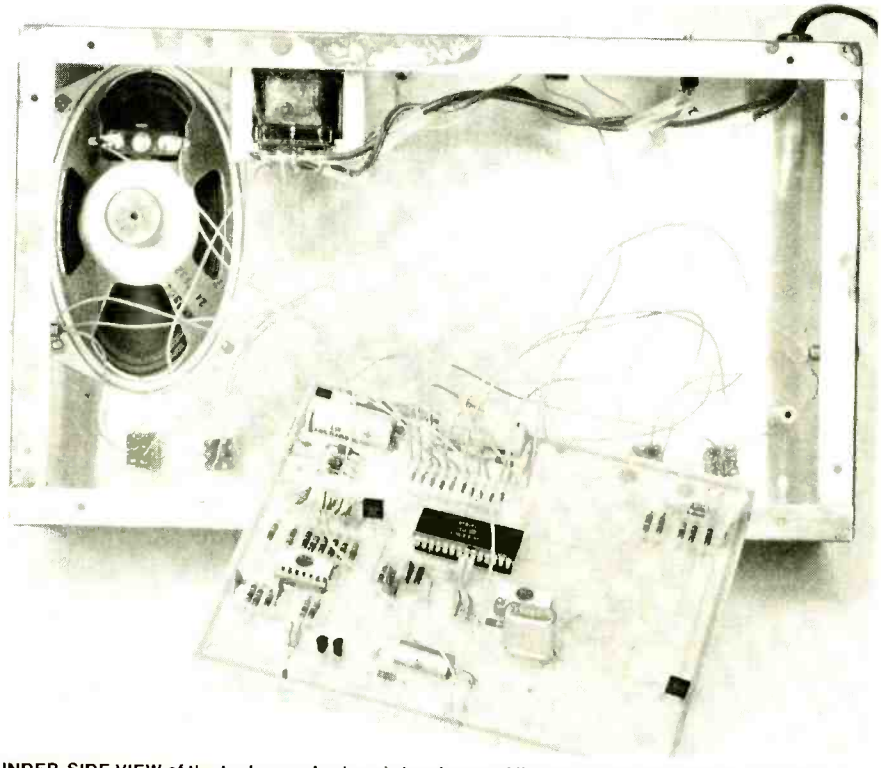


FIG. 2—BLOCK DIAGRAM of the tank battle game. Sections 5 and 6 are included on the LSI game integrated circuit.



UNDER-SIDE VIEW of the tank game's chassis/enclosure. All components except the speaker, power transformer and switches are mounted on the printed-circuit board.

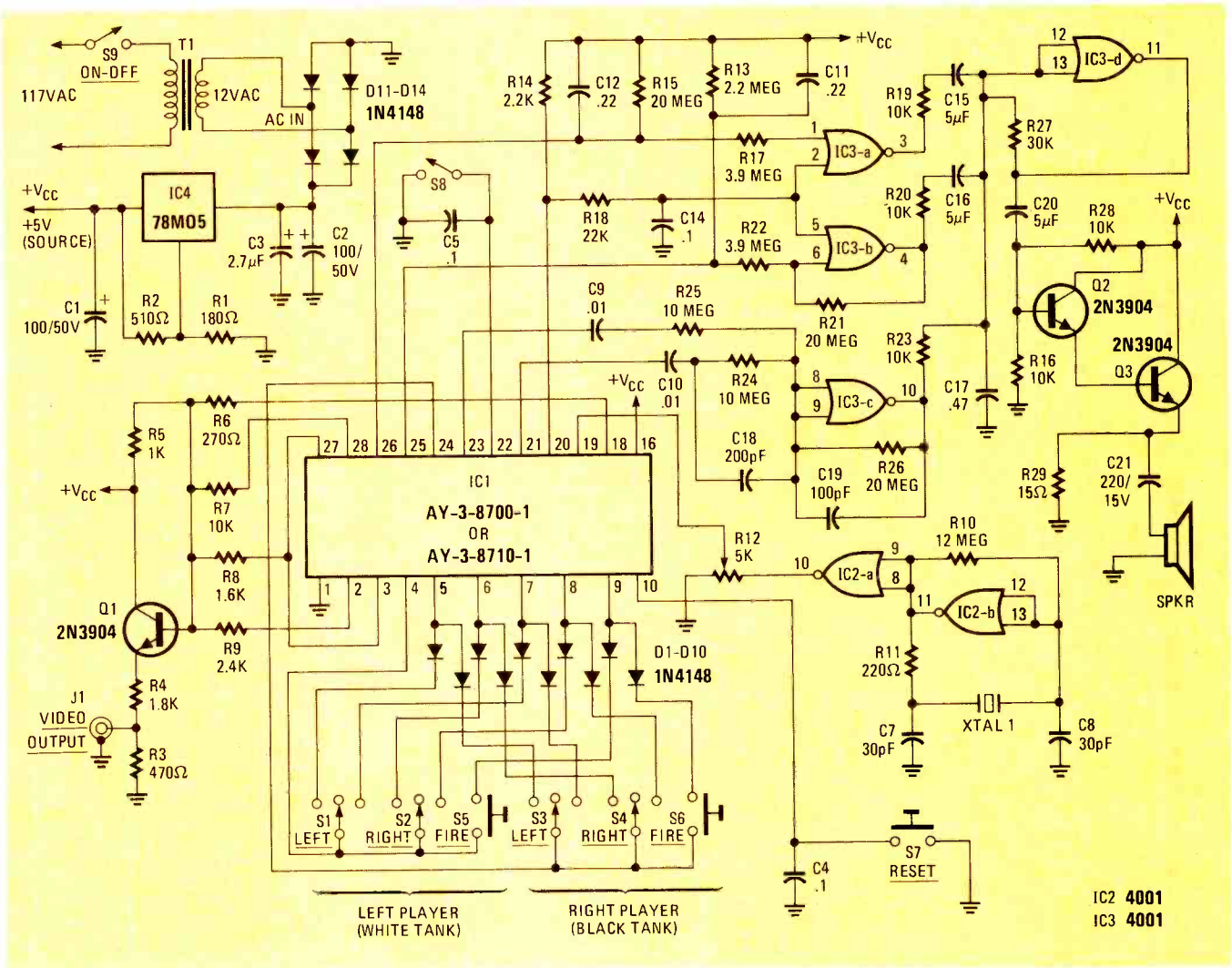


FIG 3—SCHEMATIC DIAGRAM of the tank battle video game. When using the AY-3-8700-1 IC, do not connect anything to pin 22.

lator. The output is isolated by passing the signal through another CMOS inverter. This inverter drives a 5,000-ohm potentiometer. This pot is adjusted so that the signal amplitude provided by this pot is between a 3.0-volt to 3.2-volt peak level.

The third block represents the controls. Eight switches, ten diodes and two capacitors are required. The four SPDT center-off momentary-contact switches are used to control the tank motions; the two SPST normally open pushbutton switches are used to fire the tank's main gun. The diodes provide isolation between these switches, thus allowing multiple closures. Reset is provided by an SPST normally open pushbutton and an 0.1-μF capacitor; the capacitor provides for a small amount of debouncing. The last switch, an SPST-type, and its capacitor select the barrier interaction.

Block four, the power supply, takes a 12-volt AC input and generates a 7-volt regulated DC output. Four 1-amp rectifiers convert the AC voltage into a pulsating full-wave DC voltage. Next, a filter capacitor smooths the ripple. The regulator is a 5-volt three-terminal unit. Two volts are dropped across the ground resistor. Another filter capacitor is used on the output.

Block five represents the video-summing and video-amplifier circuits. The passive summing circuit sets the luminance level (by the ratios of the resistors). Five outputs are provided: Sync; right tank/score/shells/shell burst/mines; left tank/score/shells/shell burst/mines; background; and blanking.

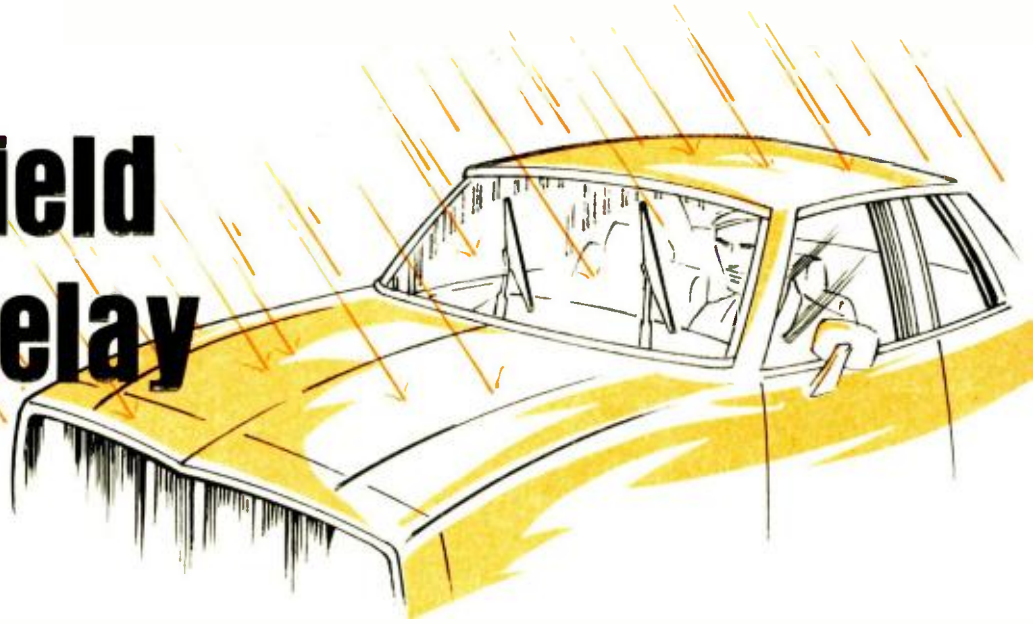
One tank is white, the other is black and the background is gray. The black video outputs and blanking are tied to a single resistor since the modulation levels are approximately equal. The video amplifier is formed using one NPN 2N3904 transistor and an emitter voltage divider. In Mr. Sellars' *Application Note,* this amplifier drove an Astec UM1082 RF modulator. If a different modulator is used, then the summing resistors and the emitter resistor may have to be adjusted. In the prototype version, the video signal was fed directly into the TV set's video amplifier; thus, no modulator was used.

Block 6 is the audio-output network. The speaker is driven by the emitter of a Darlington transistor amplifier via a DC blocking capacitor.

continued next month

BUILD THIS

Digital Windshield Wiper Delay



Most windshield-wiper pause controls require tedious trial-and-error adjustments each time they are turned on. Here's one that doesn't. Installation is easy with only six connections.

TOMMY N. TYLER

MOST VARIABLE-DELAY WINDSHIELD WIPER CONTROL CIRCUITS use a unijunction transistor or a 555 timer to periodically turn on the windshield wiper motor for one sweep of the blades. Invariably, a potentiometer is provided so that the driver of the vehicle can control the time delay between cycles.

This system has several disadvantages. Usually, when the wipers are first turned on, the delay control must be turned down all the way for a few cycles until windshield streaking has subsided. Then, you have to search for the right control setting to match the intensity of the rain. Even installing a delay control can be a headache as you search for a suitable spot on the dashboard to mount it.

This article describes a wiper-control system that eliminates these problems. First, installation is easier because no additional controls are required other than the existing windshield wiper switch. And you don't have to adjust the desired time between cycles by trial and error. When the wipers are first switched on, they run continuously in normal fashion. If the rain is only a light drizzle, the driver can select intermittent operation by switching the wipers off, then back on again when the windshield needs it. The control circuit "remembers" how long the wipers were switched off and repeats this delay between each successive cycle. The wipers continue to run intermittently at this rate until switched off.

If the rain changes intensity, you can easily readjust the delay by switching the wipers off and back on after the desired pause between the strokes. If continuous operation is needed, switching the wipers off and immediately back on (an almost instinctive reaction) in effect sets a zero delay between cycles. Whenever the wipers are left switched off for longer than 40 seconds (the maximum delay) the circuit resets itself.

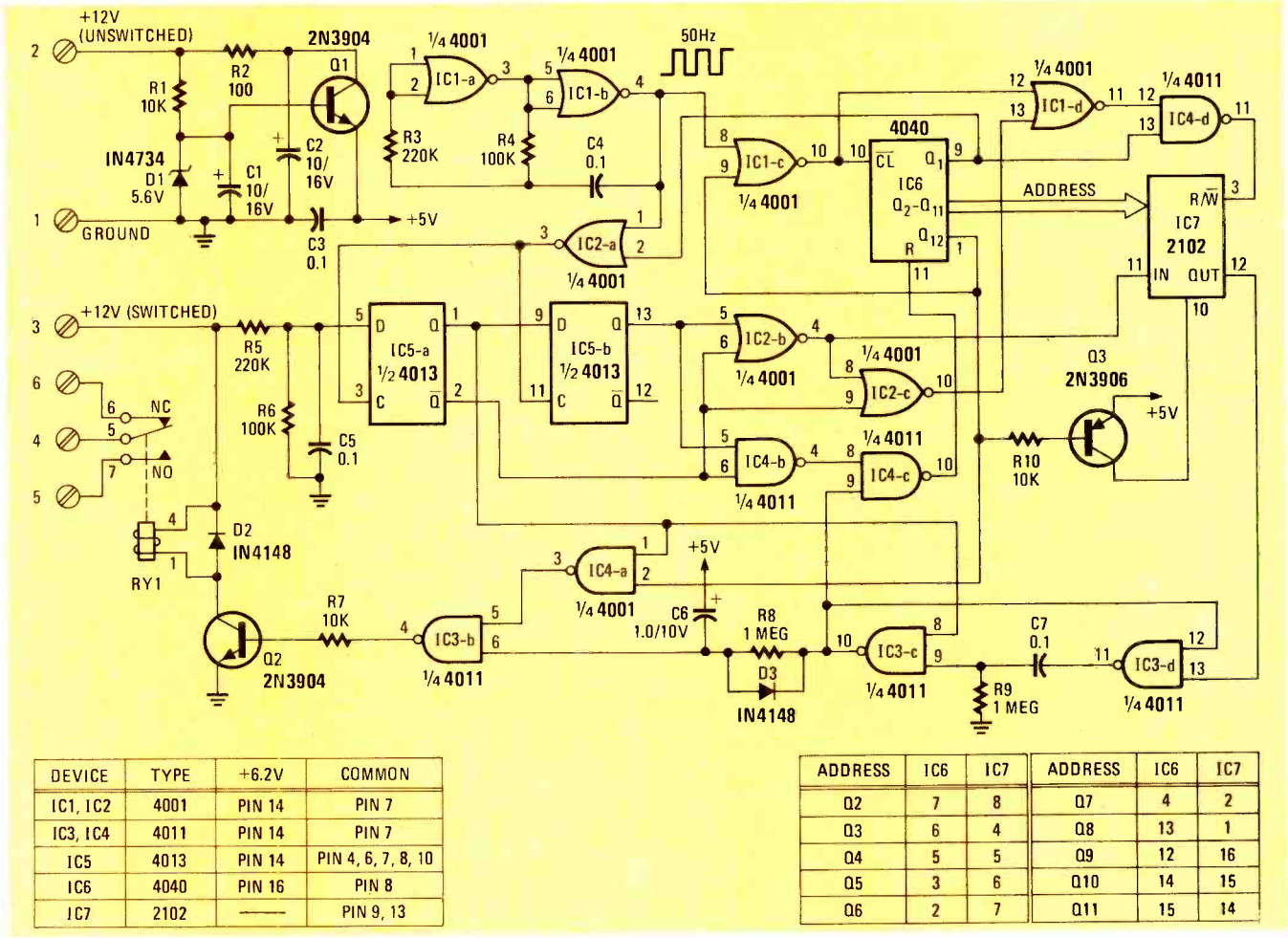
Circuit description

Figure 1 shows the timing control assembly, in which gates IC1-a and IC1-b comprise a 50-Hz clock oscillator that drives address counter IC6 via IC1-c. Counter IC6 is a 12-stage binary counter with the second through eleventh-stage outputs connected to the 10 address input pins of RAM IC7. The most significant bit, Q_{12}, is used to inhibit the counter via IC1-c when the address input to IC7 rolls over from 1023 to 0. The least significant bit, Q_1, enables gate IC4-d and inhibits gate IC2-a so that proper timing is maintained between addressing, data input and the read/write control of the RAM.

When the wipers are switched on, the Q output of IC5-a goes high on the next clock pulse, and the Q output of IC5-b goes high on the clock pulse following. With the Q_{12} output of IC6 also high, IC4-a is enabled, keeping transistor Q2 turned on so that relay RY1 is energized. The contacts of RY1 are wired into the wiper motor circuit so that the motor runs continuously.

When the wipers are switched off, the Q outputs of IC5-a and IC5-b are clocked low in sequence, causing IC4-b to be enabled for one clock cycle to deliver a reset pulse to IC6 via IC4-c. The counter now starts measuring the prospective delay interval. With pin 2 of IC5-a high, the outputs of IC2-b and IC2-c are low, causing a 0 to be loaded into the RAM since the WRITE input to IC7 goes low momentarily following each change of address, as shown in Fig. 2. Note that the lowest-order address bit, Q_2, changes on every odd clock cycle, and WRITE pulses occur on every even cycle. This causes a READ-WRITE-READ sequence at IC7 pin 3 for each new address input.

When the wipers are switched back on, outputs Q of IC5-a and IC5-b are clocked high sequentially, as before. This causes the IC2-b output to go high for one clock cycle so that a single 1 is written into the RAM. Since the output pin of the RAM continuously shows the data at the selected address, it goes high immediately. As the RAM is incremented to the next address (where a 0 is stored) its output goes low, triggering a 50-ms one-shot created by IC3-c and IC3-d. The output of this one-shot resets IC6 via IC4-c, and passes through a pulse stretcher consisting of C6, R8 and D3. The pulse stretcher energizes RY1 for about 3/4 second, long enough for the wiper motor to latch on and complete one cycle.



DEVICE	TYPE	+6.2V	COMMON
IC1, IC2	4001	PIN 14	PIN 7
IC3, IC4	4011	PIN 14	PIN 7
IC5	4013	PIN 14	PIN 4, 6, 7, 8, 10
IC6	4040	PIN 16	PIN 8
IC7	2102	——	PIN 9, 13

ADDRESS	IC6	IC7	ADDRESS	IC6	IC7
Q2	7	8	Q7	4	2
Q3	6	4	Q8	13	1
Q4	5	5	Q9	12	16
Q5	3	6	Q10	14	15
Q6	2	7	Q11	15	14

FIG. 1—SCHEMATIC of the windshield-wiper pause control. Circuit is simpler than it looks and is mounted on a perforated circuit board with point-to-point wiring.

PARTS LIST

All resistors 1/4 watt, 5%.
R1, R7, R10—10,000 ohms
R2—100 ohms
R3, R5—220,000 ohms
R4, R6—100,000 ohms
R8, R9—1 megohm
C1, C2—10 μF, 16-volt electrolytic
C3-C5, C7—0.1 μF, 50-volt ceramic disc
C6—1 μF, 10-volt electrolytic
D1—Zener diode, 5.6 volts, 1N4734
D2,D3—1N914/4148
D4—1N4001, used in Fig. 13
RY1, RY2—relay, 12-volt coil, 3-amp contacts (Radio Shack 275-206 or equal)
Q1, Q2—2N3904
Q3—2N3906
IC1, IC2—CD4001
IC3, IC4—CD4011
IC5—CD4013
IC6—CD4040
IC7—2102 static RAM
Misc.—2 × 4.8-inch glass-epoxy perforated board, 2¼ × 2¼ × 5-inch Minibox (Bud CU-3004-A or equal).

The system is now in its delay timer mode. The output of IC2-c is high, causing IC1-d to inhibit IC4-d so that no WRITE pulses can be applied to the RAM. Each time the address counter steps over the location where the 1 is stored in the RAM, the one-shot resets the counter and momentarily energizes the relay via the pulse stretcher. If the wipers are switched off to set a longer delay, the 1 previously stored in the RAM appears briefly at the RAM output before rewritten as a 0. However, this will not trigger the one-shot and reset IC6 because pin 8 of IC3-c is held low by output Q of IC5-a while the wipers are switched off. Any time the wipers are switched off and on quickly, RY1 remains energized to run the motor continuously, since the pulse stretcher blends the closely spaced output pulses from the RAM into one steady output.

The timer's performance is more than adequate for this application. The resolution of the delay interval is 1 address count, which is 2 clock cycles, or about 40 ms using the component values shown in Fig. 1. The maximum time interval is approximately 40 seconds. This range can be modified easily by changing the value of C4 or R4 to speed up or slow down the system clock.

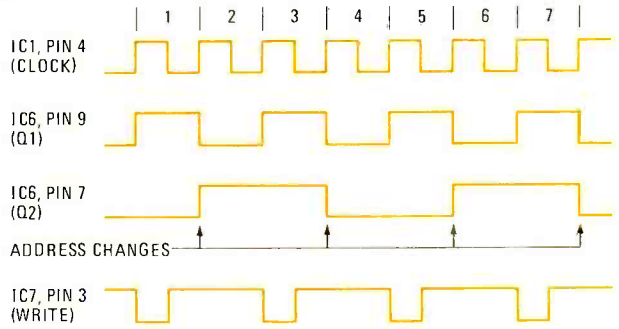


FIG. 2—TIMING DIAGRAM of the windshield-wiper pause control. A read-write-read sequence appears at pin 3 of IC7, a 2102 static RAM.

To minimize power consumption and prevent battery discharge during periods when the car is not being driven, the system uses CMOS IC's throughout except for the RAM, which needs about 30 mA at 5 volts. Since the RAM is needed only during actual operation, transistor Q3 shuts off its power when output Q_{12} of IC6 goes high (standby condition) and the total current drain is then reduced to less than 1 mA. The power supply and logic connections are well filtered to protect the circuit from transient surges and noises within the vehicle's electrical system.

Construction

The circuit fits neatly on a 2.0- by 4.8-inch piece of glass-epoxy perforated board, as shown in Fig. 3. Use sockets for the IC's so they will not be damaged by static electricity during construction. Figure 4 shows a drilling layout of the holes in the perforated board that must be enlarged. Use several flat washers beneath the relay socket to prevent it from breaking or distorting the board when the mounting screw is tightened.

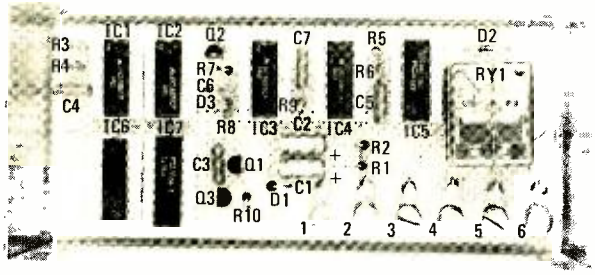


FIG. 3—INTERIOR VIEW shows positions of the various components on the perforated circuit board. Note that IC's are in sockets.

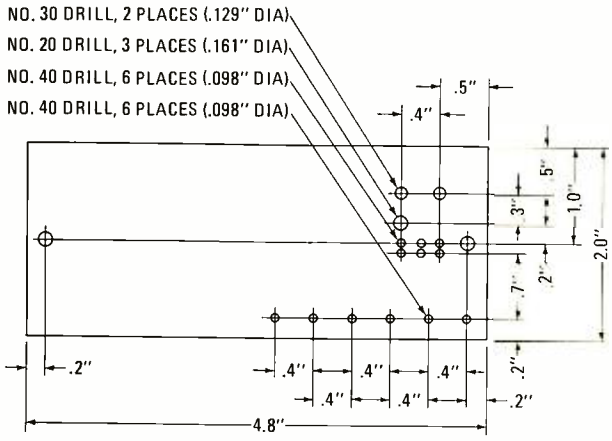


FIG. 4—DRILLING GUIDE shows locations and sizes of the 17 holes that must be drilled in the perforated circuit board.

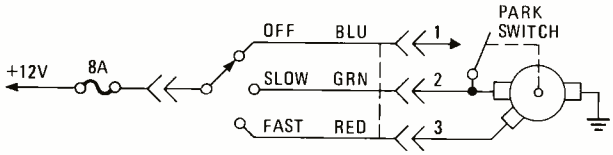


FIG. 5—THE BASIC two-speed windshield wiper.

The termination points for external wiring are made by first securing flat solder terminal lugs to the top of the board with No. 6 by 1/4-inch-long, self-tapping sheet-metal screws, then anchor them in place with the component leads bent back up through the board from below and soldered. The self-tapping screws hold remarkably well in glass-epoxy material, and can be loosened and retightened to attach spade lugs or bare wires many times without any problem.

Mount the board assembly on threaded standoffs in a 2 1/4 × 2 1/4 × 5-inch metal utility box, as shown in the photograph. After checking the circuit operation, mount the box in a convenient location beneath the dashboard and hook up the appropriate wires.

Installation

Since windshield wiper motor circuits are rarely standardized, for the details of your particular model you should refer to a shop manual or experiment. In some systems the positive supply to the motor circuit is switched, and in others it is on the ground side. Most automotive systems use permanent-magnet-field motors; but a few, including General Motors, use motors with series and shunt-field windings to obtain dual-speed operation. Let's look at a few of these circuits to determine how they can be modified to work with the wiper control circuit.

Figure 5 shows a simple dual-speed wiper circuit, such as is used on a '77 Jeep CJ model. The motor has a permanent-magnet field and uses different brush orientations to obtain slow and fast speed. If the wipers are switched off in the middle of a stroke, the motor continues to run slowly until the park switch opens when the blades are about five degrees from the bottom of their stroke. Figure 6 shows how the timing control is hooked up so that it is effective only in the SLOW position. Each time the control relay pulls in momentarily, it energizes the motor long enough for the park switch to close. When the relay opens,

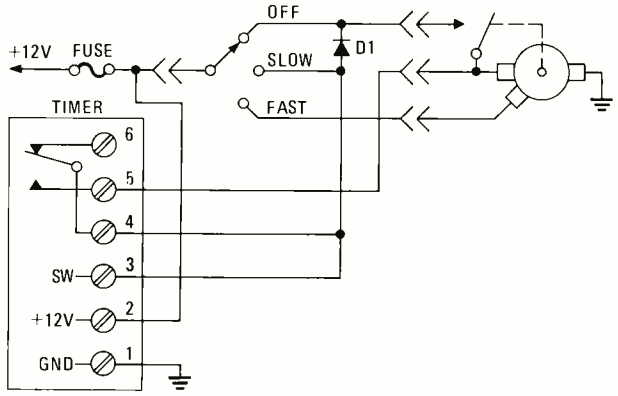


FIG. 6—HOW CONTROL IS ADDED to the two-speed windshield-wiper motor circuit.

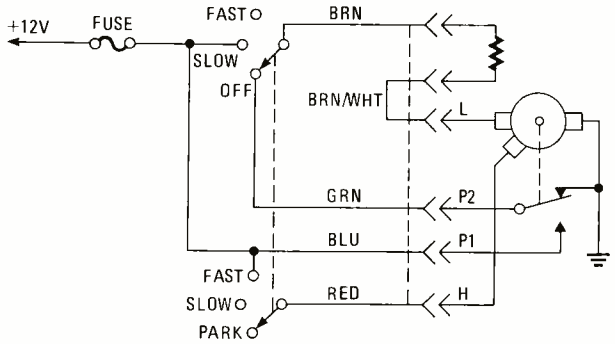


FIG. 7—WINDSHIELD-WIPER MOTOR with dynamic braking provided through the park switch.

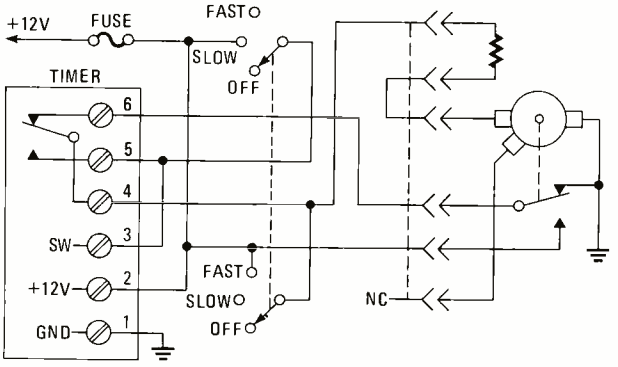


FIG. 8—CONNECTING THE CONTROLLER to the wiper motor. Fast position bypasses the timer and runs wiper continuously at slow speed.

current continues to flow through D1 until the motor completes one cycle. In this arrangement the FAST speed circuit is unaffected. This provides a backup in an emergency or a circuit failure.

Figure 7 shows the circuit for 2-speed nonconcealed wipers used on 1969–1973 Chrysler Motors vehicles. The same basic circuit, with minor switch modifications and elimination of the resistor, is used on the Volkswagen Dasher model. This circuit is similar to that in Fig. 6 except that the park switch shorts the armature when it removes power from the motor, stopping it abruptly by dynamic braking. This makes the park position more precise because it is less susceptible to variations in friction between the wiper blades and wet or dry glass. Figure 8

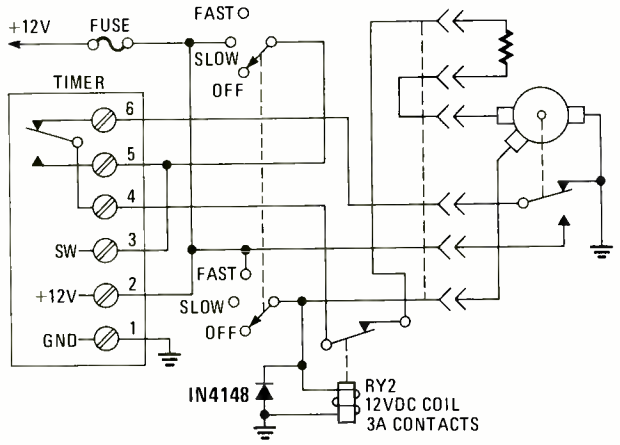


FIG. 9—INSTALLATION, with fast-speed operation made possible through addition of the relay.

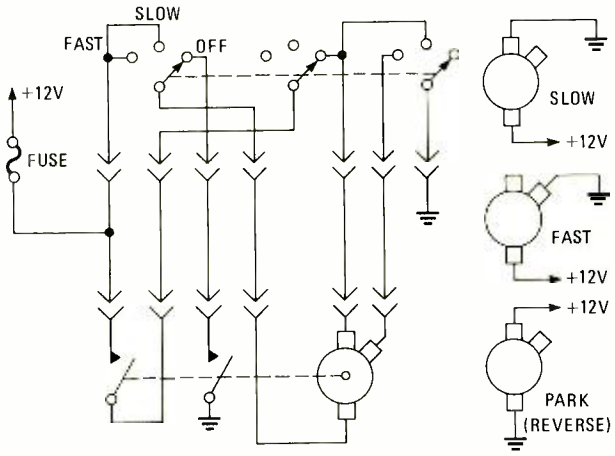


FIG. 10—REVERSIBLE MOTOR CONCEALS wiper blades in the park position when wiper is switched off.

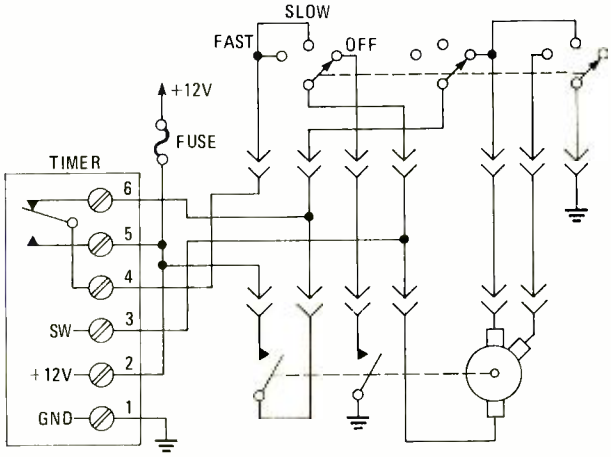


FIG. 11—TIMER IS EFFECTIVE at slow and fast speeds in this installation.

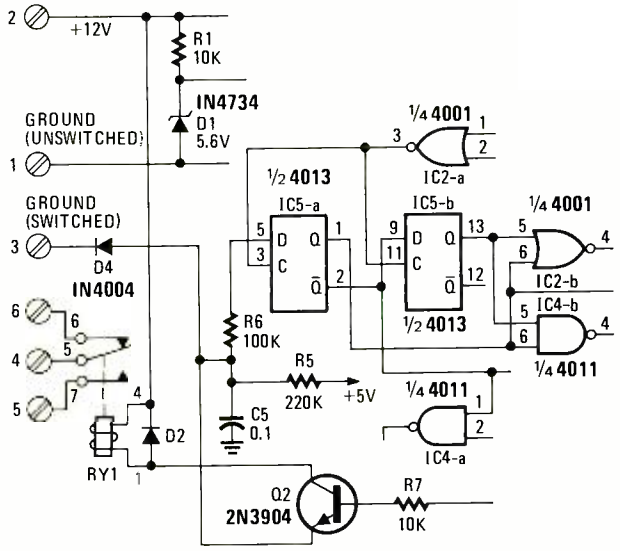


FIG. 12—BASIC CONTROL CIRCUIT modifications for use with windshield wiper motors that are controlled by switching in the grounded power lead.

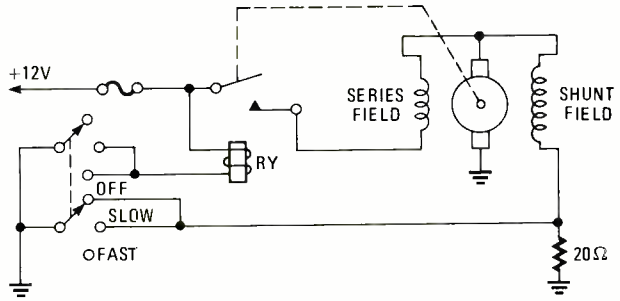


FIG. 13—TWO-SPEED circuit with switched ground is used in some GM automobiles.

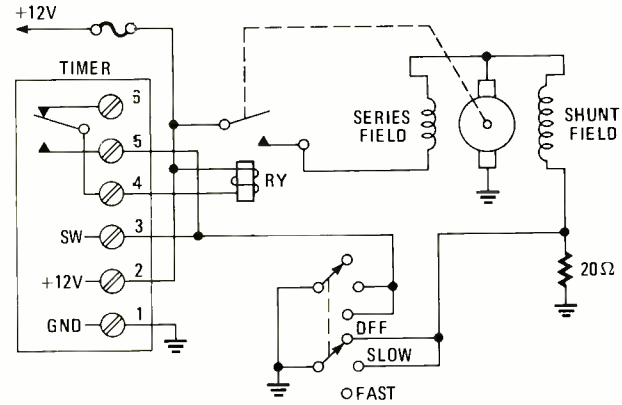


FIG. 14—TIMER CONTROL operates in either fast or slow-speed modes.

shows a method of attaching the control to this system. In this circuit the FAST position bypasses the timer and runs the motor continuously, but at slow speed. Figure 9 shows how to retain the fast speed by using an additional relay to disable the slow-speed circuit.

The wiper circuit of a '73 Ford with concealed blades in the park position is shown in Fig. 10. In this system the motor runs forward at either slow or fast speed for normal operation. When the wipers are switched off, the polarity of the motor is reversed to the slow-speed brushes. As the motor rotates backwards, it activates a mechanism that increases the stroke of the wiper arm and moves the blades down out of sight in the park position. Figure 11 shows how the wiper control can be interfaced to this type of circuit, with the timer effective in both slow and fast speed.

Figure 12 shows some slight modifications that allow the

continued on page 104

2-200,000 Hz Function Generator

Part 2—Construct your own function generator around the latest state-of-the-art waveform generator IC. Delivers sine, square and triangle waves with precision not possible with discrete components or IC's of a few years ago.

DOUG FARRAR

THIS FUNCTION GENERATOR IS DESIGNED around the 8038 waveform generator IC. Specifications, schematic, details of circuit operation and Len Feldman's Test Report on this versatile precision test instrument appeared last month.

Construction

Construction begins with the PC boards. Figure 2 is the foil pattern for the combined power supply and main circuit boards. Figure 3 shows the placement of components of the main board and Fig. 4 shows how parts are placed on the power supply section.

In an effort to minimize PC board-to-front panel wiring, all pots and switches (except S4 and S5) mount directly to the main PC board. The resulting assembly is then bolted to the chassis front panel and held in place by the threaded shafts of the pots and rotary switches. It is therefore important that the holes for the PC-mounted pots and switches accurately line up with the corresponding holes in the front panel. To do this the procedure outlined below should be followed.

After the circuit board has been etched and drilled, cut it along the indicated line. The smaller piece is the power supply board and the larger is the main board. Do not, however, begin mounting components in either board until after the drilling described below is done.

Using the LMB type 000-946 chassis, place the main PC board against the chassis' face; the foil side facing outward toward you, the component side resting against the chassis front. The drilling location for pots R5 and switch S1 will be on the chassis left-hand side while pots R23 and R33 and switch S3 are on the right-hand side. With this orientation, center the PC board so the hole location for switch S2 is exactly centered on the chassis' front-panel face (left-to-right, top-to-bottom). Using small scraps of PC board to protect the PC board's foil, tightly clamp the board in place using C-clamps. Repeat: tightly. Drill six 1/16-inch pilot holes in the PC board-chassis sandwich at the locations shown for pots R5, R23, R33 and switches S1, S2 and S3. Then drill out these holes to the diameter required by your switches and pots (3/8-inch diameter is standard). Be careful that the PC board not slip due to the drilling torque, as you want perfect alignment between board and chassis holes.

Remove the clamps and set the PC board aside for now. Drill out the rest of the chassis front as shown in Fig. 5.

A standard 1/2-inch aluminum angle bar is used to heat sink the voltage regulators and to attach the power supply board to the chassis. Cut five 1-inch strips of the bar and drill out each as shown in Fig. 3-a. Take two of the pieces and position them on the power supply board as shown in Fig. 3-b, lining up each bar with the board's edges. Hold each in place with a C-clamp and then drill two 9/64-inch holes at the locations shown. Hold each in place with a 6-32 × 1/2-inch bolt and nut.

The power supply board will be mounted on an angle bar bolted to the back edge of the chassis (Fig. 3-d). To line up and drill the two chassis mounting holes, place the board-angle bar network on the outside of the chassis rear panel, centering it left-to-right as close as possi-

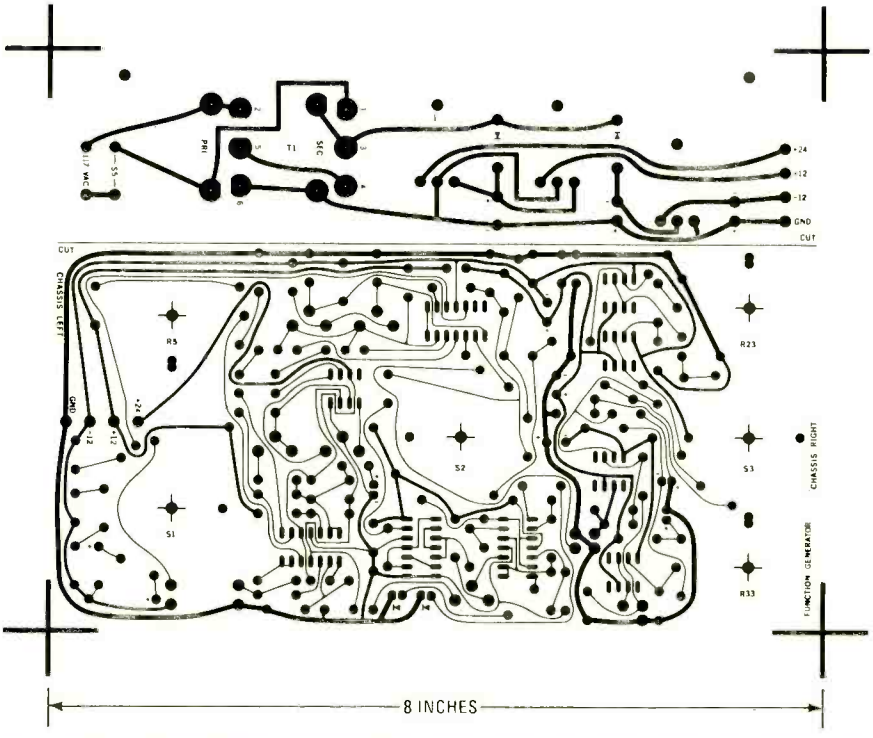
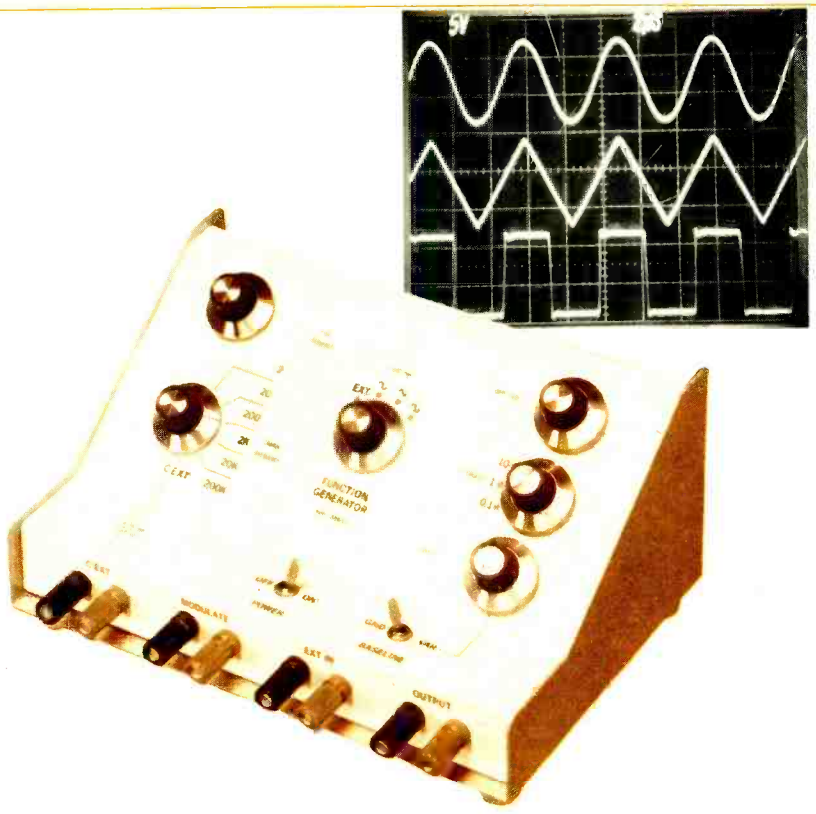


FIG. 2—FOIL PATTERNS for the main board and power supply. Cut boards apart along indicated line after etching and drilling.



ble. With the bottom of the angle bar up 3/8 inch from the bottom of the chassis, pencil in the location of the two holes on the chassis, and drill out each with a 5/32-inch drill. Remove all burrs. Lastly, drill out another hole in the chassis back for the power cord strain-relief. Center it left-to-right, 2 inches up from the chassis bottom.

The chassis is now ready for painting and lettering. I found it difficult to get the dry transfer lettering to stick to the unit's baked enamel finish, so I applied three coats of flat white lacquer, followed by two coats of flat clear lacquer. This surface, when thoroughly dry, is much more amenable to the lettering. When you've finished the lettering, apply three more coats of clear lacquer as a sealer.

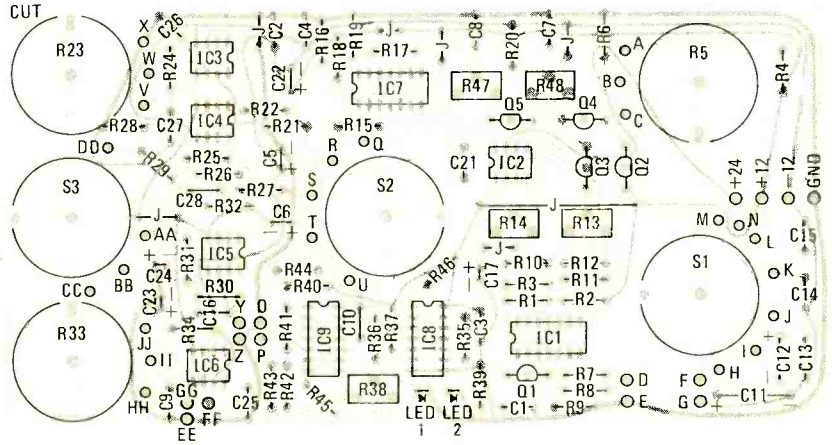


FIG. 3—PLACEMENT OF PARTS on the main PC board. Control shafts fasten this board to the front of the enclosure.

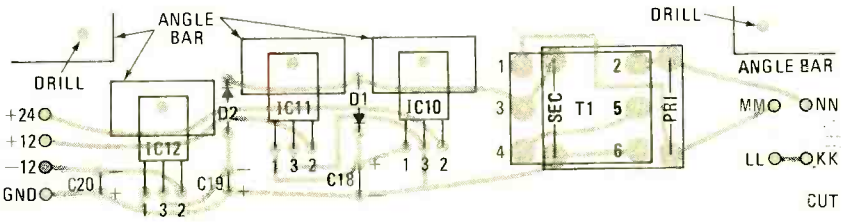


FIG. 4—MOUNTING BRACKETS and heat sinks for three regulator IC's are made from pieces of aluminum angle. These and other power supply components are placed on board as shown.

You're now ready to begin component mounting and assembly. First, mount each of the heat-sink angle bars between the regulators and PC board as shown in Fig. 6-c. Use a small amount of silicone glue under each heat sink to prevent it from twisting loose.

Mount and solder the remaining components on the power supply board. The board can accept two different types of power transformers; either a 4-pin Radio Shack variety or a 6-pin Triad unit. Use whichever one is more convenient to locate.

Now assemble the main PC board, being careful to note the IC pin 1 locations. Trim all leads as close to the foil as possible, since the foil side will be held very close to the conducting chassis. If the leads are too long, shorts will occur. Mount trimmer pots R47 and R48 and remove R20 only if you have a distortion meter. Otherwise, omit the two trimmers and use only resistor R20. (In this case, pin 12 of IC8 goes to −12 volts through R20, pin 1 connects only to C8.) When all components are soldered in place, attach pots R5, R23 and R33 and switches S1, S2 and S3 to the board. These items mount to the component side of the board and are held in place on the foil side with a lockwasher and nut. Use short jumper wires to connect the terminals of the pots and switches to the board.

Take two 30-inch lengths of wire and twist them together with an electric drill. Cut four 4-inch wire pairs and solder them into the PC board pair locations labeled as D-E, F-G, O-P and Y-Z. Cut a 9-inch length of the twisted pair and solder it to the power supply PC board locations LL and MM. At the other end of this cable, solder switch S5. Now make a 4-inch 3-wire twisted cable and solder the wires to the locations called EE-FF-GG. To the other ends of these wires solder switch S4, making sure that PC board location GG connects to S4's center post.

Twist four 12-inch wires together, then connect the wires between the two boards' power connections. Be sure that +24 connects to +24, +12 to +12, etc. Use an ohmmeter for verification.

You're now ready for a preliminary debug. Place all trimmer potentiometers in their center positions. Set the now-interconnected PC boards on a non-conducting surface, plug in the power cord and turn switch S5 on. Be very careful at this point with the exposed 117-VAC wiring! With a voltmeter, verify

PARTS LIST

Resistors ¼ watt, 5% unless otherwise noted

R1, R4—3300 ohms
R2, R7, R8, R41, R42, R46—10,000 ohms
R3—220 ohms
R5—10,000 ohms, potentiometer, linear taper (Centralab HMP-10K)
R6—470 ohms
R9, R16, R30, R31, R44, R45—2000 ohms
R10, R15, R22, R24, R29—1000 ohms
R11, R17—2200 ohms
R12, R25—1800 ohms
R13—1000 ohms, printed circuit trimmer
R14, R38—10,000 ohms, printed circuit trimmer
R18—5600 ohms
R19—1500 ohms
R20, R40, R43—82,000 ohms
R21, R28, R36, R37, R39—100,000 ohms
R23—1000 ohms, potentiometer, linear taper (Centralab HMP-1000)
R26—180 ohms
R27—22 ohms
R32, R34—56,000 ohms
R33—100,000 ohms, potentiometer, linear taper (Centralab HMP-100K)
R35—1 megohm
R47, R48—100,000 ohms, printed circuit trimmer (optional, see text).

Capacitors

C1–C4, C7–C10, C21, C25—0.1 μF, 50V, Mylar
C5, C6, C20, C22—47 μF, 35V, radial electrolytic
C11—4.7 μF, 25V, 10% tantalum
C12—0.47 μF, 25V, 10% tantalum
C13—.047 μF, 25V, 10% Mylar
C14—.0047 μF, 25V, 10% Mylar
C15—470 pF, 25V, 10% ceramic
C16, C26, C28—10 pF, 25V, ceramic
C17, C23, C24—10 μF, 25V, radial electrolytic
C18—220 μF, 50V, radial electrolytic
C19—100 μF, 50 V, radial electrolytic

D1, D2—1N4004, 100V, 1A diode
IC1, IC9—LM324 quad op-amp
IC2, IC6—LM341CN op-amp
IC3–IC5—LM318CN high-speed op-amp
IC7—8038 waveform generator (Intersil, Lithic Systems)
IC8—4001 CMOS quad NOR gate
IC10—LM340T-24, +24V regulator
IC11—LM340T-12, +12V regulator
IC12—LM320T-12, −12V regulator
LED1, LED2—XC209 (or equal) LED lamp
Q1—MPSA13, NPN Darlington
Q2–Q5—MPSA63, PNP Darlington
S1—1-pole 6-position miniature rotary switch (CTS T-206)
S2—1-pole 4-position miniature rotary switch (CTS T-206)
S3—1-pole 3-position miniature rotary switch (CTS T-206)
S4—SPDT miniature toggle switch
S5—SPST miniature toggle switch
T1—power transformer, 25.2-VAC 300-mA secondary, PC mount (Triad type F-148XP or Radio Shack 273-1386)

Miscellaneous—LMB 007-946 case, ½-inch aluminum angle bar, 6-32 × ½" bolts with hex nuts, ⅜" × 32 nuts, ⅜" lockwashers. Binding posts (J1–J8), power cord, strain relief, hookup wire.

A complete kit of parts including all components, and undrilled and unlabeled cabinet is available for $79.95. Etched, drilled and silk-screened PC boards $11.00. Full-size photo-negative of PC pattern $3.50. Available postpaid from Noveltronics, PO Box 4044, Mountain View, CA 94040. California residents add state and local taxes as applicable. Foreign readers add 5% for extra postage and handling.

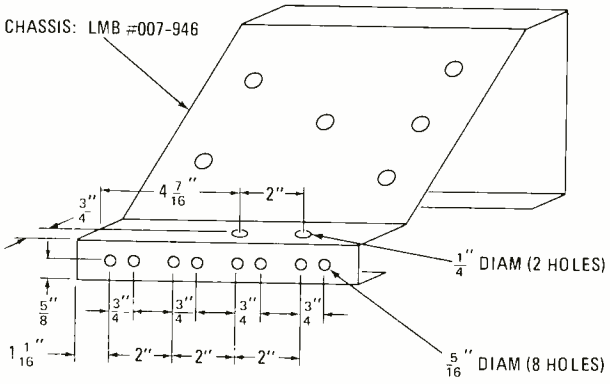


FIG. 5—FRONT PANEL has holes drilled in its three lower surfaces. The five holes for the switches and pots must be precise. See text.

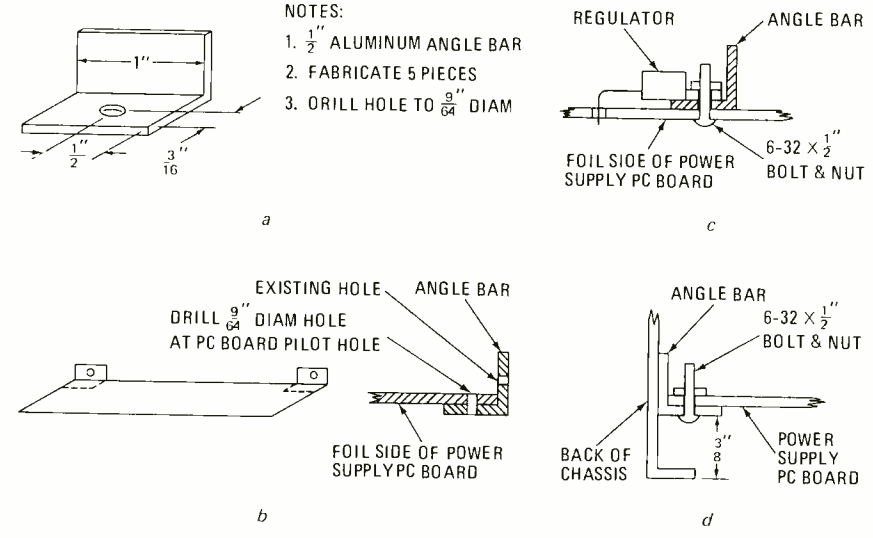


FIG. 6—ALUMINUM ANGLE STOCK is used to construct board mounting brackets and heat sinks for regulator IC's. See construction details for explanation.

that the three power supply voltages are arriving into the main board. Set pot R5 in its counterclockwise position, pots R23 and R33 in their clockwise positions. Place switch S1 in the "2—20"-Hz position, S2 in the TRIANGLE position, S3 in the "10" position and S4 in the VAR position. You should now be getting a 10-volt triangle waveform at the generator output. The low-frequency output can be observed with the voltmeter by probing at board locations Y-Z. The calibrator LED's should also be alternately blinking. Place function selector switch S2 in the square and sine positions and confirm their voltage excursions with the voltmeter. If anything is wrong at this point, remove power and locate the problem.

Calibration

Plug the power cord into an outlet and turn on power. Again keep your hands clear of the exposed line voltage at the power supply board's foil side. With a voltmeter, measure the +12-volt supply. Adjust trimmer R38 in the calibrator circuit until the voltage at pin 8 of IC9 is exactly half of the supply voltage.

Place FREQUENCY switch S1 in the "20—200"-Hz position with FINE FREQUENCY pot R5 in its fully clockwise position. Adjust trimmer R13 until both LED's are off. This is a very touchy adjustment, and you shouldn't expect the lights to remain off for any great length of time—thermal drift makes stability impossible. Now place S1 in the "200—2K"-Hz position and rotate R5 fully counterclockwise and adjust trimmer R14 until both LED's are off or just slightly glowing. Repeat this procedure one more time. The generator output will

now have a 50% duty cycle for any frequency setting.

If you're lucky (or rich) enough to have a distortion meter you can make one more distortion trimming. Set the generator for a 1-kHz sinewave and then adjust trimmers R47 and R48 for minimum distortion at the output. If you don't have such a meter then you shouldn't bother trying to make this adjustment; in fact, you should have omitted soldering the two trimmers to the board.

Operation

Using the function generator is fairly straightforward. Sine, triangle and square waveforms can be supplemented by any signal you may want to add at the external input. If you would like the output to be centered around a frequency different from that of the front panel, you can add an external timing capacitor at the C_{EXT} terminals. The swept frequency range (in Hertz) will be given by

$$10/C_{ext}(\mu F) \leq \text{frequency} \leq 100/C_{ext}\ (\mu F)$$

with about a 20% overlap on each side of the ranges.

There is a minimum capacitance that can be added at the C_{EXT} input of about 200 pF. Any value less than this causes gross signal distortion. The only limit on the maximum capacitance value is determined by the capacitor's leakage current.

By using the BASELINE OFFSET control, the waveform generator can be used as a digital pulse generator with a fixed 50% duty cycle. The output buffer will typically sink and source 25 mA, making it more than adequate for driving TTL and CMOS circuitry.

The function generator's frequency can be swept via the MODULATE INPUT. This input overrides the signal applied by FINE FREQUENCY pot R5. Its input impedance is 10,000 ohms. The net effect of the input is to force a frequency determined by this instantaneous voltage and the selected timing capacitor. Of course, if the input voltage is time-varying, then so is the output frequency. The exact relationship between input voltage, timing capacitor, and frequency is

$$\text{Frequency} = \frac{14 \times V_{in}}{C_{timing}(\mu F)}.$$

Modulation voltage V_{in} should be kept between 0.4 and 9.1 volts for reliable operation. The upper sinusoidal AC limit for the modulated input is about 20 kHz, limited by op-amp frequency response.

Another potential use for the function generator is to measure capacitance. By switching S1 to the C_{EXT} mode, different output frequencies will be produced by different-valued capacitors. If you have an oscilloscope or a frequency meter, there will be an inverse relationship between frequency and capacitance. You thus have a new way to measure capacitance. **R-E**

BUILD THIS

Digital Capacitance Meter

Part 2—A valuable addition to your workbench that lets you check the value of unmarked and suspected capacitors.

BILL WILSON AND BILL OWEN*

CAPACITOR VALUES FROM 1 pF TO 9,999 μF are easily measured using this digital capacitance meter. A quartz timebase, precision resistors and a premium IC timer yield 1% ± count accuracy. Story begins in the September issue.

Construction

The *model CM-1000* is constructed using two double-sided plated-through glass-epoxy PC boards. The display board contains a complete four-digit counter and requires only power, ground, clock input, latch enable, and three decimal point connections. This arrangement greatly simplifies the building, testing and interfacing of the display and main counter boards. The remaining circuitry with the exception of the fuse and line cord is installed on the main counter board. The POWER/RANGE switch module solders directly to the main counter board eliminating almost all of the point-to-point wiring. The electronics assembly bolts in place in the custom black anodized heavy-gauge aluminum enclosure. The front panel is cut out for the push-button switch module and has a window with a high contrast lens for the LED digits. The front panel controls are labeled with a two-color silk screen. The instrument top is extended forward to protect the LED digits from direct overhead light and the instrument bottom has a tilt stand for angled viewing. Four machine screws recessed in each side allow easy removal of instrument covers.

*Product Engineers, Optoelectronics, Inc.

An exploded view of the meter assembly is in Fig. 3.

Begin construction with the two PC boards. Figures 4 and 5 are foil patterns for the bottom and top sides of the master board while Fig. 6 shows the component layout. Similarly, Figs. 7 and 8 are foil patterns for the display board while Fig. 9 shows parts placement. All components, with the exception of the POWER/RANGE switch and trimmer capacitor C2, mount on the component screened side of the PC board. Refer to Figs. 5 and 6 for component placement. Use a 20- to 25-watt small-tipped soldering pencil and small diameter solder. Be careful not to force solder through the plated-through holes as shorts can result from solder pools on the component side of the PC board. Do not install the IC's at this time.

The POWER/RANGE switch assembly is installed using No. 4 1/16-inch-thick fiber washers next to the PC board. See Fig. 3 for assembly details. Assemble the front and rear panels and side rails using hardware provided. Set the assembled PC boards in place on the chassis. The main counter board bolts to the side rails at four locations. When the two PC boards are aligned there are eight mating pairs of foil fingers that will be soldered to connect the two boards. Place a 1-inch piece of excess component lead in the hold in the third finger from each end of the display board. With the component lead wires centered in the display board as shown, solder to the foil finger and bend each side of both wires down to align with

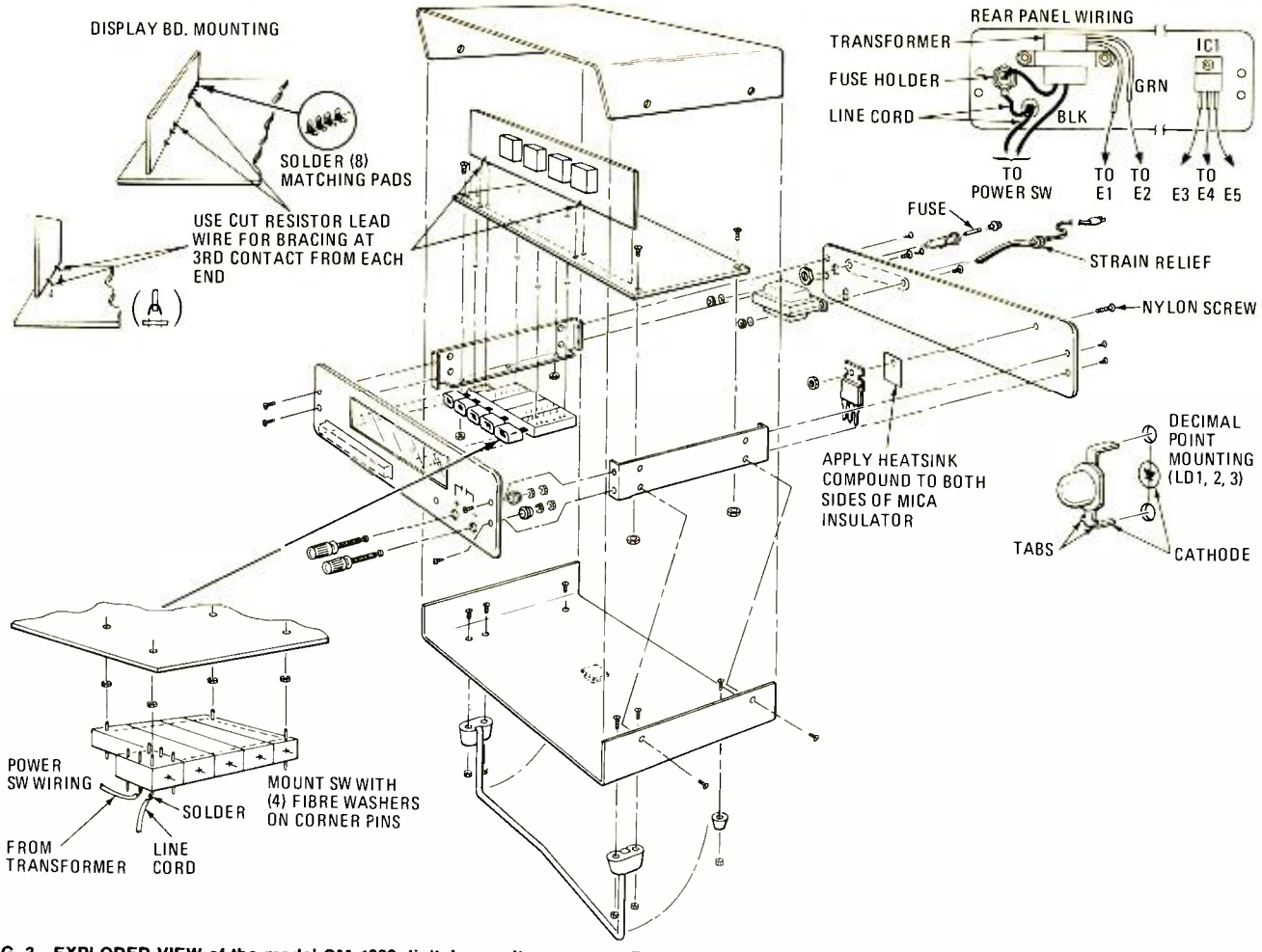


FIG. 3—EXPLODED VIEW of the model CM-1000 digital capacitance meter. Parts are as supplied in the kit. Use this as a guide if you build your meter from scratch.

PARTS LIST

Resistors are 10%, ¼ watt unless otherwise noted

R1—243,000 ohms, metal film, 0.25%, ⅛ watt
R2—11,300 ohms, metal film, 0.25%, ⅛ watt
R3—2430 ohms, metal film, 1%, ⅛ watt
R4—220 ohms, 5%
R5, R8, R21—100 ohms, carbon potentiometer, 1 watt
R6—243 ohms, metal film, 1%, ⅛ watt
R7—33 ohms, 5%
R9, R11—10,000 ohms
R10—3300 ohms
R12, R14—330 ohms
R13—6.8 megohms
R15—8.2 megohms
R16—180 ohms
R17–R19—2200 ohms
R20—1000 ohms
R22—11 megohms
R23–R26—100 ohms
R27, R28—4700 ohms
C1—47 pF NPO disc
C2—15-60 pF, ceramic trimmer
C3, C13, C19, C23—0.47 μF, 50 volts
C4, C5—3.3 μF tantalum
C6—.001 μF
C7, C8, C9, C11, C12, C14, C17, C20, C27, C28—0.1 μF
C10—.01 μF
C18—.02 μF
C21—3300 μF, 16 volts, electrolytic
C22—220 μF, 25 volts, electrolytic
C24—33 pF NPO disc
C25—8.2 pF NPO disc
C26—470 pF disc
D1–D4—1N4002 silicon rectifier diode
IC1—556 dual timer
IC2–IC4, IC12, IC14, IC16, IC18—74LS90 decade counter/divider
IC5—74LS73 flip-flop
IC6—4001 quad NOR gate
IC7—74LS04 hex inverter
IC8, IC9—74LS00 quad 2-input NAND gate
IC10—SE555 precision timer
IC11—voltage regulator, 7805
IC13, IC15, IC17, IC19—4511 BCD to 7-segment decoder/driver
DIS1–DIS4—MAN-6680 7-segment LED display
XTAL1—quartz crystal, 3.579 MHz
S1–S5—5-gang SPST pushbutton switch
T1—power transformer, 117 VAC primary, 10 VAC secondary
J1, J2—insulated banana jack
F1—120-volt, 125-mA fuse
Miscellaneous: PC boards, 1 8-pin IC socket,
4 16-pin IC sockets, 14 14-pin IC sockets, line cord, hardware

The following parts are available from Optoelectronics, Inc., 5821 N.E. 14 Avenue, Fort Lauderdale, FL 33334.

CM-1000K Complete Kit	$129.95
CM-1000WT Factory Wired & Tested	179.95
CM-1000 PC Boards Only	24.95
P-1000K Cap. Counter Probe Kit	3.95
P-1000 Assembled Probe	6.95

Add 5% shipping, handling and insurance, for foreign orders add 10%. Florida residents add 4% State Sales Tax.

holes in the main counter board. Insert the wire ends in their respective locations on the main counter board and push the display board down until the foil finger pairs touch. Check alignment to see that the display board is at right angles to the counter board and that the foil fingers are perfectly aligned. Solder the wires to the main counter board and after rechecking alignment solder the matching foil fingers together.

Feed 6 feet of the AC line cord through the back panel and secure using plastic strain relief. Mount the transformer, fuse holder, using hardware provided on the back panel where indicated. Wire one side of the AC line through the power switch to the transformer primary as shown. The other side of the AC line runs to the other side of the transformer primary through the fuse holder.

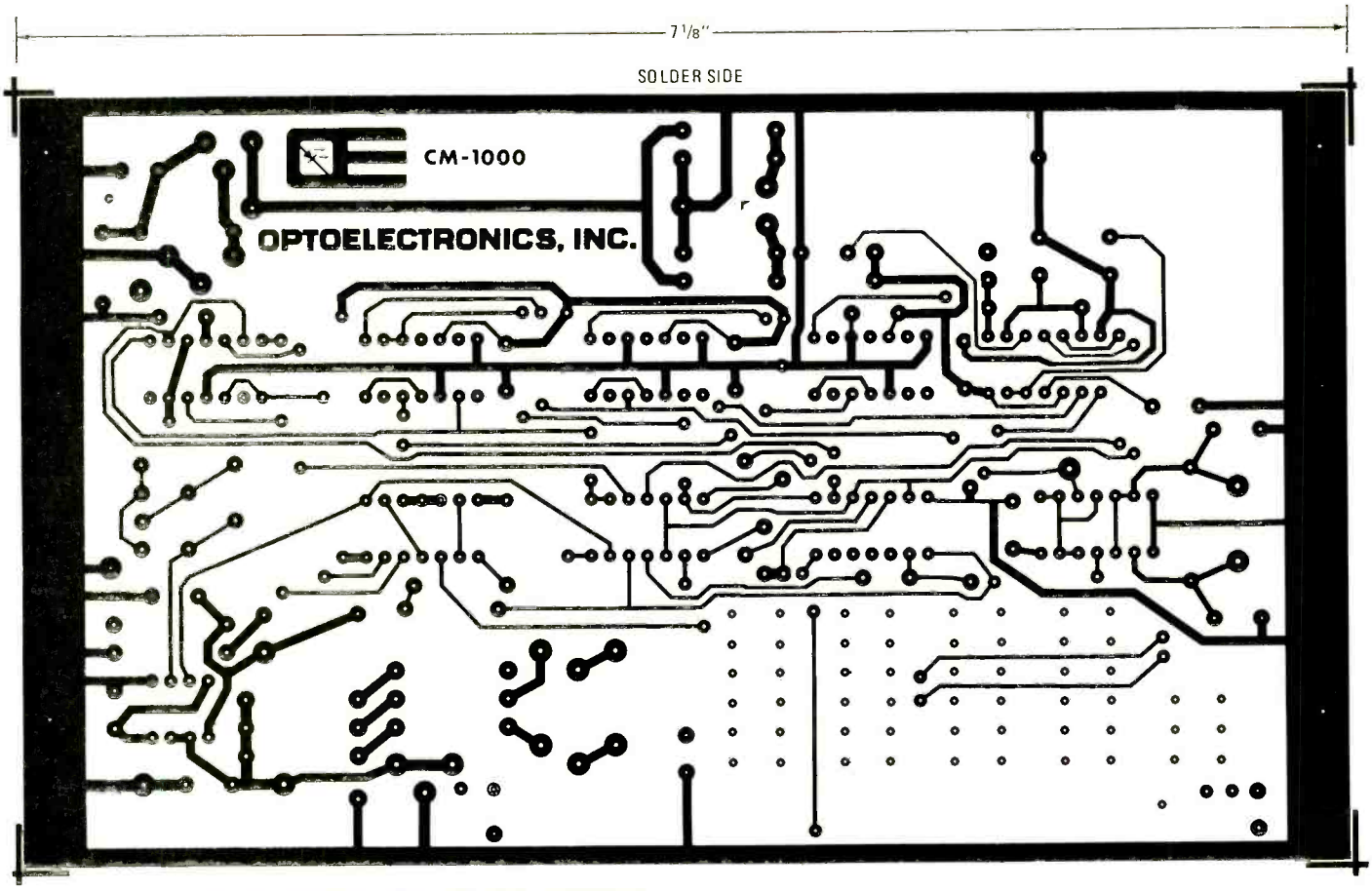


FIG. 4—FOIL PATTERN for the bottom (solder) side of the main board.

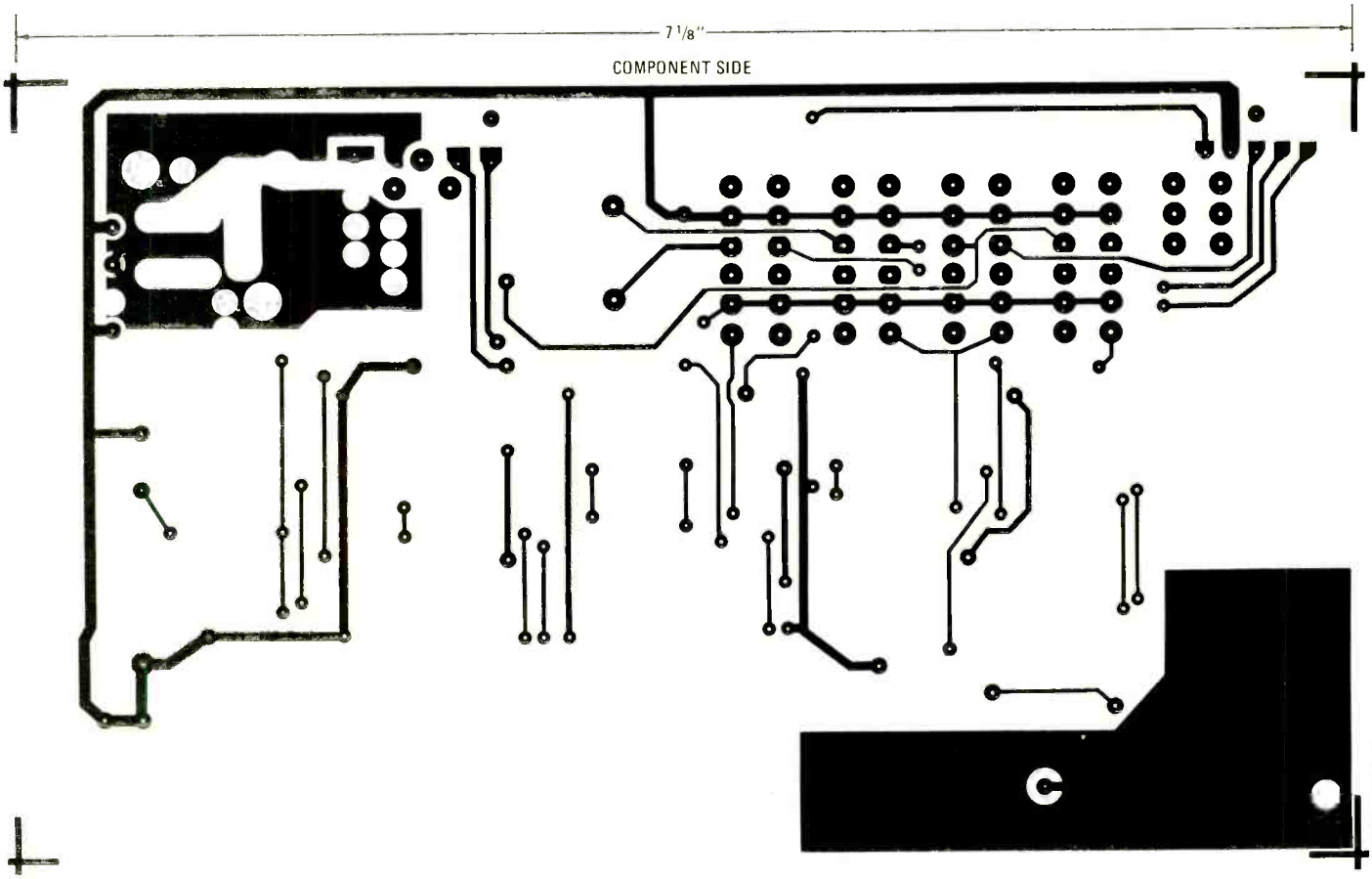


FIG. 5—COMPONENT-SIDE foil pattern. Board supplied in kit has plated-through holes. Compensate for lack of hole plating if you make your own boards.

Before installing IC's into sockets, perform a simple test by plugging in the AC power cord and depressing one of the range switches. Connect a voltmeter between the negative input terminal on the front panel and test point 1 (TP1). It should be possible to measure 5 volts DC by adjusting R21. If the voltage checks, then install all IC's in their sockets making sure that the notch on the IC is aligned with the outline on the printed-circuit board.

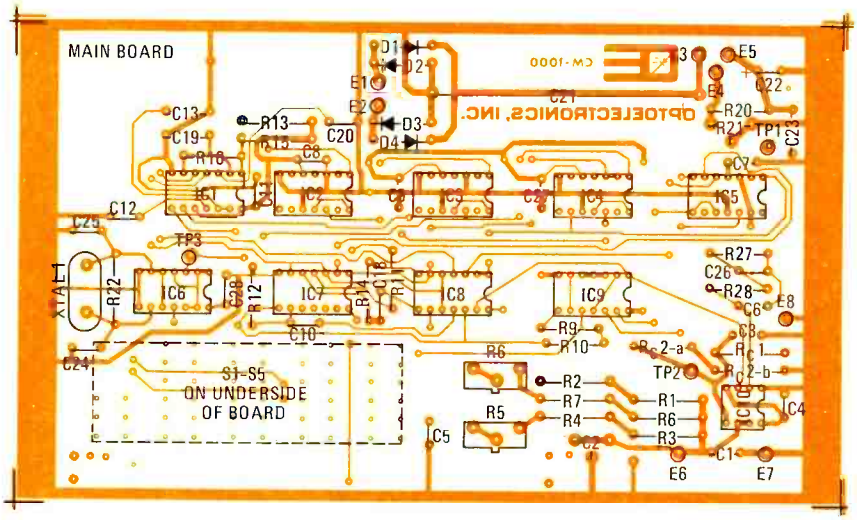
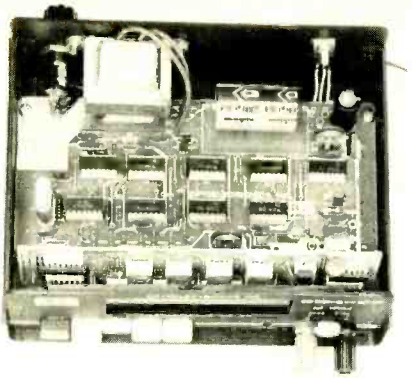


FIG. 6—COMPONENT LAYOUT for the main board. Trimmer capacitor C2 is mounted on underside of board. See text on R_c1 and R_c2.



INTERIOR VIEW of the Optoelectronics model CM-1000 digital capacitance meter.

Calibration

With IC's installed, reapply power and adjust TP1 for +5 volts referenced to ground. Depress the R1/PF switch and use a small bladed screwdriver to turn the ZERO ADJUST control (trimmer capacitor C2) until a reading of 0001 is observed. Continue to turn the control until the "1" turns to "0." **Do not adjust any further.**

The next step requires the use of an accurately known capacitor. The parts kit includes a calibrated capacitor with its value marked on the package. Connect this capacitor across the input terminals and depress the R3/μF switch. Adjust trimmer R5 to produce a reading equal to the value given.

Use a low-leakage capacitor between 10 and 22 μF to calibrate range R4/μF with trimmer R8 by comparing its reading to that observed on the previously calibrated R3/μF range. **R-E**

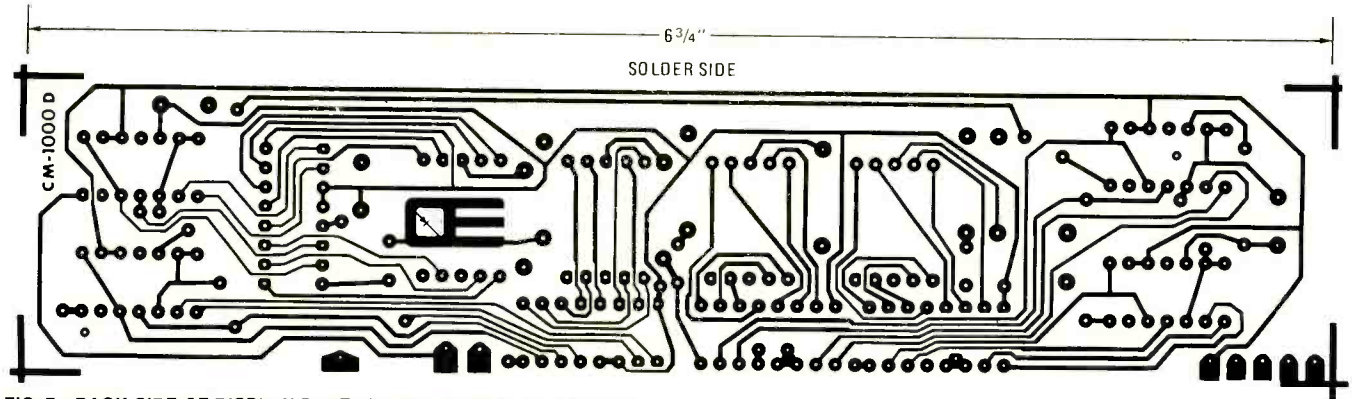


FIG. 7—BACK SIDE OF DISPLAY PANEL is etched with this foil pattern.

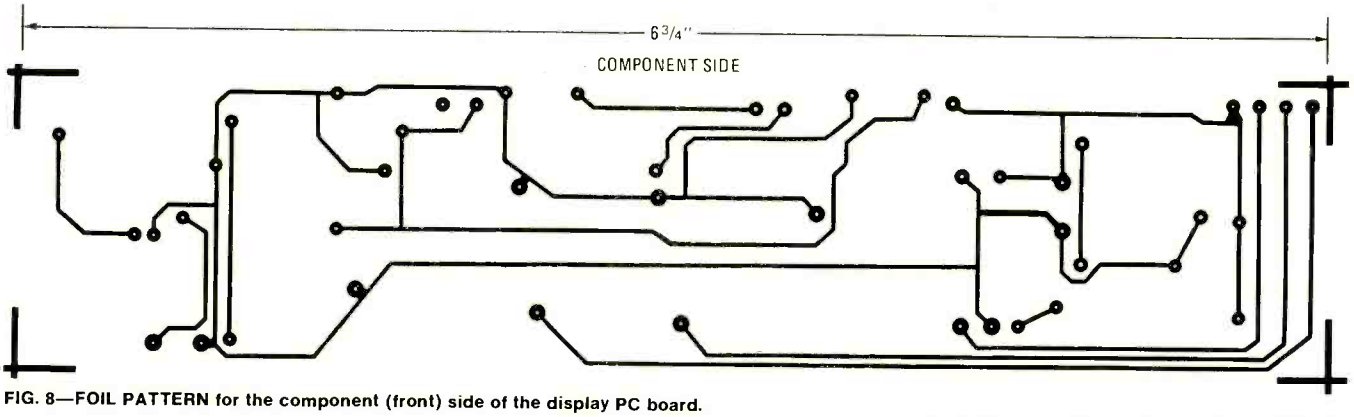


FIG. 8—FOIL PATTERN for the component (front) side of the display PC board.

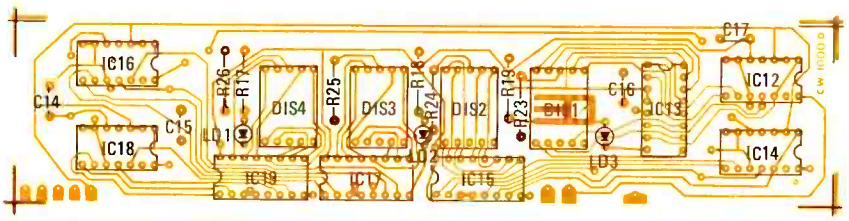
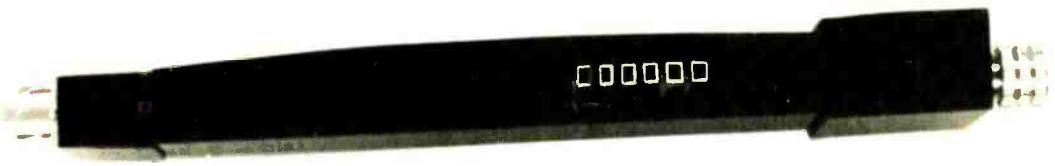


FIG. 9—DISPLAY BOARD components are laid out as shown. Decade counters and driver IC's are on board along with the LED displays and a few capacitors and resistors.

BUILD THIS

Frequency Counter In A Probe



Part 2—Completely self-contained in a handy probe, this frequency counter was constructed using a unique assembly method that makes possible an instrument that is rugged, compact and convenient to use.

WALTER T. CARDWELL, JR.

Beginning last month, this article describes an instrument that is constructed using an unusual technique (see "IC Bricklaying" in the December 1977 issue). Counter measures to 2.5 MHz with 10-Hz resolution.

Now build one

Figure 4 shows component placement using the "bricklaying" technique and keying of sockets S01 and S02. Glue a 12-pin socket on each end of the block of IC's, and a 1/16-inch acrylic plastic spacer between the socket pins. Then clip the socket flush with the spacer to allow 1/16-inch of space for soldering leads to the socket. Cut the sockets from an 80-pin PC-board edge connector.

The case is made from black opaque acrylic plastic. Glue a 1/8-inch-thick piece, as wide as the IC block, to the sides of the sockets at each end. On the front, glue a 1/16-inch black opaque piece of plastic to a 1/16-inch piece of transparent amber plastic; this strip is then glued to the front side with the transparent part placed over the readouts. Use cyanoacrylate glue, but don't get glue on the plastic surface.

Once the two sides are in place, file the top and bottom of the block flat using a metal file. You can curve the top to make it more comfortable to hold and easier to identify. When you file the block, bring the sides down as close to the IC's as possible to keep the overall size of the meter small. Be careful of the wires when you file. If the wiring is covered with tape, you are safe until the tape is marked by the file. You may have to add shims to the top of the sockets if the sockets are not as thick as the IC block. Once the top and bottom have been filed, glue two more pieces of 1/16-inch black plastic to the top and bottom. If you use cyanoacrylate glue, you can open the case easily by inserting a razor blade along the seam.

The square block that plugs into the back is the battery pack and is made from 1/16-inch glass-epoxy double-sided PC board. The battery case is also made of black acrylic plastic. The meter is powered by 20 mAH NiCad button cells. Also included in the power supply is a 2-volt reference, using an MC1403 IC and a 1000-ohm, 10-turn trimmer (see Fig. 5). This voltage reference will be used by certain meter accessories (still on the drawing board) that will plug into the front of the unit. You can use larger batteries if you don't find their weight and size objectionable.

The probe tip on the front contains the blocking capacitor, the ×10 prescaler and hold switch. A CD4013 dual-D flip-flop generates the hold and ×10 signals. The two dots on the top of the probe tip are two small copper nails inserted through a 1/4-inch black plastic strip and filed flush. These nails serve as a touch-control switch (S2) to select the ×10 range. One side is connected to the +5-volt supply through a 100,000-ohm isolation resistor, as shown in Fig. 6-a. Placing your finger across the pins charges capacitor C2 through resistor R3 and the skin resistance. Diode D1 and capacitor C2 must be used to eliminate the 60-Hz charge that the body receives from the

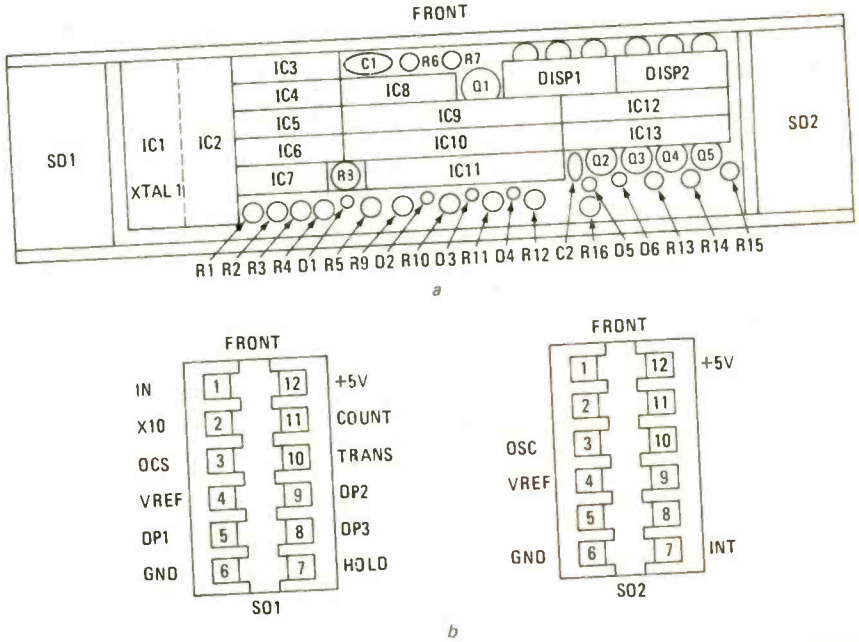


FIG. 4—INTERNAL LAYOUT of probe showing component placement. Location of signals on socket pins is shown in *b*.

power lines. Resistor R2 discharges capacitor C2. Charging C2 sets the dual-D flip-flop; the ×10 input is high and the DP1-display is low. As soon as connector S goes low, output from the 3.57-MHz oscillator resets the flip-flop.

The clear plastic front holds momentary contact switch S1. Cut the front piece from ½-inch clear acrylic plastic, which you then glue to the front of the completed black plastic back section of the unit. Sand both pieces with 100-grit sandpaper in a disc sander until you obtain the final shape (see Fig. 6-b). The drawings do not show dimensions since the size depends on the components used. Sand the probe tip with finer-grit paper, stopping at 400 grit.

Once the shape is roughed out, remove the clear plastic section with a razor blade. Drill a 1/16-inch hole through the center to hold the wire probe tip, which is made from 1/8-inch piano wire ground to a point. Wrap AGC No. 10 copper wire once around the back end and silver-solder it using a propane torch. Then, file the copper until the tip resembles a long flathead nail.

The 1/8-inch hole in the clear acrylic plastic is drilled out from the back deep enough so that the SPST miniature pushbutton switch fits completely in the clear plastic section. Remove the pushbutton and metal section. Then, remove a white spacer on the red pushbutton to the end of the copper head on the probe tip. Room is hollowed out in the clear plastic to contain the switch lugs, which are bent at right angles to the switch body.

Solder two wires to the copper part of the probe tip. These wires must be flexible; we recommend phonograph pickup wires. Before assembling the switch, glue the clear plastic back on the probe front. Then, to restore the gloss on the plastic, polish the entire unit, using jewelers' rouge on a cloth buffing wheel. Be careful not to let the edges catch in the buffing wheel.

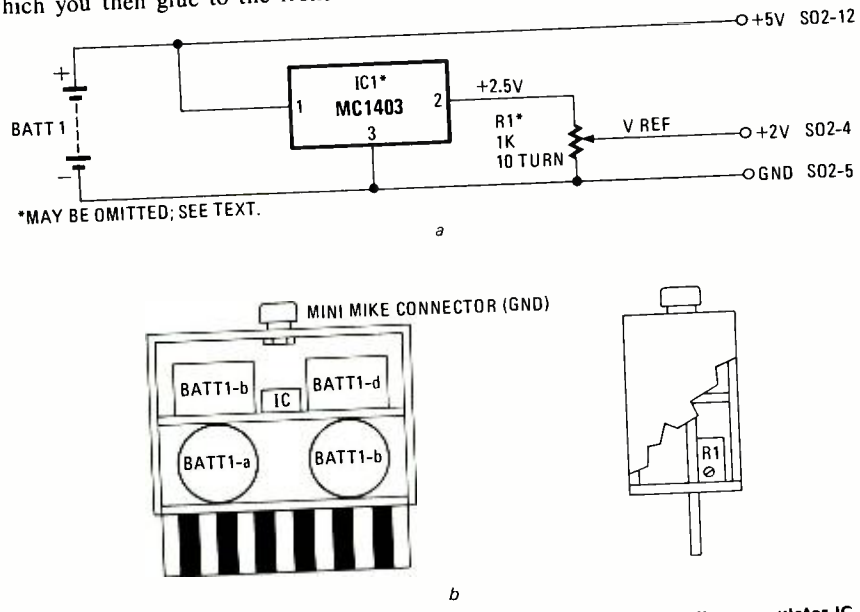


FIG. 5—POWER SUPPLY SCHEMATIC AND PARTS LAYOUT. The MC1403 voltage-regulator IC and the 1K pot are for a 2-volt source used as a reference for accessories not yet completed.

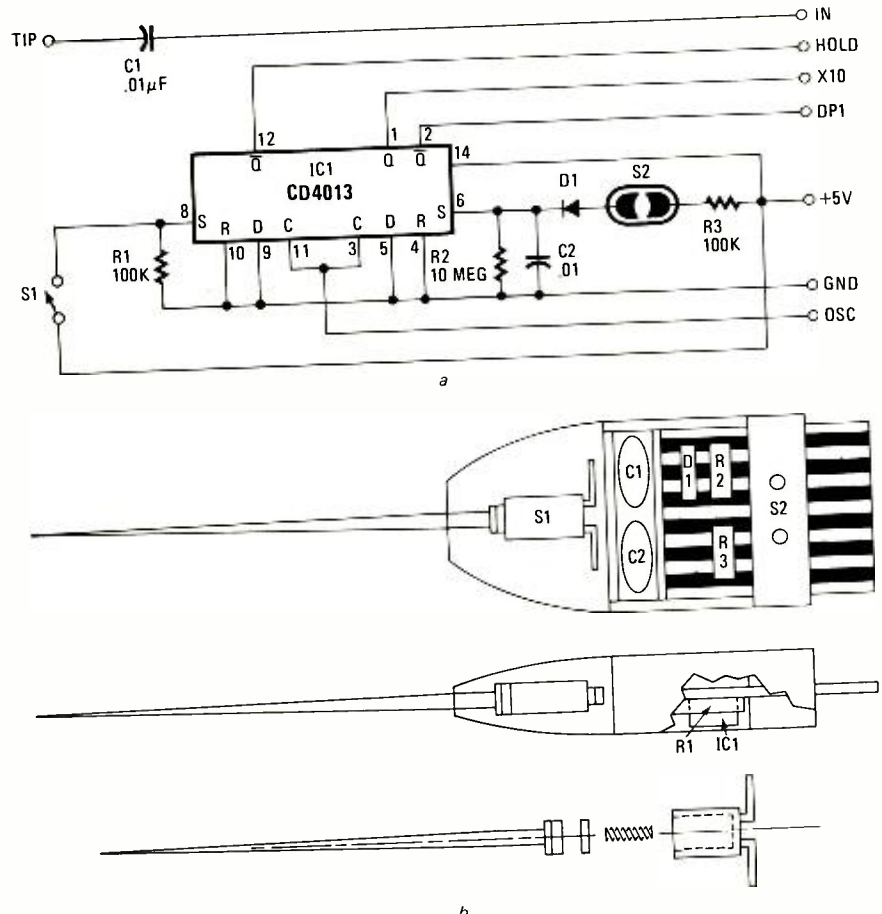


FIG. 6—CONSTRUCTION AND SCHEMATIC DIAGRAM of the probe front-end. The prescaler uses a CD4013 and is turned on by touch switch S2 consisting of two tiny nails.

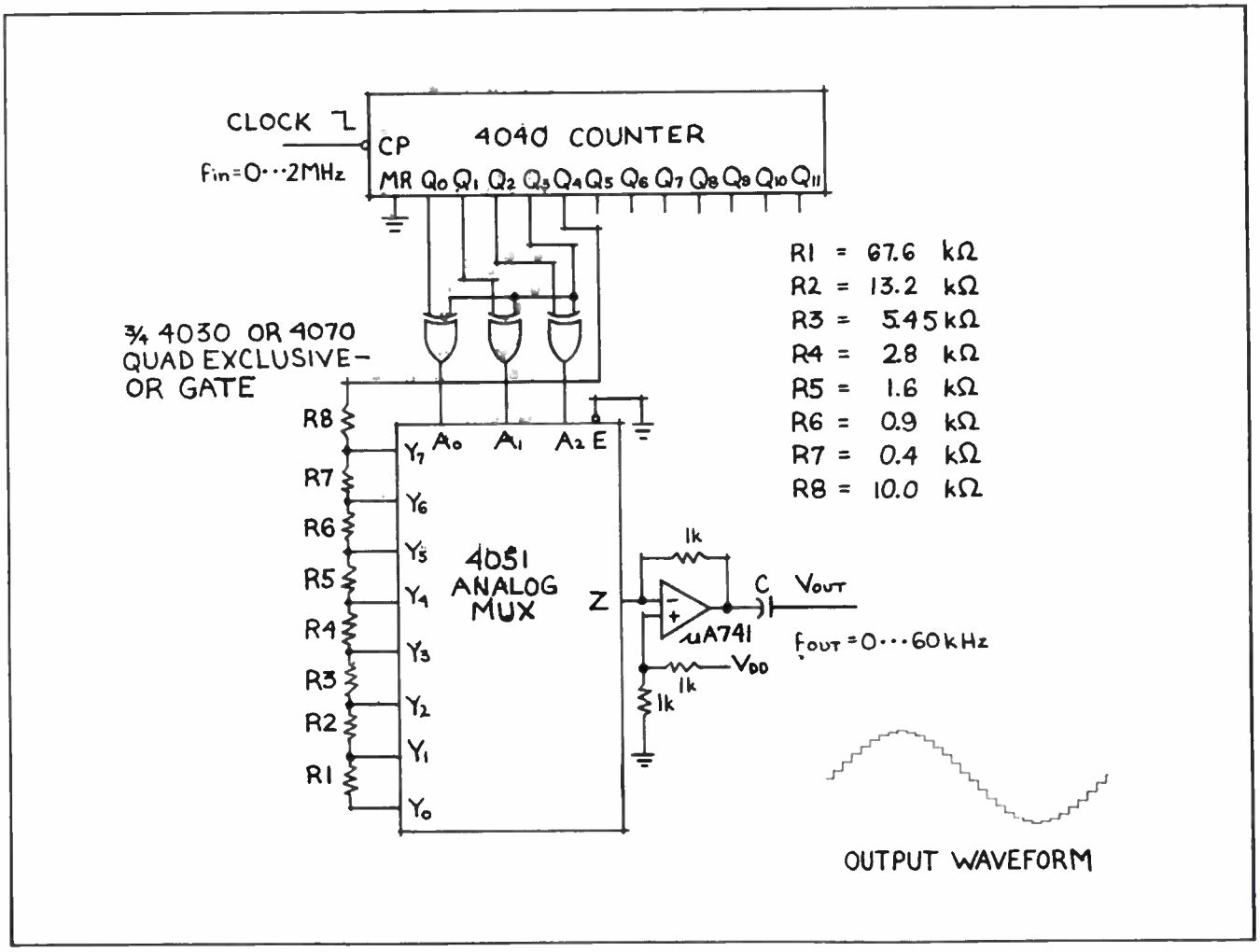
Calibration is the next step

After the probe tip is polished, you can assemble it. Unglue the clear plastic section again and file off the old glue from both sections. Push the probe tip through the 1/8-inch hole that was drilled in the clear plastic section. Insert first the spring and then the flat contact disc into the switch body. Place the switch assembly in the back of the clear plastic section and glue it in place. There should be sufficient room at the front of the switch body to allow the wires on the probe tip to move. Check the switch to make sure that it closes when the probe tip is pushed in. When the switch is finished, connect the wires to the switch, and the probe tip wires to the input capacitor. The clear plastic section is now glued to the front permanently. Any glue that appears on the surface can be removed with the buffing wheel. Be especially careful of the sharp point waiting to get you if it catches in the wheel!

When the tip is pushed in, the meter will convert until it is removed. The count will be held as long as the tip is not pushed in. When the prescalers are added you insert them between the probe tip and the meter body.

The usefulness of the basic frequency probe can be greatly expanded by accessories that plug into the main body. You can add a 5-volt calculator battery eliminator so that the meter can function off the AC power line. You can also construct a new front section so that you can use the probe as a normal bench meter. You can also add a 20-MHz to 125-MHz prescaler. Due to the construction of the main body, the number of accessories you can add is almost unlimited. **R-E**

CIRCUIT IDEAS



DIGITALLY CONTROLLED SINE WAVE GENERATOR

PETER ALFKE

Digitally derived sine waves are ideal in instruments that cover a wide frequency range, and in frequency shift keying, e.g., for data storage on audio cassette. Conventionally, these sine waves are created by filtering symmetrical square waves through low-pass filters. Such filters require several precision components (capacitors, resistors, or even inductors) and work properly only over a limited frequency range.

The approach used here eliminates the filtering and the frequency-sensitive components by generating a staircase approximation of a sine wave (of arbitrary frequency) through a specialized digital-to-analog converter.

The counter, with outputs Q_0 through Q_4, counts clock pulses at 32 times the rate of the sine wave frequency to be generated (a 1-kHz sine wave requires a 32-kHz clock rate).

The three least significant counter outputs are fed through three exclusive-OR gates into the address inputs of an 8-input analog multiplexer. The next counter output (Q_3) controls the exclusive-OR gates so that the address inputs to the multiplexer first count up (0...7), then count down (7...0), then count up again.

The inputs of the analog multiplexer are connected to a resistor chain, and the multiplexer output feeds into the inverting input of an operational amplifier. The non-inverting op amp input is connected to 50% of the supply voltage, e.g., 2.5 V in a 5 V system.

Address 0 connects the highest, and address 7 the lowest, resistor value to the op amp input. The other end of the resistor chain is tied to the most significant counter output, so that it alternates between sourcing current into the amplifier and sinking current from the amplifier. By proper choice of the eight resistor values, the amplifier output is a 32-step approximation of a sine wave with a dc component equal to half the CMOS supply voltage. **R-E**

Reprinted from "Fairchild Journal of Semiconductor Progress, Vol. 6 No. 2"

You Can

An installment of a continuing series
readiness to qualify as a

CHAPTER 4

TRY YOUR HAND AT THESE SAMPLE TEST questions on transistors and semiconductors. The answers to this month's and a new set of questions will appear in a future issue of **Radio-Electronics**. When you feel ready to take the CET Exam write to ISCET: 310½ Main St., Ames, IA 50010. Ask for the name and number of the nearest Certification Administrator, and take the CET exam.

Chapter 4 Questions, transistors and semiconductors

1. A good method of determining if the transistors are operating in a Class-A circuit, such as an audio amplifier, IF or RF amplifier, would be to check the:

( ) a. collector-base voltage
( ) b. bias voltage
( ) c. emitter-collector voltage
( ) d. base voltage

2. In a Class-A transistor amplifier circuit using a NPN silicon transistor, which of the following conditions would appear to be normal?

( ) a. collector −5V; emitter 0V
( ) b. base −5V; collector −5.6V
( ) c. emitter −5V; base −5.6V
( ) d. collector −5V; emitter −10V

3. Which of the following statements regarding Zener diodes is true?

( ) a. a Zener diode will operate the same as any low-current solid-state diode if forward-biased
( ) b. a Zener diode will operate the same as any low-current solid-state diode if reverse-biased
( ) c. variations in the reverse-current flow in a Zener diode will cause similar variations in the Zener diode voltage level
( ) d. most Zener diodes are germanium

4. Which of the following statements is true regarding FET's (*F*ield *E*ffect *T*ransistors)?

( ) a. the gate voltage necessary to cause the FET to cut off is called the "pinch-off" voltage
( ) b. the channel of a FET must be of 'N'-type material
( ) c. MOSFET's are immune to static charges
( ) d. the difference between a junction FET (JFET) and a MOSFET is that the JFET has an insulated gate to reduce reverse-bias gate current

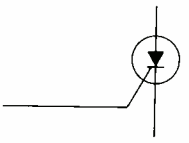


FIG. 1

ANSWERS TO

Correct answers to Chapter 3 Questions on DC circuits

Here are the answers to the questions on DC circuits that appeared in the September 1978 issue.

1. **Correct answer is "d."** A scope calibrated for vertical deflection of 100 volts-per-inch will show about 3.3 inches of peak-to-peak deflection. An AC RMS meter would show 117 volts AC because the meter first rectifies the AC voltage and then reads the effective voltage, not the peak-to-peak voltage as the scope displays. Peak-to-peak voltage is 2.82 times RMS.

2. **Correct answer is "b."** High frequencies are bypassed to ground through the capacitors. Low frequencies (such as vertical-sync pulses (60 Hz) in TV sets) find the capacitive reactance high, while high frequencies (such as the 15,750-Hz horizontal-sync pulses) find the capacitive reactance low, and are passed to ground—or filtered out—by the circuit. Low frequencies will appear at the output.

3. **Correct answer is "d."** The formula for impedance in a series LRC circuit is:

$$Z = \sqrt{R^2 + (X_L - X_C)^2}$$

In this example X_C and X_L are equal and therefore would cancel. This leaves only the resistance as a factor, or a total of 10 ohms. The formula with X_C and X_L canceling would be: $Z = \sqrt{R^2}$. The square root of R_2 is R, or 10 ohms. Figure 3 shows that L and C reactances are opposite each other, and ninety degrees from R. Being equal they cancel each other, which leaves only 10-ohms resistance as the effective impedance.

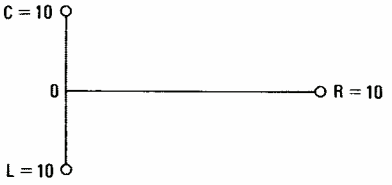


FIG. 3

4. **Correct answer is "b."** Figure 4 can be a differentiating circuit. Where it is used as such, the high-frequency response is good (the capacitor will charge quickly to a maximum value); the low-frequency response is poor (a squarewave will be reformed into a "peaky wave." See Fig. 5.)

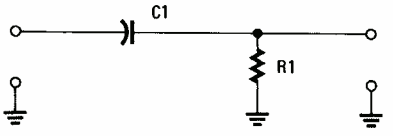


FIG. 4

5. **Correct answer is "d."** If X_L and X_C are equal, the frequency must be resonant. Higher frequencies will be

Be A CET

of questions aimed at checking your Certified Electronic Technician

DICK GLASS

5. The symbol shown in Fig. 1 is a:

( ) a. MOSFET
( ) b. thyratron
( ) c. tunnel diode
( ) d. SCR

6. A tunnel diode is most likely found in which location?

( ) a. a power supply
( ) b. the horizontal or vertical oscillator circuits of a TV set
( ) c. a UHF tuner
( ) d. an audio detector

7. The gain-bandwidth product of a transistor can tell you:

( ) a. the frequency at which the gain has decreased to 0.707 times the gain at 1000 Hz
( ) b. the frequency at which the gain has decreased 3 dB from the gain at 1000 Hz
( ) c. the frequency at which the gain has decreased to 1
( ) d. none of the above

8. A frequency correction circuit using a transistor rather than a varactor uses which two elements as the variable capacitor?

( ) a. collector-base
( ) b. emitter-collector
( ) c. all three elements must be connected
( ) d. emitter-base

9. What type of transistor is shown in Fig. 2?

( ) a. a triac
( ) b. an N-channel JFET
( ) c. a P-channel JFET
( ) d. a unijunction transistor

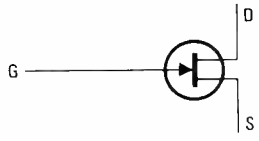


FIG. 2

10. In most high power-output transistors used in radio, amplifiers and TV receivers:

( ) a. the case is connected to the emitter
( ) b. the case is connected to the base
( ) c. the case is connected to the collector
( ) d. the case should be grounded for better shielding

Be sure to keep this month's issue of **Radio-Electronics** so you can check your answers in the next CET test. The new questions appearing in the next CET test will be on electronic components and circuits. **R-E**

PRIOR QUIZ

(September 1978)

FIG. 5

shunted through C, and the lower-than-resonance frequencies find L an easier path to ground. Only the resonant frequency finds X_L and X_C equal. The circuit responds to the resonant frequency, all others—higher or lower—to a lesser degree.

6. **Correct answer is "a."** Refer to discussion in answer 5 above.

7. **Correct answer is "d."** The time constant or R–C time for the cathode circuit is as follows:

$$t = R \times C$$

in which t is the time it takes for the capacitor to charge to 63% of full charge.

$t = 4700 \times 1\ \mu F$
$t = 4700 \times .000,001$
$t = .0047$ seconds, or 4.7 ms

8. **Correct answer is "c."** A resistor in series with either leg of a parallel L–C circuit changes the resonant frequency. It therefore could be used to tune such a circuit.
(Many practical technicians would instinctively select answer "b" as the correct one. However answer "c" is technically correct. The exact formula for the *natural resonant frequency* f_n is:

$$f_n = \frac{1}{2\pi}\sqrt{\frac{1}{L\text{–}C} - \frac{R^2}{L/L^2}}$$

When the value of R is small compared with $2\sqrt{L/C}$, natural resonant frequency f_n approaches resonant frequency f_o (when R=0) and is approximately equal to

$$\frac{1}{2\pi\sqrt{L\text{–}C}}$$

The resistance in an L–C circuit affects its Q, and, therefore, also its bandwidth. The circuit Q value must be less than 4 for f_n to differ from f_o by 1%. In the average practical circuit, the Q is at least 50. In this case, f_n and f_o differ by 1 part in 20,000. For further reading, see Terman's *Radio Engineering*, 3rd Edition, 1947, and *Radiotron Designers Handbook*, 3rd and 4th Editions.—*RFS*)

9. **Correct answer is "b."**
$X_L = 2\ \pi\ f_L$
$X_L = 6.28 \times 15,750 \times 5$
$X_L = 494,550$ ohms

10. **Correct answer is "b."** To reduce 27-MHz interference you would use a high-pass filter to shunt the 27-MHz signal, yet pass the desired 54-MHz to 216-MHz signals. **R-E**

HOBBY CORNER

Where to get parts, substituting parts and wiring prototype projects.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

VERY OFTEN READERS OF HOBBY CORNER come up with some good questions of general interest. Then, also, some questions appear again and again, showing rather widespread problems. Here are a few that might include some answers you need.

1. Where do you get the components to build your projects? To be perfectly honest, most of the components come out of my "junkbox" (that's what hams call whatever holds their component inventory—a shoebox, cabinet, cigar box, shelf, etc.). So a better question might be: "Where do I get the stuff to put in the junkbox?" I do manage to keep a fairly good stock of many kinds of components, and I work at keeping the stock up as it is used. Here's how I do it.

Perhaps the best way to build up a stock of components is to buy mixed assortments of resistors, capacitors, LED's, coils, transistors, IC's, and so forth. Mixed assortments can usually be bought for a low unit cost, so you can save 50% to 90% over the cost of individual components. Then, if you use only half of them in the course of time, you are still ahead. Of course, you won't have a choice of size or value buying components this way, but remember, if you don't have any on hand as you build a project, you'll have to buy each one you need at full price.

My assortment purchases come from several sources but mainly from surplus mail-order suppliers. I read the ads carefully in the back of **Radio-Electronics** each month and keep the postman busy delivering the flyers, catalogs and parts I have ordered.

Another source of components is from sources offering small bulk purchases. When I discover a commonly used part (for example, a 2N2222 or 7400 or 1N4004) and the price is especially favorable, I order 10 or 25 or more, even though I have no immediate need for them—sooner or later they will be used. These bargains are found in catalogs but most often in ads as monthly specials.

Another source that bears watching is the local retail outlet if you have one nearby. Every few months they take inventory and order in an especially big shipment. Someone usually decides that certain items should no longer be carried; then those parts go on a "bargain table." I have found that prices vary from store to store, but you can save from 25% to 50% when you find useful goodies on the bargain table.

As time goes by, you can build up a good stock from these and other sources. Another source you should not overlook, especially if you are just beginning to accumulate components, is old equipment. Anytime someone offers you a TV, radio, recorder, amplifier, or anything electronic, accept it! Very rarely does something like that come along that won't yield at least a few parts. I guess most of us started our junkboxes with *real* junk. You can find all sorts of components in those discarded sets—speakers, tubes, transistors, resistors, capacitors, transformers, dial lamps, sockets—they can be a real gold mine. (However, watch out for picture tubes—they can implode and cause severe damage!)

No matter how you go about it, however, you can't stock everything even if you try. Remember *Doc's law*: No project can be completed with just the components on hand! You'll always need something else to make it work.

At the start of a project when I discover something is missing, I try to find it locally to save time. I check the local retail stores, and then, if necessary, one or two of the wholesale distributors. As a final resort, I order the component and impatiently await its delivery.

In any case, I have found that time and money are saved by accumulating a stock of parts. I believe you will also find this useful.

2. I am a beginner in electronics and I want to build the projects you write about. Do I have to use exactly the same parts that you list? The answer to this is: Yes and no! There are times when you must use the exact value specified in a schematic. Fortunately, such instances are not frequent but you will experience them. You should always read very carefully both the text and any special schematic notes before starting any project.

In the Hobby Corner projects, I always try to indicate any parts that are critical in type or value; most other construction project articles also do this. Of course, there are times when you just *know* it makes a difference. For example, in a coil-capacitor tuned circuit or a resistor-capacitor timing circuit, you know that a change of value changes the frequency.

Most of the time, however, component values simply are not critical. Usually, the next standard value up or down is sufficient. An even greater difference will often do the trick, too. In fact, marked values are normally 10% or even 20% tolerance.

We sometimes fall in the trap of thinking of values as absolute just because they are numbers. If a capacitor is marked .01, we think of it as *exactly* .01 even though the chances of that being true are pretty slim unless we pay a premium price for a precision (low-tolerance) capacitor. So, when a schematic calls for a 5000-ohm resistor, for example, and you put one in marked 5K, it could range from 4500 ohms to 5500 ohms, or more!

Now you can see why the next standard value almost always works—it may be closer to the specified value than one so marked. Note that the 5K 10% resistor could be 5500 while a 5.6K resistor could be 5040 ohms!

Let's take a look at a typical case. Figure 1 shows part of a transistor amplifier stage in which R1 and R2 form a

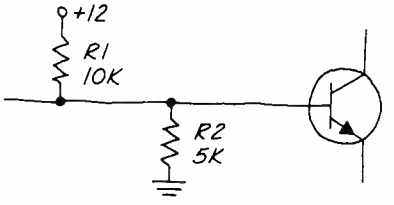


FIG. 1

voltage divider that is expected to provide +4 volts on the base of the transistor.

$(12 \times R2) \div (R1 + R2) = 4.$

But suppose R1 is 11K (10K + 10%) and R2 is 4.5K (5K − 10%). The base voltage would be 3.48, or if the resistors went the other way, the base voltage could be as much as 4.55.

The situation would be even more variable with 20% resistors (use some values in the formula to see just how much it would vary). The point is that unless 1% or 5% components are specified, the values range all over the countryside.

The next value up or even two greater

works just as well in most circuits. In substituting resistors and capacitors you should stay within the power and voltage ratings, however. If a 2-watt resistor is specified, you must use one that is 2 watts or larger. If a 16-volt capacitor is specified, make sure to use one that is rated 16 volts or more.

However, what do you do when you can't even come close to the specified value with the components you have on hand? Purchase what is needed or make them yourself if there is space in the project for one or two extra components. Note that I keep mentioning resistors, but the same principles apply to capacitors, inductors (coils) and other components.

You should always keep in mind the simple formulas for resistors and capacitors in series and in parallel. For example, suppose you need a 15K resistor. Do you have two 33K resistors to hook in parallel?

$$\frac{R1 \times R2}{R1 + R2} = \frac{33K \times 33K}{33K + 33K} = 16.5K.$$

Or how about two 6.8K resistors in series?

$$6.8K + 6.8K = 13.6K.$$

Or a 5.6K, an 8.2K and so on. Of course, capacitors work identically except that the series and parallel formulas are reversed.

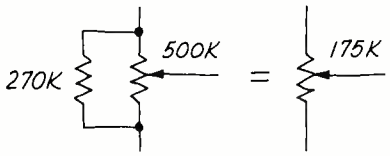


FIG. 2

This method of making your own components can also be quite handy with pots. A reader asked recently where he could obtain a 150K pot, stating he could only find values of 100K and 500K. I advised him to make the pot (see Fig. 2). The 500K pot in parallel with the 270K fixed resistor works similar to a 175K pot; this is close enough for most purposes. Actually, it's also possible to measure a handful of 20% resistors to find one at 200K, and that would yield the equivalent of a 153K pot!

With rectifier diodes, use substitutes that have an equal or higher *P*eak *R*everse *V*oltage (PRV or PIV). A 50 or 100 PRV diode replaces a 25 PRV diode in almost any circuit—or two 25 PRV's can replace a 50 PRV (with equalizing resistors).

Most LED's have almost identical electrical values. They come in different sizes and colors and have different lenses, but one will serve as well as another in all but the most critical circuits.

The same holds true for most digital readouts, although if the ones you substitute differ greatly in size, you should check the current requirements. Of course, you cannot interchange common-cathode and common-anode units without also making other circuit changes.

Transistors are hard to keep up with because there are so very many types. Most circuits work with *dozens* of different numbers. Usually it is a good idea to stay in the same transistor "families"—NPN, PNP, FET, audio, RF, silicon, germanium (even *this* list could go on forever!). Certainly you should have a transistor substitution book near your workbench.

There you have the parts story, or most of it at least. You seldom have to use the part exactly as specified. Use what you have that is in the right ball park and see how it works. I do it all the time as do all experienced builders. By the way, that's why I always run up a circuit on a solderless breadboard before building it permanently—I want to see if the circuit works properly with the components I have on hand.

3. **What's the best way to wire a project?** You came to the right place with that one! The truth is, I spend a lot of time trying to figure out the quickest and easiest way to build a project. I guess that's why I like the pencil wiring.

Over the years I must have tried every possible means of wiring. Of them all, I have settled on pencil wiring for most of my projects. It is effective and neat but, best of all, it is easy and *fast*.

You must understand that pencil wiring will not replace all the other wiring methods. I haven't given up wire-wrapping, PC boarding or even the old cut/strip/hook techniques—they still have their uses. However, most of my IC and transistor circuits are ideally suited to pencil wiring.

All you have to do is use a pencil-like device that also holds a roll of wire. As you move the point from place to place, just make a couple of loops around the components to be connected. Then go back and solder each joint—there's no need to scrape off the insulation because it vaporizes when it is touched with the hot iron.

I just finished wiring a project using Vector's new *model P178-1* wiring pencil (Vector Electronic Company, Inc., 12460 Gladstone Avenue, Sylmar, CA 91342). Vector's old model wiring pencil performed quite well, but this new slim one fits my hand better and gives me improved control. With its long metal snout, the wire can be laid exactly where you want it as you move quickly from one connection to the next. *What*? You've never done any pencil wiring? According to a once-popular expression, try it, you'll like it!

I hope these reader questions and answers have been interesting and helpful. If so, from time to time, we'll take a look at some more of them. **R-E**

computer corner

8085 *How to use the 8085 with an A/D converter to monitor eight analog channels.*

P. RONY, D. LARSEN, C. TITUS AND J. TITUS*

THIS MONTH'S COLUMN WILL SHOW HOW to interface an 8085 microcomputer with an A/D converter so that eight analog channels can be monitored with the time period between measurements programmed by the user. It is assumed that all eight channels are monitored quickly with a long period between these quick samplings. The system's computer, the 8085, must have the following input/output (I/O) devices:

1. A fast 10-bit analog-to-digital (A/D) converter with an eight-channel multiplexer.
2. A set of thumbwheel switches to select the time period (1 second to 99 seconds).
3. A set of eight control on-off outputs that can be used to control the process being monitored.

The block diagram of Fig. 1 shows how we assigned I/O ports and bits to various I/O devices. One 8155 read/write memory and one 8355 read-only memory (ROM) device are used. Note that the six I/O lines of Port C on the 8155 have not been used. These I/O lines can be used for later expansion.

The 8355's I/O ports were chosen to control the A/D converter system because a combination of inputs and outputs was needed. The 8355's I/O ports can be assigned input or output functions on a bit-by-bit basis. The 8155 was used for the switch inputs and the control outputs since these were already prearranged in groups of eight lines each.

The bits of the I/O ports must first be assigned input or output functions. The eight bits at Port A are all input bits, while those at Port B are a combination of input and output bits. Thus, the following control words must be sent to the 8355's two port-control registers:

Port A Control = 00000000_2
0 = Input Bit
Port B Control = 11111000_2
1 = Output Bit

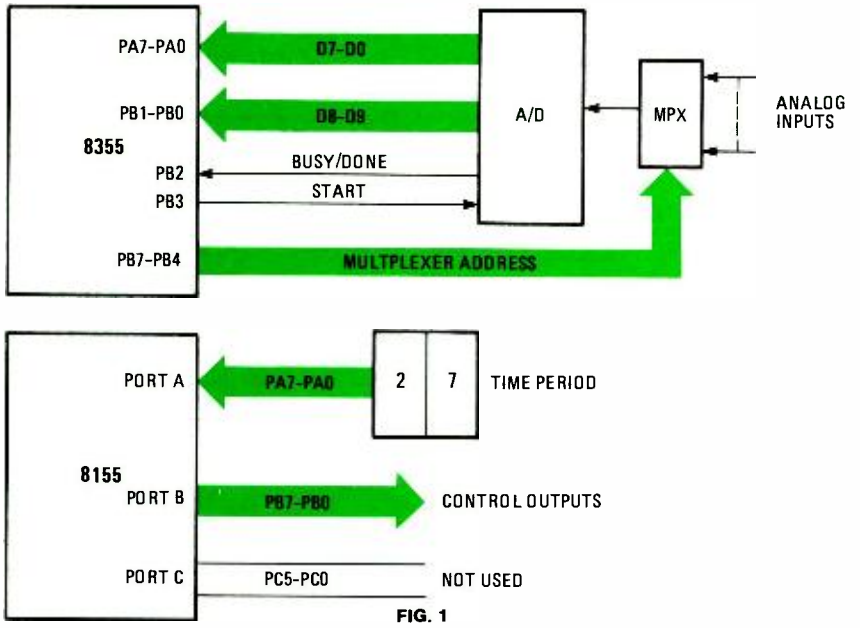


FIG. 1

```
START   MVIA    /LOAD REG A WITH PORT A CONTROL WORD
        000
        OUT     /OUTPUT IT TO THE 8355 CHIP
        002
        MVIA    /LOAD REG A WITH PORT B CONTROL WORD
        370
        OUT     /OUTPUT IT TO THE 8355 CHIP
        003
        NOP     /PROGRAM CONTINUES HERE
```

FIG. 2

```
/CONVERSION START PORTION OF THE PROGRAM
        LDA     /GET THE STATUS WORD, BIT PB3 = START
        STATUS
        0
        ORI     /SET THE START BIT TO A ONE
        010
        OUT     /OUTPUT IT
        001
        ANI     /CLEAR THE START BIT
        367
        OUT     /OUTPUT IT
        001
        NOP     /CONTINUE HERE
/MULTIPLEXER UPDATE, SWITCH TO THE NEXT CHANNEL
        LDA     /GET THE STATUS WORD, BITS PB7 - PB4
        STATUS  /ARE THE MULTIPLEXER CHANNEL ADDRESS
        0
        ADI     /ADD ONE TO MULTIPLEXER ADDRESS
        020
        OUT     /OUTPUT IT TO THE MULTIPLEXER
        001
        STA     /STORE THE NEW STATUS WORD BACK IN
        STATUS  /ITS MEMORY LOCATION
        0
        NOP     /CONTINUE HERE
```

FIG. 3

*This article is reprinted courtesy American Laboratories. Dr. Rony, Department of Chemical Engineering, and Mr. Larsen, Department of Chemistry, are with the Virginia Polytechnic Institute & State University. Both Dr. C. Titus and Mr. J. Titus are with Tychon, Inc.

```
/TIMER CONTROL PROGRAM FOR THE 8155 CHIP
        MVIA    /PRESET THE 8 LSBS OF TIMER'S COUNT
        020
        OUT     /OUTPUT TO TIMER
        204
        MVIA    /OUTPUT THE 6 MSBS OF TIMER'S COUNT &
        347     /THE 2 MODE CONTROL BITS, D6 & D7
        OUT     /OUTPUT THEM TO THE TIMER
        205
        MVIA    /SET UP PORTS A & C FOR INPUT,
        302     /PORT B FOR OUTPUT, AND START THE
        OUT     /COUNTER
        200
        NOP     /CONTINUE HERE
```

FIG. 4

```
/RESTART 7.5 INTERRUPT SERVICE ENABLING STEPS
        MVIA    /CLEAR ANY PREVIOUS RST7.5 INTERRUPTS
        020
        SIM     /SET INTERRUPT MASK
        MVIA    /ENABLE RST7.5 INTERRUPTS
        013
        SIM     /SET INTERRUPT MASK
```

FIG. 5

The output of these control words is shown in Fig. 2.

When these control words are output to the control registers, the ports will be configured as required. It is wise to exercise some caution when you use Port B, since you want to control bit PB3 and bits PB7–PB4 independently. Therefore, when bit PB3 changes, bits PB7–PB4 must not be altered. Some careful thought must be applied to this problem so that the program does not start a conversion when all you want to do is change the multiplexer's 4-bit address. A status word, stored in read/write memory, is used to tell the program the current status of the output lines. Individual bits can then be manipulated without affecting the other bits. Figure 3 shows two sections of the program, one indicating how the multiplexer is updated without affecting the converter, and the other showing how the converter is started without affecting the multiplexer. In fact, each routine can be treated as a subroutine.

The I/O ports on the 8155 are also easy to control. The bits at Port A are used as inputs and the bits at Port B are used as outputs; Port C is not used. Rather than using a software delay loop, we used the timer function in the 8155 to help time the 1-second period. Assume that the 8085 has a 1-μs clock period. With a 14-bit counter this provides periods of up to 16.36 ms. In our example, we used a 10.00-ms time period, using a 14-bit binary count of 100111 00010000, which must be loaded into the counter. Since the timer will be used repeatedly, we used it in mode 3—automatic reload with a pulse at the end of each programmed period. Now it is necessary to initialize the 8155 to control Ports A and B plus the timer. The following sequence (see Fig. 4) initializes the system and starts the 10-ms clock period.

The timer's pulse output generates an interrupt (RST 7.5) whenever a 10-ms period "times out." To activate the RST 7.5 interrupt (on the 8085) the RST 7.5 interrupt mask must be enabled using the instruction steps shown in Fig. 5.

To initialize the I/O ports fully, only combine the steps from Figs. 2, 4 and 5. Remember also that you will have to establish a stack pointer before the interrupts can be used. In a future article, we will discuss the overall software integration necessary for this application. **R-E**

service clinic

Locating replacement parts for orphan sets can be a real chore. For help, use your ingenuity and the part numbers.

JACK DARR, SERVICE EDITOR

IN THE ELECTRONICS SERVICE INDUSTRY we often find so-called "orphans" dumped on our doorstep. These are TV sets and radios sold by parent companies that have left town and cannot be located! In most cases, but specifically with the less costly imports, there's only one logical solution: Don't accept them! These sets lack service data and replacements, and are a lost cause.

With a few "brand-name" sets built by U.S. companies, there's some hope. One in particular is the Bradford line. This line appears to have been manufactured by a record number of companies, 16 in all! (This information was provided by the *Coil Replacement Guide No. 175*, published by the J. W. Miller Company of Compton, CA. This guide lists sets by brand *and* manufacturer.)

So far, in practically all cases, Bradford seems to use the original factory *part numbers*. Therefore, we have been able to trace them back and cross-reference them to the numbers used by the manufacturers in their own sets. Component numbers are often individual and identifiable. The Miller Company Guide lists only radio-stereo components. However, by checking the part number, you can identify the manufacturer, then use the TV transformer guides (such as those published by Thordarson, Triad, etc.) to find a replacement. We have done this in quite a few cases with good results.

Bradford is shown in the Miller Company Guide as having been manufactured by Admiral, Arvin, GE, RCA, Wells-Gardner and Westinghouse, as well as Sanyo, Aiwa, Matsushita, Mitsubishi and Toshiba. The American companies have distinctive part numbers. For example, an Admiral set will have flyback circuits numbered "79C187-1," and deflection yokes numbered "94C87-1." (Incidentally, the letter "C" in the number doesn't seem to be critical; it can also be a "D," etc.) Find the listing for Admiral and look for the same number; the chances are you will find the information you want.

Arvin uses five-digit numbers or seven-digit numbers with a suffix. For example, the numbers "68504-123" or "2002783-2" are used for flyback circuits. Some components have letter-digit numbers, such as "TLF-413," which can also help. General Electric uses two letters, two digits, an "X" and more digits; "ET77X88" designates flyback circuits, "ET76X32" indicates yokes.

RCA uses six-digit numbers, usually without suffixes—"133640" (flybacks), "136642" (yokes), etc.

Wells-Gardner also uses an "X." However, there is a difference: "53X362C" is used for flyback circuits and "9A2403" for yokes. Flyback circuits, vertical-output transformers, audio transformers, etc., all seem to use numbers in the 50's. The designation for yokes and smaller coils starts with "9A."

A Westinghouse component is perhaps the easiest to identify at a glance since a typical number for a flyback circuit will be, say, "690V39H32." The "690" or "490" and the "V" are the key clues. All coils and transformers have that "V" in their number.

Of the imported sets, the larger ones may be in such quantities that the replacement-transformer companies manufacture parts. In any case, just cross-reference the component to a factory number for assistance. Sony, Panasonic (Matsushita), Mitsubishi and Toshiba all have parts centers around the country, and it is often easy to find the one you need. Some of these components are listed now in the transformer guides.

Service data on many Bradford sets is found in *Sams Photofacts*, in which the part numbers are listed. Many of the part numbers for other sets are also covered in this publication. Another company that has service data and parts for the Bradford line is the firm known as the Marcel Companies (57 Enfield Street, Enfield, CT 06082).

You can often discover some helpful information by accident. I once received a letter asking for data on a "XAM" D12BW74. I found that this used a Philco 3DL20 chassis (listed in Sams No. 1277). Another reader asked for data on a XAM 14CP74. I told him to research the Philco folders. He replied, "I looked all through the area you suggested (around 1200-1300 in *Sams Photofact*) and came up empty! A week later, a Philco C3052BWA came in. I took the back off and a light bulb lit up! It looks familiar! It turns out this one is a Philco 3CN20, Sams No. 1414." Thanks to Paul Fedisson of Paul's TV in Jackson, NJ, for this help.

This cross-checking method works with other things as well. If you can find the part number, either from available data or the part itself, cross-check it to find a match. Once you can decode these numbers they can be *very* helpful. Good luck! **R-E**

service questions

B+ VOLTAGES DOWN

This Sylvania model E-21 came in with no picture, raster, or sound. It showed about 15 kV on the high voltage and all the B+ voltages were low. I opened the B+ circuit between the rectifier and filter, and read only 240 mA. This should read 700 mA. I don't get it.—R. P., Bristol, VA.

In all solid-state TV sets, the value of the B+ voltage is critical. There are three things that can cause these symptoms you describe: excessive current, a weak supply, *and* a bad DC voltage regulator. You don't have a current overload, as you noted. Check the B+ voltage right out of the rectifier; this should read +145 volts. If so, check the output of the voltage regulator, which should read +112 volts. If it is quite low, check out the voltage-regulator circuit. Something in this circuit seems to be dropping the output voltage.

SHADED RASTER

The trouble with this Sony model SCC-64A is it has a shaded raster—dark on the left side, becoming gradually brighter to a whiteout on the right side. This shading tracks evenly with adjustment of the brightness control.—D. L., Battle Creek, MI.

This was the original letter. I suggested he check parts that are "common," such as the picture tube, grids, etc. This is his answer:

When I scoped the grids of the picture

tube with the gain cranked up as high as I could get it, I detected a very tiny *sawtooth* waveform! Working my way back through the "Las Vegas Strip" (all those neon lamps!), I found that C707 was open. This is the filter capacitor for the +199-volt supply, and it comes from a winding on the flyback. Replacing the open capacitor with a new one cleared up the shading.

(Thanks to Darwin Lapham, Dar's TV, Battle Creek, MI.)

ERRATIC VOLTAGE SHUTDOWN

This Quasar model TT934HW would shut down after playing for some time. After tracing everything on the JA power-supply panel, I finally ordered a new power supply. The note included with it said if there was erratic voltage shutdown with the new panel, to install a beam current limiter kit. When I turned the set on, I had a very bright raster. I could not turn it down far enough and it shut down again. I then ordered the beam current limiter and installed it. This didn't help. I'm going in circles.—K.F., Darby, MT.

So was I for a while! This is a *model 934*, but the chassis is No. 938. The Quasar service note states that this shutdown problem could be due either to a poor contact at pin 7 of plug P2, or to a poor contact where the +200-volt lead clips to the CA panel. Also, you could run a complete check of *all* the DC voltages and adjust any that are off. These voltages are all critical and can cause shutdown on low voltages as well as high.

TRANSISTOR IGNITION CUTOUT

The transistor ignition system on my car used to cut out on the highway. I've replaced the original TO-36 transistor with a 2N2527. Now it runs up to 50 mph at highway speeds, but cuts out if I slow up for traffic. Any helpful ideas?—E. D., Tappan, NY.

I hope so. From the symptoms, the transistor is going into secondary breakdown and is not firing. This transistor is a germanium; germaniums can do this, then heal up when they cool off! The transistor is probably not getting sufficient cooling. (Try spraying coolant on it the next time it stops and see if this helps.)

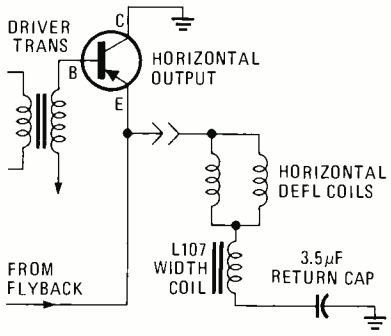
If so, then add more heat-sink area. Make an auxiliary heat sink out of a big sheet of aluminum painted flat black. Also, place the unit in the car so that air does not get to it from the radiator but, rather directly from outside the car. In

some cars, you can run a hose through the side of the radiator shell and place it so that it blows right on the transistor.

THIN VERTICAL LINE

I have problems now with a transistor TV I built while taking a course. Do you know where I can get a Sams schematic on the set? It's an HSK-T1. The problem is that all that appears on the screen is a thin white vertical line. I've replaced the horizontal driver, output and the driver transformers, with no result. This symptom indicates an open vertical deflection coil, but the continuity checks out! Help!—B. H., Orlando, FL.

Here are a couple of answers: First, you can't get a Sams schematic for anything but commercial TV sets. Second, let's recheck the cause of the problem.



A thin *vertical* line on the screen shows a loss of *horizontal* deflection, not vertical. In this set, as in many solid-state TV sets, the horizontal-deflection coil and the flyback are connected in parallel to the output of the horizontal-output transistor, which in this circuit is the emitter (see the diagram). If the horizontal-deflection circuit is open, there will be no sweep but there will be high voltage.

Check the horizontal yoke windings for continuity. Then follow the *yoke-return* circuit, which must be good. This circuit contains a width coil (L107) and a 3.5-μF capacitor to ground.

VERTICAL PROBLEM

This Motorola model TS-921 has a vertical problem. If a man is shown on the screen, his head is at his stomach level and his tie is over his head! There's not enough height, either. The voltages around the vertical stage are not too bad. Any ideas?—A.L., Dierks, AR.

You seem to have a simply massive foldover, plus other problems. Coupling capacitors can cause this problem, but you've tried these.

One thing that is easy to miss in this vertical circuit is the little 20-μF capacitor. This capacitor is actually in the vertical-output cathode circuit. It's located over on the pincushion circuit board, so it's easy to miss. Check this plus the 1500-ohm resistor across it. It can cause some odd problems.

(Feedback: "Bingo! The 20-μF shorted; the resistor was bad.") **R-E**

TROUBLESHOOTING DIGITAL CIRCUITS

Continued from page 44

RAM, no problems are detectable. If color operation is chosen or the computer accesses the RAM, the screen is not blanked properly. In the case of color operation, the color is simply not displayed—since subjective coloring is an optical illusion and requires specific conditions to be observed.

Start the test by using the logic probe to check the counters and decoding circuits. Since they seem to work as designed, proceed to the AND gates; the video signal will blink the probe indicator at a low frequency. The blanking signal will be held low or in the undefined region. Since the output of that gate should have been pulsing at a low frequency, the problem exists on that line.

Using the current tracer (and pulser if required), follow the current into the NOR gate. Since the current flows from the AND gate into the NOR gate but is not pulsing, then either the input is shorted to ground, or another output is shorted to this line. Recalling that the blanking also malfunctions during computer access, this implies that the second case is true. Now, use the current probe to follow the flow into the inverter. Since these two lines only join at the NOR gate, the conclusion is simply that the two inputs are shorted together.

The third failure for the most part acts like and produces the same symptoms as the second failure, except that during computer access the blanking functions normally. The troubleshooting should begin and proceed in similar fashion. However, you will discover there is no output from the AND gate. Now, you should suspect a broken input wire bond in the AND gate. Use the logic probe on the output and place the pulser on the suspected input—there will be no signal. Next, place the pulser on the other input—you will receive a pulse. Since you have verified that the output, the other input and the power line connecting to that pin are all functioning, the only conclusion is an open input bond.

The fourth failure is due to two outputs being shorted together. During normal operation (computer is not accessing the circuit) both NAND gates are at a logic 1 state and normal operation continues. If the computer loads a new color command, then the character generator will be affected. Similarly, if a computer access to the RAM occurs, then the color circuits may be affected (depending upon the state of signal A_0). Use the same troubleshooting procedure used in the second failure case to locate the malfunction.

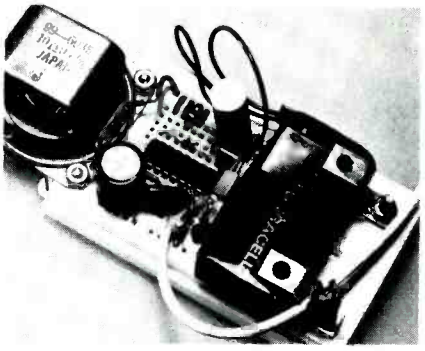
The fifth failure is due to an internal short, to ground, of the computer-access blanking signal. The obvious symptom is that the screen will always be blanked. Start by checking the NOR gate—the computer-access blanking line is always high. Next, starting at the NAND gate (the gate that drives the chip selects pins of the data IC's) follow the logic pulser's signal using a logic probe. Since this line is shorted to ground, even the pulser cannot change its state. Again using the pulser to inject a signal, but this time using the current probe, follow the current flow into the inverter—the input of the inverter therefore must be shorted to ground.

The final circuit problem shows the effect of an input being shorted to V_{CC}. The symptoms are that color is not displayed (remember that a small percentage of people cannot observe subjective color, so be sure that you can). Again, starting with the color-counting circuit, proceed to the AND gates. The blanking signal will be OK, but the video line is held high. Again the pulser cannot change the state of the line. Furthermore, if the color circuits are not selected (the Q output of the D-type flip-flop is at a logic 0 level) then the current flows into the AND gate. This indicates that the input of the video multiplex is shorted to a logic high. **R-E**

new products

More information on new products is available from manufacturers of items identified by a Free Information number. Free Information Card is inside back cover.

SOLDERLESS BREADBOARD, *Experimentor Socket, model EXP-350,* permits youngsters learning electronics to simply plug a transistor or IC into the face of a wafer-shaped plastic block, add some components and wire to create a fascinating beeping, blinking, or ticking device. The *model EXP-350* only requires a simple wire cutter



and stripper—no expensive tools—and necessary components for simple projects are inexpensive. Priced at $3.50, the *model EXP-350* can be used to design easy circuits obtainable from public libraries or electronic dealer sources.—**Continental Specialties Corp.,** 70 Fulton Terrace, New Haven, CT 06509.

CIRCLE 112 ON FREE INFORMATION CARD

DUAL-TRACE OSCILLOSCOPE, *model 1432,* is a portable dual-channel, 15-MHz instrument that offers sweep ranges from 0.5 μs to 1.5 seconds in 19 steps, with ±3% linearity. The unit has a 2-mV-per-division vertical sensitivity and 24-ns risetime. Features include a 3-inch CRT with internal graticule; ×5 magnification; front-panel

X-Y operation. Vertical modes include Channel-A only, Channel-B only, A & B, A + B and A − B. Timebase automatically switches between chopped or alternate sweeps. Unit operates on 117 VAC, 234 VAC, 12 VDC; an optional rechargeable battery pack is also available for in-case mounting. Other options include a carrying case and demodulator probes. Provided with 10:1 direct probes and tips, the *model 1432* weighs 18.3 lb. and measures 8.26 × 5.5 × 2.3 inches. Prices: *model 1432,* $750; *model BP-32* battery pack, $50; *model LC-132* carrying case, $25; *model PR-32* demodulator probes, $18.—**B&K Precision,** Dynascan Corp., 6460 W. Cortland Ave., Chicago, IL 60635.

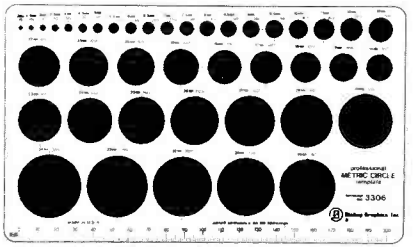
CIRCLE 113 ON FREE INFORMATION CARD

RADAR DETECTOR, *model Bearfinder Two + Two,* is the first to use two antennas to detect X- and K-bands that emanate from both moving radar and hand-held radar guns. Super-sensitive detector alerts driver both coming and going from signal emission point. Unit features "fail safe" indicator to warn of malfunction; sensitivity control dial; and a choice of either visual or audi-

tory alert signal. *Bearfinder* works on all 12-volt systems, can be plugged into car's cigarette lighter, requires no license to operate, and is guaranteed not to interfere with car radio performance or CB transceivers. The *Bearfinder Two + Two* comes in rugged heavy-gauge metal case and carries a 90-day warranty. Suggested retail price: $149.95.—**Bearfinder, Inc.,** 221 Crane St., Dayton, OH 45403.

CIRCLE 114 ON FREE INFORMATION CARD

GENERAL-PURPOSE TEMPLATES with metric dimensions together with their decimal equivalents include metric circles, large circles, squares, extra-large circles, pocket aids and sketch aids. Other templates featuring the standard U.S. deci-



mal measure include decimal circles, squares, arrowheads, brackets, combo ellipses, a free-hand lettering guide and more. Shapes and dimensions conform to MIL-STD 175 and the

Institute of Printed Circuits CM-770. Dual in-line templates are available in ×1, ×2 or ×4 scale; logic symbols templates come in ¼, ⅜, ¾, ½ and full sizes. Each template is tinted green and is .030-inch thick (freehand lettering guide is .040-inch thick) with a .025-inch pencil allowance. Information on all templates is provided in manufacturer's *Technical Bulletin No. 1020R*, available free.—**Bishop Graphics, Inc.**, 5388 Sterling Center Dr., Westlake Village, CA 91359.

CIRCLE 115 ON FREE INFORMATION CARD

WIDEBAND CABLE SPLITTER, *model 1502A*, provides a two-way split for 75-ohm cable lines. The unit can handle any audio or video signal; and has a nominal 6-dB loss and typical return

losses of 30 dB to 300 MHz and 25 dB to 890 MHz. Prices are available from the manufacturer.—**Extronix, Inc.**, 64 Gough Ave., Ivyland, PA 18974.

CIRCLE 116 ON FREE INFORMATION CARD

For faster service

USE ZIP CODE

on all mail

Our new test equipment catalog. Free!

With this catalog you can browse through one of the nation's largest electronics warehouses, packed floor to ceiling with the finest test instruments. Everything from probes to dual trace scopes; and everything at sensational savings made possible only by mail order selling. Volume pricing on orders over $500 gives you even greater savings. Every item is backed by a big brand name. Shipment is prompt from stock, always freight prepaid and there never is a handling charge on orders over $200. Write today for the big free catalog of the big brands that offers you the big savings.

NORTH AMERICAN ELECTRONICS
Dept. RE-178
1468 West 25th Street
Cleveland, Ohio 44113

Yes! Send me your big catalog.

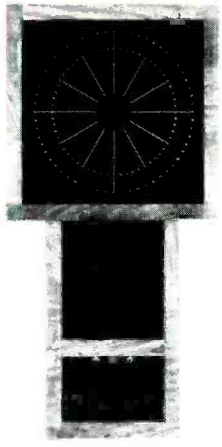
Name _____

Address _____

City _____ State _____ Zip _____

CIRCLE 81 ON FREE INFORMATION CARD

Grandfather's Clock Was Never Like This!



CL7402

If you love contemporary design and yet appreciate the more traditional, here's the perfect clock for you! Amelect has created their own version of the ever popular grandfather clock. Not only do the electronic eyes around the modern clock face light up displaying each second, minute, and hour, but our grandfather model includes a very novel and exciting electronic pendulum. There's even a shelf for displaying your prized treasures!

The upper section of the clock is 9¾″ square with an overall length of 19¼″ all encased in beautiful, hand crafted hardwoods. Select from solid walnut, maple, mahogany, or cherry. This clock is covered by a 1 year warranty on material and workmanship.

As shown on R-E April '78 front cover and described by Fred Blechman.

Available completely assembled or in kit form.

CL7402	**Assembled**	**$95.00**
CL7402	**Kit with Cabinet**	**71.50**
CL7402	**Kit less Cabinet**	**56.25**
	Shipping and Handling	**3.50**

To order write or call 219-297-3320

Indiana residents include 4% Sales Tax

AMELECT

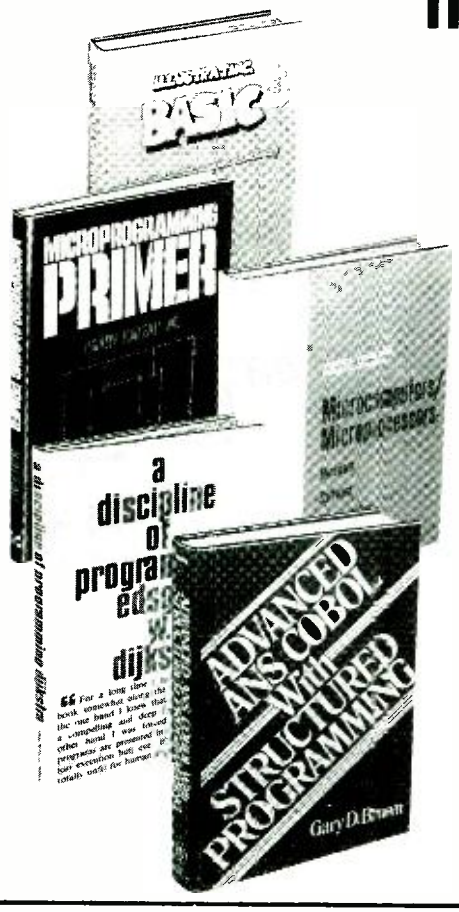
INCORPORATED

P.O. Box 367 – 106 S. Newton St.
GOODLAND, INDIANA 47948

Allow 3 to 4 weeks for delivery

CIRCLE 82 ON FREE INFORMATION CARD

Professional or not, the Computer the best books in the field . . .



PROGRAMMING LANGUAGES. By Allen B. Tucker, Jr. *439 pp., illus.* Gives you not only the *principles* of design but the *applications* of six major programming languages so you can decide—among the special features of each—what best suits your operations. Shows you the languages' strengths and weaknesses through demonstrations of their use in solving various representative "benchmark" problems. Also provides programs using a variety of computers so you can evaluate languages and their compilers on a basis of uniform and meaningful criteria.
654/158 Pub. Pr., $19.95 Club Pr., $14.95

MICROPROCESSOR PROGRAMMING For Computer Hobbyists. By Neil Graham. *282 pp., with figures, tables, and samples* If you are a personal computer enthusiast or technician, this book will prove to be one of the most valuable and interesting investments you can make It contains full details on programming—from the very basics to the state-of-the-art capabilities—and yet it is written so simply, and progresses in such a direct and logical manner, that any reader, no matter how inexperienced, can easily follow it.
783/56X Pub. Pr., $12.95 Club Pr., $10.95

A DISCIPLINE OF PROGRAMMING. By Edsger W. Dijkstra. *217 pp., with figures.* Based on the author's conviction that a carefully chosen separation of concerns is essential for the design of high-quality programs, this book focuses on—and solves with fresh insight and originality—a separate problem of design in each chapter. Rather than choosing one of the existing programming languages to work with, he has designed a mini-language that helps to stress the more fundamental aspects of the task
770/115 Pub. Pr., $19.95 Club Pr., $15.75

This title counts for two premium books

ENCYCLOPEDIA OF COMPUTER SCIENCE. Edited by Anthony Ralston and C. L. Meek, *1,500 pp., 60 illus., 100 charts, 7 x 10 format. This first and only in-depth coverage of the entire field of computer science in a single volume* is utterly comprehensive and completely up to date. An invaluable reference work for specialists, nonspecialists, educators, students, general readers, and librarians, it provides answers to any computer science discipline question in minutes. In addition to covering every aspect of the discipline in five broad areas, each is broken down into some 500 articles, most of them containing bibliographic information to make intensive study of any one subject easier.
769/01X Pub. Pr., $60.00 Club Pr., $39.95

THE "COMPULATOR" BOOK: Building Super Calculators and Minicomputer Hardware with Calculator Chips. By R. P. Haviland. *320 pp., illus.* Calculator chips are good for more than calculators—and here's the book to prove it. An imaginative, one-of-a-kind guide, it shows you how to use calculator chips in hundreds of innovative, practical ways, building bigger displays, designing better calculators, and creating exotic functions. Now experimenters can approach the full power of their own desktop minicomputers—multifunctioned, superbrained, and ready to do everything but get up and walk away!
783/578 Pub. Pr., $10.95 Club Pr., $9.30

THE 8080A BUGBOOK: Microcomputer Interfacing and Programming. By Peter R. Rony, David G. Larsen, and Jonathan A. Titus. *416 pp., with figures, charts, and tables, paperbound.* Gives you the basic concepts of microcomputer interfacing and the associated microcomputer I/O programming so you can develop your own interfaces to other digital devices. For the 8080 user, this book will be invaluable, because the Intel 8080 is penetrating every facet of life today, creating new industries and threatening old ones, and this book teaches you the fundamental tasks of microcomputer interfacing.
783/845 Pub. Pr., $9.95 Club Pr., $8.45

MICROCOMPUTERS/ MICROPROCESSORS Hardware, Software, and Applications. By John L. Hilburn and Paul N. Julich. *372 pp., illus.* This book was expressly created for people involved in the design, use, or maintenance of digital systems using microcomputers. The opening chapters provide needed background in digital logic and present well-organized discussions of number systems, arithmetic operations, and codes employed in microcomputers. The authors then describe the theory and workings behind microprocessor architecture, read-only memory (ROM), random-access memory (RAM), and input/output interfacing methods.
771/499 Pub. Pr., $22.50 Club Pr., $16.50

APPLYING MICROPROCESSORS New Hardware, Software, and Applications. Edited by Laurence Altman and Stephen E. Scrupski. *200 pp., illus., 8½ x 11 format.* A follow-up volume to *Electronics* magazine's recently published book, *Microprocessors*, this work takes you into the second- and third-generation devices rolling off semiconductor lines today. The collection of articles here is designed to smooth your way to mastery of new design methods, and it gives you both an overview of the state of the art and a wealth of design ideas, analyses, and applications.
191/603 Pub. Pr., $16.95 Club Pr., $13.25

BE SURE TO CONSIDER THESE IMPORTANT TITLES AS WELL—

GRAMMARS FOR PROGRAMMING LANGUAGES. By J. C. Cleaveland & R. C. Uzgalis
783/594 Pub. Pr., $15.95 Club Pr., $12.75

GETTING INVOLVED WITH YOUR OWN COMPUTER A Guide for Beginners. By L. Solomon & S. Veit
771/952 Pub. Pr., $9.95 Club Pr., $8.35

DIGITAL COMPUTER DESIGN. By R. Kline
784/450 Pub. Pr., $19.50 Club Pr., $15.75

MINICOMPUTER SYSTEMS Organization and Programming. By R. H. Eckhouse Jr.
768/641 Pub. Pr., $18.95 Club Pr., $13.95

MICRO-ANALYSIS OF COMPUTER SYSTEM PERFORMANCE. By B. Beizer
785/058 Pub. Pr., $22.50 Club Pr., $17.25

TOP-DOWN STRUCTURED PROGRAMMING TECHNIQUES. By C. L. McGowan & J. R. Kelly
769/052 Pub. Pr., $15.95 Club Pr., $13.50

FUNDAMENTALS OF DATA STRUCTURES. By E. Horowitz & S. Sahni
770/522 Pub. Pr. $17.95 Club Pr., $14.95

COMPUTER ARCHITECTURE. By C. C. Foster
770/794 Pub. Pr., $17.95 Club Pr., $13.95

PROGRAMMING MICROPROCESSORS. By M. W. McMurran
770/913 Pub. Pr., $9.95 Club Pr., $8.45

MICROPROCESSOR/MICROPROGRAMMING HANDBOOK. By B. Ward
768/749 Pub. Pr., $9.95 Club Pr., $8.45

Professionals' Book Club provides you with

(and at great savings, too!)

AUTOMATIC DATA PROCESSING HANDBOOK. Edited by The Diebold Group. *976 pp., 269 illus.* Written by a staff of internationally recognized authorities on ADP and sponsored by one of the nation's leading management consulting firms, this utterly comprehensive handbook explains and discusses computer systems, programming and languages, communications processes, and the design and installation of today's computers.
168/075 Pub. Pr., $34.95 Club Pr., $23.75

MICROPROGRAMMING PRIMER. By Harry Katzan, Jr. *254 pp., illus.* An introductory how-to book that treats microprogramming and emulation topics, this volume assumes that readers are acquainted with basic concepts of computers. Discussions include the complex relationships between programs, computers, and modern methods of implementation.
333/874 Pub. Pr., $20.95 Club Pr., $15.70

DATABASE PROCESSING Fundamentals, Modeling, Applications. By David M. Kroenke. *408 pp., illus.* An introduction to database-oriented systems, presenting material that covers the full spectrum of all activities involved. Physical representation, modeling, commercial systems, and implementation are discussed equally with no particular emphasis on one area to the neglect of any other.
769/931 Pub. Pr., $16.95 Club Pr., $12.95

MICROPROCESSOR APPLICATIONS MANUAL. By Motorola Semiconductor Products, Inc. *720 pp., illus., 8½ × 11 format.* With a nuts-and-bolts kind of practicality, this manual by the Motorola people (who should know) gives you detailed applications information on microprocessors and assumes no prior knowledge on your part about MPUs. It covers all the systems phases and explores such topics as architecture, the instruction set, addressing modes, interrupt structure, and other vital MPU features.
435/278 Pub. Pr., $32.50 Club Pr., $24.00

MINICOMPUTERS: Structure and Programming. By T. G. Lewis and J. W. Doerr. *282 pp., illus.* This valuable handbook makes an outstanding introductory guide to both the hardware and software of today's minicomputers. Its broad coverage includes assembly language, machine architecture, and small machine algorithms. "Timely . . . a nice job on structure and content."—*Data Processing Digest.*
773/009 Pub. Pr., $13.95 Club Pr., $11.75

ILLUSTRATING BASIC: A Simple Programming Language. By Donald Alcock. *134 pp., illus.* Completely handwritten by the author in a most unusual way, and containing an abundance of figures, diagrams, and drawings, this book was inspired by the need for a guide that would help readers who have to use computers but are terrified by them.
771/928 Pub. Pr., $10.95 Club Pr., $8.95

CHESS AND COMPUTERS By David Levy. *145 pp., illus.* All over the world, great human effort and computer resources are being devoted to producing a program that can play chess as well as a master. This first comprehensive book on the subject shows why the project is worthwhile because the techniques employed in writing a strong chess program may be used to help solve other programs.
785/252 Pub. Pr., $12.95 Club Pr., $10.50

THE Z-80 MICROCOMPUTER HANDBOOK. By William Barden, Jr. *304 pp., illus., paperbound.* Sooner or later the Z-80 will have a successor. For the time being, this book gives you the entire "state of the art" in microcomputer technology today. Arranged in three convenient and logically developed sections, the book discusses architecture and interface signals, then the powerful interrupt sequences of Z-80 and interfacing examples of I/O memory devices.
784/914 Pub. Pr., $8.95 Club Pr., $7.60

ADVANCED ANS COBOL WITH STRUCTURED PROGRAMMING. By Gary D. Brown. *497 pp., illus.* More and more people learn COBOL each year, increasing the number of active COBOL programmers. Having advanced beyond the introductory stages, they need a book that touches only lightly on the basics, and then goes into detail on both *advanced* programming techniques and *advanced* COBOL statements. This book begins where the basic manuals leave off.
772/118 Pub. Pr., $19.95 Club Pr., $15.95

COMPUTER ARCHITECTURE AND ORGANIZATION. By John P. Hayes. *512 pp., illus.* Assuring you a far deeper understanding of computer design *at the systems level*, this comprehensive, in-depth volume gives you the broad coverage you need of computer architecture—and in a most rigorous but highly readable manner. It provides all the mathematics needed for analyzing computer performance, plus extensive references for additional reading.
273/634 Pub. Pr., $21.50 Club Pr., $16.50

any *two* of these great professional books for only $2.95 values up to $67.45

Two Special premium books come to you with your first selection

COMPUTER PROFESSIONALS' BOOK CLUB
saves you both time and money!

Here is a book club designed to meet all of your professional as well as hobbyist needs by providing practical books about computers on a regular basis at below publisher prices. If you're missing out on important technical literature — if today's high cost of reading curbs the growth of your library — here's the solution to your problem.

The Computer Professionals' Book Club was organized for you, to provide an economical reading program that cannot fail to be of value. Administered by the McGraw-Hill Book Company, all books are chosen by qualified editors and consultants. Their understanding of the standards and values of the literature of interest to you guarantees the appropriateness of the selections.

How the club operates: Thirteen times a year you receive free of charge The Computer Professionals' Book Club Bulletin. This announces and describes the Club's featured book as well as alternate selections available at special members' prices. If you want to examine the Club's feature, you do nothing. If you prefer one of the alternate selections — or if you want no book at all — you notify the Club by returning the card enclosed with each Bulletin.

As a Club member, you agree only to the purchase of four books (including your first selection) over a two-year period. Considering the many books published annually, there will surely be at least four you would want to own anyway. By joining the Club, you save both money and the trouble of searching for the best books.

MAIL THIS COUPON TODAY

COMPUTER PROFESSIONALS' BOOK CLUB
P.O. Box 582 Princeton Road, Hightstown, New Jersey 08520

Please enroll me as a member and send me the three books indicated. I am to receive the two bonus books at the introductory price of $2.95 plus my first selection, plus tax, postage, and handling. If not completely satisfied, I may return the books within 10 days and request that my membership be cancelled. If I keep the books, I agree to take a minimum of three additional books during the next two years at special Club prices (guaranteed 15% discount, often more). I will receive the Club Bulletin 13 times a year. If I want to examine the featured selection, I need take no action. It will be shipped automatically. If, however, I want an alternate selection—or no book at all—I simply notify the Club by returning the convenient card always enclosed. I will always have a minimum of 10 days in which to return the card and you will credit my account fully, including postage, if this is not the case. Membership in the Club is continuous but cancellable by me at any time after the four-book purchase requirement has been filled. *This order subject to acceptance by McGraw-Hill. Orders from outside the continental U.S. must be prepaid. Company, business or institutional tax exemption status is not applicable to purchases made through individual Club memberships. All prices subject to change without notice. Offer good for new members only. Postage and handling charges are added to all shipments. Members are billed when books arrive.*

Write Code # of 1st premium book selection here	Write Code # of 2nd premium book selection here	Write Code # of 1st book selection here.

NAME _____

ADDRESS _____

CITY _____ STATE _____ ZIP _____

EXTRA SAVINGS: Remit in full with your order, plus any local and state tax, and McGraw-Hill will pay all regular postage and handling charges.

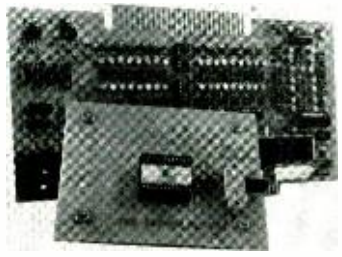
P 39349

CIRCLE 35 ON FREE INFORMATION CARD

computer products

More information on new products is available from manufacturers of items identified by a Free Information number. Free Information Card is inside back cover.

COMPUTER, *Prom Setter,* assembled or in kit form, is designed to read/write 1720A and 2704/2708 EPROM's. The unit consists of an S-100 bus-compatible main module board and a low-insertion-force PROM socket unit, with no external power supplies needed. The main module functions as an I/O device using 4 consecutive



addresses out of 256 available segments. The *Prom Setter* can be used to read/write other EPROM's just by rearranging the main module's interconnecting cable to the 25 pin connectors. Adding a DPDT switch allows the unit to read/write different EPROM combinations; i.e., 1720A, 2704/2708 and TI's 2716. Changing to a 6-pole 3-throw switch, plus diode, Zener diode and 2 resistors, lets the unit read Intel's 2716. The *Prom Setter* comes complete with all hardware and software. It sells for $210 (kit) and $375 (assembled).—**Szerlip Enterprises,** 1414 W. 259th St., Harbor City, CA 90710.

CIRCLE 117 ON FREE INFORMATION CARD

GRAPHICS COMPUTER, *Compucolor II,* is available in five models, all with 13-inch, 8-color CRT; separate ASCII keyboard; 8080A CPU; all editing features (page/roll, erase line, etc.); and a built-in

minifloppy disc drive. The models range from one providing 4K RAM with a 16-line by 64-character per-line format to a top-of-the-line unit with 16K RAM, complete vector graphics, 32-line by 64-character-per-line format and an expanded keyboard. The high-level language is BASIC 8001. Available software includes tutorial games, a checkbook balancing program and game programs for fun, such as *Star Trek, Chess* and *Biorhythm.* Suggested retail price: $795–$1995.—**Compucolor Corp.,** Box 569, Norcross, GA 30091.

CIRCLE 118 ON FREE INFORMATION CARD

HIGH-LEVEL LANGUAGE, *6800 Compiler,* is a fast 3-pass compiler providing a high-level disc-based language for 6800 computers having at least 16K RAM. The new language is called STRUBAL (*STRU*ctured *BA*sic *L*anguage) and uses relocatable and linkable code. The software contains a full set of scientific functions, one- and two-dimensional arrays, 3 data types, structured programming modes, variable-length strings, embedded assembly language in the source program, and COMMON and DUMMY sections. The *6800 Compiler* is provided on floppy disc along with a user manual. Price: $99.95.—**Hemenway Associates, Inc.,** 151 Tremont St., Suite 8P, Boston, MA 02111.

CIRCLE 119 ON FREE INFORMATION CARD

LOW-PROFILE KEYBOARD, *Touchcoder,* eliminates "double-strike" syndrome and produces 8-bit ASCII and other codes in any level or polarity without interfacing electronics. With the standard ASCII keyboard there is no restriction on the layout or number of keys; on the the standard cluster keyboard, the format is 10, 12, 16 digits.

Other specifications are: rise- and falltimes, less than 1 μs; zero bounce; life, 100 million operations. Unit can either be flush-mounted or top-surface mounted. Price: $35, OEM quantities.—**Computronics Engineering,** 7225 Hollywood Blvd., Los Angeles, CA 90046.

CIRCLE 120 ON FREE INFORMATION CARD

COMPUTER SOFTWARE, *Cosmac 1802 Simulator Program,* allows a 6502 microprocessor to execute the Cosmac 1802 instruction set. All Cosmac internal registers can be viewed in a single-step mode or in a trace mode. All Cosmac software is supported except for DMA (*D*irect *A*ccess *M*emory).

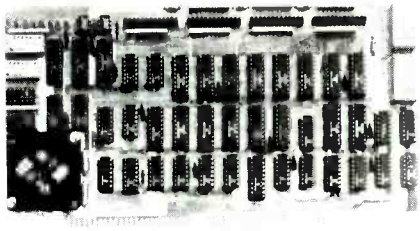
The software is in a KIM-1 mode that enables a KIM-1 to be a development and debugging tool for Cosmac software; no additional hardware or software are required. The simulator leaves two full pages of memory open for Cosmac programs;

alternative run mode provides an optional one-half page. The simulator program can be relocated in ROM and adapted to other 6502 systems.

Complete package contains KIM-1-format cassette tape, manual and assembly level source/object listing, priced at $10, plus $1.50 postage/handling (California residents add state and local taxes as applicable.)—**Dann McCreary,** Apt. 2R, 4758 Mansfield St., San Diego, CA 92116.

CIRCLE 121 ON FREE INFORMATION CARD

PARALLEL INTERFACE is S-100 bus compatible and can be used with System 2 and System 3 computers. It provides 8 bidirectional 8-bit I/O ports that can be used singly or coupled together. For handshaking operations, I/O status flags can be grouped on one port and accessed with a single I/O statement.



Additional features include 8 sense switches, 8 LED's, 2 bits of opto-isolated input and 2 bits of relay-driven output. The board is available assembled for $295, or in kit form for $195.—**Cromemco, Inc.,** 280 Bernardo Ave., Mountain View, CA 94040.

CIRCLE 122 ON FREE INFORMATION CARD

stereo products

More information on new products is available from manufacturers of items identified by a Free Information number. Free Information Card is inside back cover.

IN-DASH CAR STEREO UNITS, *Series S600* 8-track models and *Series T607* cassette models. Some units in the *Series S600* contain *Road-Rated Receiver* circuitry for increased performance when the automobile is in motion and a dial-in-door cartridge slot. Additional unit features are: for the *model S604*, repeat and separate bass/treble controls; *model S605*, LOC/DX and stereo indicator; *model S608*, repeat, separate bass/treble, FM muting, stereo matrix, LOC/DX; *model S682, Powerplay*, repeat, fast-forward, FM muting, LOC/DX; *model S683*, preset tuning, fast-forward, repeat, LOC/DX; *model S685* (shown), *Powerplay*, digital readout, clock, preset tuning switch, FM muting, LOC/DX, and power-off eject button. Price range: $129.95-$279.95.

Most units in the *Series T600* cassette format include the following features: *Road-Rated Receiver* circuitry, dial-in-door slot, FM muting, locking fast/forward rewind and LOC/DX. The *model T607* contains an auto-reverse switch and fader; *model T610*, stereo matrix and end-of-tape eject button; *model T611*, fader, power-off and end-of-tape eject buttons; *model T633*, preset tuning, fader, power-off and auto-eject buttons; *model T681, Powerplay*, power-off and end-of-tape eject buttons; *model T683*, auto-reverse, loudness and fader; *model T685*, digital readout, *Powerplay*, clock, preset tuning, auto-reverse and fader. Price range for the *Series T600* cassettes: $114.95-$299.95.—**Craig Corp.,** 921 W. Artesia Blvd., Compton, CA 90220.

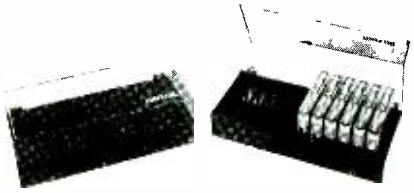
CIRCLE 123 ON FREE INFORMATION CARD

PHONO RIBBON CARTRIDGE, *model HV-9100*, is fully handmade and assembled using ribbon technology to eliminate internal conductance problems. Designed to be used with the *model HA-9000* head amplifier, the *model HV-9100*

(shown) has the following specifications: a nominal frequency response of 20 Hz–30 kHz; channel balance within 1 dB at 1 kHz; 3-ohm impedance at 1 kHz; rated output voltage of 0.04 mV (4 mV with *model HA-9000* amplifier); stylus pressure of 1.6–1.8-grams and a solid diamond 0.4 × 0.8 elliptical stylus. The cartridge weighs 19 grams. Suggested retail prices: *model HV-9100* cartridge, $220; *model HA-9000* amplifier, $275.—**Nagatronics,** 2280 Grand Ave., Baldwin, NY 11510.

CIRCLE 124 ON FREE INFORMATION CARD

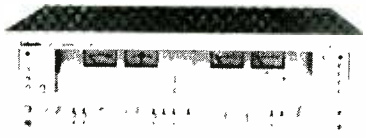
CASSETTE STORAGE CASE. Large plastic case holds 12 cassettes along with insert cards and outer box, making it ideal for developing cassette



libraries. Retail price: $5.95.—**Maxell Corp. of America,** 130 Commercial Way, Moonachie, NJ 07074.

CIRCLE 125 ON FREE INFORMATION CARD

AM/FM STEREO RECEIVER, *model LR-120DB*, is a top-of-the-line receiver that provides 120 watts-per-channel RMS into 8 ohms from 20 Hz to 20 kHz, with no more than 0.9% THD. The features include: dual tape monitors and dubbing, phono sensitivity switch, FM and audio muting switches, high-blend switch, high-cut and low-cut filter switches and stereo/mono switch, it also includes power output meters with dual ranges, built-in Dolby FM noise reduction and twin headphone jacks.



Specifications include: For the amplifier—a 15-Hz–40-kHz frequency response at 1 watt and a phono input sensitivity of 2.5 mV/5 mV/10 mV (switch-selectable); for the FM section—alternate channel selectivity, 80 dB; capture ratio, 1.3 dB; 1.8-μV sensitivity; 50-dB quieting, 14.1 dBf (mono) 36.8 dBf (stereo); frequency response, 30-Hz–15 kHz +0.5, −1.4 dB; S/N ratio, 74 dB (mono), 70 dB (stereo) without Dolby, 84 dB (mono) 80 dB (stereo) with Dolby; and IF rejection, 85 dB. The AM section provides an alternate channel selectivity of 32 dB at 1 MHz. The *model LR-120DB* measures 21½ W × 7 H × 17⅝-inches D and weighs 41 lb, 14 oz. Price: $599.—**Lafayette Radio Electronics Corp.,** 111 Jericho Turnpike, Syosset, NY 11791.

CIRCLE 126 ON FREE INFORMATION CARD

TURNTABLE TONEARM, *model MA-707,* is incorporated in Micro Seiki turntables *(models DQX-500, DQ-43* and *DD-33)* and is also available separately. A torsion bar system is used in the tonearm to provide optimum 10-Hz resonance. Specifications include: maximum tracking error less than 1.5 degrees/inch; tracking force adjustment of 0–3 grams; and a 315-mm overall length; a 4- to 12-gram-weight cartridge is recommended.

The *model DQX-500* turntable is a direct-drive, quartz-locked manual unit, with a 5.75-lb platter and dustcover; the *model DQ-43* turntable has a 3.33-lb aluminum platter with automatic lift and shutoff capability, and a rosewood base; and the *model DD-33* features a servo-controlled motor and a 2-lb aluminum platter. Suggested retail prices: *model MA-707* tonearm, $200; *model DQX-500,* $500; *model DQ-43,* $450; *model DD-33,* $350.—**TEAC Corp. of America,** 7733 Telegraph Rd., Montebello, CA 90640.

CIRCLE 127 ON FREE INFORMATION CARD

CIRCLE 7 ON FREE INFORMATION CARD

CIRCLE 8 ON FREE INFORMATION CARD

CIRCLE 72 ON FREE INFORMATION CARD

books

A BEGINNER'S GUIDE TO MAKING ELECTRONIC GADGETS, by R. H. Warring. TAB Books, Blue Ridge Summit, PA 17214. 140 pp. 5 × 8¼ in. Softcover, $4.95; hardcover, $8.95.

This book uses easy-to-follow instructions and detailed diagrams to show you how to create 100 different kinds of circuits—from basic designs to more sophisticated projects—using readily available components. Proceeding from the basic circuits, the book teaches you how to couple them and to make such devices as metal detectors, burglar alarms, Morse code senders, electronic organs, temperature sensors, ohmmeters, etc.

MAKE PC BOARDS, by Edgar S. Young. Technical Workshop Publications, P.O. Box 368, Placentia, CA 92670. 64 pp. 5½ × 8½ in. Softcover $4.98.

To produce high-quality PC boards requires sophisticated construction methods, three of which are discussed in detail in this book: the direct-transfer method, the polyester drafting film approach, and the photo film chemical method.

Each chapter starts with an outline of method procedure. The text is appropriately illustrated, and there is a handy Appendix in the back of the book.

new lit

More information on new lit is available from the manufacturers of items identified by a Free Information number. Use the Free Information Card inside the back cover of this issue.

ELECTRONIC COMPONENTS CATALOG, 1978 *Purchasing Manual 518,* 88 pages offering a broad range of components, tools, hardware and equipment. The catalog features an extensive semiconductor line, LED's and lamps, SCR's and Triacs, plus hundreds of other components—from alligator clips to wire and cables. A handy order form is contained in the back, and a convenient quick index on the front cover.—**Mouser Electronics,** 11511 Woodside Ave., Lakeside, CA 92040.

CIRCLE 128 ON FREE INFORMATION CARD

COMPUTER PRODUCTS GUIDE, *1978 System Builders' Catalog,* contains 48 pages of data on computers, peripherals and computer books and magazines, complete with descriptions and a comparison chart for over 1500 products. Included are Southest Tech 6800, IMSAI 8080, Processor Tech Sol 20, IASIS 8080, Olivetti P6060, Intersil Intercept, Jr., Commodore Kim, RCA Cosmac, Motorola 6800 and National SC/MP computers.

There's also a wide choice of used equipment, including Centronics printers, *Teletype* and Olivetti teletypewriters, CRT terminals, video monitors, keyboards, modems, and many more. The back side of the catalog carries an additional 31 pages of used computers, memory and peripherals. The catalog is available for $1.—**Computer Warehouse,** American Used Computer Corp., 584 Commonwealth Ave., Boston, MA 02215.

MICROCOMPUTER BROCHURE is a four-page roundup of manufacturer's line of computers, peripheral devices and software. Among the 18 products described is the *Memorite* video-based text-editing system incorporating the Vector-1 computer. Many S-100 bus-compatible boards are also included, as well as an assembler/editor program, a dissassembler and a flexible-disc operating system.—**Vector Graphic, Inc.,** 790 Hampshire Rd., A + B, Westlake Village, CA 91361.

CIRCLE 129 ON FREE INFORMATION CARD

HEATH SCHLUMBERGER INSTRUMENTS, *Catalog 811-25,* contains 32 pages of assembled test instruments for hobbyists and service technicians. Some of the products featured are oscilloscopes, power supplies, signal and function generators, VOM's, DMM's, strip-chart recorders, and a complete line of accessories, including probes and connecting cables. Additionally, the catalog contains a list of self-instruction courses suitable for industrial training, covering such topics as AC and DC electronics, semiconductor devices and digital techniques.—**Heath Schlumberger Instruments,** Dept. 570-020, Benton Harbor, MI 49022.

CIRCLE 50 ON FREE INFORMATION CARD

FREE

World's biggest and best source of top-quality electronic kits! Look at what's new in our new just-off-the-press catalog!

NEW

Computerized Weather Monitor

If you need weather information for ANY purpose, the ID-4001 is the way to get it! This microcomputer-based weather instrument displays — time of day in 12 or 24-hour format; wind direction and magnitude; indoor and outdoor temperature; barometric pressure; even wind chill factor! What's more, the computer's memory stores the highest and lowest data for each function so you can recall it for easy and accurate record keeping. Chart recorder and computer outputs provide even more versatility!

NEW

Digital Readout Car Clock with Trip Timer

Versatile clock/timer for any vehicle shows time in hours and minutes, has 24-hour timer that reads to nearest second. Bright, easy-to-read display, low-power circuit doesn't drain battery.

NEW

Deluxe Dual-Trace Oscilloscope

Low-priced dual-trace scope ideal for audio and TV servicing. Features outstanding sensitivity, extra-bright traces, selectable triggering, 7-position variable time base, DC to 5 MHz bandwidth.

NEW

Rack-Mount Stereo Components

Heath has developed an entire new line of sophisticated audio equipment designed to offer the striking good looks and versatility of rack mounting combined with specifications and performance capabilities that are the equal of the finest components available today! The AA-1600 Stereo Power Amplifier features 125 watts, minimum RMS, per channel into 8 ohms, with less than 0.05% total harmonic distortion from 20-20,000 Hz. The AD-1700 provides a graphic LED display of power output to monitor system performance and help prevent overloads. Other components soon to come will be a versatile, low-distortion stereo preamplifier, and a deluxe digital FM-AM Stereo Tuner.

NEW

Hand-Held 2-Meter Transceiver

Superb features specifications and a great low price make the VF-2031 a terrific buy in a hand-held two-meter transceiver. Features 8-channel simplex with ±600 kHz offset using one crystal per channel, minimum 2 watts out, and 0.5 μV sensitivity for 20 dB quieting. Includes built-in antenna, nickel-cadmium batteries and battery charger. An optional tone encoder and other accessories also available.

NO PREVIOUS EXPERIENCE NECESSARY

Thousands of people with no electronics experience whatsoever — people who have never handled a soldering iron before — have *proved* that you can build any Heathkit product you want — and enjoy every moment of it! Simple step-by-step manuals make it easy as 1-2-3, and every Heathkit product you build will be a source of pride and satisfaction for years to come as you say "I built it myself"!

Heath Company, Dept 020-470
Benton Harbor, Michigan 49022

HEATHKIT ELECTRONIC CENTERS* PROVIDE SALES AND SERVICE

* Units of Schlumberger Products Corporation. Retail prices on some products may be slightly higher.

Opening Soon:
Salt Lake City, Utah; Oklahoma City, Okla.

ARIZONA — Phoenix, 85017, 2727 W. Indian School Rd. 602-279-6247.

CALIFORNIA — Anaheim, 92805, 330 E. Ball Rd. 714-776-9420; **El Cerrito, 94530,** 6000 Potrero Ave. 415-236-8870; **Los Angeles, 90007,** 2309 S. Flower St. 213-749-0261; **Pomona, 91767,** 1555 Orange Grove Ave. N. 714-623-3543; **Redwood City, 94063,** 2001 Middlefield Rd. 415-365-8155; **Sacramento, 95825,** 1860 Fulton Ave. 916-486-1575; **San Diego, (La Mesa, 92041),** 8363 Center Dr. 714-461-0110; **San Jose (Campbell, 95008),** 2350 S. Bascom Ave. 408-377-8920; **Woodland Hills, 91364,** 22504 Ventura Blvd. 213-882-0531.

COLORADO — Denver, 80212, 5940 W. 38th Ave. 303-422-3408.

CONNECTICUT — Hartford (Avon, 06001), 395 W. Main St. (Rte. 44) 203-678-0323.

FLORIDA — Miami (Hialeah, 33012), 4705 W. 16th Ave. 305-823-2280; **Tampa, 33614,** 4019 West Hillsborough Ave. 813-886-2541.

GEORGIA — Atlanta, 30342, 5285 Roswell Rd. 404-252-4341.

ILLINOIS — Chicago, 60645, 3462-66 W. Devon Ave. 312-583-3920; **Chicago (Downers Grove, 60515),** 224 Ogden Ave. 312-852-1304.

INDIANA — Indianapolis, 46220, 2112 E. 62nd St. 317-257-4321.

KANSAS — Kansas City (Mission, 66202), 5960 Lamar Ave. 913-362-4486.

KENTUCKY — Louisville, 40243, 12401 Shelbyville Rd. 502-245-7811.

LOUISIANA — New Orleans (Kenner, 70062), 1900 Veterans Memorial Hwy. 504-722-6321.

MARYLAND — Baltimore, 21234, 13, E. Joppa Rd. 301-661-4446; **Rockville, 20852,** 5542 Nicholson Lane. 301-881-5420.

MASSACHUSETTS — Boston (Peabody, 01960), 242 Andover St. 617-531-9330; **Boston (Wellesley, 02181),** 165 Worcester Ave. (Rt. 9 just west of Rt. 128) 617-237-1510.

MICHIGAN — Detroit, 48219, 18645 W. Eight Mile Rd. 313-535-6480; **E. Detroit, 48021,** 18149 E. Eight Mile Rd. 313-772-0416.

MINNESOTA — Minneapolis (Hopkins, 55343), 101 Shady Oak Rd. 612-938-6371; **St. Paul, 55106,** 1645 White Bear Ave. 612-778-1211.

MISSOURI — St. Louis (Bridgeton) 63044, 3794 McKelvey Rd. 314-291-1850.

NEBRASKA — Omaha, 68134, 9207 Maple St. 402-391-2071.

NEW JERSEY — Fair Lawn, 07410, 35-07 Broadway (Rte. 4) 201-791-6935; **Ocean, 07712,** 1013 State Hwy. 35. 201-775-1231.

CIRCLE 100 ON FREE INFORMATION CARD

if you want quality...value...and pride of craftsmanship get the *NEW HEATHKIT® CHRISTMAS CATALOG!*

COAST-TO-COAST

NEW YORK — Buffalo (Amherst, 14226), 3476 Sheridan Dr. 716-835-3090; **Jericho, Long Island, 11753,** 15 Jericho Turnpike. 516-334-8181; **Rochester, 14623,** 937 Jefferson Rd. 716-244-5470; **White Plains (North White Plains, 10603),** 7 Reservoir Rd. 914-761-7690.

OHIO — Cincinnati (Woodlawn, 45215), 10133 Springfield Pike. 513-771-8850; **Cleveland, 44122,** 28100 Chagrin Blvd. 216-292-7553; **Columbus, 43229,** 2500 Morse Rd. 614-475-7200; **Toledo, 43615,** 48 S. Byrne Rd. 419-537-1887.

PENNSYLVANIA — Philadelphia, 19149, 6318 Roosevelt Blvd. 215-288-0180; **Frazer (Chester Co.) 19355,** 630 Lancaster Pike (Rt. 30) 215-647-5555; **Pittsburgh, 15235,** 3482 Wm. Penn Hwy. 412-824-3564.

RHODE ISLAND — Providence (Warwick, 02886), 558 Greenwich Ave. 401-738-5150.

TEXAS — Dallas, 75201, 2715 Ross Ave. 214-826-4053; **Houston, 77027,** 3705 Westheimer. 713-623-2090; **San Antonio, 78216,** 7111 Blanco Road. 512-341-8876.

VIRGINIA — Alexandria, 22303, 6201 Richmond Hwy. 703-765-5515; **Norfolk (Virginia Beach, 23455),** 1055 Independence Blvd. 804-460-0997.

WASHINGTON — Seattle, 98121, 505 8th Ave., N. 206-682-2172.

WISCONSIN — Milwaukee, 53216, 5215 W. Fond du Lac. 414-873-8250.

HEATH
Schlumberger

Heath Company, Dept 020-470
Benton Harbor, Michigan 49022

Please send me my FREE Heathkit Catalog. I am not on your mailing list.

Name_____

Address_____

City_____ State_____

GX-354 Zip_____

NOTE: This FREE Catalog Coupon can also be redeemed at any of the Heathkit Electronic Centers* nationwide. (See list at left)

CIRCLE 100 ON FREE INFORMATION CARD

DIGITAL WINDSHIELD WIPER DELAY

continued from page 63

control circuit to be used with wiper circuits having a switched ground connection. Note that the D input to IC5-a is normally high with the wipers switched off; therefore, the connections to pins 1 and 2 of IC5-a have been transposed. Rectifier D4 blocks +12 volts from any leakage paths in the wiper circuit. A wiper circuit with switched ground (used by General Motors) is shown in Fig. 13. When the wipers are switched on, the relay closes to energize the field winding in series with the armature. A secondary field winding shunts the armature in slow speed. In fast speed a 20-ohm resistor is place in series with the shunt winding to minimize its effect. When the wipers are switched off, the relay is de-energized, but *its contact remains latched closed until released mechanically by the motor* when it reaches the park position. Figure 14 shows how to attach the control to this type of wiper circuit to affect both slow and fast speed.

The most difficult windshield wiper circuits to interface with are those having one fixed speed and one variable speed plus concealed blades; some even use three-pole and even four-pole selector switches. However, with a little patience, ingenuity, and perhaps using a supplementary relay or the second set of timer-relay contacts, you should be able to create a satisfactory arrangement. (**Radio-Electronics** would like to hear from anyone who feels he has developed an unusually clever circuit for attaching the control to a popular model car, and will consider publishing details in a future issue for the benefit of other readers.) **R-E**

market center

CLASSIFIED COMMERCIAL RATE (for firms or individuals offering commercial products or services). **$1.50 per word (no charge for zip code)** . . . minimum 15 words.

NONCOMMERCIAL RATE (for individuals who want to buy or sell personal items) **85¢ per word** . . . no minimum.

ONLY FIRST WORD AND NAME set in bold caps. Additional bold face (not available as all caps) at 10¢ per word. Payment must accompany all ads except those placed by accredited advertising agencies. 5% discount for 6 issues, 10% for 12 issues within one year, if paid in advance. All copy subject to publisher's approval. Advertisements using P.O. Box address will not be accepted until advertiser supplies publisher with permanent address and phone number. Copy to be in our hands on the 26th of the third month preceding the date of the issue (i.e., August issue closes May 26). When normal closing date falls on Saturday, Sunday or a holiday, issue closes on preceding working day.

FOR SALE

FREE catalog (anglais). IC's, semi's. **CORONET ELECTRONICS,** 649A Notre Dame W., Montreal, Que., Canada, H3C-1H8. US inquiries.

RADIO & TV tubes 36¢ each. One year guaranteed. Plus many unusual electronic bargains. Free catalog. **CORNELL,** 4217-E University, San Diego, Calif. 92105

BLITZ ZOINK ZATT: UNSCRAMBLE these fascinating police communications with our CODE-BREAKER and keep informed. Tunes all scramble frequencies, works with all scanners, and is factory built and guaranteed. $34.95PP. UNSCRAMBLER KIT: Latest Technology, 2¼X2¼X1½-inch, complete instructions, only $19.95PP. Thousands of satisfied customers. Catalog 50¢. Order from KRYSTAL KITS, BOX 445, BENTONVILLE, ARK. 72712. COD orders. 501-273-5340.

NOTICE: RECORD RATERS WANTED
(No experience required) Each month you will receive nationally released albums to rate. THERE IS NO EXTRA CHARGE for the LP's you receive. You pay a small membership fee which covers all costs of the LP's. We pay postage. In return for your opinion, build your LP collection. "First come basis." For application write: EARS, DEPT. RX Box 10245, 5521 Center St., Milwaukee, WI 53210.
© 1975

SANKEN 50-watt power AMP 22.50 postpaid, 50-volt transformer for above 8.00 postpaid. **PRARIE SOUNDS,** P.O. Box 982, Champaign, IL 61820

RECORDS-TAPES! Discounts to 73%; all labels; no purchase obligations; newsletter; discount dividend certificates; 100% guarantees. Free details. **DISCOUNT MUSIC CLUB,** 650 Main St., Dept. 3-1178, New Rochelle, NY 10801

To run your own classified ad, put one word on each of the lines below and send this form along with your check for $1.50 per word (minimum 15 words) to:

Radio-Electronics, 200 Park Avenue South, N.Y., N.Y. 10003

ORDER FORM

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of $10.

( ) Plans/Kits ( ) Business Opportunities ( ) For Sale
( ) Education/Instruction ( ) Wanted ( ) _____
Special Category: $10

(PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.)

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30
31	32	33	34	35

AUDIO modules 15W-60W×2 under $85.00. Free catalog: **AUDIOVISION,** Box 955, STN.B, Willowdale, Ont., Canada M2K 2T6

PRINTED CIRCUIT
Positive Acting Photo Resist; Carbide bits; Bubble etchers; Artwork; Epoxy Glass Boards.
Send stamp & address label for flyer
TRUMBULL
833 Balra Dr., El Cerrito, CA 94530

NEW electronic parts. Continuously stocked. Stamp brings catalog. **DAYATPRO ELECTRONICS,** 3029 Wilshire Ln., Dept. RE, Arlington Hts., IL 60004

SPEAKER INFORMATION KIT

Get 70 pages of speaker facts, specs, construction tips plus info on our raw speakers, crossovers and a line of 9 quality hi-fi speaker system kits. We'll send you our **full-color catalog;** plus **How to Hook Up Your System,** an exhaustive step-by-step treatise on hi-fi system installation; and our **Speaker Operating Manual,** chock full of facts on how to get the most from any speaker system, for only $1.00. Even if you don't buy from us we want you to have the facts. That's how we got to be the world's largest manufacturer of speaker kits.

Send to:
Speakerlab, Dept. RE-H
735 N. Northlake
Seattle, WA 98103

TS-510A signal generator 10-420 MHz $250.00, USM-140C dual-trace oscilloscope $250.00. Stamp for catalog. **E. FRENCH,** Box 249, Aurora, IL 60507

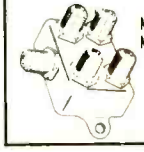
PARTS! CORNELL TUBES!
FREE Send For FREE CORNELL'S New Color Catalog 48 Pgs. New Items
33¢ per tube IN LOTS OF 100
36¢ per tube ORDER FREE IF NOT SHIPPED IN 24 HOURS
4215 E UNIVERSITY AVE. SAN DIEGO, CALIF. 92105

QUARTZ crystal-controlled clock movements $14.95 . . . transistorized movements $8.50 . . . use C battery . . . hands included. 60¢ shipping. **PEKO,** Box 1215, Studio City, CA 91604

TASCO offers reliable TV antenna system components below wholesale prices. Write for our FREE 32 page catalog full of great surplus bargains. Such bargains as:


F-59—.17¢
F-56—.20¢


75-300 ohm Transformer ACU-1—.95¢


MS-2 2-Way Splitter—$2.95
MS-4 4-Way Splitter—$4.95

TEXAS ANTENNA SUPPLY CO.
P.O. BOX 30143
HOUSTON, TEXAS 77009

B & K test equipment. Free catalog. Free shipping. Dinosaur discounts. **SPACETRON-DL**, 948 Prospect, Elmhurst, IL 60126

WHOLESALE, auto stereos, adapters, blank tapes. Write **PACIFIC PRODUCTS,** 3969 Pacific Coast Hwy, Torrance, CA 90505

PHONE CALL RECORDING ADAPTER

Record incoming and outgoing calls automatically with this all solid state unit connected to your telephone jack and tape recorder. Tape becomes a permanent record. Don't depend on your memory to recall important details of business and personal calls. Easily installed. No extra monthly phone chgs. FCC Approved

AMAZING ELECTRONIC MICRO MINI MIKE™

World's smallest, solid state, self contained with 1.3V Merc. Bat. furn. Picks up most sounds and transmits without wires up to 300 ft. thru FM Radio. Tuneable. Use as mike, ampf., alarm & alert system, baby sitter, hot line, etc. Mike **$18.95***, Phone Call Adapter **$24.50*** (* plus $1.00 ea. for pstg. & hdlg.) Cal. res: add tax. Free data. Mail Order. B/A, M/C, cod's o.k. Qty. disc. avail. AMC SALES, Dept. 19, 9335 Lubec St., Box 928, Downey, CA 90241.

2-1/4 x 3/4 x 1/2"

AMAZING ELECTRONIC PROJECTS and PRODUCTS: Lasers Super Powered. Burning. Cutting. Rifle. Pistol. Pocket. See in Dark—Shotgun Directional Mike—Unscramblers—Giant Tesla—Stunwand—TV Disrupter—Energy Producing. Surveillance. Detection. Electrifying. Ultrasonic. CB. Auto and Mech. Devices. Hundreds More—All New Plus INFO UNLTD PARTS SERVICE. Catalog $1. **Information Unlimited, Dept. R8 Box 716 Amherst, N.H. 03031.**

NEW, adjustable three-output, regulated power supply, plus 900 parts worth over $400.00 in complete **cartrivision** television electronics assembly. Documentation included. Perfect for **microprocessor** and all electronic applications. $16.95 plus $4.50 S&H. Master Charge, VISA. Free brochure. **MADISON ELECTRONICS,** 369, Madison, AL 35758. **Satisfaction guaranteed.**

Burglar · Fire · Smoke Alarm Catalog

- Billions of dollars lost annually due to lack of protective warning alarms.

FREE CATALOG Shows you how to protect your home, business and person. Wholesale prices. Do-it-yourself. Free engineering service.

Burdex Security Co.

Box 82802 RE-118 Lincoln, Ne. 68501

PC boards, your artwork. No setup charge. $0.45/sq. in. single sided, $0.60/sq. in. double sided. Ohio residents add 4.5% sales tax. **DIGITRONICS,** P.O. Box 2494, Toledo, OH 43606

NO-ETCH

Duplicate or make additions to, modifications of **Any Etched Board.** Ideal for point-to-point or wire wrap breadboards. Complete set of (3) tools IP6003 $25.00 ppd. Write for free brochure, as covered in the July Radio-Electronics. A.F. Stahler Co., P.O. Box 354R, Cupertino, CA 95014—(408) 252-4219.

SOLID-state brownout protector for central air-conditioning systems. Simple 3-wire connection to existing 24V control transformer. $14.95 ppus. **S & S Electronics,** Box 430260, Miami, FL 33143

FREE KIT Catalog

STOP! Take a minute & let us send our latest kit catalog. If you like, send us the name & address of a friend who may also be interested and we'll include to you our booklet "How to build-electronic thermometer".

contains TEST & EXPERIMENTER'S EQUIP.

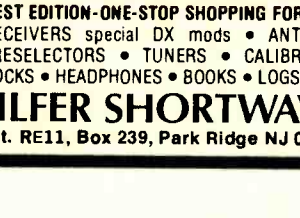
DAGE SCIENTIFIC INSTRUMENTS BOX 1054R LIVERMORE CA 94550

PRINTED circuit boards from camera-ready artwork. **Free** details. **Quantity** discounts. **CM CIRCUITS,** 22 Maple Avenue, Lackawanna, NY 14218

PICTURE TUBE MACHINE
We buy and sell NEW and USED CRT rebuilding machinery. COMPLETE TRAINING. Buy with CONFIDENCE from the ORIGINAL MFGR.
For complete details send name, address, zip to:
LAKESIDE INDUSTRIES
4071 N. Elston Avenue
Chicago, Ill. 60618
Phone: 312-583-6565

FREE catalog of **new** electronic parts. **KEY ELECTRONICS,** Box 3506-RE, Schenectady, NY 12303

FREE SHORTWAVE CATALOG



NEWEST EDITION-ONE-STOP SHOPPING FOR SWLS
• RECEIVERS special DX mods • ANTENNAS
• PRESELECTORS • TUNERS • CALIBRATORS
• CLOCKS • HEADPHONES • BOOKS • LOGS

GILFER SHORTWAVE
Dept. RE11, Box 239, Park Ridge NJ 07656

P.O. Box 4430E Santa Clara, CA 95054
For will call only: (408) 988-1640
2322 Walsh Ave.

Quest ELECTRONICS

Same day shipment. First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

7400TTL		74LS28N	.41	LM340T-15	1.10	CD4511	.94	2114	8.50		
7400N	.17	74LS30N	.25	LM340T-18	1.10	CD4515	2.52	4116	17.95		
7402N	.17	74LS33N	.39	LM340T-24	1.10	CD4516	1.10	25138	6.30		
7404N	.19	74LS38N	.30	LM343H	1.50	CD4518	1.02	MM5280	3.00		
7409N	.23	74LS74N	.35	LM370	.15	CD4520	1.02	MM5320	9.95		
7410N	.17	74LS75N	.47	LM377	1.50	CD4527	1.51	MM5330	5.94		
7411N	.63	74LS90N	.51	LM379	5.00	CD4528	.79	**CMOS**			
7420N	.17	74LS93N	.51	LM380N	1.00	CD4543	1.50	CD4001	.50	PD411D-4	5.00
7422N	1.39	74LS95N	1.89	LM381	1.80	CD4555	.75	CD4000	.16	PD411D-5	5.00
7430N	.20	74LS107N	.35	LM382	1.80	CD4566	2.25	CD4002	.21	P5101L	13.95
7442N	.50	74LS112N	.35	LM703H	.40	CD4583	1.50	CD4006	1.10	**4200A**	9.95
7445N	.69	74LS113N	.35	LM709H	.28	CD4584	1.50	CD4007	.21	82S23	2.90
7447N	.60	74LS132N	.72	LM723H/N	.50	CD40192	3.00	CD4008	.21	82S25	2.90
7448N	.69	74LS136N	.35	LM733N	.67	74C00	.28	CD4009	.39	91L02A	1.75
7450N	.17	74LS151N	.67	LM741CN	.35	74C04	.33	CD4010	.39	HD0165-5	6.95
7474N	.29	74LS155N	.67	LM741N	.25	74C10	.28	CD4011	.21	MM5700	4.50
7475N	.49	74LS157N	.67	LM747H/N	.62	74C76	1.40	CD4012	.21	GIAY38500-1	9.95
7485N	.68	74LS162N	.91	LM748N	.35	74C90	1.15	CD4013	.39	MCM6571A	9.95
7489N	2.00	74LS163N	.91	LM1303N	.82	74C93	1.40	CD4014	.86	9368	3.50
7490N	.43	74LS174N	.55	LM1304	1.10	74C154	3.00	CD4015	.86		
7492N	.43	74LS190N	1.06	LM1305	1.27	74C160	1.44	CD4016	.36	**CLOCKS**	
7493N	.43	74LS221N	1.95	LM1307	2.00	74C175	1.35	CD4017	.94	MM5309	3.00
7495N	.69	74LS258N	.67	LM1310	2.75	74C192	1.65	CD4018	.94	MM5311	3.50
74100N	.90	74LS367N	.89	LM1458	.47	74C221	2.00	CD4019	.94	MM5312	4.80
74107N	.29			LM1800	1.75	MM5841	14.45	CD4020	1.02	MM5313	3.50
74121N	.34	**LINEAR**		LM1812	7.50	MM5865	7.95	CD4021	1.02	MM5314	3.90
74123N	.59			LM1889	3.00	74C906	.75	CD4022	.86	MM5315	4.00
74125N	.39	CA3045	.90	LM2111	1.75	CT7091	1.95	CD4023	.21	MM5316	5.00
74145N	.69	CA3046	.67	LM2902	1.50	CT7002	8.95	CD4024	.75	MM5318	3.50
74150N	.95	CA3081	1.90	LM3900N	.60	CT7010	8.95	CD4025	.21	MM5369	2.10
74151N	.69	CA3082	1.90	LM3905	1.75	CT7015	7.25	CD4026	1.51	MM5841	14.45
74154N	1.00	CA3089	2.95	LM3909N	.61	CT7027	5.50	CD4027	.36	MM5865	7.95
74157N	.69	LM301AN/AH	.35	MC1458V	.50	CT7215	6.95	CD4028	.79	CT7091	5.80
74161N	.87	LM305H	.87	NE540L	2.89	MM5375AA/N	3.90	CD4029	1.02	CT7002	8.95
74162N	.87	LM307N	.35	NE550N	.65	MM5375AB/N	4.90	CD4030	.21	CT7010	8.95
74163N	.87	LM308N	.89	NE555V	.43	74C905	16.50	CD4031	1.02	2708	10.60
74174N	.98	LM309H	1.15	NE556N	.79	74C907	.75	CD4032	.86	DM8577	2.90
74175N	.90	LM309K	.95	NE565A	1.00	74C926	9.95	CD4033	1.27	8223	2.90
74190N	1.15	LM311HN	.90	NE566V	1.50	MM5314	2.50	CD4034	1.95	2716T1	22.50
74191N	.87	LM317T/K	2.92	NE567V	1.20			CD4035	.21	**CONNECTORS**	
74193N	.85	LM318	1.35	NE570B	5.00	**IC SOCKETS**		CD4040	1.02	7207	7.50
74221N	1.55	LM323K-5	6.95	78L05	.60	**Solder Tail Low Profile**		CD4041	.95	7208	15.95
74298N	1.65	LM320K-12	1.35	78L08	.60	**PIN 1 UP PIN 1UP**		CD4042	.71	7209	4.95
74365N	.66	LM320K-15	1.35	78L12	.70	8 15 22 .30		CD4043	.71	DS0026CN	3.75
74366N	.66	LM320T-5	1.60	78M05	.85	14 18 24 .35		CD4044	.63	DS0056CN	3.75
74367N	.66	LM320T-8	1.60	7510B	1.75	16 20 28 .42		CD4046	1.67	MM5314	2.50
		LM320T-12	1.60	75491CN	.50	18 22 32 .58		CD4047	1.35		
74LS00 TTL		LM320T-15	1.60	75492CN	.55	20 29 40 .57		CD4049	.36	**CRYSTALS**	
74LS00N	.25	LM324N	1.15	75494CN	.89	14 pin 25 16 pin 27		CD4050	.36	1 MHz	4.50
74LS02N	.25	LM338N	1.55	**A to D CONVERTER**		2 level 14 pin wire 26		CD4051	1.13	2 MHz	4.50
74LS04N	.25	LM340K-5	1.10	8038	4.50	3 level wire wrap gold		CD4052	1.42	4 MHz	4.25
74LS05N	.25	LM340K-8	1.10	8700CJ	13.95			CD4053	1.42	5 MHz	4.25
74LS08N	.25	LM340K-12	1.10	8701CN	22.00	**MICROPROCESSOR**		CD4054	.79	10 MHz	4.25
74LS10N	.25	LM340K-15	1.10	8750CJ	13.95	6800	19.50	CD4055	1.42	18 MHz	3.90
74LS13N	.40	LM340K 24	1.10	LD130	9.95	8080A with data	8.95	CD4056	.40	20 MHz	3.90
74LS14N	.90	LM340T-5	1.10	9400CJ/F	7.40	Z80	29.95	CD4059	1.27	32 MHz	3.90
74LS20N	.25	LM340T-8	1.10	ICL7103	9.50	Z8122	29.95	CD4060	1.02	32768 Hz	4.00
74LS22N	.25	LM340T-12	1.10	ICL7107	14.25	2102-1	.95	CD4066	.40	1.8432 MHz	4.50
						2102AL-4	1.50	CD4068	.40	2.4576 MHz	4.50
						2102L	1.25	CD4069	.21	3.2768 MHz	4.50
						2104A-4	4.95	CD4070	.40	3.5795 MHz	1.20
						2107B	4.95	CD4071	.21	4.032 MHz	4.50
						2111-1	3.75	CD4072	.21	4.433 MHz	4.50
						2112-2	3.95	CD4073	.21	5.0688 MHz	4.50
								CD4075	.21	5.185 MHz	4.50
								CD4076	1.75	6.5536 MHz	4.50
								CD4077	1.00	16K Static RAM board kit	395.00
								CD4081	.21	North Star Floppy Disk Kit	$665.00
								CD4082	.21	Additional Drive Kit	415.00
								CD4085	.42		
								CD4086	1.75		
								CD4089	1.75		
								CD4490	5.50		
								CD4507	1.00		
								CD4508	4.25		
								CD4510	1.02		

8251	9.25	**SPECIAL PRODUCTS**	
8253	10.00	MM5865 Stopwatch Timer	9.00
8255	9.25	PC board	7.50
CDP1802CD	19.95	**Switches** Mom. Pushbutton	.27
CDP1802D	25.00	3 pos. slide	.25
CDP1861	12.95	**Encoder** HD0165-5	6.95
5820	9.95	**3 Digit Universal**	
6850	12.95	**Counter Board Kit**	
6502	18.50	Operates 5–18 Volt DC to 5 MHz typ. 125" LED display	10.50
AY5-1013	5.50	**Voice actuated switch**	.50
AY5-1014	7.50		
3341	6.95	**Paralronics 100A Logic Analyzer Kit**	$224.00
PROM		Model 10 Trigger Expander Kit	$229.00
1702A	3.95	Model 150 Bus Grabber kit	$369.00
N82S23	2.95	**TRANSFORMERS**	
N82S123	3.50	6V 300 ma	3.25
N82S126	3.75	12 Volt 300 ma transformer	1.25
N82S129	3.75	12.6V CT 600 ma	3.75
N82S131	3.75	12V 250 ma wall plug	2.95
N82S135	8.75	12V CT 250 ma wall plug	3.50
N82S137	8.75	24V CT 400 ma	3.95
2708	10.60	10V 1.2 amp wall plug	4.85
DM8577	2.90	18V 6 amp	12.95
8223	2.90	**DISPLAY LEDS**	
2716T1	22.50	MAN1 CA .270	2.90
CONNECTORS		MAN3 CC .125	.39
Red TO18	.15	MAN72/74 CA/CA .300	1.00
Green, Orange, Yellow TO18	.20	DL704 CC .300	1.25
Jumbo Red	.20	DL707/DL707R CA .300	1.00
Green, Orange, Yellow Jumbo	.25	DL727/730 CA/CC .500	1.90
Giglitz LED Mounting Clips .8/$1.25 (specify red, ambar, green, yellow, clear)		DL747/750 CA/CC .500	1.95
		DL750 CC .600	1.95
CONTINENTAL SPECIALTIES in stock		FND359 CC .357	.70
Complete line of breadboard test equip.		FND500/507 CC/CA .500	1.35
MAX-100 8 digit Freq. Ctr. $128.95		FND503/510 CC/CA .500	.90
8K WIRE WRAP TOOLS in stock		FND800/807 CC/CA .600	2.20
Portable Multimeter $18.90		3 digit Bubble	.90
DIGITAL THERMOMETER $48.50		4 digit Bubble	.80
Batt. oper. General purpose or medical 32°–230°F. Disposable probe cover – 2 accuracy. Comp. assy. in compact case		DGIB Fluorescent	4.00
		DG10 Fluorescent	1.75
COMPUTER BOARD KITS		5 digit 14 pin display	1.00
8K RAM Board Kit	$134.95	N5369 9 digit display	.60
4K EPROM Kit	114.95	7520 Clarex photocells	.39
I/O Board Kit	44.50	TIL311 Hex	9.50
Extender Board w/connector	12.50	**IC Test Clips**	
Video Interface board kit	125.00	1	.18
16K EPROM board kit w/o PROMS	74.50	Red .55	.47
16K Static RAM board kit	395.00	Black .55	.47
North Star Floppy Disk Kit	$665.00	Keyer 8043	14.50
Additional Drive Kit	415.00	comp. w/spec /sock.	

CLOCK MODULES Complete alarm clocks ready to hook up with transformer and switches. Very compact with .50" and .84" digits

MA1002A, C or E .50"	8.95
102P3 Transformer	2.25
MA1016A, 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	15.95

RESISTORS ¼ watt 5%
10 per type .03 1000 per type .012
25 per type .025 350 piece pack
100 per type .015 5 per type 6.75

KEYBOARDS
56 key ASCII keyboard kit $62.50
Fully assembled 72.50
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
Giglitz LED Mounting Clips .8/$1.25 (specify red, ambar, green, yellow, clear)

Sinclair 3½ Digit Multimeter Batt./AC 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 instrucs. Green and orange displays also avail. **Same kit w/.80" displays. $21.95**

Digital Temperature Meter Kit Indoor and outdoor. 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, tenths of a degree, air or liquid. Very accurate. **$39.95** Beautiful hardwood case w/bezel **$11.75**

NiCad Batt. Fixer/Charger Kit Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts & instruc. **$7.25**

RCA Cosmac VIP Kit 249.00 Video computer with games and graphics.

'78 IC Update Master Manual 1978 IC Update Master Manual **$30.00** Complete IC data selector 2175 pg. Master reference guide. Over 42,000 cross references. Free update service through 1978. Domestic postage $3.50. Foreign $6.00.

New Cosmac Super "ELF" RCA CMOS expandable to 64K 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. 100 pg. detailed assy. man. incl. new exten. software section. PC board solder masked & all parts fully socketed. Comp. Kit **$106.95.** High address display option **8.95**; Low address display option **9.95**; Custom hardwood cab.; drilled front panel **19.75**; Nicad Battery Backup Kit w/all parts **4.95**; Fully wired & tested in cabinet **151.70**; Questdata 1802 software club. 10–12 pg. monthly publication **12.00** per yr.

4K Elf Expansion Board Kit with Cassette I/F $79.95 Available on board options: 1K super ROM monitor **$19.95** Parallel I/O port **$7.95** RS232 I/F **$3.50** TTY 20 ma I/F **$1.95** S-100 Memory I/F **$4.50**

Tiny Basic for ANY 1802 System Cassette **$10.00.** On ROM Monitor **$38.00.** Super Elf owners, 30% off. Object code listing or paper tape with manual **$5.50.**

Original ELF Kit Board $14.95

Video Modulator Kit $8.95 Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

60 Hz Crystal Time Base Kit $4.40 Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

Clock Calendar Kit $23.95 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.

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**

PROM Eraser Ultraviolet, assembled **$49.95**

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.

Auto Clock Kit $15.95 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.

FREE: Send for your copy of our NEW 1978 QUEST CATALOG. Include 28¢ stamp.

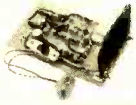
CIRCLE 46 ON FREE INFORMATION CARD

KITS • KITS • KITS

*Perforated Boards **NOT INCLUDED** w/100 Series*

103 MINI-WINK NEON FLASHER. Random flash pattern. Interesting displays. 6 neon lamps. AC operated.

103	$3.00
103A (103 w/PCB)	4.65
103B (103 w/PCB,CASE)	6.90



110 ELECTRONIC WHOOPER SIREN. Powerful wailing sound. Dual oscillator circuit. Use with any alarm circuit. Battery not included.

110	$4.95
110A (110 w/PCB)	6.50
110B (110 w/PCB,CASE)	9.60

117 TUNABLE ELECTRONIC ORGAN. Tunable 7-note scale. Play sing-a-long favorites. Battery not included.

117	$7.55
117A (117 w/PCB)	9.50
117B (117 w/PCB,CASE)	12.60

120 SIREN/CODE OSCILLATOR. Loud, piercing alarm. Practice Morse code. Battery not included.

120	$4.20
120A (120 w/PCB)	5.55
120B (120 w/PCB,CASE)	8.65

104 VARIABLE STROBE LIGHT. Great for parties and photography. Variable flash rate. AC operated.

104	$10.60
104A (104 w/PCB)	14.85
104B (104 w/PCB,CASE)	20.35

126 PROGRAMMABLE DOORBELL. Adjustable rate and pitch for 15 musical notes. Play favorite tunes. 6 IC's. Uses existing transformer and switch.

126	$16.95
126A (126 w/PCB)	23.70
126B (126 w/PCB,CASE)	29.20

502 POWER SUPPLY. Switch from 6 to 9V DC. 100mA output. Filtered. Manual. Stepdown transformer. Insulated test clips.

$6.95 Complete

540 BINARY CLOCK. Handcraft tomorrow's timepiece today. Watch constantly changing patterns of LED's as they display Binary Time. This unique clock project enhances the learning of Digital Logic and the Binary Coding System, as well as offering a beautifully styled conversation piece.

10 TTL INTEGRATED CIRCUITS • VOLTAGE REGULATOR • MANUAL TEACHES BINARY SYSTEM • FAST, SLOW AND HOLD CONTROLS • 115VAC 50 or 60Hz.

$39.95 Complete

523 STROBE LITE. Create flashing light effects. Ideal for creating kaleidoscope effects for photography. Long life flash tube. PCB. Manual. Variable flash control. On-off switch. Silicon diodes. 117VAC 50-60 Hz.

$22.95 Complete

536 8-TRANSISTOR AM RADIO. Experience jewel-like clarity in sound. The best superheterodyne kit circuit available. SEPARATE LOCAL OSCILLATOR for high sensitivity and excellent selectivity. Unique IF Transformer mounting system. Manual. 9V battery required (not included).

$16.45 Complete

504 TRANSISTOR AMPLIFIER. 4 Transistors. Push-Pull output. Variable volume control. Requires one 9V battery (not included). PCB. Manual. 3 transformer stages for maximum gain. Power output 360mW. Can be operated with any 3.2 – 8 ohm speaker.

$6.95 Complete

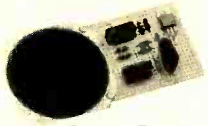
510 FIVE TUBE RADIO. Rediscover TUBES. This fun antique circuit offers high selectivity and sensitivity. 2 IF Transformers. Hi-Q Ferrite antenna. Manual. Superheterodyne circuit. Large PM speaker. For 110-120 VAC or DC.

$34.95 Complete

401 TACHOMETER. Know exactly when to shift. This fabulous Tach, with a range from 0-8 grand, will mount anywhere — dash, steering column, boat, motorcycle frame, etc. 250° wide sweep scale. Reading accuracy within 2% of full scale. PCB. Manual. Illuminated dial. For all cylinder engines.

$27.95 Complete

*Perforated Boards **NOT INCLUDED** w/100 Series*



124 WARBLING SIREN. Two-tone oscillating siren. Loud and penetrating, 2 IC's. For automobile or other 12 volt systems.

124	$5.65
124A (124 w/PCB)	7.10
124B (124 w/PCB,CASE)	10.20

105 FISH CALLER. Clicking sound imitates distressed fish. Adjustable speed. Battery not included.

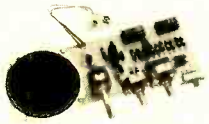
105	$3.15
105A (105 w/PCB)	4.30
105B (105 w/PCB,CASE)	5.80

107 COLOR ORGAN CONTROL — 3 CHANNEL. Over 200W per channel. Separate sensitivity control. Hi-mid-lo frequency response. AC operated.

107	$9.20
107A (107 w/PCB)	11.85
107B (107 w/PCB,CASE)	14.95

118 TV SCRAMBLER. Tunable to all VHF stations. 30 foot range. Battery not included.

118	$1.95
118A (118 w/PCB)	2.90
118B (118 w/PCB,CASE)	4.40



122 COMPUTER SOUND EFFECTS GENERATOR. Produces weird, spacey sounds. 4 IC's. Control tone, rate and blip or glide. Battery not included.

122	$14.95
122A (122 w/PCB)	19.40
122B (122 w/PCB,CASE)	22.75

We accept:
VISA,
MASTER CHARGE
BANKAMERICARD,

CALL NOW TOLL FREE
800-824-5136
IN CALIFORNIA CALL 800-852-7631
ASK FOR OPERATOR 318

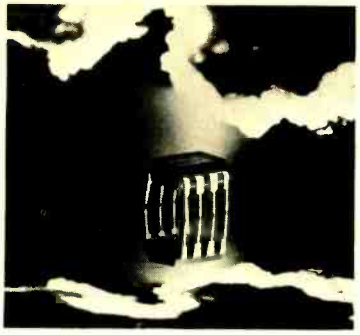
DO NOT SEND CASH • NO COD • ORDER BY PHONE OR MAIL

MINIMUM ORDER $10.00. CALIF. RESIDENTS ADD 6% SALES TAX.

WE PAY POSTAGE AND HANDLING IN U.S.A. OVERSEAS COUNTRIES: ADD 15% OF TOTAL FOR POSTAGE.

SEND CHECK OR MONEY ORDER TO:

Graymark International, Inc.
1751 McGaw Avenue Dept. 11 Irvine,CA 92714 (714) 540-5480



THE NEW HOBBY WORLD CATALOG

Your source for factory prime, professional quality equipment. Computers, add-on boards, IC's, sockets, resistors, supplies, tools, test equipment, books, and more. Shop your buy list at Hobby World. You'll find what you want, and at a solid savings. For example, look at this month's specials:

THE NEW ELENCO 3½ DIGIT SOLID STATE MULTIMETER
The ultimate in performance: measures resistance to .01 ohms, voltage to 100 micro-volts, current to one micro-amp. Assembled and tested, with 2-Year warranty. Lists at $99.95, **HOBBY WORLD PRICE ONLY $74.95!**

16K MEMORY ADD-ON FOR APPLE OR TRS-80
HOBBY WORLD PRICE IS ONLY $145.00 (specify when ordering)

WAHL ISO-TIP CORDLESS SOLDERING IRON
Includes ni-cad batteries and wall plug transformer.
Lists at $19.95, **BUT HOBBY WORLD HAS IT FOR $14.95!**

SEND ME A FREE CATALOG!

Name _____

Address _____

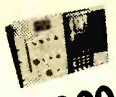
City _____ State _____

Hobby World
19355 Business Center Dr #6
Northridge CA 91324

TELEPHONE ORDERS
Inside Cal 213 886 9200
Outside Cal 800 423 5387

RE-NOV

CIRCLE 74 ON FREE INFORMATION CARD



TAPE RECORDER!

5 TRACK, 4 CASSETTE, EASILY MODIFIED TO PLAY ONE RECORD ANOTHER, ALL CONTROL SIGNALS ON EDGE CONNECTORS! 2000FT 1/4" TAPE/CASSETTE, PRINTED CIRCUIT MOTORS & TACH GEN; BALL BEARINGS, TOP QUALITY MFG! REQUIRES 12 VOLT 5 AMP DC; DATA BOOK & 1 CASSETTE FURNISHED; WT 85 LBS SHIP'D COD. BOOK $25, CASSETTE $25.

$169.00

STEPPING MOTOR

15°/STEP, 28 VOLT, LEAD SCREW SHAFT PRECISION BALL BEARING, 5 LEAD WINDING, $4.95 WITH FOLLOWER & GUIDE $9.50 SHAFT .310 DIA 5 1/16 LG 4" WORKING, MOTOR 1 7/16" DIA 2 15/16" LONG

NEW CATALOG! PLEASE SEND SELF ADDRESSED STAMPED ENVELOP FOR FREE COPY NOW!

DC MOTORS

SMALL SIZE 1 5/8" DIA 2 7/16" LG, SHAFT 1/8" DIA 1/2" LG, PM FIELD, BALL BEARING, 28 VOLT REMOVED FROM EQUIP. $6.00 EACH
HI TORQUE 3/16" DIA 3 3/4" LG SHAFT, PM FIELD W/MU-METAL SHIELD, B.B., 28 VOLT, EA. $7.50
MOTOR & TACH GENERATOR, SET $11.00
TACH GENERATOR 1" DIA 1 3/4" LG, SHAFT 1/8" DIA 3/8" LONG, PM FIELD, WIRE LEADS, $5.00
ADD $3.00 POSTAGE - BALANCE REFUNDED

CIRCUIT BOARD

WIRE WRAP, GOLD, 8-16 PIN 32-14 PIN, 8-26 PIN .025 SQ. MALE RIBBON CONNECTORS, YOU STRIP, EACH $10.00

NEW KLUGE BOARDS! EPOXY-GLASS, 2 SIDE COPPER, 1/16" X 7 1/2" X 10 1/2" DRILLED FOR 7-16 PIN, 28-14 PIN, 1-24 PIN, & 4-28 PIN SOCKETS, MANY THRU HOLES, EACH $5.00
NO.2 SAME EXCEPT HAS 13-16 PIN, & 36-14 PIN PATTERNS, YOU ETCH. $7.50 MIN ORDER $10.00

J&E ELECTRONICS SALES
PO BOX 4504, FT. WORTH, TX. 76106

CIRCLE 55 ON FREE INFORMATION CARD

Looking for Original Japanese Replacement Parts for CB, TV and Stereo ?

TYPE	25-up	10-24	1-9
2SA 234	.45	.53	.59
2SA 473	.45	.55	.60
2SA 484	1.90	2.10	2.40
2SA 485	1.90	2.10	2.40
2SA 489	1.10	1.25	1.40
2SA 495	.25	.35	.40
2SA 497	1.00	1.20	1.30
2SA 509	.30	.35	.40
2SA 537A	1.50	1.70	1.90
2SA 561	.30	.35	.40
2SA 562	.30	.35	.40
2SA 634	.40	.45	.50
2SA 643	.30	.40	.45
2SA 673	.30	.40	.45
2SA 683	.40	.53	.59
2SA 684	.40	.53	.59
2SA 695	.40	.53	.59
2SA 699A	.50	.64	.70
2SA 706	.85	1.00	1.10
2SA 719	.25	.35	.40
2SA 720	.25	.35	.40
2SA 733	.20	.27	.30
2SA 744	4.20	4.40	4.90
2SA 745R	3.60	4.00	4.40
2SA 747	4.20	4.40	4.90
2SA 847	.40	.53	.59
2SB 54	.30	.40	.45
2SB 55	.40	.53	.59
2SB 75	.30	.40	.45
2SB 77	.30	.40	.45
2SB 186	.20	.27	.30
2SB 187	.20	.27	.30
2SB 324	.25	.35	.40
2SB 367	1.10	1.25	1.40
2SB 405	.25	.35	.40
2SB 407	.70	.90	1.00
2SB 434	.80	.90	1.00
2SB 473	.70	.90	1.00
2SB 474	.70	.80	.90
2SB 507	.70	.90	1.00
2SB 511	.70	.80	.90
2SB 536	1.00	1.20	1.30
2SB 557	2.10	2.50	2.80
2SB 595	1.10	1.40	1.50
2SB 596	1.10	1.40	1.50
2SB 600	5.00	6.00	6.60
2SC 183	.40	.53	.59
2SC 184	.40	.53	.59
2SC 281	.25	.35	.40
2SC 372	.20	.27	.30
2SC 373	.20	.27	.30
2SC 380	.20	.27	.30
2SC 381	.30	.40	.45
2SC 382	.30	.40	.45
2SC 387A	.30	.40	.45
2SC 394	.30	.40	.45
2SC 458	.20	.27	.30
2SC 481	1.30	1.40	1.50
2SC 1166	.30	.40	.45
2SC 482	1.10	1.25	1.40
2SC 485	1.30	1.40	1.50
2SC 495	.45	.55	.60
2SC 497	1.10	1.25	1.40
2SC 509	.30	.40	.45
2SC 517	3.00	3.20	3.40
2SC 535	.30	.40	.45
2SC 627	1.30	1.45	1.60
2SC 696	1.00	1.20	1.30
2SC 710	.20	.27	.30
2SC 711	.20	.27	.30
2SC 712	.20	.27	.30
2SC 717	.35	.40	.45
2SC 730	3.00	3.20	3.40
2SC 732	.20	.27	.30
2SC 733	.20	.27	.30
2SC 734	.20	.27	.30
2SC 735	.20	.27	.30
2SC 756	1.50	1.80	2.00
2SC 756A	1.50	1.80	2.00
2SC 775	1.40	1.60	1.80
2SC 776	2.00	2.20	2.50
2SC 777	3.00	3.25	3.50
2SC 778	2.90	3.20	3.40
2SC 781	2.00	2.20	2.50
2SC 784	.35	.40	.45
2SC 789	.80	.90	1.00
2SC 793	2.00	2.20	2.50
2SC 799	2.00	2.20	2.50
2SC 828	.20	.27	.30
2SC 829	.20	.27	.30
2SC 838	.35	.40	.45
2SC 839	.30	.40	.45
2SC 867	3.20	3.40	3.70
2SC 897	2.00	2.20	2.50
2SC 900	.20	.27	.30
2SC 930	.20	.27	.30
2SC 945	.20	.27	.30
2SC 959	1.00	1.20	1.30
2SC 1000BL	.35	.40	.45
2SC 1013	.50	.64	.70
2SC 1014	.50	.64	.70
2SC 1018	.70	.80	.90
2SC 1030C	1.80	2.10	2.40
2SC 1060	.70	.80	.90
2SC 1061	.70	.80	.90
2SC 1079	3.40	3.55	3.90
2SC 1080	3.40	3.55	3.90
2SC 1096	.45	.55	.60
2SC 1098	.50	.64	.70
2SC 1111	2.10	2.50	2.80
2SC 1114	4.20	4.40	4.90
2SC 1115	2.50	2.70	3.00
2SC 1116	3.20	3.40	3.70
2SC 1116A	3.40	3.55	3.90
2SC 1124	.80	.90	1.00
2SC 1127	.80	.90	1.00
2SC 1162	.70	.80	.90
2SC 1172B	3.20	3.60	3.95
2SC 1173	.50	.64	.70
2SC 1177	11.00	12.60	14.00
2SC 1209	.25	.35	.40
2SC 1226	.50	.64	.70
2SC 1226A	.50	.64	.70
2SC 1237	1.80	2.00	2.25
2SC 1239	2.20	2.70	2.90
2SC 1306	1.30	1.70	1.90
2SC 1307	2.20	2.70	2.90
2SC 1318	.30	.40	.45
2SC 1364	.30	.40	.45
2SC 1383	.30	.40	.45
2SC 1384	.30	.40	.45
2SC 1400	.30	.40	.45
2SC 1403	3.20	3.40	3.70
2SC 1419	.60	.70	.80
2SC 1475	.70	.90	1.00
2SC 1567A	.60	.70	.80
2SC 1667	3.00	3.20	3.40
2SC 1675	.25	.35	.40
2SC 1678	1.30	1.45	1.60
2SC 1687	.40	.45	.50
2SC 1728	1.00	1.20	1.30
2SC 1730	.45	.53	.59
2SC 1760	.90	1.10	1.20
2SC 1775	.30	.40	.45
2SC 1816	1.50	1.75	1.95
2SC 1908	.25	.35	.40
2SC 1909	2.20	2.70	2.90
2SC 1945	4.50	5.00	5.60
2SC 1957	.60	.70	.80
2SC 1969	3.60	4.00	4.40
2SC 1973	.70	.80	.90
2SC 1974	1.30	1.70	1.90
2SC 1975	1.30	1.70	1.90
2SC 2028	.50	.64	.70
2SC 2029	1.50	1.80	2.00
2SC 2076	.50	.64	.70
2SC 2091	.90	1.10	1.20
2SC 2092	1.80	2.00	2.25
2SC 2098	3.20	3.40	3.70
2SD 72	.50	.64	.70
2SD 90	1.30	1.45	1.60
2SD 91	1.30	1.45	1.60
2SD 92	1.45	1.60	1.80
2SD 93	1.60	1.80	2.00
2SD 180	1.60	1.80	2.00
2SD 187	.30	.40	.45
2SD 188	1.80	2.10	2.40
2SD 201	2.30	2.40	2.65
2SD 202	3.40	3.55	3.90
2SD 226A	1.30	1.45	1.60
2SD 234	.80	.70	.80
2SD 235	.60	.70	.80
2SD 236	1.30	1.45	1.60
2SD 261	.30	.40	.45
2SD 287	2.50	2.70	2.90
2SD 291	2.10	2.50	2.80
2SD 313	.60	.70	.80
2SD 315	.60	.70	.80
2SD 325	.60	.70	.80
2SD 356D	.70	.80	.90
2SD 357D	.70	.80	.90
2SD 358	.70	.80	.90
2SD 359	.80	.90	1.00
2SD 381	.85	1.00	1.10
2SD 427	1.80	2.00	2.25
2SD 525	.90	1.10	1.20
2SD 526	.60	.70	.80
2SK 19BL	.45	.55	.60
2SK 23	.85	1.00	1.10
2SK 30	.40	.45	.50
2SK 33	.60	.70	.80
2SK 34	.50	.64	.70
2SK 40	.50	.64	.70
2SK 41	.50	.64	.70
2SK 49	.40	.45	.50
2SK 55	.60	.70	.80
2SK 61	1.10	1.25	1.40
2SK 68	.40	.45	.50
2SK 22Y	1.40	1.60	1.80
3SK 35	1.30	1.45	1.60
3SK 37	1.80	2.10	2.40
3SK 39	.90	1.10	1.20
3SK 40	1.30	1.45	1.60
3SK 41	1.30	1.45	1.60
3SK 45	1.30	1.45	1.60
3SK 48	3.40	3.55	3.90
3SK 49	1.30	1.45	1.60
AN 214Q	1.30	1.70	1.90
AN 239	4.20	4.40	4.90
AN 247	2.50	2.70	3.00
AN 274	1.50	1.75	1.95
AN 315	1.80	2.00	2.25
BA 511A	1.80	2.00	2.25
BA 521	1.90	2.10	2.40
HA 1151	1.50	1.75	1.95
HA 1156	1.60	1.80	2.00
HA 1306W	2.00	2.20	2.50
HA 1322	2.50	2.70	3.00
HA 1339	2.50	2.70	3.00
HA 1339A	2.50	2.70	3.00
HA 1342A	2.50	2.70	3.00
LA 4031P	1.80	2.00	2.25
LA 4032P	1.80	2.00	2.25
LA 4400	1.90	2.10	2.40
M 51513L	2.00	2.20	2.50
STK 011	3.80	4.00	4.40
STK 015	4.20	4.40	4.90
STK 435	4.50	5.00	5.60
TA 7045M	2.00	2.20	2.50
TA 7055P	2.00	2.20	2.50
TA 7060P	.90	1.10	1.20
TA 7061P	.90	1.10	1.20
TA 7062P	1.10	1.25	1.40
TA 7089P	2.00	2.20	2.50
TA 7129P	1.30	1.70	1.90
TA 7202P	2.50	2.70	2.90
TA 7204P	2.00	2.20	2.50
TA 7205P	1.50	1.80	2.00
TA 7310P	1.30	1.45	1.60
TBA 810SH	1.90	2.10	2.40
TC 5080P	5.00	5.20	5.80
TC 5081P	3.00	3.20	3.40
TC 5082P	3.40	3.55	3.90
UHIC 002	5.00	5.20	5.80
UHIC 004	5.00	5.20	5.80
UHIC 005	5.00	5.20	5.80
UPC 20C	2.10	2.50	2.80
UPC 563	1.90	2.10	2.40
UPC575C	1.30	1.45	1.60
UPC 576	1.90	2.10	2.40
UPC 592H2	.80	.90	1.00
UPC 1001H	1.90	2.10	2.40
UPC 1008C	5.00	5.30	5.90
UPC 1020H	1.90	2.10	2.40
UPC 1025	1.90	2.10	2.40
UPC 1156	1.90	2.10	2.40
UPD 857C	8.00	8.40	9.50
UPD 858C	8.00	8.40	9.50
PLL 01A	3.00	4.20	4.60
PLL 02A	5.00	5.30	5.90
PLL 03A	7.60	8.00	8.80
IS 84	.45	.55	.60
IS 188	.16	.18	.20
IS 332	.35	.40	.45
IS 953	.16	.18	.20
IS 1007	.35	.40	.45
IS 1209	.35	.40	.45
IS 1211	.35	.40	.45
IS 1555	.20	.22	.25
IS 1588	.20	.22	.25
IS 1885	.16	.18	.20
IS 2076	.20	.22	.25
IS 2093	.35	.40	.45
IS 2473	.16	.18	.20
IN 34	.12	.13	.15
IN 60	.12	.13	.15
10D1	.25	.35	.40
10D10	.45	.55	.60
VO 6B	.25	.35	.40
VO 6C	.25	.35	.40
WZ 060	.20	.22	.25
WZ 052	.20	.22	.25
WZ 061	.20	.22	.25
WZ 071	.20	.22	.25
WZ 075	.20	.22	.25
WZ 081	.20	.22	.25
WZ 090	.20	.22	.25
WZ 120	.20	.22	.25
WZ 192	.20	.22	.25
WZ 260	.20	.22	.25
WZ 280	.20	.22	.25
SG 613	5.20	5.40	5.95
MPS U31	1.30	1.70	1.90
78L05	.90	1.00	1.10

PRICES MAY CHANGE WITHOUT NOTICE **COD ORDERS WELCOMED**

Minimum order $5.00 Ohio residents add 4% sales tax Add $1.00 postage and handling
Quantity discount prices Ask For Our Complete Price List Manufacturer Inquiries Welcomed
ALL PARTS GUARANTEED FACTORY DEFECT

TOLL FREE TELEPHONE

Nationwide 800/543-1607 LOCAL 513/874-0220
Ohio 800/582-1630 874-0223
Hours Mon Fri 10-7 Sat 11-5

IMMEDIATE DELIVERY WITHIN 48 HOURS
ON ALL TRANSISTORS IN STOCK

FUJI-SVEA ENTERPRISE
a Division of Fuji Svea Incorporated
Dept.
P.O. Box 40325 Cincinnati, Ohio 45240
Telex 21-4732

Active Electronic Sales Corp.

1978 IC MASTER

Complete integrated circuit data selector. New 1978 edition (2200 pages) is twice as big as last year. Master guide to the latest I.C.'s including microprocessors and consumer circuits.

Free quarterly updates.

~~$24.95~~ **$19.95**

Tremendous Opportunity, **Subject to Prior Sale,** *Lowest Price Ever Offered Anywhere.*

TTL LOW POWER SCHOTTKY PLASTIC DUAL-IN-LINE I.C.

Part No.	Price	Part No.	Price	Part No.	Price	Part No.	Price	Part No.	Price	Part No.	Price
74LS00	.15	74LS47	.89	74LS123	.79	74LS170	1.25	74LS258	.75	74LS368	.55
74LS01	.15	74LS48	.89	74LS124	.99	74LS173	.95	74LS259	1.45	74LS373	1.75
74LS02	.15	74LS49	.89	74LS125	.59	74LS174	.69	74LS260	.29	74LS374	1.75
74LS03	.15	74LS51	.19	74LS126	.59	74LS175	.69	74LS261	1.85	74LS375	.65
74LS04	.19	74LS54	.19	74LS132	.79	74LS181	2.50	74LS266	.39	74LS377	1.50
74LS05	.19	74LS55	.19	74LS133	.29	74LS183	3.50	74LS273	1.65	74LS378	1.25
74LS08	.19	74LS63	1.50	74LS136	.39	74LS190	.89	74LS275	4.50	74LS379	1.35
74LS09	.19	74LS73	.29	74LS138	.64	74LS191	.89	74LS279	.59	74LS386	.49
74LS10	.15	74LS74	.35	74LS139	.64	74LS192	.95	74LS280	1.75	74LS390	1.50
74LS11	.19	74LS75	.49	74LS145	.99	74LS193	.95	74LS283	.85	74LS393	1.25
74LS12	.19	74LS76	.39	74LS147	1.95	74LS194	.75	74LS290	.85	74LS395	1.50
74LS13	.35	74LS78	.39	74LS148	.99	74LS195	.66	74LS293	1.10	74LS396	1.70
74LS14	.59	74LS83	.79	74LS151	.59	74LS196	1.09	74LS295	1.25	74LS398	2.65
74LS15	.19	74LS85	.99	74LS153	.59	74LS197	1.09	74LS298	1.25	74LS399	1.50
74LS20	.15	74LS86	.35	74LS155	.99	74LS221	1.25	74LS299	2.95	74LS424	4.50
74LS21	.19	74LS90	.59	74LS156	.80	74LS240	1.95	74LS324	1.25	74LS445	1.25
74LS22	.19	74LS91	.99	74LS157	.59	74LS241	1.95	74LS325	2.55	74LS447	1.25
74LS26	.25	74LS92	.59	74LS158	.69	74LS242	1.95	74LS326	2.55	74LS490	1.95
74LS27	.21	74LS93	.49	74LS160	.84	74LS243	1.95	74LS327	2.55	74LS668	.90
74LS28	.21	74LS95	.70	74LS161	.84	74LS244	1.95	74LS347	1.25	74LS669	.90
74LS30	.15	74LS96	.99	74LS162	.84	74LS245	1.95	74LS348	1.75	74LS670	2.00
74LS32	.25	74LS107	.39	74LS163	.84	74LS247	1.25	74LS352	1.35		
74LS33	.27	74LS109	.32	74LS164	.89	74LS248	1.25	74LS353	1.35		
74LS37	.23	74LS112	.32	74LS165	1.25	74LS249	1.25	74LS362	7.00		
74LS38	.23	74LS113	.39	74LS166	1.45	74LS251	.85	74LS365	.55		
74LS40	.19	74LS114	.39	74LS168	1.50	74LS253	.85	74LS366	.55		
74LS42	.54	74LS122	.50	74LS169	1.50	74LS257	.60	74LS367	.55		

Dual In-line Sockets

Finest Quality Sockets Available Anywhere

- PLUGGABLE SOCKET FOR IC PACKAGES WITH LEADS
- HIGH RELIABILITY GAS TIGHT JOINT.
- FULLY QUALIFIED TO MIL-S-8374
- COMPACT LOW PROFILE DESIGN
- NO WICKING WHEN SOLDERED TO PC BOARD
- FLAMMABILITY RATING :UL-940V-0

Stock level	Contacts	Price
14000	8 PIN	.11
345000	14 PIN	.13
156000	16 PIN	.15
33000	18 PIN	.19
18000	22 PIN	.27
84000	24 PIN	.28
25000	28 PIN	.36
46000	40 PIN	.48

All new major manufacturer production material offered. Largest variety of device types available anywhere.

UV EPROM

Stock level	Part No.	Price
7300	2708	7.99
6800	TMS 2716	24.95

3 power supply version, 16K pin for pin plug in replacement for 2708.

MOS Static RAM'S

Stock level	Part No.	Price
41400	2114 (4K (1K x 4) 450NS)	7.50
59500	2102LFPC (1K 350NS (Low Power))	1.19

MOS Dynamic RAM'S

Stock level	Part No.	Price
21110	4K 4060 (300NS)	3.95
27550	16K 416-3 (200NS)	11.95
18650	16K 416-5 (300NS)	8.95

UART's

Stock level	Part No.	Price
29000	AY5-1013A	4.95
9200	AY3-1015	5.95

1K CMOS RAM

Stock level	Part No.	Price
4400	5101 (450NS (Low Power))	4.95

MICROPROCESSOR CHIPS

CPU's

Stock level	Part No.	Price
21600	8080A	~~5.95~~ 5.50
2700	6800	~~8.95~~ 7.95

INTERFACE SUPPORT CIRCUITS

Stock level	Part No.	Price
1250	8212	1.98
1800	8214	~~4.95~~ 3.95
11200	8216	1.98
1700	8224	2.75
2800	8226	1.98
1500	8228	4.75
1000	8238	4.75
4900	8251	~~5.95~~ 4.95
500	8253	14.95
5200	8255	5.95
1100	8257	9.95
300	8259	14.95
1500	6810	~~3.95~~ 3.50
1700	6820	~~4.95~~ 3.95
1400	6821	~~4.95~~ 3.95
2800	6850	~~5.95~~ 4.95
700	6852	~~5.95~~ 4.95

GENERAL INSTRUMENT

1 Amp Rectifiers (Epoxy)

Stock level	Part No.		Price
1.7 Million	1N4001	50V	.029
.9 Million	1N4002	100V	.039
5 Million	1N4003	200V	.045
5.7 Million	1N4004	400V	.049
1.6 Million	1N4005	600V	.055
.8 Million	1N4006	800V	.065
1.8 Million	1N4007	1000V	.07

1.5 AMP Single Phase Silicon Bridge Rectifiers

Stock level	Part No.		Price
29000	W02M	200V	.28
57000	W04M	400V	.32
390000	W06M	600V	.34
80000	W08M	800V	.39
7000	W10M	1000V	.60

SWITCHING DIODES

Part No.		Price
1N914	(100V 4NS)	.027
1N4148	(100V 4NS)	.027

Zilog

Z80-CPU	14.95	Z80-S10/0	59.00
Z80A-CPU	24.95	Z80A-SIO/0	68.00
Z80-PIO	7.95	(common TX & RX clocks with DTRB)	
Z80A-PIO	11.95		
Z80-CTC	7.95	Z80-SIO/1	59.00
Z80A-CTC	11.95	Z80A-SIO/1	68.00
Z80-DMA	46.00	(separate TX & RX clocks without DTRB)	

P.O. BOX 1035 FRAMINGHAM, MASSACHUSETTS 01701

Over-the-counter sales.
12 Mercer Rd., Natick, Mass. 01760
Behind Zayres on Rte. 9
Telephone Orders & Enquires (617) 879-0077

IN CANADA 3 LOCATIONS

5651 FERRIER ST.
MONTREAL, QUEBEC
H4P 2K5
Tel: (514) 735-6425

4800 DUFFERIN ST.
DOWNSVIEW, ONTARIO
M3H 5S9
Tel: (416) 661-1115

BAXTER CENTRE
1050 BAXTER ROAD
OTTAWA, ONTARIO
K2C 3P2
Tel: (613) 820-9471

MINIMUM ORDER $10.00 ● ADD $2.00 TO COVER POSTAGE & HANDLING ● Canadian customers add 30% for exchange and handling. All federal and provincial taxes extra.

Foreign customers please remit payment on an international bank draft or international postal money order in American dollars.

master charge VISA

CIRCLE 37 ON FREE INFORMATION CARD

NAME brand test equipment. Up to 50% discount. Free catalog and price list. **SALEN ELECTRONICS,** P.O. Box 82, Skokie, IL 60076

PLANS & KITS

SCANNER users—build many useful accessories. Free kit catalog. **CAPRI ELECTRONICS,** Route 1R, Canon, GA 30520

CONSTRUCTION plans; over 100. From TV to telephone, from broadcasting to computers. Catalog air mailed $1.00; includes year's subscription to Electronic Newsletter. **DON BRITTON ENTERPRISES,** PO Box G, Waikiki, HI 96815

HOBBYIST give your project the professional look. Printed circuit boards from your sketch or artwork. Affordable prices. Also fun kit projects. Rush free details. **DANOCINTHS,** Box 261, Westland, MI 48185

LINEAR AMPLIFIER: Ham only 2-30 MHz, 100 watt, solid-state. **FREQUENCY COUNTER:** 300 MHz, miniportable/mobile, memory! **VOX—COMPRESSOR:** Splatter-free modulation booster. Construction plans $3.00 each. All $7.50! Many others, catalog with order. **PANAXIS PRODUCTIONS,** Box 130-F11, Paradise, CA 95969

AMPLIFIER kits: Low TIM, Class A, BI-FET circuitry. Free 60-page manual. **MOONLIGHTER ELECTRONICS,** 117 Inverness, San Francisco, CA 94132

TESLA coil: simplified instructions, inexpensive parts easily obtained, plans $3.00. **TOM ABRAMS,** 1359 Lakeland Drive, North Charleston, SC 29406

PROJECTION TV . . . Convert your TV to project 7-foot picture. Results equal to $2,500 projector. Total cost less than $20.00. Plans & lens $16.00. Illustrated information **free. MACROCOMM,** Washington Crossing, PA 18977

GOVERNMENT SURPLUS

JEEPS — $59.30! — Cars — $33.50! — 200,000 items! Government surplus—most comprehensive directory available tells how, where to buy—your area—$2.00—moneyback guarantee—**GOVERNMENT INFORMATION SERVICES,** Department VA—10, Box 99249, San Francisco, CA 94109

BIORHYTHMS

PERSONALIZED biorhythms. Three month printout **only $1.00,** send birthdate. **BRIAN PETERSON,** Box 231, Northfield, MN 55057

BUSINESS OPPORTUNITIES

HIGHLY PROFITABLE ONE-MAN ELECTRONIC FACTORY

Investment unnecessary, knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! **Postcard will do. Barta-RE-K, Box 248, Walnut Creek, CA 94597.**

MECHANICALLY inclined individuals desiring ownership of Small Electronics Manufacturing Business—without investment. Write: **BUSINESSES,** 92-R, Brighton 11th, Brooklyn, NY 11235

MECHANICALLY INCLINED INDIVIDUALS —WANTED—

Assemble electronic devices in your home. Get started in spare time. Experience, Knowledge or Investment Not Necessary. Expect big profits: $300 - $600/Wk. Possible. Write for free literature telling how.

ELECTRONIC DEVELOPMENT LAB
Box 1535R, Pinellas Park, FL 33565

W-H-O-O-P-!! W-H-O-O-P-! W-H-O-O-P-!

Delta Is Ready With The $24.50 World's Best Bargains!

MOTION DETECTOR

When there is a new development in electronics, it takes some time before that development is available to hobbyists and experimenters, especially at surplus prices. This time we have reversed the trend, and announce a DELTA EXCLUSIVE: the DELTA MOTION DETECTOR. This device detects any motion or movement for a minimum distance of 8-ft. The secret is in the ultra-complex custom LSI chip, which combines the latest in linear & digital circuitry. The device is completely self-contained, in a case 6 x 3 x 2 ½", and operates from four "AA" NiCad batteries. Nothing else is needed, for the device to perform its basic function, motion detection. When motion or movement is detected, a "whoop" alarm is sounded. The MOTION DETECTOR is designed to provide either an audible or silent alarm. The silent alarm is controlled by a timer, which delays the alarm up to 30 seconds. The silent alarm activates a relay, whose contacts are brought out to plug, and will activate ANY device, such as siren, horn, tape recorder, telephone dialer, etc.

The Motion Detector works on a CHANGE OF LIGHT. Any change of +5% or more, triggers the detector. Works within a range of 0.1 candlepower (almost dark), to 100 candlepower, (quite brite), a range of 1000 to 1. NO external light source is needed.

When left in a darkened or semi-darkened room, the Motion Detector acts as a fantastic FIRE ALARM. The light from a single match, anywhere in the room, triggers the alarm, so that the device becomes an intrusion alarm and fire alarm, all in one.

Delta No.	Description	Sale
☐ 5611R	Complete motion detector kit (less batteries	$24.50
☐ 1072R	Motion Detector Chip only, with data	8.95
☐ 5611R	P.C. boards, set of 2	6.50
☐ 5288R	"AA" NiCad Batteries, set of 4	4.50
☐ 5636R	Battery charger for above	5.95
☐ 5635R	Completely assembled kit, w/batteries & charger	69.50

FERRO RESONANT TRANSFORMER

Has 12V 4 amp winding & 26V CT @ 15A. For building computers, lab power supplies, battery chargers. Brand new; designed for computer buffs. Complete with 6 mfd capacitor. Wt. 25 lbs.

☐ 6835R $24.95

STEP UP/STEP DOWN ISOLATION TRANSFORMER

Hard-to-find step up or down isolation transformer. It will take either 208 or 230 volts, and give an output of 115 volts, or it will take an input of 115 volts and give an output of either 208 or 230 volts. Rating is 800 VA. CRAMER catalog shows a STANCOR with 500 VA rating for $94.19. Wt. 23 lbs. ☐ 6592R

$24.50 ea. (2 for $47)

AMPEX TAPE We have acquired an inventory of AMPEX 1.0 mil recording tape. These tapes have been used one time by government weather stations, and then we get them. On standard 7" AMPEX reel. ☐ 5588R ..... $1.75 (4 for $6)

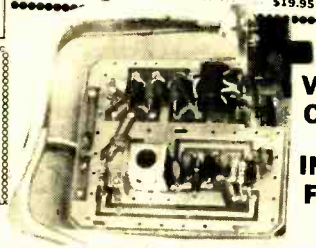
GOLD PLATED WIRE WRAP PROTOTYPE BOARDS

Wire wrap boards for prototyping or small run permanent work have been very expensive, with some boards running in excess of $2000 for some of the medium size boards. We have come up with the price range of the hobbyist user. The board we have is 7 ¾ x 8". It has provision for forty 14 or 16 pin integrated circuits plus four 24-pin LSI sockets. The LSI sockets are dual purpose, so that if not used, they may be used for 14 or 16 pin ICs. All the wire wrap pins are brought out to the top of the board, for simplicity in wire wrapping. The board has a ground plane, and a Vcc plane, with pins from each plane at every socket. There are 50 gold plated contacts on each side of the board, for use with standard edge connector. The board is g 10 fiberglass, and each comes sealed in protective plastic. We just can't say enough about this board. ☐ 6592R ..... $19.95 (2 for $47)

SERIES SN74XX BENT PIN SPECIAL

Delta has a lot of SERIES SN74XX ICs, plus a few linears, which were removed from wire wrap boards. Included are just about every SN74XX in the book, plus op amps, phase locked loops, etc., and others found in a sophisticated computer system. Only defect is pins bent when removed from board. We are selling these in lots of 125 which will include a good cross-section of the mixture. Money back guarantee if not 100% satisfied. No choices at this price, but you will get a good working supply of these useful devices. ☐ 4591R 125-pc. set, 5N74XX & linears

$10 (3 for $25)



VIDEO CUBE TV INTER FACE

The VIDEOCUBE is an RF Oscillator/Modulator, which can take as its input a composite video signal, such as the output of a TV game, video camera, or video output of a micro or mini computer, and present it to the atenna terminals of a conventional b & w or color TV set, and displaying the information as if it was a monitor.

The VIDEOCUBE comes with a 300 ohm output, and a selector switch for switching between TV and Videocube. Videocube 5 to 12 VDC and draws about 10 mils. Meets all FCC requirements for this type of device, and is so certified.

"Complete kit" contains all parts necessary to make an operating Videocube, which includes the p.c. board, the shield, the special switch, special capacitors, coils and balun transformer, plus all resistors, capacitors and diodes. The "partial kit" contains all the hard-to-get parts, and you use your own resistors, capacitors & diodes, the kit comes with complete instructions, circuit diagram and assembly drawings, plus a reprint of the article by GLEN DASH, entitles, "THE VERSATILE VIDEOCUBE", appearing in Aug. Radio Electronics.

☐ 5500 Complete Kit of Parts ..... $13.95 (2 for $26)
☐ 5500 Partial Kit of parts ..... $11.95 (2 for $22)

Limited Quantities! 5V 75 AMP REGULATED POWER SUPPLY By POWERTEC—worth over $200. Can run a complete computer system! 16 x 15 x 4¾". Wt. 35 lbs. ☐ 5642R $89

When in our area, Northeastern Massachusetts or Southern New Hampshire, visit our new showroom, loaded with many desirable items that never get in the catalog or ads, due to a limited quantity.

Please enclose sufficient postage. Excess refunded.

BANKAMERICARD

FREE CATALOG

DELTA ELECTRONICS

P.O. BOX 2, DEPT. 11R 7 OAKLAND ST., AMESBURY, MASS. 01913

ATLANTA, GEORGIA

DELTA ELECTRONIC HOBBIES
5151 BUFORD HWY, DORAVILLE, ATLANTA, GA.

Send for new catalog 19—120 pages of computer & electronic bargains... the best in the world!

CIRCLE 54 ON FREE INFORMATION CARD

CATCH-A-PULSE II LOGIC PROBE

10 Nsec SPEED AT 4 to 15V LEVELS

Compatible with DTL, TTL, CMOS, MOS, and Microprocessors using a 4 to 15V power supply. Thresholds automatically programmed. Automatic resetting memory. No adjustment required. Visual indication of logic levels, using LEDs to show high, low, bad level or open circuit logic and pulses. Highly sophisticated, shirt pocket portable (protective tip cap and removable coil cord). Eliminates need for heavy test equipment. A definite savings in time and money for engineer and technician.

Pat Pend

Dealer inquiries welcome

ONLY $44.95

- 10 Nsec pulse response
- Open circuit detection
- Replaceable tip & cord
- High input impedance
- Pulse stretching
- Multi-family

SPECIAL PAK-II $51.95

Includes a standard coiled cord, coiled cord with micro hooks, adapter for using CATCH-A-PULSE on logic families whose power supply is 15V to 25V. Shipping add $2.00 per probe.

AR ELECTRONICS
Box 19299, San Diego CA 92119
(714) 447-1770

CIRCLE 1 ON FREE INFORMATION CARD

Radio Shack: No. 1 Parts Place
Low Prices and New Items Everyday!

Top-quality devices, fully functional, carefully inspected. Guaranteed to meet all specifications, both electrically and mechanically. All are made by well-known American manufacturers, and all have to pass manufacturer's quality control procedures. These are not rejects, not fallouts, not seconds. In fact, there are none better on the market! Always count on Radio Shack for the finest quality electronic parts!

Linear ICs

By National Semiconductor and Motorola — first quality

Type	Cat. No.	ONLY
301CN	276-017	49¢
324N	276-1711	1.49
339N	276-1712	1.49
386CN	276-1731	99¢
555CN	276-1723	79¢
556CN	276-1728	1.39
566CN	276-1724	1.69
567CN	276-1721	1.99
723CN	276-1740	69¢
741CN	276-007	49¢
741H	276-010	49¢
3900N	276-1713	99¢
3909N	276-1705	99¢
3911N	276-1706	1.99
4558CN	276-038	79¢
75491	276-1701	99¢
75492	276-1702	99¢
7805	276-1770	1.29
7812	276-1771	1.29
7815	276-1772	1.29

Computer Chip

8-Bit Data Bus, 16-Bit Address Bus

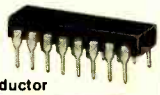
8080A Microprocessor. 100% prime CPU handles up to 65K bytes memory. **276-2510** **12.95**

RAM Memory IC

Under 450 nS Access Time

2102 1K Static RAM. Low power version. 16-pin DIP. Buy 8 and save! **276-2501** ..... **2.49 Ea. or 8/14.95**

TTL and CMOS Logic ICs



Full-Spec Devices Direct from Motorola and National Semiconductor

Type	Cat. No.	ONLY
7400	276-1801	35¢
7402	276-1811	39¢
7404	276-1802	35¢
7406	276-1821	49¢
7410	276-1807	39¢
7413	276-1815	79¢
7420	276-1809	39¢
7427	276-1823	49¢
7432	276-1824	49¢
7441	276-1804	99¢
7447	276-1805	99¢
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¢
7490	276-1808	79¢
7492	276-1819	69¢
74123	276-1817	99¢
74145	276-1828	1.19
74150	276-1829	1.39
74154	276-1834	1.29
74192	276-1831	1.19
74193	276-1820	1.19
74194	276-1832	1.19
74196	276-1833	1.29
4001	276-2401	49¢
4011	276-2411	49¢
4013	276-2413	89¢
4017	276-2417	1.49
4020	276-2420	1.49
4027	276-2427	89¢
4049	276-2449	69¢
4050	276-2450	69¢
4511	276-2447	1.69
4518	276-2490	1.49

Hand-Held 6-Digit Frequency Counter

- **Counts from 100 Hz to 45 MHz**
- **kHz and MHz Decimals**

99.95

A high quality "pocket" counter with accuracy of 3ppm at 25°C or less than 30 Hz at 10 MHz! Overload-protected 1-meg input. Sensitivity, 30 mV up to 30 MHz. Lead-zero blanking. Just 3x4½". With mini-rod antenna, leads, case, instructions. Requires 9V alkaline battery. **22-351** **99.95**

Wire Wrapping Accessories

IC Socket Wrapping Tool. Strips and wraps 30-gauge wire. 276-1570 ..... 6.95
14-Pin Wire Wrapping Sockets. 276-1993 ..... 2/1.29
16-Pin Wire Wrapping Sockets. 276-1994 ..... 2/1.39
DIP Header. 16 pins. 276-1980 ..... 1.29
50' Red 30-ga. Kynar® Wire. 278-501 ..... 1.99
50' White 30-ga. Kynar Wire. 278-502 ..... 1.99
50' Blue 30-ga. Kynar Wire. 278-503 ..... 1.99

NEW IC Breadboard Sockets

Modular boards snap together and feature standard 0.3" center. Accepts 22 through 30-gauge solid hookup wire.

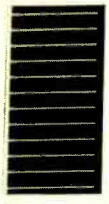
A 550 connections in 2 bus strips of 40 tie points each with 47 rows of 5 connected tie points. 2⅛x6". **276-174** **9.95**

B 270 connections in 2 bus strips of 40 tie points each with 23 rows of 5 connected tie points. 2⅛x3⅜". **276-175** **5.95**

C **Mini-Socket.** 22 rows of 5 tie points each, plus 2 bus strips with 10 connections each. 2⅛x1⅞". **276-176** **3.95**

Solar Cells

Electricity from Light!



4cm x 2cm Silicon Cell

Silicon type cell converts light to electrical power, delivering up to 100 mA at 0.5V. Use several in series-parallel for higher voltage or current. **276-120** **2.99**

2¼" Dia. Silicon Cell

Highly efficient! Delivers up to 400 mA at 0.5V. Ideal for solar power projects, battery charging and operating electronic equipment. **276-121** **5.99**

Low-Cost Power Transformers

- **Primaries Designed to Operate from 120VAC, 60 Hz**
- **Solder Lugs for Easy Wiring or PC Board Mounting**

Volts	Current	Cat. No.	Each
6.3	1.2A	273-050	2.49
6.3	300 mA	273-1384	1.99
12	300 mA	273-1385	1.99
24	300 mA	273-1386	2.49
24	1.2A	273-1480	2.99
12.6 CT	1.2A	273-1505	2.89

Volts	Current	Cat. No.	Each
6.3 CT	3A	273-1510	3.99
12.6 CT	3A	273-1511	4.69
25.2 CT	2A	273-1512	4.99
12	5A	273-1513	8.95
18 CT*	4A	273-1514	8.95
18 CT*	2A	273-1515	4.99

*Ideal for 5V (using CT) or 12V solid-state regulators

NEW 3-Amp 4PDT Relay

With Clear Protective Cover

Switch up to four different circuits! Contacts rated 3 amps at 125VAC. 12VDC coil, 160 ohms resistance. Solder terminals. Just 1¾x1⅛x13/16". **275-214** **4.99**

Radio Shack Reference Books

Digital Integrated Circuits. Complete specs. AC test circuits, waveforms. **62-1370** **3.95**

Voltage Regulator Handbook. **62-1371** **2.95**

Linear Integrated Circuits. Covers op-amps, voltage regulators, more. **62-1372** **3.95**

Linear Applications. Fully indexed and cross-referenced. **62-1373** **2.95**

Linear Applications, Vol. 2. The latest data sheets, applications. **62-1374** **2.95**

CMOS Integrated Circuits. Covers 74C series, CD4000 with data specs. **62-1375** **3.95**

Memory Data Book. **62-1376** **3.95**

Intel® 8080/8085 Programming Manual. Uses Intel's assembly language. **62-1377** **3.95**

Intel Memory Design Handbook. Companion to Data Catalog, below. **62-1378** **3.95**

Intel Data Catalog. 928 pages of complete specs on most Intel standard devices. **62-1379** **4.95**

Paddle Switches

NEW

Rated 6 Amps at 125VAC

Mounts in ¾" round hole—no need to cut square opening.
SPST Black. 275-641 ..... **1.69**
SPDT Red. 275-642 ..... **1.89**
DPDT Black. 275-643 ..... **2.19**

Lighted DPDT Pushbutton Switch

NEW

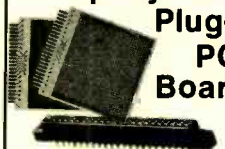
Push-on/push-off switch rated 4A at 12VDC. Button glows red in "on" position. Mounts in 9/16" hole. U.L. listed. **275-675** **4.69**

8-Rocker DIP Switch

Standard .100x.300" DIP

Designed for easy change of preset logic states in digital circuits. Fits 16-pin IC socket or mounts on PC board. **275-1301** **1.99**

Epoxy-Glass Plug-In PC Boards



For 22-pin connectors. 4½x4". 1/10" grid. 3 styles available.
Standard. 276-155 ..... **4.49**
Digital. 276-156 ..... **4.49**
Op-Amp. 276-157 ..... **4.49**
22-Pin Dual Connector. **276-1551** **2.99**

WHY WAIT FOR MAIL ORDER DELIVERY? IN STOCK NOW AT OUR STORE NEAR YOU!

Prices may vary at individual stores and dealers

Radio Shack®

A DIVISION OF TANDY CORPORATION • FORT WORTH, TEXAS 76102
OVER 7000 LOCATIONS IN NINE COUNTRIES

CABLE FM station. No experience required, excellent spare-time income, others operate for you. Details free. **BROADCASTING,** Box 130-F11, Paradise, CA 95969

WANTED: Manual for model MC-930 TV camera by Javelin Electronics. **DAN OGLE,** Box 84, Council, ID 83612

EDUCATION & INSTRUCTION

GRANTHAM's FCC License Study Guide—377 pages, 1465 questions with answers/discussions—covering third, second, first radiotelephone examinations. $13.45 postpaid. **GSE PUBLICATIONS,** 2000 Stoner, Los Angeles, CA 90025

UNIVERSITY degrees by mail! Bachelors, Masters, Ph'D's . . . Free revealing details. **COUNSELING,** Box 317-RE11, Tustin, CA 92680

F.C.C. EXAM MANUAL

PASS FCC EXAMS! Memorize, study—Tests-Answers for FCC 1st and 2nd class Radiotelephone licenses. Newly revised multiple choice questions and diagrams cover all areas tested in FCC exams, plus Self-Study Ability Test. $9.95 postpaid. Money-back guarantee.

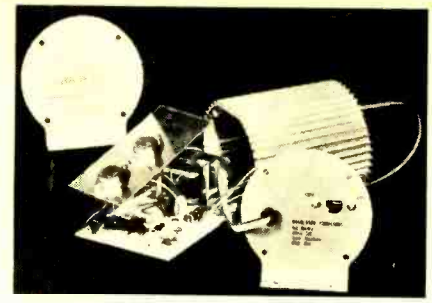
Tests-Answers for FCC First and Second Class Commercial License

COMMAND PRODUCTIONS RADIO ENGINEERING DIV. P.O. BOX 26348 E SAN FRANCISCO, CAL. 94126

TELEPHONE bugged? Don't be Watergated! Countermeasures brochure $1.00. **NEGEYE LABORATORIES,** Box 547-RE, Pennsboro, WV 26415

Have regular medical check-ups.

American Heart Association
We're Fighting For Your Life



FROM KIT TO CAR IN 80 MINUTES!

Electronic ignition is "in." Update your car with the TOPS in power, efficiency and reliability — the TIGER SST capacitive discharge ignition (CD).

The TIGER delivers everything other CD's promise — and more: quicker starting, more power, more gas mileage, tune-ups eliminated, lifetime plugs and points, reduced repairs and pollution.

The TIGER can be built and installed in your car in 80 minutes. The TIGER is unique!

The TIGER comes with a switch for TIGER or standard ignition for 12V negative ground only.

Simpli-Kit $21.95
POST PAID U.S.A.

WE ACCEPT:
Mastercharge or Bank Americard.
Send check or money order with order to:

Tri-Star Corporation
DEPT. FF, P.O. Box 1727
Grand Junction, Colorado 81501

CIRCLE 28 ON FREE INFORMATION CARD

Why is this the
LARGEST SELLING low cost COUNTER KIT?

This counter is such a great seller because people like you have found that, feature for feature, the CT-50 gives you more for your money. Advanced LSI and CMOS circuitry has; lowered power consumption, increased performance, and reduced cost. Complete push button operation makes using the CT-50 a snap, and automatic decimal point positioning gives you quick, reliable readings. Battery operation is also possible because the CT-50 runs equally as well on 12VDC as it does on 110VAC. For ultra-accuracy we offer the CB-1 color burst adapter, it locks the CT-50's internal crystal to the television networks color standard for .001 ppm accuracy! Why sacrifice performance by using another counter when you can get professional quality at the unheard of price of **$89.95**? Order yours today!

SPECIFICATIONS
Sensitivity: less than 10 mv.
Frequency range: 5 Hz to 60 MHz, typically 65 MHz
Gatetime: 1 second, 1/10 second, with automatic decimal point positioning on both direct and presacle
Display: 8 digit red LED .4" height
Accuracy: 2 ppm, internal TCXO standard.
Input: BNC, 1 megohm direct, 50 Ohm with prescale option
Power: 110 V ac 5 Watts or 12 V dc @ 300 400 ma
Size: Approx. 6" x 4" x 2", high quality aluminum case

CT 50,60 MHz Counter Kit $89.95
CT-50 wt 60 MHz Counter Wired & Tested $159.95
CT-600, 600 MHz prescaler option for CT-50, add $29.95

MINI-KITS

FM WIRELESS MIKE KIT
Transmit up to 300' to any FM broadcast radio, uses any type of mike. Runs on 3 to 9V. Type FM-2 has added super-sensitive mike preamp.
FM-1 – $2.95 FM-2 – $4.95

SUPER-SLEUTH AMPLIFIER
A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or 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

COLOR ORGAN/MUSIC LIGHTS
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

TONE DECODER KIT
A complete tone decoder on a single PC Board. Features: 400-5000 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. Runs on 3 to 9 volts.
Complete Kit, BL-1 ..... $2.95

POWER SUPPLY KIT
Complete triple regulated power supply provides variable +15 volts at 200 mA and ±5 volts at 1 Amp. 50 mV load regulation good filtering and small size. Kit less transformers. Requires 6-8V at 1 Amp and 18 to 30 VCT.
Complete Kit, PS-3LT $6.95

SIREN KIT
Produces upward and downward wail characteristic of police siren. 5 watts audio output, runs on 3-9 volts, uses 8-45 ohm speaker.
Complete Kit, SM-3 ..... $2.95

VIDEO MODULATOR KIT
Converts any TV to video Monitor. Super stable tunable over Ch. 4-6. Runs on 5-15V, accepts std. video signal. Best unit on the market.
Complete Kit, VD-1 ..... $6.95

SIX DIGIT 12/24 HOUR CLOCK KIT

Here's a clock you can be proud of. The best looking, most complete kit on the market! Features include: time set push-buttons, jumbo .4" readouts, and extruded aluminum case available in 5 colors, All parts included. Colors: gold, silver, bronze, black, blue (specify)

Clock Kit, DC-5 ..... $22.95
Mobile Clock, DC-7 ..... 25.95
Alarm Clock, 12 Hr., DC-8 ..... 24.95
Clock with HAM ID timer DC-10 25.95

Assembled and tested clocks available, add $10.00 to Kit price.

600 MHz PRESCALER

Extend the range of your counter to 600 MHz. Works with all counters. Less than 150 mv sensitivity. Specify −10 or −100. Wired, tested,

PS-1 B $59.95
Kit, PS-1 B $44.95

CALENDAR ALARM CLOCK

Has every feature one could ever ask for. Kit includes everything except case, build it into wall, station or even car!

FEATURES:
- 6 Digits, .5" High LED
- 12/24 Hour Format
- Calendar shows mo./day
- Snooze button
- True 24 Hour Alarm
- 7001 chip does all!!
- Battery back up with built-in on chip time base.

Complete Kit, less case
DC-9 ..... $34.95

TV TYPEWRITER KIT

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, 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

CAR CLOCK KIT

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 for DC-11 ..... $2.50

741 OP AMP SPECIAL
Prime, Mini-dip 10/$2.00

ICs		LINEAR		REGULATOR		TRANSISTORS	
5314 Clock	$2.95	555	$ .50	78MG	$1.49	MRF-238 30W VHF	$11.95
7001 Clock	6.95	556	.75	309K	.89	NPN 2N3904 type	10/$1.00
5369 Cnos	1.95	566	1.49	309H	.99	PNP 2N3906 type	10/$1.00
7447	.79	567	1.49	340K-12	.99	NPN Power Tab 40W	3/$1.00
7473	.35	1458	.50	7805	.89	PNP Power Tab 40W	3/$1.00
7475	.50	LED DRIVER		7812	.89	FET MPF-102 type	3/$2.00
7490A	.55	75491	.50	7815	.89	UJT 2N2646 type	3/$2.00
74143	3.50	75492	.50	7818	.89	2N3055 NPN Power	.75

SPECIAL

ORDER BY PHONE OR MAIL
Satisfaction guaranteed or money refunded. Add 5% for shipping and insurance. COD add $1.50. Orders under $10.00 add $.75. NY residents add 7% sales tax. Minimum order $6.00

ramsey electronics
BOX 4072B ROCHESTER, NY 14610 (716) 271-6487

RADIO-ELECTRONICS

CIRCLE 42 ON FREE INFORMATION CARD

YOU'RE UNDER SURVEILLANCE!!

A HOST OF PEOPLE, AGENCIES, AND COMPUTERS ARE BUSY SPYING ON YOU AND YOUR BUSINESS EVERY DAY, OFTEN ILLEGALLY. . . .

HOW TO STOP IT OR DO IT BACK!

THE BIG BROTHER GAME

A Large Format (8½'' x 11'') Quality Paperback, 240 Pages

BUGGING
WIRETAPPING
TAILING
OPTICAL AND
ELECTRONIC SURVEILLANCE
SURREPTITIOUS ENTRY
DETECTIVE TECHNIQUES
WEAPONS
COUNTERMEASURES

$9.95

"A VIRTUAL ENCYCLOPEDIA ON SURVEILLANCE . . . EVERYTHING YOU'VE ALWAYS WANTED TO KNOW ABOUT SPYING."—
PLAYBOY MAGAZINE

With Each Order You Receive Free Other Material And Literature For Investigative Procedure
Anarchist Cookbook $9.95
CIA Improved Munitions Black Book $9.95

QUIMTRONIX
Postpaid—P.O. Box 548-RE
Seattle, Washington 98111

CIRCLE 34 ON FREE INFORMATION CARD

INTERNATIONAL ELECTRONICS UNLIMITED

fall sale

LOW POWER SCHOTTKY - 74LS series
Prime Motorola IC's Factory warranted
Buy $10.00 -any mix- deduct 10%
Buy $15.00 -any mix- deduct 10%

74LS00	$.18	74LS54	$.18	74LS157	$.44	74LS251	$.66
74LS01	.18	74LS55	.18	74LS158	.53	74LS253	.66
74LS02	.18	74LS74	.26	74LS160	.63	74LS256	.83
74LS03	.18	74LS83	.60	74LS161	.63	74LS257	.44
74LS04	.20	74LS85	.71	74LS162	.63	74LS258	.66
74LS05	.20	74LS86	.30	74LS163	.63	74LS259	.83
74LS08	.18	74LS90	.42	74LS165	.86	74LS260	.18
74LS09	.18	74LS92	.43	74LS168	.84	74LS266	.29
74LS10	.18	74LS93	.43	74LS169	.84	74LS279	.31
74LS11	.18	74LS95	.74	74LS170	1.27	74LS283	.71
74LS13	.31	74LS109	.26	74LS173	.51	74LS290	.56
74LS14	.48	74LS112	.26	74LS174	.51	74LS293	.63
74LS15	.18	74LS113	.26	74LS175	.51	74LS295	.89
74LS20	.18	74LS114	.26	74LS181	2.17	74LS298	.89
74LS21	.18	74LS122	.33	74LS190	.96	74LS365	.36
74LS22	.18	74LS123	.63	74LS191	.81	74LS366	.36
74LS26	.21	74LS125	.36	74LS192	.64	74LS367	.36
74LS27	.18	74LS126	.36	74LS193	.64	74LS368	.36
74LS28	.20	74LS132	.59	74LS194	.66	74LS378	.69
74LS30	.18	74LS133	.18	74LS195	.64	74LS390	.96
74LS32	.18	74LS136	.28	74LS196	.76	74LS393	.96
74LS33	.21	74LS138	.51	74LS197	.76	74LS395	.96
74LS37	.21	74LS139	.59	74LS240	1.39	74LS490	1.78
74LS38	.21	74LS151	.44	74LS241	1.39	74LS670	1.89
74LS40	.20	74LS153	.44	74LS242	1.32		
74LS42	.60	74LS155	.76	74LS243	1.32		
74LS51	.18	74LS156	.76	74LS244	1.39		

TTL - 7400 - Full Spec
Some items overmarked house numbers
Buy $10.00 -any mix- deduct 10%
Buy $15.00 -any mix- deduct 15%

7400	.10	7441	.75	7491	.64	74163	.75
7401	.15	7442	.35	7492	.39	74164	.65
7402	.14	7443	.45	7493	.39	74165	.75
7403	.12	7444	.60	7494	.59	74166	.95
7404	.14	7445	.50	7495	.59	74170	1.50
7405	.17	7446	.55	7496	.49	74173	1.25
7406	.15	7447	.55	74100	.89	74174	1.05
7407	.15	7448	.60	74105	.38	74175	.65
7408	.18	7450	.15	74107	.25	74176	.70
7409	.15	7451	.15	74121	.29	74177	.70
7410	.10	7453	.13	74123	.32	74180	.40
7411	.19	7454	.10	74125	.45	74181	1.95
7413	.30	7460	.10	74126	.40	74182	.70
7414	.55	7464	.20	74132	.60	74185	1.85
7415	.22	7465	.20	74141	.70	74190	.95
7416	.14	7470	.27	74145	.70	74191	.85
7417	.20	7472	.30	74150	.89	74192	.50
7420	.14	7473	.29	74151	.50	74193	.50
7423	.28	7474	.18	74153	.50	74194	.85
7425	.32	7475	.42	74154	.95	74195	.50
7426	.15	7476	.29	74155	.55	74196	.80
7427	.20	7480	.17	74156	.40	74197	.75
7430	.17	7483	.58	74157	.45	74198	1.40
7432	.15	7485	.75	74158	.55	74199	1.25
7437	.15	7486	.27	74160	.65	74S200	3.25
7438	.15	7489	1.25	74161	.60	74279	.65
7440	.13	7490	.35	74162	.95		

LINEAR CIRCUITS
All guaranteed functional
Some items overmarked house numbers
Buy $10.00 -any mix- deduct 10%
Buy $15.00 -any mix- dedict 15%

LM300H	.49	LM340T (78XX)		LM566CN	1.19
LM301CN	.20	5,6,8,12,		LM567CN	1.19
LM302H	.45	15,18,24	1.19	LM567H	1.49
LM304H	.80	LM370	.65	LM703H	.59
LM305H	.45	LM372N	2.93	LM703CN	.39
LM307CN	.20	LM376CN	.25	LM709N	.25
LM307H	.30	LM377N	.95	LM709H	.29
LM308H	.39	LM380N	.79	LM710N	.59
LM309H	1.05	LM380-8CN	.59	LM711N	.35
LM309K	1.05	LM381N	1.75	LM723H	.55
LM310CN	1.07	LM382N	1.75	LM723N	.52
LM311CN	.40	LM385K	.25	LM733H	.59
LM311H	.50	LM386CN	.49	LM739N	.65
LM319N	1.13	LM387CN	.49	LM741CN(8)	.25
LM320K		NE531V	1.90	LM741CN(14)	.32
5,5.2,12,		NE540L	1.90	LM741CH	.35
15	1.29	NE546A	1.09	LM747H	.79
LM320T (79XX)		NE550A	.75	LM747N	.65
5,12,15	1.19	LM555CN	.39	LM748CN	.25
LM322N	.69	NE556A	.85	LM1310N	2.25
LM324N	.95	LM560N	2.95	LM1414N	.60
LM339N	.69	LM561N	2.95	LM1456CN	1.29
LM340K		LM565N	.59	LM1458CN	.59
5,6,8,12,		LM565H	1.39	LM1496N	.89
15,18,24	1.29	LM566H	1.39	LM1800N	1.75

ULN2208	.89	75451CN	.25
ULN2209	.89	75452CN	.25
CA3046	1.19	75453CN(351)	.25
CA3081N	1.49	75454CN	.35
CA3081H	1.97	75491N	.65
CA3082	1.45	75492N	.75
CA3090N	.35	XR320	1.19
LM7524	.79	XR2207	1.49
LM7525	.79	XR2567	1.49
LM7535	.45	XR4136	1.49
8038B	4.59	XR4202	.69
75450AN	.35	XR4212	.69
		XR4739	.69

IC SOCKETS

Low Profile Solder Tail				Wire Wrap	
8 pin	$.16	24 pin	$.36	8 pin	.45
14 pin	.19	28 pin	.44	14 pin	.49
16 pin	.21	40 pin	.61	16 pin	.55
18 pin	.28				

CAPACITOR ASSORTMENT - All ±10%
(10pf-820pf ceramic) (.001uf-.47uf polyester)

10pf/50V	68pf/50V	220pf/50V	.001uf/100V	.022uf/100V
22pf/50V	82pf/50V	270pf/50V	.0022uf/100V	.047uf/100V
33pf/50V	100pf/50V	470pf/50V	.0033uf/100V	.1uf/100V
47pf/50V	150pf/50V	600pf/50V	.0047uf/100V	.2uf/100V
56pf/50V	180pf/50V	820pf/50V	.01uf/100V	.47uf/100V
			.015uf/100V	

TANTALUM CAPACITORS
±20% solid dipped

	1-10	11-		1-10	11-
.22u/35V	.25	.20	10u/16V	.35	.30
.33u/35V	.25	.20	10u/20V	.38	.33
1u/35V	.25	.20	15u/6.3V	.38	.33
2.2u/20V	.28	.23	15u/20V	.45	.40
2.2u/35V	.30	.25	22u/16V	.45	.40
3.3u/35V	.35	.30	33u/10V	.55	.50
4.7u/16V	.30	.25	47u/6V	.55	.50
6.8u/6V	.30	.25	47u20V	.65	.55
6.8u/16V	.30	.25	56u/6V	.75	.65
6.8u/50V	.35	.30	100u/20V	1.45	

cylindrical (axial)

	1-10	11-
.68u/15V	.20	.15
15u/25V	.40	.35

CERAMIC DISC CAPACITORS - 50V

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

1pf-.050u .1uf

	1-10 per value	$.10	$.15
11-100		.05	.10
100-		.04	.08

CERAMIC CAPACITOR ASSORTMENT - 50V

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

10ea of above values.....$11.95
Supplied in steel cabinet with clear styrene drawers.....$19.95
Cabinet shipping chrg (US & Canada).....$2.00

TANTALUM CAPACITOR KIT
solid dipped, 12 values, 5 each

.1uf/35V	2.2/35	10/25	33/10
.33/35	4.7/16	15/20	47/25
1/35	6.8/16	22/16	56/6

capacitors only.....$14.95

SUMMER CIRCUITS
ELEKTOR 78
Double issue containing more than 100 circuits - such as high-perf. disc pre-amp, Audio control ampl., LED level indicator, Car ammeter, Bike speedometer, A/D converter and many more.
with order $3.00
mag only 4.25

Carbon Film ± 5% 1/4 w or 1/2 w
15 ea. of 12 values:
100, 220, 470, 1K, 1.5K, 3.3K
4.7K 6.8K, 10K, 33K, 100K, 1M.
$5.45

PRECISION RESISTOR PACKAGE
Metal film, ±1%, 1/4w, 50ppm
240 resistors, 4 ea. from 10.5 to 464K $27.95
Supplied in steel cabinet with clear styrene drawers $39.50
Cabinet shipping chrg, US & Can.$2.00

PRECISION RESISTOR PACKAGE
Metal Film ± 1% 1/4 watt
Starter Kit - 2ea. 60 values
120 Resistors 10.5 ohm- 464K
$14.95
Supplied in 15 Drawer 60 Comp. Cabinet - $26.50 + $2.00 Sh.

VECTOR BOARD - Phenolic
169P44-062 (.1"spacing .42" dia.)
4-1/4" x 4-1/2" x .0625"...$1.15 ea.

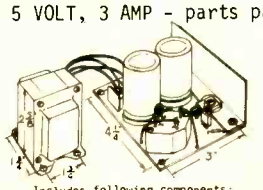
DL10A	.27" Red CA LHD		.79
MAN66	.60" Red CA LHD		1.19
DL33B	2 Dig .17" Red CC		.29
DL33B	3 Dig .17" Red CC		.49
NSN33	3 Dig .17" Red CC		.39
MAN72	.30" Red CA LHD		.59
MAN74	.30" Red CC RHD		.59
NSN74R	.30" Red CC RHD		.59
MAN82	.30" Yellow CA LHD		.69
OL702	.30" Red CC LHD		.69
HP7651	.5" Red CA RHD		.79
HP7653	.5" Red CC RHD		.79
HP3400	.8" Red CA LHD		1.25
HP3405	.8" Red CC LHD		1.25
MAN3620	.30" Orange CA LHD		.79
MAN3630	.30" +1 Orange CA RHD		.49
MAN4610	.40" Orange CC RHD		.59
HP5082	5 dig .11"mag. Red CC RHD		.49
HP5082	4 dig .11"mag. Red CC RHD		.39
HP5082	5 dig .11"mag. Red CC CD		.49

8EZELS - with red filters

140-2	cut-out 1.125" x 2.375" max .062" panel thickness	$1.75
140-4	cut-out 1.160" x 4.375" max .125" panel thickness	$2.75

MM5316	Clock Chip	.95
MM5370	Clock Chip	3.95
MM5375AA	Clock Chip	2.95

POWER SUPPLY
5 VOLT, 3 AMP - parts package



Includes following components:

115/9V Transformer	2 - 3300uf/25V Caps.
PC Board	Diode
Rectifier	Terminal Block
Power Transistor	Heat Sink
5V Regulator	Power cord

Supplied with layout and schematic..$22.95
Shipping (US & Canada).....$3.00

IC SPECIALS

LM311N, LM311CN Volt. comparator	$ .29
LM739N Dual hi perf op amp	.59
LM1414N Dual diff comp	.49
LM3900N Quad op amp	.29
XR4136N Quad op amp	.79
SL-5-4025 Quad 25bit shift reg.	.50
2510 Dual 100bit static shift register	.50
2511 Dual 200bit static shift register	.65
2513 64x8x5 Char gen upper case	3.95
2513 64x8x5 Char ger lower case	3.95
2516 64x6x8 Char gen ASCII	6.95
F93410 256bit RAM bi-polar	.95
74S200 (82S16) 256bit RAM tri-state	2.75
8008 8 bit microprocessor	9.95
LD110/111 set 3 1/2 digit A/D convert	17.95
F7001 Calendar clock	4.95
TR1602 UART	3.95

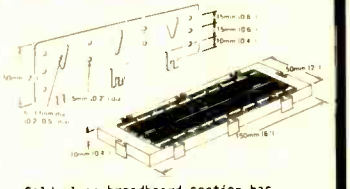
2N1132	PNP Gen Purp. Ampl TO-5 $ .69
2N2218A	NPN Low Power Trans TO-5 .69
2N2222A	NPN Low Power Trans TO-18 .29
2N2223	NPN Low Power Trans. TO-5 .69
2N2369	NPN Low Power Trans TO-5 .29
2N2904	PNP Low Power Trans TO-5 .49
2N2905A	PNP Low Power Trans TO-5 .76
3N3227	NPN Low Power Trans TO-18 .69
2N3904	NPN Low Power Trans TO-92 .17
2N3906	PNP Low Power Trans TO-92 .17
SCA 13572	NPN Pwr Trans - 200V TO-5 1.75

ELECTRONIC BUZZER

Miniature, Solid State
6V 15ma (4-9V oper.) $1.29 ea.
12V 15ma (8-20V oper.) $1.29 ea.

CLOCK KIT - Mark I
6 digit clock kit with one PC board. Accommodates MM5314 clock chip and 6 FND 359 displays contains all components except transformer. Includes 3 switches. Board has terminals for remote displays. $10.95

8IMBOARD - BREADBOARD KIT



Solderless breadboard section has 94 breadboard strips of 5 sockets each. 2 bus strips of 40 sockets each. Component bracket for switches lamps etc., accepts leads .01" to .035" diameter. $11.95 ea.

Silicon SW diode assorted 400 mw	$.05ea
1N4148 (1N914) Silicon diode 400 mw	.10
1N3064 Silicon SW diode 400 mw	.10
1N4006 Silicon rect. diode 600V 400mw	.10
Zener diode 400 mw - 2.4V, 3.6V, 5.1V, 6.5V, 6.8V, 10V, 12V, 14.5, 15V, 120V	.15
Germanium diode 400 mw	.08

CERMET TRIMMER SPECIAL
2ea of following values of Mepco 8014 - single turn
500, 1K, 2K, 5K, 10K, 20K
50K, 100K, 500K, 1M
$12.50

TRIMPOT - Single Turn
Mepco - Cermet 8014
.5w, ± 100 PPM/°C ± 20%
500 ohm, 2K, 10K, 20K, 50K, 100K, 500K, 1M

1-9	10-99	100-999	1000-
$.75ea	.69	.63	.57

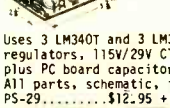
METAL FILM RESISTORS
Rohm QUALITY RELIABILITY
± 1%, 1/4w, ± 50 PPM/°C
Standard Decade Values 10.5 - 464K

Qty.	Ea.	Min 10/value	Min 100/value
1-99	$.20	$.15	
100-999	.20	.10	$9.00/100
1000-			8.00/100

Carbon Film Fesistors ± 5% 1/4w, 1/2w

Qty.	Ea.	Min 10/value	Min 100/value
1-99	$.10	$.05	
100-999	.10	.04	$3.00/100
1000-			2.50/100

REGULATED POWER SUPPLY

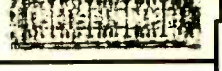


Plus & minus 5V 12V 15V
Uses 3 LM340T and 3 LM320T regulators, 115V/29V CT transformer plus PC board capacitors & diodes. All parts, schematic, instructions PS-29.....$12.95 + $1.00 Shppng.

TRIMPOT - 25 turn
Bourns - Cermet 3299W
PC Mount, vert. adj.
2K, 10K, 20K

1-9	10-999	100-
$1.65	1.50	1.35

I C BREADBOARD
Silver plated copper circuits holds 5 - 16 pin DIP IC's and interconnection holes. $1.00



UNIVERSAL BREADBOARD
Silver placed copper circuits fits any IC and related components. 2 triple rows of 27 holes for DIP. 3-3/16"x5-1/16" $1.00

COMPLETE SATISFACTION GUARANTEED. SHIPMENT TO US AND CANADA PREPAID UNLESS INDICATED OTHERWISE. OTHER COUNTRIES ADD 10% - EXCESS REFUNDED. ORDERS SHIPPED IN 3 WORKING DAYS FROM RECEIPT. MINIMUM ORDER $10.00 CALIFORNIA RESIDENTS ADD SALES TAX. MINIMUM COD OR CHARGE ORDER $15.00

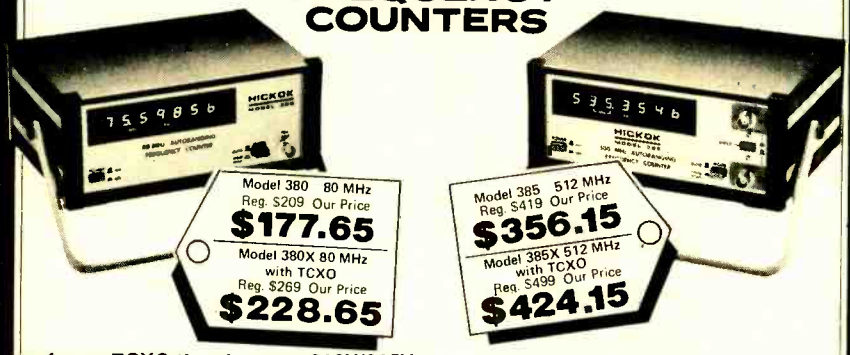
INTERNATIONAL ELECTRONICS UNLIMITED
VILLAGE SQUARE, P.O. BOX 449, CARMEL VALLEY, CA 93924 USA
TELEPHONE 408 659-3171

CIRCLE 14 ON FREE INFORMATION CARD

FORDHAM BEST BUYS

HICKOK INSTRUMENTS

FREQUENCY COUNTERS



Model 380 80 MHz
Reg. $209 Our Price
$177.65
Model 380X 80 MHz with TCXO
Reg. $269 Our Price
$228.65

Model 385 512 MHz
Reg. $419 Our Price
$356.15
Model 385X 512 MHz with TCXO
Reg. $499 Our Price
$424.15

• 1 ppm TCXO time base on 380X/385X meets FCC regulations for most communications service. • External time base input on 380/385. • TCXO output on 380X, 385X will drive 4 other counters. • Standard 10 ppm time base (380/385) meets FCC regulations for CB service. • Built-in tilt stand/handle. •Autodecimal in prescaled mode 385/385X • Display freeze (380/385).

SPECIFICATIONS:

	380, 380X	385, 385X
Range:	1 Hz to 80MHz	1 Hz to 512 MHz
Accuracy:	± 1 count ± time base uncertainty	± 1 count ± time base uncertainty
Display:	7 LED digits, .3", auto decimal	7 LED digits, .3", auto decimal
Gate Times:	autoranging 1 sec., 0.1 sec., 1 sec. manual, 0.1 sec SPEED READ	autoranging 1 sec., 0.1 sec., 1 sec manual, 0.1 sec SPEED READ
Input		
Impedance:	1MΩ, 25pF	
Sensitivity:	100 mVrms from 1 Hz to 100 kHz increasing linearly to 25 mVrms from 1 MHz to 30 MHz decreasing linearly to 80 mVrms at 80 MHz	1 Hz to 80 MHz input: same as 380/380X 10 MHz to 512 MHz input: 50Ω 25 mVrms 50 MHz to 100 MHz 50 mVrms to 300 MHz 100 mVrms to 400 MHz 300 mVrms to 512 MHz
Time Base:	380, 385	380X, 385X
Type:	crystal oscillator	temperature compensated crystal oscillator (TCXO)
Frequency:	10 MHz	10 MHz
Setability:	to ± 0.1 ppm	to ± 0.1 ppm
Stability with line:	0.1 ppm for ± 10% line variation	0.1 ppm for ± 10% line variation
with temp:	10 ppm from 0° C to 50° C	± 1 ppm from 0° C to 40° C
Aging Rate:	5 ppm/year	± 1 ppm/year
External Input:	1 MHz, 1 Vrms	
Output:		Buffered TCXO, 1 MHz, TTL level
General — ALL UNITS		
Power:	105-125 Vac/210-250 vac. 50-400 Hz, 14 watts	
Dimensions:	8-1/2"w X 4"h X 6"d (Not including handle)	
Weight:	4 pounds	

CB IN-LINE TESTER

Model 388
Reg. $399 Our Price
$339.15
Model 388X with TCXO
Reg. $499 Our Price
$424.15

• Seven-digit frequency — accurate to 10 ppm with 10 Hz resolution. • Three-digit power output — two ranges — 10 watts or 100 watts with resolution to 0.1 watt. • Four-digit SWR reading 1.00:1 to 20.00:1 — with exclusive "dynamic ratio" technique, one-step measurement — No Cal/Set required — continuously reads accurate SWR regardless of changing power level. • Three digit % modulation readings 0% to 100% in 1% increments — also uses "dynamic ratio" technique — No Cal/Set required. • Front panel counter input. • External timebase input. • TCXO timebase output (388X). • AC or DC powered.

FREE

Immediate Delivery. . . To Place Your Order

Call TOLL FREE (800) 645-9518

N.Y. State call (516) 752-0050

FORDHAM RADIO SUPPLY CO., INC.
855R Conklin St.
Farmingdale N.Y. 11735

Mastercharge
BankAmericard
VISA and
C.O.D.s accepted

ADD $3.00 TO COVER SHIPPING, HANDLING & INSURANCE. N.Y. Res. add approp. Sales Tax

YOUR ONE STOP DISCOUNT CENTER

Send for new 1978 catalog of over 3,000 items. 164 pages of test equipment, CB, tools, tubes, components and electronic supplies.

CIRCLE 73 ON FREE INFORMATION CARD

ALDELCO ELECTRONICS COMPANY

NEW IMPROVED DIGITAL ALARM CLOCK KIT
0.5 LED Display 12 hour format
Snooze Feature
Elapsed Timer
Simulated Wood Grain or Black Leather Cabinet $24.95
12 or 24 Hour Clock Kit. Similar to above but without Alarm or Timer features Only $23.95
Crystal Time Base Kit for 12 Volt DC use 4.95

DIGITAL MULTIMETER—THERMOMETER KIT 3½ digit—5 ranges on each. Functions: AC-DC, 2 to 2,000 Volts, 2 Micro Amps to 2 Amps, 2,000 Ohms to 2 Meg Ohms. Price $49.95

VOLTAGE REGULATORS
TO220 Package

Positive	Negative
$1.00	$1.25
7805	7905
7806	7906
7808	7912
7812	7915
7815	7918
LM309H	$1.10
LM309K	1.10
LM723	.55

Special Electrolitics
555 Timers 3MFD @12v 3/$.25
3 for $1.10
2200 MFD @16v 3/$1.00

CAPACITOR SPEC.
25 for $1.00

8pF	15pF	22pF
.01	20pF	47pF
.001	100pF	800pF

.01 Disc 30 volt 100 for $3.50
500 for $15.50

TURNER PTT Hand Mike Model J360DM with 5 pin DIN. GOOD for Ham CB marine and aviation only $10.95

Kit of parts for power supply. Includes schematic
5 Volt, 6 Amp $17.95
+15 and −15 2 Amp $16.95

FETS 40673 1.55
MPF102 .55
We have transistors. Send stamp for catalog.

MA 1003 National Car Clock Module
With 3 push button switches and filters $19.95
New aluminum cabinet for MA 1003 $6.95

MC1458P SPEC.
Only .49
567 PLL $1.10

Monsanto MV5053 Jumbo Red LED and LED Holder .25 each
Green, Yellow or Orange LEDS 5 for $1.00
FND 70 CC 0.3 Display LED .49
FND 500 CC 0.5 Display LED .89
FND 503 or FND 507 1.35
CLOCK FILTERS 2¼ x 5¼" Red, Blue, Green or Amber .60 ea

BRIDGE RECTIFIERS

2 Amp 200 Volt	$.50
2 Amp 400 Volt	.95
3 Amp 200 Volt	.85
25 Amp 200 Volt	2.50
25 Amp 400 Volt	4.00

BLINKEY-FLASHER-TIMER KIT Includes 555, PC Board Parts & Instructions $2.50

ACCUKEYER KIT. Uses TTL, includes IC's, sockets, Speaker, PC Board, instructions and all parts ONLY $19.95
MEMORY KIT. Matches above & other accukeyer kits ONLY $19.95

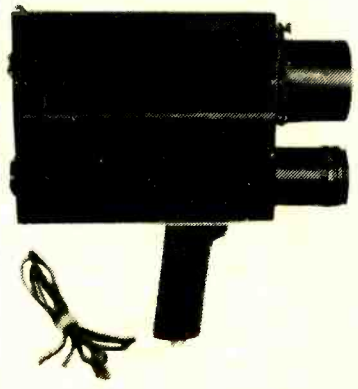
VARIABLE POWER SUPPLY KITS. .5 Amps 5-15 Volt DC $6.95
add $1.00 per kit shipping .5 Amps 12-28 Volt DC 6.95

Visit Our Store. Hours 9:00 AM to 6:00 PM Mon. to Fri. Sat. 9:00 AM to 2:00 P.M. Phone Orders accepted. Visa & Master Charge. ADD 5% FOR SHIPPING. ORDERS UNDER $10.00 add $1.00. Foreign Orders add 15% shipping (Except Canada & Mexico) send Certified Check or Money Order in USA funds.

ALDELCO

2281R BABYLON TURNPIKE, MERRICK, N.Y. 11566
(516) 378 4555

CIRCLE 33 ON FREE INFORMATION CARD



SEE IN THE DARK

IR viewer complete ready to operate. Guaranteed by the manufacturer. Portable, runs on lantern battery. New, see in total darkness. No shipments to Calif. Comes complete with built in IR source and adjustable focus lens. SPL-21 $199.00

CHARACTER GENERATOR CHIP
Memory is 512X5 produces 64 five by seven ASCH characters. New by National, w/specs $6.00

TOUCHTONE ENCODER CHIP
Compatible w/Bell system. Ideal for repeater work. W/specs $6.00

HAWKEYE RADAR SPEED TRAP alarm
Plugs into cigar lighter outlet $30

12 VOLT DC POWER SUPPLY 2½ amps.
Runs CB's, tape decks in house. New in metal cabinet. $14

customer pays all postage

MESHNA, PO BOX 62, E. Lynn Ma 01904

CIRCLE 39 ON FREE INFORMATION CARD

30 MHZ LOW COST FREQUENCY COUNTER KIT

Features:
- Frequency Range—100Hz to 30MHz min., resolution 100 Hz
- All TTL Circuitry—No tears in the eyes when replacing ICs
- FET Input Stage—Offers high input impedance
- High Sensitivity—15mV typical
- Xytal Time Base—0.001% 10MHz for better accuracy
- On Board Regulator—No external power supply needed
- All ICs Socketed—Easy to service
- Easy to Operate—No switches to flip
- Tin Plated & Screened Board—For easy assembly

COMPARE and SAVE!

$54.95

KIT # T-250-30A

KIT INCLUDES: Detailed Instructions (22 pages). All parts including transformer (case not available).

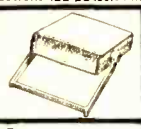
OUR BEST SELLER
5V 10A POWER SUPPLY KIT
Includes: Extra large heat sink, power transistor, ICP regulator, P.C. board with OVP.
Kit No. T-500 $14.95
With optional rectifiers and filtering cap. $17.95

2-20V ADJ. POWER SUPPLY
KIT INCLUDES: Transformer, PC Board, Large heat sink, Large filtering capacitor and all the parts with detailed instruction. KIT # T-1658 $12.95

Car Battery Eliminator
KIT INCLUDES: Transformer, PC Board, Large heat sink, Large filtering capacitor
KIT#700 $16.95

0.8" 4 Digit Jumbo Display
Alarm Clock Kit
Features:
A. Fairchild 0.8" FSC8000 Display Array
B. Fairchild Super-Chip – F-3817PC
C. P.C. Board, Transformer, Speaker and all parts included (less case) **$19.50**
D. Detailed Instructions

Plastic Molded Instrument Case
H—2 7/16" W—8½" D—9¼"
Adjustable heights to accommodate most needs. Available in tan & gray.
Model #CH-200 $19.50



Instrument Case for Kit
H—2½" W—6 1/16" D—6¼"
Ideal for many smaller projects. Similar to CH-200 less handle.
CM-6-225 $9.40

6-DIGIT AUTO CLOCK KIT WITH ALARM
Features:
A. Fairchild 0.5" FND 500 Series Display
B. Display Board may be remote
C. Xtal time base
D. P.C. Boards, speaker, IC's and all parts.
E. Detailed Instructions
$19.95
KIT # T-1302

I.C. SOCKETS

	Lo-pro 5 pcs	Lo-pro 10 pcs	Lo-pro 100 pcs	Wire Wrap 5 pcs.	Wire Wrap 10 pcs.	Wire Wrap 100 pcs.
8-pin	0.80	1.50	12.00	1.90	3.50	32.00
14-pin	0.95	1.75	15.00	2.10	3.90	36.00
16-pin	1.05	2.00	17.00	2.50	4.20	39.00
18-pin	1.40	2.50	23.00	3.20	6.00	55.00
20-pin	1.60	3.10	28.00	3.50	6.50	60.00
22-pin	1.80	3.40	32.00	3.75	7.00	65.00
24-pin	1.85	3.50	33.00	4.25	8.00	75.00
28-pin	2.20	4.20	39.00	4.75	9.00	85.00
40-pin	3.50	6.20	59.00	6.50	12.00	100.00

FREQUENCY COUNTER LSI CHIPS
1CM7207 $ 8.25
1CM7207 $16.95
6.5536 MHz X'ytal $ 4.25
SAVE MORE BUY THEM ALL FOR $28.00

STOP WATCH CHIP
1CM7205 $18.50
3.2768 MHz X'ytal $ 4.75
Trimmer Cap. $ 0.50
ALL FOR JUST $21.50

TRIACS

TIC 206A	3A	100V	.80
TIC 206B	3A	200V	.90
TIC 206D	3A	400V	1.00
TIC 216A	6A	100V	.99
TIC 216B	6A	200V	1.05
TIC 216D	6A	400V	1.25
TIC 236B	12A	200V	1.40
TIC 236D	12A	400V	1.70
TIC 253B	20A	400V	2.50
TIC 253D	20A	400V	2.95
TIC 253E	20A	600V	3.55
TIC 263B	25A	200V	3.10
TIC 263D	25A	400V	3.70
TIC 263E	25A	600V	4.25

SCR's

2N5062	0.8A	100V	.30
2N5064	0.8A	200V	.40
TIC 106B	5A	200V	.45
TIC 106D	5A	400V	.55
TIC 116A	8A	100V	1.00
TIC 116B	8A	200V	1.20
TIC 116D	8A	400V	1.50
TIC 116E	8A	500V	1.80
TIC 116M	8A	600V	2.10
TIC 126A	12A	100V	1.35
TIC 126B	12A	200V	1.50
TIC 126D	12A	400V	1.90
TIC 126E	12A	500V	2.25
TIC 126M	12A	600V	2.55

TRANSISTORS

NPN Gen. Pur. 30V	10/$1.00
PNP Gen. Pur. 30V	10/$1.10
2N5458 Gen. Pur. FET	10/$4.00
2N5245 R F FET	10/$5.00
2N2222 Switching	10/$1.75
2N3055 150W Power	10/$6.00

POWER TRANSISTORS
MATCHED PAIR
MOTOROLA MJE2955 PNP
MJE3055 NPN
10 AMP 60 VOLT 90 WATTS
$2.25 PER PAIR

MINIATURE SLIDE SWITCH
DPDT .20 each
10 for $1.75
100 for $15.00

MINIATURE TOGGLE SWITCH
SPDT $1.30 ea
DPDT $1.50 ea.

PUSH BUTTON SWITCH
White, green and yellow
30¢ ea
4/$1.00

0.2" L.E.D. Lamps

Red	15¢	100/10.00
Green	20¢	100/15.00
Yellow	20¢	100/15.00
Amber	20¢	100/15.00

L.E.D. Displays

END 503	C.C. 0.5"	75¢
END 510	C.A. 0.5"	75¢
1720R	C.A. 1"	4.75
1723R	C.C. 1"	4.75

JUMBO LED READOUT ARRAY
- 1.00 Inch High Characters
- Common Cathode Connections
- 3½ Digits with Colons
- Independent Segments

LT1012 $7.50

SOLDER
Quick solder remover

1/32"	5 ft.
1/16"	5
1/8"	5
1/4"	2½

1.40 ea.

TANTALUM CAP AXIAL LEADS

1	10V	15¢
1	35V	20¢
3.3	35V	25¢
10	50V	30¢
22	35V	30¢

DIP PLUGS

	5 pcs	10 pcs	100 pcs
14-pin	3.25	6.00	55.00
16-pin	3.50	6.50	60.00
40-pin	9.50	18.00	150.00

DIP TANTALUM

10u 20V	35¢
22u 15V	50¢
33u 15V	65¢
68u 10V	80¢
100u 10V	99¢

AUDIBLE TRANSDUCERS
Manufactured by "GULTON INDUSTRIES" for producing audible sound. With a very simple one X'istor ckt ideal for smoke detector & morse code practicer. $1.75 ea. 10/$14.00

TIME BASE MINI KIT
Includes MM5369 I.C. 3.5795 MHz X'ytal Trimmer Cap.
$3.45

Wire Wrap Wire Special Purchase
500 ft. roll @ 5.00
White only

WIRE-WRAP TOOLS
Hobby Wrap - 30
Hobby Wrap—BW-630
Battery Op. (less batt.)
$30.95

ERIE MINI CERAMIC TRIMMER CAP.
10 - 40 p/F 10/$4.50

SWITCHING DIODES IN4148
10 for 0.5u
50 for 2.00
100 for 3.50

SPECIAL OF THE MONTH

AN214-4.5W Power IC with spec.	$2.95 ea.
MH0026-5MHz Clock Driver	$1.95 ea.
14-pin Lo pro IC Socket	100/$16.00
16-pin Lo pro IC Socket	100/$17.00
P.C. Mount X'former. 24V .45A	$1.95 ea
1,000 uF 50V cap. Axial Lead	$1.00 ea
C-60 Digital Cassette Tape	$1.50 ea

HAMMOND BREADBOARD KIT

BIMBOARD 1 $9.95 ea.
Accepts DIP packages without adaptors or damaging component leads.
Contacts are double sided, nickel silver, current carrying capacity of 1 Amp with less than 10 milliohms contact resistance.
Total of 550 sockets identified by a letter and number matrix for recording experiments
Buss strip section runs up each side of board.
Component bracket (included with each board) will fit on any of the four edges or down the center.

BIMBOARD 2 $23.95
2 Bimboards and 2 component brackets
1 Aluminum base with 4 insulated Terminals

BIMBOARD 3 $34.95
3 Bimboards and 3 component brackets
1 Aluminum base with 4 insulated terminals

BIMBOARD 4 $43.
4 Bimboards and 4 component brackets
1 Aluminum base with 4 insulated terminals.

FULLY ENCODED 74-key keyboard manufactured by Micro Switch for Honeywell (Limited Qty.) $50.00 ea.

PRECUT WIRE WRAP WIRE
30 Kynar in red, orange, blue, yellow, green, black, white.
Pre-stripped both end.

	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

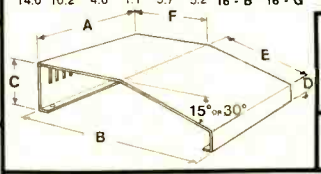
MINIATURE CONSOLES

15° SLOPING PANELS — **CASES (bottoms)** — **PANELS (tops)**

A	B	C	D	E	F								
4.0	5.5	2.0	1.1	3.3	2.2	1 - B	1 - G	1 - L	5.50	1 - W	1 - S	1 - K	5.50
6.5	5.5	2.0	1.1	3.3	2.2	2 - B	2 - G	2 - L	6.10	2 - W	2 - S	2 - K	6.10
6.5	8.5	2.0	1.1	3.3	5.2	3 - B	3 - G	3 - L	6.70	3 - W	3 - S	3 - K	6.70
6.5	8.3	3.0	1.3	6.3	2.2	4 - B	4 - G	4 - L	7.30	4 - W	4 - S	4 - K	7.30
10.0	8.3	3.0	1.3	6.3	2.2	5 - B	5 - G	5 - L	7.80	5 - W	5 - S	5 - K	7.80
10.0	11.3	3.0	1.3	6.3	5.2	6 - B	6 - G	6 - L	8.40	6 - W	6 - S	6 - K	8.40
14.0	8.3	3.0	1.3	6.3	2.2	7 - B	7 - G	7 - L	8.80	7 - W	7 - S	7 - K	8.80
14.0	11.3	3.0	1.3	6.3	5.2	8 - B	8 - G	8 - L	9.70	8 - W	8 - S	8 - K	9.70

30° SLOPING PANELS — B=Blue, G=Green, L=Gold, W=White, S=Sand, K=Black

4.0	5.5	3.0	1.1	3.7	2.2	9 - B	9 - G	9 - L	5.50	9 - W	9 - S	9 - K	5.50
6.5	5.5	3.0	1.1	3.7	2.2	10 - B	10 - G	10 - L	6.10	10 - W	10 - S	10 - K	6.10
6.5	7.2	4.0	1.1	5.7	2.2	11 - B	11 - G	11 - L	6.70	11 - W	11 - S	11 - K	6.70
10.0	5.5	3.0	1.1	3.7	2.2	12 - B	12 - G	12 - L	7.30	12 - W	12 - S	12 - K	7.30
10.0	7.2	4.0	1.1	5.7	2.2	13 - B	13 - G	13 - L	7.80	13 - W	13 - S	13 - K	7.80
10.0	10.2	4.0	1.1	5.7	5.2	14 - B	14 - G	14 - L	8.40	14 - W	14 - S	14 - K	8.40
14.0	7.2	4.0	1.1	5.7	2.2	15 - B	15 - G	15 - L	8.80	15 - W	15 - S	15 - K	8.80
14.0	10.2	4.0	1.1	5.7	5.2	16 - B	16 - G	16 - L	9.70	16 - W	16 - S	16 - K	9.70



CRYSTALS ± =0.002%

Frequency MHz					
1.000	2.4576	4.0000	6.144	10.000	32.0000
1.8432	2.667	4.1943	6.400	14.318	36.0000
@5.25	3.000	4.9152	6.5536	14.391	48.0000
	3.200	5.0000	8.0000	18.000	
	3.2768	5.0688		18.4320	
2.000	3.5795	5.1850	@4.25	20.0000	@3.50
2.0100		5.7143		22.1184	
2.097152	@4.75	6.0000		27.0000	

KEPCO Ferroresonant power supply.
Input 110V 3A Factory Price $206
Output 24V 8A Our Price $80

LAMBDA Precision Power Supply
Model LXS-EE-5-0V
5V 45A Factory Price $600
Our Price $100

Please add $5.00 extra postage to these items.

THE KIM-1 MICROCOMPUTER SYSTEM
- 6502 - 8 bit MPU with powerful instruction set, 13 addressing modes, multiple interrupts, full 65K byte address range.
- 2 MOS 6530 chips each with 1024 bytes of ROM, 64K bytes of RAM, 15 I/O pins, and an interval timer.
- The KIM-1 monitor and operating programs are stored permanently in the 1048 ROM bytes provided.
- Comes with keyboard and alpha-numeric display.
- TTY and cassette interface
- Completely assembled and tested and documented.
- Including KIM-1 user manuel, 6500 programming manual, and 6500 hardware manual.

ALL THESE FOR JUST $235.00

KIM SUPPORT

6102	8.00
6502	11.95
6520	10.00
6522	9.25
6530	15.95
6530-002	15.95
6530-003	15.95
6530 004	15.95
6530 005	15.95

VHF Modulator
For TV Game or Computer
Modulates Video Input to a RF output (ch. 3)
Supply voltage 5V
$4.50 ea.

3815 5-DECADE COUNTER
The 3815 is a 5-Decade Counter which includes a memory with static latches for each counter digit and an output multiplexer. The 3815 is designed to drive a multiplexed display which has a Binary Coded Decimal output and five decoded outputs to strobe the display.
With Specification $5.00 ea.

TRINCO
2795-L West Lincoln Ave.
Anaheim, CA 92801
(714) 821-0234

Minimum order $5.00. Please add $2.00 postage and handling for out of States, $1.00 inside California plus Tax. C.O.D. orders welcome (Min. Order $20.00)

Store Hours 10 - 7, Mon. - Sat.
VISA MASTERCHARGE

Z-80 CPU BOARD/KIT

On board 2708 EPROM addressable to any 4K boundary above 32K. Power-on-jump to any 4K boundary above 32K, or the on board 2708. On board run-stop flip-flop and optional generation of Memory Write allow front panel-less operation.

BARE BOARD $34.00
$130.00 (2MHz) $145.00 (4MHz)
ASSEMBLED & TESTED ADD $50.00

8080 A CPU BOARD/KIT
With 8 level vector interrupt, CPU chip 8080 clock chip: 8224; crystal Freq.: 18MHz; vector interrupt chip: 8214.
BARE BOARD $28.50 KIT $95.00
Assembled and Tested $145.00

REAL TIME CLOCK FOR S-100 BUSS
On board 1MHz Crystal Oscillator; two independent interrupts. 16 bit counter in 10 s steps, and decade steps from 100 s to 10 sec.
Kit $120 Assembled & Tested $179.95
BARE BOARD $24.00

8K STATIC RAM

8K Kit	450ns	350ns	250ns
	$129.95	$139.95	$169.95

ASSEMBLED/TESTED ADD $25.00 Bareboard $25.00

16K STATIC RAM KIT $375
BOARD $24.00 ASSEMBLE/TEST $425.00

32K STATIC RAM
BARE BOARD $35.00

KIT	ASSEMBLE/TESTED
250ns $795.00	$875.00
450ns $625.00	$775.00

2708/2716 EPROM KIT $59.95
Special Kit With 8ea
2708's $129.95
Bare Board $30.00

ULTRAVIOLET EPROM ERASER
Erase up to 48 ICs each time
$49.50

MICROCOMPUTER COMPONENTS

MICROPROCESSOR'S

F8	16.95
Z80	22.00
Z80A	28.00
CDP1802CD	19.95
2650	24.95
AM2901	22.95
6502	11.95
6800	18.95
6802	25.00
8008-1	9.95
8035	22.00
8080A	11.95
8085	27.00
IM5900IL	75.00

6800 SUPPORT

6810P	4.95
6810P	6.00
6820P	7.50
6821P	7.50
6828P	11.25
6834P	16.95
6850P	9.75
6852P	11.75
6860P	10.00
6880P	14.50
6871P	28.00
6875P	8.75
6880F	2.50

STATIC RAMS

2102	1.50
2102	1.50
2102 (350)	1.60
2102 (250)	1.75
4100	10.75
1101A	1.00
2101-1	2.95
2102	1.25
2111-1	3.95
2112-1	2.95
2114-3	11.00
2125	11.10
2147	37.50
3101	2.50
3106	3.95
3107	3.95
TMS 4044	9.95
4200A	12.95
TMS 4045	11.00
5101	8.30
74C89	3.25
7489	2.25
74S201	4.50
P8101	4.20
P8150	17.00
P8156	21.00
8599	1.84
9102BPC	1.65

CHARACTER GENERATORS

2513	6.75
2513 5v upper	9.75
2513 5v lower	10.95
2515	10.95

8080A SUPPORT DEVICES

8212	3.50
8214	9.00
8216	3.75
8224	3.50
8224-4	3.95
8226	3.95
8228	7.95
8238	7.50
8251	9.95
8253	21.95
8255	21.95
8257	21.95
8259	21.95
8275	75.00
8279	20.00

PROM'S

1702A	4.00
2704	15.00
2708	12.00
2716	30.00
2716 unit	38.00
2758	26.60
D3601	4.50
D3604	13.00
5203AQ	5.00
5204AQ	7.50
6834	17.50
6834-1	14.95
8252/3	4.00
8251298	4.25
82238	3.50

DYNAMIC RAMS

4160/4116	32.00
1103	1.00
2104	4.00
2107B	4.25
2107B-4	3.95
TMS4050	4.00
TMS4060	4.50
TMS4070-2	32.00
4096	4.00
4116/4160	32.00

Z80 SUPPORT DEVICES

3881	12.95
3882	12.95

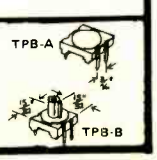
USART'S

AY5-1013A	5.25
AY5-1014A	8.25
TR1602B	5.25
TMS6011	5.95
IM6402	10.80
IM6403	10.80

KEYBOARD CHIPS

AY5-2376	13.75
AY5-3600	13.75

P.C. MOUNT PUSH BUTTON SWITCHES
45¢ ea.
10/$4.00



CIRCLE 27 ON FREE INFORMATION CARD

NATIONAL EMERGENCY ALARM REPEATER

UNIQUE DEVICE MADE FOR THE U.S. GOVERNMENT TO WARN OF NUCLEAR ATTACK. IT WAS TO BE PLUGGED INTO THE WALL OUTLET AND WAS TO SOUND OFF WHEN THE POWER COMPANY SWITCHED FROM 60 CYCLE TO 50 CYCLES. CONTAINS RELAY, TIMER/NOISE GENERATOR, RESISTORS, CAPACITORS, DIODE, REED SWITCH AND 50 CYCLE VIBRATING REED ALL IN AN ATTRACTIVE BLACK AND SILVER CASE. APPROX. SIZE: 3.7" x 3.2" x 2¼". AN EXPERIMENTOR'S DELIGHT! BRAND NEW IN BOXES. C22706 **$3.95**

GE FAST CHARGE Nicad Pack
CONTAINS 3 SERIES CONNECTED AA SIZE CELLS EACH RATED 1.2V AT 500MAH. CAN BE CUT APART OR USED AS A PACK. RECHARGE THESE IN AS LITTLE AS 3 HOURS! BRAND NEW. C23351 **$2.95**

BISTABLE RELAY C23437 $2.00

SLA-1
7 SEGMENT COMMON ANODE READOUT. CHARACTER HEIGHT .334". PRIME - SEALED PKG. 4 for $2.00

150 Watt Seconds STROBE TUBE C23443 **$3.95**

PHOTOFLASH CAPS
350 mf 330V 1.00
720 mf 360V 1.50
1600 mf 360V $2.25

CALCULATOR BOARDS
WITH DISPLAY LESS KEYBOARD AND CASE (AS IS) $1.50

CARRYING CASE C22864 89¢

STROBE TUBE & REFLECTOR ASSEMBLY $2.25 ea C22874

2" Round Speaker C23068 99¢

V.O.X. Solid state Voice Operated Switch. Complete and as sembled. With schematic. C21623 99¢

HONEYWELL PROJECTION LENSES 5" F/3.5 C23370 $3.95

Crystal Oscillator 14.04 Mhz IC clock oscillator C23269 $1.98

C103B SCR 200V 8 amp C23083 8 for $1.00

6 HV TRIGGER COILS 2 for $1

Green Neon Same as NE2 but glows GREEN. Op erates on 120V. 6 for $1.00

LIQUID CRYSTAL WATCH DISPLAY with specs $1.25 MOTOROLA

SLIDE SWITCH ASSORTMENT 10 for $1.00

MICRO-MINIATURE ROTARY SWITCH 1 POLE 8 POSITION 79¢

LASCR 200 VOLT .3 AMP. 4 for $1.00

MINIATURE .1 MF, 250V CAPACITOR SMALL SIZE MYLAR WITH LONG LEADS 10 for $1

LED PANEL MOUNTING KITS 12 for $1 C22707

Hex Nuts Standard size hex nuts for pots, lamps C22791 30 for $1

Strobe Light Kit COMPLETE variable-rate strobe light kit. Contains all parts, including line cord, PC board and instructions. Operates on 117 VAC $7.50 each

Electronic Warning Flasher Kit This battery operated device continuously emits bursts of intense light. Great safety device for bicycle riders, skiers, hikers, boaters & campers. Comes complete w/ all electronic parts, quality glass-epoxy PC board & easy to understand instructions. Uses high-output xenon flash tube which flashes 2 times per second when batteries are fresh. Operates continuously for 12 hours on 2 alkaline "C" batteries. You need only to supply the batteries and, if C23207 $6.95

STROBE TUBE ASST. Brand new factory prime strobe tubes. Assortment of 5 strobe tubes, w/ schematics C23280 $3.00

MINIATURE REFLECTOR Appx. size: 1-7/16"L x 7/8"W x 3/4"D. C23227 $1.00

AMAZING EARADIO

THIS IS PROBABLY THE WORLD'S SMALLEST RADIO. IT WEIGHS ONLY 1/2 OUNCE AND IS WORN BEHIND THE EAR. CONTAINS AN IC AND SEVERAL DISCRETE DEVICES TO GIVE AN EQUIVALENT OF 12 TRANSISTORS. THE RADIO HAS A T.R.F. DESIGN OPERATING FROM 1 STANDARD S13E 1.5V HEARING AID BATTERY (INCLUDED). IT PROVIDES GOOD VOLUME TO EARPHONE ON SEVERAL STATIONS IN METROPOLITAN AREAS. DOESN'T REQUIRE ANY ANTENNA, GROUND OR OTHER ADDITIONAL WIRES - FULLY SELF CONTAINED & TUNABLE. SIZE: 1 1/8"x1 1/4"x3/8". **$5.95**

510V BATTERY $9.99 C23458
EVEREADY NO. 497 PHOTOGRAPHIC FLASH BATTERY PROVIDES 510V AND 180V. THESE ARE NEW UNITS IN THEIR ORIGINAL BOXES.

WAFER THIN COPPER CLAD GLASS EPOXY BOARDS C23534 50¢

SOLID CARBIDE PC DRILL BITS .034" C21626 $1.50

ULTRA MINIATURE ADJUSTABLE CAPACITOR 3.5 - 11 PF 3 for $1.49

100M PHOTOFLASH Kit NEW
SIMPLE TO ASSEMBLE KIT INCLUDES PRE-ASSEMBLED CIRCUIT BOARD, CAPACITOR, FLASHTUBE, REFLECTOR, SWITCH AND HOOKUP DIAGRAM. LESS CASE, BATTERY HOLDER, AND BATTERIES (OPERATES ON 2 AA CELLS). GUIDE #28 AT ASA 25. C23435 $2.95

14" **STROBE SHUTTER CORD** $1

CHANEY electronics
- Minimum order $5.00
- Please include $1 for postage
- Visa, MC and COD accepted.
- Phone orders are welcome.

P.O. BOX 27038, DENVER, CO. 80227 Ph: 303-781-5750

Send for our FREE GIANT CATALOG of unique items

MULTI-TESTER

IT TESTS TRANSISTORS AND LED's AS WELL!!

YX-360TR
TRANSISTOR TESTER
20K OHMS/VOLT

SPECIFICATIONS

DCV	0-0.1-0.5-2.5-10-50-250-1000 (20kΩ/V) ±3%, 25k (w/HV probe)
DCA	0-50μA-0.2.5-25mA-0-0.25A (100mV & 250mV) ±3%
ACV	0-10-50-250-1000 (8kΩ/V) ±4% Freq. 30Hz to 30kHz
Ω	×1 ×10 ×1k ×10k (max. 20M) Batt. 1.5V×2 & 9V×1
dB	−10 to +62
ICEO	0-150μA 0-15-150mA ±5%
hFE	0-1000 ±3% (w/connector)

150×100×57 420gr

$28.50

SANYO HYBRID

Audio power amplifiers I.C. Max. hi-fi output power, minimum ext. components needed.

15 Watts	STK-28	$ 8.50
23 Watts	STK-054	$13.50
30 Watts	STK-056	$17.50
50 Watts	STK-050	$26.50
10W + 10W (stereo)	STK-040	$14.50
15W + 15W (stereo)	STK-041	$25.50
20W + 20W (stereo)	STK-043	$31.50

*data sheet comes with purchase

THE MOST POPULAR MM5314 CLOCK KIT

Features:
* 12/24 Hours Display
* 50/60 Hz Input
* 6 Digits Bright Orange Readouts

Kit includes plastic case, MM 5314 I.C. One set transistor drivers, P.C. Board, gas discharge displays, all other electronic parts and transformer. Catalog no. DC-8SP

SPECIAL PRICE
$16.95 PER KIT

COMPUTER GRADE CAPACITORS

All capacitors are Brand New U.S. made in standard size

9000MFD	50V	$3.25 EA.
11000MFD	35V	$3.20 EA.
14500MFD	40V	$3.40 EA.
23000MFD	20V	$3.00 EA.
58000MFD	20V	$3.20 EA.
100,000MFD	6V	$2.50 EA.

9 STEPS LED LEVEL INDICATOR KIT

for most stereo amplifiers
This new project works as a pair of VU meter to indicate the output level of your amplifier from -20dB to +3dB. Kit includes all LED, transistors, electronic components, P.C. Board and instructions.
Easy to build and fun to see.
ONLY **$9.90 EA.**

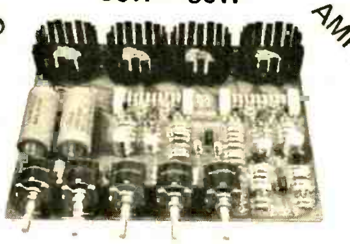
ULTRA-SONIC REMOTE CONTROL SWITCH KIT

NEW

Kit includes the transmitter, the receiver, ultra sonic transducers, P.L.L. I.C., all other electronic parts and P.C. Boards. Ideal for control TV, light, fan or garage door. Case not included.

$18.50 PER KIT

60W + 60W STEREO AMPLIFIER



OCL pre amp. & power stereo amp. with bass, middle, treble 3-way tone control. Fully assembled and tested, ready to work. Total harmonic distortion less than 0.5% at full power. Output maximum is 60 watts per channel at 8Ω. Power supply is 24 - 36V AC or DC. Complete unit only **$37.50 ea.**
Power transformer **$7.50 ea.**

DIP SWITCHES

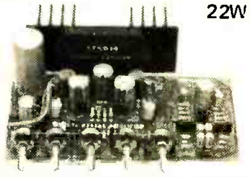
(On-Off Contacts)

4 positions	$1.50
5 positons	$1.60
6 positions	$1.70
7 positions	$1.70
8 positions	$1.80
10 positions	$2.00

ELECTRONIC WHEEL OF FORTUNE KIT!

With 10 numbers split into black and white on dial. The LED turns when you hit the play switch, then it slows down and stops on one number. It sounds like a motor inside, but there is none. Lots of fun and easy to build. Kit comes with nice looking case, all electronic parts, P.C. Board and LEDs. Battery not included. **$12.50**

22W + 22W STEREO HYBRID AMPLIFIER KIT



It Works in 12V D.C. As Well! Kit includes 1 PC SANYO STK-024 stereo power amp. IC LM 1458 as pre amp, all other electronic parts, PC Board, all control pots and special heat sink for hybrid. Power transformer not included. It produces ultra hi-fi output up to 44 watts (22 watts per channel) yet gives out less than 0.1% total harmonic distortion between 100Mz and 10KHz. **$32.50 PER KIT**

POWER TRANSFORMER $6.50 EACH

CIRCLE 9 ON FREE INFORMATION CARD

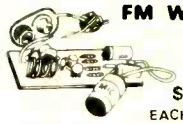
SUPER 15 WATT AUDIO AMP KIT

ONLY $23.50 each

Uses STK-015 Hybrid Power Amp

Kit Includes: STK-015 Hybrid IC, power supply with power transformer, front Amp with tone control, all electronic parts as well as PC Board. Less than 0.5% harmonic distortion at full power ½dB response from 20—100,000 Hz. This amplifier has QUASI—Complimentary class B output. Output max is watt (10 watt RMS) at 4Ω .

FM WIRELESS MIC KIT



$6.95 EACH KIT

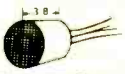
This new model FM wireless MIC kit uses 3 high freq. transistors, works in the FM range (88-108 MHz). It transmits the sound wave fidelity clearly over long distances (up to 250 ft.). Kit comes with all electronic parts, P.C. Board and mini microphone!

WE FOUND THE CASE FOR THE FM MIC!!

Small nice looking aluminum case size like a pack of cigarettes. It is an intercom. Audio amp inside with a mic jack, a mini toggle sw on top, can be used for many projects. We give you the circuit data as well.

VERY SPECIAL PRICE 2 for $4.99

Sub-Mini Size Condenser Microphone
$2.50 each
FET Transistor Built-in



63 KEYS ASC11 DECORDED COMPLETE KEYBOARD

by Honeywell
with dual color key tops, uses TMS 5000 decorder LSI. (schematic data included)

SPECIAL
$56.50
NOT A KIT!

PROFESSIONAL CASE

for our 0-30V Power Supply. It is a nice looking metal cast case with giant 4" volt/amp meter; output blinding post and fuse holder, on/off switch and line cord! ONLY $21.50 EA.

CASE 030

POWER SUPPLY KIT

0-30V D.C. REGULATED

Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts.

0-30 POWER SUPPLY **$10.50 each**

Transformer for Power Supply, 2 AMP 24V x 2 $6.50
30V DC Panel Meter $4.20

FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED

Lights up 8—15 Watt Fluorescent Light Tubes
Ideal for camper, outdoor Auto or Boat
Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board, light tube not included!

ONLY $5.50 PER KIT

MANY SOUND DECISIONS!

$3.60 EACH

Solid state sound indicator operating voltage 6V DC 30μA. Small size approximately ¾" X 1¼".

Model EB2116 (Continuous)
Model EB2126 (Slow Pulse)
Model EB2136 (Fast Pulse)

Continuous Slow pulse Fast pulse

12V DC MINI RELAY

P.C. Board Solder Type

2AMP Contact SPDT $1.30 EA
2AMP Contact DPDT $1.75 EA
5AMP Contact 4PDT $2.20 EA

12V D.C. AUTO DIGITAL CLOCK

Complete Unit
Not a Kit!

0.4" blue color 4 digits display. Turn off readouts when car is not running. X'tal controlled time base for time accuracy. Special designed case for easy mounting on top of your dashboard. Ideal for car, boat and campers.

ONLY ~~$29.50~~ ea. SALE! $24.50

HEAVY DUTY CLIP LEADS

10 pairs — 5 colors
Alligator clips on a 22" long lead. Ideal for any testing.

$1.85/pack

1Watt AUDIO AMP

All parts are pre assembled on a mini PC Board
Supply Voltage 6—9V D.C.
SPECIAL PRICE $1.95 ea.

"FISHER" 30 WATT STEREO AMP

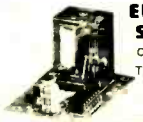
MAIN AMP (15W X 2)

Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not included). Power band with (KF 1% ± 3dB). Voltage gain 33dB. 20Hz — 20KHz.

Super Buy Only $18.50

ELECTRONIC SWITCH KIT

CONDENSER TYPE



Touch On Touch Off uses 7473 I.C. and 12V relay
$5.50 each

AA SIZE NI-CD BATTERY
6 in a pack (1.2V X 6) 500 MA/HR
$4.80 PER PACK

AUTO ALARM KIT

The Crimefighter Auto Alarm is an electronic, self-controlled auto protection system, normally mounted within the glove box of an automobile. Two minutes after turning off the ignition, the alarm automatically turns itself "on". When auto is re-entered, the horn will sound after a 10-45 second entry delay. The automobile owner, by inserting the ignition key, will activate the alarm. Once activated, the alarm will sound for two minutes before automatically turning off. The alarm then resets and is ready to again protect the vehicle from unwanted entry.

FEATURES: Simple installation: 5 wires. Automatically turns on when auto is parked. Adjustable entry time. Extended exit time to allow for unrushed exit from vehicle. Numerous applications include protection of boats, campers, trailers, motorcycles, trucks. Cannot be deactivated by "hot wiring" an auto. Cannot be turned off without ignition key. Negative ground only.

ONLY $14.00 PER KIT

BRAND NEW EVEREADY CH15 AA size NI-CD 500 MA/HR. 4 for $5.50

Only limited quantity available

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Supply 6—18V DC
only $5.00 ea.

TIMER KIT

Time Controlled from 1-100sec.
Ideal to be used as timer delay unit for burglar alarm, photo service, and other purposes.
Max. loading 110V, 2 AMP.
Supply voltage 12-18V DC.
$11.50 each

FT-80 ELECTRONIC IC TIMER

Sub Mini Size PANEL METER

500 UA
ONLY $1.20 ea

PANEL METER (D.C. Type)

$5.50 ea.

Size 60MM X 66MM
White Face Type

0-50 UA	0-30V
0-1MA	0-50V
0-5MA	0-100V
0-100MA	

ELECTRONIC ALARM SIREN

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 130dB
Voltage Supply 6—12V $7.50

AU—999

4 DIGITS ALARM CLOCK

COMPLETE UNIT NOT A KIT

- 0.5" RED LED READ OUT
- 24 HRS. ALARM SET
- 10 MINS. SNOOZE SET
- AM/PM ALARM INDICATORS
- SECOND DISPLAY SWITCH
- AUTOMATIC BRIGHTNESS CONTROL
- COMPACT AND HANDSOME PACKING
- 110V AC 60HZ INPUT

$17.50 EACH

TRANSFORMERS

ALL 117 VOLT INPUT

30V	4AMP	$7.50 EA.
36V CT	3AMP	$6.50 EA.
48V CT	3AMP	$6.50 EA.
24V CT	3AMP	$6.50 EA.
24V CT	0.8AMP	$1.80 EA.
12V CT	0.8AMP	$1.80 EA.
12V CT	120MA	$1.25 EA.

AC POWER SUPPLY

Wall Type Transformer

12V AC	Output	200MA $2.75 EA.
16V CT AC	Output	100MA $2.10 EA.
6V DC	Output	120MA $1.90 EA.
12V DC	Output	100MA $1.90 EA.

MINI-SIZED I.C. AM RADIO

Size smaller than a box of matches!
Receives all AM stations
Batteries and ear phone included

Only $8.50

MINI-MINI TOGGLE SWITCH

Half size of submini toggle switch rated 3 amp 125V AC contact

1-9 10-99

MS 244	SPDT	1.00	0.90
MS 245	DPDT	1.20	1.10

LARGE QUANTITY AVAILABLE FOR OEM

SUBMINIATURES TOGGLE SWITCHES

SPDT	On Off	$1.30 ea
DPDT	On Off	$1.50 ea
3PDT	On Off	$1.75 ea

Mini size Rocker Type
Also available at the same price

SOUND ACTIVATED SWITCH

All parts completed on a PC Board
SCR will turn on relay, buzzer or trigger other circuit for 2—10 sec. (adjustable)
Ideal for use as door alarm, sound controlled toys and many other projects
Supply voltage 4.5V—9V D.C.
$1.75 ea./2 for $3.00

MINI SIZE REED RELAY

Approx. 1" square
SPST Normal Open
Contact rated 1AMP
Coil 6—12V DC
All brand new by AMF
3 for $2.00

LINEAR SLIDE POT 500KΩ SINGLE

Metal Case 3" Long
2 FOR $1.20

2¼" ROUND SPEAKER

8Ω 0.25W
for most sound projects

SPECIAL 3 for $2.00

WIDE ANGLE PANEL METER

1¾" x ⅜"
1MA Full Scale
(scale marks 0-100)
$1.50 each

PUSH-BUTTON SWITCH

N/Open Contact
Color: Red, White, Blue, Green, Black. 4/$1.00
N/Close also Available 50¢ ea.
LARGE QTY. AVAILABLE

DIGITAL ELECTRONIC LOCK KIT

$6.50 ea. CMOS I.C. IN CIRCUIT

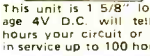
for auto Ignition, entry door, burglar alarm, etc.
4 Digits Programmable to Any Combination

400Ω RELAY AND KEY PAD NOT INCLUDED

I.C. TEST CLIPS

Same as the E-Z clips With 20" Long Leads In Black and Red Colors
$2.75 per pair

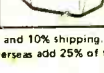
HOUR INDICATOR



This unit is 1 5/8" long operating voltage 4V D.C. will tell you how many hours your circuit or machine has been in service up to 100 hours.

Limited Quantity ONLY $1.75 ea.

SOLID STATE ELECTRONIC BUZZER



Mini size 1" x ⅜" x ⅜"
Supply voltage 1.5V 12V
Ideal for Alarm or Tone Indicator
$1.50 each

BATTERY POWERED FLUORESCENT LANTERN

FEATURES

- Circuitry: designed for operation by high efficient, high power silicon transistor which enable illumination maintain in a standard level even the battery supply drops to a certain low voltage.
- 9" 6W cool/daylight miniature flourescent tube.
- 6 X 1.5V UM-1 (size D) dry cell battery.
- Easy sliding door for changing batteries.
- Stainless reflector with wide angle increasing lumination of the lantern.

$9.60 EACH
MODEL 888-R

MINIMUM ORDER $10.00. California residents add 6% sales tax and 10% shipping.
Out of state add 15% of total purchase for shipping charges, out of USA and Overseas add 25% of total purchase.
SEND CHECK OR MONEY ORDER TO:

FORMULA INTERNATIONAL INC.

12603 CRENSHAW BOULEVARD • HAWTHORNE, CALIFORNIA 90250

For more information please call (213) 973-1921, (213) 679-5162
STORE HOURS 10-7 Monday - Saturday

master charge

your BANKAMERICARD welcome

SEND $1.00 FOR DETAILED CATALOG

CIRCLE 9 ON FREE INFORMATION CARD

TRS-80 memory SPECIAL

Our Conversion Kit upgrades TRS-80 mainframe from 4K to 16K, or populates Memory Expansion Module. With conversion instructions. Also works with APPLEs. **Only $159 (3 kits/$450) . . . and we back up our parts with a 1 year warranty.**

HEATH H8 memory SPECIAL

Econoram VI™ brings 12K of Econoram quality to the H8 buss. Fully static. Regular price: $235 for "unkit" (sockets, bypass caps pre-soldered in place); **now, through cover month of magazine, buy 2 unkits for $399.**

SEE OUR PRODUCTS AT YOUR LOCAL COMPUTER STORE.

the S-100 ECONORAM™ family...

Our memories are recognized as outstanding buys, thanks to static design, compatibility with *all* S-100 machines, buffering, high speed/low power parts, conservative engineering and useful extras. **Econoram II** is 8K of cost-effective memory; kit **$135**, assembled/tested $155. The **16K Econoram IV** costs **$279** for "unkit" (sockets, bypass caps soldered in place); $314 assembled/tested; and $414 for CSC qualified*. The top of the line **24K Econoram VII** costs **$445** for "unkit"; $485 assembled/tested; and $605 CSC qualified*.

*Certified Systems Components board are assembled, tested, serial numbered, burned in for 200 hours, and guaranteed to run at 4 MHz over full temp range. Board exchanged if failure occurs within 1 year of invoice date.

MA1003 clock module $16.50

Simple to apply; requires only 3 time-setting switches and 12V DC. Ideal for car, van, or other portable use thanks to built-in timebase. Four 0.3" blue-green flourescent digits. Extra features (such as automatic dimming) included for car use. With applications data. **$16.50 ea., 3/$46.**

TERMS: Add 5% shipping, excess refunded. Cal res add tax. COD OK with street address for UPS. VISA®/Mastercharge® orders call 24 hrs (415) 562-0636. Thank you!

GODBOUT

BILL GODBOUT ELECTRONICS
BOX 2355, OAKLAND AIRPORT, CA 94614

CIRCLE 43 ON FREE INFORMATION CARD

AUDIO/ANALOG Experimenters

VOLTAGE CONTROLLED SINEWAVE OSCILLATOR BasiKit™: w sine & cosine outputs. 10 vP-P out, 10 Hz to over 16kHz. Needs ± 15 VDC @20 mA. Easy to build. **$49.00**

DC-DC CONVERTER: Outputs ± 15 VDC @100 mA, for 15 VDC input. Ultra hi isolation, .05% reg'n. Only 2" sq. by 3/5" thick. An extremely unusual bargain. **$19.00**

SYNTHESIZER (MUSIC) VCO: Sawtooth & trigger outs; ± 10 vP-P. 10-10kHz out. 1 volt per octave response (exponential), linear input. Needs ± 15 VDC. **$26.50**

ANALOG DELAY IC. Identical to SAD 1024A. Produces real time audio delay. w/data. **$17.95**

ARTICLES & SYNTHESIS LITERATURE: "TECH NOTES", our own R&D newsletter. Featuring articles on building Active Filters, Audio Freq. Shifters, VCO's, VCF's, Flangers, Synthesizers, & other Audio/electronic devices.
TECH NOTES Subscription/12 Issues. $19.50

DUAL SEC. PWR TRANSFORMERS. 117 V Primary, output = 2x 19V @ 1 amp. Hi quality. **$8.95**

5 VOLT, 50 WATT ZENER: TO-3 pkg., 10 amp capability. Unusual bargain. **$4.95**

UNUSUAL IC: 14-pin DIP, generates psuedo-random musical sequence. A "synthesizer-on-a-chip." Clear plastic pkg; also, senses motion VISUALLY. A unique buy. **$7.95**

STATE VARIABLE FILTER IC. Hybrid, identical to the AF 100 ICJ. 4 on-board op amps. DC-10kHz. Hipass, Bandpass, Lopass, & Notch. **$6.95**

"NON-LINEAR CIRCUITS HANDBOOK". By A.D. this is probably THE reference work for analog multipliers, dividers, logging, & antilogging circuits. A WEALTH of unique information. Over 500 pages. **$5.95**

THE INVISIBLE IC. This *clear plastic* IC lets you peer into the inner workings of an intergrated circuit. 14-pin DIP. Features gold wirebonding & BIG IC chip. **$1.50**

TO-220 POWER TRANSISTORS: Complimentary pair, 10 amp iC, over 60 V, 5mHz. **$1.50 pr.**

PREMIUM MINIDIP OP AMPS: BB-3500, lo noise, I-bias; NE-531, Hi slew rate. **Your Choice, 99¢**

DUAL 15 VOLT REGULATOR IC: Outputs ± 15 VDC @ over 50 mA, more with pass Xsistors. Balanced, tracking outputs with .5% reg'n or better. w/data. **99¢ea.**

AMPHENOL 9-PIN "Miniature Tube" CONNECTOR PLUG. Male plug w/gold plated pins. Fits standard 9-pin mini tube socket & includes rubber cover. **2/$1.00**

MINIDIP SOCKET: Solid nylon w/machined gold plated pins. Augat. **3/$1.00**

1 uF, 50 VDC CAPACITORS: Mylar construction, PC leads. Special price. **12/$1.00**

OP AMP SPECIALS

CA 3140 minidip	79¢ea.	LM 307 minidip	19¢ea.
SG (LM) 308A minidip	79¢ea.	LM 301A minidip	24¢ea.
CA 3401 DIP (LM3900)	49¢ea.	LH 0024CH TO-99 hybrid	$4.50
LM 310 TO-99	89¢ea.	UA 791 1 amp	$4.50

We have many unusual and unique bargains in our FREE FLYER/CATALOG. Send us a stamp or 25¢ (for postage) for a FREE COPY and get on our mailing list.

CFR Associates, Inc.
Newton, N.H. 03858
(603)382-5179

- *Minimum order $10.00*
- *Add $2.00 for shipping*
- *MC, VISA, & C.O.D. accepted*
- *Phone orders are welcome*

SATISFACTION GUARANTEED

CIRCLE 62 ON FREE INFORMATION CARD

NEW-TONE ELECTRONICS INTERNATIONAL

A division of New-Tone Electronics

New — RECENT ADDITIONS

Specializing in Japanese Semiconductors, with
THE LARGEST INVENTORY AND LOWEST PRICES ANYWHERE

AND YOU CAN ORDER TOLL FREE 800-631-1250

Check the prices in this partial list

Dealers — send for our complete volume discount price list

POPULAR TYPES

INTEGRATED CIRCUITS	
AN115	2.25
AN228	4.65
AN272	3.90
AN313	4.85
AN321	2.25
AN326	3.30
AN362	2.70
AN366	2.49
AN606	4.50
AN612	2.70
BA401	1.50
BA402	1.50
BA505	6.30
BA612	2.40
BA1310	2.34
HA1125	2.10
HA1329	2.45
HA1366W	3.30
HA1366WR	3.30
HA1388	3.35
HA1406	1.20
LA1222	1.59
LA1365	2.20
LA1368	3.42
LA3101	3.75
LA4220	2.55
LA4430	2.70
LD3000	2.25
LD3080	2.70
LD3110A	3.75
LD3150	1.95
M5109P	3.30
M5112Y	6.70
M5118L	2.50
M5130P	3.12
M5135P	3.40
M5142P	5.70
M5340P	1.55
M5930P	.85
M5935P	1.20
M5946P	.85
M5953P	2.55
M5962P	.85

INTEGRATED CIRCUITS	
M51202	1.55
M53216P	1.80
M53273P	1.60
M58473P	7.90
MB3710	2.95
MB8719	7.70
MN3006	5.90
MN3007	19.95
NPC5107	14.95
PLL03A	14.95
SG264A	7.80
SG609	4.50
SG629-3	3.40
SG6523	17.50
SI1010	6.90
SI1020	13.95
SI1030	19.00
SI1050	27.80
SM5104	8.90
SM5107C	11.95
STK013	11.25
STK014	11.85
STK041	17.40
STK075	8.22
STK413	6.75
TA7092P	6.50
TA7117P	3.60
TA7206P	3.06
TA7214P	5.15
TA7217AP	3.30
TA7222P	3.50
TA7521M	3.55
TA7607P	9.90
TA7609P	4.80
TBA810AS	3.30
T8A810DS	3.30
TBA810S	3.30
TBA810SH	3.30
TBA820	2.10
TDA1190Z	6.50
TDA2002	4.60
UPC141C	2.50
UPC572C	4.10

INTEGRATED CIRCUITS	
UPC574	1.20
UPC583C	3.30
UPC1028	1.80
UPC1031H	2.98
UPC1032H	1.35

TRANSISTORS	
2SA772	.89
2SA786	.39
2SA811	.54
2SA818	1.05
2SA835	1.35
2SA840	1.68
2SA841	.39
2SA842	.43
2SA861	1.29
2SA879	.93
2SA880	.75
2SA911	6.33
2SA915	.77
2SA922	3.98
2SA923	4.50
2SA940	.96
2SA991	.58
2SB509	2.79
2SB528	.99
2SB549	.79
2SB567	2.30
2SB618	2.65
2SC352A	2.55
2SC356	.95
2SC583C	.81
2SC895	4.90
2SC983	.89
2SC1056	5.50
2SC1424	2.98

TRANSISTORS	
2SC1429	1.49
2SC1452	1.40
2SC1474	.96
2SC1548	.79
2SC1583	.68
2SC1622	.49
2SC1630	3.60
2SC1681	.39
2SC1682	.39
2SC1761	1.58
2SC1762	4.85
2SC1775	.54
2SC1778	.45
2SC1787	.62
2SC1811	1.29
2SC1844	.54
2SC1885	.79
2SC1906	.48
2SC1923	.39
2SC1940	.64
2SC1945	6.75
2SC1951	1.59
2SC1959	.39
2SC1963	3.30
2SC1981	2.60
2SC1982	3.30
2SC2009	.85
2SC2021	.65
2SC2072	3.95
2SC2120	.45
2SC2212	1.65
2SC2213	1.45
2SC2214	2.95
2SD388	3.65
2SD477	1.65
2SD528	3.30
2SK58	4.45
2SK97	4.85
2SK107	1.15
2SK120	1.20
2SK121	1.20
2SK125	1.75
2SK130A	3.90

INTEGRATED CIRCUITS	
AN214	2.75
AN217	1.70
AN239	6.50
AN241	2.10
AN247	4.10
AN315	2.80
BA511A	2.65
BA521	2.75
CX101G	6.20
HA1306W	3.50
HA1339A	3.75
LA1366	3.60
LA4051P	2.70
LA4400	3.10
LD3141	1.80
M5115P	4.90
M51513L	3.90
MN3001	19.50
MN3002	11.70
MN3003	11.70
PLL01A	8.60
PLL02A	8.40
PLL02A-G	8.40
STK011	5.80
STK015	6.15
STK032	13.80
STK050	23.75
STK056	10.90
STK415	8.10
STK439	10.10
TA7045M	2.80
TA7060P	1.05
TA7063P	1.10
TA7074P	2.90
TA7089P	2.75
TA7092P	5.45
TA7120P	1.05
TA7153P	6.75
TA7201P	3.15
TA7203P	3.60
TA7204P	3.20
TA7205P	2.60
TA7310P	2.95

INTEGRATED CIRCUITS	
UH1C004	5.60
UH1C005	5.60
UH1C006	6.40
UPC20C	3.65
UPC555H	1.80
UPC563H2	3.65
UPC566H	1.15
UPC575C2	2.35
UPC592H2	1.05
UPC1001H2	3.40
UPC1008C	5.75
UPC1020H	3.05
UPC1025H	2.85
UPC1152H	3.25
UPC1156H	2.80
UPD857C	9.99
UPD858C	7.20

TRANSISTORS	
2SA102	.39
2SA473	.65
2SA484	2.25
2SA496	.89
2SA497	1.39
2SA564A	.39
2SA634	.65
2SA636	1.25
2SA643	.55
2SA678	.55
2SA682	1.35
2SA683	.45
2SA684	.45
2SA699A	.80
2SA706	1.25
2SA733	.35
2SA822	.45
2SB54	.35

TRANSISTORS	
2SB175	.39
2SB324	.55
2SB337	1.35
2SB370	.62
2SB405	.45
2SB407	1.20
2SB435	1.25
2SB463	1.40
2SB474	.85
2SB492	.85
2SC372	.35
2SC373	.35
2SC380	.35
2SC387A	.45
2SC394	.39
2SC458	.45
2SC460	.45
2SC481	1.45
2SC482	1.35
2SC495	.79
2SC509	.45
2SC517	3.25
2SC535	.45
2SC627	1.35
2SC634A	.45
2SC710	.37
2SC730	3.95
2SC732	.35
2SC735	.35
2SC756A	2.40
2SC778	3.35
2SC781	2.50
2SC784	.45
2SC789	.85
2SC793	2.45
2SC799	2.65
2SC828	.35
2SC839	.43
2SC867A	3.95
2SC930	.35
2SC945	.35
2SC1014	.83
2SC1018	.85

TRANSISTORS	
2SC1034	5.45
2SC1061	1.00
2SC1079	3.95
2SC1096	.75
2SC1166	.40
2SC1172	4.80
2SC1173	.70
2SC1226A	.70
2SC1237	2.15
2SC1239	3.15
2SC1306	2.45
2SC1307	3.85
2SC1383	.45
2SC1384	.55
2SC1675	.40
2SC1678	1.90
2SC1728	1.00
2SC1760	1.05
2SC1909	2.75
2SC1957	.95
2SC1973	.55
2SC2028	.74
2SC2029	3.35
2SC2091	2.40
2SC2092	3.10
2SC2098	3.40
2SD72	.78
2SD92	1.75
2SD180	2.35
2SD218	3.45
2SD234	.80
2SD235	.80
2SD261	.49
2SD313	.90
2SD315	1.05
2SD325	.85
2SD330	.89
2SK19	.68
2SK33	.85
2SK55	.89
3SK22	1.80
3SK40	1.90
3SK45	2.10

N.J. Residents add 5% Sales Tax
We pay postage for prepaid orders of $50.00 or more under $50.00 add $1.00. Canada $1.50

COD's WELCOME
Hours — Daily 9 AM 7 PM E.S.T., Sat 9 AM 5 PM

nte INTERNATIONAL

NEW-TONE ELECTRONICS INTERNATIONAL
P.O. Box 1738 Bloomfield, N.J. 07003
New Jersey Phone: 201/748-6171

CIRCLE 71 ON FREE INFORMATION CARD

Regency SCANNER

- POLICE
- FIRE

4 Channels UHF

- Continuously Monitors 4-Channels
- Hear UHF (450-500MHz)
- Model ACT-C4U

Reg. ~~39.95~~

$33

RA-214

RADAR DETECTOR BEARFINDER

55.55

AU-651

- Audible and Visual Indicator
- Detects Stationary and Moving Radar

* Ask about BEARFINDERS Out of Warranty Special!

Reg. ~~89.99~~

RECORDER

"MESSAGE MINDER"

Reg. ~~7.99~~

4.99

RA-731

AS-IS

SWR METER

7.99

CB-067

INCLUDES ANTENNA

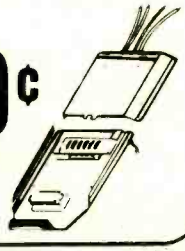
LOCKMOUNT

For Under Dash Mounting of CB's, Radios, etc.

99¢

AU-149

Reg. ~~1.98~~



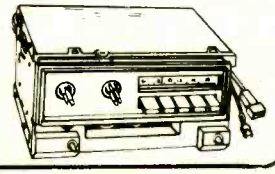
AM AUTO RADIO

Pushbutton Controls

Reg. ~~19.99~~

8.99

AU-580



CASSETTE

30-Minute Blank

29¢

TA-987

8-TRACK

40-Minute Blank LIMIT 30

49¢

TA-907

MULTIMETER

Olson 1000 Ohms/Volt

For Best CB Performance

8.99

TE-184

Reg. ~~12.50~~

AC ADAPTER

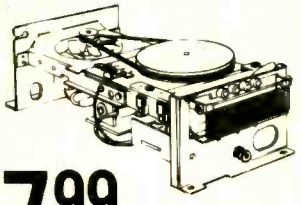
AC to 6, 7.5, 9 VDC

2.99

BA-159

Reg. 2 for $11

8-TRACK TAPE DECK CHASSIS



7.99

RA-617

Reg. ~~9.00~~

Olson electronics

Dept. LJ
260 S. Forge St.
Akron, Ohio 44327

NAME _____

ADDRESS _____

CITY _____

STATE _____ Zip _____

Qty.	Stk. #	Description	Price Ea.	Total

Tax _____

Postage _____

Total _____

FREE!

☐ Please send me a free subscription to Olson Value Packed Catalog.

OLSON COMPUTERS

commodore "PET"

Ohio Scientific Challenger III

Challenger IIP

VideoBrain

SWTPC

Olson - 8 8080

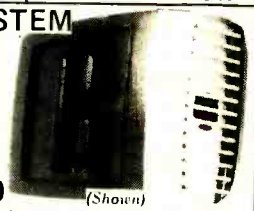
Write for FREE Computer Catalog

ELECTRONIC SUPERMARKET

Phone Orders: (617) 532-2323 BA,MC or AE

Terms: Add postage. No C.O.D.'s. Phone Orders BA-MC-AE: (617) 532-2323.
Lynnfield, Massachusetts 01940 Dept. R-11 P.O. Box 619

REMOTE CONTROL SYSTEM



This handy control was part of an Admiral remote control package for color TV. The original functions were: On-Off, Volume, VHF-UHF, and channel select. Receiver contains 3 relays and one-four position stepping relay. Also a complete 4 page data pkg. Use it to make all kinds of remote operating toys, alarms detectors, appliances, etc. Transmitter requires AA cell (not included). Qty Ltd.

Sh.Wt. 1 lb. . . . . 8C30372 . . . $25.00
3 for $69.88 . . . . . 8C30372 . . . . $69.88/3

(Shown) *Includes Transmitter & Receiver*

AM/FM STEREO RECEIVER/AMP CHASSIS

"REPAIRMAN SPECIAL"

Surplus Brand-name receiver/amplifier chassis, including bulls-eye stereo light on tuning needle, slide controls, amp & tuner (no case). Mfr.'s "questionables", may need repair. You fix & save! Qty. is limited. AS IS (no returns). W/data. 5 Lbs . . . . 8K3035 $19.88 ea.

ALARM SYSTEM TOUCH SWITCH

New package system. A super close-out item. Protects your valuables; gun's, CB's, stereo equipment, test equipment, etc. . . . List Price $22.88.
Sh.Wt. 1 lb. . . . . MD33. . . $7.88
3 for $22.88. . . . MD33 . . . $22.88/3

MOTION DETECTOR

ULTRASONIC

This alarm sensor fills the protected area with an energy screen that cannot be seen, felt or heard. Triggers your alarm whenever burglar moves through detector field. Mounts on ceiling, wall, desk, shelf etc. Optional delay mode, auto-reset. Operates on 12.5 VDC. A close-out that originally sold for $179.00! 3 Lbs. Qty. Ltd. #8D30336. . $49.88

MICROPROCESSOR

The Viatron Data Management Station; Used, complete system. Running Condition. Sold "AS IS". Send for more information. Qty. Ltd . . . $495.00 ea.

SEND FOR FREE CATALOGUE
***CIRCLE FREE INFO. CARD**

Visit our Retail Stores — 177R Washington St., Peabody, Mass. or our NEWEST store — THE TOWNE DUMPE, INC. next to WOOLCO. 777 So. Willow St., Manchester, New Hampshire.

10% OFF ON ALL ORDERS OVER $10.00 FROM THIS AD.

CIRCLE 65 ON FREE INFORMATION CARD

INTEGRATED ELECTRONICS

540 Weddell Drive, #4, Sunnyvale, CA 94086 (408)734-8470

CMOS

4000	.15	4001	.20
4002	.20	4007	.20
4010	.36	4011	.20
4012	.20	4013	.35
4014	.80	4015	.80
4016	.35	4017	.92
4018	.92	4019	.20
4020	1.00	4022	.83
4023	.21	4024	.75
4025	.20	4027	.34
4028	.79	4029	1.00
4030	.20	4035	.95
4040	1.00	4041	1.00
4042	.70	4044	.60
4049	.35	4051	1.10
4066	.70	4068	.40
4069	.40	4075	.20
4082	.23	74C00	.25
74C02	.45	74C04	.32
74C08	.65	74C10	.25
74C14	1.75	74C20	.26
74C30	.26	74C32	.30
74C42	1.40	74C48	2.75
74C73	1.25	74C74	.75
74C86	1.00	74C90	1.10
74C93	1.25	74C151	2.75
74C154	3.00	74C157	2.10
74C160	1.40	74C162	1.70
74C164	1.75	74C165	1.75
74C174	1.50	74C902	.85
74C904	.85	74C905	3.00
74C914	1.95		

TTL

7400	.16	7401	.17
7403	.17	7404	.19
7406	.40	7407	.40
7409	.25	7410	.18
7413	.78	7414	.68
7417	.38	7420	.18
7421	.35	7427	.35
7430	.15	7432	.30
7437	.44	7440	.18
7442	1.00	7445	.70
7446	.70	7448	.70
7450	.25	7451	.25
7453	.25	7454	.35
7460	.22	7472	.40
7473	.40	7474	.40
7475	.55	7476	.45
7483	1.05	7485	1.10
7486	.43	7489	2.00
7492	.75	7493	.65
7495	.78	7496	.85
74121	.35	74122	.49
74123	.65	74126	.65
74132	1.25	74141	1.15
74145	1.10	74148	1.20
74150	.90	74153	1.10
74154	1.25	74155	.75
74157	1.00	74161	1.00
74163	1.30	74164	1.45
74165	1.35	74166	1.20
74173	1.70	74175	1.05
74177	.90	74182	.95
74191	1.20	74192	1.45
74193	1.35	74195	1.00
74196	1.10	74197	1.10
74199	2.25	74367	.90

Interface

0025	3.50	0026	1.75
8640	1.25	8641	2.75
8806	3.00	8819	1.25
8820	5.00	8830	4.90
8833	2.45	8835	2.45
8836	1.25	8837	2.45
8838	2.45	8859	1.50
8865	1.50	8866	1.50
8867	1.85	8869	1.75
8879	2.25	8880	2.75
8884	2.45	8891	1.00
8973	2.95	8974	2.95
8976	2.95	75107	3.25
75450	1.00	75451	.80
75452	.80	75453	.80
75491	1.25	75492	1.40
75494	1.50		

Peripheral

8212	3.50	8214	8.50
8216	3.75	8224	4.75
8228	9.90	8251	11.50
8255	10.50	2513	9.50
2516	9.50	1013	6.50

8000 TTL

8T20	3.25	8T97	1.75
8092	.95	8094	.60
8095	.80	8096	.90
8098	.90	8121	2.25
8136	3.25	8220	3.25
8231	2.25	8242	1.75
8250	1.75	8260	2.25
8281	1.00		

8334	4.00	8553	6.50
8556	3.25	8599	3.25

LINEAR

301N	.35	307N	.35
308H	1.00	309K	1.25
309H	1.00	318H	1.50
320H-5	.88	320T-5	1.25
320T-12	1.25	324N	1.75
340T-5	1.25	340T-12	1.25
340T-15	1.25	340T-24	1.25
387N	1.25	388N	1.15
555N	.35	556N	.85
558N	2.80	561N	5.00
566N	1.70	567N	1.65
709N	.30	741H	.25
3035	2.40	3401	1.25

74LSxx *

74LS00 .25 through 74LS670 3.95

* For more 74LSxx, refer to our ad in the June issue of this magazine.

SPECIAL DISCOUNT
OEM EDUCATORS AND SCHOOLS
For a low quote, send a list of your needs and, if possible, desired prices.
No quantity is too small.

Minimum order $5.00 US currency. Check or money order only. Add 5% to cover shipping and handling charges. Calif. residents add 6% sales tax. Santa Clara County residents add 6.5% sales tax.

CIRCLE 51 ON FREE INFORMATION CARD

BULLET ELECTRONICS

P.O. BOX 19442R DALLAS, TEX. 75219
(214)823-3240

MC1351P FM-IF AMP AND DISCRIMINATOR

USED IN FM & TV SOUND CIRCUITS. REQUIRES MINIMUM EXTERNAL COMPONENTS. 14 PIN DIP. DIRECT REPLACEMENT FOR HEPC 6060, ECG 748 and MANY OTHERS. HOUSE # WITH SPECS 50¢

LM3900 QUAD NORTON AMP

WE BOUGHT A LARGE QUANTITY OF THESE HOUSE NUMBERED PARTS AT A BARGAIN PRICE THAT ALLOWS US TO SELL THEM AT A LOW, LOW 39¢

MINI GRANDFATHER CLOCK KIT

Complete Electronics!
- Chimes the hour (ie: 3 times for 3 O'clock)
- Unique "swinging" LED pendulum
- Tick tock sound matches pendulum swing.
- Large 4 digit .5" LED readout
- All CMOS construction
- Complete electronics including transformer & speaker; drilled and plated PC boards measure 4.5" x 6.5"

39.95

Reviewed in April 1978 RADIO ELECTRONICS

BEAUTIFUL SOLID WALNUT
Custom case for above kit. Over 9¾" tall. 19.95

MK-05 MINI MOBILE CLOCK

This smallest and best priced mobile clock kit on the market. Designed to be a mobile clock from the ground up! There has been no compromise on quality.

FEATURES
- Quartz crystal timebase
- Toroid & zener noise & overvoltage protection.
- Magnified .15", 6 digit LED readout
- Complete with presettable 24 hr. alarm
- 9 - 14 VDC @ 40 to 50 ma.
- Readouts can be suppressed
- EASY QUICK ASSEMBLY
- All components required included (you supply the speaker)
- Top quality drilled and plated PC boards

Clock board: 2.6" x 2"
Readout board: 2 3/8" x .75"
Small enough to mount in the instrument panel!

12.95

MJ900 - MJ1000

COMPLIMENTARY PNP, NPN DARLINGTON POWER TRANSISTORS. 8 AMPS. WE SUPPLY A SCHEMATIC TO BUILD A HIGH POWER (35W) LOW DISTORTION AUDIO AMP WITH ONLY ONE ADDITIONAL TRANSISTOR AND A DOZEN INEXPENSIVE COMPONENTS! TO-3 CASE STYLE **BUY A PAIR FOR** $3.00!

FND510 69¢

COMMON ANODE READOUT ½" CHARACTER
LIMIT 24 PER CUSTOMER!

CAPACITORS

SMALL SIZE!

2200 MFD @ 16 VDC RADIAL 3/1.00

POWER SUPPLY METERS

Quality 3½" meters for the PS14, 0-15VDC & 0-25A. Matched set, individually packaged. NOT SURPLUS! 12.95/set

POWER SUPPLY KIT PS-14

- Better than 200MV load and line regulation
- Foldback Current Limiting
- Short Circuit Protected
- Thermal Shutdown
- Adjustable Current Limiting
- Less than 1% ripple.
- 15 amps 11.5 to 14.5V
- All parts supplied including heavy duty transformer.
- Quality plated fiberglass PC board.

Less Case, meters & jacks
UPS SHIPPING PAID!

REVIEWED IN 7/78 73 MAG.

15A CONT. 20A INT. 42.95

ALL COMPONENTS 100% GUARANTEED

CA3011	WIDEBAND IF AMP w/specs	50¢
2N3569	NPN EPOXY 1W	6/1.00
741	OP AMP 8 PIN DIP	5/1.00
723	VOLTAGE REG. 14 PIN DIP	50¢
MPS6530	NPN HOUSE #	8/1.00
725	OP AMP LOW NOISE HOUSE #	99¢
7815	15V 1A REGULATOR HOUSE #	69¢
LM340T-12	12V 1A VOLT. REG. w/specs	75¢
TCA430	QUAD OSCILLATOR 1/specs	69¢
2N4343	P CHANNEL J FET	4/1.00
2N6111	PNP MED PWR 40W TO-220	3/1.00
2N6028	PROGRAMMABLE UNIJUNCTION w/specs	50¢
TRIAC	200V 8A UNMARKED	3/1.00

UNIVERSAL SOUND EFFECTS BOARD

New!

HAVE YOU EVER WISHED YOU COULD DUPLICATE THE SOUND OF A STEAM TRAIN OR A PHASOR GUN? HOW ABOUT GUNSHOTS, WHISTLES, SIRENS, BARKING DOGS AND OTHER SOUND EFFECTS? NOW YOU CAN WITH OUR PROGRAMMABLE SOUND EFFECTS KIT. IT USES THE NEW 28 PIN T.I. SOUND SYNTHESYZER CHIP, SN76477 AND SUPPORT CIRCUITRY. 5 TO 12VDC IS REQUIRED TO GIVE APPROX. 1/4 WATT OF AUDIO OUTPUT. WE PROVIDE THE P.C. BOARD, PARTS AND INSTRUCTIONS ALONG WITH A CHART TO PROGRAM SOME COMMON SOUNDS. USE YOUR IMAGINATION TO CREATE ORIGINAL SOUND EFFECTS. ORDER: SE-01 14.95 (Less Spkr.) 3/39.95

OVERVOLTAGE PROTECTION KIT 6.95

Provides cheap insurance for your expensive equipment. Trip voltage is adjustable from 3 to 30 volts. Overvoltage instantly fires a 25A SCR and shorts the output to protect equipment. Should be used on units that are fused. Directly compatible with the PS-12 and PS-14. All electronics supplied. Drilled and plated PC board. (Order OVP-1)

MK-03A CLOCK/TIMER KIT

Features 24 hour Zulu time and up to 24 hours of elapsed time on the same set of six digit LED readouts. Totally independent operation of both functions. Clock has presettable alarm with 10 minute snooze. Timer has reset, hold, and count functions. Full noise and overvoltage protection. 24 hour only. Readouts has dimmer feature or they can be turned off without disturbing the clock or timer. Timebase included (.01% accuracy). Because of the many options and mounting considerations the case and switches are not included. Switches are standard types. Will fit inside standard aircraft instrument case.

9-14VDC 28.95

CAPACITORS

.022	@ 100VDC Mylar	8/1.00
.22	@ 50VDC Mylar	6/1.00
1.5mfd	@ 400VDC Mylar	4/1.00
1mfd	@ 35V Tant Axial	6/1.00
.47mfd	@ 35V Tant Axial	6/1.00
2.2mfd	@ 35V Tant Axial	5/1.00
22mfd	@ 20V Dip Tant	4/1.00
33mfd	@ 10V Dip Tant	4/1.00
220mfd	@ 25V Alum. Axial	7/1.00
500mfd	@ 35V Alum. Axial	5/1.00

HOUSE # PNP POWER

TO-3 IDENTICAL TO 2N3790

150 WATTS
80 VCEO
10 AMPS

1.00

LOOK! FANTASTIC SOUND EFFECTS CHIP

AVAILABLE ONLY FROM BULLET!

THIS 28 PIN MARVEL CONTAINS A LOW FREQUENCY OSCILLATOR, VCO, NOISE OSCILLATOR, ONE SHOT, MIXER AND ENVELOPE CONTROL. WITH 8 PAGE MANUAL. 5 to 9VDC 3.95

WARBLE ALARM KIT

A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 5-12VDC at up to 1 amp (using 12VDC+8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker. 2.50 ORDER WB-02

IL-1 OPTO ISOLATORS

BY LITRONIX 6 PIN DIP STANDARD PINOUT LED-TRANSISTOR COMBINATION. 50¢ *WHILE THEY LAST!*

ULTRASONIC SENDER RECEIVER KIT US-02

TOTAL SECURITY! Completely invisible ultrasonic (23KHZ) Sound beam works like a photoelectric beam but is unaffected by light, heat or noise. Seperate Transmitter and Receiver can be used from 6 inches to 25 feet! A solid object breaking the beam causes an output to go low that will sink up to 150 MA to Drive a Relay, TRIAC, etc. Complete electronics are provided. Works on 12VDC (unregulated) and draws less than 100 MA. Use it for burgler alarms, object counters, automatic door openers, automatic door bells, electronic rat trap(?) and more.

COMPLETE KIT LESS CASES 21.50

Optional entry delay and Alarm Timeout Circuit 3.95 will source or sink up to 200 MA DC.

- NO C.O.D.'S
- SEND CHECK M.O. OR CHARGE CARD NO.
- PHONE ORDERS ACCEPTED ON VISA AND MASTERCHARGE ONLY.
- ADD 5% FOR SHIPPING
- TX. RES. ADD 5% STATE SALES TAX
- ORDERS OF $50. & OVER TAKE 10% DISCOUNT
- FOREIGN ORDERS ADD 10% (20% AIRMAIL) U.S. FUNDS ONLY.

STUDENTS & TEACHERS
WITH YOUR ORDER, SEND PROOF OF YOUR STATUS AND RECEIVE 5% OF YOUR PRESENT ORDER AS A CREDIT CERTIFICATE YOU CAN USE ON YOUR NEXT ORDER.

FREE SOCKETS
WITH PURCHASE OF ANY OF THESE I.C.'s.

READ THE FINE PRINT AND SAVE!

THE FIRST MEMORY SPECIAL YOU WON'T FORGET

2102-2	650ns	8/$9.95	32/$37.00	64/$71.00	128/$135.00
2102-4	450ns	8/$10.95	32/$41.00	64/$78.00	128/$145.00
2114D	450ns	8/$79.00	16/$149.00	32/$274.00	64/$499.00

PRESCALER · 250 MHZ
complete $23.95
PRESCALER · 650 MHZ
complete $49.95
11C90 · PRESCALER CHIP
650 mc $19.95

SOLID STATE RELAY
- 400 V at 3 AMPS • TTL COMPATIBLE
- MICRO REED ACTUATED TO MINIMIZE CHANCES OF AC POWER SPILLOVER INTO LOGIC CIRCUITS $3.95

OPTO ISOLATORS
1. MCT2 $ .79
2. MOC1000 $ .89
3. 4N-26 $ .95
4. CL1422

CLAIREX PHOTD MODULE (USE AS VDLTAGE VARIABLE RESISTOR—40 MEG OHM TO 40 OHM—MILLION TO ONE RATIO—OR USE AS VERY HIGH VOLTAGE OPTO ISOLATOR) $1.49

CHEAPER BY THE 100

LEDS-	(HP AXIAL-RED)	100/8.95
LEDS-	(MINI-RED)	100/9.95
LEDS-	(JUMBO-RED)	100/13.95
LEDS-	(DUAL COLOR)	100/59.00
1N4001-	(50V-1 AMP)	100/ 4.95
1N4148-	(SWITCHING DIODE)	100/ 3.95
2N4303-	(N-JFET)	100/21.95
2N3392-	(PRIME-NPN LDW NOISE)	100/ 9.95

REFLECTIVE PHOTO COUPLERS
TIL-139 LED INTO PHOTO TRANSISTOR $2.95
ROC100 INCANDESCENT INTO CDS CELL—20 MEG OHM OFF RESISTANCE $1.95

AUDIO POWER AMPS

SINGLE

TDA-2020-20 Watt	$9.95
S11020H-20 Watt	$10.50
S11130H-30 Watt	$12.50
STK-50 -50 Watt	$18.95

STEREO

STK433-5 Watts per channel	$6.95
STK435-7 Watts per channel	$9.95
STK437-10 Watts per channel	$11.95
STK439-15 Watts per channel	$13.95
STK441-20 Watts per channel	$16.95

8080 SYSTEM

80804	5.95
8212	3.75
8214	8.95
8216	3.50
8224	4.80
8226	4.75
8228	7.25
8238	8.25
8251	9.45
8253	21.50
8255	10.75
8257	20.50
8259	20.50

Z-80 SYSTEM

3880	22.50
3881	12.50
3882	12.50
3883	49.00
3884	73.00

6800 SYSTEM

6800	16.95
6810	7.20
6820	7.95
6821	8.50
6850	8.95
6852	11.95
6860	9.95
6862	13.75

6500 SYSTEM

6502	14.95
6520	12.75
6522	12.50
6530	17.50

9900 SYSTEM

9900	66.00
9901	23.75
9902	19.50
9980	54.00
9981	54.00

1800 SYSTEM

1802	24.00
1821	19.50
1822	20.25
1824	13.50
1852	13.75
1856	11.75
1857	11.76
1861	20.00

CPU's

2650	19.95
2901	19.95
PACE	19.00
SC/MP	14.95

CPU's cont.

8008	8.95
8035	19.95

RAM

7489	2.95
3101	3.95
8225	2.95
2101-1	2.95
2101-2	3.25
2101A-4	3.25
2102-2	1.50
2102L1	1.95
82S10	4.95
82S11	4.95
5101L-3	11.95
2107	3.95
TMS4060	3.95
UPD411	3.95
4200A	9.95
2114 200ns	13.50
2114 450ns	10.95
2114 650ns	6.25
4116 200ns	18.50
4116 300ns	17.50
4116 450ns	13.50

PROMS

8223	2.95
82S23	3.75
82S126	5.95
82S129	6.95
82S131	7.25
6306-1	6.95
93427	5.95
D3604	11.95
2616	50.00
1702A	4.95
2708	12.95
2716-5V	46.95

CHARACTER GENERATORS

2513 UC	7.95
2513 LC	7.95
2516	7.95
5240	7.95
MM6571A	9.95

KEYBOARD ENCODER

AY5-2376	14.95

UARTS

AY5-1012	8.95
AY5-1013	8.95
TR-1602	9.95
TMS6011	8.95

FIFO's

3341	7.95
1502E	10.95

PROG. LOGIC ARRAYS

82S100	11.95
82S101	11.95

SHIFT REGISTERS

C1402A	1.95
MM1403AH	1.95
MM5006AH	2.95
MM5060	3.95

CLOCK CHIPS

MM5311	7.95
MM5312	4.95
MM5313	7.95
MM5314	4.95
MM5315	7.95
MM5316	4.50
MM5375	5.95
TMS3834	6.95
CT7001	6.50

CALCULATOR CHIPS

MM5725	1.95
MM5736	1.95
MM5738	1.95
MM5739	1.95
MCS2521	1.95

INTERFACE CHIPS

DS0026	3.25
DS3608	3.85
DM8093	.95
DM8094	.95
DM8095	.95
DM8096	.95
DM8097	.95
DM8098	.95
DM8131	3.25
DM8202	1.45
DM8233	1.10
DM8234	1.10
DM8241	.45
DM8242	.45
DM8250	.90
DM8251	.90
DM8266	1.35
DM8267	1.35
DM8271	1.35
DM8544	1.30
DM8831	2.95
DM8833	2.60
DM8835	2.60
DM8836	4.75
DM8837	2.45
74273	2.60
74390	2.10
81LS95	1.95
81LS96	1.95
81LS97	1.95

S-100 MOTHER BOARD — 8 Slot Kit 69.00
S-100 32K STATIC MEMORY BOARD
ALL BURNED IN 650ns 599.00
AND TESTED 450ns 735.00
ultra low power 200ns 875.00
S-100 EDGE CARD CONNECTORS 3.50
MAXI KEYBOARD — 53 Keys 19.95
MAXI KEYBOARD — 74 Keys 33.95
KEYPAD — 16 key x-y matrixed 1.95
KEYPAD — 20 key x-y matrixed 2.95
WIRE WRAP POSTS
2 level 100/3.95 4 level 100/4.95
WIRE WRAP SOCKET PIN 100/7.95
TAPE READER — 12 level — includes both IR sources and pickups 29.00
MAKE YOUR OWN PAPER TAPE READER
1/10" SPACED PHOTO TRANSISTORS 10/9.50
REED RELAY — TTL compatible 1.89
SOLID STATE RELAY — micro reed actuated for total isolation 3.95
CRYSTAL FILTERS — 455 Kc miniature
single section 1.95 dual section 2.95

PRECISION THERMISTORS
YSI- BEAD — 1% 5000 OHM 2.95
GLASS BEAD — 1% 15000 OHM 2.95
GLASS BEAD — 1% 200 OHM 2.95
CYLINDRICAL — .01% 3.95
POWER THERMISTOR — positive temperature coefficient 20-2500 OHM 2.95

D/A CONVERTER — NE5008 (8 bit) 7.95
D/A CONVERTER — DAC-01-SH (6 bit) 6.95
PHOTO DIODE — super fast 0.5ns 3.95
IR DETECTOR — super sensitive 4.95

READ OUTS — MULTI DIGIT
LCD-3-1/2 dig. .4"-4.95 3-1/2 dig. .3" 1.95
LED .17"-3 dig. 1.25 — 6 dig. 3.95 — 8 dig. 4.95

PHOTO DEVICES—DIODES, XSTR's, DARLINGTONS
2N5771 - 1.25 FPT100A - .79 MD1 -1.95
H-38 - 3.25 MRD-250 - 1.95 LASCR-1.95

HIGH VOLTAGE TRANSISTORS

2SC1358	100W-1400V-5A	TO-3	7.95
BUY69B	110W-800V-10A	TO-3	5.95
W905	100W-500V-5A	Plastic	4.95
362-4	20W-500V-1A	Plastic	2.25
338-7	20W-350V-1A	Plastic	1.50

HIGH VOLTAGE DIODES

UNMARKED	1500V at 1 AMP	10/1.99
EG 250	2500V at .35 AMP	.95
HV60EL	6000V at 25 ma	1.95
SUBMINIATURE	20,000V at 100 ma	2.95

CARBIDE DRILL BITS AND ROUTER BITS for P.C. board work — *MIXED SIZES*
OUR MIX — DRILLS 10/12.95 100/95.00
OUR MIX — ROUTERS 10/15.95 100/125.00

RADIO SHACK®

TRS-80™ COMPUTER

SERVICE AND MODIFICATION

BE FIRST TO TURN YOUR TRS-80 INTO A SUPER MACHINE

1. Keyboard and Video Mod
ADD RAM FOR LOWER CASE CHARACTERS AND CLEAN UP HORIZONTAL SMEAR (SEND YOUR TRS-80 MICROCOMPUTER ONLY)
PARTS AND LABOR $59.00

2. Install 16K Memory
JUST SEND US YOUR TRS-80 MICROCOMPUTER AND WE DO THE REST.
16K OF MEMORY AND LABOR $189.00

3. Level 2 plus 1 Mod
WE INSTALL *YOUR* LEVEL 2 SO YOU KEEP LEVEL 1 AND CAN USE IT BY JUST FLIPPING A SWITCH. (SEND LEVEL 2 WITH YOUR TRS-80)
$69.00

4. Clock Mod
INCREASE YOUR PROCESSING SPEED BY 30%. WITH THIS OPTION YOU CAN SWITCH-SELECT BETWEEN THE FASTER 2.66 MHZ CLOCK RATE AND 1.77 MHZ.
INSTALLATION, PARTS AND LABOR $49.00

5. Serial Printer Interface Mod
OPERATE CRYSTAL CONTROLLED TTY WITH LEVEL 1 OR 2. WE INSTALL SWITCH SELECTABLE BAUD RATES OF 75, 110, 137.5, 150, 300, 600, 1200, 2400, 4800, 9600 OR EXTERNAL. EIA RS232 AND CURRENT LOOP OUTPUT.
PARTS AND LABOR $119.00

6. Mini Floppy Mod
YOU PROVIDE EXPANSION INTERFACE AND WE'LL INSTALL A PERTEC F D 200 MINI FLOPPY.
PARTS AND LABOR (PERTEC F D 200 MINI FLOPPY INCLUDED) FOR ONLY $425.00

SPECIALS!! DO MORE THAN ONE MOD AND SAVE

MODS 1, 2, 3, 4 AND 5	$449.00
MODS 1 AND 2	$234.00
MODS 2 AND 3	$243.00
16K OF MEMORY, PARTS AND INSTALLATION DATA.	$159.00

ALL WORK GUARANTEED UNCONDITIONALLY FOR 1 YEAR

REPAIR—*WE WILL REPAIR ANY ORIGINAL TRS-80 MICROCOMPUTER OR ONE OF OUR MODIFICATIONS.*
ALL PARTS AND LABOR $69.00

NOTE: THIS IS AN INDEPENDENT SERVICE EFFORT NOT AFFILIATED WITH RADIO SHACK® OR TANDY CORPORATION.

TERMS FOR TRS-80 WORK: WE ACCEPT ONLY TRS-80 MICROCOMPUTERS! SHIP YOUR TRS-80 MICROCOMPUTER TO US, INSURED AND SUITABLY PACKAGED AND WE WILL RETURN SAME FREIGHT COLLECT. ALL FACTORY SEALS MUST BE INTACT. ANY UNIT WHOSE SEALS HAVE BEEN TAMPERED WITH WILL BE SHIPPED BACK IMMEDIATELY. MODS 1, 2, 4 AND 5 SEND TRS-80 MICROCOMPUTER ONLY. MOD 3 SEND YOUR TRS-80 MICROCOMPUTER AND LEVEL 2. MOD 6 SEND TRS-80 AND EXPANSION INTERFACE. **NORMAL TURN AROUND TIME IS UNDER 10 DAYS** WITH CERTIFIED FUNDS

F. REICHERT SALES

1110 E. GARVEY AVE.
W. COVINA, CA 91790
(213) 967-3846

- $20 MINIMUM ORDER
- FREE UPS DELIVERY ON U.S. ORDERS ONLY—OR BY SURFACE MAIL IF SPECIFIED.
- MONEY BACK GUARANTEE (MOS & LED DEVICES EXCLUDED)
- UNDER 8 HOUR PROCESSING ON MONEY ORDERS & CASHIER'S CHECK.
- SORRY! NO COD'S, PO'S OR CREDIT CARDS
- CALIF. RES. ADD 6% SALES TAX
- CANADA, PUERTO RICO & U.S. POSSESSIONS ADD U.S. $3.50. ALL OTHERS ADD U.S. $7.00.
- U.S. FUNDS ONLY.

DROP INTO ONE OF OUR LOCATIONS

LOS ANGELES
(213) 967-4611
LMN ELECTRONICS
1042 E. GARVEY AVE.
WEST COVINA, CA

PORTLAND
(503) 646-4044
WIZARD OF PARTS
8225 S.W. CIRRUS DR.
BEAVERTON, OREGON

DENVER
(303) 573-5214
ELECTRONIC LOLLIPOP
5643 N. BROADWAY, DENVER
(I-25 & 58th AVE.)

ALL ITEMS SUBJECT TO PRIOR SALE

PRICES SUBJECT TO CHANGE WITHOUT NOTICE

CIRCLE 80 ON FREE INFORMATION CARD

ASCII KEYBOARD KIT $74.00

Additional Improvements: Double Size Return Key Control Characters Molderd on Key Caps

- Power: +5V 275mA
- Upper and Lower Case
- Full ASCII Set
- 7 or 8 Bits Parallel Data
- Optional Serial Output
- Selectable Positve or Negative Strobe, and Strobe Pulse Width
- 2 Key Roll-Over
- 3 User DEfineable Keys
- P.C. Board Size: 17-3/16" x 5"

OPTIONS:

- Metal Enclosure Painted Blue and White $27.50
- 18 Pin Edge Con. $ 2.00
- I.C. Sockets $ 4.00
- Serial Output Provision (Shift Register) $ 2.00
- Upper Case Lock Switch for Capital Letters and Nos. $ 2.00

Assembled (on Sockets) and Tested $90.00

Shipping: Keyboard $3.50;

California residents add 6% sales tax

ELECTRONICS WAREHOUSE Inc.

1603 AVIATION BLVD.
REDONDO BEACH, CA. 90278
TEL. (213) 376-8005
WRITE FOR FREE CATALOG

Dept. R

CIRCLE 48 ON FREE INFORMATION CARD

WIRE WRAP

— PRECUT WIRE —

Why buy wire on rolls?

PRECUT & STRIPPED WIRE IS:

- Fast - No more cutting & stripping by hand
- Reliable - Good, clean, uniform strip
- Economical - Cheaper than using bulk wire

PRECUT WIRE	BULK WIRE
100 pcs of 3" at $.82 - 3 1/4¢/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
2" in	.78	2.40	4.30/K	3.89 K
3" in	.82	2.60	4.71/K	4.22/K
3" in	.86	2.80	5.12/K	4.55/K
4" in	.90	3.00	5.52/K	4.88/K
4" in	.94	3.21	5.93/K	5.21/K
5" in	.98	3.42	6.34/K	5.52/K
5" in	1.02	3.65	6.75/K	5.86/K
6" in	1.06	3.85	7.16/K	6.19/K
6" in	1.15	4.05	7.57/K	6.52/K
7" in	1.20	4.25	7.98/K	6.85/K
7" in	1.25	4.45	8.39/K	7.18/K
8" in	1.29	4.65	8.80/K	7.53/K
8" in	1.32	4.85	9.21/K	7.84/K
9" in	1.36	5.05	9.62/K	8.17/K
9" 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 KITS

#1 $6.95

250 3" 100 4"
250 3" 100 5"
100 4" 100 6"

2 $19.95

250 2" 250 4" 250 6"
500 3" 250 5" 100 6"
500 3" 100 5" 100 7"
500 4" 1,250 ft. roll bulk

Choose One Color or Assortment

WIRE WRAP SOCKETS

	1-9	10-24	25-99	100-249	250-999	1K-5K
8 pin	.35	.33	.31	.29	.25	.23
14 pin	.35	.33	.31	.29	.28	.27
16 pin	.37	.35	.33	.31	.30	.29
18 pin	.60	.55	.45	.43	.40	.37
20 pin	.84	.78	.71	.63	.59	.54
22 pin	.90	.85	.82	.78	.70	.60
24 pin	.91	.84	.78	.68	.64	.59
28 pin	.95	.89	.84	.80	.76	.74
40 pin	1.50	1.40	1.30	1.20	1.05	.90

Gold 3-Level Closed Entry Sockets
End & Side Stackable — All prices include gold
2-Level Sockets Available

WIRE WRAP TOOLS

$34.95

HOBBY WRAP
MODEL BW 630

With FREE Wire Kit #1 ($6.95 Value)

Batteries & Charger	$11.00
WSU 30 Hand Wrap-Unwrap Strip Tool	6.25
WSU 30M, for Modified Wrap	7.25
BT 30 Extra Bit	2.95

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

PAGE DIGITAL ELECTRONICS

135 E. Chestnut St. #5
Monrovia, California 91016
(213) 357-5005

ORDERING INFORMATION

- Orders under $25 and COD's, add $2
- All others, shipped Ppd in U.S. via UPS
- For Blue Label (Air) or 1st Class, add $1
- We accept Visa & Mastercharge
- Most orders shipped same day

DEALER INQUIRIES INVITED

CIRCLE 22 ON FREE INFORMATION CARD

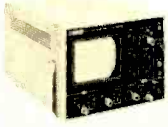
EDLIE ELECTRONICS'
TEST EQUIPMENT BONANZA.

EICO 272

Measures up to 1000 DC volts and up to 600 AC volts up to 1000 DC and AC millamperes. Resistance in kilohms up to 1 meg, 3 digits .3 in four ranges 1(.999), 10(9.99) 100(99.9) 1000(999) Accuracy: DC volts ±0.5% of reading. All other functions ±1% of reading. Automatic zero, automatic polarity

Reg. $79.95. Our price $67.95

B&K Dual-Trace 10 MHz Triggered 5" Scope MODEL 1471B



Mode automatically shifts between CHOP and ALTERNATE as you change sweep time for fast set-up. Bright P31 blue phosphor. 18 calibrated sweeps—1 μSEC/cm to .5SEC/cm. Sweep to 200nSEC/cm with 5X magnification. Front panel X-Y operation using matched vertical amps. Input grounding switches. TV sync separators. Check most digital logic circuitry including CMOS. Character display applications using TTL compatible Z-axis intensity modulation. Includes probes.

Reg. price $599.00. Our price $505.00

B&K 520 MHz Frequency Counter MODEL 1850

5Hz to 520 MHz reading quaranteed—600 MHz typical. Gate time from 10ms to 10 seconds. Full period measurement capability. 50 mV input sensitivity at 520MHz. Operates from 115 to 230 VAC, or 12 VDC. Well protected input circuitry. Temperature compensated crystal oscillator (TCXO).

APPLICATIONS RF frequency measurement to 520MHz, including business band, broadcast service, amateur radio, marine band, paging systems, mobile telephones and citizens band.

Reg. price $450.00. Our price $382.50

B&K Industrial Transistor Tester MODEL 520B

Now with HI/LO Drive. Works in-circuit when others won't. Identifies all three transistor leads. Random lead connection. Audibly and visually indicates GOOD transistor. Automatic NPN/PNP determination. Positive Si/Ge identification. Tests diodes, SCR's, FET's and Darlingtons.

The 520B with HI/LO Power Drive lets you test even more transistors and semiconductors in-circuit—with shunt resistances as low as 10 ohms and shunt capacitances up to 15 mF. A complete test can take less than nine seconds.

Reg. price $175.00. Our price $148.75

DE109 #22 GAUGE TWISTED PAIR (Solid); available in the following colors: Red and Black, Blue and Black, Yellow and Black.

100 ft. rolls Price only $1.75 per roll
1000 ft. rolls Price only $12.00 per roll

Back by popular demand. Mini speaker/dynamic mike element. 500Ω impedance. Used for Hi-Fi, experimentation, or even digital.

Price now only 99¢, 3 for $2.65

Another EDLIE Super Tape Special. 1800 Quality Tape made by Scotch, Ampex or Soundcraft on 7" regular reels. They were bought surplus and are of excellent grade.

79¢ 3 for $2.25 6 for $3.99
100 for $59.95

DE391 extra special!! 8" high compliance suspension speaker.

10 oz. magnet. Capable of handling the really heavy wattage Stereo & Hi-Fi Equipment.
Really Exceptional Buy!! **Only $7.95**

DE108 #20 WIRE STRANDED Red, White, Grey, Off-White (Clear), Orange, Black with White. Please Specify Color Desired.

100 ft. rolls Price only $1.49 per roll
10 rolls assorted Price only $12.95
1000 ft. rolls (1 color) $10 per 1000

Buy 10,000 feet in any assortment or one color Price only $75

EDLIE Electronics
2700 Hempstead Tpke.
Levittown, N.Y. 11756
Your one stop, full line Electronic Discount Center
(516) 735-3330

WRITE FOR FREE VALUE PACKED CATALOG

Mastercharge
BankAmericard
VISA accepted

Terms: Minimum order $10.00. Include postage. Either full payment with order or 30% deposit, balance C.O.D. F.O.B. Levittown, N.Y.

An EDLIE Super Special

DE944
Heavy Duty 6"x9" Air Suspension Speaker, 10 oz. magnet, 55-15,000 Hz. **Price $6.95 ea.**

CIRCLE 38 ON FREE INFORMATION CARD

POLY PAKS®
DISCOUNT ALLEY

WE'RE PUTTING "GREENBACKS" IN YOUR POCKET!

Poly Paks, originator of the world famous PENNY SALE, now introduces DISCOUNT ALLEY, with the best bargains available anywhere! For any $15 shipment of material from this ad, TAKE 10% DISCOUNT! Or, for any $50 shipment of material from this ad, TAKE 25% DISCOUNT! NOBODY GIVES THE CONSUMER DISCOUNTS LIKE POLY PAKS!

300 CFM HIGH POWER BLOWER

$12.50

Made by Fasco! For home, shop, industry! 115VAC, 2.2 Amps. Overall size 14" long x 4-3/4" Wheel size 5¼ dia, 3" deep. Removed from new equipment. Wt. 12 lbs. **Cat. No. 5165**

RIBBON CABLE AT THIN PRICES

• Ultra flat! • 28 AWG

Cond	Sale			
☐ 25	4 ft. $1.98	☐ 36	3 ft. $1.98	Order by Cat.
☐ 26	4 ft. $1.98	☐ 40	3 ft. $1.98	No. 3939 and
☐ 34	3 ft. $1.98	☐ 50	2 ft. $1.98	conductors.
		☐ 60	2 ft. $1.98	

SANYO AUDIO AMPLIFIER MODULES

Easy to build a complete audio amplifier for hi-fi, tape, AM, FM, PA, and more! Response 20-20,000 Hz, less than .5% distortion at full power. Efficient heat radiating construction. Output 8 ohms. Size 3½ x 2 x ¼" thick approx. Wt. 8 oz. With instructions.

Cat. No.	Type	Watts-RMS	Sale
☐ 5350	STK-009	13	$8.88
☐ 5351	STK-013	15	11.50
☐ 5352	STK-028	20	14.88
☐ 5411	STK-056	30	18.88
☐ 5228	STK-050	50	26.88
☐ 5353	STK-014*	15x2	18.88

*Stereo

1N4000 EPOXY RECTIFIERS

Order by Cat. No.

Cat. No.	Type	PIV	Sale
☐ 2377	1N4001	50	10 for .49
☐ 2378	1N4002	100	10 for .59
☐ 2379	1N4003	200	10 for .69
☐ 2380	1N4004	400	10 for .89
☐ 2381	1N4005	600	10 for 1.09
☐ 2382	1N4006	800	10 for 1.49

BLOCK FANS $9.95

For cooling, flushing, heating and ventillating! Quiet & dependable. Lightweight, flame retardant. 3 blades or better (sorry, no choosing). Removed from new equipment. Ship wt. 1½ lbs. **Cat. No. 92CU3108**

• Famous USA Makers! • 4-11/16" sq. 1½" deep.

30 WATT STEREO AMPLIFIER KIT $24.95

• Use with any preamp!

Easy to build, assembles in minutes. Uses two 15 watt Hybrid Amplifier Modules with heat sinks included! Power output 2 x 15W RMS, both channels into 8 ohms from 40-22,000 Hz. Total distortion less than 1%. Size: 5¼ x 2-3/4". Wt. 1 lb. **Cat. No. 5408**

Made For Fisher.

POCKET VOM $8.88

• 1000 ohms per volt!

1% precision resistors, D'Arsonval movement with burnout protection. Measures DC volts 0-15-150-1000; AC Volts 0-15-150-1000; DC Current 0-150mA; Resistance X1000 ohms. Sensitivity 1000 ohms per volt AC/DC. Uses AA penlite cell, not included. Size 2-3/8" x 3½" x 1-3/8" Wt. 6 oz. **Cat. No. 3921**

FREQUENCY COUNTER PRESCALER KIT

Fits inside our Frequency Counter Cabinet. Requires +5VDC, 100mA. With instructions.

• Works with all frequency counters!

$24.95 kit

Cat. No. 5215 PRESCALER KIT $24.95

Cat. No. 5225 PRESCALER WIRED $34.95

• Extends range to 500 MHz!

MICROPROCESSORS! MEMORIES! SUPPORT!

Order by Cat. No. 3459 and type

☐ 8008	$7.95	☐ 8259	19.95
☐ 8080A	9.95	☐ 2102-L1	$1.59
☐ 8212	3.50	☐ 1103	.79
☐ 8214	7.95	☐ MM5260	.99
☐ 8216	3.50	☐ MM5262	.39
☐ 8224	3.50	☐ MM5280*	3.95
☐ 8228	6.95	☐ MK4200P-11	3.95
☐ 8238	7.95	☐ MK4096	3.95
☐ 8251	9.95	☐ MK4116	19.95
☐ 8253	19.95	☐ 1702A	4.85
☐ 8255	10.50	☐ MM5202	2.95
☐ 8257	19.95	☐ 2708	10.95

SOLAR ENERGY DISCS

Converrts sunlight directly to electricity! All discs 0.5VDC. Add is series or parallel for higher voltages and amperages.

Cat. No.	Size	mA	Sale
☐ 5046	2"	200	3.95
☐ 3211	2¼"	500	5.50
☐ 3862	3"	1000	8.88
☐ 3788	3½"	1500	10.95
☐ 5075	4"	1500	12.95

FULL WAVE BRIDGE RECTIFIERS

PIV	2 AMP (#1346)	6 AMP (#2456)	10 AMP (#2447)	25 AMP (#2273)
☐ 50	.59	.88	1.29	1.59
☐ 100	.69	.99	1.49	1.79
☐ 200	.79	1.25	1.69	2.25
☐ 400	.89	1.50	1.99	2.49
☐ 600	.99	1.75	2.25	3.75
☐ 800	1.19	1.95	2.50	4.50

Order by Catalog Number and voltage.

NEW!

DIGITAL CAPACITANCE METER KIT $69.95

• 5 Ranges! • Four .5" digits! • You've seen it at twice the price!

Measure any capacitor value from 100 pF to 10,000 uF! Five ranges: 0-1uF, 10uF, 100uF, 1000uF, 10,000uF. Also tests leakage! Directly reads all types of capacitors at the touch of a button. Easy to assemble! Complete kit, nothing else required. With step-by-step instructions. Size 6¼ x 2¼ x 5½" deep, vinyl covered wooden cabinet. Wt. 2 lbs.

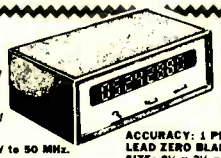
Cat. No. 5238 Capacitance Meter Kit $69.95

Cat. No. 5239 Capacitance Meter Wired $95

BARGAIN PRICED ONE-LINE SPECIALS

☐ ULTRASONIC TRANSDUCER, 42kHz, alarms, remote cont. (#5375)	1.49
☐ DYNAMIC MIKE, 500 ohm impedance, with stand. (#5330)	1.95
☐ LED RAY DIODES, emits coherent beam, 5-9W. (#3508)	6.88
☐ 12VDC BLOCK RELAY, 5A contacts, SPDT, 700 ohms (#4032)	1.00
☐ RED DISC SPECIAL, Eris, mostly marked, pop values (# 5341)	150 for 2.00
☐ LONG LEAD DISC CAPACITORS, pop values, asst'd.(# 2598)	100 for $2.00
☐ TRANSISTOR 'LYTICS, asst. pop values, upright, axial.(# 2747)	50 for $2.00
☐ MOLEX IC SOCKET PINS, cut to any length.(# 3146)	200 for $2.00
☐ AXIAL ELECTROS, asst'd values & capacitance. (# 3227)	40 for 2.00
☐ LED DRIVER IC'S, untested, like 75491-2, 50% good.(# 3360)	30 for $2.00
☐ JUMBO RED LEDS, 100% prime, long leads.(# 3369)	15 for $2.00
☐ LINE CORDS, 18ga, 2 cond, with plug, 5 ft.(# 3843)	8 for $2.00
☐ HARDWARE SURPRISE! screws, nuts, washers, and more.(# 3967)	500 pc for $2.00
☐ TUBULAR CAPACITORS, asst values from 100 pf up.(# 35A219)	70 for $1.00
☐ COILS AND CHOKES, RF, AF, osc, peaking, and more.(# 35A297)	60 for $1.00
☐ RCA PLUGS & JACKS, for audio, RF, etc.(# 35B402)	15 for $1.00
☐ SLIDE SWITCHES, asst types, from SPST up.(# 1495)	20 for $1.00
☐ 9 VOLT BATTERY SNAPS, fits std types.(# 2852)	6 for $1.00
☐ 1N4148 SWITCHING DIODES, like 1N914, 100% prime.(# 3000)	20 for $1.00
☐ UTILITY AC OUTLET, rect mounting.(# 3582)	8 for $1.00
☐ 1 AMP CIRCUIT BREAKERS, glass, thermal.(# 3905)	2 for $1.00
☐ CAPACITOR SPECIAL, discs, mylar, lytics, more (# 2738)	100 for 2.00
☐ VOLTAGE REGULATORS, hobby LM320, 340, TO-3 (# 3330)	10 for 2.00
☐ PANEL SWITCHES, slides, rotaries, mod, etc (# 3268)	30 for 2.00
☐ RESISTOR SPECIAL, ¼ to 1W, carbon, metal (# 3054)	200 for 2.00
☐ HALF WATTERS, resistors, carbon, metal (# 3046)	200 for 2.00
☐ NATIONAL IC BONANZA, linears, 7400s ROMS (# 2860)	100 for 2.00
☐ LM340T VOLTAGE REGULATORS, 5 to 24V, TO-220 (# 2638)	15 for 2.00
☐ POLYSTYRENE CAPS, asst'd values, voltage, hi-Q (# 2720)	100 for 2.00
☐ BRIDGES, untested, 2...6 amp, full wave (# 4022)	10 for 2.00
☐ MIXED READOUTS, hobby, untested, .127, .3, .5, etc. (# 3619)	15 for 2.00
☐ QUARTER WATTERS, resistors, metal film, marked (# 3413)	150 for 2.00
☐ PLASTIC TRANSISTORS, untested, TO-92 (# 2604)	100 for 2.00
☐ PREFORMED RESISTORS, ¼, ½, 1W, marked, asst'd (# 2608)	200 for 2.00
☐ PRECISION RESISTORS, ¼, ½, 1W, 1%, 2% marked (# 2428)	200 for 2.00
☐ DIPPED MYLARS, shiny finish, asst'd values (# 2587)	60 for 2.00
☐ VOLUME CONTROLS, audio, linear, asst'd values (# 2421)	30 for 2.00
☐ CLOCK CHIPS, National, hobby & untested, alarm (# 5089)	30 for 2.00
☐ MM5262 2K RAMS, hobby, untested (# 3940)	30 for 2.00
☐ PUSH SWITCHES, push-to-break, spst, alarms (# 5289)	10 for 2.00
☐ CD-4000 SERIES CMOS, untested, 50% useable yield (# 5284)	25 for 2.00
☐ CONDENSER MIKES, sensitive, 500 ohms 1.5 Volts (# 3178)	1 for 2.95
☐ UNMARKED CAPACITORS, polystyrene, molded, pop values (# 3805)	250 for 2.00
☐ IC SOCKETS, 14, 16 pin, solder tail. (# 3821)	8 for 2.00
☐ PC TRIM POTENTIOMETERS, thumbwheel, screwdriver ass't. (# 3345)	30 for 2.00
☐ SLIDE VOLUME CONTROLS, asst'd values, duals, singles (# 3057)	15 for 2.00
☐ CRYSTALS, may include CB, Ham & more (# 3250)	10 for 2.00
☐ TERMINALS STRIPS, from 2 lugs up (# 3136)	100 for 2.00
☐ NE-2NEON LAMPS, all 100% good (# 2813)	30 for 2.00
☐ SHIELDED CABLE, 1 cond, mikes, phones, (# 3577)	40 ft. for 2.00
☐ SOUND TRIGGER, sound triggers scr w/amp (# 3625)	3 for 2.00
☐ VEEDER ROOT COUNTER, 000-999, resettable, panel mt. (# 5081)	1 for 1.49
☐ DUAL GATE MOSFET, sim. to 3N200, 3N204 or RF & Mixer (# 5101)	2 for 1.00
☐ LCD THERMAL INDICATORS, 88-108°F, 7x1", flexible (# 5195)	2 for 1.00
☐ JOYSTICK, four 100K pots, (# 3808A)	1 for 2.95
☐ EECO THUMBWHEEL SWITCH, BCD, 0-7 (#2870A)	1 for 1.49
☐ PLESSEY TV SIDEBAND FILTER, for chan. 3 or 4 (# 3975)	1 for 1.95
☐ 9V NI-CAD CHARGER PAK, plug-in, 125ma, 125 VAC pri (# 4098)	2 for 1.49
☐ DATA ENTRY PUSH-SWITCHES, spst, norm open, for keyboards (# 5279)	20 for 2.00
☐ SN7400 TTL ICs, untested 50%+ yield, pop types (# 2415)	75 for 2.00
☐ MINI DIP ICs, linears, untested 50%+ yield, pop types (# 3245)	100 for 2.00
☐ LM380 AUDIO IC's, 2 watts on-a-dip 50%+ yield (# 5284)	30 for 2.00
☐ LINEARS, OP AMPS, untested 50%+ yield, amps-dips-minidips (# 2416)	75 for 2.00
☐ LED WATCH GUTS, man's, how good? We don't know (# 5267)	1 for 1.95
☐ SLIDE SWITCHES, asst pop styles (# 1495)	10 for 1.00
☐ UPRIGHT ELECTROS, asst'd values & capacitance. (# 3226)	40 for 2.00
☐ PREFORMED DISC CAPACITORS, marked values, asst'd (# 2605)	150 for 2.00
☐ CALCULATOR KEYBOARDS, 20 keys and up. (# 5371)	10 for 2.00
☐ ALARM SWITCHING STICKERS, for windows, 2-3/4" x 3" (# 5338)	3 for 1.00
☐ CALCULATOR SWITCHES, SPST-N.O., asst'd, ½" sq. (# 3524)	10 for 1.00
☐ ITT 6 DIGIT COUNTER, 110VAC, with mounting flange (# 5392)	1 for 1.95
☐ 2N2369 TRANSISTORS, NPN switch. like 2N2222. (# 1992)	6 for 1.00
☐ FACTORY REJECT DIODES, zeners, rect, signal. untested (# 5369)	2000 for 1.00

8 DIGIT FREQUENCY COUNTER $77



• More features for the money! • Easy to assemble and calibrate!

Easy to read .35" led digits, dependable MOS/LSI circuitry. Quartz crystal controlled for high accuracy! Displays internal frequency standard at the touch of a button. Built in power supply! Flip-top black vinyl covered wooden cabinet for easy access.

SPECIFICATIONS:

SENSITIVITY: 25mV to 35 MHz, 50 mV to 50 MHz.
FREQ. RANGE: 10Hz to 50MHz.
Optional prescaler to 500 MHz.
RESOLUTION: 1 Hz @ 1 sec, 10 Hz @ 10 sec.
GATE TIMES: 1 and 0.1 sec.
INTERNAL FREQUENCY STANDARD: 5.24288 MHz
INPUT IMPEDANCE: 1 megohm
ACCURACY: 1 PPM @ 4 MHz
LEAD ZERO BLANKING
SIZE: 6¼ x 2¼ x 5½" deep. WT: 2 lbs.
POWER REQUIREMENTS: 110VAC, 60 Hz.

Cat. No. 4049 COUNTER KIT... $77
Cat. No. 4050 COUNTER WIRED & CALIBRATED... $112
Cat. No. 8433 COUNTER WITH PRESCALER WIRED & CALIBRATED... $150

TTL's

Order By Cat. No. 1981 & Type No.

TYPE	SALE					TYPE	SALE
☐ SN7400	.12	☐ SN7453	.12	☐ SN7492	.39	☐ SN74158	.49
☐ SN7401	.12	☐ SN7454	.19	☐ SN7493	.43	☐ SN74161	.49
☐ SN7402	.14	☐ SN7455	.12	☐ SN7494	.49	☐ SN74163	.69
☐ SN7403	.12	☐ SN7460	.18	☐ SN7495	.39	☐ SN74164	.39
☐ SN7404	.14	☐ SN7464	.12	☐ SN7496	.12	☐ SN74165	.69
☐ SN7405	.14	☐ SN7465	.12	☐ SN7499	.12	☐ SN74166	.99
☐ SN7406	.12	☐ SN7470	.12	☐ SN74100	.79	☐ SN74173	.99
☐ SN7409	.20	☐ SN7472	.12	☐ SN74107	.25	☐ SN74174	.79
☐ SN7410	.12	☐ SN7473	.29	☐ SN74109	.29	☐ SN74175	.69
☐ SN7411	.19	☐ SN7474	.29	☐ SN74113	.49	☐ SN74177	.59
☐ SN7413	.49	☐ SN7475	.39	☐ SN74114	.25	☐ SN74179	1.49
☐ SN7416	.25	☐ SN7476	.35	☐ SN74121	.29	☐ SN74180	.39
☐ SN7420	.12	☐ SN7480	.12	☐ SN74123	.39	☐ SN74182	.29
☐ SN7421	.25	☐ SN7482	.12	☐ SN74132	.65	☐ SN74190	.79
☐ SN7423	.12	☐ SN7483	.59	☐ SN74140	.39	☐ SN74191	.99
☐ SN7426	.12	☐ SN7485	.69	☐ SN74145	.59	☐ SN74192	.69
☐ SN7430	.14	☐ SN7486	.25	☐ SN74151	.55	☐ SN74193	.69
☐ SN7437	.12	☐ SN7489	1.25	☐ SN74153	.55	☐ SN74194	.69
☐ SN7438	.14	☐ SN7490	.39	☐ SN74155	.49	☐ SN74195	.19
☐ SN7440	.12	☐ SN7491	.19	☐ SN74156	.29	☐ SN74197	.69
☐ SN7441	.49			☐ SN74157	.55	☐ SN74199	.79
☐ SN7443	.29					☐ SN74200	1.99
☐ SN7444	.12					☐ SN74251	.59
☐ SN7446	.65					☐ SN74284	2.49
☐ SN7447	.65					☐ SN74285	2.95
☐ SN7450	.12					☐ SN74298	.99
☐ SN7451	.12						

DISCRETE LED CLOSEOUT

6 for $1

Jumbo .34" high
Medium .24" high
Micro .21" high

Cat. No.	Description
☐ #2135	Jumbo Red
☐ #2790	Jumbo Red Clear
☐ #1944	Jumbo Yellow
☐ #2138	Jumbo Green
☐ #2793	Jumbo Amber
☐ #2137	Micro Red
☐ #1948	Micro Yellow
☐ #2140	Micro Green
☐ #2143	Micro Amber
☐ #1788	Micro Top-hat Red
☐ #1802	Micro single pin Red

Order in multiples of 6 of each type.

MOTOR SPEED CONTROL "BASIC" KIT $2.95

Controls up to 10 AMps, 1000 watts! Works with noninductive type motors and incandescent lights. Varies from 5% to 95%. Wt. 10 oz. **Cat. No. 5327**

*Basic kits include all necessary electronic components, less PC board, case, line cord, transformer, or battery. Easy to breadboard, with instructions.

GIANT SALE! MINI TOGGLE SWITCHES

• 3A 125VAC contacts or better! • Top USA makers!

Cat. No.	Contacts	Sale
☐ 4038	SPDT	89c
☐ 5085	SPDT*	99c
☐ 4037	DPDT	1.29
☐ 5422	DPDT*	1.49
☐ 5434	3PDT	1.69
☐ 5087	4PDT*	1.95

*center off

LINEAR "POP" OP AMPS

Type	Each		
☐ LM300N	.49	☐ NE556N	.99
☐ LM300H	.49	☐ NE558V	.29
☐ LM301V	.25	☐ NE558N	.29
☐ LM301H	.25	☐ NE561N	1.99
☐ LM307V	.25	☐ NE565N	.89
☐ LM308V	.29	☐ NE565H	.79
☐ LM308H	.59	☐ NE567V	1.20
☐ LM309K	.99	☐ LM703H	.39
☐ LM311V	.29	☐ LM704H	.19
☐ LM320T-6V	.99	☐ LM709N	.19
☐ LM322N	.79	☐ LM710N	.29
☐ LM322H	.59	☐ LM711N	.39
☐ LM324N	.59	☐ LM723N	.49
☐ LM339N	.99	☐ LM733N	.59
☐ LM340K-5V	.99	☐ LM741V	.19
☐ LM340K-6V	.99	☐ LM741H	.19
☐ LM340K-12V	.99	☐ LM747H	.39
☐ LM340K-15V	.99	☐ LM1304N	.99
☐ LM340K-18V	.99	☐ LM1310N	.99
☐ LM340K-24V	.99	☐ MC1312N	2.49
☐ LM340T-5V	.99	☐ LM1414V	.49
☐ LM340T-6V	.99	☐ LM1458V	.29
☐ LM340T-12V	.99	☐ LM1800N	.29
☐ LM340T-15V	.99	☐ LM3028H	.89
☐ LM340T-18V	.99	☐ LM3900N	.29
☐ LM340T-24V	.99	☐ LM3909V	.69
☐ LM350N	.79	☐ LM4250H	1.99
☐ LM377N	1.49	☐ 75451	.29
☐ LM379S	8.50	☐ 75453	.29
☐ LM380N	.89	☐ 75491	.49
☐ NE531H	1.49	☐ 75492	.49
☐ NE532N	.25	☐ 75494	.69
☐ NE540H	2.50	☐ PA263	.77
☐ NE555V	.39	☐ DM8864	.99

Order by Type No.

Case code: T=TO-220 Power Tab; V=Mini dip; K=TO-3; H=TO-5; N=DIP.

DIP SWITCHES

Order by Cat. No.

Cat. No.	Switches	Sale
☐ 3668	2	.77
☐ 3669	3	.88
☐ 3021	4	.99
☐ 2677	7	1.79
☐ 5164	8	1.99
☐ 3672	10	2.50

Send for new FREE 20 page catalog

FREE!

including the best bargains on:

- SEMICONDUCTORS
- Solar Energy!
- Computer Components
- Fiber Optics!
- Over 400 assortments!
- Plus more-n-more!
- Digital clocks and test equipment!
- IC'S
- Hi-Fi stereos, speakers!
- LED'S

SEND FOR YOURS NOW!

POLY PAKS®

COD's MAY BE PHONED!

P.O. BOX 942-R11
SO. LYNNFIELD, MA
01940

Terms: Add Postage **Rated:** Net 30
Phone: (617) 245-3828
Retail: 16-18 Del Carmine St.
MINIMUM ORDER: $8 Wakefield, MA

ORDERING INSTRUCTIONS: When ordering, always use catalog number, type no., the name of the magazine you are ordering from and the month

SALE S·100 BUS EDGE CONNECTORS SALE

NLS MS-215 DUAL TRACE MINISCOPE $435.00

NLS

1¢ SALE

LM3A 3 dig 1% DC	$134.00
LM3.5A 3½ dig .5% DC	$158.50
LM40A 4 dig .1% DC	$209.00
LM4A 4 dig .03% DC	$250.00

- Rechargeable batteries and charger included
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- Rechargeable batteries and charger
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- No zero adjustment and no full-scale ohms adjust
- Battery-operated — NiCad batteries; also AC line operation.
- Large LED display for easy reading without interpolation
- Size: 1.9"H x 2.7"W x 4"D
- Parts & labor guaranteed 1 year
- Tilt stand option ..... $ 3.50
- Leather case $20.00

Purchase any of the LM series Meters and buy the LEATHER CASE for 1¢

NLS

$318.

MS-15 MINISCOPE

With Rechargeable Batteries & Charger Unit

- 15 megahertz bandwidth.
- External and internal trigger.
- Time base — .1 microsec. to 0.5 Sec/div - 21 settings ± 3%.
- Battery or line operation.
- Automatic & line sync modes.
- Power consumption < 15 watts.
- Vertical Gain — .01 to 50 V/div - 12 settings ± 3%.
- Viewing area 1.1" x 1.35".
- Case size 2.7"H x 6.4"W x 7.5"D, 3 pounds.
- Parts & Labor guaranteed 1 year
- 10 to 1, 10 meg probe ..... $27.
- Leather carrying case ..... $45.

PROBE 1¢

PROBE 1¢ with the purchase of SCOPE and the MENTION of this MAGAZINE

NLS

● MS-215 Dual Trace Version of MS-15 **$435.**

SALE S-100 BUS EDGE CONNECTORS SALE

S100-WWG 50/100 Cont. .125 ctrs. 3 LEVEL WIRE WRAP .025" sq. posts on .250 spaced rows. GOLD plated

1-4	5-9	10-24
$4.00	$3.75	$3.50

S100-STG 50/100 Cont. .125 ctrs DIP SOLDER TAIL on .250 spaced rows for VECTOR and MASI motherboards GOLD plated

1-4	5-9	10-24
$4.00	$3.75	$3.50

RG81G 50/100 Cont. .125 ctrs DIP SOLDER TAIL on .140 spaced rows for ALTAIR motherboards. GOLD plated $8.00

R681-3 50/100 Cont. .125 ctrs PIERCED SOLDER EYELET tails GOLD $7.36

Other Popular Edge Connectors

R644-G 22/44 Cont. .156 ctrs. PIERCED SOLDER EYELES tails. GOLD plated

1-4	5-9	10-24
$3.00	$2.75	$2.50

R644-3 22/44 Cont. .156 ctrs WIRE WRAP tails GOLD $4.71

ATTN: OEM'S and Dealers, many other connectors available call or quotation.

3 LEVEL GOLD WIRE WRAP SOCKETS

	1-24	25-49	50-99	100-249	250-999	1K-5K
8 pin*	.41	.38	.35	.31	.27	.23
14 pin*	.39	.38	.36	.32	.29	.27
16 pin*	.43	.42	.39	.35	.32	.30
18 pin	.63	.58	.54	.47	.42	.36
20 pin	.80	.75	.70	.63	.58	.53
22 pin*	.90	.85	.80	.70	.61	.57
24 pin	.90	.84	.78	.68	.63	.58
28 pin	1.10	1.00	.90	.84	.76	.71
40 pin	1.50	1.40	1.30	1.20	1.04	.89

Sockets purchased in multiples of 50 per type may be combined for best price.

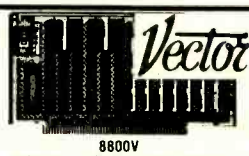
All sockets are GOLD 3 level closed entry *End and side stacable. 2 level, Solder Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION

8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

Vector

- Kit includes 12 tantalum capacitors for +5, +12, —12 buses and insulated mounting spacers.
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads.
- Solder mask with solder windows on etched circuits to avoid accidental short circuits.
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R681-2; or mounts 10 receptacles plus interconnections to smaller mother board for expansion.
- Includes etched circuits and instructions for option of active pull-up, or floating terminations.
- Large buses, +5V and GND (10 AMPS), ±12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10ºC rise.
- Fits in Vector case enclosures.
- Fits in IMSAI 8080 microcomputer as expander board.

Price: $29.50



Vector

Plugboards

8800V

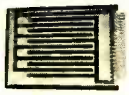
Universal Microcomputer/processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

1-4	5-9	10-24
$19.95	$17.95	$15.96

8801-1

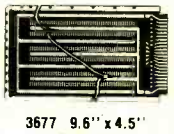
Same as 8800V except plain; less power buses & heat sink.

1-4	5-9	10-24
$14.95	$13.46	$11.96



3682 9.6" x 4.5"
$10.97
3682-2 6.5" x 4.5"
$9.81

Hi-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156

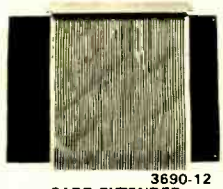


3677 9.6" x 4.5"
$10.90
3677-2 6.5" x 4.5"
$9.74

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

3662 6.5" x 4.5"
$7.65
3662-2 9.6" x 4.5"
$11.45

P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156



3690-12 CARD EXTENDER

Card Extender has 100 contacts-50 per side on .125 centers-Attached connector is compatible with S-100 Bus Systems $25.00

3690 6.5" 22/44 pin .158 ctrs. Extenders $12.00

1/16 Vector BOARD

.042 dia holes on 0.1 spacing for IC's

Phenolic PART NO.	SIZE	PRICE 1 - 9	10 - 19
64P44XXXP	4.5x6.5"	$1.49	1.34
169P44XXXP	4.5x17"	$3.51	3.16
Epoxy Glass			
64P44	4.5x6.5"	$1.70	1.53
84P44	4.5x8.5"	$2.10	1.89
169P44	4.5x17"	$4.30	3.87
169P84	8.5x17"	$7.65	6.89

SLIT-N-WRAP

Wraps insulated wire on .025" square posts **FOUR TIMES FASTER** than regular manual wrap-post tools

$24.50

P180 with two 100' spools of 28 ga. wire

P180-4T includes charger, wire **$75.00**

Vector

NO PRE-STRIPPING* NO PRE-CUTTING* SPOOL-FED WIRE*

*The spooled wire passes through the tool past a slitting edge next to the wrap post. A narrow longitudinal cut is made in the insulation where it presses the square post corner. The bared copper is indented by the sharp edge. (7 turns = 28 contacts)

*Insulation is cut when wrapped but not between terminal posts when tool is taken out of the slot.

"Daisy-chain" runs. Reliable and easy to use. Manual or power operation.

SLIT-N-WRAP WIRE NO. 28 GAGE INSULATED WIRE, 100' SPOOLS

W28-2-A Pkg. 3, Green W28-3-C Pkg. 3, Clear W28-2-B Pkg. 3, Red W28-2-D Pkg. 3, Blue

$2.25 Package

2708
8K 450 ns
EPROM
FACTORY PRIME
$ 9.00 EA.
25 + *Call For Price*

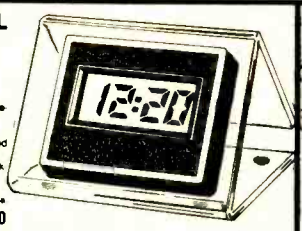
14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKETS

14 - G3 100 for $30.00
16-G3 100 for $30.00
50 of each for $32.00

Sockets are End & Side stackable, closed entry

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR

- For Auto, Home, Office
- Small in size (2x2¾x⅓)
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE: LCD-101, portable model runs on self-contained batteries for better than a year. LCD-102, runs on 12 Volt system and is back lighted.
- LCD 101 or LCD-102 your choice $34.95
- Clear desk stand for $2.00



LEDU MG 10A List $72.

Perfectly balanced, fluorescent lighting with precision magnifier lens. For profl., techn'l, & hobbist. Has die cast protective shade, inst. start 3 diopter lens, 42" reach.

$44.95

with T-9 fluorescent lamp (required) add 95

colors: Gray-on-Black Chocolate Brown 2 choices please

$44.95 SPECIAL

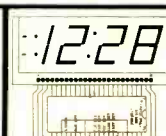
SC-5 With Rechargeable Batteries & Charger Unit $98

FM-7 With Rechargeable Batteries & Charger Unit $215

Features Include: • By using the new NLS SC-5 Prescaler, the range of the FM-7 Frequency Meter, which is 10 Hz to 60 MHz, may be extended to 512 MHz (the upper VHF & UHF frequency bands). • The FM-7 utilizes an LED readout, providing 7-digit resolution. • The FM-7 can be calibrated to an accuracy of 0.00001%. • The SC-5 is accurate to one part per million. • Each unit has 30 milliVolts sensitivity. Is battery powered and has a charger unit included. • Dimensions of each are 1.9" H x 2.7" W x 3.9" D. • The units may be obtained separately or as a "Frequency Duo." • Parts & Labor guaranteed 1 year.

Tilt stand option ..... $ 3.50
Leather case $20.00

MICRO-KLIP
for .042 dia. holes
(all boards on this page)
T42-1 pkg. 100 $ 1.50
T42-1 pkg. 1000 $11.00
P-149 hand installing tool ..... $ 2.03



.8" LED ALARM CLOCK

12 hr. LED Alarm Clock uses 3½ digit .8" LED Display with AM/PM indicators and colons. Direct drive. PIN to PIN interface with **MM5314** I.C. Just add switches. AC Supply. Alarm. Display and I.C. only.

$7.95 or 2/$15.00

1

Price Breakthrough!

$17.50
MA1003 CAR CLOCK

Bright Green Fluorescent Display Crystal Time Base Assembled, just add switches and 12 VDC.

SPECIAL
14CS2 100 for $14.00
16CS2 100 for $16.00
14 pin CS2 10 for $2.00
16 pin CS2 8 for $2.00

These low cost DIP sockets will accept both standard width plugs and chips.

For use with chips, the sockets offer a low profile height of only .125" above the board. These sockets are end stackable.

WRAP POST
for .042 dia. holes
(all boards on this page)
T-44 pkg. 100 ..... $ 2.28
T-44 pkg. 1000 ..... $14.00
A-13 hand installing tool ..... $ 2.80

PRIORITY ONE ELECTRONICS ©

10031 S. Woodley Ave. Sepulveda CA. 91343

Terms: VISA, MC, BAC, check, Money Order, C.O.D., U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00. Orders less than $75.00 include 10% shipping and handling; excess refunded. Just in case please include your phone no. **"Sorry, no over the counter sales"**

GOOD THRU NOVEMBER 1978

Send for our latest brochure.

phone orders welcome (213) 893-8202

OEM and Institutional inquiries invited.

24 PIN DIP PLUGS WITH COVERS

3 / $1.00
40 / $10.00

NLS MS-215 DUAL TRACE MINISCOPE $435.00

SALE S·100 BUS EDGE CONNECTORS SALE

CONTINENTAL SPECIALTIES CORPORATION

CSC

Logic Probes and Digital Pulsers

LOGIC PROBES

CSC logic probes are the ultimate tool for breadboard design and testing. These hand-held units provide an instant overview of circuit conditions. Simple to use; just clip power leads to circuit's power supply, set logic family switch to TTL/DTL or CMOS/HTL. Touch probe to test node. Trace logic levels and pulses through digital circuits. Even stretch and latch for easy pulse detection. Instant recognition of high, low or invalid levels, open circuits and nodes. Simple, dual-level detector LEDs tell it quickly, correctly. HI (Logic "1"); LO (Logic "0"). Also incorporates blinking pulse detector, e.g., HI and LO LEDs blink on or off, tracking "1" or "0" states at square wave frequencies up to 1.5 MHz. Pulse LED blinks on for 1/3 second during pulse transition. Choice of three models to meet individual requirements: budget, project and speed of logic circuits.

MODEL LP-1

Hand-held logic probe provides instant reading of logic levels for TTL, DTL, HTL or CMOS. **Input Impedance:** 100,000 ohms. **Minimum Detectable Pulse:** 50 ns. **Maximum Input Signal (Frequency):** 10 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.

CSC Model LP-1 Logic Probe—Net Each **$44.95**

MODEL LP-2

Economy version of Model LP-1. Safer than a voltmeter. More accurate than a scope. **Input Impedance:** 300,000 ohms. **Minimum Detectable Pulse:** 300 ns. **Maximum Input Signal (Frequency):** 1.5 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** None.

CSC Model LP-2 Logic Probe—Net Each **$24.95**

MODEL LP-3

High speed logic probe. Captures pulses as short as 10 ns. **Input Impedance:** 500,000 ohms. **Minimum Detectable Pulse:** 10 ns. **Maximum Input Signal (Frequency):** 50 MHz. **Pulse Detector (LED):** High speed train or single event. **Pulse Memory:** Pulse or level transition detected and stored.

CSC Model LP-3 Logic Probe—Net Each **$69.95**

DIGITAL PULSER

The ultimate in speed and ease of operation. Simply connect clip leads to positive and negative power, then touch DP-1's probe to a circuit node; automatic polarity sensor detects circuit's high or low condition. Depress the pushbutton and trigger an opposite polarity pulse into the circuit. Fast troubleshooting includes injecting signals at key points in TTL, DTL, CMOS or other popular circuits. Test with single pulse or 100 pulses per second via built-in dual control push-button; button selects single shot or continuous modes. LED indicator monitors operating modes by flashing once for single pulse or continuously for a pulse train. Completely automatic, pencil-size lab field pulse generator for any family of digital circuits. **Output:** Tri-state. **Polarity:** Pulse-sensing auto-polarity. **Sync and Source:** 100 mA. **Pulse Train:** 100 pps. **LED Indicator:** Flashes for single pulse; stays lit for pulse train.

CSC Model DP-1 Digital Pulser—Net Each **$74.95**

Prototype Design Equipment

PROTO-BOARD® UNITS

All the speed and convenience of QT Sockets and Bus Strips in both kits and preassembled units. Assemble, test and modify circuits literally as fast as you can think.

PROTO-BOARD 6 KIT

Contains one preassembled QT-47S socket, two preassembled QT-47B bus strips, four 5-way binding posts, metal ground/base plate, non-marring feet and all hardware. Ten minute assembly time. **Size:** 6" l. x 4" w. x 1.4" h. **Weight:** 7 ozs.

CSC Model PB-6 Kit—Complete. List Price **$15.95**

PROTO-BOARD 100 KIT

Contains two preassembled QT-35S sockets, one preassembled QT-35B bus strip, two 5-way binding posts, non-metallic base plate, non-marring feet and all hardware. Ten minute assembly time. **Size:** 4.5" w. x 6" l. x 1.4" h. **Weight:** 7.5 ozs.

CSC Model PB-100 Kit—Complete. List Price **$19.95**

PROTO-BOARD 101

Fully assembled breadboard contains two QT-35S sockets and four QT-35B bus strips mounted on metal ground/base plate with non-marring feet. Excellent for audio and small digital projects. **Size:** 5.8" l. x 4.5" w. x 1.4" h. **Weight:** 9 ozs.

CSC Model PB-101 Breadboard—Complete. List Price ~~$29.95~~ $22.95

PROTO-BOARD 102

Fully assembled breadboard contains two QT-47S sockets, three QT-47B bus strips and one QT-35B bus strip on a metal ground/base plate with non-marring feet. Excellent for intermediate digital needs. **Size:** 7" l. x 4.5" w. x 1.4" h. **Weight:** 10 ozs.

CSC Model PB-102 Breadboard—Complete. List Price ~~$39.95~~ $26.95

PROTO-BOARD 103

Fully assembled breadboard contains three QT-59S sockets, four QT-59B and one QT-47B bus strips, four 5-way binding posts on a metal ground/base plate with non-marring feet. Build calculators, interfaces, networks, etc. **Size:** 9" l. x 6" w. x 1.4" h. **Weight:** 1¼ lbs.

CSC Model PB-103 Breadboard—Complete. List Price ~~$59.95~~ $44.95

PROTO-BOARD 104

Fully assembled breadboard contains four QT-59S sockets, seven QT-59B bus strips and four 5-way binding posts on a metal ground/base plate with non-marring feet. Build a CPU, encoder, complex display, etc. **Size:** 9.8" l. x 8" w. x 1.4" h. **Weight:** 1¾ lbs.

CSC Model PB-104 Breadboard—Complete. List Price ~~$79.95~~ $54.95

PROTO-BOARD 203

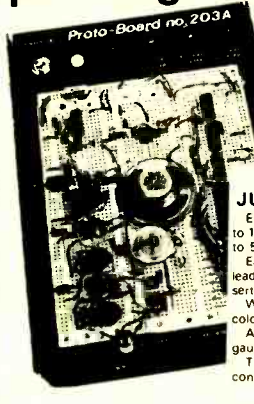
Fully assembled breadboard contains built-in, short-proof, fused, 5 VDC at 1 amp, regulated power supply. In addition to three QT-59S sockets, four QT-59B bus strips, one QT-47B bus strip and four 5-way binding posts. Capacity for most digital and many analog projects. **Size:** 9.75" l. x 6.6" w. x 3.25" h. **Weight:** 5 lbs.

CSC Model PB-203 Breadboard—Complete. List Price **$75.00**

PROTO-BOARD 203A

Provides all the features of Proto-Board 203 with additional +15 and −15 VDC at 0.5 amp power supplies with internally adjustable output voltages. **Size:** Same as PB-203. **Weight:** 5.5 lbs.

CSC Model PB-203A Breadboard—Complete. List Price .... $124.95 ~~$150.00~~



BREADBOARD 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 923351 .... $10.00

Digital IC Testers

LOGIC MONITOR 1

Trace signals through all types of digital circuits. Unit clips over any DIP IC up to 16 pins. Each of its 16 contacts connects to a single-bit level detector that drives a high-intensity, numbered LED readout activated when the applied voltage exceeds a fixed 2 V threhold. Logic "1" turns LED on; logic "0" keeps LED off. A power-seeking gate network automatically locates supply leads and feeds them to the LM-1's internal circuitry. Saves minutes, even hours in design, troubleshooting, debugging of equipment. **Voltage Threshold:** 2 V ± 0.2 V. **Input Impedance:** 100,000 ohms. **Input Voltage Range:** 4-15 V max. across any two or more inputs. **Current Drain:** 200 mA at 10 V. **Size:** 4" l. x 2" w. x 1.75" d. when open. **Weight:** 3 ozs.

CSC Model LM-1 Logic Monitor—Complete. List Price **$59.95**

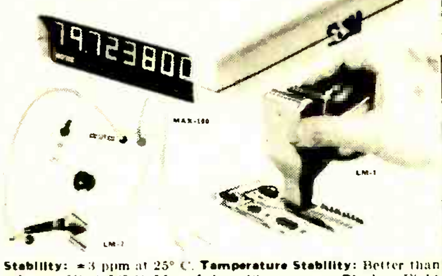
LOGIC MONITOR 2

Provides greater versatility and precision in testing all types of digital circuits. The fully isolated power supply and selectable trigger threshold let you match the precise characteristics of the logic family under test, permitting more accurate measurements. The connector, display unit clips over any DIP IC up to 16 pins. The power supply module contains the precision reference power supply and logic family selector switch. Operation is simple. Set the threshold switch to the proper logic family. Connect black clip lead to circuit ground. For CMOS circuitry, the red clip is connected to circuit positive or Vcc. The clip module is then clipped over the IC and the LED display instantly gives the logic states of all pins. **Logic Thresholds:** CMOS, 70% of circuit Vcc; HTL, 7.5 V; TTL, 2.4 V; DTL, 1.6 V; RTL, 1.2 V. **Maximum Visible Input Frequency:** 30 KHz at 50% duty cycle. **Size:** Test Clip, 4" l. x 2" w. x 1.75" d. when open; Power Module, 6" w. x 5.63" d. x 3" h. max. **Total Weight:** 20 ozs. **Power Required:** 117 VAC, 50/60 Hz, 10 W; also available for 220 VAC, 50/60 Hz at slightly higher price.

CSC Model LM-2 Logic Monitor—Complete. List Price **$129.95**

MAX-100 PORTABLE FREQUENCY COUNTER

MAX-100 is a portable, high precision frequency counter that sets new standards in performance and value. In a compact, portable case, it gives you continuous readings from 20 Hz to a guaranteed 100 MHz, 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 3 ppm accuracy. High-sensitivity readings from signals as low as 30 mV, with diode overload protection up to 200 V peaks. Input signals over 100 MHz automatically flash the most significant digit, and to indicate low-battery condition and extend battery life, the entire display flashes at 1 kHz.



Stability: ±3 ppm at 25° C. **Temperature Stability:** Better than 0.2 ppm/°C, 0–50° C. Max. **Aging:** 10 ppm/year. **Display:** Eight 0.6" LED digits. **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 sec. plus 1 sec. gate time. **Low Battery Indicator:** When battery supply falls below 6.6 VDC, all digits flash at 1 Hz. **Power Required:** Internal, 6 "AA" cells; external, 110 or 220 VAC charger/eliminator, auto cigarette lighter adapter or 7.2–10 VDC external supply. **Battery Charging:** 12–14 hrs. **Size:** 1.75" h. x 5.63" w. x 7.75" d. **Weight:** Less than 1.5 lbs. with batteries.

CSC Model MAX-100 Frequency Counter—Net Each **$134.95**

MAX-100 ACCESSORIES

Model 100-CLA	Mobile charger/eliminator. Net Each	$ 3.95
Model 100-CA1	110 VAC charger/eliminator. Net Ea.	9.95
Model 100-CA2	220 VAC charger/eliminator. Net Ea.	9.95
Model 100-IPC	Input cable with clip leads. Net Each	5.95
Model 100-LLC	Low-loss tap-off	14.95
Model 100-MWA	Mini-whip antenna	3.95
Model 100-CC	Carrying case	9.95

SPECIFICATIONS

Frequency Range: 20 Hz to 100 MHz guaranteed; 110 MHz typical. **Gate Time:** 1 sec. **Resolution:** 1 Hz. **Accuracy:** ±1 count + time base error. **Input Impedance:** 1 megohm shunted by 56 pF. **Coupling:** AC. **Sine Wave Sensitivity:** 30 mV RMS at 50 MHz. **Internal Time Base Frequency:** 3.579545 MHz crystal oscillator.

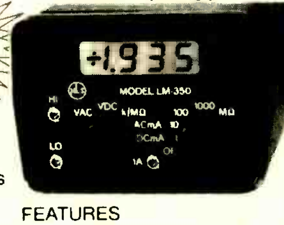
NEW VOLKSMETERS!

With LCD Display— Excellent Readability in Direct Sunlight!

NLS

NEW

0.5% 3½ digits
LM-350 **$144.00***



1%
LM-300
Full three digits
$114.00 *

FEATURES

- Measures DC volts, AC volts, ohms and current.
- Automatic polarity, decimal and overload indication
- No zero adjustment and no full scale ohms adjust
- Large LCD display for easy reading without interpolation.
- Size 1.9" H x 2.7" W x 4.0" D
- Parts and labor guaranteed for one year

SPECIFICATIONS

MODE	RANGE	ACCURACY LM-300	ACCURACY LM-350	RESOLUTION	INPUT RESISTANCE	TEST CURRENT
VOLTS DC*	1 10 100 1000	±1% Reading†	±0.5% Reading†	1 mV 10 mV 100 mV 1 V	10 MΩ	
VOLTS AC*	1 10 100 1000	±1% Reading† 50–400 Hz	±0.7% Reading† 50–400 Hz	1 mV 10 mV 100 mV 1 V	10 MΩ, 30 pF	
KILOHMS**	1 10 100 1000 10000	±1% Reading†	±0.5% Reading†	1 Ω 10 Ω 100 Ω 1 kΩ 10 kΩ		1 mA 100 μA 10 μA 1 μA 100 nA
CURRENT	1 mA 10 mA 100 mA 1 A	±1% Reading†	±1% Reading†	1 μA 10 μA 100 μA 1 mA	1 kΩ 100 Ω 10 Ω 1 Ω	

* 1000 vdc or peak ac maximum any range. †±2 Digits
**Test Voltage (Ohms) 1 vdc Full Scale – LM-300; 3 vdc Full Scale – LM-350
• LM-350 has 100% over-range – full scale readings are 1.999, 19.99, etc.

Tilt Stand Option, add	$ 3.50
Leather Case	$ 20.00
3AA NiCad-Batts. & Charger	$ 12.00

Standard AA-size batteries provide up to 20 hours of operation
Rechargeable NiCad batteries and charger unit available as optional equipment
*Batteries not included

PRIORITY ONE ELECTRONICS ©

10031 S. Woodley Ave. Sepulveda CA. 91343

VISA

Terms: VISA, MC, BAC, check, Money Order, C.O.D., U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00. Orders less than $75.00 include 10% shipping and handling, excess refunded. Just in case please include your phone no. **"Sorry, no over the counter sales"** GOOD THRU NOVEMBER 1978

Purchase any of the LM series Meters and buy the LEATHER CASE for 1¢

Send for our latest brochure. **phone orders welcome (213) 893-8202** OEM and Institutional inquiries invited.

New Tone Electronics
Quality components at fair prices

HIGH FIDELITY SPEAKERS

8-INCH COAXIAL
Combines a high quality 8" woofer and a tweeter into a pre-phased sound reporducer. Built-in cross-over network. Excellent choice for a low cost Hi-Fi system for autos, vans, or in your home. Frequency response is a smooth 80-15000 Hz. 8-ohm VC, 10 oz. ceramic ring magnet. 25W rating. **NT577 $13.99 plus 40 cents postage**

10-INCH WOOFER
The speaker for your "big sound" system. Frequency response is 20-4000 Hz; 8-ohm aluminum VC; powerful 20 oz. ceramic ring magnet and a rubberized accordion-edge suspension for excellent compliance. Handles 50W max. Use with the NT576 for a super system. **NT578 $17.99 plus 40 cents postage**

50W DOME TWEETER
Here is the super tweeter. A rugged 10 cm (4") dome tweeter which handles 50W max. Frequency response is 4000-20000 Hz. 8-ohm VC, 8-oz. ceramic magnet. Your system can have a brilliance you never imagined. **NT576 $6.99**

Resistors Standard values, ±5%, first quality. Packed 5 of one value.
¼W 5 for $.25 ½W 5 for $.30

Capacitor Special 3600 mF, 40Vdc Sprague "Powerlytic" **$1.89**

Relay SPDT, 12Vdc - 5A contacts **NT565 $1.79**

Sound Activated Switch Complete, ready to use. Built-in microphone's output triggers a Triac which acts as a switch. Measures only 1" x 3". Requires 3-6Vdc.
NT527 $1.29

And, the largest inventory of domestic and Japanese transistors and ICs in the United States.

ALL PARTS GUARANTEED
WRITE FOR FREE CATALOG

Minimum Order $5. Add $1.50 Postage and Handling.
Canada add $2.00. N.J. Residents add 5% Sales Tax.

nte

New Tone Electronics
PO BOX 1738
Bloomfield, N.J. 07003

Digital Auto Security System 3-Way Protection For Your Entire Car or Van

- Proximity Triggered Theft Protection - for valuables, CB or Ham equipment.
- Voltage Triggered Entry Protection - for doors and trunk.
- Mechanically Triggered Entry Protection - for under-hood parts.
- Activated by Personal 4-Digit Code.
- Uses Your Auto Horn As An Alarm, Or Add A Siren.

Forget about anything you may have heard about other anti-theft systems. The OCULAR 2®, total security system, adds a new dimension to automobile security — **Proximity Detection.** Even if the would-be thief could enter your car without triggering the voltage sensing circuit (not likely) — just approaching the protected area will sould your alarm instantly. **He does not have to touch anything!** Attention is the one thing the "rip-off" artist doesn't want.

And, there's more protection. Raising the hood sounds the alarm. Any change in voltage (dome or trunk light on, starting the car) sounds the alarm. If the cable connecting the units in the passenger compartment is cut, the OCULAR 2 turns itself on and sounds the alarm.

Your personal 4-digit code activates and deactivates the whole system. Just enter your code through the attractive push-button "Code Lok" keyboard when you leave your car and the system is activated. When you return, there's enough time to enter your code to deactivate the system before the alarm sounds.

Installation is easy and requires only simple hand tools. Complete with all hardware, instructions and your personal code. For 12-volt, negative-ground electrical systems only.

Sorry, but at this price, we must limit each order to only two systems per customer.

Was $49.95, now ..... Ocular 2 $19.95

CIRCLE 66 ON FREE INFORMATION CARD

UNIVERSAL 4Kx8 MEMORY BOARD KIT
$69.95
32-2102-1 fully buffered, 16 address lines, on board decoding for any 4 of 64 pages, standard 44 pin buss, may be used with F-8 & KIM

EXPANDABLE F8 CPU BOARD KIT
$99.00
featuring Fairbug PSU,1K-of static ram, RS 232 interface, documentation, 64 BYTE regis.er

C/MOS (DIODE CLAMPED)

4001	.18	4019	.37	4049	.35	74C73	.65
4002	.18	4020	.90	4050	.35	74C74	.45
4006	.95	4021	.90	4053	1.10	74C83	1.15
4007	.18	4022	.90	4055	1.25	74C86	.40
4009	.37	4023	.18	4066	.70	74C93	.75
4010	.37	4024	.75	4071	.18	74C151	1.40
4011	.18	4025	.18	4076	.97	74C160	1.05
4012	.18	4027	.37	4520	.70	74C161	1.05
4013	.29	4028	.80	74C00	.22	74C174	1.05
4014	.75	4029	.95	74C02	.22	74C175	1.05
4015	.75	4030	.33	74C04	.24	74C193	1.20
4016	.29	4035	.97	74C08	.22	74C901	.48
4017	.90	4042	.65	74C10	.27	74C902	.48
4018	.90	4046	1.35	74C42	.85	74C914	1.70

2708 8K EPROM (450 ns)	$ 9.25
2716 (TTL)	$ 29.90
2522 STATIC SHIFT REG	$ 1.95
2513 CHARACTER GEN	$ 6.75
2518 HEX 32 BIT SR	$ 2.20
2102-1 (450ns)	$ .99
21L02-1 (450ns)	$ 1.25
MM5270 4K XI DYN	$ 3.45
MK 4008P	$ 1.95
2101-1 256 x 4 STATIC	$ 2.45
2111-1 256 x 4 STATIC	$ 2.45
2112-1 256 x 4 STATIC	$ 2.75
2114 4K STATIC RAM (450ns)	$ 8.50
4116	$18.95
5280-2107B 4K DYNAMIC RAM	$ 3.40
TMS 4050L	$ 3.95
5204 4K PROM	$ 4.95
82S23	$ 1.95
82S129	$ 3.25
AY-5-1013 UART	$ 5.25
TR1602B	$ 4.95
6403C TELEDYNE 8 BIT A/D CONVERT	$ 9.95
8080A	$ 1.75
8224	$ 2.95
8228	$ 4.95
AMD 8214DC 512 - 8 ROM (450 NS)	$15.75

CRYSTALS $3.45 ea.
4.000 MHz
5.000 MHz
6.000 MHz
8.000 MHz
10.000 MHz

RIBBON CABLE
FLAT (COLOR CODED)
#30 WIRE
26 cond. - .50/per foot
40 cond. - .75/per foot
50 cond. - .90/per foot

CTS 206-8 eight position dip switch $1.60
CTS-206-4 four position dip switch $1.45
LIGHT ACTIVATED SCR's
TO-18, 200V 1A ..... $ .70

SILICON SOLAR CELLS
2¼" diameter .4V at 500 ma $4.00

FND 359 C.C. .4" $ .50
FCS 8024 4 digit C.C. .8" display $5.95
FND 503 C.C. .5" $ .85
FND 510 C.A. .5" $ .85
DL-704 .3" C.C. $ .85

LED READOUTS
DL-704 C.A. .3" $ .75
DL 747 C.A. .6" $1.75
FND 803 C.C. .8" $1.95
FND 810 C.A. .8" $1.95

PRINTED CIRCUIT BOARD
4.1 2" x 6.1 2" SINGLE SIDED EPOXY BOARD 1 16" thick, unetched
$ 60 ea. 5/$2.60

7 WATT LD-65 LASER DIODE IR $8.95

2N 3820 P FET	$ .45
2N 5457 N FET	$ .45
2N2646 UJT	$ .45
ER 900 TRIGGER DIODES	4 $1.00
2N 6028 PROG UJT	$ .65

MINIATURE MULTI-TURN TRIM POTS
100, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1Meg, 2Meg, $.75 each 3/$2.00

CHARGED COUPLE DEVICES
CCD 201C 100x100 Image Sensor $95.00
CCD 202C 100x100 Image Sensor $145.00

VERIPAX PC BOARD $4.00
This board is a 1/16"single sided paper epoxy board, 4½"x6½" DRILLED and ETCHED which will hold up to 21 single 14 pin IC's or 8,16 or LSI DIP IC's with busses for power supply connector.

FP 100 PHOTO TRANS	$ .50
RED, YELLOW, GREEN or AMBER LARGE LED's .2"	6/$1.00
TIL-118 OPTO-ISOLATOR	$ .75
MDLEX PINS	100/$1.00
	1000/$8.00
1 WATT ZENERS: 3.3, 4.7, 5.6, 9.1, 10, 12, 15, 18, or 22V	6/$1.00
MC6860 MODEM CHIP	$9.95
MCM 6571A 7 x 9 character gen ...	$10.75

Silicon Power Rectifiers

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.30	.80	3.70	5.00
200	.07	.20	.35	1.15	4.25	6.50
400	.09	.25	.50	1.40	6.50	9.50
600	.11	.30	.70	1.80	8.50	12.50
800	.15	.35	.90	2.30	10.50	16.50
1000	.20	.45	1.10	2.75	12.50	20.00

SAD 1024 a REDICON 1024 stage analog "Bucket Brigade" shift register. **$18.95**

IN 4148 (1N914) 15, $1.00

RS232 CONNECTORS
DB 25P male $2.25
DB 25S female $2.95
HOODS $1.00

REGULATORS

309K	$ .95	340K-12,15 or 24V	$ .95
723	$ .50	340T-5, 6, 8, 12 15,18 or 24V	$ .95
LM 376	$ .60	78 MG	$1.35
320T-12, 15 or 24V	$1.25	79 MG	$1.35

TRANSISTOR SPECIALS

2N6233-NPN SWITCHING POWER	$ 1.95
MRF-8004 a CB RF Transistor NPN	$ .75
2N3772 NPN Si TO-3	$ 1.00
2N1546 PNP GE TO-3	$ .75
2N4908 PNP Si TO-3	$ 1.00
2N6056 NPN Si TO-3 Darlington	$ 1.70
2N5086 PNP Si TO-92	4/$ 1.00
2N3137 NPN Si RF	$ .55
2N3919 NPN Si TO-3 RF	$ 1.50
2N1420 NPN Si TO-5	3/$ 1.00
2N3767 NPN Si TO-66	$ .70
2N2222 NPN Si TO-18	5/$ 1.00
2N3055 NPN Si TO-3	$ .50
2N3904 NPN Si TO-92	6/$ 1.00
2N3906 PNP Si TO-92	6/$ 1.00
2N5296 NPN Si TO-220	$ .50
2N6109 PNP Si TO-220	$ .55
2N3638 PNP Si TO-5	5/$ 1.00
MPSA 13 NPN Si	4/$ 1.00

TTL IC SERIES

7400	.13	7445	.65	74151	.61
7401	.13	7446	.68	74153	.61
7402	.13	7447	.58	74154	.94
7403	.13	7448	.68	74155	.58
7404	.15	7450	.15	74157	.55
7405	.13	7472	.25	74161	.55
7406	.16	7473	.28	74163	.55
7407	.20	7474	.28	74164	.85
7408	.18	7475	.45	74165	.95
7409	.18	7476	.30	74170	1.68
7410	.13	7480	.31	74173	1.20
7411	.18	7483	.65	74174	.95
7412	.13	7485	.87	74175	.85
7413	.36	7486	.28	74176	.75
7414	.60	7489	1.25	74177	.75
7416	.22	7490	.42	74180	.65
7417	.25	7491	.58	74181	1.90
7420	.13	7492	.43	74190	1.00
7425	.25	7493	.43	74191	1.00
7426	.22	7494	.67	74192	.79
7427	.19	7495	.65	74193	.79
7430	.13	74107	.28	74194	.80
7432	.22	74121	.29	74195	.50
7437	.21	74122	.38	74196	.86
7438	.21	74123	.45	74279	.55
7440	.13	74125	.40	74367	.50
7441	.70	74126	.40	75325	1.50
7442	.37	74150	.94	75491	.50
				75492	.50

DATA CASSETTES 1/2 HR $ .95

22/44 Pin Solder Tail .156" Conn. $1.95

MM 5387AA new clock chip which will directly drive LED's 12/24 hrs.; 1 supply & alarm $5.95

NO. 30 WIRE WRAP WIRE SINGLE STRAND 100' $1.40

ALCO MINIATURE TOGGLE SWITCHES

MTA 106 SPDT	$ .95
MTA 206 DPDT	$ 1.70
MTA 206 P-DPDT CENTER OFF	$ 1.85
MSD 206 P-DPDT CENTER OFF LEVER SWITCH	$ 1.85

Full Wave Bridges

PRV	2A	6A	25A
100			1.30
200	.75	1.25	2.00
400	.95	1.50	3.00
600	1.20	1.75	4.00

DIP SOCKETS
8 PIN .17 24 PIN .35
14 PIN .20 28 PIN .40
16 PIN .22 40 PIN .60
18 PIN .25

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS	$ 7.80
Si 1020 G 20 WATTS	$15.70
Si 1050 G 50 WATTS	$28.50

TANTULUM CAPACITORS

22UF 35V 5/$1.00	6.8UF 35V 4/$1.00
47UF 35V 5/$1.00	10UF 10V $ .25
68UF 35V 5 $1.00	22UF 25V $ .40
1UF 35V 5 $1.00	15UF 35V 3/$1.00
2.2 UF 20V 5 $1.00	30UF 6V 5/$1.00
3.3UF 20V 4/$1.00	47UF 20V $ .35
4.7UF 15V 5/$1.00	68 UF 15V $ .50
	100 UF 10V $ .40

74LS SERIES

74LS00	.19	74LS132	.70
74LS02	.19	74LS138	.70
74LS03	.19	74LS139	.70
74LS04	.21	74LS151	.59
74LS05	.21	74LS153	.59
74LS08	.21	74LS155	.62
74LS09	.21	74LS156	.62
74LS10	.20	74LS157	.59
74LS11	.20	74LS160	.79
74LS13	.40	74LS161	.79
74LS14	.80	74LS162	.79
74LS15	.21	74LS163	.79
74LS20	.21	74LS168	.80
74LS21	.21	74LS169	.80
74LS22	.21	74LS170	1.40
74LS26	.29	74LS173	.95
74LS27	.25	74LS174	.72
74LS28	.26	74LS175	.75
74LS30	.21	74LS181	2.00
74LS32	.25	74LS190	.88
74LS37	.28	74LS191	.88
74LS38	.28	74LS192	.88
74LS40	.21	74LS193	.88
74LS42	.60	74LS195	.50
74LS47	.73	74LS196	.75
74LS51	.25	74LS197	.75
74LS54	.25	74LS221	1.00
74LS73	.35	74LS257	.68
74LS74	.34	74LS258	.68
74LS75	.50	74LS265	.75
74LS76	.36	74LS279	.50
74LS85	.75	74LS290	.60
74LS86	.35	74LS293	.58
74LS90	.50	74LS365	.49
74LS92	.50	74LS366	.49
74LS93	.50	74LS367	.49
74LS109	.35	74LS368	.49
74LS112	.35	74LS375	.60
74LS113	.35	74LS386	.35
74LS114	.38	74LS390	1.45
74LS125	.45	74LS670	2.00
74LS126	.45		

LINEAR CIRCUITS

LM 101	.75
LM 301/748	.25
LM307	.30
LM 308	.75
LM 311	.75
LM 318	1.20
LM 324	.70
LM 339	1.10
LM 358	.70
LM 370	1.15
LM 377	1.60
LM 380	.95
LM 381	1.25
LM 382	1.25
LM 387	1.25
LM 537	2.50
LM 553	2.50
LM 555	.39
LM 556	.85
NE540L	2.25
560	2.00
565	.95
566	1.10
567	1.10
703	.90
733H	.75
592H	.95
709	.25
710	.35
741C or V	.25
747	.50
LM 1310	2.50
1456	.95
1458	.50
3900	.40
8038CC	3.90
791	1.95
LF356H	1.20

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

Terms: FOB Cambridge, Mass. Send Check or Money Order. Include Postage, Minimum Order $5.00, COD'S $20.00

Send 25¢ for our catalog featuring Transistors and Rectifiers
145 Hampshire St., Cambridge, Mass.

SOLID STATE SALES
P.O. BOX 740
SOMERVILLE, MASS. 02143 TEL. (617) 547-7053

WE SHIP OVER 95% OF OUR ORDERS THE DAY WE RECEIVE THEM

CIRCLE 24 ON FREE INFORMATION CARD

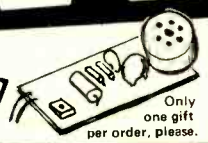
GOOD NEWS

ETCO T.M.

BARGAIN BLITZ!

For UNUSUAL ITEMS not found in stores or catalogs anywhere, write for our NEW 32 PAGE No. BB BARGAIN IDEA BOOK!

FREE-GIFT!



WITH EVERY ORDER OF $10 OR MORE — SOUND ACTIVATED SWITCH!

Intriguing surplus assembly. Microphone picks up sound and drives SCR switch. Ask for 039SU210 or you may order these at 99c each.

Only one gift per order, please.

ASSOCIATE DEALERS: Advertised merchandise available at the following dealers; prices may vary.

ETCO ELECTRONICS, 183G Hymus Blvd., Pointe Claire, Quebec

ETCO ELECTRONICS, 464 McGill St., Montreal, Quebec

ETCO ELECTRONICS, Greenfield Park Shopping Center, Greenfield Park, Quebec

DEALERS WANTED! Write for details to: ETCO ELECTRONICS Dealer Division, North Country Shopping Center, Plattsburgh, N.Y. 12901

EVEREADY TRADE MARK

MALLORY

ALKALINE PENCELL (SIZE "AA") BUYOUT!

SPECIAL PURCHASE

FALL SPECIAL!

39¢ Reg. 59c

37c ea./10 lots
33c ea./100 lots

Sensational ETCO Purchase - 14,000 in Stock! Mallory Duracells and Eveready Alkalines! Every cell fully guaranteed. Selling below nationally advertised prices! (2 oz.) 039BA220

JUST ARRIVED! A few more of the LESLIE ROTATING TREMOLO ORGAN SPEAKERS as advertised in the April 78 issue of Radio-Electronics — 039SP012 (15 lb.) $49.95

THIS IS DIFFERENT

ULTRASONIC HAND TRANSMITTER!

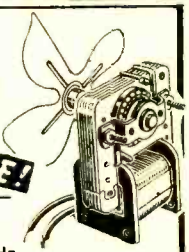
$3.95 100 in stock!

Made for Curtis Mathes, for TV remote control. Push button for burst of ultrasonic energy. Electronic transmitter powered by 9V battery (not included). A nice experimenters item. (8 oz.) 039SU321.

4" COOLING FANS!

4" fans - ventilate your hi-fi or other electronic equipment with this silent 110 VAC fan. Will prolong life of your gear. (2 lb.) 039ST062 (reg. $2.95)

1.99 SAVE!



BUYOUT OF SYNCHRONEX RECORD-ONLY CASSETTE MACHINES!

Our Reg. Catalog Price $9.95! Factory clear-out! Brand new. Intended for use with movie camera. With leather case. Convert to telephone recorder, etc. Uses standard cassettes-play back on any machine. (3 lb.) 039TR499

5.95

039TR254 - as above, factory warranty returns for parts value, sold as is. (3 lb.) $3.95 ea.

ovenaire

COMPENSATED 2.675200 MHz CRYSTAL OSCILLATOR MODULE

Very high precision (to Milgo spec No. ICC30C122) Ovenaire No. 67-11-2 (2 oz.) 039SU319.

9.95 3/$26.95

LET'S GET ACQUAINTED

SPECTACULAR NOVEMBER SPECIALS!

039TR619	5" BASF plastic tape storage box (2 oz.)	39c
039JK117	2.5mm ultra mini closed circuit phone jack (1 oz.)	5c
039MS400	3.5mm mini closed circuit phone jack (1 oz.)	7c
039SW040	SP - 3 position 3A appliance switch (2 oz.)	9c
039MS117	Silicon treated record cleaning cloth (1 oz.)	13c
039BB288	F15 T5 CW-15 photocopier bulb (3 oz.)	29c
039SU091	33-transistor Nixie board assembly (3 oz.)	29c
039TE739	Mini vertical "S" meter (2 oz.)	79c
039MS037	Ball-point "stick" pens ... (1 oz.)	4c
039MS050	Black marker pens (1 oz.)	9c
039OP120	Intriguing electronic camera shutter (6 oz.)	69c
039BB079	12-volt mini pigtail bulb (1 oz.)	5c
039HD054	Plastic telephone wall plates (4 oz.)	5c
039HP725	Home converter for car stereo c/w speakers (9 lb.)	$12.95
039RL010	24 VDC 4PDT Potter & Brumfield relay (2 oz.)	49c
039HP325	6 VDC 85ma. calculator power supply (10 oz.)	99c
039SU322	SWR meter assemblies – U fix (10 oz.)	$2.99
039SU234	3 foot cable complete with stereo phone plug (3 oz.)	39c
039SU243	Thermostatic appliance switch (3 oz.)	18c
039SU305	Crazy incandescent digital clock assembly (1 lb.)	$1.49
039SU308	12 VDC DPDT relay assembly (4 oz.)	$1.99
039SW159	SPST "in-door" plunger switch (4 oz.)	29c
039TR731	Crazy – 1 minute Fidelipack tape cartridge (7 oz.)	99c
039TR791	BASF cassette library storage box (3 oz.)	29c
039TT251	Record player single play turntables (3 lb.)	$2.49
039PT252	6 asst. precision (marked) transmitting crystals (5 oz.)	99c
039PT214	10 asst. strip volume controls (8 oz.)	$1.49
039PT124	10 assorted IF transformers (8 oz.)	39c
039PT087	10 assorted selenium rectifiers (2 lb.)	99c
039PT059	Nice assortment of spaghetti tubing (6 oz.)	39c
039PT017	20 assorted wirewound resistors (2 lb.)	69c
039PT011	25 assorted push-on plastic knobs (12 oz.)	49c
039PK032	3 transistor audio amplifier (3 oz.)	49c
039MS027	SO239 single hole coaxial socket (2 oz.)	39c
039HP079	6 VDC 30ma. calculator power supply (5 oz.)	99c
039DS178	Philips No. ZC1050 trigger tube (2 oz.)	99c

TUBE SPECIALS!						
	5Y4	$1.29	12AJ6	$1.69	401A	$2.69
	6AK6	$2.59	12X4	$ .99	955	$1.95
	6AN4	$1.49	27AA	$5.95	5693	$3.89
	6AQ6	$ .99	350B	$5.95	5696	$1.49

BARGAIN SCOOP

4 INCH, 3.2 OHM REPLACEMENT SPEAKER!

PRICE BREAK!

59¢ SENSATIONAL ETCO VALUE!

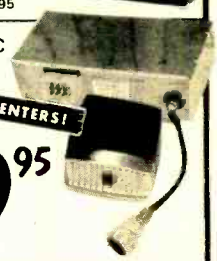
039SP004 (8 oz.) 10/$4.99 100/$42.88

3-CHANNEL ULTRASONIC REMOTE CONTROL SET!

EXPERIMENTERS!

Regular $29.95! Brand new factory surplus! Matched pair. Hand unit has 3 buttons: on/off, VHF/UHF, channel. Uses 1.5V battery (not included). Receiver operates on 41.5, 40, 38.5 KHz. 110v operation. Ideal for experimenters-build all sorts of remote control devices. (3 lb.) 039SU323.

19.95



SANGAMO 1.950 – 2.050 H VARIABLE INDUCTANCE!

SURPLUS

99¢

Brand new factory surplus. Bears Sangamo No. CV-246-37800(7114). Permeability tuned variable inductor for PC board mounting. An interesting experimenter and builder item. 23mm dia. x 18mm high. (2 oz.)039MS124.

BURROUGHS GIANT 15-SEGMENT ALPHA-NUMERIC TUBES!

ETCO SPECIAL!

99¢

Reg. $1.95 - Display full alphabet plus numbers 0-9. Burroughs No. B7971. 2½" high characters. Ultra long life. 170 volt operation. (6 oz.)039DR377.

SPECIAL PURCHASE OF ULTRASONIC ALARMS!

Bookshelf design - 12VDC operation. For Rec vehicles. Use at home with battery eliminator. (requires 30 ma.) Operates on 31.5 KHz. Covers 1000 sq. ft. Features: Sensitivity control, normal/memory mode. Jack for remote key switch, output for alarm bell or siren, inputs for remote detector, heat/fire detectors, window/door switch, panic switch; (3 lb.) 039AL058.

39.95

5" x 7" – 8 OHM REPLACEMENT SPEAKER

2.99 SALE

039SP410 (1 lb.) $2.49 ea./24 lot.

24 HOUR – 7 DAY A WEEK TELEPHONE ORDER SERVICE! Call in your CHARGE-CARD Orders at Low Weekend and Evening Rates! Dial: 1-518-561-8700.

DEALER INQUIRIES INVITED

FREE

BRAND NEW No. BB 32 page catalog packed with electronic bargains and unusual items! Write or circle the information card number below!

NOTE: If you have ordered from ETCO previously and your address remains unchanged, you will automatically receive all new catalogs.

ETCO T.M.

ELECTRONICS LIQUIDATORS OF EXCESS ELECTRONIC INVENTORIES

Rush Your Order Today . . .

ETCO ELECTRONICS, North Country Shopping Center, Route No. 9, Plattsburgh, N.Y. 12901.

MERCHANDISE SUBJECT TO PRIOR SALE. Full remittance with each order, please. Money order, Certified check, BANKAMERICARD, VISA, MASTERCHARGE, or CHARGEX. Add 15% for UPS (or postage) and handling (we refund excess). Please try to bring your order total to $10 or more. Worldwide export orders solicited. Open account to Government agencies, schools, institutions and triple "A" rated industrial & commercial accounts. Special quotes for quantities. Dealer inquiries invited. N.Y. state residents: Add 7% Sales tax.

CIRCLE 41 ON FREE INFORMATION CARD

7400 TTL

SN7400N	.16	SN7470N	.29	SN74160N	.89
SN7401N	.18	SN7472N	.29	SN74161N	.89
SN7402N	.18	SN7473N	.35	SN74162N	1.95
SN7403N	.18	SN7474N	.35	SN74163N	.89
SN7404N	.18	SN7475N	.49	SN74164N	.89
SN7405N	.20	SN7476N	.35	SN74165N	.89
SN7406N	.29	SN7479N	5.00	SN74166N	1.25
SN7407N	.29	SN7480N	.50	SN74167N	1.95
SN7408N	.20	SN7482N	.99	SN74170N	1.59
SN7409N	.20	SN7483N	.59	SN74172N	6.00
SN7410N	.18	SN7485N	.79	SN74173N	1.25
SN7411N	.25	SN7486N	.35	SN74174N	.89
SN7412N	.25	SN7489N	1.75	SN74175N	.79
SN7413N	.40	SN7490N	.45	SN74176N	.79
SN7414N	.70	SN7491N	.59	SN74177N	.79
SN7416N	.25	SN7492N	.43	SN74179N	1.95
SN7417N	.25	SN7493N	.43	SN74180N	.79
SN7420N	.20	SN7494N	.65	SN74181N	1.95
SN7421N	.29	SN7495N	.65	SN74182N	.79
SN7422N	.39	SN7496N	.65	SN74184N	1.95
SN7423N	.25	SN7497N	3.00	SN74185N	1.95
SN7425N	.29	SN74100N	.89	SN74186N	9.95
SN7426N	.29	SN74107N	.35	SN74188N	3.95
SN7427N	.25	SN74109N	.59	SN74190N	1.25
SN7429N	.39	SN74116N	1.95	SN74191N	1.25
SN7430N	.20	SN74121N	.35	SN74192N	.79
SN7432N	.25	SN74122N	.39	SN74193N	.79
SN7437N	.25	SN74123N	.49	SN74194N	.89
SN7438N	.25	SN74125N	.49	SN74195N	.69
SN7439N	.25	SN74126N	.49	SN74196N	.89
SN7440N	.20	SN74132N	.75	SN74197N	.89
SN7441N	.89	SN74136N	.75	SN74198N	1.49
SN7442N	.49	SN74141N	.79	SN74199N	1.49
SN7443N	.75	SN74142N	2.95	SN74S200	4.95
SN7444N	.75	SN74143N	2.95	SN74251N	1.79
SN7445N	.75	SN74144N	2.95	SN74279N	.79
SN7446N	.69	SN74145N	.79	SN74283N	2.25
SN7447N	.59	SN74147N	1.95	SN74284N	3.95
SN7448N	.79	SN74148N	1.29	SN74285N	3.95
SN7450N	.20	SN74150N	.89	SN74365N	.69
SN7451N	.20	SN74151N	.59	SN74366N	.69
SN7453N	.20	SN74152N	.59	SN74367N	.69
SN7454N	.20	SN74153N	.59	SN74368N	.69
SN7459A	.25	SN74154N	.99	SN74390N	1.95
SN7460N	.20	SN74155N	.79	SN74393N	1.95
		SN74156N	.79		
		SN74157N	.65		

20% Discount 100 pcs combined order 25% -1000 pcs combined order.

C/MOS

CD4000	.23	CD4028	.89	CD4070	.55
CD4001	.23	CD4029	1.19	CD4071	.23
CD4002	.23	CD4030	.49	CD4072	.49
CD4006	1.19	CD4035	.99	CD4076	1.39
CD4007	.25	CD4040	1.19	CD4081	.23
CD4009	.49	CD4041	1.25	CD4082	.23
CD4010	.49	CD4042	.99	CD4093	.99
CD4011	.23	CD4043	.89	CD4098	2.49
CD4012	.25	CD4044	.89	MC14409	14.95
CD4013	.39	CD4046	1.79	MC14410	14.95
CD4014	1.39	CD4047	2.50	MC14411	14.95
CD4015	1.19	CD4048	1.35	MC14419	4.95
CD4016	.49	CD4049	.49	MC14433	19.95
CD4017	1.19	CD4050	.49	MC14506	.75
CD4018	.99	CD4051	1.19	MC14507	.99
CD4019	.49	CD4053	1.19	MC14562	14.50
CD4020	1.19	CD4056	2.95	MC14583	3.50
CD4021	1.39	CD4059	9.95	CD4508	3.95
CD4022	1.19	CD4060	1.49	CD4510	1.39
CD4023	.23	CD4066	.79	CD4511	1.29
CD4024	.79	CD4068	.39	CD4515	2.95
CD4025	.23	CD4069	.45	CD4518	1.29
CD4026	2.25			CD4520	1.29
CD4027	.69			CD4566	2.25

74C00

74C00	.39	74C85	3.95	74C163	3.00
74C02	.55	74C90	3.00	74C164	3.25
74C04	.75	74C93	2.00	74C173	2.60
74C08	.75	74C95	2.00	74C192	3.49
74C10	.65	74C107	1.25	74C193	2.75
74C14	3.00	74C151	2.90	74C195	2.75
74C20	.65	74C154	3.00	74C922	9.95
74C30	.65	74C157	2.15	74C923	8.95
74C42	2.15	74C160	3.25	74C925	14.95
74C48	4.75	74C161	3.25	74C926	11.95
74C73	1.50			80C95	1.50
74C74	1.15			80C97	1.50

LINEAR

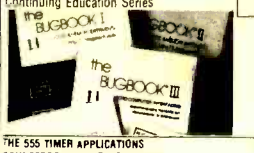
78MG	1.75	LM340T-6	1.25	LM741CN/H	.35
LM300H	.80	LM340T-8	1.25	LM741-14N	.39
LM301CN/H	.35	LM340T-12	1.25	LM747N/H	.79
LM302H	.75	LM340T-15	1.25	LM748N/H	.39
LM304H	1.00	LM340T-18	1.25	LM1303N	.90
LM305H	.60	LM340T-24	1.25	LM1304N	1.19
LM307CN/H	.35	LM350N	1.00	LM1305N	1.40
LM308CN/H	1.00	LM351CN	.65	LM1307N	.85
LM309H	1.10	LM370N	1.15	LM1310N	2.95
LM309K	1.25	LM373N	3.25	LM1351N	1.65
LM310CN	1.15	LM377N	4.00	LM1414N	1.75
LM311N/H	.90	LM380N	1.25	LM1458CN/H	.59
LM312H	2.00	LM380CN	.99	MC1488N	1.95
LM317K	6.50	LM381N	1.79	MC1489N	1.95
LM318CN/H	1.50	LM382N	1.79	LM1496N	.95
LM319N	1.30	NE501N	8.00	LM1556V	1.75
LM320K-5	1.35	NE510A	6.00	MC1741SCP	3.00
LM320K-5.2	1.35	NE529A	4.95	LM2901N	2.95
LM320K-12	1.35	NE531H/V	3.95	LM3053N	1.50
LM320K-15	1.35	NE536T	6.00	LM3065N	.69
LM320K-18	1.35	NE540L	6.00	LM3900N(3401)	.49
LM320K-24	1.35	NE544N	4.95	LM3905N	.89
LM320T-5	1.25	NE550N	1.30	LM3909N	1.25
LM320T-5.2	1.25	NE555V	.39	MC5556V	.59
LM320T-8	1.25	NE556N	.99	LM7525N	.90
LM320T-12	1.25	NE560B	5.00	LM7534N	.75
LM320T-15	1.25	NE561B	5.00	8038B	4.95
LM320T-18	1.25	NE562B	5.00	LM75450N	.50
LM320T-24	1.25	NE565N/H	1.25	75451CN	.39
LM323K-5	5.95	NE566CN	1.75	75452CN	.39
LM324N	1.80	NE567V/H	.99	75453CN	.39
LM339N	.99	NE570N	10.50	75454CN	.39
LM340K-5	1.35	LM703CN/H	.45	75491CN	.79
LM340K-6	1.35	LM709N/H	.29	75492CN	.89
LM340K-8	1.35	LM710N	.79	75494CN	.89
LM340K-12	1.35	LM711N	.39	RC4136	1.25
LM340K-15	1.35	LM723N/H	.55	RC4151	5.95
LM340K-18	1.35	LM733N	1.00	RC4194	5.95
LM340K-24	1.35	LM739N	1.19	RC4195	4.49
LM340T-5	1.25				

74LS00 TTL

74LS00	.23	74LS51	.23	74LS139	.69
74LS01	.23	74LS54	.23	74LS151	.69
74LS02	.23	74LS55	.23	74LS155	.69
74LS03	.23	74LS73	.35	74LS157	.69
74LS04	.29	74LS74	.35	74LS160	.89
74LS05	.29	74LS75	.49	74LS161	.89
74LS08	.23	74LS76	.35	74LS162	.89
74LS09	.29	74LS83	.75	74LS163	.89
74LS10	.23	74LS85	.99	74LS164	.99
74LS13	.49	74LS86	.35	74LS175	.79
74LS14	.99	74LS90	.49	74LS181	2.49
74LS15	.29	74LS92	.59	74LS190	.89
74LS20	.23	74LS93	.59	74LS191	.89
74LS21	.29	74LS95	.79	74LS192	.89
74LS22	.29	74LS96	.89	74LS193	.89
74LS26	.29	74LS107	.35	74LS194	.89
74LS27	.29	74LS109	.35	74LS195	.89
74LS28	.29	74LS112	.35	74LS253	.79
74LS30	.23	74LS123	.99	74LS257	.69
74LS32	.29	74LS132	.79	74LS260	.55
74LS37	.35	74LS136	.39	74LS279	.59
74LS40	.29	74LS138	.69	74LS367	.59
74LS42	.69			74LS368	.59
74LS47	.69			74LS670	1.95

BUGBOOK®

Continuing Education Series



THE 555 TIMER APPLICATIONS SOURCEBOOK WITH EXPERIMENTS — $6.95
by Howard M. Berlin W3HB
This book shows you what the 555 timer is and how to use it. Included are over 100 various design techniques, equations and graphs to create ready-to-go timers, generators, power supplies, measurement and control circuits, party games, circuits for the home and automobile, photography, music and Amateur Radio.

INSTRUCTOR'S MANUAL — $3.00
Necessary for instruction of Bugbook I and II. Answers questions regarding experiments, suggestions for further reading, philosophy of authors approach to digital electronics. A must for self teaching individuals.

OP AMP MANUAL by Howard M. Berlin W3HB — $9.00
An experiment guide to application of operational amplifiers. Over 25 experiments on all phases of Op Amps.

DBUG — $5.00
8080 interpretive debugger. A program for entering, debugging and storing assembly language programs.

BUGBOOKS I and II — $17.00 per set
by Peter R. Rony, David G. Larsen, WB4HYJ
Sold as a set these two books outline over 90 experiments designed to teach the reader all he will need to know about TTL logic chips to use them in conjunction with microprocessor systems. You'll learn about the basic concepts of digital electronics including gates, flip-flops, latches, buses, decoders, multiplexers, demultiplexers, LED displays, RAM's, ROM's, and much, much more.

BUGBOOK IIa — $5.00
by Peter R. Rony, David G. Larsen, WB4HYJ
This volume will introduce you to the fabulous UART chip — that all important interface between data terminals, etc., and your microcomputer. It also covers current loops and the RS 232C interface standard. Particularly recommended for any RTTY enthusiast.

BUGBOOK III — $15.00
by Peter R. Rony, David G. Larsen, WB4HYJ, Jonathan A. Titus
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
by David G. Larsen, Peter R. Rony, Jonathan A. Titus
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. Detail & laboratory experiments included with each book.

CMOS-M — DESIGNERS PRIMER AND HANDBOOK New expanded version — $8.50
Starts at basic structure of CMOS devices through integration into MSI.

COMPLETE MANUAL FOR DIGITAL CLOCKS by John Weiss and John Brooks — $3.95
Familiarizes technician or hobbyist with basic theories behind digital clocks. Includes trouble shooting guides, basic characteristics of clocks, soldering techniques, clock component data sheets and construction tips.

DISCRETE LEDS

.125" dia			.190" dia.		
XC209 Red	5/$1		XC111 Red	5/$1	
XC209 Green	4/$1		XC111 Green	4/$1	
XC209 Yellow	4/$1		XC111 Yellow	4/$1	
			XC111 Clear	4/$1	

.200" dia		.185" dia		.200" dia.		.085" dia	
XC22 Red	5/$1	XC526 Red	5/$1	XC556 Red	5/$1	MV50 Red	6/$1
XC22 Green	4/$1	XC526 Red	100/$8	XC556 Red	100/$8	.170" dia.	
XC22 Yellow	4/$1	XC526 Green	4/$1	XC556 Green	4/$1	MV10 Red	4/$1
		XC526 Yellow	4/$1	XC556 Yellow	4/$1	INFRA-RED LED	
		XC526 Clear	4/$1	XC556 Clear	4/$1		5/$1.00

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	.270	2.95	MAN 6730	Common Anode-red ±1	.560	.99
MAN 2	5 x 7 Dot Matrix-red	.300	4.95	MAN 6740	Common Cathode-red D.D.	.560	.99
MAN 3	Common Cathode-red	.125	.25	MAN 6750	Common Cathode-red ±1	.560	.99
MAN 4	Common Cathode-red	.187	1.95	MAN 6760	Common Anode-red	.560	.99
MAN 52	Common Anode-green	.300	1.25	MAN 6780	Common Cathode-red	.560	.99
MAN 72	Common Anode-red	.300	.99	DL701	Common Anode-red ±1	.300	.99
MAN 74	Common Cathode-red	.300	1.25	DL704	Common Cathode-red	.300	.99
MAN 82	Common Anode-yellow	.300	.99	DL707	Common Anode-red	.300	.99
MAN 84	Common Cathode-yellow	.300	.99	DL741	Common Anode-red	.600	1.25
MAN 3620	Common Anode-orange	.300	.99	DL746	Common Anode-red ±1	.630	1.49
MAN 3630	Common Anode-orange ±1	.300	.99	DL747	Common Anode-red	.600	1.49
MAN 3640	Common Cathode-orange	.300	.99	DL749	Common Cathode-red ±1	.630	1.49
MAN 4610	Common Anode-orange	.300	.99	DL750	Common Cathode-red	.600	1.49
MAN 4640	Common Cathode-orange	.400	.99	DL338	Common Cathode-red	.110	.35
MAN 4710	Common Anode-red ±1	.400	.99	FND70	Common Cathode	.250	.69
MAN 4730	Common Anode-red	.400	.99	FND359	Common Anode	.350	.75
MAN 4740	Common Cathode-red	.400	.99	FND503	Common Cathode (FND500)	.500	.99
MAN 4810	Common Anode-yellow	.400	.99	FND507	Common Anode (FND510)	.500	.99
MAN 6610	Common Anode-orange-D.D	.560	.99	5082-7730	Common Anode-red	.300	1.30
MAN 6630	Common Anode-orange	.560	.99	HDSP-3400	Common Anode red	.800	2.10
MAN 6640	Common Cathode-orange-D.D.	.560	.99	ADSP-3403	Common Cathode red	.800	2.10
MAN 6650	Common Cathode-orange ±1	.560	.99	5082-7300	4 x 7 Sgl. Digit-RHDP	.600	19.95
MAN 6660	Common Anode-orange	.560	.99	5082-7302	4 x 7 Sgl. Digit-LHDP	.600	19.95
MAN 6680	Common Cathode-orange	.560	.99	5082-7304	Overrange character (±1)	.600	15.00
MAN 6710	Common Anode-red-D.D	.560	.99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	.600	22.50

RCA LINEAR

CA3013	2.15	CA3082	2.00
CA2023	2.56	CA3083	1.60
CA3035	2.48	CA3086	.85
CA3039	1.35	CA3089	3.75
CA3046	1.30	CA3130	1.39
CA3059	3.25	CA3140	1.25
CA3060	3.25	CA3160	1.25
CA3080	.85	CA3401	.49
CA3081	2.00	CA3600	3.50

CALCULATOR CHIPS AND DRIVER

FCM3817 (1998A)	$ 5.00
MM5725	2.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	.75
DM8889	.75

CLOCK CHIPS

MM5309	$ 9.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5387	4.95
MM5841	9.95

9374 - 7 segment LED driver common anode LEDs $ .99

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	$.17	.16	.15	22 pin LP	$ .37	.36	.35
14 pin LP	.20	.19	.18	24 pin LP	.38	.37	.36
16 pin LP	.22	.21	.20	28 pin LP	.45	.44	.43
18 pin LP	.29	.28	.27	36 pin LP	.60	.59	.58
20 pin LP	.34	.32	.30	40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin ST	$.27	.25	.24	28 pin ST	$ .99	.90	.81
16 pin ST	.30	.27	.25	36 pin ST	1.39	1.26	1.15
18 pin ST	.35	.32	.30	40 pin ST	1.59	1.45	1.30
24 pin ST	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin SG	$.30	.27	.24	24 pin SG	$ .70	.63	.57
14 pin SG	.35	.32	.29	28 pin SG	1.10	1.00	.90
16 pin SG	.38	.35	.32	36 pin SG	1.75	1.40	1.26
18 pin SG	.52	.47	.43	40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin WW	$.40	.38	.35	22 pin WW	$ .95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
14 pin WW	.39	.38	.37	28 pin WW	1.40	1.25	1.10
16 pin WW	.43	.42	.41	36 pin WW	1.59	1.45	1.30
18 pin WW	.75	.68	.62	40 pin WW	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM / 27 OHM	12 OHM / 33 OHM	15 OHM / 39 OHM	18 OHM / 47 OHM	22 OHM / 56 OHM	1/4 WATT 5%	50 PCS
ASST. 2	5 ea.	68 OHM / 180 OHM	82 OHM / 220 OHM	100 OHM / 270 OHM	120 OHM / 330 OHM	150 OHM / 390 OHM	1/4 WATT 5%	50 PCS.
ASST. 3	5 ea.	470 OHM / 1.2K	560 OHM / 1.5K	680 OHM / 1.8K	820 OHM / 2.2K	1K / 2.7K	1/4 WATT 5%	50 PCS.
ASST. 4	5 ea.	3.3K / 8.2K	3.9K / 10K	4.7K / 12K	5.6K / 15K	6.8K / 18K	1/4 WATT 5%	50 PCS
ASST. 5	5 ea.	22K / 56K	27K / 68K	33K / 82K	39K / 100K	47K / 120K	1/4 WATT 5%	50 PCS
ASST. 6	5 ea.	150K / 390K	180K / 470K	220K / 560K	270K / 680K	330K / 820K	1/4 WATT 5%	50 PCS.
ASST. 7	5 ea.	1M / 2.7M	1.2M / 3.3M	1.5M / 3.9M	1.8M / 4.7M	2.2M / 5.6M	1/4 WATT 5%	50 PCS

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets — 25¢
1979 A Catalog Available—Send 41¢ stamp

NEW 1979 Catalog

Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS — WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070
Advertised Prices Good Thru November

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire

$12.95

WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP - $6.95

WIRE WRAP WIRE — 30 AWG
25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30
- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.95 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red **$1.98/spool**

JE2206A $14.95
Function Generator Kit (includes chip, P.C. Board and instructions)

EXAR

JE2206B $19.95
Function Generator Kit (includes all components, P.C. Board and instructions)

XR-L555 $1.50
Micro-Power version of the popular 555 Timer and directly interchangeable. Dissipates 1/15th the power and operates down to 2.7 volts. Perfect for battery operation and CMOS circuits.

XR2242CP $1.50
Precision timing circuit for generating timing pulses in **minutes, hours** and days or up to 1 year by using two. Reduces cost of time delay circuits. Basic 555 Timer with built-in 8-bit Counter.

XR205	$ 8.40			XR2556	$ 3.20
XR210	4.40	XR1489	1.39	XR2567	2.99
XR215	4.40	XR1800	3.20	XR3403	1.25
XR320	1.55	XR2206	4.40	XR4136	1.25
XR555	.39	XR2207	3.85	XR4151	2.85
XR556	.99	XR2208	5.20	XR4194	1.45
XR567CP	.99	XR2209	1.75	XR4202	3.60
XR567CT	1.25	XR2211	5.25	XR4212	2.05
XR1310P	1.30	XR2212	4.35	XR4558	.75
XR1468CN	3.85	XR2240	3.45	XR4739	1.15
XR1488	1.39	XR2264	4.25	XR4741	1.47

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
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	4/1.00	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
1N456	25	40m	6/1.00	1N4742	12	1w	.28
1N458	150	7m	6/1.00	1N4744	15	1w	.28
1N485A	180	10m	5/1.00	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	1.70
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	.50
MDA 980-1	12A @ 50V	FW BRIDGE REC	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1.95

TRANSISTORS

C106B1	.50			2N3904	4/1.00
MPSA05	.30	2N3055	.89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
TIS133	5/1.00	PN3567	3/1.00	PN4249	4/1.00
TIS135	5/1.00	PN3568	4/1.00	PN4250	4/1.00
40409	1.75	PN3569	4/1.00	2N4400	4/1.00
40410	1.75	MPS3638A	5/1.00	2N4401	4/1.00
40673	1.75	MPS3702	5/1.00	2N4402	4/1.00
2N918	4/1.00	2N3704	5/1.00	2N4403	4/1.00
2N2219A	3/1.00	MPS3704	5/1.00	2N4409	5/1.00
2N2221A	4/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2222A	5/1.00	MPS3705	5/1.00	2N5087	4/1.00
2N2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2369A	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
MPS2369	5/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2484	4/1.00	2N3711	5/1.00	PN5134	5/1.00
2N2906	4/1.00	2N3724A	.65	PN5138	5/1.00
2N2907	5/1.00	2N3725A	1.00	2N5139	5/1.00
2N2925	5/1.00	2N3772	2.25	2N5210	5/1.00
MJE2955	1.25	2N3823	1.00	2N5449	3/1.00
2N3053	2/1.00	2N3903	4/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100		1-9	10-99	100
10 pf	.05	.04	.03	.001µF	.05	.04	.035
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

100 VOLT MYLAR FILM CAPACITORS

	1-9	10-99	100		1-9	10-99	100
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

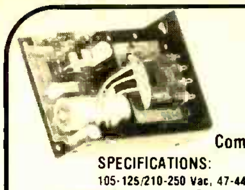
+20% DIPPED TANTALUMS (SOLID) CAPACITORS

	1-9	10-99	100		1-9	10-99	100
.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.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
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead	1-9	10-99	100	Radial Lead	1-9	10-99	100
.47/50V	.15	.13	.10	.47/25V	.15	.13	.10
1.0/50V	.16	.14	.11	.47/50V	.16	.14	.11
3.3/50V	.14	.12	.09	1.0/16V	.15	.13	.10
4.7/25V	.15	.13	.10	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

CIRCLE 20 ON FREE INFORMATION CARD



ELPAC POWER SUPPLIES

Completely Assembled

SPECIFICATIONS:
105-125/210-250 Vac, 47-440 Hz input:

Line Regulation	±0.1%
Load Regulation	±0.1%no-load to rated-load
Output Ripple and Noise	±0.1%p-p dc to 10 MHz
Input/Output Isolation	100 megohm dc, 900 Vac
Short Circuit Current	35% rated current

PART NO.	RATINGS WATTS	VOLTS	AMPS	PRICE
SOLV15-5*	15	5	3	$39.95
SOLV15-12*	18	12	1.5	39.95
SOLV30-5	30	5	6	59.95
SOLV30-12	48	12	4	59.95
OVP1	over voltage protection for SOLV30-5,-12			9.95

*SOLV15-5, 12 includes OVP installed

SUP 'R' MOD II

UHF Channel 33 TV Interface Unit Kit

* Wide Band B/W or Color System
* Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazzler, SOL-20, IRS-80, Challenger, etc.
* MOD II is pretuned to Channel 33 (UHF).
* Includes coaxial cable and antenna transformer.

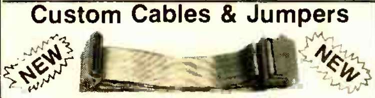
MOD II $29.95 Kit

CRYSTALS

THESE FREQUENCIES ONLY

PART NO.	FREQUENCY	CASE	PRICE
CY1A	1.000MHz	HC33	5 95
CY1 84	1.8432MHz	HC33	5.95
CY2A	2 000MHz	HC33	5 95
CY2.01	2.010MHz	HC33	1.95
CY2.50	2.500MHz	HC33	4 95
CY3.27	3.2768MHz	HC33	4.95
CY3.57	3.579545MHz	HC33	4.95
CY3A	4.000MHz	HC18	4 95
CY4 91	4.916MHz	HC18	4 95
CY7A	5.000MHz	HC18	4 95
CY5 18	5 185MHz	HC18	4.95
CY6 14	6 144MHz	HC18	4 95
CY6.40	6.400MHz	HC18	4 95
CY6.55	6.5536MHz	HC18	4 95
CY12A	10.000MHz	HC18	4 95
CY14A	14.31818MHz	HC18	4 95
CY19A	18.000MHz	HC18	4 95
CY18 43	18.432MHz	HC18	4 95
CY22A	20.000MHz	HC18	4 95
CY30A	32 000MHz	HC18	4 95

Custom Cables & Jumpers



DB 25 Series Cables

Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft.	2-DP25P	$15.95 ea.
DB25P-4-S	4 Ft.	1-DP25P/1-25S	$16.95 ea.
DB25S-4-S	4 ft.	2-DP25S	$17 95 ea.

Dipped Jumpers Plugs

DJ14-1	1 ft.	1-14 Pin	$1.59 ea.
DJ16-1	1 ft.	1-16 Pin	1.79 ea.
DJ24-1	1 ft.	1-24 Pin	2.79 ea.
DJ14-1-14	1 ft.	2-14 Pin	2.79 ea.
DJ16-1-16	1 ft.	2-16 Pin	3.19 ea.
DJ24-1-16	1 ft.	2-24 Pin	4.95 ea.

For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing

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

CONNECTORS

25 Pin-D Subminiature

DB25P(as pictured)	PLUG	$2 95
DB25S	SOCKET	3 50
DB51226-1	Cable Cover for DB25 P or S	1.75

MOLEX CONNECTOR PINS

M-530-1 — $1.95/100 pins (minimum order) — $16.00/1000 pins

Pre-packaged in Strips

INSTRUMENT/ CLOCK CASE

Injection molded unit. Complete with red bezel. 4½" x 4" x 1-9/16"

$3.49

MICROPROCESSOR COMPONENTS

CDP 1802	CPU	$19.95
P8085	CPU	19.95
8080A	CPU	9.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8228	System Controller/BusDriver	5.95
8251	Prog. Comm. Interface	7.95
8253	Prog. Interval Timer	14 95
8255	Prog. Periph. Interface	9.95
8257	Prog. DMA Control	19.95
Z80(780C)	CPU	$19.95
Z80A(708-1)	CPU	24.95
2650	MPU	26.50
MC6800	MPU	14.95
MC6810API	128 x 8 Static Ram	5 95
MC6821	Periph.Interface Adapter(6820)	7.49
MC6830L8	1024 x 8 Bit ROM(68A30)	14.95
MC6850	Asychronous Comm Adapter	7.95
MC6852	Syn. Serial Data Adapter	9.95
MC6880	(MC8T26) Quad Tri State Bus Trans	2.25
MC6802	MPU w/Clock & Ram	24.95

RAM'S

1101	256 x 1	Static	$ 1.49
1103	1024 x 1	Dynamic	.99
2101(8101)	256 x 4	Static	3.95
2102	1024 x 1	Static	1 75
2107/5280	4096 x 1	Dynamic	4.95
2111(8111)	256 x 4	Static	3.95
2112	256 x 4	Static	4.95
2114	1024 x 4	Static 450ns	9.95
2114L	1024 x 4	Static 450ns Low Power	10.95
2114-3	1024 x 4	Static 300ns	10.95
2114L-3	1024 x 4	Static 300ns Low Power	11.95
7489	16 x 4	Static	1.75
8599	16 x 4	Static	3.49
21L02	1024 x 1	Static	1.95
74S200	256 x 1	Static	4.95
93421	256 x 1	Static	2.95
MM5262	2K x 1	Dynamic	3/1 00
MK4027 (UPD414)	4K	DYNAMIC 16 PIN	4.95
MK4116 (UPD416)	16K	DYNAMIC 16 PIN	14 95
TMS4044-45NL	4K	STATIC	14.95

ROM'S

2513(2140)	Character Generator (upper case)	$ 9 95
2513(3021)	Character Generator (lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048 Bit Read Only Memory	1.95

USER MANUALS

1802M	CDP1802 Manual	$ 7 50
Z80M	Z80 Manual	7 50
2650M	2650 Manual	5 00

PROMS

1702A	2048 x 1	Famous	$ 5.95
5203	2048 x 1	Famous	14.95
82S23	32 x 8	Open C	3.95
82S115	4096 x 1	Bipolar	19.95
82S123	32 x 8	Tristate	3 95
74S287	1024 x 1	Static	2 95
TMS2532	32K	EPROM	99.95
2708	8K	EPROM	10 95
2716 T I	16K	EPROM	29 95
2716 Intel (2516 T I)	16K	EPROM	49.95
6301-1	1024 x 1	Tri-State Bipolar	3 49
6330-1	256 x 1	Open C Bipolar	2.95

SHIFT REGISTERS

MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4 95
2522	Dual 132 Bit Static	2 95
2524	512 Dynamic	99
2525	1024 Dynamic	2 95
2527	Dual 256 Bit Static	2 95
2528	Dual 250 Static	4 00
2529	Dual 240 Bit Static	4 00
2532	Quad 80 Bit Static	2.95
2533	1024 Static	2 95
3341	Fifo	6.95
74LS670	4 x 4 Register	1.95

UART'S

AY-5-1013	30K BAUD	$ 5 95

SPECIAL REQUESTED ITEMS

TELEPHONE KEYBOARD CHIPS

AY-5-9100	$14 95
AY-5-9200	14 95
AY-5-9500	4 95
AY-5-2376	14.95
HD0165	7 95
74C922	9 95

ICM CHIPS

ICM7045	$24 95
ICM7205	19 95
ICM7207	7 50
ICM7208	19 95
ICM7209	6 95

NMOS READ ONLY MEMORIES

MCM6571	$13 50
MCM6574	13 50
MCM6575	13 50

TV GAME CHIP SET
AY-3-8500-1 Chip and 2 010 MHz Crystal **$7.95**

MISCELLANEOUS

11C90	$19.95
MC3061P	11.95
MC1408L7	4.95
MC1408L8	5 75
MK40240	$17 50
DS0026CH	3 75
TIL308	10 20
95H90	11 95
LD110/111	$25.00/set
MC4016(74416)	7 50
4N33	3 95

The Sinclair PDM35. A personal digital multimeter for only $59.95

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 is supplied completely assembled with test leads and prods, protective wallet and Operator's Manual.

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.

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 1V 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: 6 oz

Power supply: 9 V battery or Sinclair AC adapter (Battery not incl.)

Sockets: Standard 4 mm for resilient plugs

Options: AC adapter for 117 V 60 Hz power. De-luxe padded carrying wallet

PART NO	DESCRIPTION	PRICE
PDM35	Digital Multimeter (Completely Assembled)	$59.95
PDM AC	117volt AC Adapter	6.95
PDM-DP	Deluxe padded carrying case	6.95

B&K PRECISION 3½-Digit Portable DMM

* Overload Protected
* 3 high LED Display
* Battery or AC operation
* 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 4 4 x 2

Model 2800
$99.95

Comes with test leads, operating manual and spare fuse

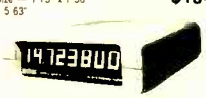
Accessories:

AC Adapter BC-28	$9.00
Rechargeable Batteries BP-26	20.00
Carrying Case LC-28	7.50

CSC 100 MHz 8-Digit Counter

* 20 Hz-100 MHz Range
* 6" LED Display
* Crystal-controlled timebase
* Fully Automatic
* Portable — completely self-contained
* Size — 1 75" x 7 38" x 5 63"
* Four power souces, i e batteries, 110 or 220V with charger 12V with auto lighter adapter and external 7 2-10V power supply

MAX-100 $134.95



ACCESSORIES FOR MAX 100:

Mobile Charger Eliminator
use power from car battery — **Model 100 — CLA $3.95**

Charger/Eliminator
use 110 V AC — **Model 100 — CAI $9.95**

KEYBOARDS

63-Key Unencoded

This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK **$29.95/each**

Hexadecimal Key Pad Unencoded

19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. **$10.95/each**

$5.00 Minimum Order – U.S. Funds Only
California Residents – Add 6% Sales Tax

Spec Sheets — 25¢
1979 A Catalog Available—Send 41¢ stamp

NEW 1979 Catalog

Jameco ELECTRONICS

A division of JAMES ELECTRONICS of California

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS – WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070
Advertised Prices Good Thru November

The Incredible "Pennywhistle 103"

$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

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.

The Original the 3rd Hand

$9.95 each

* Leaves two hands free for working
* Clamps on edge of bench, table or work bench
* Position board on angle or flat position for soldering or clipping
* Sturdy, aluminum construction for hobbyist, manufacturer or school rooms

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K. Kit comes complete with:

* 8 each UPD416 (16K Dynamic Rams)
* Documentation for conversion

TRS-16K $115.00

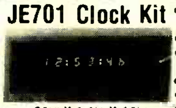
Special Offer - Order both your TRS-16K and the Sup'R' MOD II Interface kit together (retail value $144.95) **for only $139.95**

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 KB503 5V Power Kit	**$17.50**

JE701 Clock Kit



6¾" X 3 ⅛" X 1¾"

$19.95 per Kit

* 6 Digit, .300 Height Common Cathode Display
* Uses MM5314 Clock Chip
* Push Button Switches for setting Hours, Minutes & Hold.
* Easily Viewable to 20 Feet
* Simulated Walnut Case
* 115 VAC Operation
* 12 or 24 Hour Format
* Includes all Components & Case

JE803 PROBE

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

$9.95 Per Kit

printed circuit board

T_2L 5V 0.5A Supply

This is standard TTL power supply using the well known LM309K regulator IC to provide a solid 0.5 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.

JE225 $9.95 Per Kit

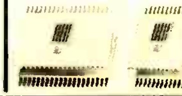
CSC PROTO BOARDS

PROTO BOARD 6
$15.95
(6" long X 4" wide)

PB100 - 4.5" x 6"	$ 19.95
PB101 - 5.8" x 4.5"	22.95
PB102 - 7" x 4 5"	26.95
PB103 - 9" x 6"	44.95
PB104 - 9.5" x 8"	54.95
PB203 - 9.75 x 6½ x 2¾	75.00
PB203A - 9.75 x 6½ x 2¾	124.95

(includes power supply)

PROTO CLIPS



14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

CIRCLE 20 ON FREE INFORMATION CARD

SAVE

COMPUTER INTERFACES & PERIPHERALS

SAVE

For free catalog including parts lists and schematics, send a self-addressed stamped envelope.

APPLE II SERIAL I/O INTERFACE *

Part no. 2
Baud rate is continuously adjustable from 0 to 30,000 • Plugs into any peripheral connector • Low current drain. RS-232 input and output • On board switch selectable 5 to 8 data bits, 1 or 2 stop bits, and parity or no parity either odd or even • Jumper selectable address • SOFTWARE • Input and Output routine from monitor or BASIC to teletype or other serial printer. • Program for using an Apple II for a video or an intelligent terminal. Also can output in correspondence code to interface with some selectrics. Board only — $15.00; with parts — $42.00; assembled and tested — $62.00.

MODEM *

Part no. 109
• Type 103 • Full or half duplex • Works up to 300 baud • Originate or Answer • No coils, only low cost components • TTL input and output-serial • Connect 8 ohm speaker and crystal mic. directly to board • Uses XR FSK demodulator • Requires +5 volts • Board $7.60; with parts $27.50

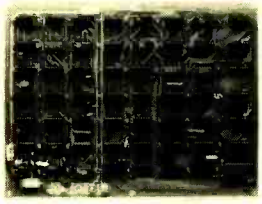
DC POWER SUPPLY *

Part no. 6085
• Board supplies a regulated +5 volts at 3 amps., +12, -12, and -5 volts at 1 amp. • Power required is 8 volts AC at 3 amps., and 24 volts AC C.T. at 1.5 amps. • Board only $12.50; with parts excluding transformers $42.50

TAPE INTERFACE *

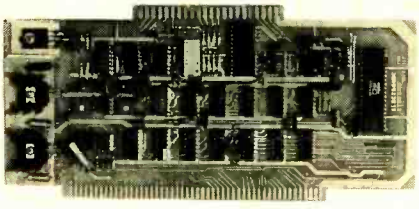
Part no. 111
• Play and record Kansas City Standard tapes • Converts a low cost tape recorder to a digital recorder • Works up to 1200 baud • Digital in and out are TTL-serial • Output of board connects to mic. in of recorder • Earphone of recorder connects to input on board • No coils • Requires +5 volts, low power drain • Board $7.60; with parts $27.50

T.V. TYPEWRITER



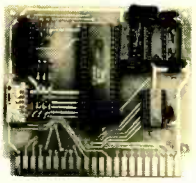
Part no. 106
• Stand alone TVT • 32 char/line, 16 lines, modifications for 64 char/line included • Parallel ASCII (TTL) input • Video output • 1K on board memory • Output for computer controlled curser • Auto scroll • Non-destructive curser • Curser inputs: up, down, left, right, home, EOL, EOS • Scroll up, down • Requires +5 volts at 1.5 amps. and -12 volts at 30 mA • All 7400, TTL chips • Char. gen. 2513 • Upper case only • Board only $39.00; with parts $145.00

TIDMA *



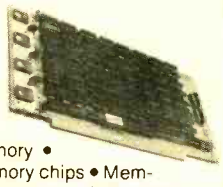
Part no. 112
• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate. • S-100 bus compatible • Board only $35.00; with parts $110.00

UART & BAUD RATE GENERATOR *



Part no. 101
• Converts serial to parallel and parallel to serial • Low cost on board baud rate generator • Baud rates: 110, 150, 300, 600, 1200, and 2400 • Low power drain +5 volts and -12 volts required • TTL compatible • All characters contain a start bit, 5 to 8 data bits, 1 or 2 stop bits, and either odd or even parity. • All connections go to a 44 pin gold plated edge connector • Board only $12.00; with parts $35.00 with connector add $3.00

8K STATIC RAM

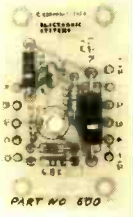


Part no. 300
• 8K Altair bus memory • Uses 2102 Static memory chips • Memory protect • Gold contacts • Wait states • On board regulator • S-100 bus compatible • Vector input option • TRI state buffered • Board only $22.50; with parts $160.00

RF MODULATOR *

Part no. 107
• Converts video to AM modulated RF, Channels 2 or 3. So powerful almost no tuning is required. On board regulated power supply makes this extremely stable. Rated very highly in Doctor Dobbs' Journal. Recommended by Apple. • Power required is 12 volts AC C.T., or +5 volts DC • Board $7.60; with parts $13.50

RS 232/TTY * INTERFACE



Part no. 600
• Converts RS-232 to 20mA current loop, and 20mA current loop to RS-232 • Two separate circuits • Requires +12 and -12 volts • Board only $4.50, with parts $7.00

RS 232/TTL * INTERFACE

Part no. 232
• Converts TTL to RS-232, and converts RS-232 to TTL • Two separate circuits • Requires -12 and +12 volts • All connections go to a 10 pin gold plated edge connector • Board only $4.50; with parts $7.00 with connector add $2.00

ELECTRONIC SYSTEMS

Dept. RE-9 P.O. Box 21638, San Jose, CA. USA 95151

To Order: Mention part number and description. For parts kits add "A" to part number. In USA, shipping paid for orders accompanied by check, money order, or Master Charge, BankAmericard, or VISA number, expiration date and signature. Shipping charges added to C.O.D. orders. California residents add 6.5% for tax. Outside USA add 10% for air mail postage, no C.O.D.'s. Checks and money orders must be payable in US dollars. Parts kits include sockets for all ICs, components, and circuit board. Documentation is included with all products. All items are in stock, and will be shipped the day order is received via first class mail. Prices are in US dollars. No open accounts. To eliminate tariff in Canada boxes are marked "Computer Parts." Dealer inquiries invited.
24 Hour Order Line: (408) 226-4064

* Circuits designed by John Bell

DIGI-KEY CORPORATION

Quality Electronic Components

TOLL FREE 1-800-346-5144

MN., AK., HI. RESIDENTS 218-681-6674

master charge · VISA

DON'T FORGET OUR DISCOUNTS WHEN COMPARING PRICES

I.C.'S • RESISTORS • TRANSISTORS • CAPACITORS • DIODES • I.C. SOCKETS & PINS • SWITCHES
CLOCK MODULES • OPTOELECTRONICS • BREADBOADING & TESTING DEVICES • DRAFTING SUPPLIES
DATA BOOKS • HEAT SINKS • WIRE • TOOLS . . . AND MORE . . . WRITE FOR FREE CATALOG . . . .

INTEGRATED CIRCUITS

TTL	
7400	.16
7401	.18
7402	.18
7403	.18
7404	.17
7405	.21
7406	.25
7407	.25
7408	.21
7409	.21
7410	.17
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	.79
74162	.88
74163	.88
74164	.96
74165	1.15
74166	1.26
74170	2.64
74173	1.42
74174	.98
74175	.93
74176	.79
74177	.79
74180	.70
74181	2.15
74182	.79
74184	2.19
74185	2.19
74189	3.50
74190	1.23
74191	.95
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
74LS75	.53
74LS76	.39
74LS78	.39
74LS83	.79
74LS85	.98
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
74LS162	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	.88
74LS196	.86
74LS197	.86
74LS240	1.90
74LS241	1.90
74LS242	1.70
74LS243	1.70
74LS244	1.70
74LS247	.79
74LS248	.79
74LS249	.79
74LS253	.84
74LS257	.75
74LS258	.75
74LS260	.34
74LS261	2.00
74LS266	.39
74LS273	1.28
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

74C00	
74C00N	.25
74C02N	.25
74C04N	.27
74C08N	.25
74C10N	.25
74C14N	.90
74C20N	.25
74C30N	.25
74C32N	.25
74C42N	.98
74C48N	1.28
74C73N	.72
74C74N	.48
74C76N	.72
74C83N	1.38
74C85N	1.38
74C86N	.40
74C90N	.98
74C93N	.98
74C95N	1.10
74C107N	.70
74C150N	2.90
74C151N	1.90
74C154N	2.90
74C157N	1.90
74C160N	1.18
74C161N	1.18
74C162N	1.18
74C163N	1.18
74C164N	1.10
74C165N	1.10
74C173N	1.30
74C174N	1.16
74C175N	1.16
74C192N	1.38
74C193N	1.38
74C195N	1.10
74C221N	1.90
80C95N	.48
80C96N	.48
80C97N	.48
80C98N	.48
74C901N	.48
74C902N	.48
74C909N	1.78
74C926N	7.80

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	.40
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

INTERFACE	
8093	.40
8094	.40
8095	.67
8096	.67
8097	.67
8098	.67
75450	.88
75451	.61

MISC IC	
MM5314N	3.75

75452	.61
75453	.61
75454	.61
75491	.81
75492	.81
75493	1.09
75494	1.19
MC1488N	.90
MC1489N	.90

LINEAR	
CA3046	.75
CA3086	.50
LF351N	.76
LF356N	1.20
LF357N	1.20
LF13741	.76
LM301AN	.44
LM307N	.64
LM308N	1.00
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
LM386	.85
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
LM3905N	1.40
LM3909N	.61
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
UA710CV	.44
UA711CA	.53
UA723CA	.60
UA733CA	.75
UA741CV	.44
UA747CA	.70
UA748CV	.49
UA7805CU	1.25
UA7806CU	1.25
UA7808CU	1.25
UA7810CU	1.25
UA7812CU	1.25
UA7812CU	1.25
UA7815CU	1.25
UA7818CU	1.25
UA7824CU	1.25
UA78L05ACZ	.40
UA78L06ACZ	.40
UA78L08ACZ	.40
UA78L10ACZ	.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
UA8918CU	1.70
UA7924CU	1.70

PREPAID SHIPPING AND INSURANCE (on U.S. and Canadian ...)

I.C. SOCKETS

WIRE WRAP SOCKET ARE STANDARD PROFILE

Part No.	Description	Prices		
8 ST	8 Pin Solder Tab I.C. Socket	.17	1.60/10	14.50/C
14 ST	14 Pin Solder Tab I.C. Socket	.20	1.90/10	17.00/C
16-ST	16 Pin Solder Tab I.C. Socket	.22	2.10/10	18.75/C
18-ST	18 Pin Solder Tab I.C. Socket	.29	2.75/10	24.50/C
20-ST	20 Pin Solder Tab I.C. Socket	.30	2.85/10	25.75/C
22 ST	22 Pin Solder Tab I.C. Socket	.33	3.15/10	27.75/C
24-ST	24 Pin Solder Tab I.C. Socket	.38	3.60/10	32.75/C
28-ST	28 Pin Solder Tab I.C. Socket	.45	4.25/10	38.25/C
40-ST	40 Pin Solder Tab I.C. Socket	.63	6.00/10	53.50/C
8-WW	8 Pin Wire Wrap I.C. Socket	.24	2.30/10	20.50/C
14-WW	14 Pin Wire Wrap I.C. Socket	.26	2.50/10	22.00/C
16-WW	16 Pin Wire Wrap I.C. Socket	.30	2.85/10	25.50/C
18-WW	18 Pin Wire Wrap I.C. Socket	.60	5.70/10	51.00/C
20-WW	20 Pin Wire Wrap I.C. Socket	.70	6.65/10	59.50/C
22-WW	22 Pin Wire Wrap I.C. Socket	.84	8.00/10	71.50/C
24-WW	24 Pin Wire Wrap I.C. Socket	.96	9.10/10	81.50/C
28-WW	28 Pin Wire Wrap I.C. Socket	1.12	10.00/10	95.20/C
40-WW	40 Pin Wire Wrap I.C. Socket	1.36	12.50/10	115.00/C

MOLEX I.C. SOCKET PINS

.85/C 8.20/M 38.[illegible]/5M 275.00/50M

MICROPROCESSORS

8080A	8-BIT CPU 2 USEC CYCLE	$ 9.95
8212	8-BIT I/O PORT	$ 3.25
8216	BI-DIRECTIONAL BUS DRIVER	$ 3.25
8224	CLOCK GENERATOR	$ 3.25
8228	SYSTEM CONTROLLER	$ 6.00
8251	COMMUNICATIONS INTERFACE	$10.50
8255	PERIPHERAL INTERFACE	$10.50
1702A	2K EPROM 1 USEC	$ 5.75
2708	8K EPROM 450 NSEC	$15.75
2102AN-4L	1K LOW POWER 450 NSEC RAM	$ 1.69
SC/MP	5 VOLT SC/MP CPU	$ 9.95
2650	MICROPROCESSOR 1.25 MH-2 CLOCK 40 DIL	$24.95

½ WATT ZENER DIODES

.15 1.30/10 11.00/C

1N5226B	3.3V	1N5242B	12V
1N5227B	3.6V	1N5243B	13V
1N5228B	3.9V	1N5244B	14V
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
1N5239B	9.1V	1N5255B	28V
1N5240B	10V	1N5256B	30V
1N5241B	11V	1N5257B	33V

SILICON DIODES

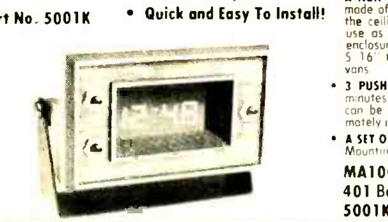
1N4001	.64/10	5.50/C
1N4002	.66/10	5.60/C
1N4003	.68/10	5.80/C
1N4004	.70/10	5.95/C
1N4005	.82/10	7.05/C
1N4006	.90/10	7.75/C
1N4007	.99/10	8.60/C
1N4148	.40/10	3.50/C

SLIDE SWITCHES

SPST	.15	1.25/10	10.00/C
SPDT	.19	1.70/10	13.00/C
DPDT	.23	2.00/10	19.00/C

Call or Write For FREE CATALOG

• DIGI-KEY MEANS QUALITY PRODUCTS



NEW! DIGI-CLOCK KIT ONLY $21.90

- Trouble-free Module!
- 270° Swivel Mount!
- Inlaid Walnut Chrome Trim Bezel!
- Ideal for Car, Van or Boat!
- 3-5/8"x2-3/16" Tall x 2-1/8" Deep!
- Quick and Easy To Install!

Part No. 5001K

- **AN MA1003 CLOCK MODULE BY NATIONAL SEMICONDUCTOR** — Fully assembled, tested, and ready to run on 12 VDC, this 0.3" fluorescent display is designed to replace those troublesome mechanical clocks. It is protected against automotive voltage transients and reversals with timekeeping maintained to 9 VDC. Automatic display brightness control logic blanks the display with the ignition off, reduces brightness to 33% with park or head lights and follows the dash lamp dimming control setting. Its crystal time base assures an accuracy of 2 seconds per day at 25°C and 5 seconds per day over the range of -25°C to 65°C.
- **AN ATTRACTIVE INLAID WALNUT & CHROME TRIM BEZEL** — Designed to be either flush mounted or used as a face plate for the enclosure. Its deep recessed display eliminates glare and reflection while its blue acrylic filter provides optimum display contrast.
- **A NON-GLARE BLACK ENCLOSURE WITH A 270° SWIVEL BRACKET** — Is made of ABS plastic and designed for mounting on, under or against the ceiling, dash or almost anywhere in your car, van, or boat. Or use as a back box if you choose, to flush mount the bezel. The enclosure - bezel combination can be flush mounted on paneling up to 5/16" thick and in addition is designed to fit between the ribs of most vans.
- **3 PUSH BUTTON SWITCHES** — For quick and simple setting of hours, minutes, and display activation with the ignition off. These switches can be mounted directly on the bezel or enclosure or mounted remotely if you prefer.
- **A SET OF EASY TO FOLLOW INSTRUCTIONS** — To guide you step by step. Mounting hardware included.

MA1003 Clock Module and Switches only **15.95**
401 Bezel and Enclosure only **5.95**
5001K Digi-Clock Kit (includes MA1003 and 401) . . . **21.90**

ADAM OSBORNE MICROPROCESSOR BOOKS

AN INTRODUCTION TO MICROCOMPUTERS VOL. 0	[illegible]	[illegible]
AN INTRODUCTION TO MICROCOMPUTERS VOL. 1	90008-ND	8.50
AN INTRODUCTION TO MICROCOMPUTERS VOL. 2	90018-ND	15.00
An Introduction to Microcomputers vol. 3	90098-ND	15.00
8080 PROGRAMMING FOR LOGIC DESIGN	90028-ND	8.50
6800 PROGRAMMING FOR LOGIC DESIGN	90038-ND	8.50
SOME COMMON BASIC PROGRAMS	90068-ND	8.50
PAYROLL WITH COST ACCOUNTING IN BASIC	90058-ND	15.00
Z80 PROGRAMMING FOR LOGIC DESIGN	90078-ND	8.50
8080A 8085 ASSEMBLY LANGUAGE PROGRAMMING	90088-ND	8.50
Accounts Payable and Accounts Receivable	90406-ND	15.00

DATA BOOKS

TTL DATA BOOK 592 P. NAT. SEMI.	9010B	$4.00
LINEAR DATA BK 952 P. NAT. SEMI.	9011B	$4.00
CMOS DATA BK 77 EDIT. 555 P. NAT. SEMI.	9012B	$3.00
POWER TRANSISTORS. 151 P. NAT. SEMI.	9014B	$3.00
MEMORY DATA BK. 592 P. NAT. SEMI.	9014B	$3.00
MOS LSI DATA BK. 713 P. NAT. SEMI.	9015B	$4.00
INTERFACE DATA BK. 464 P. NAT.	9016B	$4.00
VOLTAGE REG. BK. 128 P. NAT. SEMI.	9017B	$3.00
AUDIO HANDBOOK, 196 P. NAT. SEMI.	9020B	$4.00
SC/MP MICRO. APP. HANDBK. NAT. SEMI.	9022B	$5.00
DISCRETE DATABOOK	9024B	$4.00

SAMS BOOKS

CIRCUITS AND COMPONENTS		
CMOS COOKBOOK	21398-ND	10.50
THE BIG CMOS WALL CHART	21399-ND	2.95
FET CIRCUITS (2ND EDITION)	21439-ND	4.95
IC TIMER COOKBOOK	21416-ND	9.95
PRINCIPLES AND APPLIC OF INVERTERS & CONVERTERS	21454-ND	7.95
TRANSISTOR SPECIFICATIONS MANUAL (8TH EDITION)	21335-ND	6.95
TRANSISTOR SUBSTITUTION HANDBOOK (16TH EDITION)	21333-ND	4.95
SEMICONDUCTOR REPLACEMENT GUIDE	21092-ND	3.95
SEMICONDUCTOR GENERAL PURPOSE REPLACEMENTS	21522-ND	14.95
ABC'S OF CAPACITORS (3RD EDITION)	21498-ND	4.95
ABC'S OF INTEGRATED CIRCUITS (2ND EDITION)	21462-ND	3.95
ABC'S OF RESISTANCE & RESISTORS	21126-ND	3.95
ABC'S OF FET'S (2ND EDITION)	21510-ND	3.95
ABC'S OF TRANSISTORS (3RD EDITION)	21146-ND	4.75
ABC'S OF ZENER DIODES	21045-ND	3.95
FET PRINCIPLES, EXPERIMENTS, & PROJECTS (2ND EDIT)	21167-ND	8.50
ABC'S OF SILICON CONTROLLED RECTIFIERS	20124-ND	4.25
TRANSISTOR CIRCUIT ACTIONS (2ND EDITION)	20025-ND	5.25
ABC'S OF VOLTAGE-DEPENDENT RESISTORS	20771-ND	3.25
ACTIVE FILTER COOKBOOK	21168-ND	14.95
COLLECTED BASIC CIRCUITS	20784-ND	5.50
HOW TO DESIGN AND USE MULTIVIBRATORS	21043-ND	3.95
HOW TO USE INTEGRATED-CIRCUIT LOGIC ELEMENTS	21081-ND	4.95
IC OP AMP COOKBOOK	20969-ND	12.95
LED CIRCUITS AND PROJECTS	21006-ND	5.25
MOS DIGITAL IC'S	21299-ND	6.50
PRACTICAL SOLID-STATE CIRCUIT DESIGN	21018-ND	6.50
RC CIRCUITS	21332-ND	4.95
RTL COOKBOOK	20715-ND	5.75
TRANSISTOR-TRANSISTOR LOGIC	20967-ND	6.50
TUBE SUBSTITUTION HANDBOOK (19TH EDITION)	21405-ND	2.95
SPECIAL TWIN-PAK TUBE SUBSTITUTION HANDBOOK PKG	21407-ND	3.75
SOLID STATE COMPONENTS	21099-ND	3.95
SOLID-STATE POWER SUPPLIES & CONVERTERS	20310-ND	3.95
TRANSISTOR AUDIO AMPLIFIERS	20838-ND	5.95
TTL COOKBOOK	21035-ND	9.50
USER'S GUIDE TO TTL	21080-ND	7.50
Regulated Power Supplies	21482-ND	9.95
UNDERSTANDING CMOS INTEGRATED CIRCUITS	21129-ND	4.95
UNDERSTANDING IC OPERATIONAL AMPLIFIERS (2ND EDIT)	21511-ND	4.95
UNDERSTANDING OSCILLATORS	20837-ND	4.95
UNIQUE IC OP AMP APPLICATIONS	21163-ND	4.95
COMPUTERS/MICROCOMPUTERS		
YOUR OWN COMPUTER	21483-ND	1.95
HOW TO BUY & USE MINICOMPUTER & MICROCOMPUTERS	21351-ND	9.95
HOW TO PROGRAM MICROCOMPUTERS	21459-ND	8.95
MICROCOMPUTER PRIMER	21404-ND	7.95
THE 8080A BUGBOOK MICROCOMPUTER INTERFACING AND PROGRAMMING	21447-ND	10.50
COMPUTER DICTIONARY (2ND EDITION)	20943-ND	8.95
COMPUTER DICTIONARY AND HANDBOOK (2ND EDITION)	20850-ND	19.50
COMPUTERS & PROGRAMMING GUIDE FOR ENGINEERS	20950-ND	12.95
TV TYPEWRITER COOKBOOK	21313-ND	9.95
Z-80 MICROCOMPUTER HANDBOOK	21500-ND	8.95
USING THE 6800 MICROPROCESSOR	21512-ND	6.95
GETTING ACQUAINTED WITH MICROCOMPUTERS	21486-ND	9.95
PRACTICE PROBLEMS IN NUMBER SYSTEMS, LOGIC, AND BOOLEAN ALGEBRA (2ND EDITION)	21451-ND	6.50
THE CHEAP VIDEO COOKBOOK	21524-ND	5.95
DBUG AN 8080 INTERPRETIVE DEBUGGER	21536-ND	4.95
NCR DATA PROCESSING CONCEPTS COURSE	21547-ND	7.95
MICROCOMPUTER SOFTWARE	21541-ND	9.50
LOGIC AND MEMORY EXPERIMENTS USING TTL INTEGRATED CIRCUITS		
BOOK 1 384 PAGES	21542-ND	10.50
BOOK 2 352 PAGES	21543-ND	9.95
TWO VOLUMES	21544-ND	18.95
INTERFACING AND SCIENTIFIC DATA COMMUNICATIONS EXPERIMENTS	21546-ND	5.95
NCR DATA COMMUNICATIONS CONCEPTS	21548-ND	6.95
INTRODUCTORY EXPERIMENTS IN DIGITAL ELECTRONICS AND 8080A MICROCOMPUTER PROGRAMMING AND INTERFACING		
BOOK 1	21550-ND	12.95
BOOK 2	21551-ND	12.95
TWO VOLUMES	21552-ND	23.95
MICROCOMPUTER-ANALOG CONVERTER SOFTWARE AND HARDWARE INTERFACING	21540-ND	9.50
COMMUNICATIONS/AMATEUR RADIO		
AMATEUR TESTS AND MEASUREMENTS	24007-ND	5.95
ELECTRONICS FOR THE AMATEUR	24022-ND	7.95
GENERAL CLASS AMATEUR LICENSE HANDBOOK (2ND EDIT)	20639-ND	4.50
HAM AND CB ANTENNA DIMENSION CHARTS	24023-ND	2.75
INTERNATIONAL CODE TRAINING SYSTEM		
3-33⅓ RPM RECORDS	20138-ND	12.50
TAPE CASSETTE	20812-ND	12.50
REFERENCE DATA FOR RADIO ENGINEERS (6TH EDIT)	21218-ND	30.00
NOVICE CLASS AMATEUR RADIO LICENSE MANUAL	21529-ND	3.95
FIRST-CLASS RADIOTELEPHONE LICENSE HANDBOOK (4TH EDITION)	21144-ND	8.[illegible]
SECOND-CLASS RADIOTELEPHONE LICENSE HANDBOOK (5TH EDIT)	21111-ND	8.50
THIRD-CLASS RADIOTELEPHONE LICENSE HANDBOOK (4TH EDIT)	21353-ND	6.50
LASER FUNDAMENTALS AND APPLICATIONS	21130-ND	6.50
LIGHT-BEAM COMMUNICATIONS	21147-ND	4.95
MARINE RADIOTELEGRAPH OPERATOR LICENSE HANDBOOK	21109-ND	9.95
101 QUESTIONS AND ANSWERS ABOUT FIXED RADIOCOMMUNICATIONS	20584-ND	3.95
WIND, SOLAR ENERGY FOR RADIOCOMMUNICATIONS & LOW POWER ELECTRONIC ELECTRIC APPLICATIONS	21305-ND	7.95
AM FM BROADCASTING EQUIPMENT OPERATING & MAINTENANCE	21012-ND	18.95
RADIO HANDBOOK (20TH EDITION)	24032-ND	19.50
RADIO TRANSMITTER PRINCIPLES AND PROJECTS	24031-ND	6.95
SEMICONDUCTOR AMATEUR PROJECTS	24025-ND	4.95
SO YOU WANT TO BE A HAM (7TH EDITION)	21343-ND	5.95
73 DIPOLE AND LONG-WIRE ANTENNAS	24006-ND	5.50
73 VERTICAL, BEAM AND TRIANGLE ANTENNAS	24021-ND	5.50
101 QUESTIONS AND ANSWERS ABOUT AMATEUR RADIO	20731-ND	2.95
REFERENCE		
MODERN DICTIONARY OF ELECTRONICS (5TH EDIT)	21314-ND	18.95
HANDBOOK OF ELECTRONIC TABLES & FORMULES (4TH EDIT)	20987-ND	7.95
TECHNIQUES FOR PREPARING AND OBTAINING YOUR OWN PATENT	20995-ND	4.2[illegible]
ELECTRICITY & ELECTRONICS		
INTRODUCTION TO BIOMEDICAL ELECTRONICS	21005-ND	6.50
OPTOLECTRONICS	21180-ND	5.95
ABC'S OF ELECTRONIC POWER	20884-ND	3.40
ABC'S OF INFRARED	20778-ND	3.95
TRANSISTOR FUNDAMENTALS		
VOL 1 — BASIC SEMICONDUCTOR & CIRCUIT PRINCIPLES	20641-ND	5.75
VOL 2 — BASIC TRANSISTOR CIRCUITS	20642-ND	5.75
VOL 3 — ELECTRONIC EQUIPMENT CIRCUITS	20643-ND	5.25
VOL 4 — DIGITAL AND SPECIAL CIRCUITS	20644-ND	5.25
4 VOLUME SET	20645-ND	21.00
WORKSHOP IN SOLID STATE (2ND EDITION)	21450-ND	8.50
MICROMINIATURE ELECTRONICS	20582-ND	5.75
BASIC ELECTRICITY AND INTRODUCTION TO ELECTRONICS (3RD EDITION)	20932-ND	7.50
BASIC ELECTRICITY ELECTRONICS		
VOL 1 — BASIC PRINCIPLES & APPLICATIONS	20167-ND	5.50
VOL 2 — HOW AC & DC CIRCUITS WORK	20168-ND	5.50
VOL 3 — UNDERSTANDING TUBE & TRANSISTOR CIRCUITS	20169-ND	5.50
VOL 4 — UNDERSTANDING & USING TEST INSTRUMENTS	20170-ND	5.50
VOL 5 — MOTORS & GENERATORS—HOW THEY WORK	20171-ND	5.50
FIVE VOLUME SET	20172-ND	25.50
HOW TO READ SCHEMATIC DIAGRAMS (3RD EDITION)	21127-ND	5.50
TEST EQUIPMENT		
KNOW YOUR OSCILLOSCOPE (3RD EDITION)	21102-ND	5.25
KNOW YOUR VOM VTVM (3RD EDITION)	21134-ND	6.50
TROUBLESHOOTING WITH THE OSCILLOSCOPE (3RD EDITION)	21103-ND	5.95
101 MORE WAYS TO USE YOUR VOM AND VTVM (2ND ED.)	20513-ND	4.50
101 WAYS TO USE YOUR OSCILLOSCOPE (2ND EDITION)	20416-ND	5.50
101 WAYS TO USE YOUR VOM & VTVM (2ND EDITION)	20510-ND	4.75
INSTRUMENTATION		
ABC'S OF HYDRAULIC CIRCUITS	21003-ND	4.50
ABC'S OF PNEUMATIC CIRCUITS	20970-ND	4.50
INSTRUMENTATION TRAINING COURSE		
VOL 1 — PNEUMATIC INSTRUMENTS	20621-ND	9.50
VOL 2 — ELECTRONIC INSTRUMENTS	20622-ND	7.50
TWO VOLUME SET		15.50
PROJECTS		
ELECTRONIC CIRCUITBOOK 5 LED PROJECTS	21311-ND	3.75
ELECTRONIC CLOCKS AND WATCHES	21162-ND	6.50
ELECTRONIC FLASH EQUIPMENT	21020-ND	4.50
ELECTRONIC GAMES & TOYS YOU CAN BUILD	20183-ND	4.25
SCIENCE PROJECTS IN ELECTRONICS (2ND EDITION)	20846-ND	4.50
SOLAR CELLS AND PHOTOCELLS	21175-ND	3.95
SOLID-STATE ELECTRONIC PROJECTS	[illegible]-ND	
DIGITAL EQUIPMENT SERVICING GUIDE	21200-ND	6.50
99 ELECTRONIC PROJECTS	20818-ND	3.95
BUILDING AND INSTALLING ELECTRONIC INSTRUSION ALARMS (2ND EDITION)	21465-ND	4.95
HOW TO BUILD PROXIMITY DETECTORS & METAL LOCATORS (2ND EDITION)	20881-ND	4.95
HOW TO BUILD SIMPLE ELECTRICAL METERS AND INDICATORS	20930-ND	3.95
BUILD IT BOOK OF CAR ELECTRONICS	21[illegible]-ND	3.95
INTEGRATED CIRCUITS PROJECTS	211[illegible]-ND	4.95
BUILD IT BOOK OF FUN AND GAMES	21219-ND	3.95
AUTOMOBILE ELECTRONICS SERVICING GUIDE	20927-ND	4.95
LED CIRCUITS AND PROJECTS	21006-ND	5.25
SEMICONDUCTOR AMATEUR PROJECTS	24025-ND	4.95
PROJECTS IN SIGHT, SOUND, & SENSATION	21125-ND	5.25
30 IC PROJECTS	21145-ND	3.50
LINEAR IC PRINCIPLES, EXPERIMENTS, & PROJECTS	21012-ND	9.50

ELECTROLYTIC CAPACITORS

VALUE	RADIAL LEADS			AXIAL LEADS		
.47/50V	.10	.78/10	6.20/C	.13	1.10/10	8.50/C
1/50V	.10	.78/10	6.20/C	.13	1.10/10	8.50/C
2.2/50V	.10	.78/10	6.20/C	.13	1.10/10	8.50/C
3.3/50V	.10	.78/10	6.20/C	.13	1.10/10	8.50/C
4.7/35V	.10	.78/10	6.20/C	.13	1.10/10	8.50/C
4.7/50V	.10	.78/10	6.20/C	.16	1.30/10	10.25/C
10/16V	.10	.78/10	6.20/C	.13	1.10/10	8.50/C
10/25V	.10	.78/10	6.20/C	.13	1.10/10	8.50/C
10/35V	.10	.78/10	6.20/C	.16	1.30/10	10.25/C
10/50V	.12	.94/10	7.60/C	.18	1.45/10	11.60/C
22/16V	.10	.78/10	6.20/C	.16	1.30/10	10.25/C
22/25V	.11	.86/10	6.90/C	.16	1.30/10	10.25/C
22/35V	.14	1.12/10	8.95/C	.18	1.45/10	11.60/C
22/50V	.15	1.25/10	9.95/C	.21	1.70/10	13.55/C
33/16V	.11	.86/10	6.90/C	.16	1.30/10	10.25/C
33/25V	.12	.94/10	7.60/C	.18	1.45/10	11.60/C
33/35V	.15	1.25/10	9.95/C	.21	1.70/10	13.55/C
33/50V	.16	1.31/10	10.43/C	.24	1.95/10	15.55/C
47/10V	.11	.86/10	6.90/C	.16	1.30/10	10.25/C
47/16V	.12	.94/10	7.60/C	.18	1.45/10	11.60/C
47/25V	.15	1.22/10	9.74/C	.21	1.70/10	13.55/C
47/35V	.16	1.31/10	10.43/C	.25	2.00/10	16.10/C
47/50V	.17	1.39/10	11.12/C	.27	2.20/10	17.55/C
100/10V	.12	.94/10	7.60/C	.18	1.45/10	11.60/C
100/16V	.15	1.22/10	9.74/C	.21	1.70/10	13.55/C
100/25V	.16	1.32/10	10.52/C	.25	2.00/10	16.10/C
100/35V	.17	1.39/10	11.12/C	.32	2.65/10	21.05/C
100/50V	.29	2.36/10	18.85/C	.33	2.75/10	21.85/C
220/10V	.16	1.32/10	10.52/C	.22	1.85/10	14.55/C
220/16V	.17	1.39/10	11.12/C	.25	2.00/10	16.10/C
220/25V	.25	2.08/10	16.59/C	.33	2.75/10	21.85/C
220/35V	.30	2.47/10	19.75/C	.38	3.13/10	25.05/C
220/50V	.36	2.97/10	23.69/C	.45	3.68/10	29.90/C
330/6V	.16	1.32/10	10.52/C	.22	1.85/10	14.55/C
330/10V	.17	1.39/10	11.12/C	.25	2.00/10	16.10/C
330/16V	.25	2.08/10	16.62/C	.33	2.68/10	21.43/C
330/25V	.30	2.47/10	19.75/C	.37	3.10/10	24.55/C
330/35V	.36	2.96/10	23.69/C	.45	3.68/10	29.44/C
330/50V	.59	4.86/10	38.83/C	.57	4.70/10	37.50/C
470/6V	.17	1.35/10	10.74/C	.25	2.00/10	16.10/C
470/10V	.26	2.12/10	16.95/C	.33	2.75/10	21.85/C
470/16V	.28	2.34/10	18.65/C	.37	3.10/10	24.55/C
470/25V	.35	2.84/10	22.71/C	.45	3.80/10	30.05/C
470/35V	.45	3.71/10	29.62/C	.48	4.00/10	31.80/C
470/50V	.65	5.37/10	42.92/C	.69	5.68/10	45.40/C
1000/6V	.28	2.28/10	18.18/C	.37	3.05/10	24.25/C
1000/10V	.29	2.35/10	18.77/C	.43	3.55/10	28.15/C
1000/16V	.34	2.84/10	22.72/C	.45	3.70/10	29.40/C
1000/25V	.59	4.86/10	38.83/C	.63	5.20/10	41.45/C
1000/35V	.63	5.18/10	41.46/C	.73	6.05/10	48.35/C
2200/6V	.38	3.09/10	24.68/C	.45	3.75/10	29.60/C
2200/10V	.49	4.02/10	32.09/C	.58	4.80/10	38.30/C
2200/16V	.63	5.19/10	41.46/C	.68	5.70/10	45.28/C

MINIBOX METALIZED POLYESTER CAPACITORS

[illegible] 1000V	.16	1.32/10	10.35/C	.0022 1000V	.16	1.32/10	10.35/C
.0033 1000V	.16	1.32/10	10.35/C	.0047 630V	.14	1.15/10	9.00/C
.0068 630V	.14	1.15/10	9.00/C	.01 630V	.16	1.32/10	10.35/C
.022 400V	.17	1.44/10	11.50/C	.033 250V	.17	1.44/10	11.50/C
.047 250V	.15	1.25/10	10.00/C	.068/250V	.17	1.44/10	11.50/C
.1 100V	.19	1.55/10	12.65/C	.22 100V	.26	2.13/10	17.25/C
.33 100V	.35	2.88/10	23.00/C	.47 100V	.41	3.45/10	27.60/C

CLOCK MODULE SALE OF SALES

MA1010 0.84" High Digits

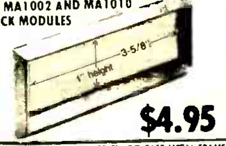
Actual size: 1.75" x 3.75"

The 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.

MA1010A .84" LED 12 Hour AM PM Clock Module	~~$13.00~~	9.95
MA1010A SET Module w Transformer & Switches	~~$16.46~~	11.95
MA1010C .84" LED 24 Hour Clock Module	~~$13.00~~	9.95
MA1010C SET Module w/Transformer & Switches	~~$16.46~~	11.95

JMJ DIGITAL DISPLAY BEZEL

FOR MA1002 AND MA1010 CLOCK MODULES



$4.95

PATENTED CHROMAFILTER SCREEN, OR CAST METAL FRAME MOUNTS IN PANELS UP TO 3/16" THICK, NO EXPOSED HARDWARE, SCRATCH RESISTANT AND EASILY CLEANED, ELIMINATES GLARE.

MOUNTING ADAPTERS AVAILABLE TO SIMPLIFY MOUNTING AND ASSURE PERFECT ALIGNMENT.

400 BEZEL WITH RED FILTER	4.95
420 MOUNTING ADAPTER FOR MA1001 & MA1002	.69
421 MOUNTING ADAPTER FOR MA1010	.69

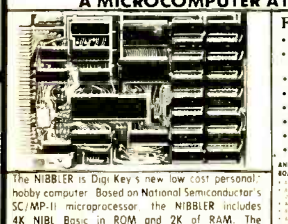
SILICON TRANSISTORS

MPS918	.16	1.55/10	13.60/C	130.00/M
MPS930	.16	1.55/10	13.60/C	130.00/M
MPS2222A	.16	1.55/10	13.60/C	130.00/M
MPS2369A	.16	1.55/10	13.60/C	130.00/M
MPS2907A	.16	1.55/10	13.60/C	130.00/M
MPS3393	.16	1.55/10	13.60/C	130.00/M
MPS3393	.16	1.55/10	13.60/C	130.00/M
MPS3394	.16	1.55/10	13.60/C	130.00/M
MPS3395	.16	1.55/10	13.60/C	130.00/M
MPS3563	.16	1.55/10	13.60/C	130.00/M
MPS3565	.16	1.55/10	13.60/C	130.00/M
MPS3638A	.16	1.55/10	13.60/C	130.00/M
MPS3641	.16	1.55/10	13.60/C	130.00/M
MPS3643	.16	1.55/10	13.60/C	130.00/M
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
2N4401	.16	1.55/10	13.60/C	130.00/M
2N4403	.16	1.55/10	13.60/C	130.00/M
2N4410	.16	1.55/10	13.60/C	130.00/M
2N5087	.16	1.55/10	13.60/C	130.00/M
2N5089	.16	1.55/10	13.60/C	130.00/M
2N5210	.16	1.55/10	13.60/C	130.00/M
2N3055	.99	9.20/10	85.00/C	800.00/M
MPF102	.36	3.35/10	30.60/C	300.00/M
2N5457	.48	4.50/10	41.00/C	400.00/M
MPSA13	.28	2.60/10	24.00/C	230.00/M
MJ2955	.99	9.20/10	85.00/C	800.00/M

HAYDEN BOOKS
(Not Discountable)

PERSONAL COMPUTERS		
HOME COMPUTER SYSTEMS HANDBOOK	56788H-ND	8.45
MICROPROCESSOR BASICS	57636H-ND	10.95
COMPUTER MATHEMATICS	50941H-ND	11.95
BASIC BASIC AN INTRODUCTION TO COMPUTER PROGRAMMING IN BASIC LANGUAGE (2ND EDITION)	51069H-ND	8.95
MICROPROCESSOR DATA MANUAL	51148H-ND	7.95
THE FIRST BOOK OF KIM	51190H-ND	9.00
ADVANCED BASIC APPLICATIONS AND PROBLEMS	58551H-ND	7.95
COBOL WITH STYLE PROGRAMMING PROVERBS	57814H-ND	6.95
FUNDAMENTALS AND APPLICATIONS OF DIGITAL LOGIC CIRCUITS (2ND EDITION)	56613H-ND	7.95
COMPUTERS IN SOCIETY THE WHERES, WHYS AND HOWS OF COMPUTER USE	59159H-ND	5.50
BASIC FROM THE GROUND UP	57601H-ND	8.95
MICROPROCESSORS NEW DIRECTIONS FOR DESIGNERS	57776H-ND	10.95
STANDARD DICTIONARY OF COMPUTERS AND INFORMATION PROCESSING (REVISED 2ND EDITION)	50992H-ND	16.95
GAME PLAYING WITH BASIC	51093H-ND	6.95
GAME PLAYING WITH COMPUTERS (REVISED 2ND EDITION)	51034H-ND	16.95
FORTRAN FUNDAMENTALS A SHORT COURSE	58608H-ND	4.95
COMPUTERS IN ACTION HOW COMPUTERS WORK	58616H-ND	5.50
PROGRAMMING PROVERBS	55226H-ND	6.95
PROGRAMMING PROVERBS FOR FORTRAN PROGRAMMERS	58209H-ND	6.95
DIGITAL EXPERIMENTS WORKBOOK OF IC EXPERIMENTS	5713XH-ND	8.95
DIGITAL TROUBLESHOOTING PRACTICAL DIGITAL THEORY AND TROUBLESHOOTING TIPS	57083H-ND	9.95
FORTRAN WITH STYLE PROGRAMMING PROVERBS	56826H-ND	6.95
6800 LAB MANUAL	51204H-ND	5.95
HOW TO PROFIT FROM YOUR PERSONAL COMPUTER PROFESSIONAL BUSINESS AND HOME APPLICATIONS	5761XH-ND	7.95
MINICOMPUTERS STRUCTURE AND PROGRAMMING	56427H-ND	13.95
THE BASIC WORKBOOK CREATIVE TECHNIQUES FOR BEGINNING PROGRAMMERS	51042H-ND	5.50
COMPUTER SCIENCE		
DIGITAL SIGNAL ANALYSIS	58784H-ND	19.95
COMPUTER MATHEMATICS	5095XH-ND	13.95
SOLUTIONS MANUAL PAPER	57792H-ND	1.95
COMPUTER CAREERS PLANNING PREREQUISITES POTENTIAL	59132H-ND	5.95
BASIC OF DIGITAL COMPUTERS (REVISED 2ND EDITION)		
VOL 1 PAPER	07388H-ND	4.95
VOL 2 PAPER	07396H-ND	4.95
VOL 3 PAPER	0740XH-ND	4.95
SET OF 3 VOLUMES	0737XH-ND	14.85
ANALOG LOGIC COMPUTER PROGRAMMING AND SIMULATION	9192H-ND	15.95
I O DESIGN DATA MANAGEMENT IN OPERATING SYSTEMS	5789XH-ND	17.50
INTEGRITY AND DISCOVERY IN COMPUTER SYSTEMS	54548H-ND	9.95
MANUFACTURING MANAGEMENT SYSTEMS NEW CHALLENGES AND PROFIT OPPORTUNITIES	5940XH-ND	10.50
PARALLEL PROCESSOR SYSTEMS TECHNOLOGIES AND APPLICATIONS	9155H-ND	25.90
MANAGEMENT OF INFORMATION HANDLING SYSTEMS	9211H-ND	12.95
DATA MANAGEMENT FOR ON-LINE SYSTEMS	5100XH-ND	14.95
FILE STRUCTURES FOR ON LINE SYSTEMS	59434H-ND	13.75
DISCOVERING BASIC A PROBLEM SOLVING APPROACH	57830H-ND	6.85
THE SYSTEMS ANALYST HOW TO DESIGN COMPUTER BASED SYSTEMS	51026H-ND	19.95
HANDBOOK OF DATA COMMUNICATIONS	54564H-ND	28.00
MODERN DATA COMMUNICATION CONCEPTS LANGUAGE AND MEDIA	56672H-ND	8.95
FUNDAMENTALS OF DATA BASE SYSTEMS	5758XH-ND	15.95
OPERATING SYSTEM ANALYSIS AND DESIGN	56435H-ND	10.95
PROJECTS		
HOW TO BUILD A LOW COST LASER	59345H-ND	5.95
25 SOLID STATE PROJECTS	58810H-ND	5.45
TELEPHONE ACCESSORIES YOU CAN BUILD	57482H-ND	4.95
SIMPLE CIRCUIT BUILDING	54475H-ND	5.25
RADIO CONTROL FOR MODEL CARS	50569H-ND	4.90
50 IC PROJECTS YOU CAN BUILD	0723XH-ND	5.95
ELECTRONIC COMPONENTS	54440H-ND	5.25
PRINTED CIRCUIT ASSEMBLY	54467H-ND	5.25
103 SIMPLE TRANSISTOR PROJECTS	03137H-ND	4.95
110 CMOS DIGITAL IC PROJECTS	08567H-ND	5.95

NEW! The "NIBBLER"
A MICROCOMPUTER AT A MICROPRICE!



FEATURES:

- Assembled and Tested, yet only $149.95
- Standard 4.5" by 6.5" card with 72 pin edge connector pattern
- All IC's are socketed for easy maintenance
- Memory expandable to 28K
- 110 Baud Serial I/O
- It Speaks Basic Beautifully
- 4K NIBL Basic in ROM and 2K of RAM
- Easily Interfaced with CRT or Teletype

AND NOW AVAILABLE . . . THE "NIBBLER" POWER SUPPLY-INPUT/OUTPUT BOARD. THIS OPTIONAL BOARD GIVES YOU —

The NIBBLER is Digi-Key's new low cost personal/hobby computer. Based on National Semiconductor's SC/MP-II microprocessor, the NIBBLER includes 4K NIBL Basic in ROM and 2K of RAM. The NIBBLER requires 5 volts at ½ amp providing 110 baud serial ASCII I/O which is easily interfaced with a CRT or Teletype. And our low price of $149.95 is for an assembled and tested system! Software/Hardware manual included with NIBBLER available separately for $5.00.

THE "NIBBLER" MICROCOMPUTER & ACCESSORIES

THE "NIBBLER" MICROCOMPUTER	NIBI-ND	149.95
SOFTWARE HARDWARE MANUAL	MAN1-ND	5.00
THE "NIBBLER" POWER SUPPLY	PS11-ND	39.95
22/44 PIN EDGE CONNECTOR	3776PS-ND	2.50

8080A CHIP SET

ONE EACH 8080A, 8212, 8224 and 8228 PLUS SIXTEEN 2102AN-4L ALL FOR — **$44.95**

HARDWARE

2-56 1/4 SCREW	1.39/C
2-56 1/2 SCREW	1.39/C
4-40 1/4 SCREW	.99/C
4-40 1/2 SCREW	.99/C
6-32 1/4 SCREW	.99/C
6-32 1/2 SCREW	.99/C
8-32 3/8 SCREW	1.39/C
8-32 5/8 SCREW	1.39/C
2-56 HEX NUT	.75/C
4-40 HEX NUT	.75/C
6-32 HEX NUT	.75/C
8-32 HEX NUT	.75/C
NO. 2 LOCKWASHER	.85/C
NO. 4 LOCKWASHER	.55/C
NO. 6 LOCKWASHER	.55/C
NO. 8 LOCKWASHER	.55/C

DOUBLE DIGIT DISCOUNTS SAVE YOU EVEN MORE!

HANDLING CHARGES

$ 0.00-$ 4.99	Add $2.00
$ 5.00-$24.99	Add $0.75
$ 25.00-$49.99	Add $0.50
$ 50.00-$99.99	Add $0.25
$100.00 & Up	No Charge

VOLUME DISCOUNT & HANDLING CHARGE

All items except those with catalog numbers ending with the suffix-ND may be combined for discount. First—total all discountable items and apply the volume discount. Then add to this subtotal the nondiscountable items. Add the handling charge. This is your total cost. We pay all shipping and insurance to addresses in the U.S.A. and Canada.

VOLUME DISCOUNT

$ 0.00-$ 24.99	NET
$ 25.00-$ 99.99	Less 10%
$ 100.00-$499.99	Less 15%
$ 500.00-$999.99	Less 20%
$1000.00 & Up	Less 25%

Orders Accepted by Phone or Mail
MasterCharge • Bank-Americard • COD • Check • Money Order
P.O. Box 677, Thief River Falls, Minn. 56701 (218) 681-6674

DIGI-KEY CORPORATION

Quality Electronic Components

P.O. Box 677 Thief River Falls, MN 56701 (218) 681-6674

Bishop COOLGLO™ Light Table

110 Vac, 18"x20" Portable Light Table
Cat. No. 3200-ND . . . $139.50
(Not Discountable)

50 VOLT DISCS

100 PF	.40/10	3.50/C
220 PF	.40/10	3.50/C
470 PF	.40/10	3.50/C
.001 UF	.40/10	3.50/C
.0022 UF	.40/10	3.50/C
.0047 UF	.40/10	3.50/C
.01 UF	.45/10	3.65/C
.022 UF	.50/10	4.00/C
.047 UF	.70/10	5.60/C
.1 UF	1.35/10	11.50/C

STRANDED HOOK UP WIRE

20 ga PVC 2.50/100' 10.00/500'
22 ga PVC 2.80/100' 11.25/500'
24 ga PVC 2.80/100' 11.25/500'

SURPLUS SPECTACULAR!

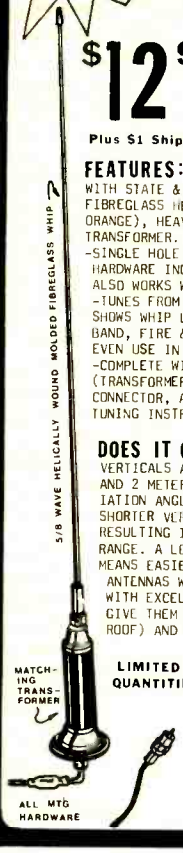
2 METER MOBILE ANTENNA

$12.95 Plus $1 Shipping

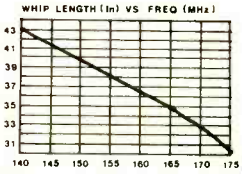
BRAND NEW FACTORY BOXED ANTENNAS MADE BY WELL KNOWN TOP LINE MFR. FOR POLICE AND GOVT. AGENCIES. ORIGINAL COST IN HUGE QUANTITIES WAS TWICE OUR LOW PRICE.

FEATURES: -HIGHEST QUALITY; DESIGNED FOR USE WITH STATE & COUNTY POLICE VEHICLES. MOLDED FIBREGLASS HELICALLY WOUND WHIP (FLOURESCENT ORANGE), HEAVILY PLATED PARTS, SEALED MATCHING TRANSFORMER.
-SINGLE HOLE MOUNT (1/2" DIA) WITH ALL MOUNTING HARDWARE INCLUDING TRIM RINGS AND RUBBER SEALS. ALSO WORKS WITH MOST "CLAMP TYPE" ADAPTERS.
-TUNES FROM 140-176 MHz -- WHIP CUTTING CHART SHOWS WHIP LENGTH VS FREQUENCY. CUT FOR 2M HAM BAND, FIRE & POLICE BANDS (FOR SCANNERS) OR EVEN USE IN THE MARINE BAND!
-COMPLETE WITH ALL PARTS - WHIP, LOADING COIL (TRANSFORMER), HARDWARE, COAX (RG58A/U), PL259 CONNECTOR, AND COMPLETE INSTALLATION AND TUNING INSTRUCTIONS.

DOES IT GET OUT ? YOU BET !! 5/8 WAVE VERTICALS ARE MOST WIDELY USED IN COMMERCIAL AND 2 METER FM WORK BECAUSE OF THE LOW RADIATION ANGLE AND CONSIDERABLE GAIN OVER SHORTER VERTICAL WHIPS. BANDWIDTH IS GOOD, RESULTING IN LOWER SWR OVER A WIDER FREQUENCY RANGE. A LESSER DEPENDENCE ON A GROUND PLANE MEANS EASIER MOUNTING IN MANY CASES. (THESE ANTENNAS WERE USED ON POLICE MOTORCYCLES WITH EXCELLENT RESULTS -- GROUND PLANE ?) GIVE THEM A GOOD GROUND PLANE (LIKE A CAR ROOF) AND THEY'RE NEARLY UNBEATABLE !

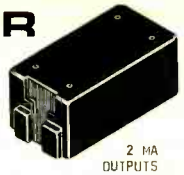


LIMITED QUANTITIES



FREE CATALOG

LASER POWER SUPPLIES


2 MA OUTPUTS

COMMERCIAL QUALITY SUPPLIES FEATURE 120 VAC INPUT, RECTIFIED AND FILTERED DC OUTPUT! THESE NEW UNITS ORIGINALLY COST THE MFR ABOUT $30 EACH IN BIG QUANTITIES. USE FOR LASERS, BUG ZAPPERS, HIGH VOLTAGE EXPERIMENTS OF ALL SORTS. SUPPLIES ARE POTTED IN PLASTIC WITH THE RECTIFIERS ACCESSABLE THROUGH A REMOVABLE PLATE.

12,500 Vdc 25 Watts L-1250
$7.95 Plus $2 Ship. (They are HEAVY!)

7,500 Vdc 15 Watts L-750
$6.95 Plus $1.40 shipping

CRYSTALS

HC-6 case tune w/18pf FRESH STOCK !

0-3125

3.579 MHz	$1.25
4.000 MHz	$1.50
4.194 MHz	$1.50

BEZELS


NEW, EASY MOUNT

RED LENS, BLACK FRAME, VIEWING AREA 0.8" H x WIDTH GIVEN.

J-1200	2" Wide	$1.79
J-1300	3" Wide	$2.29
J-1400	4" Wide	$2.98

"OUR FIFTH YEAR"

DIAMONDBACK ELECTRONICS COMPANY
PO BOX 194
SPRING VALLEY, IL 61362

BANKAMERICARD

FREE CATALOG
ALL MERCHANDISE 100% GUARANTEED
MINIMUM ORDER $5
ILL RESIDENTS ADD 5% SALES TAX
PLEASE INCLUDE SUFFICIENT POSTAGE
RATES QUOTED ARE CONTINENTAL US ONLY
PHONE ORDERS 815/664-5151

CIRCLE 83 ON FREE INFORMATION CARD

GREAT IDEAS FROM WEST SIDE ELECTRONICS

17 Digit, 10 Function Digital Clock Kit

The Ultimate Electronic Timepiece. 17 digits continuously read out the time, date, alarm setting, and timer. 12/24 HR. AC/DC, crystal timebase, 3 mode timer, status LEDs, snooze, and more. Now with DIGISET™ thumbwheel preset option (see below). Featured in Radio-Electronics (Aug/Sept 1977)

MT1-C kit, less case $129.95

Pink Noise Generator Kit $13.95

NOW IMPROVED!! with 5% tolerance components
Allows proper set-up of graphic equalizer in a stereo system to achieve acoustically flat response. Uses latest MOS IC. See Jan. '78 Radio-Electronics.

PNG-2C Partial kit $13.95
PNG-2K Complete kit with case $19.95
PNG-2W Assembled and tested $27.95

WRITE FOR DETAILS

DIGISET™ - Thumbwheel preset for MT1. Simply dial in alarm setting, timer, etc. and DIGISET™ does the rest. Also adds second ALARM feature. Will work with other 7001 based clocks.

APPLE II OWNERS: Real Time Clock plugs directly into any I/O slot. Crystal oscillator and AC supply (with battery backup) keeps clock running at all times.

★ ★ SPECIAL ★ ★
16K MEMORY EXPANSION KIT $130.00

Includes 8 MK4116 RAMs and instructions for Apple and TRS-80. Upgrade NOW at this LOW PRICE.

BANKAMERICARD
WEST SIDE ELECTRONICS
P.O. Box 636, Chatsworth, CA 91311

We pay all shipping in Continental U.S.A. Others add 10% California residents add 6% tax.

CIRCLE 67 ON FREE INFORMATION CARD

JUMBO LED READOUT ARRAY

By Bowmar. .5 in. character common cathode. Designed for use with multiplexed clock chips 4 digits in 1 pack!

$1.95 LIMITED STOCK

MICRO-MINI TOGGLE SWITCH

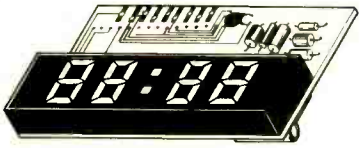
SPDT. By RAYTHEON. MADE IN USA! WITH HDWR.

99¢ EACH

6 FOR $5

NATIONAL SEMICONDUCTOR JUMBO CLOCK MODULE

MA1008A BRAND NEW!



$6.95

2 FOR $13

(AC XFMR $1.95)

FEATURES:
* FOUR JUMBO ½ INCH LED DISPLAYS
* 12 HR REAL TIME FORMAT
* 24 HR ALARM SIGNAL OUTPUT
* 50 OR 60 Hz OPERATION
* LED BRIGHTNESS CONTROL
* POWER FAILURE INDICATOR
* SLEEP & SNOOZE TIMERS
* DIRECT LED DRIVE (LOW RFI)
* COMES WITH FULL DATA

ASSEMBLED! NOT A KIT!

ZULU VERSION!
We have a limited number of the 24 HR Real time version of this module in stock.
#MA1008D — $9.95

PERFECT FOR USE WITH A TIMEBASE.

COMPARE AT UP TO TWICE OUR PRICE!

MANUFACTURER'S CLOSEOUT!

16K DYNAMIC RAM CHIP

16K X 1 Bits. 16 Pin Package. Same as Mostek 4116-4. 250 NS access. 410 NS cycle time. Our best price yet for this state of the art RAM. 32K and 64K RAM boards using this chip are readily available. These are new, fully guaranteed devices by a major mfg.

VERY LIMITED STOCK!

$17.95 EACH **8 FOR $129**

EXPERIMENTER'S CRYSTAL

262.144KHZ. This frequency is 2 to the 18th power. Easily divided down to any power of 2, and even to 1HZ. New by CTS-Knight. A $5 value!

$1.25 each

SALE! 1N4148 DIODES

High speed switching diodes. Silicion. Same as 1N914. Brand New. Full Leads. Prime!

100 FOR $2 1000 FOR $17.50

FAIRCHILD JUMBO READOUTS

.5 Inch Char. High Efficiency!
FND-503-Common Cathode
FND-510-Common Anode

YOUR CHOICE 69¢
10 FOR $5.75

DISC CAPACITORS

.1 MFD 16V. P.C. leads. Most popular value! By Sprague.

20 for $1.00

Full Wave Bridge 4 Amp 200 PIV

69¢ea. 10/5.75

MALLORY POWER SUPPLY CAPACITOR

1500 MFD 16 WVDC

3/$1.00 10/$2.95

FACTORY FRESH! SMALL SIZE

RECTIFIER SALE!

1N4006. Prime New by ITT.
1 AMP. 800 PIV.

15 FOR $1

FET SALE!

2N4304. Brand New N Channel, Junction Fet. BVGD0-30V IDSS-15 MA Typ. 1500 uMHOS. TO-18 Plastic Case. Mfg. by Teledyne.

6 FOR $1

Motorola PNP Power!

2N4905 TO-3 case. 90W. VCEO-60. HFE-100 max. at 2.5A. Good mate for the 2N3055. PRIME!

75¢ ea. 4/$2.50

COMPUTER CAPACITOR

By GE. 36,000 MFD 15W VDC. Small Size: 4¾ x 1¾ Inches. SUPER DEAL! $2.95 Each

3 FOR $8

RCA MICRO-POWER OP AMP.

#CA3078T. Metal Can. Most OPAMPS require ±15V to operate. But the CA3078 is designed to operate from ±.75 V to ±6V!!! Perfect for battery use. Standby power as low as 700 NW.! High Gain. 92 DB typical Open Loop Gain. Requires only one capacitor for compensation. See RCA Linear Data Book for more details. Similar to National LM112. Originally cost about $2 each.

75¢ EACH 3 FOR $2

Digital Research Corporation
(OF TEXAS)
P. O. BOX 401247B GARLAND, TEXAS 75040 • (214) 271-2461

TERMS: Add 30¢ postage, we pay balance. Orders under $15 add 75¢ handling. No C.O.D. We accept Visa, Mastercharge, and American Express cards. Tex. Res. add 5% Tax. Foreign orders (except Canada) add 20% P & H. 90 Day Money Back Guarantee on all items.

ADVANCED COMPUTER PRODUCTS

THE FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES NOW LOWERS PRICES EVEN FURTHER!

1. Proven Quality Factory tested products only, no re-tests or fallouts. Guaranteed money back. We stand behind our products.

2. Same Day Shipment All prepaid orders with cashiers check, money order or charge card will be shipped same day as received.

S100 PRODUCTS

LOGOS I 8K STATIC RAM

- ★ Low Power
- ★ Selectable Memory Protect
- ★ Totally Buffered
- ★ Battery Back-up
- ★ Address on 1K boundary
- ★ Requires no front panel
- ★ No wait states

ASSEMBLED & TESTED
250ns. 199.95
450ns. 179.95

KIT
250ns. 149.95
450ns. 125.95

WE OFFER GROUP DISCOUNTS

Bare PC Board w/Data **$21.95**
Now over 1 year successful field experience
"Special Offer" Buy (4) 8K 450ns. Kits $117.00 ea.

IMS 16K STATIC RAM

- ★ Memory mapping
- ★ Phantom
- ★ Address 16K Bound
- ★ Use with or w/o front panel
- ★ Power 2.1 amps typ.
- ★ Uses 2114

ASSEMBLED & TESTED ONLY
450ns. $439.95 250ns. $495.95

S-100 32K STATIC RAM

- ★ Address 32K Boundary
- ★ Power 450ns. 2.8 amps typ.
- ★ No wait states on 2MHz
- ★ Fully Buffered
- ★ Phantom can be added
- ★ 2114/TMS4045 or 9135

ASSEMBLED & TESTED	KIT
250ns. $849.00	250ns. $790.00
450ns. $769.95	450ns. $625.00

Bare PC Board w/Data $59.95
SPECIAL OFFER:
Kit without Memory only $99.95.
Add 2114 Memory for 8 @ $7.50 ea.

PARATRONICS LOGIC ANALYZER KIT

MODEL 100A $219.95
(analyzes any type of digital system)
Trigger Expander Model 10 .... $229.00
Baseplate 9.95
Model 10 Manual 4.95
Model 150 Bus Grabber Kit 369.00

DC HAYES DATA COMMUNICATIONS ADAPTER

★ Telephone/TWX ★ S-100 compatible
★ Bell 103 freq ★ Originate & answer mode
Assembled & Tested $279.95
Bare PC Board w/data .... $ 49.95

Z-80/Z-80A CPU BOARD

- ★ On board 2708
- ★ Power on jump
- ★ 2708 included (450ns.)
- ★ completely socketed

Assembled and tested $185.00
Kit $129.95
Bare PC Board .... $ 34.95
★ For 4MHz Speed Add $15.00

MICRODESIGN MR-16 2716 EPROM BOARD (MR-8 Also Available at same price)

- ★ Individual Prom Address
- ★ Uses Low cost 16K TI EPROMS
- ★ Optional 1K RAM ★ Phantom-control

Assembled and Tested 174.95
Kit 99.50

SPECIAL SPECIAL SPECIAL

2708-6 Eprom .... 8 @ $ 5.50 ea.
416 16K Ram .... 32 @ $16.95 ea.
1771-01 Floppy .... 5 @ $25.95 ea.
Pet Connector Set .... 5 @ $ 7.95 ea.

BYTE USER 8K EPROM BOARD

★ Power on Jump ★ Reset Jump
Assembled & Tested 94.95
Kit 64.95
Bare Pc Board 21.95
Special Offer: Buy 4 kits only $59.95 each
NOTE: 2708-6 only $5.95

TARBELL FLOPPY INTERFACE

★ S100 Compatible ★ Uses CPM
★ Jumper Selectable ★ Persci, Shugart, etc
Assembled and tested $269.95
Kit $179.95
Bare PC Board .... $ 39.95
NOTE: For CPM Add $70.00
Documentation Add $20.00

TRS 80 UPGRADE KIT

16K Memory with Jumpers and Instructions $159.95
(Specify Level I or Level II)
APPLE II 16K UPGRADE KIT $149.95

PET TO S-100 ADAPTER

Allows Pet to be interfaced to popular S-100 Bus.
Kit $189.95
Assembled $269.95
For Low Cost 8 Slot Bus to expand your Pet only .... $149.95 Kit

DATABOOKS & MANUALS

NSC TTL Data	$ 3.95	AMI MOS/LSI Data	3.95	Mot Vol 4 Mecl Data	3.95
NSC Linear Data	4.95	GI MOS/LSI Data	4.95	Mot. Vol 5 CMOS Data	2.95
NSC Linear APP/note I	3.95	Osborne Intro to Micro Vol 0	7.50	Mot Vol 6 Linear Data	3.95
NSC Linear APP/note II	3.95	Osborne Intro to Micro Vol I	7.50	Mot Vol 9 Schottky TTL	2.95
NSC CMOS Data	2.95	Osborne Intro to Micro Vol II	7.50	Mot MPU Applications	25.00
NSC Audio Data	3.95	Osborne 8080 Programming	7.50	Mot MPU Prog Ref Manual	3.95
NSC Volt Reg Data	2.95	Osborne 6800 Programming	7.50	Mot Power Data	2.95
NSC Memory Data	3.95	Osborne Z80 Programming	7.50	Mot Rectifier Data	2.95
NSC MOS/LSI Data	3.95	TI Powr Semi's Data	7.50	Mot Switching Tran	2.95
NSC Power Transistors	2.95	TI TTL Data	6.95	Mot Zeners	2.95
Intel Databook	3.95	TI Transistors & Diodes	8.50	Basic Software SRI Vol. I or II	24.95
Intel MCS85 Manual	7.50	TI Memory Data	3.95	Basic Software SRI Vol III	39.95
Intel MCS80 Manual	7.95	TI Optoelectronics	3.95	Basic Software SRI Vol IV or V	9.95
Intel MCS40 Manual	4.95	TI Linear Data	3.95	Basic Software SRI Vol VI	49.95
AMD 8080 Handbook	5.95	TI Bipolar Memory	3.95	Basic Software SRI Vol VII	39.95
AMD Linear Data	4.95	TI Interface Data	4.95	1978 IC Master	47.50
AMD Schottky Data	4.95	Motorola Semi Data 1, 2, 3	9.95		

DISKETTES

5" MINI
★ Soft Sector
★ 10 Sector
★ 16 Sector
$4.50 each $3.90/10

NORTH STAR MINI
$4.95 each $4.50/10

8" STANDARD
★ Hard
★ Soft
$4.50 each $4.10/10

6800 DESIGNER BOARDS MODULES PROTO BOARDS

★ Motorola Compatible Modules*

MEK 6800 D2 Kit	$235.00
9600 6800 MPU Module	495.00
9601 16 slot Mother Bd.	175.00
9602 16 slot Card Cage	75.00
9603 8 slot Mother Bd.	99.00
9604 System Power Supply	250.00
9610 Prototype Board	36.00
9615 4KEprom Module	250.00
9620 16 port parallel I/O	375.00
9626 8K Static RAM	295.00
9626K 8K Static RAM Kit	225.00
9630 Extender Card	60.00
9640 Multiple Tuner Prog.	395.00
9650 8 port Duplex Asyn. I/O	395.00
Mot 43/86 Connectors w/w or s/t	5.95
AMI EVK 99* 6800 sub Kit	99.00
AMI EVK 200 Kit	249.95
AMI EVK 300 Assembled	275.00
EVK Kluge Board	95.00
EVK 16K Byte Ram Board	75.00
EVK 6 Slot Motherboard	35.00
EVK Extender Board	45.00
EVK Solid Frame Chassis	129.00
EVK Connectors	6.50
AMI 6800 Proto Rom	30.00
AMI 6800 Micro Assembler Rom	30.00
6800 Tiny Basic Paper Tape	20.00
6800 Tiny Basic Eprom	125.00

Hi PLOT LOW COST DIGITAL PLOTTER

- ★ RS 232
- ★ Plot Size 7" x 10"
- ★ Digitizer Avail. Soon
- ★ High Resolution
- ★ 2.4"/sec Plot Speed

NEW List: $1085.00
OUR PRICE $999.00

SPECIAL KEYBOARD BUY WHILE THEY LAST

"Clare Pender 62 Key ASCII w/26 Pin & 34 Pin Output Conn." $54.95

SUPPORT DEVICES

AM9511 Arith Processor	$195.00
AM9517 DMA Controller	71.95
AM9519 Universal Interrupt	24.95
3881 (Z80 PIO)	10.45
3881-4 (4MHz)	14.95
3882 (Z-80 CTC)	10.45
3882-4 (4MHz)	14.95
8205/74S138 Decoder	2.95
8212 8 bit I/O	2.50
8214 Priority Int	6.95
8216 Bus Driver	2.50
8224 Clock Gen.	2.95
8224-4 (4MHz)	9.75
8226 Bus Driver	3.95
8T26 Bus Driver	2.39
8228 Sys Control	6.95
8238 Sys Cont	6.95
8251 Prog I/O	11.50
8253 Int Timer	19.50
8255 Prog I/O	11.50
8257 Prog DMA	19.50
8259 Prog Int	19.50
8275 CRT Controller	74.95
8279 Prog Keyboard	19.95
6810-1 128 x 8 RAM	4.75
6820 PIA	7.20
6821 PIA	7.25
6828 Priority Int	11.95
6834-1 512 x 8 Eprom	12.95
6850 ACIA	7.20
6852 Serial Adapter	9.95
6845/HD46505 CRT Contr	39.95
6860 Modem	14.50
6862 Modulator	14.50
6871A 1.0MHz OSC	25.95
6875	8.25
2350 USRT	9.95
6880 Bus Driver	2.39
1821 SCD 1K RAM	25.00
1822 SCD 256 x 4 RAM	16.95
1824 CD 32 x 8 RAM	9.95
1852 CD 8 bit I/O	10.95
1856 CD I/O	8.95
1857 CD I/O	8.95
6520 PIA	7.50
6522 Mult.	9.95
6530-002	15.50
6530-003	15.50
6530-004	15.50
6530-005	15.50
3851 F8 Prog Store	14.95
3853 F8 Memory I/O	14.95

PROMS

2708	9.95
2708-6	5.95
1702A	3.95
1702A-6	3.50
2716-5V	44.85
2716-5V, 12V	24.95
2758 5V	25.95
5203AO	11.95
5204AO	9.95
6834-1	12.95
IM 5610	2.95
82S123	2.95
82S126	4.50
82S129	4.95

RAMS DYN.

4116 16K x 1	17.95
4115 8K x 1	6.95
4050 4K x 1	4.45
4060 4K x 1	4.45
4096 4K x 1	4.25
2104 4K x 1	4.95
2107B-4 4K x 1	4.25
5261	1.95
5262	1.95
5270	4.95
5280	4.95
1103	1.95
4008L	4.95
TMS4070 16K x 1	19.95
4027-3	4.95
MCM6605 4K x 1	4.95

FLOPPY DISK I/O

1771-01 8" & Minifloppy	27.95
uPd372 Nec Floppy	49.95
1781 Dual Floppy	39.95

CHARACTER GENERATORS

RO32513-001 (5V) Upper	9.50
RO32513-002 (5V) Lower	10.95
RO32513-ADM3 (5V) Lower	14.95
MCM6571	10.75
MCM6571A	10.75
MCM6574	14.50
MCM6575	14.50

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75

UARTS/USRTS

TR1602B (5V, 12V)	3.95
AY51013 (5V, 12V)	5.50
AY51014A/1612 (5-14V)	6.95
AY51015A/1863 (5V)	6.95
TMS 6011 (5V, 12V)	5.50
IM6402	9.95
IM6403	9.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	**9.95**

BAUD RATE GENERATORS

MC14411	11.25
4702	14.95
WD1941	9.95

TV CHIPS

MM5320 TV Synch	7.95
MM5369 Prescaler	3.95
LM1889 Modulator	3.95
CW300 Saw Function	1.50
MM57100 Color TV Game	6.95
MM57104 Clock	3.75
AY38500-1 TV Game	5.95
AY38600 Color TV Game	24.95
AY38615-1 Color Converter	8.95
AY38700-1 Tank Chip	29.95
RF Modulator with Audio	8.95

A/D CONVERTERS

8700	8 bit Binary	13.50
8701	10 bit Binary	22.00
8702	12 bit Binary	36.95
8705	12 bit TS	42.95
9400	Volt to Freq Conv	7.25
8750	3-1/2 Digit BCD	13.95
8038	Multifunction	3.95
1408L6	6 bit	3.95
1408L8	8 bit	5.95
DAC01	A/D	5.95

TV INTERFACES

Pixie-Verter	8.50
TV-1 Video Interface	8.95
Pickles & Trout TV Mod Kit	20.00
Multiverter	35.00
M&R Modulator	35.00

MICROPROCESSORS

Z-80	**$19.95**
Z-80A	26.95
F-8 (3850)	16.95
2650	24.95
CD1802	19.95
8080A	9.95
SALE 8085	**18.95**
8008-1	14.95
2901	21.95
2901A	29.95
TMS 9900JL	69.95
CP1600	39.95
6502	13.95
IM6100	29.95
6800	**19.95**
6802P	32.95
8035	17.50

SOCKETS

8 Pin W/W	32	8 Pin S/T	17
14 Pin W/W	37	14 Pin S/T	20
16 Pin W/W	38	16 Pin S/T	.22
18 Pin W/W	60	18 Pin S/T	31
20 Pin W/W	90	20 Pin S/T	34
22 Pin W/W	93	22 Pin S/T	35
24 Pin W/W	85	24 Pin S/T	41
28 Pin W/W	1.15	28 Pin S/T	.49
40 Pin W/W	1.49	40 Pin S/T	63

CONNECTORS

6 Pin Single S/E	1.49
15/30 Dual S/E	1.95
18/36 Dual S/E	2.35
22/44 Dual S/E	2.95
40/80 W/W	4.95
43/86 Dual W/W/S/T	6.50
50/100 IMSAI W/W	4.75
50/100 IMSAI S/T	4.75
50/100 Altair W/W/S/T	5.95
IMSAI Card Guides	4/1.00

25 Pin D Subminature	
DB25P	3.25
DB25S	3.75
Hood	1.25
Set w/Hood	6.50

NEW CTS DIPSWITCHES

CTS206-4	$1.75	CTS208-8	$1.95
CTS206-5	$1.75	CTS209-9	$1.95
CTS206-6	$1.75	CTS209-10	$1.95
CTS207-7	$1.75		

8080 USER'S IT'S HERE LIVERMORE BASIC

ON 65K ROM
THAT'S RIGHT ON ROM!!!
OUR PRICE only $95.00

PCG PROGRAMMABLE CHARACTER GENERATOR

The hottest version of STARWARS available.
S-100 Compatible 2MHz Kit with object code on tarbell or cuts $169.95

NAKED PC BOARD SALE S-100

Z-80 CPU (ITHACA)	34.95
Z-80 CPU (TDL comp.)	34.95
8080A CPU	34.95
8K Static Logos	21.95
8K Eprom Byteuser	21.95
32 Static S-100	59.95
Tarbell Floppy I/O	39.95
Tarbell Cassette	29.95
Vector 8800 Proto	19.95
ACP Proto Bd	27.95
ACP Extender w/conn	15.95
Realtime Clock	34.95
WMC 13 Slot Mother Bd	33.00
S-100 8 Slot Mother Bd	34.95
Vector 8803 11 Slot M. Bd	29.95
SSM Video I/O	27.95
SSM I02 Parallel I/O	27.95

UV "Eprom" Eraser

Model UVs-11E $64.95
Holds 4 Eprom's at a time
Backed by 45 years UV experience
Model S-52T $219.95
Professional Industrial Model

ATTENTION KIM USERS

KIMSA-expansion to S-100	125.00 Kit/165.00
KIMSI to KIM Connector	5.75/pair
KIM 1 6502 Single Board Computer	245.00
KIM 1 Power Supply	89.00
KIM Memory Plus (consists of 8K Ram, 8K 2716 Eprom, Programmer, I/O etc.)	245.00
KIM SOFTWARE	
• Please package (cassette) 12 games	18.95
• Help Editor package (cassette)	18.95
• Help Mailing List pkg (cassette)	18.95
• Help Info Retrival pkg (cassette)	18.95
• Microchess (cassette)	16.95
• Microad Assembly Disassem/Editor	27.95
• Microad Source Listing (cassette)	27.95
• Tiny Basic for KIM (paper tape)	10.95

ATTENTION PET USERS

BETSI-pet expansion to S100	105.00 Kit/180.00
PET Connector Kit includes (4) Connectors for memory expansion, IEEE 488 I/O cassette I/O and parallel user port	9.95/set

ATTENTION TRS-80 USERS

Now in stock the hard to find 20/40 Memory Expansion Connector with contacts 7.95

ATTENTION APPLE II USERS

APPLE II w/16K (get a spare)	$1125.00
416/4116 16K Memory Module	8/200.00
Floppy Disc II w/Controller	495.00
Applesoft II Firmware Card	100.00
Video Monitor II (B/W)	205.00
Printer Centronics Micro	695.00
Printer Centronics 779	1445.00
Apple II Prototype Board	24.00
Parallel Interface Card	180.00
Communications Interface Card	180.00
PR40 Printer I/O w/cassette	49.95
2716 Eprom Burner	89.95
requires 2716 Socket Adaptor	10.00
Apple II to MFE tape I/O	197.50
Coresident Assembler cassette	19.95
Apple II Softech Software Exchange Membership includes 8 pack of cassettes	39.95

All Shipments FCM or UPS. Orders under $100.00 add 5% handling and postage. Orders over $100.00 add 2.5% handling & postage. Mastercharge/Bankamericard/COD accepted w 25% deposit. California Residents add 6% tax. Foreign Orders add 8% handling. All parts prime factory tested guaranteed. Same day shipment. Add 25 cents for Data.

Retail pricing may vary from Mail Order Pricing

STATIC RAM HEADQUARTERS

	1-24	25-99	100
21L02 450ns	1.30	1.25	1.15
21L02 250ns	1.59	1.55	1.45
2102	1.25	1.15	1.10
91L02APC	1.75	1.65	1.50
21L11-1	4.10	3.95	3.75
2111-1	3.75	3.65	3.55
21L12-1	4.25	4.10	3.95
2112-1	2.95	2.85	2.65
21L01-1	3.95	3.75	3.65
2101-1	2.90	2.70	2.55
2114-3 300ns	9.95	9.75	8.25
2114-4 450ns	7.95	7.50	5.50
TMS4044	9.95	9.75	8.25
TMS4045	9.95	9.75	8.25
EMM4200A	12.50	11.95	9.95
EMM4402	7.95	7.25	6.25
5101C-E	7.95	7.95	7.25
upd410 (4200)	10.95	10.25	9.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
FSC 460/464 16K CCD Only $18.95 Each			
1101	1.95	1.75	1.25
P2125/93425 (45 ns)	7.95	7.35	7.25
6508 1K x 1 CMOS	7.95	7.95	7.25
6518 1K x 1 CMOS	7.95	7.95	7.25
74S189 64 bit Ram	3.95	3.25	2.50

WAVEFORM GENERATORS

8038 Function Gen.	3.95
MC4024 VCO	2.45
LM566 VCO	1.75
XR2206 Function Generator	5.25

CHARGE COUPLED DEVICES

16K CCD - First time offered Fairchild 460 CCD 16K Memory (now you can experiment with CCD technology at a reasonable price. 17 page Application note supplied with each order. Quantity limited)

$18.95 each (reg. 43.00)

CRYSTALS

Microprocessor Timebases TV Game

Frequency	Price	Frequency	Price
1.0MHz	$5.85	6.0MHz	$ 4.95
1.8432	4.95	6.144	4.95
2.0MHz	5.85	6.5536	4.95
2.01MHz	2.95	10.0MHz	4.95
2.097152MHz	5.85	13.0MHz	4.95
2.4576MHz	5.85	14.31818	4.95
3.579545MHz	1.50	18.0MHz	4.95
4.0MHz	4.95	18.432MHz	5.95
4.194304MHz	5.95	20.0MHz	4.95
4.91520MHz	5.95	22.1184MHz	5.95
5.0MHz	4.95	27.0MHz	5.95
5.0688	4.95	36.0MHz	5.95
5.7143MHz	5.95	48.0MHz	5.95
		100KC	12.95

DISPLAYS/OPTO

DL 704/707/CC/CA .300	1.25
FND359 CC .357	.95
FND 500/507/CC/CA .500	1.35
FND 503/510 CC/CA .500	.95
FND 800/807 CC/CA .800	2.50
Bowmar 9 digit bubble	.99
FSC 8024 4 digit CC .800	4.95
HP7340 HEX Display	19.95
TIL 305 5 x 7 Array	4.50
TIL 306 7 seg w/logic	8.95
TIL 308 7 seg w/logic	8.95
TIL 309 7 seg w/logic	7.95
TIL 311 HEX Display	12.95
MA 1003 12 auto clock	17.95
MA 1002 4 digit clock module	9.95
MA 1010 4 digit clock module	9.95
Bezel for above	4.95
NSN 373/374 dual CC/CA .300	2.20
NSN 583/584 dual CC/CA .500	2.60
NSN 783/784 dual CC/CA .700	3.00
4N25 Opto Isolater	1.10
MCT 2 Opto Isolater	.89
4N33 Darlington ISOL	1.75
Red Led's .185 Dia	5/1.00
Green/Yellow	4/1.00
HP 5082/7731 7 seg	.90

MONTHLY SPECIALS

14 Pin W/W 100 pcs	19.95
14 Pin S/T sockets 1000 pcs	1C
16 Pin S/T sockets 1000 pcs	11
22 Pin S/T sockets 1000 pcs	12
FSC460/464 16K CCD's	18.95
AMD 9140CDC Static Ram	10.95
4116/416 16K Dynamic Ram's	8 for/149.95
1488 or 1489 RS232 Driver	.95
8T97 Buffer	1.25
8130 or 8131	2.45
8833 or 8835	1.99
74367 or 74368	6/5.00
75451/52/53	10/2.50
8T26 Bus Driver	2.39
78L05 Regulator	2/1.00
MCT2 Optoisolator	.89
2510A Shift Register	2.95
2519A Shift Register	2.95
MM5056 Shift Register	2.95
LM760N-14 Comparitor	1.10
DS0025CN Clock Driver	1.49
DS0026CN Clock Driver	2.50
8T20 Bidirect oneshot	3.49
1403AN Shift Register	1.50
9368	2.95
Intel 8155 22 I/O w/Ram	17.95
ICL 7107 CPL 3½ Dig A/D	11.95

NEW 1978 CATALOGUE SEND 25¢ POSTAGE

DISCOUNT COMPUTER CORNER

	Discount Cash	Computer Credit Card
Apple II/16K	$1125.00	$1155.00
TEI PT208	4599.00	4699.00
TEI MCS122	450.00	462.00
Cromemco Z-2	536.00	551.00
Cromemco SYS III	5499.00	5561.00
Decwriter II	1475.00	1525.00
Persci 277	1230.00	1266.00
Shugart 800/801	495.00	512.00
Pertec FD200	299.00	319.00
MFE Dual 751	730.00	744.95
Shugart 400	325.00	315.00
Horizon I	1439.00	1479.00
North Star	599.00	617.00
Low Cost S-100 Bus	149.95	155.95
ADM 3 Assem	829.95	865.00
Sorcer IQ 120	895.00	945.00
Teletype Model 43	1199.00	1230.00
AM100	Contact sales desk	
Imsai w 22 slots	599.00	617.00
Oliver 2708 16 Programr	275.00	288.00
Pennywhistle Modem	129.95	129.95
Cromemco 16K Ram	449.00	462.00
Hazeltine 1500	1175.00	1195.00
Okidata 110 w TI RS232	1675.00	1705.00
Okidata 22 w TI RS232	2705.00	2810.00
MEK 6800 D2 Kit	235.00	Same
KIM 1 6502	229.95	Same
Intercept Jr 6100	281.00	Same
Technico 9900 Kit	299.00	Same
RCA VIP Cosmac	249.00	Same
Rockwell AIM	375.00	Same
Synertek VIM-1	269.00	Same

P. O. BOX 17329 Irvine, California 92713 New Phone (714) 558-8813
TWX: 910-595-1565

Retail Store Open Mon. – Sat.
Located at 1310 "B" E. Edinger,
Santa Ana, CA 92705

CIRCLE 3 ON FREE INFORMATION CARD

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

MOVING?

Don't miss a single copy of **Radio-Electronics.** Give us:

Six weeks' notice

Your old address and zip code

Your new address and zip code

ATTACH LABEL HERE

name (please print)

address

city state zip code

Mail to: Radio-Electronics
SUBSCRIPTION DEPT., P.O. BOX 2520,
BOULDER, COLO. 80322

$44.95 KNOW-IT-ALL

CSC's multi-family Logic Probe 1 with memory. Already the industry standard for performance and value.

This compact, enormously versatile test and trouble-shooting aid is like a pencil-sized scope at your fingertips. Simply connect its clip leads to the circuit's power supply, set a switch to the proper logic family, and touch the probe tip to the node under test.

LP-1's unique circuitry does the work of a level detector, pulse detector, pulse stretcher and memory. HI LED indicates logic "1," LO LED, logic "0," and all pulse transitions—positive *and* negative, as narrow as 50 nanoseconds—are stretched to 1/3 second and displayed on the PULSE LED. One-shot, low-rep-rate narrow pulses—nearly impossible to see even with a fast scope, are easily detectable and visible. And you can indefinitely store single-shot as well as low-rep-rate events.

At frequencies above 1 MHz, there is an additional indication with unsymmetrical pulses: duty cycles of less than 30%, light the LO LED; over 70% the HI LED. In all modes and circuit states, LP-1's high input impedance virtually eliminates loading problems. The unit also features overvoltage and reverse-polarity protection, interchangeable probe tips, cables and other optional accessories.

Order today. Call 203-624-3103 (East Coast) or 415-421-8872 (West Coast): 9 a.m.-5 p.m. local time. Major credit cards accepted. Or see your CSC dealer. Prices slightly higher outside USA.

Specifications

Input impedance: 100,000Ω

Thresholds (switch selectable)	**DTL/TTL**	**HTL/CMOS**
logic "1" thresholds (HI-LED)	2.25V ± .15V	70% Vcc ± 10%
logic "0" thresholds (LO-LED)	0.80V ± .10V	30% Vcc ± 10%

Min. detectable pulse width 50nsec. guaranteed.

Pulse detector (PULSE LED) in PULSE position of PULSE/MEMORY switch. ⅓-sec. pulse stretcher makes high-speed pulse train or single events (+ or − transitions) visible; in MEMORY position, first transition lights and latches LED.

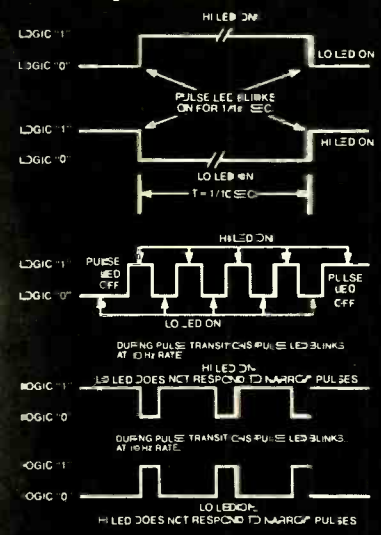
Operating temperature 0-50°C

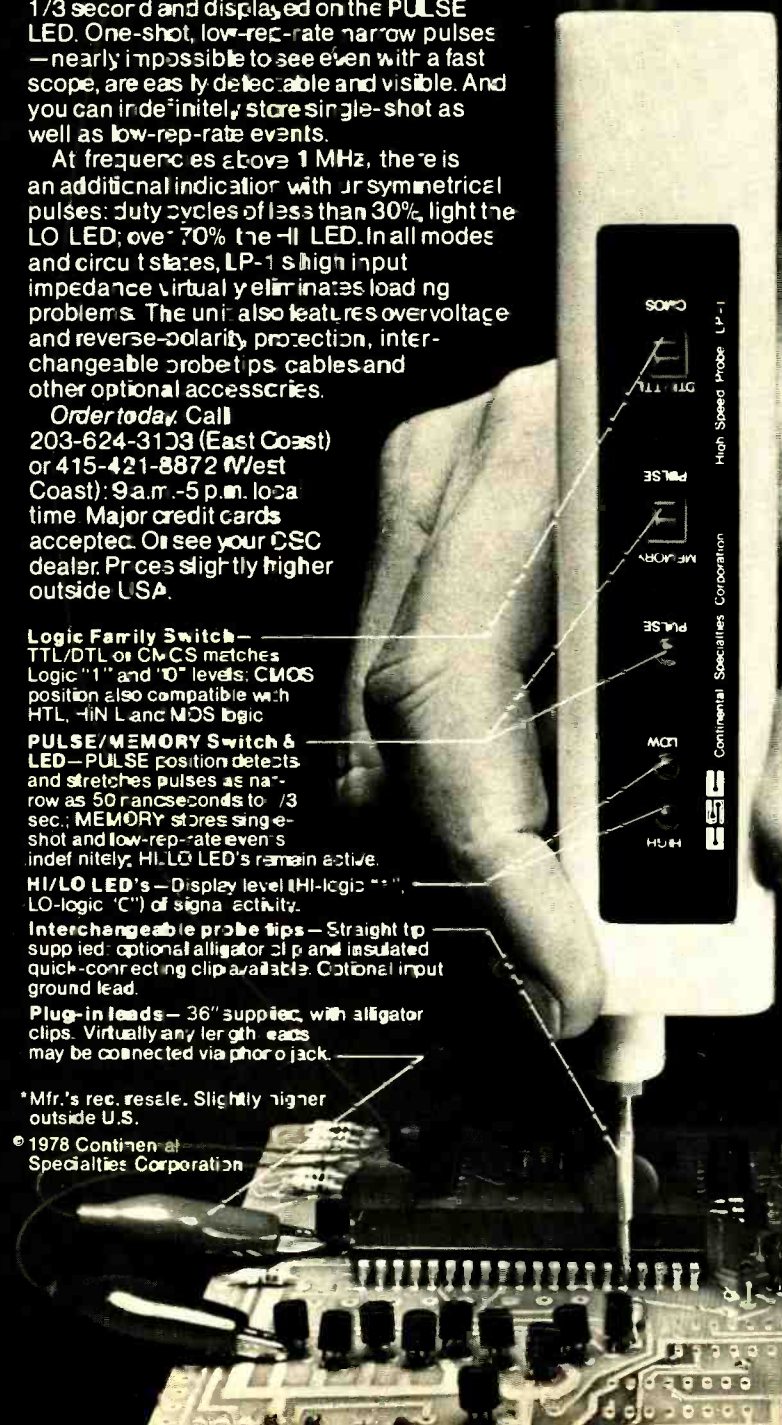
Physical size (l x w x d)
5.8 x 1.0 x 0.7" (147 x 25.4 x 17.8mm)

Weight 3oz. (.085Kg)

Power leads removable 36" (914mm) with color-coded insulated clips; others available

Input protection overload, ± 500V continuous, 117 VAC for less than 15 sec.; reverse polarity, 50V; power leads reverse-voltage protected.





Logic Family Switch—TTL/DTL or CMOS matches Logic "1" and "0" levels. CMOS position also compatible with HTL, HiN L and MOS logic.

PULSE/MEMORY Switch & LED—PULSE position detects and stretches pulses as narrow as 50 nanoseconds to 1/3 sec.; MEMORY stores single-shot and low-rep-rate events indefinitely. HI, LO LED's remain active.

HI/LO LED's—Display level (HI-logic "1", LO-logic "0") of signal activity.

Interchangeable probe tips—Straight tip supplied; optional alligator clip and insulated quick-connecting clip available. Optional input ground lead.

Plug-in leads—36" supplied, with alligator clips. Virtually any length leads may be connected via phono jack.

*Mfr.'s rec. resale. Slightly higher outside U.S.

CONTINENTAL SPECIALTIES CORPORATION

CSC

70 Fulton Terrace Box 1499, New Haven, CT 06509
203-624-3103 TWX 710-465-1227
WEST COAST: 351 California St., San Francisco, CA 94104,
415-421-8872 TWX 910-372-7992
GREAT BRITAIN: CSC UK LTD.
Spur Road, North Feltham Trading Estate,
Feltham, Middlesex England.
01-890-0782 Int'l Telex: 851-931-3669
CANADA: Len Finkler Ltd., Ontario

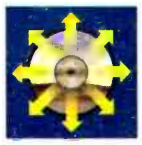
CIRCLE 5 ON FREE INFORMATION CARD

NEW LP-1!

New, K40 Magnamount: Grips like a grapple, actually improves transmission.

We double guarantee it.*

Exclusive Octopole Construction.



That's eight magnets set in eight different directions to give you a magnetic seal so complete and powerful, your antenna would stay up there if you could squeeze between two semis passing each other at 180 miles an hour. That's magnetic octopower.

* GUARANTEE I

Placed on the roof of a vehicle; properly tuned, the K40 Magnamount is guaranteed to transmit a further distance than a standard K40 without the Magnamount or you will receive a prompt and full refund from your K40 dealer who installed and tuned the Magnamount K40 for you.

* GUARANTEE II

Materials and workmanship are guaranteed for a full 12 months. Any part that fails to perform satisfactorily will be replaced absolutely free.

Exclusive K40 Flux Harmonics for Greater Transmission.

The magnetic radiation pattern was designed to match the K40 antenna radiation for greater distance than the standard K40. See our guarantee.

The facts: Physics and Physical.

1. Magnamount is a bigger, stronger magnet—in fact it's 8 bigger, stronger, magnets.
2. It doesn't just hold the K40 antenna, it helps it transmit further.
3. Remember the law of reciprocity. The antenna that transmits better, receives better.
4. It provides a flatter, lower SWR because the Magnamount is capacitance grounded.
5. It puts your 5/8 wave K40 antenna securely in place in the most advantageous place to work against a ground plane—high and free from obstruction. That's square in the middle, right up on top.

$15.95 buys it.

(SUGGESTED RETAIL)

K40 Magnamount.

American Antenna 1945 South Street Elgin, Illinois 60120

This professional CB equipment available only through Registered K40 Dealers!

CIRCLE 4 ON FREE INFORMATION CARD