BUILD A TUNABLE SHORTWAVE ANTENNA

JULY 1994

Electronics NOW

Combined with Radio Electronics®

Build this Amateur TV Station

and enter a new world of communications!

Build the
LED Head
electronic emotion machine!

Practical
Relay Circuits
you can put to work

The fundamentals of
I/O Transfer
on your PC

Update on
Caller ID:
Calling-name delivery

How to design and build your own
Electronic Games

A GERNSBACK PUBLICATION

$3.50 U.S.
$3.95 CAN.

There are copies and then there are originals. Only Fluke meters – the original and most copied DMMs in the world – deliver the safety, quality and value they promise. They're built tough enough to achieve C.S.A. and U.L. listings, not to mention the considerable on-the-job punishment they endure. Each meter is loaded with features, of course. But those features are also designed to work together intelligently, so your job is easier. Faster. And safer.

If you're going to spend your hard-earned money on a multimeter, why buy an inferior copy when you can own an original? See Fluke's full line of handheld meters and accessories at your local distributor; or call 1-800-87 FLUKE for the name and number.

O R I G I N A L S

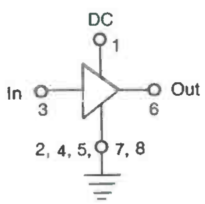
FLUKE®

CIRCLE 121 ON FREE INFORMATION CARD


Actual Size

VNA Amplifiers +17.5dBm, 0.5to2.5GHz only $2^{95} (1000 qty.)

Very New Amplifiers...at a very affordable price, from Mini-Circuits! Yes, VNA-25 RF amplifiers are very small, yet incredibly powerful (+17.5dBm typ. output at 1dB compression). The SOIC-8 pin surface mount units operate directly from a +3V to +5V single DC supply with 18dB typ. gain and cover the popular 0.50-2.50GHz wireless band. These units are very easy to use because all capacitors are internal and RF/DC connections are separate, eliminating the need for both external coupling capacitors and an RF choke. You can buy these very new amplifiers for the low price of just $2.95 ea., qty.1000. Development qty.10, only $4.95ea.! So, call Mini-Circuits today for immediate off-the-shelf availability and guaranteed 1 week shipment.



Freq.(GHz)	.5-.8	.8-1.0	1.0-2.0	2.0-2.5
Gain (dB) typ.	14.0	17.0	18.0	16.0
Max. Output (dBm) @1dB Comp. typ.	+18.0	+18.5	+17.5	+17.0
I P 3rd Order (dBm) typ.	+27	+27	+27	+27
VSWR Output typ.	1.5:1	1.7:1	1.7:1	1.5:1
VSWR Input typ.	6.4:1	2.8:1	2.0:1	1.4:1

DC Power.: +5.0V for specified performance.
Current,(mA): 85typ., 105 max.
Thermal Resistance. Junction-to-case: 125°C/W
Price ($) ea. : 2.95 (qty. 1000), 4.95 (qty. 10).

•All specs at 25°C (case temp. 35°).
•Available in Tape and Reel.
•MTTF at 150°C max. junction temp.: 3×10^7 hrs. typ.
"Case" is defined as mounting surface of leads.

Mini-Circuits...we're redefining what VALUE is all about!

Mini-Circuits®

P.O Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718)332-4661

For detailed specs on all Mini-Circuits products refer to • THOMAS REGISTER Vol. 23 • MICROWAVES PRODUCTS DIRECTORY • EEM • MINI-CIRCUITS' 740- pg. HANDBOOK.

CUSTOM PRODUCT NEEDS...Let Our Experience Work For You.

F 180 Rev Orig

CIRCLE 180 ON FREE INFORMATION CARD

July 1994

Electronics NOW

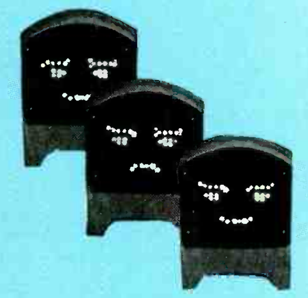
Vol. 65 No. 7

BUILD THIS

COMPUTERS

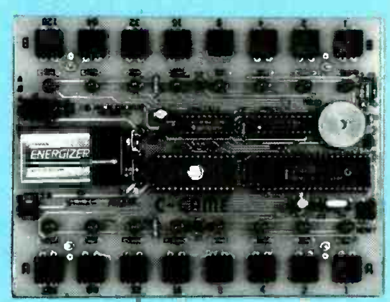
TECHNOLOGY

DEPARTMENTS



PAGE 41

PAGE 60



PAGE 62

AND MORE

ON THE COVER

Although two-way amateur television (ATV) has been around for years, the prohibitive cost of the necessary equipment put it out of reach for most radio amateurs. But, thanks to recent advances in solid-state technology, prices for ATV components have dropped dramatically. This month, we show you how to take advantage of those affordable VCRs, camcorders, color TV receivers, and tiny video cameras by incorporating them into a mobile, battery-operated ATV station weighing less than five pounds. Four related ATV projects are presented: a complete ATV transceiver; a 5-watt, three-channel transmitter only; a ¾-watt, single channel Mini ATV transmitter; and the ¾-watt, single-channel "ATV Jr." (without audio capability). Turn to page 31.

COMING NEXT MONTH

THE AUGUST ISSUE GOES ON SALE JULY 5.

COMMERCIAL EDITOR
Get rid of the commercials from your videotapes!

CIRCUIT COOKBOOK
PLL Basics

RESTORE IT RIGHT!
Working with vintage audio gear.

EPROM PROGRAMMER
Put the IBM PC I/O breadboard to work.

ELECTRONICS NOW, (ISSN 1067-9294) July 1994. Published monthly by Gernsback Publications, Inc., 500-B Bi-County Boulevard, Farmingdale, NY 11735. Second-Class Postage paid at Farmingdale, NY and additional mailing offices. Canada Post IPM Agreement No. 334103, authorized at Mississauga, Canada. One-year subscription rate U.S.A. and possessions $19.97, Canada $27.79 (includes G.S.T. Canadian Goods and Services Tax, Registration No. R125166280), all other countries $28.97. All subscription orders payable in U.S.A. funds only, via international postal money order or check drawn on a U.S.A. bank. Single copies $3.50.

POSTMASTER: Please send address changes to ELECTRONICS NOW, Subscription Dept., Box 55115, Boulder, CO 80321-5115.

Electronics NOW®

Hugo Gernsback (1884-1967) founder

Larry Steckler, EHF, CET, editor-in-chief and publisher

Electronics Now is indexed in *Applied Science & Technology Index*, and *Readers Guide to Periodical Literature*, *Academic Abstracts*, and *Magazine Article Summaries*.
Microfilm & Microfiche editions are available. Contact circulation department for details.

Advertising Sales Offices listed on page 94.
Electronics Now Executive and Administrative Offices
1-516-293-3000.
Subscriber Customer Service:
1-800-288-0652.
Order Entry for New Subscribers:
1-800-999-7139.

Audit Bureau of Circulations Member

WHAT'S NEWS

A review of the latest happenings in electronics.

Micromachined magnetic actuators

Photolithographic and micromachining techniques permitted researchers at the Georgia Institute of Technology to form the tiny electrical windings and nickel-iron cores in low-voltage magnetic microactuators that do things their electrostatic counterparts can't do.

The microactuators are so small that they must be viewed under an electron microscope, as shown in Fig. 1. Georgia Tech scientists say the microactuators, made by techniques similar to those used in fabricating integrated circuits, could, for example, replace transistors for switching high-frequency signals, operate microscopic valves, and be components in microminiature voltage converters.

The low-voltage magnetic microactuators are said to be more compatibile with existing microelectronic circuits than electrostatic actuators. According to the researchers, electrostatic actuators depend on high voltages to generate the electrical charge differentials that draw the electrodes together to create the necessary actuating force.

The lower voltages of the magnetic microactuator make it less likely that it will cause the electrical arcs that could trigger an explosion where volatile gases or dust are present. They say the devices will also work in the human veins and arteries where blood conductivity would inhibit the generation of an electrostatic charge.

Magnetic microactuators also can generate more force than their electrostatic equivalents, although they are usually larger and draw more current. To surmount a major drawback of magnetic microactuators—high resistive loss—the Georgia Tech team is perfecting a device that can be switched by a single current pulse.

The researchers formed integrated electrical windings and a magnetic actuator that has its iron core wrapped around its windings. This contrasts with an earlier microactuator made by forming the iron core and electrical windings as separate components.

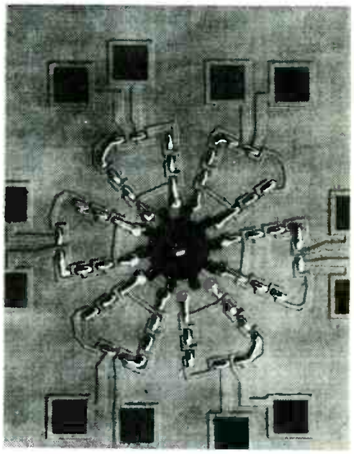


FIG. 1—MICROMACHINED microactuator made by integrated circuit fabrication techniques is examined under an electron microscope by Georgia Tech scientists, (left), and a microphotograph of a prototype planar, variable-reluctance magnetic micromotor (right).

By integrating the tiny components, it is possible to produce multiples of one device simultaneously on the same substrate as is done with integrated circuits. As in IC fabrication, this technique would lower manufacturing costs. (See Fig. 1.)

Dr. Mark G. Allen, assistant professor in Georgia Tech's School of Electrical and Computer Engineering, said the number of devices that can be made at one time is only limited by the diameter of the substrate silicon wafer.

Several microactuator devices have been built and tested. Among them was a micro-relay that Dr. Allen believes could replace transistors as switches of high-frequency signals. "If you are trying to switch gigahertz-frequency signals for a microwave integrated circuit (MIC), a transistor is ineffective because of its leakage," he explained. "But if you had a microminiature version of the electromechanical relay with two conductor lines in contact until you move one away, you could switch the signal far more effectively."

Plastic lithium-ion battery

A new, solid, rechargeable lithium-ion power cell that is as thin and flexible as a credit card, has been developed by Bell Communications Research (Bellcore, Livingston, NJ), the research arm of the regional Bell telephone operating companies.

The plastic cells can be stacked to form batteries for powering small, light, handheld portable telephones, pagers, laptop computers, and video games. Bellcore officials also believe that their new electrochemical technology can be scaled up to function as automotive batteries and even power electric cars.

According to Bellcore officials, the new cell is capable of offering equal or greater energy than the rechargeable cells it is intended to replace, and they are in cases which

Continued on page 85

VIDEO NEWS

What's new in the fast-changing video industry.

DAVID LACHENBRUCH

• **Home Digital VCR.** Fifty companies worldwide have agreed on specifications for all-digital consumer VCRs designed for standard TV formats—NTSC, PAL, and SECAM—and HDTV. Meeting in Tokyo, the Digital VCR Conference, organized last September, ratified earlier proposals and added some features. The specifications will be submitted to the International Electrotechnical Commission (IEC) for adoption as a world standard in an attempt to avert a standards battle in the future. The system is designed to record both analog and digital broadcasts as digital signals. The new digital video recorders, or DVRs, could be in stores as early as next year—initially at high prices. The first models in the U.S. are likely to be for standard (non-HDTV) broadcasts only.

One immediately noticeable feature of the new format is the cassette, which is considerably smaller than current VHS types. Two sizes are specified—one presumably for camcorders and the other for home decks. The smaller type is about the size of a digital audio tape (DAT) cassette. It measures 2.6×1.9×0.48 inches and is designed to record for 60 minutes in standard mode and 30 minutes in HDTV. The larger cassette is just slightly bigger than an audio-cassette box, at 4.9×3×0.57 inches; it can store 4½ hours of standard video, and half that amount of HDTV. The cassettes contain ¼-inch-wide tape with evaporated metal "or equivalent" coating. An optional feature of the cassette is a built-in IC memory for storage of a table of contents, recording dates, program title, and other information.

The Specifications. The system will use digital component recording for video. For all existing non-HDTV standards, the luminance sampling frequency will be 13.5 MHz, the video quantization will be 8 bits, and the video recording frequency will be 25 megabits per second after bit-rate reduction. The audio track will use 48 kHz (18 bits) for two-channel recording, and 32 kHz (12 bits) for four-channel recording. Audio specifications are similar to those for DAT recording, and presumably were chosen to make digital copying difficult—although the specifications as released did not contain any specific mention of anti-copy system.

Tape speed for 60-Hz systems (such as NTSC) will be 18.812 millimeters per second; for 50-Hz systems (PAL, SECAM), 18.831 mm/sec. Discrete cosine transformation (DCS) will be used for video rate reduction. For high-definition systems, the video luminance sampling frequency will be 40.5 MHz; the video recording rate will be 50 megabits per second after bit rate reduction for both 1125/60 and 1250/50 systems. The tape will run at 27.594 mm/sec in both modes.

Detailed specifications are available for only one high-definition system—Japan's analog MUSE transmissions—because no country has yet adopted a digital HDTV system. However, the conference assigned working groups to develop detailed specifications for new HDTV systems—one for the Grand Alliance system now undergoing tests in the United States, and another for the proposed European digital HDTV system.

How soon, how much? Although industrial and broadcast versions of the new digital recorders could appear relatively soon, affordable consumer models could take quite a bit longer. One estimate is that the first versions will cost more than $3000. JVC, the inventor of VHS recording and a member of the Digital VCR Conference, is trying to reassure the public that VHS will continue to live, particularly in view of the vast library of material already recorded on VHS. For the near term, JVC is pushing its compatible analog HDTV recording system, W-VHS, which is already available in Japan for recording and playback of standard, widescreen, and HDTV signals. However, it seems unlikely to achieve any great popularity in the U.S. or Europe.

• **Tapeless recording.** Tape might not be the last word digital recording. The first no-moving-parts recorders for consumer use are beginning to appear. Norris Communications, of Poway, California, is planning the first deliveries this summer of a voice recorder that uses solid-state flash memory modules instead of tape. Initially, the "SoundClip" modules will have a playing time of 30 minutes, but Norris plans to extend that to 120 minutes and eventually to offer a music recorder. The initial solid-state digital voice recorder is a pocket device that will list for $199.

In video recording, there are increasing warnings that the mechanical recording is doomed to disappear—just as the spinning disc and the mechanically rotated tuner disappeared from the television set. John Bermingham, vice president of AT&T's Advanced Communications Technologies Group, recently called magnetic media "an endangered species" and classified optical discs as merely a short-term interim replacement. Addressing a group of recording media executives, he forecast relatively rapid change to solid-state recording. With increasing sophistication of data-compression algorithms, denser and less expensive solid-state devices, and development of broadband communication into the home, mechanical recording is doomed, he said.

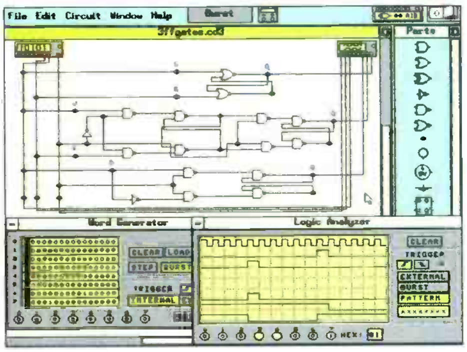
Microelectronics will make possible chips with "up to a billion components each" within about 15 years, Bermingham said. At some time in the future, "audio compo-

Continued on page 25

Design and Verify Circuits. Fast.

Analog Module includes:

- complete control over all component values
- ideal *and* real-world models for active components
- resistors, capacitors, inductors, transformers, relays, diodes, Zener diodes, LEDs, BJTs, opamps, bulbs, fuses, JFETs, and MOSFETs
- manual, time-delay, voltage-controlled and current-controlled switches
- independent, voltage-controlled and current-controlled sources
- multimeter
- function generator (1 Hz to 1 GHz)
- dual-trace oscilloscope (1 Hz to 1 GHz)
- Bode plotter (1 mHz to 10 GHz)
- SPICE simulation of transient and steady-state response



Digital Module includes:

- fast simulation of ideal components
- AND, OR, XOR, NOT, NAND and NOR gates
- RS, JK and D flip-flops
- LED probes, half-adders, switches and seven-segment displays
- word generator (16 eight-bit words)
- logic analyzer (eight-channel)
- logic converter (converts among gates, truth table and Boolean representations)

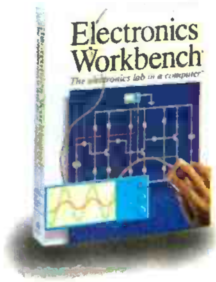
Complement Your Test Bench

Here's why Electronics Workbench belongs on *your* test bench: Wires route themselves. Connections are always perfect. And the simulated components and test instruments work just like the real thing. The instruments are indestructible and the parts bin holds an unlimited supply of each component. The result: thousands of electronics professionals and hobbyists save precious time and money. **Over 90% would recommend it to their friends and colleagues**. Electronics Workbench: the ideal, affordable tool to design and verify your analog and digital circuits before you breadboard.

And now the best is even better – Electronics Workbench Version 3.0 is here. It simulates more and bigger circuits, and sets the standard for ease of use. Guaranteed!

NEW Features in Version 3

- new components include JFETs, MOSFETs, voltage-controlled and current-controlled sources and manual, time-delay, voltage-controlled and current-controlled switches
- real-world models for opamps, BJTs, JFETs, MOSFETs and diodes – over 100 models available
- MS-DOS version now supports up to 16 MB of RAM for simulation of bigger circuits
- new Microsoft® Windows™ version available
- technical support now also available on CompuServe®



Just $299!

Electronics Workbench®

The electronics lab in a computer™

Call: 800 263-5552

INTERACTIVE IMAGE TECHNOLOGIES LTD.
908 Niagara Falls Blvd. #068, North Tonawanda, NY 14120-2060
Telephone: (416) 361-0333 FAX: (416) 368-5799

MICROSOFT WINDOWS COMPATIBLE

*30-day money-back guarantee.

Prices in U.S. dollars. Shipping $15. Offer valid in U.S. and Canada only.
All trademarks are the property of their respective owners.

CIRCLE 126 ON FREE INFORMATION CARD

INTERACTIVE

Write to Q & A, Electronics Now, 500-B Bi-County Blvd., Farmingdale, NY 11735

AM INTERFERENCE

I've put amplifiers and speakers in several rooms of my house, and they're all driven by line-level signals from a distribution amplifier in my living room. Everything works well except that I can always hear a local AM radio station from the speakers. Do you have any idea what's causing this, and can you suggest any solutions?—B. Fishen, Albany, NY

This kind of interference can be a real pain in the neck to eliminate since there are several factors that can cause it. I can make a few suggestions, but I'm willing to bet that you'll have to do a lot of work to make it disappear completely.

The problem you're having is that something in your system is acting as an antenna and introducing the AM signal into the input stage of your power amplifiers. The cable running from your distribution amplifier to the individual power amplifiers is probably a standard audio cable with a single conductor and a shield. If I'm right about that, you should replace it with two-conductor shielded cable and use the shield as a chassis ground.

The best way to find the source of your problem is to disconnect the inputs to the power amplifier and short them by connecting a short piece of wire from signal to ground at the back of the amplifier. If that kills the AM radio signal, you'll know that the cable from the distribution amplifier is acting as an antenna. That means you'll have to replace the wire connecting the two.

I suggest that you try replacing the cable by just placing it on the floor before you go to the trouble of routing it through the walls. If this solves the problem, you've got some rewiring to do. If you're still getting the AM signal, then the chances are it's sneaking in through the power line. Then only way to get rid of it is to use a power-line filter.

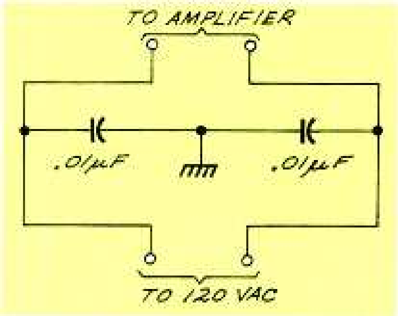


FIG. 1—BASIC AM TRAP. This trap can prevent AM signals in the AC power line from getting into audio equipment.

The schematic in Fig. 1 is a basic AM trap for the power line that I've used with success. Remember to follow proper safety procedures when you're working with 120 volts AC. Put the circuit in a plastic box and be sure to ground the trap properly. AM signals are really pervasive and hard to eliminate. If the filter shown here doesn't clean up the audio, try a commercial line filter as the next step.

MCA TO ISA ADAPTER

I own an IBM PS/1 model 2121-E42 that has Micro Channel Architecture expansion slots on the motherboard. I would like to use some ISA (Industry Standard Architecture) cards in the computer since they're less expensive, and there's also a much larger variety of them available. I need information about the pin assignments for the Micro Channel Bus, and would like to know how I could make some kind of an adapter.—R. Keats, Rexdale, Ontario

In its short life, the PC industry hasn't had much time to generate the kinds of stories that go down in history, but IBM's switch to the Micro Channel Bus is certainly something that will be discussed in MBA classes for years to come.

When the original PC was developed in the early 80's, its bus allowed for expansion. The design of the PC followed the path previously taken by Apple and, before that, the older S-100 based computers. The motherboard carried the CPU, memory, and the circuitry to support expansion cards.

Although IBM also marketed software under its own name (most of it was licensed from other companies), it realized that its success depended on the creation of a third-party market that would make hardware and software for use with IBM personal computers. IBM published the specifications of the bus and made them available to any company that wanted to go into the business of making plug-in peripherals for the IBM PC. This was the same strategy that had been successful for Apple and others.

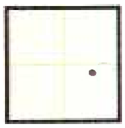
When the IBM-AT was developed around the 80286 processor, the bus was expanded to 16-bit width, and the specifications were again made available to anyone who wanted them. Both the 8- and 16-bit buses were far from perfect in terms of speed and signal availability, but they did provide a standard for the industry.

The bus was completely redesigned for 32-bit machines, and IBM started shipping computers with the Micro Channel bus. This was a good architecture that corrected the shortcomings found in the ISA standard, but the specifications and pinouts of the Micro Channel bus remained proprietary. If you wanted to make cards for the newer IBM PCs, you had to pay for the privilege.

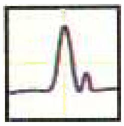
This licensing and royalty requirement caused a lot of companies to stay away from the newer IBM PCs. Remember that when IBM switched to Micro Channel, the clone and compatible industry had taken on a life of its own. There was some confusion about a new standard but, after some time, the EISA (Extended Industry Standard Architecture) and VESA (Video Electronics Standards Association) standards

Get a sample of reality.

Looking for analog confidence in a digital oscilloscope? Tektronix' TDS 350 sets the standard with Digital Real Time. ■ Its incredible *one gigasample/second* sampling delivers real-life capture like never before—both for single shot or repetitive events. Select peak detect for slow events, or push the scope to its full 200 MHz bandwidth—with no aliasing. ■ And, like the entire TDS 300 family, the TDS 350 sets a new standard in price/performance: under $4000.



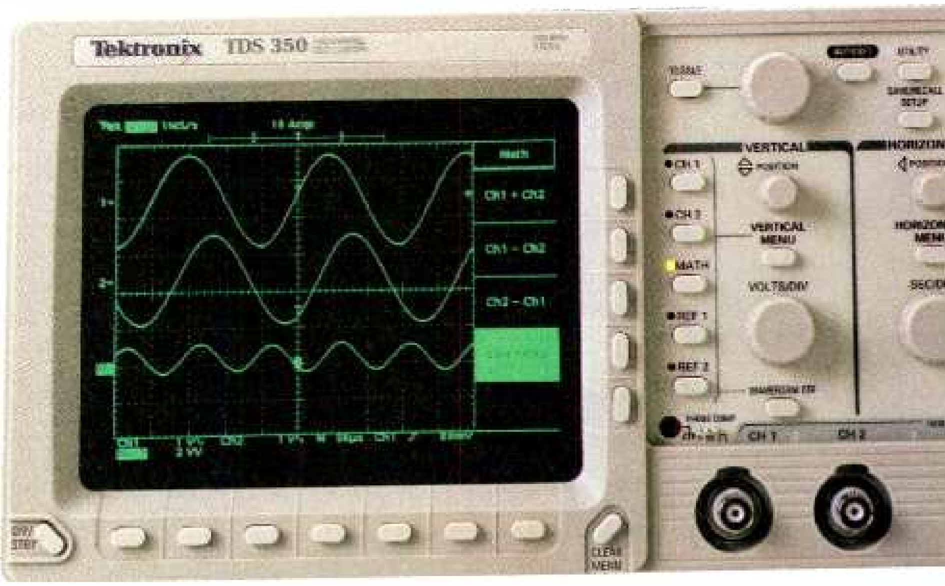
One Point Captured. Single event capture using Equivalent Time Sampling. 20 MS/s 100 MHz DSO.



Real Life Capture. Single event capture using Digital Real Time. 500 MS/s 100 MHz DSO.

Analog look and feel. The TDS 300 family is simple and intuitive; just like your trusty analog scope. Even the digital interface is simplified with on-screen icons. You may never have to crack open the instruction manual!

High-end digital features. Each model features over 20 automatic measurements. Continuous update for hands-free operation. Four acquisition modes and video trigger—perfect for tailoring the display. And a communication option for hardcopy to most printers, or to send/receive waveforms and setups.



There's a TDS 300 Series scope for every application. And every budget.

FEATURES	TDS 310	TDS 320	TDS 350
Bandwidth	50 MHz	100 MHz	200 MHz
Max Sample Rate	200 MS/s/chan	500 MS/s/chan	1 GS/s/chan
Sweep Speeds	10 ns/div - 5 s/div	5 ns/div - 5 s/div	2.5 ns/div - 5 s/div
Channels	2	2	2
Vertical Sensitivity	2 mV - 10 V	2 mV - 10 V	2 mV - 10 V
Vertical Resolution	8 bits	8 bits	8 bits
Record Length	1K/channel	1K/channel	1K/channel
Standard Advanced Features	TV Line & Field Trigger, Roll Mode, Autoset, 21 Automatic Measurements, Peak Detect		
Comm. I/O (Option 14)	GPIB, RS-232, Centronics and VGA video output		
Price	$2295.	$2895.	$3995.

Get real. For more real-time benefits of the TDS 300 family, call your authorized Tektronix distributor today. Or call Tektronix at (800) 426-2200, ext. 212.

Tektronix

CIRCLE 92 ON FREE INFORMATION CARD

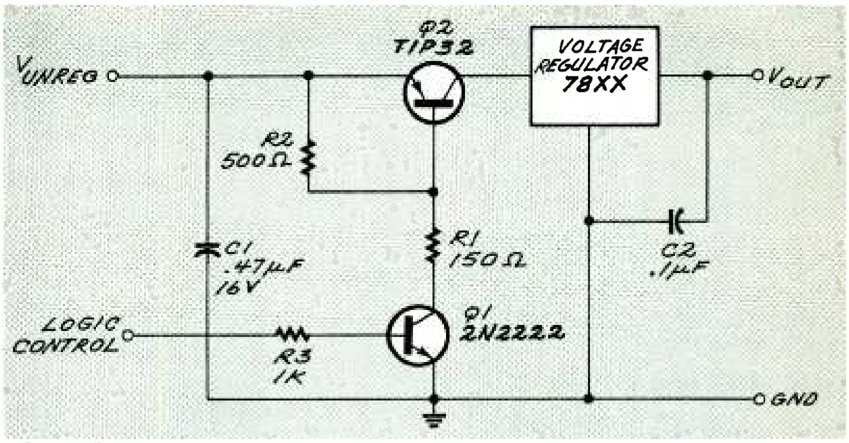


FIG. 2—TRANSISTORS CAN BE USED to control any 78xx series regulator with logic signals. Both transistors are controlled by the logic level present at the base of Q1.

were developed, and the PC industry had a 32-bit standard of its own.

It's clear now that the Micro Channel Bus, no matter how good a bus it is, will remain exclusively IBM, and it's unlikely that it will be a standard for anyone but IBM. Since there are licensing and royalty fees that are associated with it, any third-party product made for the Micro Channel bus will necessarily be more expensive than a similar product made for the ISA bus. And, as long as the specifications for the Micro Channel bus remain proprietary with IBM, you won't be able to find the pin assignments in the reference section of your local library, or adapter cards on the shelves of your local computer store.

REGULATOR SWITCH

I'm using several 78xx series three-terminal voltage regulators in a circuit that I built, and I need a way to turn them on and off with logic level signals that are generated by another part of the circuit. I don't want to use a brute-force approach with relays, so please tell me how to do it with solid-state devices.—D. Ketting, St. Louis, MO

There's no internal circuitry in the 78xx series devices that can turn them on and off. I don't know why you're against using relays but, since you are, you'll see it's also simple to control them with a transistor.

The schematic in Fig. 2 gives you the basic idea of how to control any of these regulators with logic signals. Both transistors are set up as simple switches, and their operation is controlled by the logic level present at the base of Q1. Whenever a high is presented to the base of Q1, the resulting low at its collector pulls enough current through R1 to turn on Q2. Using two transistors is a good idea because Q1 not only does the inversion needed to properly control Q2, but it also acts as a buffer to isolate the control logic from the power supply.

The component in the circuit whose value is critical is R1. It has to pass enough current to turn on Q2. However, it's easy to calculate the value for R1. You'll need about 50 milliamperes of current to turn on Q2, and the value of R1 can be determined from Ohm's law as follows:

$R1 = V_{UNREG}/50$ milliamperes

You can see from the schematic that all the regulator current must pass through Q2, so make sure you use a part that can handle whatever current your circuit is going to draw. It would be smart to heatsink Q2 as well.

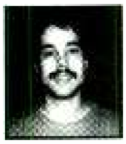
IS IT SAFE?

I'm thinking of buying a larger hard drive for my computer, and am intrigued by the possibility of using disk-doubling software to let me increase the amount of storage. I could get 340 megabytes with a 170-megabyte drive, 420 megabytes from a 210-megabyte drive, and so on. Is this kind of software safe to use?—P. Murphy, Victoria, NJ

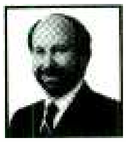
Data-compression software has become really popular in the last couple of years, and will probably be used for years to come. Although

Continued on page 82

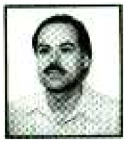
Just like these Fully Trained Electronics Professionals



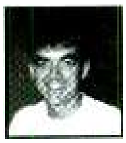
"Thanks to CIE I have tripled my previous salary, and I am now in a challenging and rewarding new field where only the sky is the limit."
Daniel Wade Reynolds
Industrial Electrician
Ore-Ida Foods



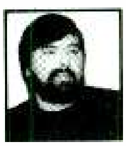
"CIE was recommended to me by my boss. It was appealing since I could study at my own pace at home and during business travel."
Dan Parks
Marketing Manager/Consumer Products
Analog Devices, Inc.



"I loved the flexibility CIE offered. It was the only way I could continue both school and my demanding job."
Britt A. Hanks
Director of Engineering
Petroleum Helicopters, Inc.



"I liked the way the school was set up with laboratory assignments to enforce conceptual learning. The thing which impressed me the most about CIE's curriculum is the way they show application for all the theory that is presented."
Daniel N. Parkman
Missile Electro-Mechanical Technician
U.S. Air Force



"Completing the course gave me the ability to efficiently troubleshoot modern microprocessor based audio and video systems and enjoy a sense of job security."
Tony Reynolds
Service Manager/Technician
Threshold Audio & Video

Graduate with an Associate Degree from CIE!

CIE INSTITUTE OF ELECTRONICS · 1934 ·

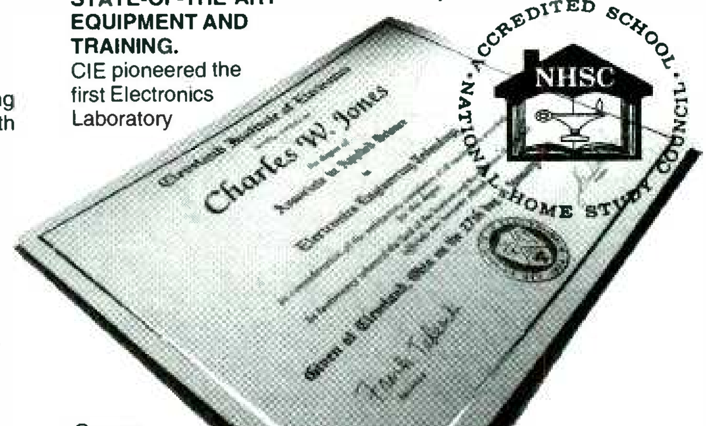
CIE is the best educational value you can receive if you want to learn about electronics, and earn a good income with that knowledge. CIE's reputation as the world leader in home study electronics is based solely on the success of our graduates. And we've earned our reputation with an unconditional commitment to provide our students with the very best electronics training.

Just ask any of the 150,000-plus graduates of the Cleveland Institute of Electronics who are working in high-paying positions with aerospace, computer, medical, automotive and communications firms throughout the world. They'll tell you success didn't come easy...but it did come...thanks to their CIE training. And today, a career in electronics offers more rewards than ever before.

CIE'S COMMITTED TO BEING THE BEST...IN ONE AREA...ELECTRONICS.
CIE isn't another be-everything-to-everyone school. CIE teaches only one subject and we believe we're the best at what we do. Also, CIE is accredited by the National Home Study Council. And with more than 1,000 graduates each year, we're the largest home study school specializing exclusively in electronics. CIE has been training career-minded students for nearly sixty years and we're the best at our subject... ELECTRONICS... IT'S THE ONLY SUBJECT WE TEACH!

CIE PROVIDES A LEARNING METHOD SO GOOD IT'S PATENTED.
CIE's AUTO-PRO-GRAMMED® lessons are a proven learning method for building valuable electronics career skills. Each lesson is designed to take you step-by-step and principle-by-principle. And while all of CIE's lessons are designed for independent study, CIE's instructors are personally available to assist you with just a toll free call. The result is practical training... the kind of experience you can put to work in today's marketplace.

LEARN BY DOING...WITH STATE-OF-THE-ART EQUIPMENT AND TRAINING.
CIE pioneered the first Electronics Laboratory Course and the first Microprocessor Course. Today, no other home study school can match CIE's state-of-the-art equipment and training. And all your laboratory equipment, books and lessons are included in your tuition. It's all yours to use while you study and for on-the-job after you graduate.



PERSONALIZED TRAINING....TO MATCH YOUR BACKGROUND.
While some of our students have a working knowledge of electronics others are just starting out. That's why CIE has developed twelve career courses and an A.A.S. Degree program to choose from. So, even if you're not sure which electronics career is best for you, CIE can get you started with core lessons applicable to all areas in electronics. And every CIE Course earns credit towards the completion of your Associate in Applied Science Degree. So you can work toward your degree in stages or as fast as you wish. In fact, CIE is the only school that actually rewards you for fast study, which can save you money.

Send for CIE's FREE Course Catalog and See How We Can Help Your Career Too!

FREE CATALOG

YES! I want to get started. Send me my CIE course catalog including details about the Associate Degree Program. (For your convenience, CIE will have a representative contact you - there is no obligation.)

Please Print Clearly AE64

Name ______

Address ______

City ______

State ____ Zip ______ Age ____

Phone No. ______

Check box for G.I. Bill Benefits.
☐ Veteran
☐ Active Duty

Cleveland Institute of Electronics, Inc.
1776 East 17th Street
Cleveland, OH 44114

A School of Thousands.
A Class of One. Since 1934.

LETTERS

Write to Letters, Electronics Now, 500-B Bi-County Blvd., Farmingdale, NY 11735

RADON MONITOR REVISITED

There were several errors in the article "Radon Monitor" published in the January and February 1994 issues of *Electronic Now.* In Fig. 4 (voltage tripler, Jan, p. 61) diode D2 should be reversed. In Fig. 10 (power supply, Feb, p. 70) resistor R3 should be 3.3-kilohms.

Almost any general purpose JFET can be substituted for the National Semiconductor J201 specified for Q1 in Fig. 2 (Jan, p. 58) provided the drain resistor is selected as described on page 62. For example, the 2N3819 (Radio Shack) will work if R1 is 510 ohms. However, the ON resistance of some JFETs could be so low that it would cause excessive power drain.

In Fig. 6 (pulse-rate counter, Jan, p. 67), any matched general purpose JFETs can be substituted for the two 2N5566 JFETs, Q4-a and Q4-b, (including the 2N3819) without affecting temperature drift significantly. However, it might be necessary to substitute different values for resistors R10 and R13 to zero the meter properly if the JFETs are not closely matched.

Also in Fig. 6, one section of an LM324 quad op-amp (Radio Shack) used as a comparator can replace the LM392 specified. (Disable its unused sections by grounding their inputs.

It is not necessary to remove *all* of the plastic coating from the inside surface of the cathode sleeve: The sleeve is conductive enough to allow charge combination. Remove only enough to assure a sound high-voltage capacitor connection.

In response to a question about the effective volume of the beverage can chamber, it is considerably smaller than the physical volume of the can. The reason for this is:

Free electrons, from alpha particle ionizations, are repelled by the negatively charged cathode toward any relatively positive surface. The anode wire collects only about one-quarter of those electrons because it is essentially at ground potential; most are attracted to the ends of the can, which are also at ground potential.

Alpha particle ionizations can occur anywhere within the chamber, but only those electrons released near the middle of the chamber are likely to be attracted to the anode wire. As a result, the can's volumetric efficiency is only about 25 % or about one-quarter of its physical volume.

I gave a calibration constant of 1.9 for k/(n × VE) in the article, but based on a year of additional field testing, I now I believe that constant should be 2.1.

Experimenters should be sure to subtract the background (or outdoor air) count rate from the indoor rate when calculating actual radon concentration:
Radon (pCi/l) = 2.1 (indoor rate - outdoor rate)

I'll be happy to answer any further questions about the Radon Monitor from readers directly by mail. Please include a self-addressed, stamped envelope. PAUL NEHER
1016 Engler Road
Las Cruces NM 88005

IMPROVING TECHNICIAN TRAINING

I read with great interest Larry Steckler's editorial in the March issue of *Electronics Now.* As an electronics engineering (laboratory) technician, there are a few points that I would like to contribute to the discussion.

In my college, certain basics, such as soldering techniques, wiring, and circuit layout (for prototype construction), were not taught. Teachers apparently thought that those skills would be taught in industry. But after graduation, I found that employers were annoyed that technicians weren't taught those skills in school.

I would very much like to see colleges take the approach that instructors are like supervisors at work, and the students must learn to function in the real world. A school environment, where there is less pressure, is the ideal place to teach students what the industry expects from them.

Most people in industry don't seem to know who (or what) they're hiring. Someone should clarify the difference for them between a factory technician (the person who specializes in troubleshooting, testing, and repair) and a laboratory technician (who can do basic design work, solder, and keep an engineering notebook).

I was trained as a laboratory technician. During my last year in college, my final exam required that I design and build simple circuit prototypes. That kind of exam encourages technicians to decide if they prefer to work in a laboratory or in a factory. Those who choose the laboratory are taught basic circuit design concepts.

Companies such as Motorola offer semiconductor data manuals to colleges free of charge. All an instructor need do is write to the company on college letterhead paper and specify the number and titles of the manuals he wants.

I would like to encourage more college instructors to do that. If the teacher explained to the students what components are available and how to work with actual component, their learning would be enhanced.

Students of electronics technology face two main stumbling blocks in school—lack of money for building circuit projects and lack of access to information about how to build them. If, at least, basic electronic components (such as standard resistors, logic-gate, and timer ICs) were made more readily available to students, I think that their learning would skyrocket.

It might take a combination of two

We don't just make our test equipment better...

we make it here, and we sell it for less!

Unmatched quality. For over 20 years, Global Specialties has built the world's most reliable electronic testing and design equipment... and sold it for significantly less than its competition. How? By eliminating the features you don't need, but that drive your costs way up!

American made. Every Global product is designed and built in New Haven, Connecticut. You get the satisfaction of buying the best... made in the U.S.!

A tradition of value. For more than two decades, major high-tech companies, government and military contractors, and electronics hobbyists have relied on Global to give them just what they need: low cost... high quality... and real value!

GLOBAL MAKES: *Breadboards & Prototyping Cards · Instruments · Power Supplies · Data Acquisition Boards · Frequency Counters · Logic Probes & Analyzers · Enclosures · And more!*

Call 1-800-572-1028 toll-free for a current catalog today, or write to: Global Specialties, 70 Fulton Terrace, New Haven, CT 06512.

an Interplex Industries™ company

GLOBAL SPECIALTIES®

Just what you need... for over 20 years.

CIRCLE 122 ON FREE INFORMATION CARD

approaches to get my ideas accepted. The first, borrowed from high-school lunch programs, is subsidies for students for buying components. The second would be for manufacturers to offer sample components to students free of charge. That policy would be good public relations, and the companies could write off the expense as advertising.

Along with the components made available at no cost to students, the manufacturers could include copies of any recently superseded data books that they would normally throw away.

By the way, what happens to all those outdated issues of electronics magazines that the newsstands don't sell? I'd suggest that they be shipped off to the electronics schools instead of being thrown away. Rather that take a loss for magazines that are not sold, the publisher could write off the expense as "educational assistance."

I'm sure there are plenty of other good ideas out there for encouraging electronic technician training, but I think these make a good start.
KLAUS SPIES
Niles, IL

LCD PANEL REPAIR

In response to the *Q&A* inquiry titled "Dangerous Cleaner" (*Electronics Now*, February 1994), it might be possible to repair a broken LCD panel. If you can see the LCD segments while rotating a pair of polarized sunglasses over the display, it can probably be fixed easily.

Buy a low cost item with a small LCD display such as a game (about $6) and remove the tin-oxide coated polarizing sheets from the front and back. Place the appropriate sheet in front of the LCD panel in the proper orientation, and you're set.

I repaired an LCD watch this way. Its polarization coating was partially removed because of a cracked crystal and exposure to steam.
RON DOZIER
Wilmington, DE

IMPEDANCE MATCHING

I would like to respond to M. Bith's question that appeared in *Q&A* in April. Speaking from experience, I believe that Q&A's suggestion—matching a low-impedance microphone to a high-impedance input—would give very poor results.

It is apparent that Mr. Bith is already experiencing hum as well as low-level output. The amplifier would raise the microphone's output level, but I believe the hum would be increased proportionally.

High-impedance microphones have two disadvantages. First, microphone lines tend to pick up 60-Hz hum, which can be induced in the microphone cable line and/or its extension. Second, long microphone lines will drastically reduce high-frequency response because of the effective capacitance between the center conductor and shield.

Both of those drawbacks are eliminated with low-impedance microphones having a balanced line input. Generally, that means the use a microphone transformer. That transformer then accepts any induced voltage on one line and balances it out with an equal but opposite voltage on the other line.

Moreover, interconductor capacitance, while not reduced, has virtually no effect on the low impedance involved. Another approach takes advantage of the impedance switch found on most low-impedance microphones by allowing them to be switched to high. If that is done, use a single-conductor, high-impedance cable because has lower capacitance. I hope this suggestion helps.
DWIGHT EGGLESTON
Hendersonville, NC

COMPLEMENTARY PAIR PREAMP

Thank you for presenting Ray Marston's article, "Audio Amplifiers" (*Electronics Now*, March 1994). I have long been interested in audio circuits, especially those containing discrete transistors. Over the years, I've enjoyed reading articles on this subject in *Electronics Now* and before that in *Radio-Electronics*.

However, I can't recall seeing my favorite audio preamplifier circuit before—the complementary pair shown in Fig. 1. Here are some of its benefits: high input impedance (approximately R1) and a low output impedance (significantly lower than

Continued on page 82

EQUIPMENT REPORTS

BDM40 Benchtop Digital Multimeter

When performing benchtop troubleshooting or repair, it's best to use test equipment intended for benchtop use.

CIRCLE 14 ON FREE INFORMATION CARD

Most readers of this magazine are familiar with bench testing; it's a essential part of working with electronics. For infrequent testing, a handheld multimeter might be sufficient. However, anyone who is doing bench testing day-in and day-out needs test equipment better suited for benchtop use.

A handheld multimeter is the perfect tool for general-purpose testing both because of its versatility and portability. It can be a technician's "Swiss Army knife"—a real lifesaver for countless unexpected repairs. But you would never see an auto mechanic repairing a car with a Swiss Army knife—there are better tools for the job. Similarly, although a TV service center might have a few handheld multimeters in its equipment arsenal, you are sure to find benchtop test instruments being used for benchtop testing.

Benchtop test equipment is usually intended for making only a few specific kinds of tests. However, it is generally capable of making those measurements with greater accuracy and precision than handheld units. Traditional digital multimeter (DMM) functions are the measurement of AC and DC voltage, AC and DC current, and resistance. While some handheld units might boast ten times that number of features, the additional features usually lack the precision and operating range for professional work.

A person who uses a DMM every day wants a unit that's easy to position on a test bench and that stays put. The unit should also have a display that's easy to read from as wide an angle as possible. The liquid-crystal display on a portable DMM conserves battery power, but it can be hard to see from wide angles. Because battery power conservation is usually not a concern at the test bench, power-hungry LED displays, which are much easier to see, are practical.

The Wavetek BDM40

When buying a benchtop DMM it's a good idea to find one that strikes a happy median between price and performance—an example is the model *BDM40* from Wavetek Corporation (9045 Balboa Avenue, San Diego, CA 92123, 619-279-2955). This 4½-digit, true-RMS benchtop DMM has a list price of $429.

The BDM40 can measure AC and DC voltage in five ranges to 1200 volts, AC and DC current in six ranges to 20 amperes, and resistance in six ranges to 20 megohms. It can also test diodes. Each measurement range has automatic polarity detection, overrange indication, and overload protection. All of the measurement functions are enabled by interlocking pushbuttons, and the LED display characters are a ½-inch high. A pair of test leads, two spare fuses, and an instruction manual are included in the price.

The BDM40 is housed in a rugged gray plastic case that measures about 10 inches wide by 12 inches long. The rubber-cushioned carrying handle also doubles as a bail that locks into various positions making the DMM very easy to position. The power cord plugs into the back of the meter and, when not in use, can be wrapped around two plastic lugs molded onto the case. The back of the instrument, or the bottom depending on how you look at it, has two wide rubber feet that allow the DMM to stand in a vertical position.

Measurements

Four input jacks are provided on the front panel: volt/ohm, common, and 2- and 20-ampere current. The test probes must be plugged into the different jacks, depending on whether current or voltage and resistance is to be measured. A red push-on, push-off switch turns the power on and off.

The DMM can measure AC voltage to 1000 volts in 200-millivolt, 2-volt, 20-volt, 200-volt, and 1000-volt ranges. The true-RMS function is pushbutton-enabled for AC and AC + DC coupled measurements. DC voltage measurements can be made in the same ranges up to 1200 volts.

Alternating and direct current (AC and DC) can be measured in 200-microampere, 2-milliampere, 20 milliampere, 200 milliampere, 2-ampere, and 20-ampere ranges. Two current-input jacks are provided on the front panel of the unit; one is for measurements up to 2 amperes, and the other must be used for current measurements between 2 and 20 amperes.

Resistance can be measured in six ranges: 200 ohms, 2 kilohms, 20 kilohms, 200 kilohms, 2000 kilohms, and 20 megohms. In the first two ranges, the value of lead resistance will show up on the display.

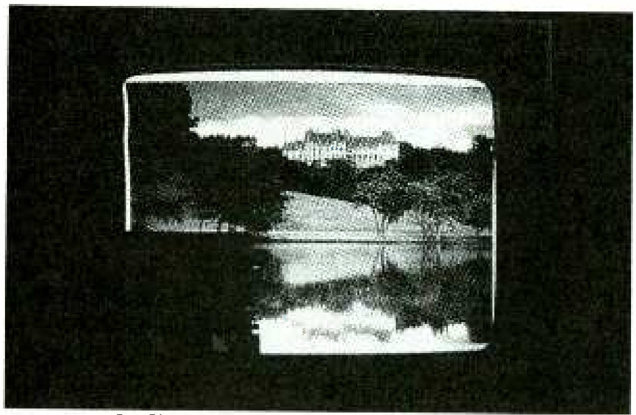
The 4½-digit (20,000-count) display can register measurements from 0000 to 19999. The polarity of the input signal is indicated by the appearance of a sign on the left side of the display. The position of the

Continued on page 77

NEW PRODUCTS

Use the Free Information Card for more details on these products.

VGA-TO-NTSC CONVERTER. The *VideoOut* plug-in card and software from *International Computers* allows the images on a computer screen to be displayed on a television monitor or be saved to videotape for a VCR. Capable of displaying text and graphics and both black and white and color screens, it can be used to create demonstration videotapes and instructional videos. *VideoOut* works on any IBM PC/XT/AT or compatible computer with a VGA display adapter. If the VGA card can send interlaced signals, *VideoOut* can display them on a television monitor in 480-line resolution. It will also work with non-interlacing VGA cards.



CIRCLE 20 ON FREE INFORMATION CARD

VideoOut includes a board that functions as a pass-through for the VGA video signals. A program remains resident until the hot key is pressed for start-up. The registers on the VGA card are reprogrammed to convert the video signal to NTSC timing.

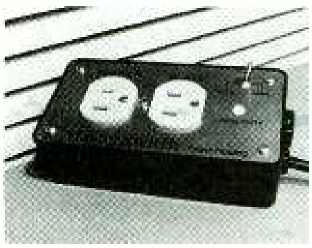
VideoOut supports both text and graphics modes. It contains a lookup table for determining the proper addressing and mode number for the VGA installed. It also identifies the specific board's manufacturer automatically.

The card is installed in the computer, and the cable from the VGA card is unplugged and plugged into the top connector of *VideoOut* card. The VGA cable provided is then plugged between the VGA card and the bottom connector of *VideoOut*. An additional cable included connects the *VideoOut* card to the television, monitor, or VCR.

The *VideoOut* 4.2 × 4-inch plug-in board, two cables and connectors, user's manual, and software diskettes are priced at $99.

International Computers
12021 West Bluemound Road
Wauwatosa, WI 53226
Phone: 414-764-9000

AC SWITCHING DEVICE. *The MasterSwitch* with master and slave AC outlets permits you to turn on your television with your remote control while it turns on your stereo or amplifier automatically. Now you can hear television sound through your stereo system with one convenient remote control setting.



CIRCLE 21 ON FREE INFORMATION CARD

Any electrical appliance plugged into the slave outlet will automatically switch on or off depending on the on/off status of the device which is plugged into the master outlet. The current level threshold at which the slave outlet switches is adjustable with a sensitivity control. That control can cause the unit to ignore low current being drawn from the master outlet. The *MasterSwitch* also includes an auto/manual switch.

The *MasterSwitch* works in most situations where you want the on and off function of one or more appliances controlled by a master appliance. A three-way tap or a power strip can be plugged into the slave outlet to control more than one appliance.

In the automatic position the *MasterSwitch* functions normally, but a manual position overrides the circuitry and turns on the slave outlet whenever desired. The maximum current rating for each outlet is 4 amperes (480 watts).

Plans, instructions and circuit board patterns for building your own *MasterSwitch* is priced at $7.50. That Documentation with a printed circuit board is priced at $14, and a kit with all documentation and parts is priced at $39 plus $4 S&H. A fully assembled and tested unit is priced at $49 plus $4 S&H. California residents add 8.25% sales tax.

Progressive Concepts
1313 North Grand Avenue
Suite 291
Walnut, CA 91789
Phone: 909-626-4969

12-DIGIT UNIVERSAL COUNTER. *Hewlett-Packard* has increased the resolution of its universal-counter family by 12-digits per second with its introduction of the *HP 53132A* 225-MHz universal counter. It is able to make high-resolution measurements in a fraction of the time required by conventional counters. This feature can speed up product testing and troubleshooting in computer-controlled systems whose data transfer rate exceeds 200 fully formatted measurements per second.

In addition to typical universal-counter measure-

CIRCLE 22 ON FREE INFORMATION CARD

ments, such as frequency, period, and time interval, the *HP 53132A* can measure pulse parameters, duty cycle, and frequency ratios. Built-in statistical and mathematical functions allow the user to display scaled measurement data. An optional third channel is available that can measure frequency up to 3 gigahertz.

Automatic limit testing permits the setting of upper and lower boundaries on any measurement. An analog display mode speeds testing by allowing users to see if a measurement falls within pass/fail limits.

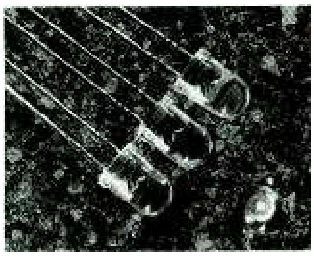
The counter logs and flags out-of-limit conditions, and it can generate an output signal to trigger external devices when a limit is exceeded. A single keystroke recalls up to 20 different panel setting that were stored after the instrument was set up for a specific application.

A standard HP-IB port provides full SCPI-compatible programmability, and a standard RS-232 (talk only) interface provides printer support or data transfer to a computer through a terminal-emulation program.

The *HP 53132A* universal counter, complete with operating, service, and programming manuals and a power cord, is priced at $2400.

Hewlett Packard Company
3000 Hanover Street
Palo Alto, CA 94304

HIGH-BRIGHTNESS LED'S. The red LED lamp in *Rohm Corporation's SLA-570 Series* provides luminous intensity of up to 2400 millicandelas (mcd) at 20 milliamperes, while a green LED lamp emits up to 750 mcd. Both LED lamps have 24° viewing angles. They are said to be suitable for illuminating airport terminal and stadium signs and theater marquees. Their use will avoid the cost and time required to replace incandescent lamps in those lighting applications.



CIRCLE 23 ON FREE INFORMATION CARD

The red gallium phosphide LEDs have typical forward voltages of 1.75 volts, and they dissipate 100 milliwatts; equivalent values for green gallium aluminum arsenide LEDs are 2.3 volts and 75 milliwatts. Both are rated for 100,000-hour MTBF.

Red *SLA-570* LEDs are priced at less than $.07 each, and green LEDs are priced at less than $.125 each when purchased in quantities of 10,000.

Rohm Corporation
3034 Owen Drive
Antioch, TN 37013
Phone: 615-641-2020
Fax: 615-641-2022

UNDERWATER METAL DETECTOR. The *Impulse* metal detector from *Fisher Research Laboratory* is intended for shoreline and underwater treasure hunting. Based on pulse induction (PI) circuitry, it has the ability to detect metal (in-

NEXT MONTH IN Electronics NOW

The August, 1994, issue is a real winner. The pages are jam packed with articles like:

COMMERCIAL EDITOR
Zap those annoying commercials from your video tapes.

RESTORE IT CORRECTLY
Doing it right with vintage audio gear.

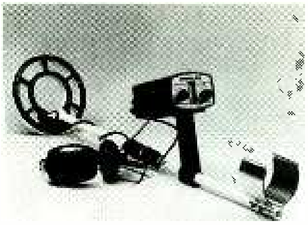
EPROM PROGRAMMER
Put the IBM PC input/output breadboard to work.

CIRCUIT NOTEBOOK
All about low-voltage converter circuits.

☆ Plus additional interesting articles, columns and departments on topics covering theory and equipment servicing.

The August 1994 Issue is on Sale JULY 5, 1994 Watch for it!

Pick Up *Electronics Now* at your favorite Newsstand, Convenience Store, Bookstore or Supermarket



CIRCLE 24 ON FREE INFORMATION CARD

cluding gold and silver) in salt water and black sand. Both of those materials are seen as targets by most metal detectors.

The detector's transmission frequency is 5,333 pulses per second. A voltage-controlled oscillator provides audio target response through a piezoelectric headset. An LCD bargraph displays signal strength and battery condition. The detector can have an 8- or 10-inch spider coil with a 7-foot cable. Alkaline AA power cells provide up to 100 hours of service.

The *Impulse* can withstand depths up to 250 feet. It has two control knobs: a threshold tone control sets the tuner for maximum sensitivity, and a volume control, which is also an on/off switch, adjusts headset volume.

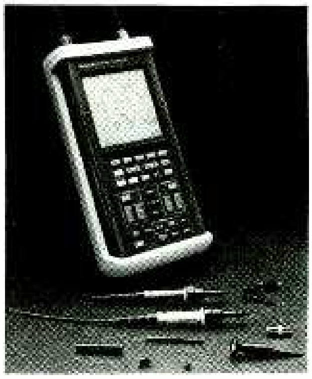
The *Impulse* underwater metal detector is $900.

Fisher Research Laboratory
Department EN
200 West Wilmott Road
Los Banos, CA 93635
Phone: 1-800-M-SCOPE-1

INSULATED PROBES. Oscilloscope probes from *ITT Pomona* are intended as replacements for factory-supplied probes for Fluke ScopeMeter 90 Series, Leader Model 300, and Hitachi 5025 handheld oscilloscopes.

The *6033 Scope Probe Kit* includes a paired set of *Model 6006* 10X probes (red and gray) with overvoltage protection to 360 volts rms. It is rated at 200 MHz, and includes fully insulated leads and an insulated BNC connector for direct interface.

Pomona has also introduced an new family of switchable (1X/10X) insulated probes that are sold separately. The *Model 6035* has a non-slip handle and a slide switch for the probe's attenuation range. A non-switchable *Model 6006* is also sold as a separate item.

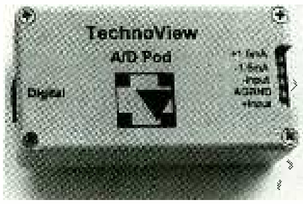


CIRCLE 25 ON FREE INFORMATION CARD

The *6035 is priced at $95 each, the Model 6006* is priced at $75, and *Model 6033* kit is priced at $125.

ITT Pomona Electronics
1500 East Ninth Street
Pomona, CA 91766-3835
Phone: 909-469-2900
Fax: 909-629-3317

PC-BASED DATA-ACQUISITION AND PROCESS-CONTROL TOOL. *TechnoView's A/D Pods* combine the functions of a 7½ to 8½-digit voltmeter, a digital output card, and a multichannel personal computer-based data-acquisition system. They were designed for use with bridge transducers that measure force, load, pressure, acceleration, flow, stress, and gain. The pods allow a sensor to be digitized and controlled over a serial RS-232 interface.



CIRCLE 26 ON FREE INFORMATION CARD

The A/D pods do not depend on amplifiers to permit the reading of low-level signals. An *A/D pod* is selected with a full-scale input voltage range that closely matches the output voltage range of the transducer. Each pod contains an A/D converter IC and voltage reference tuned to the required full-scale input range.

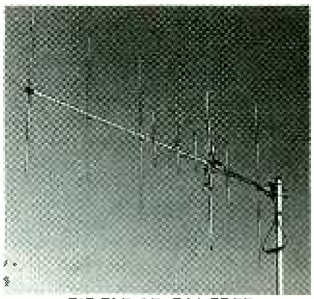
A/D Pods have full-scale inputs between 100 millivolts and 2.0 volts. The A/D IC offers ± 18 bits with 25 % overrange. The pod's *TVIHOST* data-acquisition software will run on computers with PC-DOS and Unix operating systems.

The *A/D Pod Senior* starter kit which includes eight *A/D Pods*, one PC-interface module, software, "C" driver source code, all necessary cables, and power supply is priced at $6,495. The *A/D Pod Junior* starter kit which includes four *A/D Pods* is priced at $4195.

TechnoView, Inc.
98 Baycrest Court
Newport Beach, CA 92660-2922
Phone: 714-854-5559

DUAL-BAND YAGI. *Cushcraft's A270-10S* dual-band Yagi array for two meters and 70 centimeters provides the gain and directional characteristics of a Yagi array with the convenience of a dipole antenna.

The boom for the *A270-10S* is six feet, two inches long, and weighs less than two pounds. Because its wind load is only 0.725 square feet, light-duty rotors can be used. The antenna covers both the 144- to 148-MHz and 430- to 450-MHz bands.



CIRCLE 27 ON FREE INFORMATION CARD

The *A270-10S* yagi array is priced $99.

Cushcraft Corporation
48 Perimeter Road
Manchester, NH 03103
Phone: 603-627-7877
Fax: 603-627-1764

DC POWER SUPPLY. *B+K's Model 1688* 3- to 14-volt DC power supply is intended to replace a 12-volt automotive battery for continuous duty operation. It can power mobile electronic equipment such as mobile cellular phones, car stereos, and amateur radios.

The *Model 1688* avoids concern for acid leaks from 12-volt automotive batteries, does not need recharging, and can tolerate short-circuited loads. It produces 35 amperes (nominal) and a maximum of 25 amperes at 13.8 volts volts DC, continuously, without overheating.

Output voltage of the

CIRCLE 28 ON FREE INFORMATION CARD

Model 1688 can be varied from 3 to 14 volts DC. Current and voltage can be monitored simultaneously on separate analog meters. The outputs are fully isolated, so either output terminal can be floated or grounded.

The *Model 1688* DC power supply is $299.

B + K Precision Corp.
6470 West Cortland Street
Chicago, IL 60635
Phone: 312-889-1448
Fax: 312-794-9470

LOW-PASS FILTER. The *Gatewave, Shape Shifter SL55* adjustable low-pass filter is intended for laboratory use. It is sold as a kit with an assortment of transmission-line segments that are combined by sliding them onto a metal core which also serves as the center conductor. A tubular jacket forms the outer conductor with removable SMA connectors.

The basic core has a characteristic impedance of 100 ohms. Transmission-line segments placed over the core provide characteristic impedances of either 50 or 20 ohms. The segments can form a stepped-impedance tubular filter. There can be from three to 11 segments. Each segment of transmission line is attached to the core with a special crimping tool.

CIRCLE 29 ON FREE INFORMATION CARD

Connections are electrically and mechanically secure, yet can be reconfigured in minutes. Cut-off frequencies range from 500 MHz to 5.0 GHz with up to 11 sections. Typical insertion loss is 0.2 dB at 1 GHz and 1 dB at 5 GHz. Its maximum power requirement is 10 watts. All components except the core are reusable and they are designed to last for at least 100 filter responses. More than 50 cores are included.

The *Shape Shifter SL55* kit, including instructions and all necessary tools is priced at $595.

Gavewave
Division of Parkview R&D, Inc.
565 Science Drive
Madison, WI 53711
Phone: 800-797-9283
Fax: 608-238-5120

SPECIALTY CABLE TESTER. *L-com's* cable tester can test for continuity and identify any video or data cable equipped with nine-pin, D-type subminiature cable connectors.


CIRCLE 30 ON FREE INFORMATION CARD

Twenty LEDs verify cable continuity, open and short circuits between conductors, and shield ground. The tester has two modes: continuous scan and manual step scan.

The *D-Sub 9 Cable Tester* is priced at $179.50.

L-com, Inc.
1755 Osgood Street
North Andover, MA 01845
Phone: 800-343-1455
Fax: 508-689-9484 Ω

VIDEO NEWS

continued from page 8

nents and video players will be the same device," he added. They will be in "wallet-sized packages containing a digital recorder and player with 100 gigabytes of built-in memory as well as removable cards on which programs can be downloaded."

As envisioned by Bermingham, the recorder/player of the future "will be battery-powered, and have a small color viewing screen; it will go from home to car to pocket." It will be able to digitally copy any software from any electronic source, with "an embedded computer program" keeping track of copied material and routing royalties to the "appropriate copyright holders."

All conventional recording media, "even those newest technologies, still involve mechanical devices," Bermingham said, noting they are "conceptually identical to the tinfoil recorder Thomas Edison discovered in 1877." Ω

NEW LITERATURE

Use The Free Information Card for fast response.

A Field Guide to Windows Icons: An Introduction to the Commonest Icons in North America; by Patricia C. Hedtke and John V. Hedtke. Osborne McGraw-Hill, 2600 Tenth Street, Berkeley, CA 94710; Phone: 510-549-6600; Fax: 510-549-6603; $7.95.

Learn the Windows operating system while laughing at the humor in this book that has a lighter look at Windows. By sending up the field-guide format familiar to bird-watchers, Windows learners at all levels of computer experience will be able to identify *iconus vulgaris* (common icons), *controllum panellum* (control panel) and *scribi microsoftii* (Microsoft Write).

CIRCLE 337 ON FREE INFORMATION CARD

Each entry includes the icon's common name followed by its Latin name, distinguishing marks, voice, a full description, and a single-sentence explanation of what the icon really does.

The book presents each common icon in its "natural habitat." The icon's attributes are examined, and its individual peculiarities are noted with a naturalist's eye for detail.

JEDEC Style Integrated Circuit Package Trays; 3M Electronic Products Division, 6801 River Place Blvd., Austin, TX 78726-9000; free.

This brochure describes 3M's full line of trays for transporting integrated circuits in quantity. The brochure discusses trays best


CIRCLE 338 ON FREE INFORMATION CARD

suited for high-, medium-, and low-temperature environments. All of the trays are designed to be compatibile with JEDEC tray outline stacking dimensions, and they are made with dimensional tolerances that match those of the IC packages. 3M will design and manufacture non-standard trays to customer specifications.

This brochure includes product specifications, pictures of the trays, ordering information, and a chart presenting the properties of the plastic materials used in making the trays for customer selection.

1994 Electronic Parts & Accessories Catalog; Parts Express, 340 East First Street, Dayton, OH 45401-1257; Phone: 800-338-0531.

This 188-page catalog describes the Parts Express line of electronic components. The line


CIRCLE 339 ON FREE INFORMATION CARD

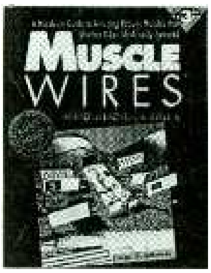
focuses on consumer-electronics products and hobbyist needs.

Among the products described in this 1994 catalog are speakers and audio accessories for home and car, audio products for home installation, professional audio equipment, and repair parts and accessories for CATV and VCRs. Other products available from Parts Express include telephone products, semiconductors, tools, chemicals, wire, connectors, computer accessories, and educational books and videos.

Muscle Wires Project Book, Third Edition; by Roger G. Gilbertson. Mondo-Tronics, 524 San Anselmo Avenue, No. 107, San Anselmo, CA 94960; Phone: 415-455-9330; Fax: 415-455-9333: $17.95; book with Muscle Wires sample kit: $34.95; book with Muscle Wires deluxe kit: $59.95.

This book discusses Muscle Wires™, nickel-titanium filaments that shorten when they are electrically powered. When heated, they act like human msucles. This characteristic gives them the ability to lift weights that are thousands of times their own weight. Until recently, these shape memory wires were little known outside of the scientific laboratory.

The author of this project book is the president of Mondo-Tronics, Inc., the company that manufactures Muscle Wires™. Mr. Gilbertson points out that they are now finding applications in teleoperated manipulators, mini- and micro-robotic devices, and heat-actuated tools. They can also actuate valves, relays, switches, circuit breakers, and temperature controlled devices.



CIRCLE 340 ON FREE INFORMATION CARD

The wires have been included in prosthetic limbs and heat-controlled medical instruments. Nevertheless, they are inexpensive enough to be suitable for animating dolls, toys, and puppets. When included in educational science kits and made available for home experimentation, they offer unlimited possibilities for amateur experimentation.

The author gives enough information in this book to permit the reader to design and build his own electromechanical and thermal-controlled devices with Muscle Wire™.

DC/DC Converters Application Note. Conversion Devices, Inc., 15 Jonathan Drive, Brockton, MA 02401; Phone: 508-559-0880; Fax: 508-559-9288; free.

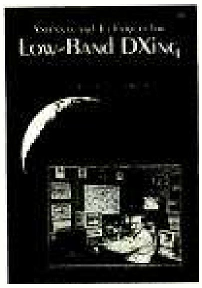
This comprehensive, eight-page technical note from Conversion Devices discusses applications for DC/DC converters in many different circuit configurations. It also gives designers advice on how to avoid many common DC/DC application problems.

CIRCLE 341 ON FREE INFORMATION CARD

The subjects in this application note include wiring and making connections, grounding, input circuits, output circuits, and the linking of multiple converters. Specific converter problems such as input transients and line drops are discussed. Circuit diagrams illustrate important technical points.

Antennas and Techniques for Low-Band DXing: Your Guide to Ham Radio DXcitement on 160, 80, and 40 meters; by John Devoldere, ON4UN. The American Radio Relay League, 225 Main Street, Newington, CT 06111; Phone: 203-666-1541; Fax: 203-665-7531; $20.

This book offers the tips and techniques intended to improve the performance of amateur radio operators and help them win DXing contests. Entry-level amateurs as well as seasoned amateur operators alike can profit from the information given in this book to



CIRCLE 342 ON FREE INFORMATION CARD

improve their on-the-air efficiency, whether they participate in DXing contests or not.

The topics discussed in DeVoldere's book include specific antenna systems that can improve station performance.Details about dipoles and vertical arrays are discussed. This guide has been updated regularly since it was first published in 1987. This latest edition has been expanded, and large sections have been rewritten to make them more valuable to a wider reader base.

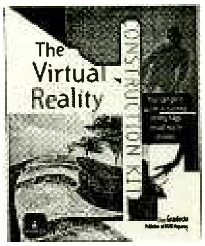
The author has made use of the latest and most powerful computer analysis and modeling tools in the preparation of his section on antennas. A revised equipment review section includes recent product introductions. Another important addition is a directory of outstanding low-band DX'ers. The listing includes their scores, and describes the equipment and antennas they have.

The Virtual Reality Construction Kit; by Joe Gradecki. John Wiley & Sons, Inc., 605 Third Avenue, New York, NY 10158-0012; $27.95.

This book allows you to immerse yourself in the subject of virtual reality regardless of your level of training and experience with computers, programming or electronic circuits.

The author has included detailed instructions for 18 inexpensive virtual-reality do-it-yourself projects. These range from adapting Nintendo PowerGloves and VictorMaxx 3D goggles, to building your own goggles, motion trackers, and 3D sound systems.

Gradecki's book includes a diskette containing all the software required to test, calibrate,



CIRCLE 343 ON FREE INFORMATION CARD

and run the virtual reality projects discussed in the book. It includes virtual worlds, which are accessible with your mouse and computer monitor. Projects in the book include "duck and fire" a robot combat game that can be played over modems.

You can also play virtual reality racquetball in a realistic virtual-reality court and hook up a bicycle to your computer and pedal through a virtual park. Other adventures includes lifting marble slabs and columns to build an ancient Greek virtual temple. Those readers with C programming experience can make use of the information in the book to generate their own programs.

1994 AUDIO DATA BOOK. Crystal Semiconductor Corporation, Literature Department, 4210 South Industrial Drive, Austin, TX 78744; Phone: 512-442-7555, ext. 254; free.

This 1072-page data book from Crystal Semiconductors covers its com-

CIRCLE 344 ON FREE INFORMATION CARD

plete range of audio integrated circuits. It contains detailed product descriptions and discussions of circuit functions.

Among the topics covered in this data book in six product categories are: digital-to-analog converters, analog-to-digital converters, combined ADCs and DACs, digital signal processors and synthesizers, digital audio transmitters and receivers, and volume controls.

Data sheets are provided for 23 products, including 11 new to this edition, application notes, and reprinted articles from the Audio Engineering Society publications.

Mastering Electronics Math, Second Edition; by R. Jesse Phagan. Tab Books Inc., Blue Ridge Summit, PA 17294-0850; Phone: 800-233-1128; $17.95.

This book was written as a guide to the understanding of the mathematics most widely used in electronics. It covers the practical calculations needed to design and troubleshoot circuits as well as test basic components.

Phagan has avoided the heavy theoretical approach taken in many mathemarics books. His explanations and sample problems that illustrate each concept are

Continued on page 83

Build this Amateur TV Station

Build your own two-way TV station that permits base and mobile operation

WILLIAM SHEETS AND RUDOLF F. GRAF

RADIO AMATEURS HAVE BEEN COMmunicating with two-way television for years, but their equipment was so expensive that it cost more than most amateurs could afford. However, recent advances in solid-state technology have drastically reduced the prices of the necessary components for amateur television (ATV) and made them available to a far wider group of amateur operators.

Today, many key components in ATV systems that were once either prohibitive in cost or unavailable are now stock items. These include VCRs, camcorders, low-priced, quality color TV receivers, and solid-state video cameras. Credit-card-sized cameras based on charge-coupled devices (CCDs) are now available for less than $200.

All of those components, together with the transceiver and transmitters described in this article, make the mobile, battery-operated TV station a reality. You can package a complete station in a case weighing less than 5 pounds that can easily be operated in the field.

In addition to two-way communications, the ATV projects presented in this article can be applied to radio-controlled model aircraft, boats, and cars. A transmitter and a small CCD camera placed in the vehicle act as "eyes" for the radio-controlled model; the view from the platform can be seen on a TV receiver. You can also build wireless video cameras, surveillance devices, and carry out unobtrusive nature studies. All this is possible with a package that fits in the palm of your hand and operates from AA power cells.

This is a two-part article; the first part describes the operation of the projects and the second part will cover the construction of them. There are four related ATV projects:

- Complete ATV transceiver with a 5-watt, three-channel transmitter, downconverter, line sampler, and RF switching relay
- 5-watt, three-channel transmitter only
- 3/4-watt, single-channel Mini ATV transmitter
- 3/4-watt, single-channel ATV Jr. transmitter (it is the same as Mini ATV but without audio capability)

The first project is a complete two-way amateur TV station, with a three-channel transmitter, an integral receiving converter, antenna relay, and test circuitry, all contained on a 3½- × 4-inch PC board. An integral heatsink that cools the RF power amplifier and modulator adds another ½-inch, making the overall size 4 × 4 × 1 inch.

Because some readers might want to build only the transmitter section, the PC board is designed so that the receiving section (the downconverter), relay, and line sampler (the test circuitry) can be omitted. That will result in a three-channel, 5-watt ATV transmitter measuring only 2½ × 4 inches, including the heatsink.

The transmitter can be made even smaller if transmitter power less than 5 watts is acceptable. The low-power transmitter, which measures 1¾ × 2¾ inches, generates a 0.5 to 1-watt output, and is powered from an 8- to 14-volt source. Because it can be powered by a 9-volt battery, this smaller version is suitable for many applications in radio-controlled model aircraft, boats, cars, and robots. Its circuitry is similar to the 5-watt version except that it has no high-power RF amplifier and modulator. Table 1 lists suggested applications for the different ATV units.

A valid Technician Class amateur license (which does not require a knowledge of Morse code) is required to operate these transmitters legally in the United States. Also, you should know that it is illegal to transmit on commercial frequencies with these units. If you do not have a license, you can operate these transmitters only into nonradiating dummy loads for test purposes. However, you can legally construct these units and you can listen to the transceiver, but you will need a license to transmit. Outside the U.S., similar laws might apply—check the regulations of the country you are visiting. A nocode amateur license is suitable, and if you can construct these projects successfully, you should be able to pass the required exam for an amateur license easily. Call your local amateur radio club, or a licensed radio amateur for details. You can also write to the American Radio Relay League (ARRL), Newington, CT 06111 for details. (203) 666-1541.

ATV transmissions can be received on a standard TV receiver with a simple downconverter that converts signals in the 420 to 450 MHz band down to a suitable IF frequency. In the lower VHF range, Channel 3 (60 to 66 MHz) or Channel 4 (66 to 72 MHz) are the IF frequencies most commonly used. A TV tuner usually can be modified to tune down to 420 MHz because all UHF TV tuners will tune as low as Channel 14 (470 MHz). Some cable-ready sets can also tune to certain UHF amateur frequencies. Channel 60 (cable), at 439.25 MHz, is the most commonly used amateur TV frequency. A downconverter provides the simplest approach, however. It can also be the most effective, because the downconverter can be made continuously tunable.

TABLE 1—ATV APPLICATIONS

5-Watt Transceiver	ATV base station ATV portable and mobile operations ATV video handie-talkies
5-Watt Transmitter	ATV base with separate down converters
3/4-Watt Transmitter	R/C video links Surveillance applications Remote sensing Wireless cameras

The projects to be described include relatively low-priced RF transistors characterized for 450-MHz operation to deliver 1 or 5 watts output. With a suitable antenna, a 30- to 40-mile range can be obtained, depending on factors such as height, terrain, local noise and interference levels, and path characteristics. A small antenna, such as simple 6-inch quarter-wave whip, will reduce the range. In general, simple antennas give unspectacular results. An efficient antenna at 450 MHz doesn't have to be large; a good Yagi antenna with over 10 dB gain need only be a few feet long.

The transceiver includes a three-channel 5-watt crystal-controlled transmitter that produces both picture and sound, a low-noise, tunable downconverter covering the 420 to 440 MHz ATV frequencies, a sampling circuit to monitor or test the transmitter output, and a changeover relay to perform antenna (RF) switching. The circuit draws less than 50 milliamperes when receiving and 800 to 900 milliamps when transmitting. Typically, the transmitter produces 6 watts peak output into a 50-ohms load.

Circuitry

Figure 1 is the ATV transceiver block diagram. Notice that the transmitter section is enclosed in dashed lines. The crystal oscillator produces a signal of about 110 MHz. The exact frequency depends on the crystals installed. Any three crystals whose frequencies are within 2.5 MHz of each other are suitable. They will allow a 20-MHz frequency spread between the three output frequencies. A PIN-diode network (Q1, D1, D2, D3) selects the appropriate crystal.

A tuned network couples the oscillator's second harmonic to doubler Q2, which produces a 220-MHz output. That is coupled to a second doubler, Q3, which again doubles the frequency to 440 MHz and produces 50 to 75 milliwatts of RF energy. A double-tuned network couples this energy to Q8 which can produce nearly 1 watt of RF energy. In the ¾-watt transmitter, Q8 is the final RF amplifier. (It is labeled Q4 in that version.)

Amplifier Q8 drives Q9 to produce an output of about 6 watts during modulation peaks. Video modulator Q10 is in series with the collector voltage supply to Q8 and Q9. It modulates the V_{CC} supply to Q8 and Q9 with the video signal it receives from amplifiers Q6 and Q7. A small sample of the RF output voltage is rectified by D11 and fed to emitter-follower Q14. The output of Q14 is the modulation envelope of the transmitted signal. The envelope can be observed with an oscilloscope, or it can drive a monitor so that you can check picture quality.

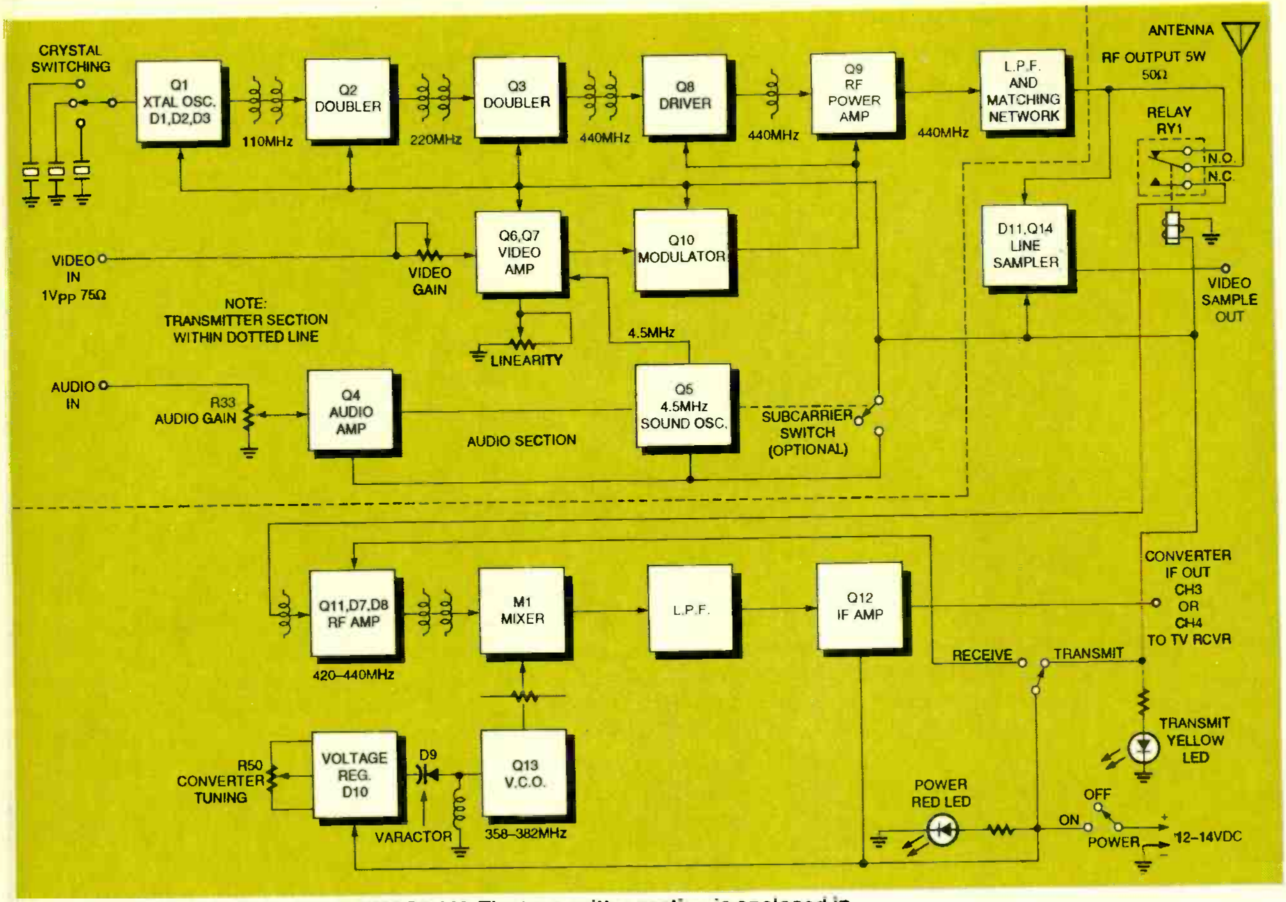


FIG. 1—ATV TRANSCEIVER BLOCK DIAGRAM. The transmitter section is enclosed in dashed lines.

The transmitter output is fed to relay RY1 which is activated by the transmitter V_{CC} line. The relay is used solely for RF switching. In the receive mode, the relay is de-energized and RF from the antenna is fed to down-converter RF amplifier Q11. The RF stage has a noise figure of less than 1 dB, a single-tuned input, and double-tuned output. Gain is about 20 to 23 dB. Signals from the RF amplifier are fed to double-balanced mixer M1 where they are mixed with the local oscillator (LO) signal from Q13. Voltage-controlled oscillator (VCO) Q13 has about a 15-MHz tuning range.

Varactor diode D9 is fed a bias voltage from tuning potentiometer R50. During transmit, DC voltage is removed from the RF stage. That reduces downconverter gain by about 50 dB. It also allows the downconverter to tune to the transmitted signal, which is useful for monitoring. The IF output of mixer M1 (60 to 72 MHz) feeds a lowpass filter that rejects UHF signals above 100 MHz. IF amplifier Q12 has a 20 dB gain, and it provides an IF signal to drive a standard TV receiver tuned to VHF Channel 3 or 4.

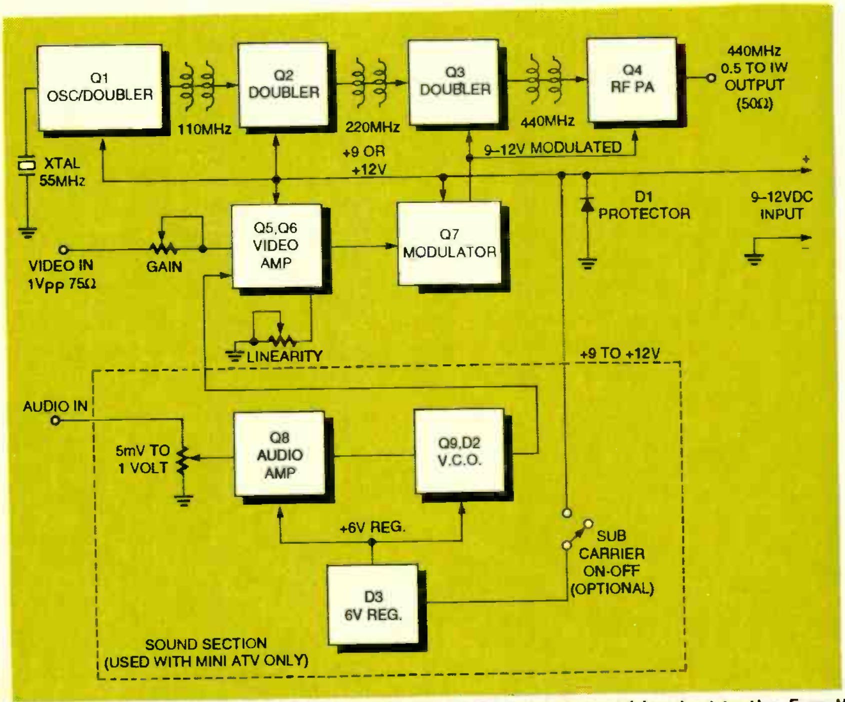


FIG. 2–BLOCK DIAGRAM OF THE ¾-WATT UNIT. It is almost identical to the 5-watt version except that it has no 5-watt stage or crystal-switching circuitry.

If audio transmission is also

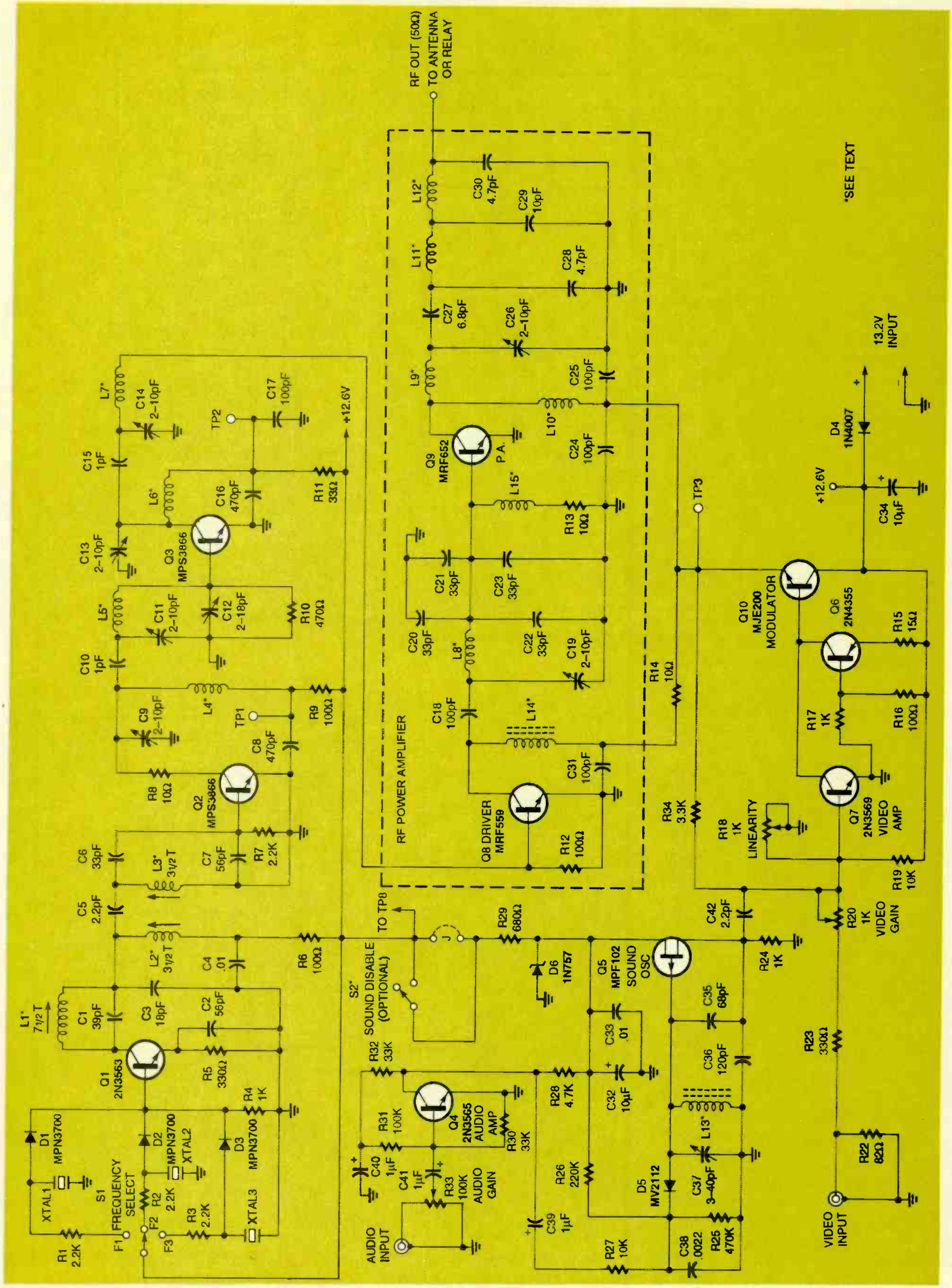


 FIG. 3—5-WATT TRANSMITTER. A 30- to 40-mile range can be obtained with a suitable antenna and favorable height, terrain, local noise and interference levels, and path characteristics.

desired, Q5 and D6 generate a frequency-modulated audio subcarrier at 4.5 MHz. The 4.5 MHz subcarrier is fed to video amplifier Q6-Q7, and it modulates the transmitted carrier. An optional subcarrier switch mutes the sound if desired. This feature is also useful for test purposes. The FM subcarrier produces a "fuzz" on the monitor waveform from Q14 if not turned off. The subcarrier can also generate colored stripes on the video from Q14 because of a beat with the 3.58-MHz color subcarrier. This occurs because some monitors do not have a sound trap in their video input circuits.

The ¾-watt version has a similar RF chain (see Fig. 2). Oscillator Q1 and doublers Q2 and Q3 are almost identical to those in the 5-watt version. Transistor Q4 serves as a power amplifier while Q5, Q6, and Q7 make up the video amplifiers and modulator, respectively. The main difference is in its lack of the 5-watt stage and crystal-switching circuitry.

A detailed circuit description of the 5 watt transceiver follows. Remember that the 5-watt transmitter is the transceiver without the downconverter, line sampler, and the RF relay. Also, much of the circuitry in the ¾-watt version is identical to the circuitry in the 5-watt unit, so only the 5-watt unit will be discussed here.

PARTS LIST—5-WATT TRANSMITTER

All resistors are ⅛-watt, 5%, unless otherwise specified.
R1–R3, R7—2200 ohms
R14—10 ohms, ¼-watt
R4, R17—1000 ohms
R5, R23—330 ohms
R6, R9, R12, R16—100 ohms
R8, R13—10 ohms
R10—470 ohms
R11—33 ohms
R15—15 ohms
R18, R20—1000 ohms, potentiometer
R19, R27—10,000 ohms
R21—not used
R22—82 ohms
R25—470,000 ohms
R26—220,000 ohms
R28, R34—4700 ohms
R29—680 ohms
R30, R32—33,000 ohms
R31—100,000 ohms
R33—100,000 potentiometer
R34 (alternate value)—2200 or 3300 ohms

Capacitors
C1—39 pF, NPO
C2, C7—56 pF, NPO
C3—18 pF, NPO
C4, C33—0.01 µF, disc GMV
C5, C42—2.2 pF, NPO (C42 alternates 1 or 3.3 pF)
C6—33 pF, NPO
C8, C16—470 pF, 20% disc
C9, C11, C13, C14, C19, C26—2–10 pF, trimmer (yellow body)
C10, C15—1 pF, NPO
C12—2–18 pF, trimmer (green body)
C17, C18, C24, C25, C31—100 pF, chip 60 × 120
C20–C23—33 pF, chip 60 × 120
C27—6.8 pF, NPO
C28, C30—4.7 pF, NPO
C29—10 pF, NPO
C32—10 µF, 16 volts, electrolytic
C34—10 µF, 16 volts, tantalum chip
C35—68 pF, NPO or SM
C36—120 pF, NPO or SM
C37—3–40 pF, trimmer (gray body)
C38—0.0022 µF, 50 volts, Mylar
C39–C41—1 µF, 35 or 50 volts, aluminum electrolytic

Semiconductors
D1–D3—Motorola MPN 3404 PIN diode (alternate MPN 3700)
D4—1N4007 diode
D5—Motorola MV2112 varactor diode
D6—1N757 diode
Q1—2N3563 transistor
Q2, Q3—Motorola MPS3866 transistor
Q4—2N3565 transistor
Q5—Motorola MPF102 FET
Q6—2N4355 transistor
Q7—2N3569 transistor
Q8—Motorola MRF559 transistor (alternate MRF627)
Q9—Motorola MRF652 transistor
Q10—Motorola MJE200 transistor

Inductors (all coils wound on 8-32 mandrel unless noted—inductances below 50 nH are approximate and may vary ±10nH)
L1—125 to 300 nH (7½ turns No. 22 enameled with Cambion Blue 8-32 × ¼ slug)
L2, L3—50 to 100 nH (3½ turns No. 22 enameled with Cambion Blue 8-32 × ¼ slug)
L4—30 nH (4 turns No. 22 tinned)
L5—39 nH (5 turns No. 22 tinned)
L6, L8—5 nH (½ turn No. 22 tinned)
L7—10 nH (1½ turns No. 22 tinned)
L9—7 nH (½ turn No. 20 tinned, 0.375" dia.)
L10—40 nH (5 turns No. 22 tinned)
L11—20 nH (2 turns No. 20 tinned)
L12—12 nH (1 turn No. 29 tinned)
L13—11 µH (12 turns No. 22 enameled on 0.375" toroid core)
L14—Bead choke, 43 matl
L15—part of R13

Other components
XTAL1—54.90625 MHz crystal
XTAL2—54.25000 Mhz crystal
XTAL3—53.28125 MHz crystal
S1—SP3T switch and hardware
S2—SPST toggle switch

Miscellaneous: 2 RCA jacks, 1 female BNC, 1 power connector, 1 LED, 1 1000-ohm ¼-watt resistor, No. 22 enameled wire, No. 20 tinned wire, No. 22 tinned wire, No. 32 enamelled wire, heatsink material, 1 TO220 mica insulator, 5 No. 2 × ¼" BHMS, 5 No. 2 nuts, 6 No. 4 locks, 1 No. 4 × ½" BHMS, 1 No. 4 nut, 1 No. 8 nut, 1 No. 8 lock, 1 No. 8 × 1" BHMS (for use as coil form), transmitter PC board, power-amp PC board

ATV transmitter

Figure 3 is the schematic for the 5-watt transmitter, Fig. 4 is the schematic for the Mini ATV, and Fig. 5 is the schematic for the ATV Jr. Transistor Q1, a 2N3563, forms part of the crystal oscillator. Depending on which of three crystals is selected by S1, a +12-volt bias is applied to R1, R2, or R3, which forward biases PIN diode D1, D2, or D3. The bias causes the PIN diode to appear as a resistance of a few ohms or less. Resistor R4 completes the path to ground and forms the bottom leg of a voltage divider, supplying about +3 volts bias to Q1's base. The corresponding crystal is connected to the base of Q1 through a PIN diode. In the ¾-watt version, R1 and R2 bias Q1's base to about +3 volts, and XTAL1 is connected between its base and ground.

At its series-resonant frequency, XTAL1 appears as a low impedance, effectively grounding the base of Q1. This forms a common-base oscillator at the crystal's series-resonant frequency. Frequency-selector switch S1 applies 12 volts to the selected crystal. Components L1 and C1 provide a high impedance load for the collector of Q1; L1 and C1 should be resonant at a frequency slightly higher than the crystal frequency (around 55 MHz or so). Because 55-MHz crystals are used, the oscillator frequency must be multiplied by 8 to obtain 440 MHz. While three doubler stages or a doubler and a quadrupler stage could do that, quadruplers are not usually efficient.

To minimize the number of

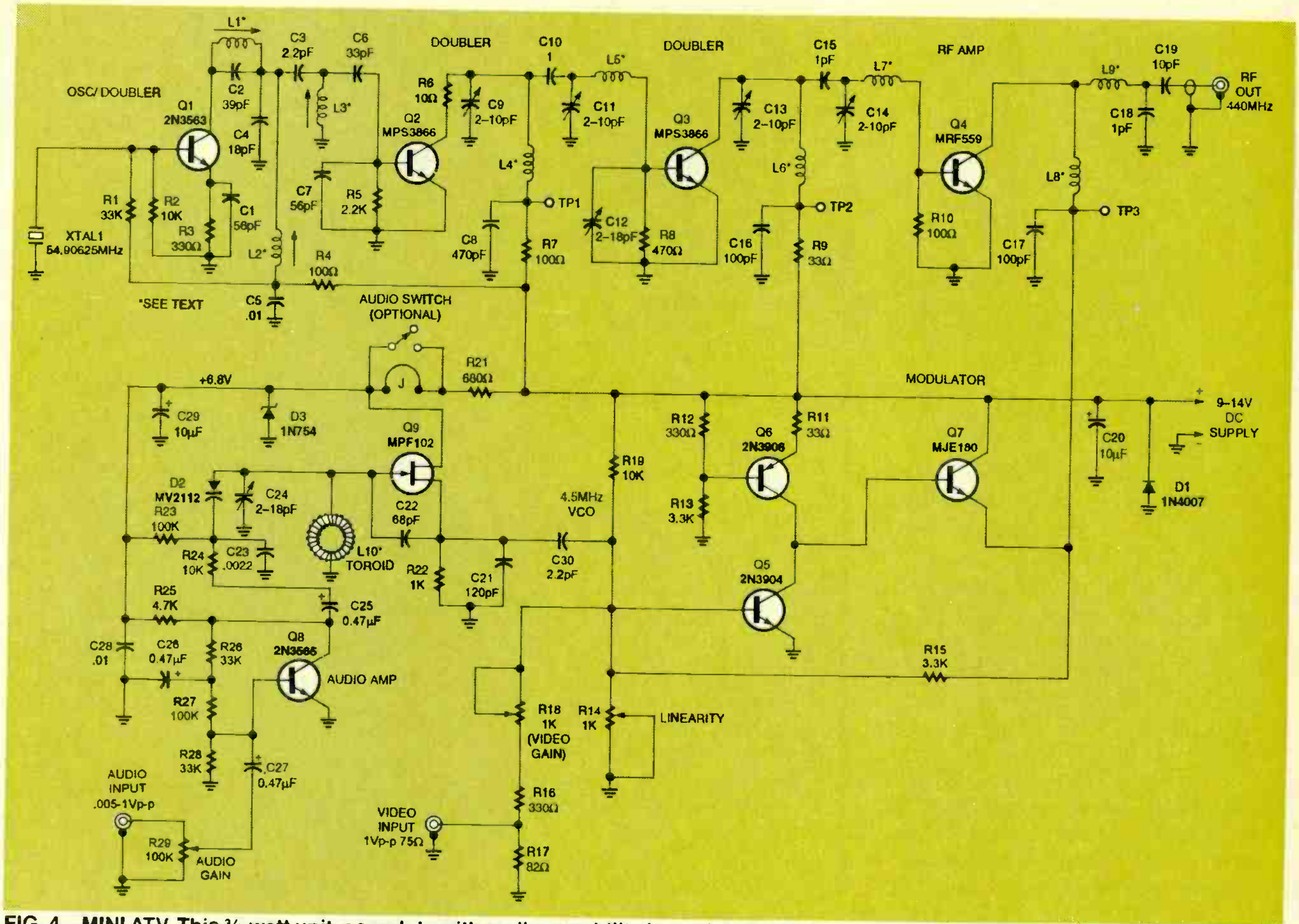


FIG. 4—MINI ATV. This ¾-watt unit, complete with audio capability is useful where size is a factor.

stages, the oscillator is made to act as its own doubler. This is done by placing a resonant circuit—L2 and C3—in series with the collector circuit, tuned to twice the crystal frequency. Capacitor C4 acts as a bypass capacitor. In the ¾-watt Mini ATV versions, the corresponding parts C4, L2, and C5 perform the same function. This circuit has a high impedance at 110 MHz, and it also appears as a very low impedance at 55 MHz. Similarly, L1-C1 appears as a high impedance at 55 MHz but a very low impedance at 110 MHz. Capacitor C5 couples 110 MHz energy to resonant circuit L3-C6-C7, which is tuned to 110 MHz. With this double-tuned circuit, a fairly clean 110-MHz signal is produced.

The RF voltage at the junction of C6, C7, and bias resistor R7 drives the base of Q2 (an MPS3866) fairly hard at 110 MHz. This results in a signal at the collector of Q2 that is rich in harmonics. The collector of Q2 is connected to oscillation-suppresser resistor R8 and to resonant-circuit C9-L4-C8 tuned to 220 MHz. Components C13 and L6 select the 220-MHz component of the signal and couple it via C10 to another tuned circuit, C11-L5-C12, also tuned to 220 MHz.

Notice that test point TP1 is located at the "cold" side of L4 in both the 5- and ¾-watt versions. It is the test point for measuring the DC current in the collector circuit of Q2. As more RF drive is applied to the base of Q2, more current is drawn by Q2. By monitoring the DC voltage drop across 100-ohms resistor R9 (R7 in the ¾-watt versions), it is possible to tune L1, L2, and L3 properly without detuning them. Adjust L1 to produce a voltage drop across R9, and then adjust L2 and L3 to maximize the drop, which can be as much as 4 to 5 volts DC. Base resistor R10 supplies 220-MHz bias to Q3 after RF rectification.

Transistor Q3 is driven hard, causing it to act as a highly non-linear amplifier. This stage draws 30 to 50 milliamperes of current. Tuned circuit C11-L5-C12 at the base of Q3 couples 220-MHz energy to Q3. Capacitor C10 couples the collector circuit of Q2 to the base of Q3. This provides a double-tuned circuit at 220 MHz, yielding good rejec-

5-WATT ATV TRANSCEIVER. This small package contains all the circuitry you'll need for transmitting, receiving, and downconverting a video signal complete with sound.

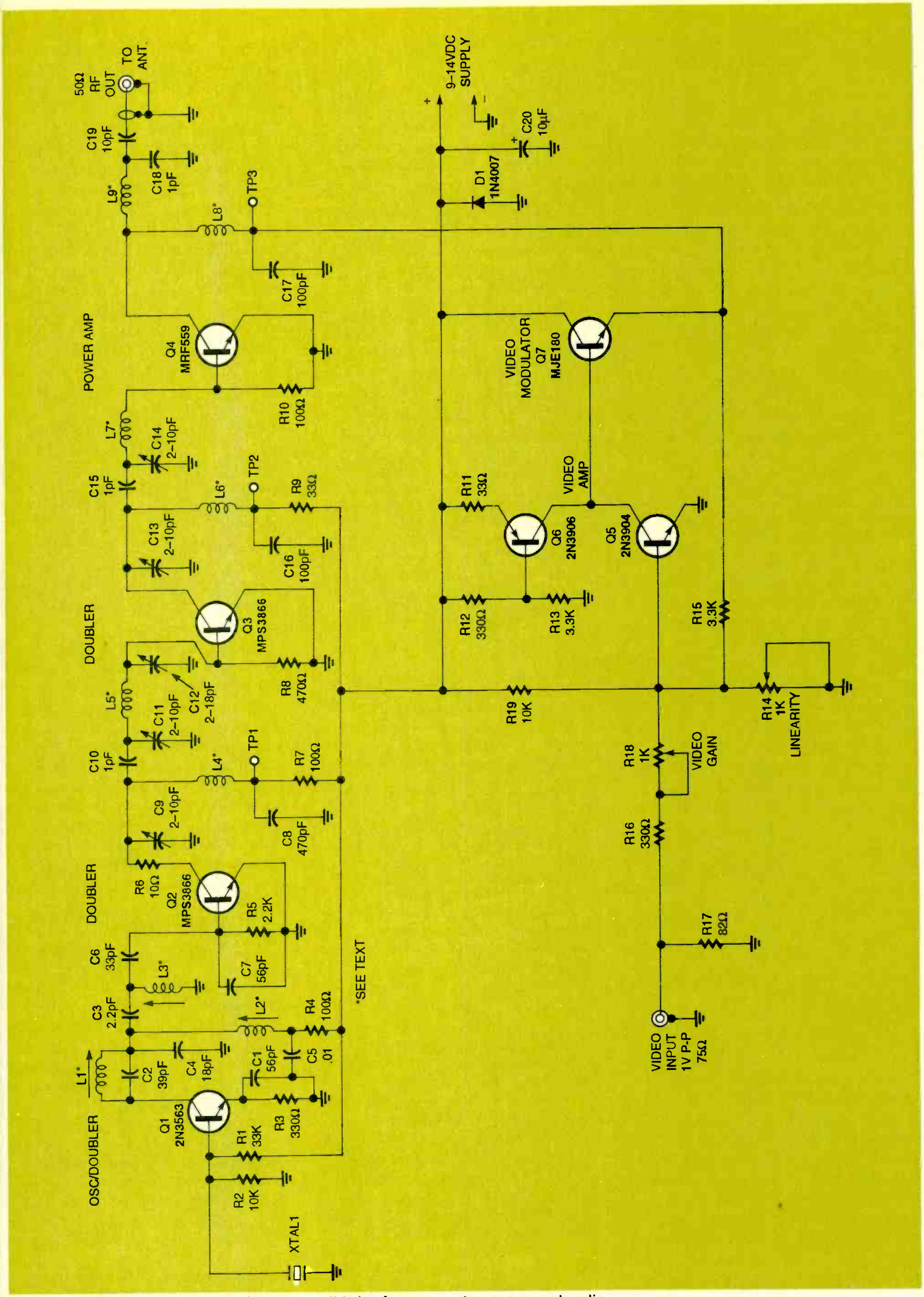


FIG. 5—ATV JR. If keeping cost as low as possible is of paramount concern, and audio output is not needed, build the ATV Jr.

PARTS LIST—5-WATT TRANSCEIVER

All resistors are ⅛-watt, 5%, unless specified

R1–R3, R7, R49—2200 ohms
R14—10 ohms, ¼-watt
R4, R17, R53, R55—1000 ohms
R5, R23, R45, R47, R56—330 ohms
R6, R9, R12, R16, R35, R36—100 ohms
R8, R13—10 ohms
R10, R41—470 ohms
R11—33 ohms
R15, R44—15 ohms
R18, R20—1000 ohms, horizontal-mount potentiometer
R19, R27, R46—10,000 ohms
R21—not used
R22—82 ohms
R25, R39—470,000 ohms
R26—220,000 ohms
R28, R34, R42—4700 ohms (7× gain R34 = 3300 ohms, 5X gain R34 = 2200 ohms)
R30, R32—33,000 ohms
R31, R38, R51—100,000 ohms
R33—100,000 ohms, horizontal-mount potentiometer
R29, R43—680 ohms
R37—47 ohms
R40—220 ohms
R48—6800 ohms
R50—1000 ohms, thumbwheel potentiometer
R52—470 ohms, ¼-watt
R54—3300 ohms (4700 ohms for normal use)

Capacitors

C1, C53—39 pF, NPO
C2, C7—56 pF, NPO
C3, C52—18 pF, NPO
C4, C33, C53–C55, C62, C67, C69, C70—0.01 µF disc GMV
C5, C42—2.2 pF, NPO (alternate C42—1 or 3.3 pF)
C6, C56—33 pF, NPO
C8, C16—470 pF, 20% disc
C9, C11, C13, C14, C19, C26, C43, C46, C57, C59—2–10 pF trimmer (yellow body)
C10, C15, C60, C64—1 pF, NPO
C12—2–18 pF trimmer (green body)
C17, C18, C24, C25, C44, C45, C47–C49—100 pF, chip
C20–C23—33 pF,60 × 120 chip
C27—6.8 pF, NPO
C28, C30—4.7 pF, NPO
C29, C65—10 pF, NPO
C32, C63, C66—10 µF, 16 volts, electrolytic
C34—10 µF, 16 volts, tantalum chip
C35—68 pF, NPO or SM
C36—120 pF, NPO or SM
C37—3-40 pF, trimmer (gray body)
C38—0.0022 µF, 50 volts, mylar
C39, C40, C41—1 µF, 35 or 50 volts, electrolytic
C50—0.6 pF (part of PC board)
C57—6.8 pF, NPO
C58—5.6 pF, NPO
C61—100 pF, NPO
C68—470 µF, 16 volts, electrolytic

Inductors (all coils wound on 8-32 mandrel unless noted—inductances below 50 nH are approximate and may vary ±10nH)

L1—125 to 300 nH (7½ turns No. 22 enameled with Cambion Blue 8-32 × ¼ slug)
L2, L3—50 to 100 nH (3½ turns No. 22 enameled with Cambion Blue 8-32 × ¼ slug)
L4—30 nH (4 turns No. 22 tinned)
L5—39 nH (5 turns No. 22 tinned)
L6, L8—5 nH (½ turn No. 22 tinned)
L7—10 nH (1½ turns No. 22 tinned)
L9—7 nH (½ turn No. 20 tinned, 0.375" dia.)
L10—40 nH (5 turns No. 22 tinned)
L11—20 nH (2 turns No. 20 tinned)
L12—12 nH (1 turn No. 29 tinned)
L13—11 µH (12 turns No. 22 enameled on 0.375" toroid core)
L14—Bead choke, 43 matl
L15—part of R13
L16—7 nH (½ turn No. 20 tinned)
L17, L18—20 nH (2 turns No. 20 tinned)
L19—75 nH (5 turns No. 22 enameled)
L20—200 to 550 nH (11½ turns No. 22 enameled with Cambion Blue, 8-32 × ¼ slug)
L21—8 nH (½ turn No. 20 square loop)
L22—18 µH RF choke

Semiconductors

D1–D3—Motorola MPN 3404 PIN diode (alternate MPN 3700)
D4—1N4007 diode
D5—Motorola MV2112 varactor diode
D6, D10—1N757 diode
D7, D8, D11—8200-2835 diode
D9—Motorola MV2103 varactor diode
Q1, Q12—2N3563 transistor
Q2, Q3—Motorola MPS3866 transistor
Q4—2N3565 transistor
Q5—Motorola MPF102 FET
Q6—2N4355 transistor
Q7—2N3569 transistor
Q8—Motorola MRF559 transistor(alternate MRF627)
Q9—Motorola MRF652 transistor
Q10—Motorola MJE200 transistor
Q11—NEC 25137 or NEC 25139 FET
Q13—Motorola MPSH81 transistor
Q14—2N3904 transistor

Other components

XTAL1—54.90625 MHz
XTAL2—54.25000 Mhz
XTAL3—53.28125 MHz
S1—2P3T switch
S2—SPST toggle switch
RY1—12-volt DIP relay
M1—SBL-1 mixer

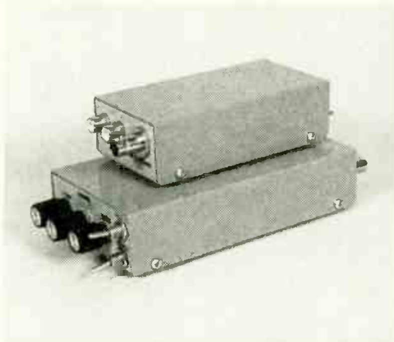
Miscellaneous: 2 RCA jacks, 1 female BNC, 1 power connector, 1 LED, 1 1000-ohm ¼-watt resistor, No. 22 enameled wire, No. 20 tinned wire, No. 22 tinned wire, No. 32 enameled wire, heatsink material, 1 TO220 mica insulator, 5 No. 2 × ¼" BHMS, 5 No. 2 nuts, 1 12" teflon cable, 1 2" potentiometer shaft, 6 No. 4 locks, 1 No. 4 × ½" BHMS, 1 No. 4 nut, 1 No. 8 nut, 1 No. 8 lock, 1 8 × 1" BHMS (for use as coil form), transceiver PC Board, power-amp PC board

tion of unwanted frequencies. Adjust trimmer C12 for optimum matching to the base of Q3.

Capacitors C16 and C17 form a resonant circuit tuned to 440 MHz. Inductor L6 is a half-turn loop of No. 20 wire (about 0.006 microhenry). Capacitor C17 has a low impedance at 440 MHz, and C15 couples the 440-MHz energy to tuned circuits C14 and L7. At this point, about 50 to 75 milliwatts of RF energy at the transmit frequency (426 to 440 MHz) is available. The same RF exciter circuitry (Q1-Q2-Q3) is in both the 5- and ¾-watt transmitters. Test point TP2 permits monitoring collector current of Q3 for tuning C9, C13, and C12. It is adjusted by peaking the three trimmer capacitors for a maximum current drain in Q3's collector. In the 5-watt version, Q8 and Q9 form a power amplifier. Resistor R12 provides self-bias for Q8, which receives base drive from tuned circuit C12-L7.

The collector circuit of Q8 consists of RF choke L14, bypass capacitor C31, and matching network C19 and L8. All bypass capacitors are ceramic chips. They are the only bypass capacitors that are both small and effective at 440 MHz. The collector of Q9 feeds matching network L9, C26, C27, C28, L11, C29, L12, and C30, which also acts as a lowpass filter. Harmonic output is a low 45 to 50 dB.

Transistors Q8 and Q9, which form the power amplifier assembly, are mounted on a separate heatsinked subassembly. Video-modulated DC is fed to



5-WATT TRANSMITTER (bottom) has audio output but it can't receive or downconvert video. Mini ATV (top) is a ¾-watt unit that can transmit audio and video.

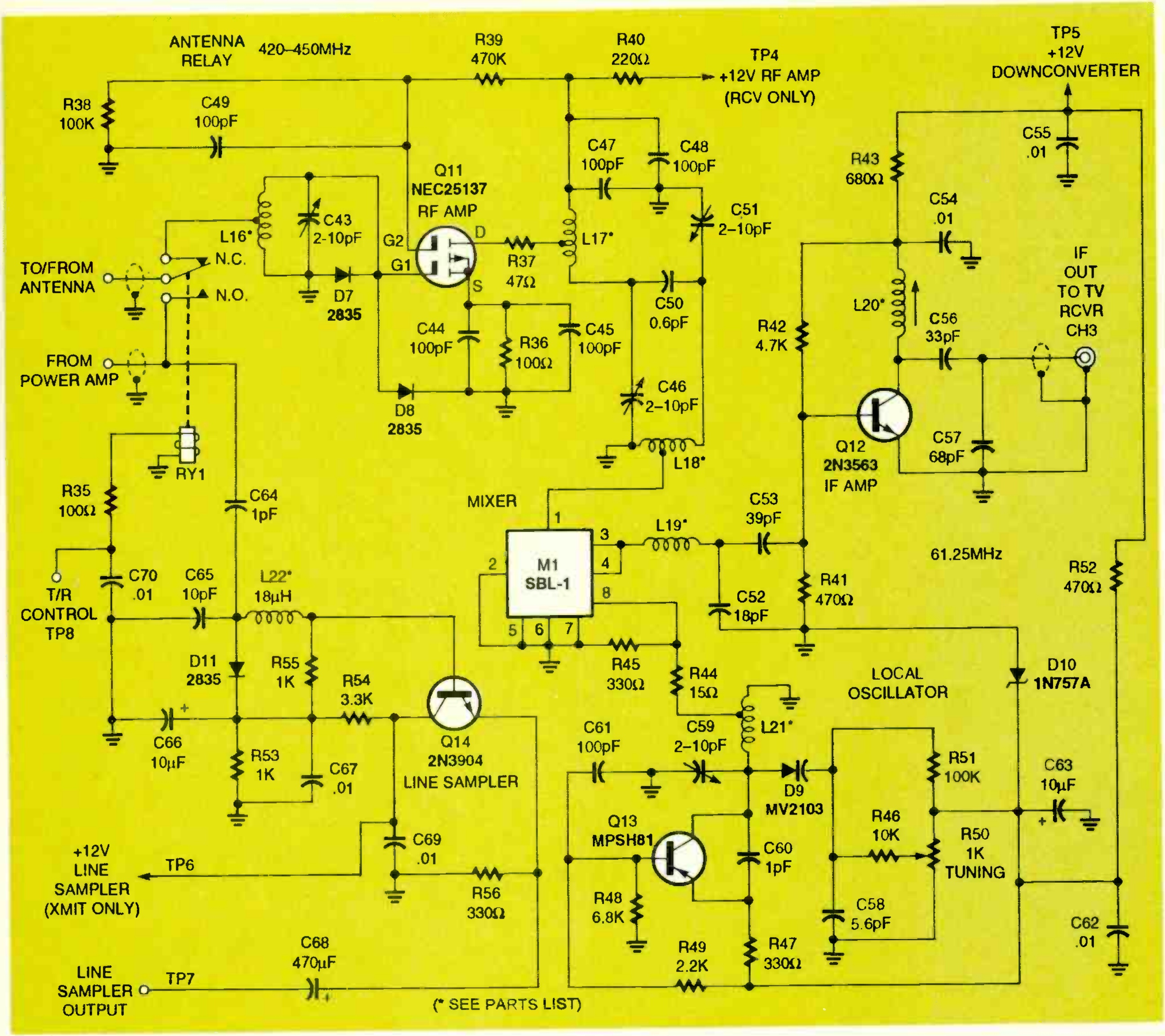


FIG. 6—DOWNCONVERTER, antenna relay, and line sampler. The downconverter consists of a tuned RF stage with a low-noise, dual-gate GASFET, a double-balanced diode mixer, an IF amplifier, and a varactor-tuned local oscillator.

PARTS LIST—ATV JR.

All resistors are ⅛-watt unless otherwise specified

R1—33,000 ohms
R2, R19—10,000 ohms
R3, R12, R16—330 ohms
R4, R7,—R10—100 ohms
R5—2200 ohms
R6—10 ohms
R8—470 ohms
R9, R11—33 ohms
R13—3300 ohms
R14, R18—1000 ohms, horizontal-mount potentiometer
R15—3300 ohms (alternate 2200 to 4700 ohms)
R17—82 ohms

Capacitors

C1, C7—56 pF, NPO
C2—39 pF, NPO
C3—2.2 pF, NPO
C4—18 pF, NPO
C5—0.01 μF, disc GMV
C6—33 pF, NPO
C8—470 pF, disc GMV
C9, C11, C13, C14 2–10 pF trimmer (yellow body)
C10, C15, C18—1 pF, NPO
C12—2–18 pF trimmer (green body)
C16, C17—100 pF, chip
C19—10 pF, NPO
C20—10 μF, 16 volts, chip

Semiconductors

D1—1N4007 diode
D2—Motorola MV2112 varactor diode
Q1—2N3563 transistor
Q2, Q3—Motorola MPS3866 transistor
Q4—Motorola MRF559 transistor
Q5—2N3904 transistor
Q6—2N3906 transistor
Q7—Motorola MJE180 transistor

Inductors (all coils wound on 8-32 × ¼" form unless noted—inductances below 50 nH are approximate and may vary ±10 nH)

L1—125 to 300 nH (7½ turns No. 22 enameled with 8-32 × ¼" Cambion Blue slug)
L2, L3—50 to 100 nH (3½ turnsNo. 22 enameled with 8-32 × ¼" Cambion Blue slug)
L4—30 nH (4 turns No. 22 tinned)
L5, L8—39 nH (5 turns No. 22 tinned)
L6—5 nH (½ turn No. 22 tinned 0.375" dia.)
L9—25 nH (2½ turns No. 22 tinned)

Other components

XTAL1—54.90625 MHz crystal

Miscellaneous: ATV Jr. PC board, 8-32 screw for coil winding

PARTS LIST—MINI ATV

All resistors are ⅛-watt unless otherwise specified
R1, R26, R28—33,000 ohms
R2, R19, R24—10,000 ohms
R3, R12, R16—330 ohms
R4, R7,—R10—100 ohms
R5—2200 ohms
R6—10 ohms
R8—470 ohms
R9, R11—33 ohms
R13—3300 ohms
R14, R18—1000 ohms, thumbwheel trimmer potentiometer
R15—3300 ohms (alternate 2200 to 4700 ohms)
R17—82 ohms
R20—not used
R21—680 ohms
R22—1000 ohms
R23, R27—100,000 ohms
R25—4700 ohms
R29—100,000 thumbwheel trimmer potentiometer
Capacitors
C1, C7—56 pF, NPO
C2—39 pF, NPO
C3—2.2 pF, NPO
C4—18 pF, NPO
C5, C28—0.01 µF, Disc GMV
C6—33 pF, NPO
C8—470 pF, Disc GMV
C9, C11, C13, C14—2–10 pF trimmer (yellow body)
C10, C15, C18—1 pF, NPO
C12, C24—2–18 pF trimmer (green body)
C16, C17—100 pF, chip
C19—10 pF, NPO
C20—10 µF, 16 volts, chip
C21—120 pF, NPO or SM
C22—68 pF, NPO
C23—0.0022 µF, 50 volts, mylar
C25–C27—0.47 or 1.0 µF, 35 volts, tantalum electrolytic
C29—10 µF, 16 volts, electrolytic
C30—1 to 3.3 pF, NPO (1 pF, and 2.2 pF supplied in Mini-ATV kits—value determines sound subcarrier level)
Inductors (all coils wound on 8-32 × ¼" form unless noted—inductances below 50 nH are approximate and may vary ±10 nH)
L1—125 to 300 nH (7½ turns No. 22 enameled with 8-32 × ¼" Cambion Blue slug)
L2, L3—50 to 100 nH (3½ turnsNo. 22 enameled with 8-32 × ¼" Cambion Blue slug)
L4—30 nH (4 turns No. 22 tinned)
L5, L8—39 nH (5 turns No. 22 tinned)
L6—5 nH (½ turn No. 22 tinned 0.375" dia.)
L9—25 nH (2½ turns No. 22 tinned)
L10—11 µH (12 turns No. 22 enameled on toroid)
Semiconductors
D1—1N4007 diode
D2—Motorola MV2112 varactor diode
D3—1N754 diode
Q1—2N3563 transistor
Q2, Q3—Motorola MPS3866 transistor
Q4—Motorola MRF559 transistor
Q5—2N3904 transistor
Q6—2N3906 transistor
Q7—Motorola MJE180 transistor
Q8—2N3565 transistor
Q9—Motorola MPF102 FET
Other components
XTAL1—54.90625 MHz crystal
Miscellaneous: Mini ATV PC board, 8-32 screw for coil winding form

Note: The following items are available from North Country Radio, PO Box 53, Wykagyl Station, New Rochelle, NY 10804-0053:
- **5-watt transceiver kit (contains PC boards, all parts that mount on them, chassis connectors suitable for basic operation, and three crystals for 439.25, 434.0, and 426.25 MHz)—$179.00**
- **5-watt transmitter kit (contains PC boards, all parts that mount on them, suitable chassis connectors for basic operation, and three crystals for 439.25, 434.0, and 426.25 MHz—downconverter and line sampler components and RF switching relay NOT included)—$149.00**
- **¾-Watt Mini-ATV kit (contains PC board and all parts that mount on it with crystal for 439.25 MHz operation)—$79.00**
- **¾-Watt ATV Jr. kit (contains PC board and all parts that mount on it and crystal for 439.25 MHz operation)—$59.00**
- **Test Crystals (CH14, 15, 16, 17, 18, for test or export only—not legal for on the air transmission in the USA) and others for 434.0-, 427.75-, 426.25-, and 421.25-MHz are available—$8.50 each, specify channel**
- **Other ATV kits for 440- and 915-MHz and CCD cameras are available—contact North Country Radio for details**
- **A complete catalog of kits is available from North Country Radio—send $1.00 with a self addressed stamped (52 cents) envelope**

Please include $4.50 for the first item and add $1.00 for each additional item for postage and handling. New York residents add sales tax.

L10 and through R14 to L14. Capacitors C24, C25, and C31 have low impedance at 440 MHz but high impedance at the higher video frequencies. The modulator must deliver video at 10 to 12 volts p-p into a 12-ohm load. This requires a power amplifier with a response from DC to 4 MHz. Modulator Q10 is installed on the same heatsink as Q8 and Q9.

A 440-MHz signal is fed through L7 to the base of Q8. About 0.5 to 1 watt of RF is produced by Q4, depending on the supply voltage. A matching network is formed by L9, C18, and C19. The network is broadband, and fixed tuning was found to be adequate. Notice that in the ¾-watt version, the V_{CC} supply fed to Q4 is the only modulating source.

The video modulating circuit in both transmitter circuits is identical except for component values. Transistor Q10 is part of a feedback-pair video amplifier with Q7 acting as a video amplifier. Transistor Q6 supplies constant current to the base of Q10, assuring drive at peak voltages. This current produces a larger voltage swing than if a resistor were used in the collector of Q6.

The quiescent point (zero signal voltage) is set by the ratio of feedback-resistor R34 to linearity-control resistance R18, as well as gain-control potentiometer R20. Adjust R20 for maximum gain without white or black clipping, and adjust R18 to set the operating point. Input video should be between 0.7 to 1.5 volts p-p, negative sync.

Audio

The audio channel (not used in the ATV Jr.) is basically the same in all versions. It consists of a preamplifier stage built around a 2N3565 (Q4) with a voltage gain of about +43 dB. In both 5-watt boards, audio is fed to gain-control R33 through coupling capacitor C41 to the base of Q4. Audio developed across R28 is coupled by C39 and R27 to varactor diode D5. The oscillator frequency is determined by L13 and the capacitance that shunts it. This is the series equivalent of C36 and C35, the input capacitance of Q5, trimmer C37, and the varactor diode capacitance.

Adjust the oscillator by setting C37 for operation at 4.5 MHz. When an audio signal is applied to the junction of C38, R25, R26 and D5, the effective capacitance of D5 varies with the instantaneous voltage across it. This response causes

Continued on page 84

THE 'LED-HEAD'

Build this amusing Electronic Face that appears to change mood when the LEDs that define its features are randomly switched.

ROGER SONNTAG

HUMANS RESPOND TO CHANGES IN the expressions on other human faces that reflect emotional state—happiness, anger, depression, boredom, and so on. Psychological studies have shown that people respond to those changes regardless of their gender, cultural background, race, or age difference.

Most people draw inferences (rightly or wrongly) about the mood of others by noticing relatively minor changes in facial features—the tilt of the eyebrows, the cast of the eyes, and the turn of the lips. The Electronic Face reproduces these effects symbolically with an array of 36 LEDs positioned to represent a line drawing of the eyebrows, eyes, and mouth of a human face.

The LEDs on the circuit board are illuminated for varying lengths of time by oscillators set to change waveforms at different time intervals. These variations impart a randomness to the changes in facial expression. You'll find that this dynamic electronic display attracts a lot of attention—even from people who normally wouldn't pay much attention to electronic circuits.

Wear it around your neck on a cord, place it on your desk, or hang it up as decoration, and watch other people respond to its many changing faces. They'll be curious about it and want to know how and why the expressions change.

If you build the Electronic Face you'll learn about astable multivibrators based on Schmitt trigger inverters. The periods of the square-wave outputs of each oscillator can be set manually by adjusting trimmer potentiometers on the circuit board.

How does it work?

Random triggering of the array array of 36 LEDs arranged to outline eyebows, eyes and mouth by Schmitt-trigger inverter oscillators can cause the face to smile, frown, move its eyes from side to side, and arch its eyebrows.

Figure 1 is an elementary schematic for each Schmitt trigger inverter circuit that is organized as an astable multivibrator to produce a variable square-wave output. A resistance-capacitance network consisting of a 1-megohm trimmer potentiometer in a feedback loop around the oscillator and a 47-microfarad capacitor from input to ground permit manually changing the RC time constant. This, in turn, changes the duty cycle of the output square wave. The trimmer is normally set at about its 500-kilohm mid-range position

Manually changing the trimmer's wiper position can change the frequency of the oscillator's square-wave output from 5 pulses per second down to once

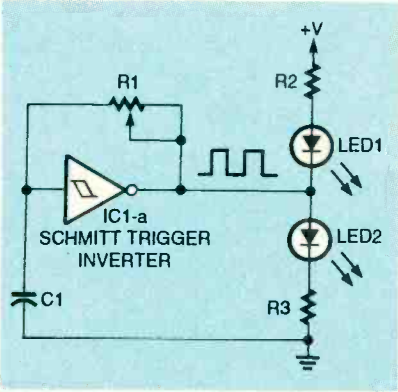


FIG. 1—BASIC CIRCUIT of the Electronic Face is a Schmitt trigger inverter with a feedback resistor and a capacitor to ground. The circuit sources or sinks LEDs.

PARTS LIST

All resistors are ¼-watt, 10 %.

R1, R2, R5, R7, R14, R15—330 ohms

R2, R3, R6, R8, R12—220 ohms

R9, R10, R11, R13—680 ohms

R16, R17, R18, R19, R20—1 megohm trimmer potentiometer three-pin, PC mount, single-turn rotary unit.

Capacitors

C1, C2, C3, C4, C5,—47 µF, 10 volts, radial-leaded, aluminum electrolytic

Semiconductors

IC1—MC74HCT14 hex Schmitt trigger inverter, plastic DIP or equivlent (see text).

LED1–LED36—light-emitting diode, red, radial-leaded, T1 package (see text)

Miscellaneous: circuit board, red translucent plastic filter (see text); battery holder (see text); mounting board or case (see text), AC to DC adapter and coaxial jack (optional—see text); solder; fastening hardware

Note: The following options are offered by General Science and Engineering, P.O. Box 447, Rochester, NY 14603, 716-338-7001.

- **Completely assembled and mounted circuit with filter, wall-outlet adapter, and matching jack—$59.00**
- **Kit of parts including circuit board, all components, and filter, less case, and battery holder—$24.00**
- **Wall outlet AC- to DC-adapter.—$5.00**

Money orders, Visa, or Master Card accepted. Add $3.00 S&H. New York State residents add local tax.

every 50 seconds. Each circuit can source or sink current to turn on the LEDs.

Figure 2 is a schematic for the Electronic Face. Five of the six gates of IC1, a 74HCT14A CMOS hex Schmitt trigger inverter drive the LEDs by sinking or sourcing them. The shading indicates the positions of the 36 LEDs that define the eyebrows, eyes, and mouth of the circuit. The features will change at different rates when set by adjusting trimmer potentiometers R16 to R20.

Motorola offers an MC74HCT14A hex Schmitt trigger inverter IC, but any of the following can be substituted: Motorola MC74HC14A, MC14584B or the Harris CD40106B. All of these parts have the same pinout diagram, and pins 3 and 4 are unused.

Making the Face

An octagonal circuit board is recommended for the construction of this project. A foil pattern for this circuit board is included in this article, but a finished, trimmed and drilled board can be obtained from the source given in the Parts List as part of a kit.

Before inserting and soldering any components, decide how you want to mount the circuit board and whether you want to power it from four power cells or a wall outlet-

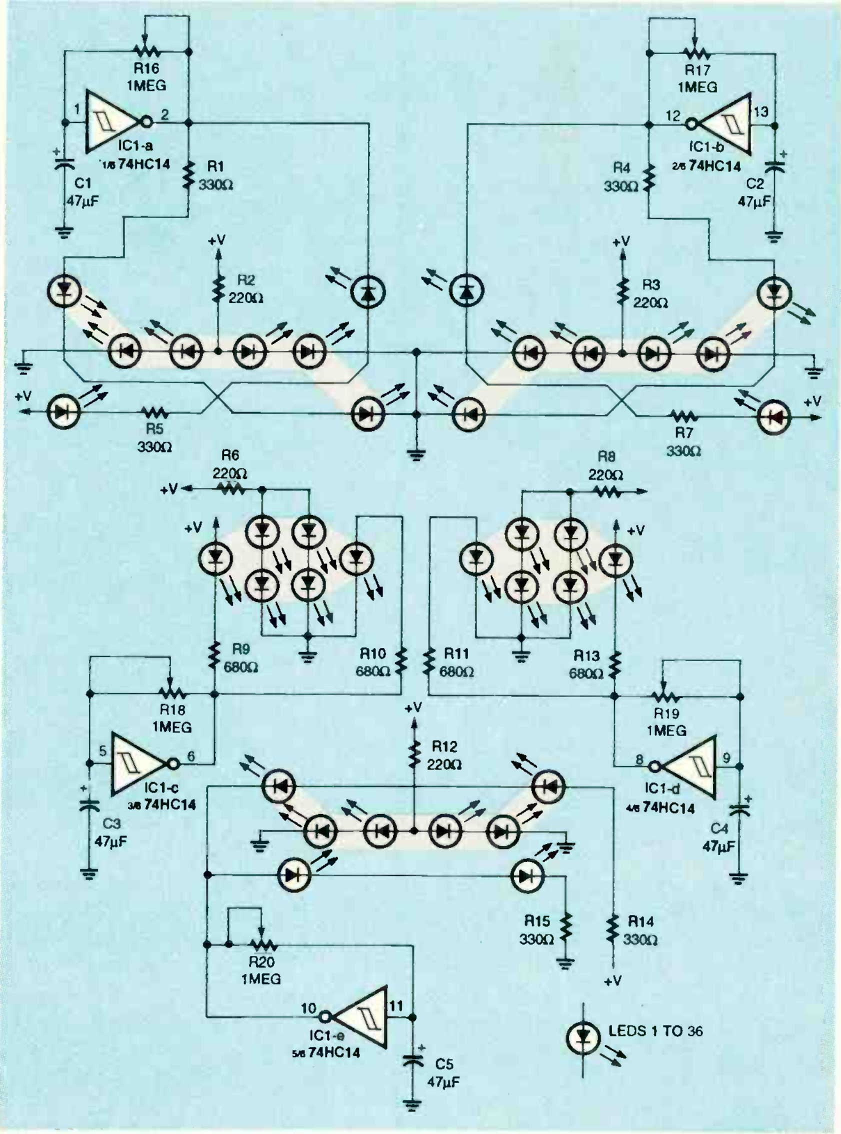


FIG. 2—SCHEMATIC FOR THE ELECTRONIC FACE. The shading defines the LEDs for each moving feature. Five of the six Schmitt trigger inverters in a hex IC illuminate the face LEDs to show mood changes.

mounted AC to DC adapter. Drill the clear mounting holes at the edges of the circuit board if you make your own.

Refer to Fig. 2 and component side parts placement diagram Fig. 3. Form and insert resistors R1 to R13 on the component side of the PC board and solder all leads with a soldering pencil with a fine tip set at a heat level satisfactory for melting rosin-core solder. Trim the leads close to the board

Form and insert the leads of electrolytic capacitors C1 to C5 in the board, observing their correct polarities. Solder the leads and trim them close to the board. Insert trimmer potentiometers resistors R16 to R20, solder them in position and trim excess leads.

The LEDs to be soldered on the solder side of the board are specified as red, radial-leaded units in T1 cases. They might or might not have flat surfaces at their bases. However, even without the flats, the cathode lead is typically the shorter of the two. (The LED die is mounted on the cathode lead.) It is recommended that all LEDs be tested to see that they are functional with a suitable battery before they are inserted in the board.

Reverse the circuit board and this time refer to Fig. 2 and solder-side parts placement diagram Fig. 4. Insert the LEDs in the circuit board in clusters of six to eight, observing their correct polarities. Adjust the height of the LED bases about ¼ inch above the board. Avoid bending the leads of the LEDs when inserting them. Solder those LEDs and trim their leads close to the board.

Continue inserting and positioning the LEDs in small clusters until all 36 have been soldered and trimmed. Then recheck their polarities to be sure that placement was correct. Note: the LEDs can be inserted from the component side and soldered on the foil side without changing the operation of the circuit, if you prefer.

Insert and solder IC1 on the solder (foil) side of the circuit board. Then recheck the complete board looking for solder bridges or cold solder joints (dull gray). Make any repairs needed.

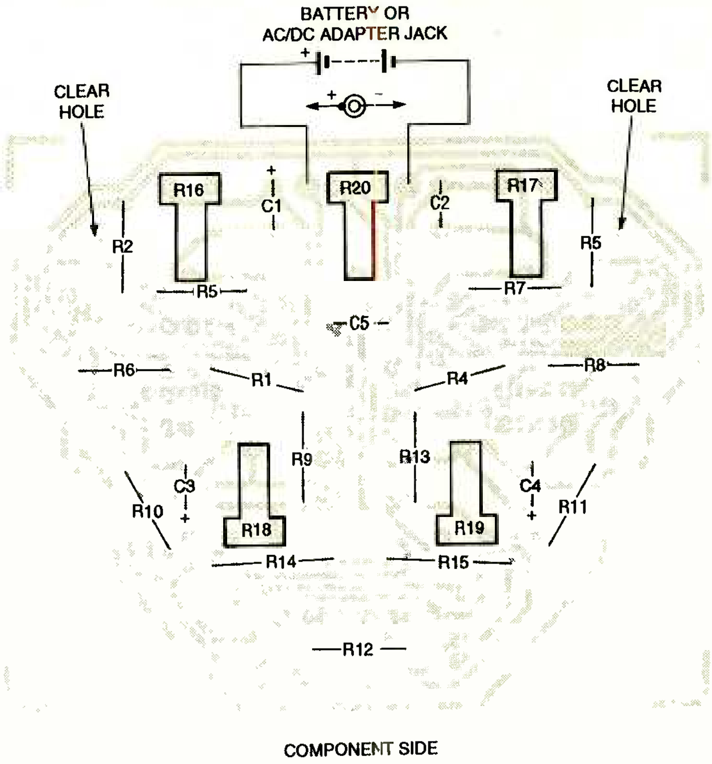


FIG. 3—COMPONENT SIDE PARTS PLACEMENT DIAGRAM for the Electronic Face.

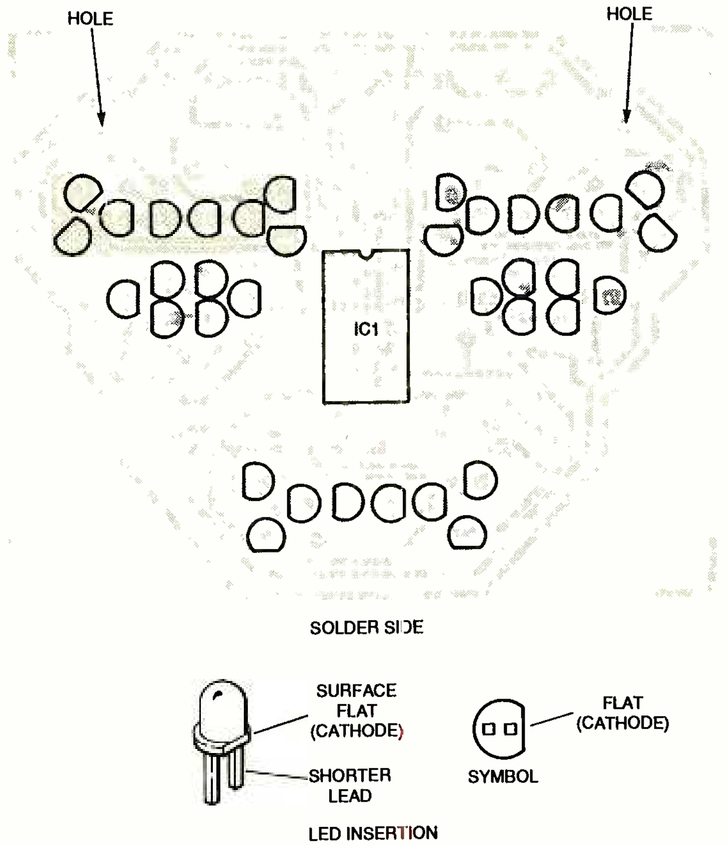
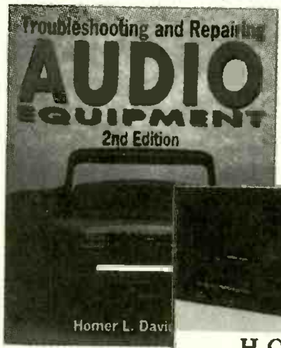


FIG. 4—SOLDER SIDE PARTS PLACEMENT DIAGRAM for the Electronic Face.

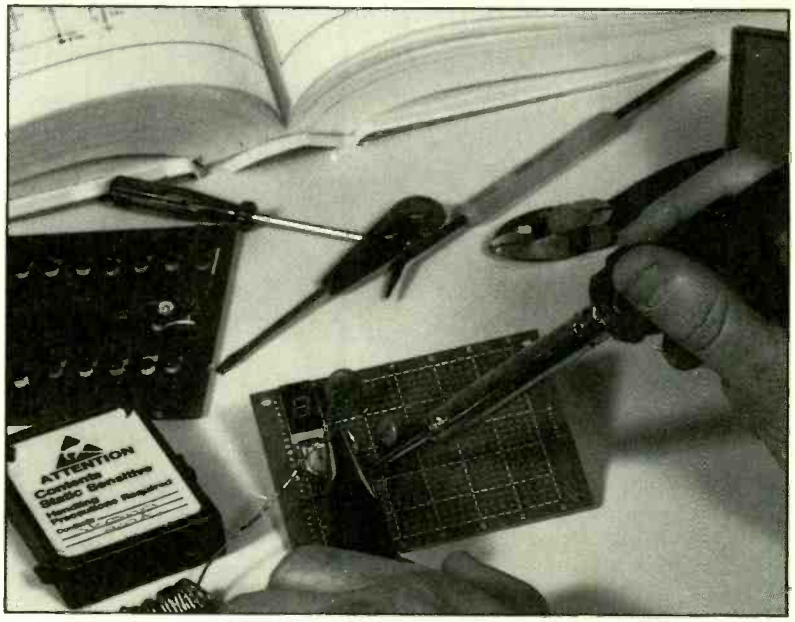
Circuit operation

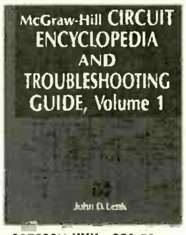
Adjust each of the trimmer potentiometers R14 to R17 with



4112H-XX $29.95
Counts as 2

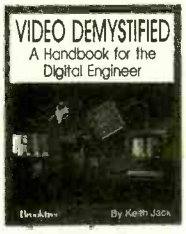
3711P $19.95
Softcover



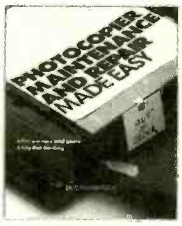


037603H-XXX $59.50
Counts as 3

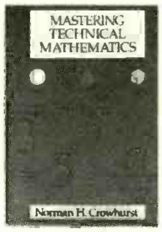
4179H $28.95



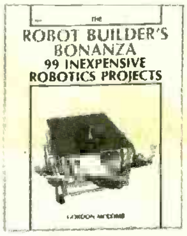
586446H-XX $29.95
Counts as 2



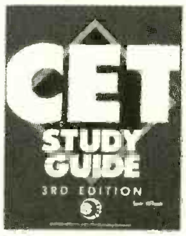
4326P $14.95
Softcover



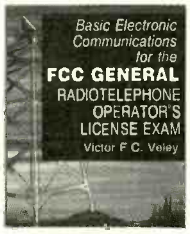
3438H-XX $39.95
Counts as 2



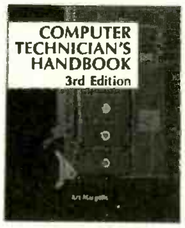
2800P $17.95
Softcover



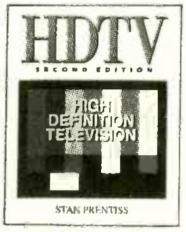
4076P $17.95
Softcover



4055H-XX $34.95
Counts as 2

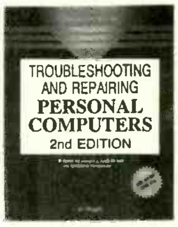


3279P $24.95
Softcover

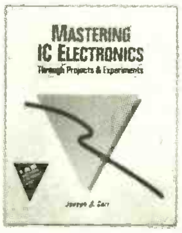


4323H-XX $29.95
Counts as 2

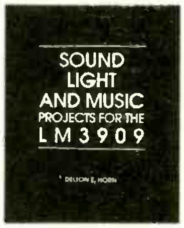
2724P $17.95
Softcover



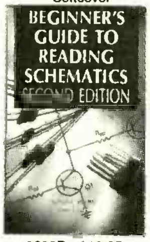
3677H-XX $34.95
Counts as 2



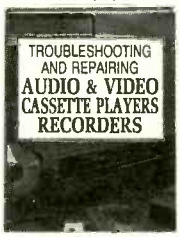
3660H $32.95



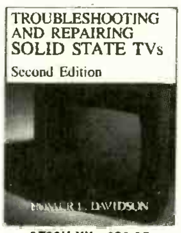
4110H $27.95



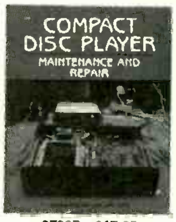
3632P $10.95
Softcover



3795P $19.95
Softcover



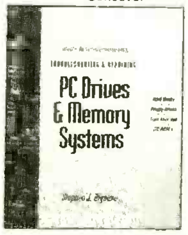
3700H-XX $36.95
Counts as 2



2790P $17.95
Softcover

3550H $34.95

586354H-XX $30.00
Counts as 2



4491H $39.95

3457P $19.95
Softcover

4283H $26.95

3887H $26.95

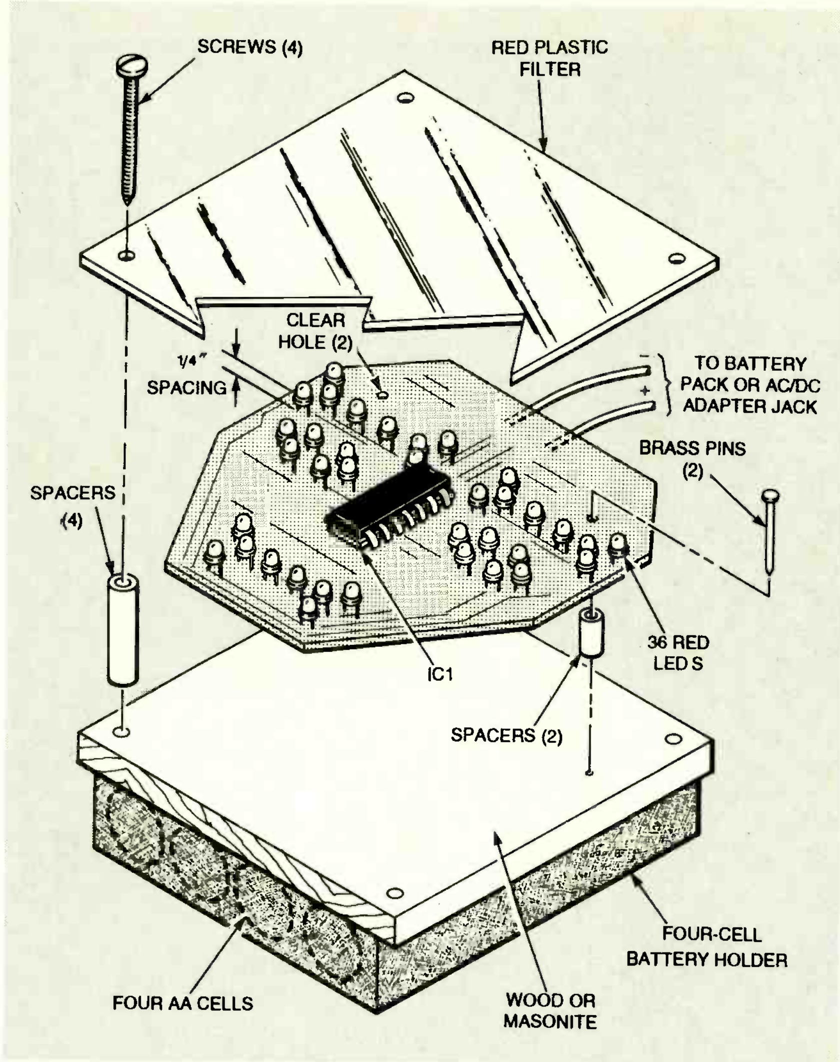
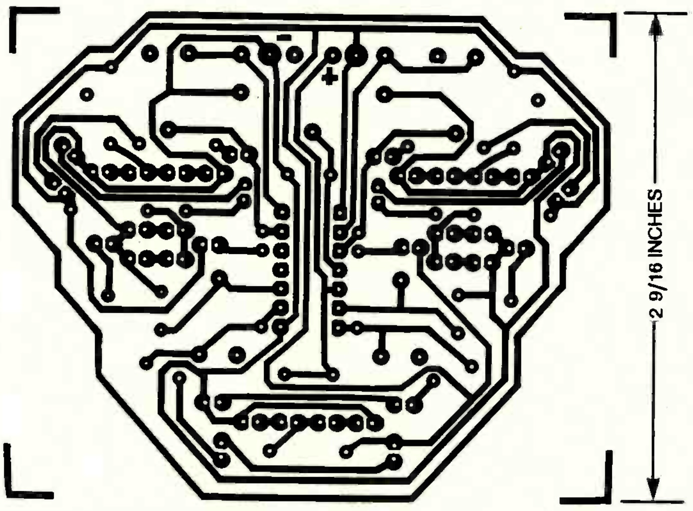


FIG. 5—MECHANICAL ASSEMBLY. The mounting board can be wood or even a suitable plastic case. The three parts are assembled with screws, nuts, pins and spacers.



FOIL PATTERN for Electronic Face.

an insulated tool and check to see that each Schmitt trigger oscillator section is switching. Then adjust the time constants sc that the "facial" pattern will change with reasonable frequency. A good place to start is with the following settings:

Feature	Time (seconds)
Eyes	2 to 3
Eyebrows	4 to 10
Mouth	8 to 15

Packaging the circuit

Refer to the mechanical assembly diagram Fig. 5 for one possible packaging configuration. There are, however, many other possibilities. For the most effective display, it is recommended that the LEDs be covered with a red filter made from red-dyed transparent sheet plastic. The red filter screens out obvious variations in the brightness level of individual LEDs and masks the circuit components and circuit board traces that would otherwise be visible on the board.

If you want to power the face with batteries, obtain a battery holder for four AA cells (Radio Shack No. 270-383 or equivalent). Determine the lengths of the wires from the holder wires that you will need after you have decided how you want to mount the circuit.

Strip the ends of the insulated hookup wire from the holder, and solder the red wire in the hole marked + on the circuit board and the black (ground) wire in the hole marked −. The four AA cells will provide a DC voltage of about 5 volts for battery-powered circuit operation.

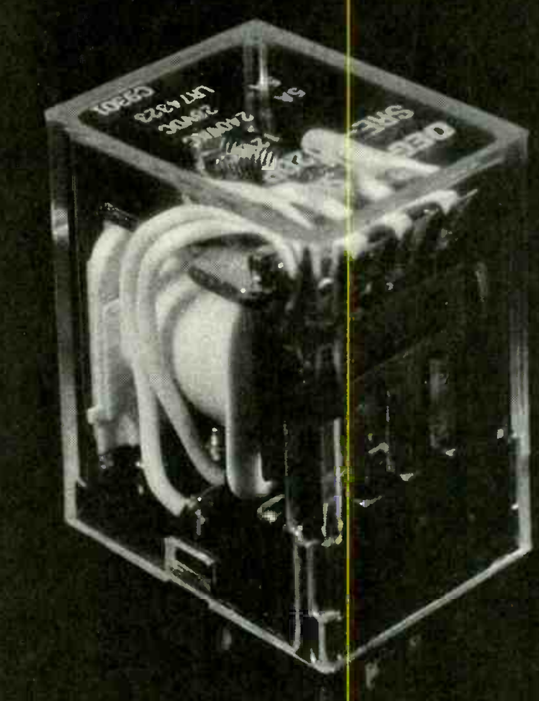
Alternatively, Electronic Face can be powered from a 120-volt AC to 6-volt DC wall-outlet adapter. This should be a UL Listed Class 2 transformer with a rating of 120 volts AC, 5 watts and an output of 6 volts DC at 150 to 200 milliamperes. The circuit board can be mounted on a square ⅛-inch plywood or Masonite of appropriate size to permit the circuit board to be sandwiched between the filter and substrate. Allow enough room for nuts, bolts and spacers near the edges if you elect to power the face from cells in a battery holder. If you use a battery holder, cement or bolt it to the underside of the mounting board.

Alternatively, you might want

Continued on page 90

RAY MARSTON

RELAY OUTPUT CIRCUITS



Learn to design transistorized circuits that can switch and time relay functions remotely with low-power input.

THIS ARTICLE CONTINUES THE relay switching circuit theme of last month by presenting a selection of practical control circuits for electromagnetic relays. Last month's article discussed the basic operating principles and application rules for four well-known relay classes—the electromagnetic relay (EMR), the reed relay, the solid-state relay (SSR), and the CMOS bilateral switch.

High-impedance relays. Electromagnetic and reed relays are low-impedance, electromechanical devices whose typical coil impedance values range from tens to hundreds of ohms while input drive signal sources typically have much higher impedance values. Maximum power is transferred between the input drive signal and the relay coil when the source and load impedances are matched.

This is accomplished by inserting additional circuitry between the input drive signal and the relay coil. These circuits can be either a transistor stage or a transistor stage with one or more IC logic gates. Figures 1 to 4 show four different ways to boost the input impedance of a relay with transistors and logic gates.

Transistor Q1 in Fig. 1 is organized as a simple common-emitter amplifier that increases the effective sensitivity of the 12-volt coil of relay RY1 about one hundred times (e.g., the current gain of Q1 in this circuit is about 100). The introduction of this amplifier stage reduces relay sensitivity to a few volts.

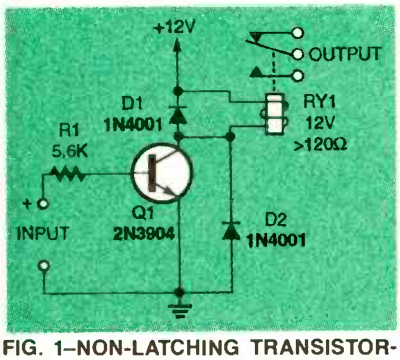


FIG. 1—NON-LATCHING TRANSISTOR-driven relay switching circuit.

Resistor R1 puts safe limits on the input current to Q1, and it also determines the effective input impedance of the circuit. (The impedance is equal to the value of R1 plus about 1 kilohm.) Diodes D1 and D2 damp the coil's back EMF. (See last month's article.) The contacts of relay RY1 can control external circuitry.

Figure 1 is a schematic for a *non-latching* relay driver circuit. Relay RY1 is OFF when the input voltage is less than 600 millivolts and ON when the input voltage exceeds a few volts. This driver circuit can be made *self-latching* by modifying it as shown in Fig 2. Relay RY1 now has two sets of normally open (NO) contacts; the upper set is

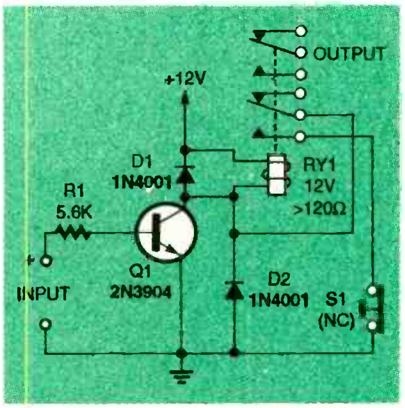


FIG. 2—SELF-LATCHING TRANSISTOR-driven relay switching circuit.

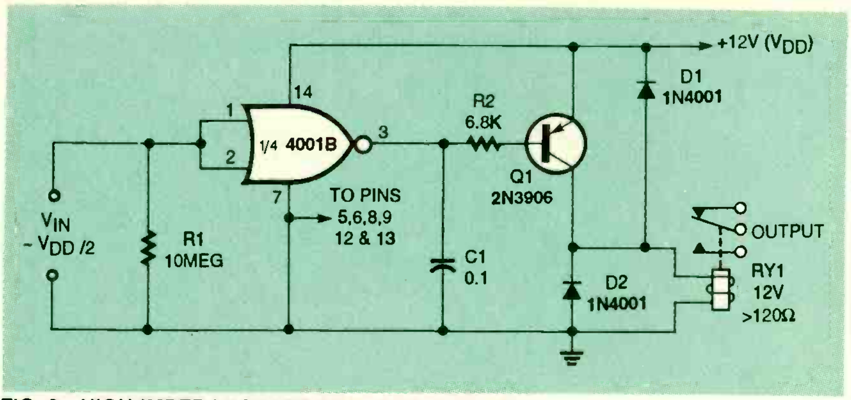


FIG. 3—HIGH-IMPEDANCE RELAY switching circuit.

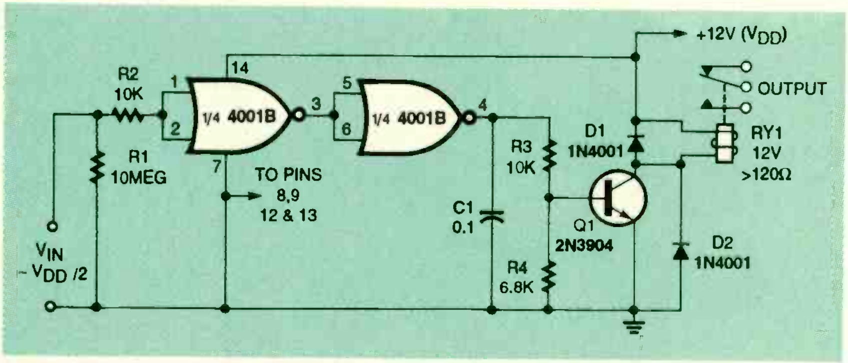


FIG. 4—MODIFIED HIGH-IMPEDANCE relay switching circuit.

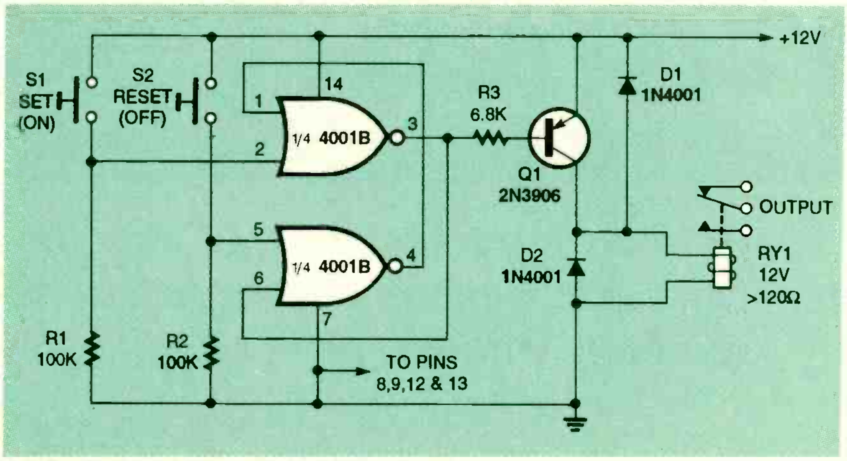


FIG. 5—BISTABLE RELAY SWITCHING circuit.

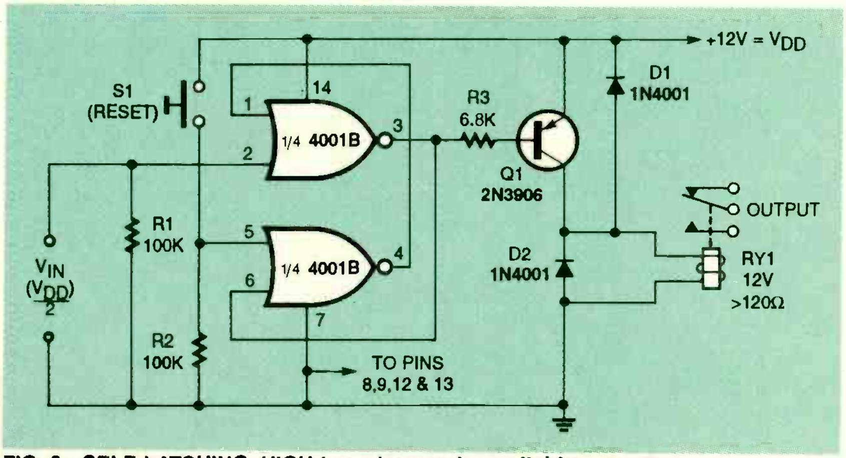


FIG. 6—SELF-LATCHING, HIGH-impedance relay switching circuit.

for the relay's output and the lower set is for latching. The latching set is in parallel with Q1, and it is actuated by normally closed (NC) switch S1.

As a result, these contacts bypass Q1 and self-latch RY1 after the relay has been initially energized. Once it has self-latched, the relay can be turned off again only by opening S1 or breaking the power connection.

The circuits of Figs. 1 and 2 have input impedances of only a few thousand ohms. If desired, the input impedance can be raised to 10 megohms or more by driving Q1 through a CMOS buffer stage as shown in Figs. 3 and 4. In these circuits, the CMOS buffer consists of one of four NOR gates of a CD4001B quad, 2-input NOR gate. The gate is wired as an inverter by short-circuiting its two input pins 1 and 2 together.

Figure 3 has only a single CMOS inverter stage. Consequently, to ensure that the relay turns off when the input voltage is low, transistor driver Q1 must be a PNP device, in this instance a 2N3906. In Fig. 4, two CMOS inverter stages are wired in series, so that the overall signal inversion is zero. Consequently, Q1 can be an NPN transistor such as the 2N3904.

It is worth noting in both Figs. 3 and 4 that the input impedance actually equals the value of resistor R1, and that the relay actually turns ON (or OFF) when the input signal exceeds (or drops below) about one half the supply voltage. This is the transition voltage for the CD4001B CMOS input gate. At that value the gate operates in the linear mode. Capacitor C1 inhibits any high-frequency or transient signals that might appear at the gate when the circuit is operated in the linear mode.

Bistable circuits

A relay can be organized for bistable operation. In this mode it turns on and self-latches when a SET pushbutton switch is pressed, and it can be turned off again only by pressing a RESET pushbutton switch. Figure 5 is the schematic for a bistable relay switching circuit.

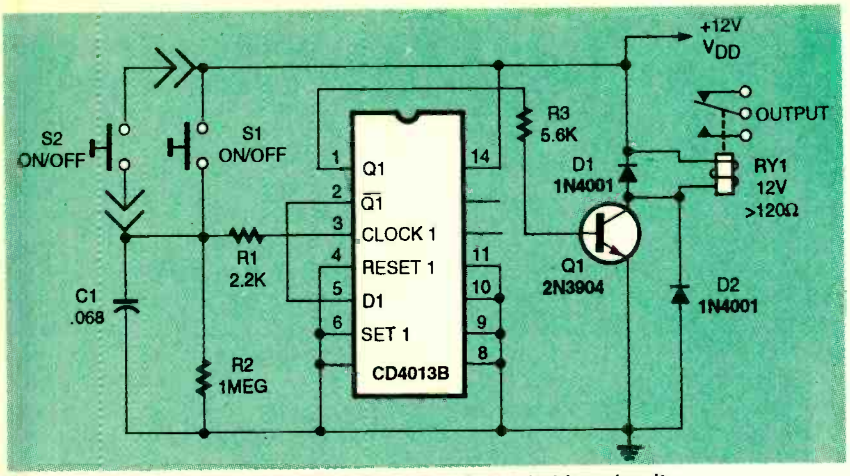


FIG. 7—PUSHBUTTON-OPERATED BINARY relay switching circuit.

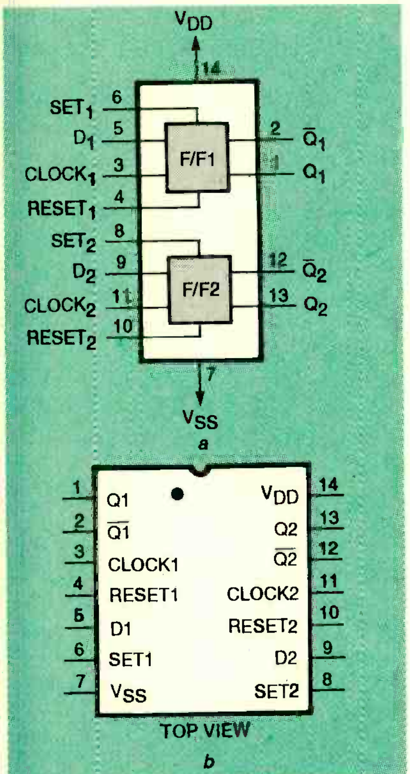


FIG. 8—CMOS DUAL D-TYPE FLIP-FLOP CD4013B: functional diagram (*a*), and pinout diagram (*b*).

In that schematic, two NOR gates of a CD4001B CMOS NOR gate are set up as a simple manually-activated bistable multivibrator. One of its outputs is connected to the relay coil through the Q1 common-emitter buffer stage. (Three other CD4000B series CMOS logic ICs are also specified in this article: CD40013B, CD40017B and CD4020B. All are offered by Harris Semiconductor and many other suppliers).

The circuit in Fig. 5 actually changes state as its SET or RESET input signal rises through the half supply voltage transition value of the CMOS gate. This response makes it easy to modify the circuit so that it acts as a self-latching, high-impedance relay, as shown in Fig 6.

The relay turns on and self-latches when the input voltage rises above the transition value; the relay can then be turned off only by removing or reducing the input voltage and pressing the RESET switch. This circuit has an input impedance of 10 megohms.

Figure 7 shows another practical pushbutton-operated relay switching circuit. A single switch can turn the relay on and off, but many similar switches can be wired in parallel to permit the relay to be remotely controlled from many different locations. The relay changes state each time an input switch is pressed or released.

As a result, if the relay is initially on, it will turn off when any switch is pressed. But it can be turned on again when any switch is pressed after that. Therefore, the circuit exhibits a binary relay characteristic.

The circuit in Fig. 7 is designed around a CD4013B CMOS, dual D-type flip-flop IC whose functional and pinout diagrams are shown in Fig. 8. One flip-flop stage can be disabled by grounding its input pins, and the other flip-flop is configured as a divide-by-two circuit. This is done by shorting its Q̄ and D1 pins together.

The input clock pulses to this divide-by-two stage must have rise times that are less than 15 microseconds; these are obtained by pressing one of the pushbutton switches. Each time the switch contacts are closed, capacitor C1 charges rapidly through the switch to provide the fast-rise time clock pulse.

Capacitor C1 then discharges slowly through R2 when the switch is re-opened. This response eliminates false triggering caused by switch bounce or

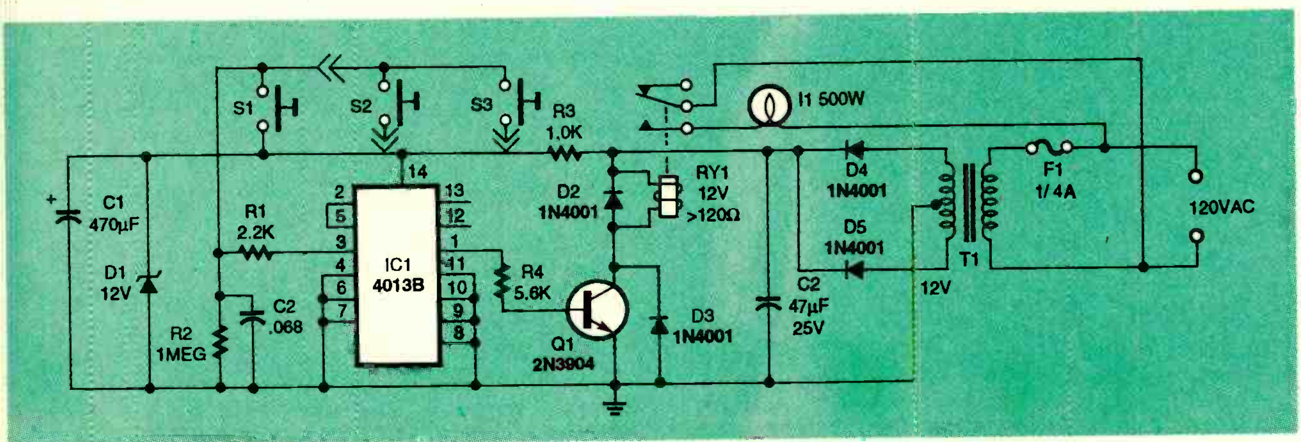


FIG. 9—MULTIPLE-INPUT, AC-LINE-powered binary lamp and relay switching circuit.

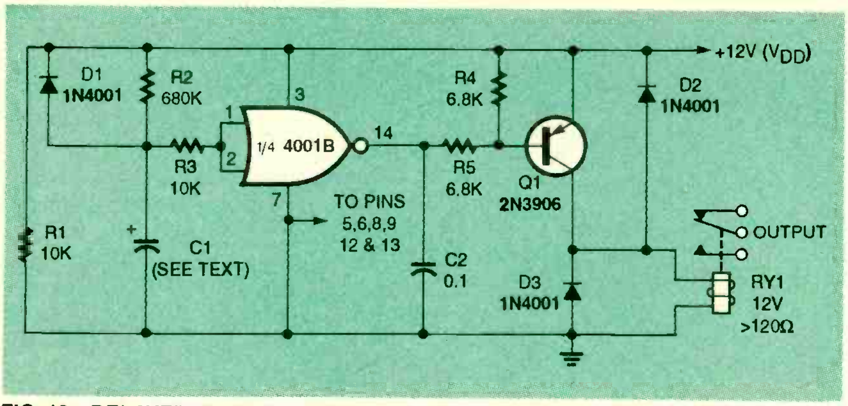


FIG. 10—**DELAYED-TURN-ON RELAY** switching circuit.

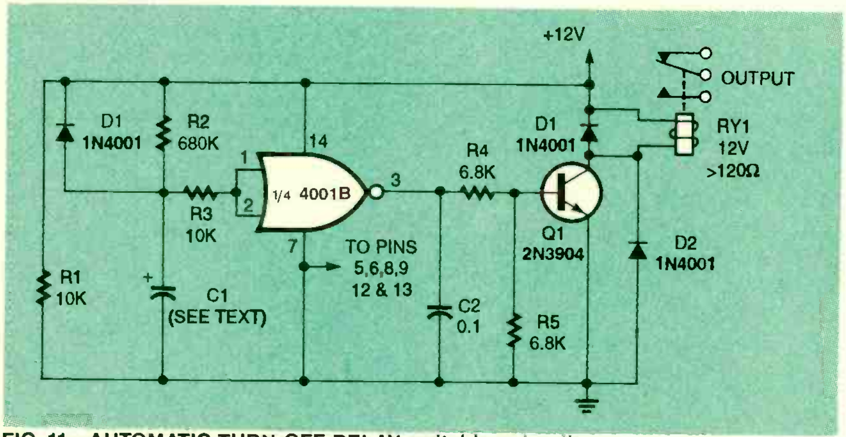


FIG. 11—**AUTOMATIC TURN-OFF RELAY** switching circuit.

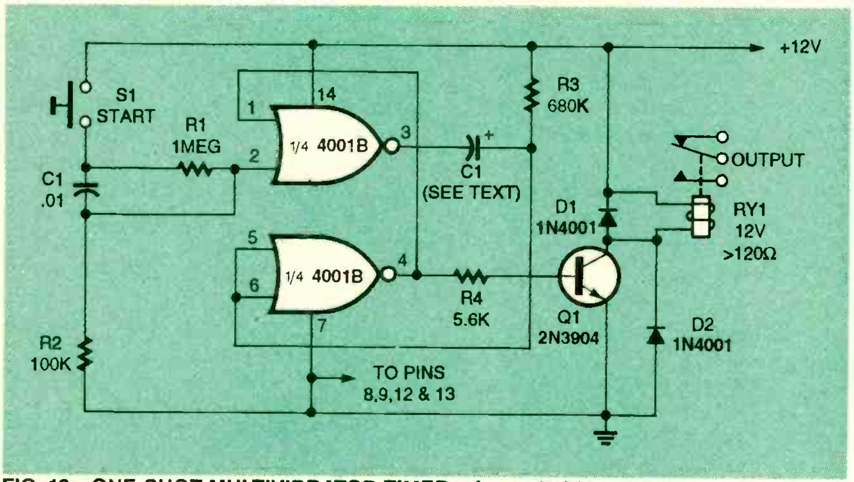


FIG. 12—**ONE-SHOT MULTIVIBRATOR TIMER** relay switching circuit.

chatter. As a result, transistor Q1 and the relay reliably change state each time a pushbutton switch is pressed.

The circuit illustrated in Fig. 7 will permit the relay to be actuated from many different locations. If this circuit is installed for use in a home or office it is recommended that approved switches suitable for use 120-volt AC operation be installed. Hall, landing, or corridor lights can be controlled from several different locations. Approved insulated twin-lead cable connecting the components can be concealed in the walls or along the baseboards.

Figure 8 shows the functional and pinout diagrams for the CMOS, dual D-type flip-flop. It consists of two identical flip-flops. Each flip-flop has independent DATA, SET, and CLOCK inputs and Q and $\overline{Q}$ outputs.

In the light control application, the circuit should be powered from the 120-volt AC line. Figure 9 shows how the circuit in Fig. 7 can be modified to operate from the AC line. Transformer T1 must be selected to provide a 24-volt, center-tapped output at 100 milliamperes or greater.

Timer circuits

Relays can be put to work in a wide variety of timer or time-delayed-switching applications with time delays from a fraction of a second to tens of hours. Figures 10 to 15 are practical examples of timing circuits for relay control.

Figures 10 to 12 show how CD4001B CMOS NOR gate ICs can produce time delays of up to several minutes with reasonable accuracy. The circuit in Fig. 10 offers delayed turn-on relay switching, and it operates as follows:

The CMOS gate is configured as a simple digital inverter. Its output is fed to the base of PNP transistor Q1 at the junction of resistor R5 and capacitor C2. The input to IC1 is taken from the junction of the time-controlled potential divider formed by resistor R2 and capacitor C1.

Before power is applied to the circuit, capacitor C1 is fully discharged. Therefore, the inverter input is grounded, and its output equals the positive supply voltage; transistor Q1 and relay RY1 are both off under this circuit condition.

When power is applied to the circuit, C1 charges through resistor R2, and the exponentially rising voltage is applied to the input of the CMOS inverter gate. After a time delay determined by the RC time constant values of capacitor C1 and resistor R2, this voltage rises to the threshold value of the CMOS inverter gate.

The gate's output then falls toward zero volts and drives transistor Q1 and relay RY1 on. The relay then remains on until power is removed from the circuit. When that occurs, capacitor C1 discharges rapidly through diode D1 and resistor R1, completing the sequence.

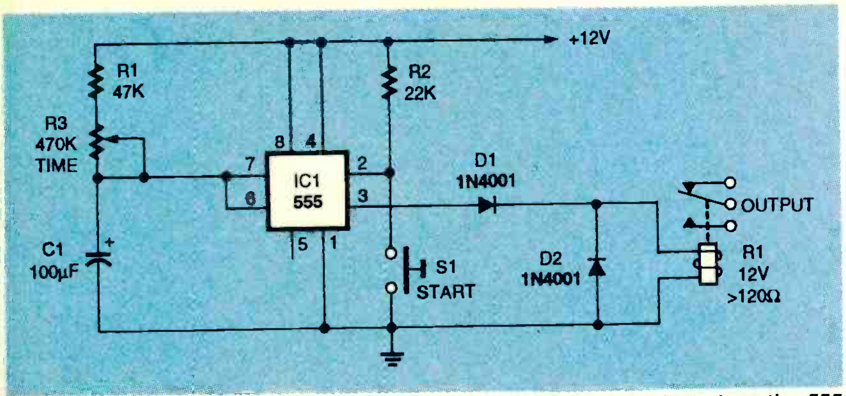


FIG. 13—SIMPLE 6-TO-60-SECOND timer relay switching circuit based on the 555 timer IC.

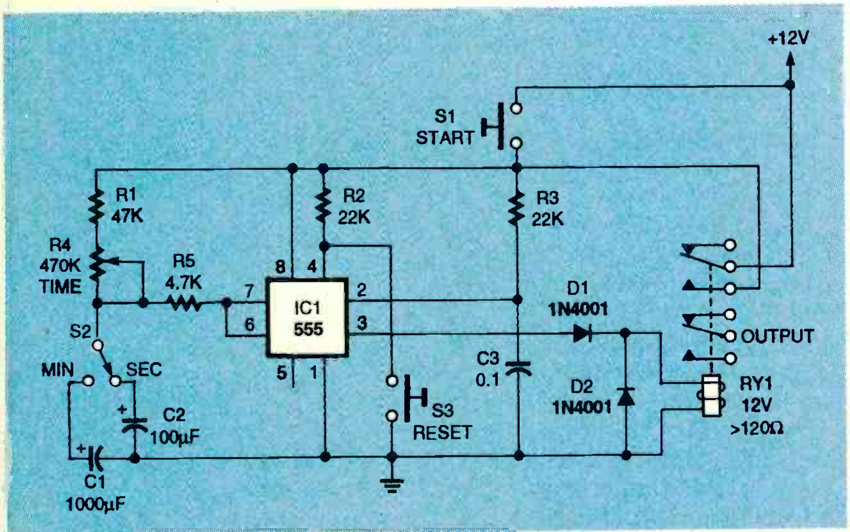


FIG. 14—TWO-RANGE 6-TO-60-SECOND and 1-to-10 minute timer-relay switching circuit based on the 555 timer IC.

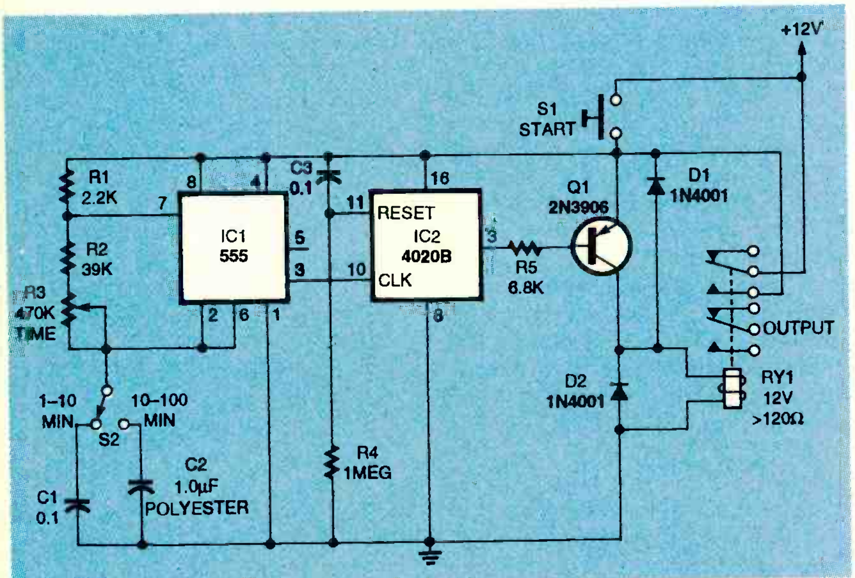


FIG. 15—TWO-RANGE 1-TO-10 MINUTE and 10-to-100-minute timer-relay switching circuit based on the 555 and 4020B ICs.

Figure 11 shows how the circuit function of Fig. 10 can be reversed so that the relay turns on when power is applied but turns off again automatically after a preset delay. This response is obtained by modifying the relay-driving stage for an NPN transistor.

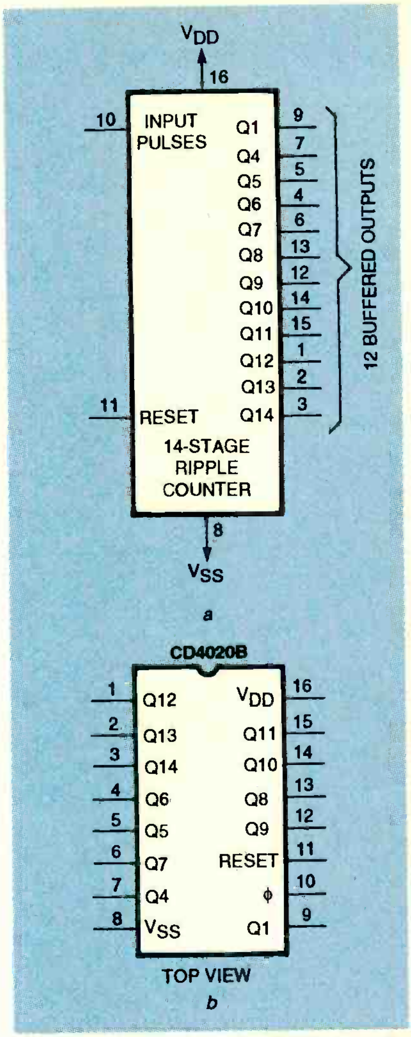


FIG. 16—CMOS 14-STAGE RIPPLE-CARRY binary counter CD4020B: functional diagram (*a*), and pinout diagram (*b*).

It is worth noting that the circuits in Figs. 10 and 11 each provide a time delay of about 0.5 seconds for every microfarad in the value of capacitor C1. This permits delays of up to several minutes. If desired, the delay periods can be made variable by replacing resistor R2 with a fixed and a variable resistor in series whose nominal values are approximately equal to that of resistor R2.

Figure 12 shows how a pair of CMOS gates can form a push-button-activated one-shot multivibrator relay-switching circuit that provides delays up to several minutes with reasonable accuracy. The relay turns on as soon as START switch S1 is closed. However, it turns off

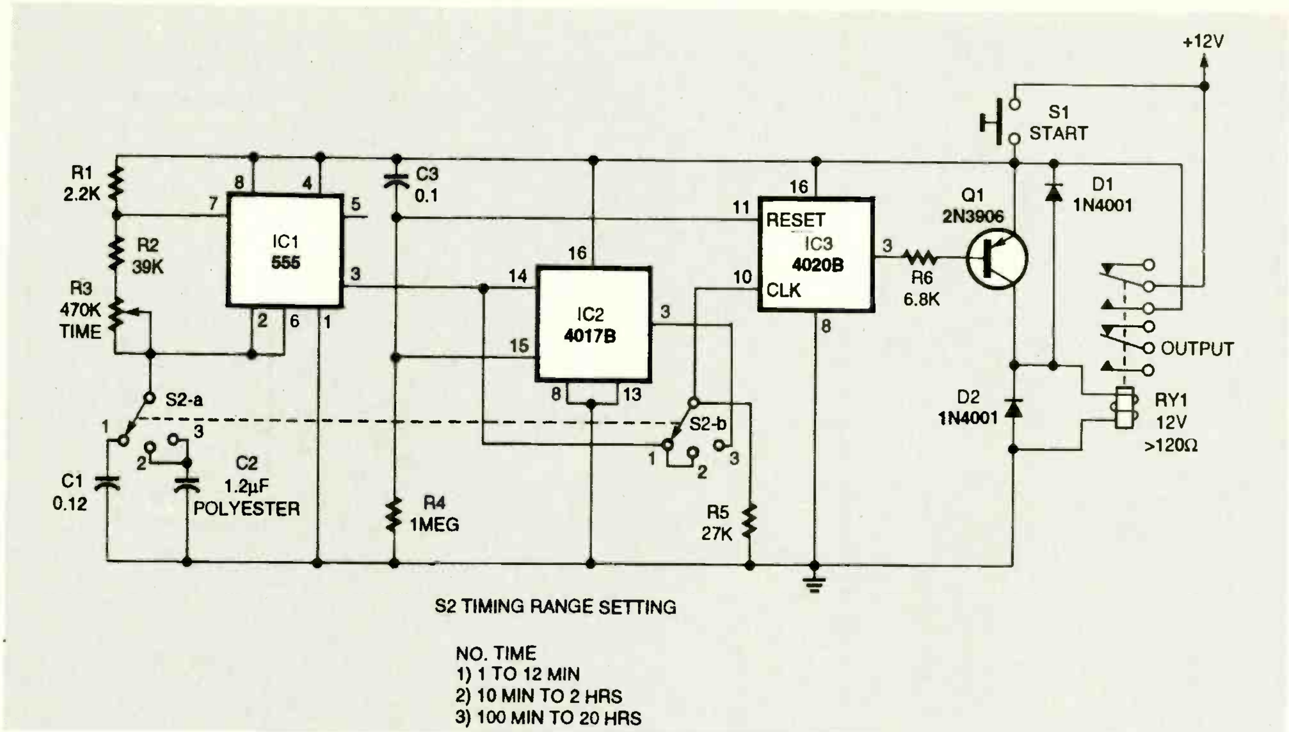


FIG. 17—WIDE-RANGE TIMER-RELAY switching circuit spans 1 minute to 20 hours in three ranges with a three-step,two-deck rotary switch.

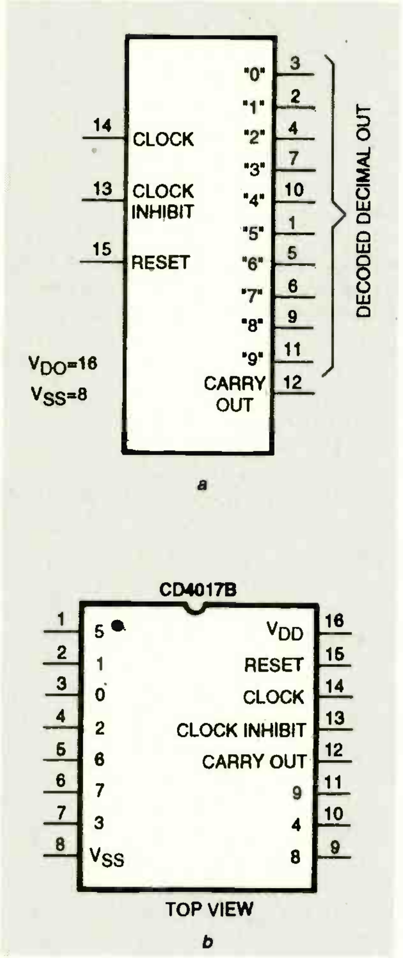


FIG. 18—CMOS FIVE-STAGE DECADE COUNTER CD4017B: functional diagram (*a*), and pinout diagram (*b*).

again automatically after a preset delay of about 0.5 seconds per microfarad of the value of capacitor C1. The two CMOS gates are configured as a manually-triggered monostable multivibrator whose output is fed to the relay through R4 and transistor Q1.

The circuits in Figs. 10 to 12 are all based on simple CMOS gates, and they are intended for applications where high timing accuracy is not required. Far greater timing accuracy can be obtained in circuits based on the 555-type timer IC. Figures 13 to 16 show four practical timer relay control circuits that include the 555 timer.

If you wish to learn more about how to apply the 555 timer IC (or brush up on what you do know), refer to previous articles in this series: page 58 of the September and page 69 of the October 1992 issues of *Electronics Now.*

Figure 13 is a circuit schematic for a simple 6 to 60 second timer-control circuit. The 555 IC is configured as a monostable multivibrator or a one-shot multivibrator. The circuit starts a timing cycle when START switch S1 is closed; relay RY1 is turned on immediately, and electrolytic capacitor C1 starts to charge toward the positive power supply through 47-kilohm resistor R1 and 470-kilohm trimmer potentiometer R3.

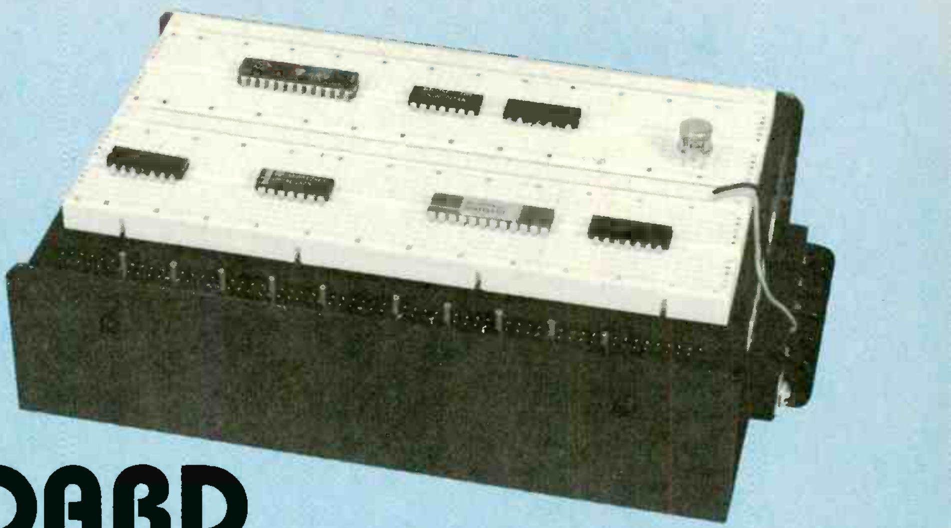
The capacitor will continue to charge until, after a delay determined by the trimmer setting, C1 rises to two-thirds of the supply voltage. At that time, the IC1 changes state and the relay is turned turned off. The timing cycle is then complete.

A shortcoming of the simple one-shot multivibrator relay control circuit in Fig. 13 is that it permanently draws current from the supply—even when the relay is off. Figure 14 is the schematic for a two-range timer circuit that overcomes this drawback. It is capable of timing over a range of 6 seconds to 10 minutes. The circuit operates as follows:

When START switch S1 is momentarily closed, a START pulse is sent to pin 2 of the IC1 through R3 and C3, and relay RY1 turns on. The control contacts then close, maintaining the power connections to the circuit when S1 is released. The circuit then runs through a timing cycle that is similar to the one described for Fig. 13. How-

Continued on page 90

Putting last month's PC breadboard hardware to work.



BUILD THIS PC I/O BREADBOARD

DAVE DAGE

SOME PEOPLE MASTER HARDWARE, others master software—but few master both. Those who do, however, can expect great rewards. Last month's project was building the hardware: a PC interface card and a breadboard system with ten fully decoded and latched input/output (I/O) ports. This month's article is about the software required to make the hardware do something interesting. Along the way, you'll learn how to breadboard some hardware for demonstrating input and output capabilities, and you'll see software examples in three popular computer languages: BASIC, assembler, and C.

It will be helpful if you have had some experience with programming in at least one of those languages. But if not, don't worry—this presentation allows for inexperience. If you are just beginning to program, it's better to learn two—or more—languages at the same time. Most programming languages do the same things; learning several will help you place the statements and procedures of each in perspective.

Hardware setup

To begin, breadboard the circuit shown in Fig. 1. The schematic specifies the resistor networks, a DIP switch, and LED bargraph indicator, but any discrete components that are electrically equivalent can be substituted. Figure 2 shows how to mount the components on the breadboard.

The input circuit connects to port four, which appears at address 260 decimal (0104 hex) if you configured the interface card at the default base I/O port address. Resistors R2a–R2h pull all eight data lines low. By switching the poles of the DIP switch, you can pull each line high through resistors R3a–R3h.

The output circuit also connects to port four (260 decimal, 0104 hex). The output lines can drive each of the eight LEDs that are tied to ground through current-limiting resistors R1a–R1h. An LED will turn on when the associated data line goes high, and off when it is low.

Now let's see how to use the software to read the switches and light the lights. First I'll discuss the BASIC language, then assembler, and then C.

BASIC programming

BASIC, as supplied with DOS, is an interpreted language. When you run a BASIC program, you are running the large BASIC.EXE program, which takes each statement one at a time, "interpreting" what it means, and then executing it.

As with any programming language, BASIC has advantages and disadvantages. BASIC's advantages include simple setup; most housekeeping chores are handled for you automatically by the BASIC interpreter. In addition, testing and experimenting with BASIC is quick and easy because you can execute code in the immediate mode, rather than running "source code" through a program called a compiler.

BASIC also has disadvantages that include slow speed, awkward bit-level manipulation, and variables that are always global. An interpreted BASIC program is much slower than an equivalent compiled program in almost any other language. Bit-level manipulation can be troublesome for people who want to work directly with hardware. The problem with global variables is that simple typographical errors make it easy to create hard-to-debug problems, particularly in those large programs with lots of variables.

Despite those disadvantages, BASIC is ideal in situations where speed is not a requirement, the program is not large, and quick development and testing are paramount.

Listing 1 shows a simple BASIC program that will read the input port, transfer the data to the output port, and then repeat the process indefinitely. The overall effect of this program is that the switches directly control the LEDs. (Press Ctrl-Break when you've had enough.)

The objective of this program

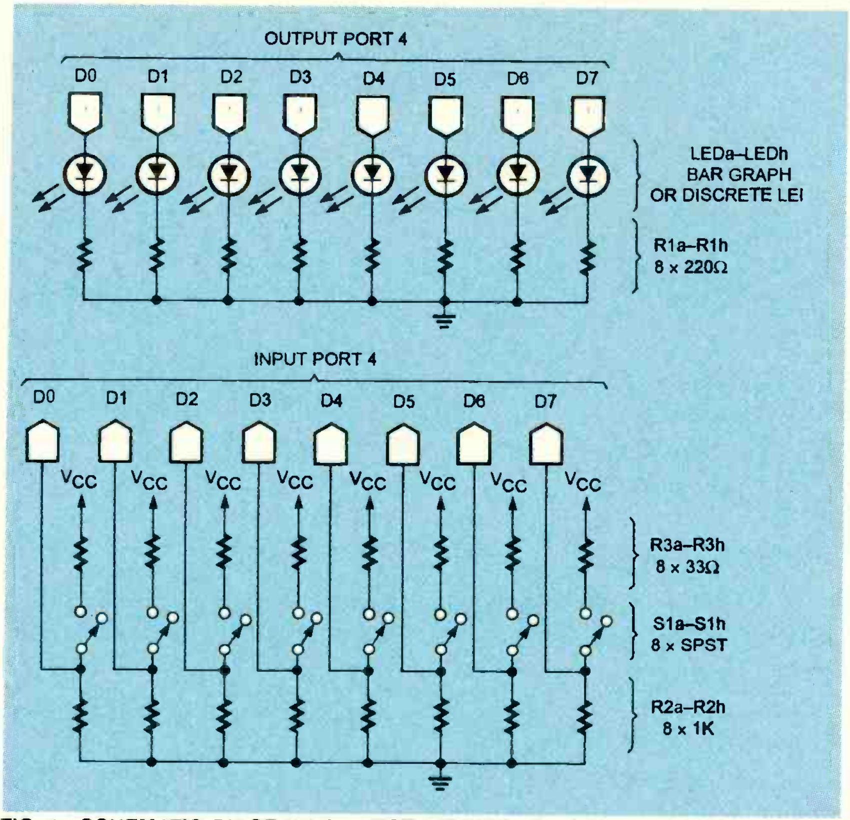


FIG. 1—SCHEMATIC DIAGRAM OF TEST CIRCUIT: The input port reads an eight-position DIP switch, and the output port drives an eight-LED bargraph.

is to show that the computer really controls the connection between the two ports. You could write a program that would switch a light on or off only after a password has been entered. Similarly, you could write a program so that the switch that controls a particular LED could be changed to control a completely different LED without rewiring the board. Try doing something like that without using software—it's next to impossible!

Another possibility would be to assign the input and output ports for completely separate purposes. For example, the DIP switch could serve as eight additional function keys for a special program, and the LEDs could function as a bargraph displaying, for example, the time remaining in some particular process.

Of course, it's also possible to have some fun with the circuit. Listing 2 provides one example. (Depending on the speed of your computer, you might have to adjust the value of the time delay in line 190.)

Assembly language programming

If BASIC represents one end of the programming-language spectrum, assembler or assembly language represents the other. Where BASIC is slow and cumbersome, assembler is quick and lithe. On the other hand, it's easy to perform tests and do experiments in BASIC, but assembler requires careful forethought in planning those tasks. However, it's easy to control the hardware in assembler.

LISTING 1—SIMPLE TEST PROGRAM

```
10 N = INP (260)
20 OUT 260, N
30 GOTO 10
```

Every microprocessor has its own assembly language. Intel's 80X86 family has one, Motorola's 68XXX family has another, and so on. Moreover, within a given microprocessor family, successive additions to the family usually call for new instructions specific to that more advanced device.

Some microprocessors have a single address space that is occupied by both system random-access memory (RAM) and I/O ports. Other CPUs have separate locations for memory and I/O. Intel CPUs, for example, have separate memory and I/O locations. In this architecture, the CPU and I/O devices share common address and data buses; separate CPU control signals determine whether a given operation occurs in an address space or an I/O space.

In the 80X86 microprocessor family, different instructions allow the transfer of one, two, or four bytes of data simultaneously between an I/O port and the CPU's accumulator, or *A* register. The CPU can specify which port participates in a transfer in several ways. In assembly language, the port can be selected by an *immediate value*, which is actually part of the instruction the CPU executes. Another way to select a port is to preload the DX register with the address of the desired port, and then execute a slightly different instruction.

Figure 3 shows the register model for the 8086 CPU. Later members of the Intel family ex-

LISTING 2—LEDSWING.BAS

```
100 REM * for ST-1. Purpose: walk a single bit back and forth for display on
110 REM * a LED bar indicator.  Hardware: LED bar indicator, limit resistors.
120 REM * Note: TON (line 180) is loop delay, increase for faster cmptrs.
130 REM ***************************************************************
140 REM * AO address output port, TON time LED is on, TOFF time LED is off.
150 REM ***************************************************************
160 CLS:REM START
170 INPUT" Enter output port address in decimal ";AO
180 TON=500  : REM increase to slow cycling. Try 500 to 5000.
190 FOR C=1 TO 7
200 OUT AO,2^C: FOR T=1 TO TON:NEXT T
210 NEXT C
220 FOR C=6 TO 0 STEP -1
230 OUT AO,2^C: FOR T=1 TO TON:NEXT T
240 NEXT C
250 GOTO 190
```

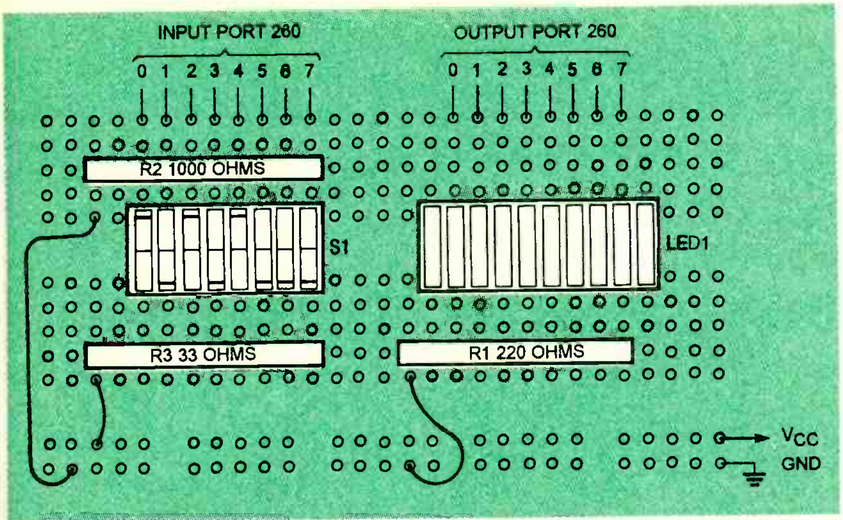


FIG. 2—PARTS PLACEMENT DIAGRAM for the test circuit. Parts placement is not critical; just be sure the power-supply polarity is not reversed.

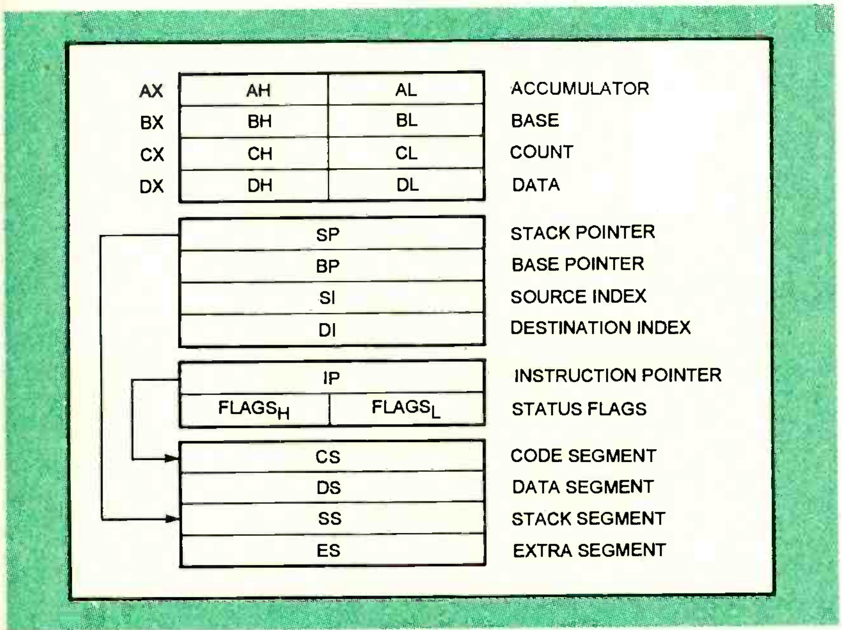


FIG. 3—INTEL MICROPROCESSOR REGISTER MODEL shows the 16-bit register format common to the 8088, 8086, 80186, and 80286 CPUs. The 386 and higher-level CPUs have 32-bit wide registers.

tend the architecture of the model, but all are backward compatible with it. Note that the main registers (AX, BX, CX, and DX) are 16 bits wide, but they can be addressed in 8-bit blocks: AL and AH (A low and A high), and so on. The 80386 and more powerful CPUs extend the concept to the 32-bit level.

The number of bits that can be transferred to or from an I/O port simultaneously depends on the CPU's capability, and on the interface hardware. This project's interface card works at the byte level, so only eight bits can be transferred at a time, through the lower half of the accumulator, designated AL.

The assembly-language instructions for reading and writing a port specified by the DX register are, respectively, IN AL, DX and OUT DX, AL. Those instructions assemble to hexadecimal machine-code values EC and EE, respectively. At this time you should know how to build an assembly-language version of our earlier BASIC test program. See Listing 3.

The only difference between the BASIC program and the assembly program is that the assembly program is that the assembly program must preload the DX register with the desired hexadecimal port address. In Listing 3, the first instruction moves port address 0104h into the DX register. The second instruction transfers the data byte from the I/O port specified by DX into register AL. Then the CPU writes this same value back out to the same I/O port. Last, the program jumps back to line 2 to continue to the process indefinitely. Instead of using a GOTO statement with a line number, an assembly-language program uses labels such as "loop1" in the example.

To enter and execute an assembly-language program, you will need a program that can translate the assembler statements into machine code. This kind of program is called an assembler. A full-featured assembler such as MASM (Microsoft), TASM (Borland), or A86 (a shareware product by Eric Isaacson) will assign addresses to labels, keep track of data by name, and much more. However, for simple test programs, those programs are more comprehensive than necessary. For the purposes of this project, the DOS program DEBUG.COM will suffice.

Debug

A version of DEBUG is packaged with every copy of DOS. Unfortunately, it's one of the most user-*unfriendly* programs ever written. To make things easy on yourself, set up a separate directory (or use a separate floppy disk) just for DEBUG and the assembly programs that you will write. DEBUG is normally installed in your DOS directory, so you should be able to run it directly from your test directory.

Now execute the program. You should see its prompt, a simple hyphen. Press "A" followed by Enter. This puts DEBUG into its Assemble mode.

LISTING 3— ASSEMBLER TEST PROGRAM

```
        mov  dx, 104
loop1:       in al, dx
        out  dx, al
        jmp  loop1
```

The program will display eight hexadecimal digits, divided into two groups of four separated by a colon. The value on the left is called the segment address, and the value on the right is called the offset address. The segment address, shown here as "xxxx" might vary from machine to machine; for small programs, its value doesn't matter. To determine the actual address associated with a segment:offset pair, multiply the segment by 16 (10 hex) and then add the offset. For example, hex address 2345:0006 = 23450 + 0006 = 23456.

The offset address, on the other hand, is critical. If you don't deliberately specify a value, DEBUG begins assembly at location 0100h (256 decimal). DOS allocates the first 256-byte block of memory within a given segment to store information about small COM programs of the kind being developed here. That block is a historical remnant from an earlier programming language, CP/M; it's officially called the PSP or Program Segment Prefix. Leave the PSP alone; don't try to place code or data there. (By the way, DOS's EXE file format does not use the PSP. In addition, COM programs are limited to 64K of code space, whereas EXE programs can be much larger.)

Intel CPUs have a set of registers called *segment registers:* code segment (CS), data segment (DS), stack segment (SS), and extra segment (ES). The segment registers typically function as indexes into various areas of memory. By default, DEBUG loads the current segment address into each of those registers.

Notice that the stack pointer (SP) is initialized at offset FFFE, and the instruction pointer (IP, also called the *program counter*) is set to offset 0100.

You now have a 64K block of memory ready for the entry of programs. Enter the code shown in Listing 4 at the DEBUG prompt.

Unfortunately, you cannot use symbolic addresses (e.g., the loop1 in the previous example) with DEBUG; you must enter the actual CPU offset address. That's why you see jmp 0103 at offset 0105. After entering the final instruction, press Enter again, and you'll return to the DEBUG prompt.

Before running the program, save it. First name the program with DEBUG's "n" command:

LISTING 4—DEBUG PROGRAM SW2LED

```
-a100 <Enter>
xxxx:0100 mov dx, 104 <Enter>
xxxx:0103 in al, dx <Enter>
xxxx:0104 out dx, al <Enter>
xxxx:0105 jmp 0103 <Enter>
xxxx:0107 <Enter>
-
```

LISTING 5—DEBUG PROGRAM SW2LED2

```
        mov dx, 104
loop1:      in al, dx
        out dx,al
        shl al
        jnc loop1
        mov ah,0
        int 21
```

LISTING 6—C LANGUAGE PROGRAM

```
#include <conio.h>
main()
{
    int inp(unsigned), outp(unsigned, int)
    while(1)
     {
        outp(260,inp(260));
         _asm mov ah, 11
        _asm int 33
     }
}
```

-n SW2LED.COM <enter>
Drive and path are optional, but for this project unnecessary, because the default directory has been specifically set aside for our test programs.

DEBUG's "w" command writes current memory contents to disk. However, you must specify the exact number of bytes in two registers: BX and CX. For anything less than 64 Kbytes, BX will contain zero and CX the remainder. The test program is only seven bytes long. So enter 0000 and 0007 into registers BX and CX as follows:

-r cx <enter>
CX 0000
:7 <enter>
-r bx <enter>
BX 0000
: <enter>
-

After you enter the first line ("r cx"), DEBUG displays the current value of CX and presents a colon (:) prompt. Enter 7 followed by Enter. Repeat the process with BX. To accept the currently displayed value, just press Enter.

The next step is to write the file to disk. Press "w" followed by Enter. Debug will respond with the number of bytes it is writing. Verify that the value displayed is correct:

-w <enter>
Writing 00007 bytes

Be certain the value is correct before proceeding—you'll see why in a moment. Now run the program by entering "g" (go) at the prompt. The hardware should respond just as it did with the BASIC program; cycling the DIP switch positions will cycle the corresponding LEDs.

There are, however, two major differences between the BASIC and the assembly program. The assembly program runs much faster, and pressing Ctrl-Break does not halt the program. With mechanical switches, the speed difference is insignificant, but if you are not able to stop the program and regain control, the only thing to do is reboot.

Now return to the test directory, load DEBUG, and reload the test program. Loading a file is a step that is opposite to writing it: first name it using "n," then load it using "l:"

-n SW2LED.COM <enter>
-l <enter>

How will you know that the correct program loaded? Try the unassemble command, "u." The assemble command used previously converts assembly-language instructions into hexadecimal bytes that are executed by the CPU, the unassemble command (sometimes called the *disassemble command*) converts hex bytes into assembly-language instructions that can be understood by people. Issue the following command to disassemble the test program:

-u 100 L7 <enter>

The "u" stands for unassemble, 100 is the starting address, and L7 instructs the program to disassemble seven bytes beginning at that address.

DEBUG should display a list of program instructions identical to that in Listing 4.

Graceful ending

For the final assembly-language exercise, the program is made a little more "intelligent." The program can be allowed to end gracefully, so you don't have to reset the computer to halt the program. One way of doing it is to use DIP switch position 8 as a "break" key. After each pass through the read-switches, write-LEDs loop, check switch 8. If it's on, end the program; otherwise continue.

The shift instruction provides a simple way to do this in assembly language. You will shift bit 8 out of the accumulator and into a special register called the *carry flag*. As its name implies, the carry flag is normally used for arithmetic instructions. But it's also useful for determining the flow of a program based on the state of some condition—for example, the on or off state of a DIP switch.

Listing 5 shows how all these instructions tie together. As before, preload DX with 0104h, input the byte from the port at that address, then write it back out. Now for a surprise. The "shl al" instruction causes the CPU to shift the contents of its AL register left one bit position, moving the most-significant bit into the carry flag. The following instruction tells the CPU to jump back to the input instruction (at address loop1) if the carry bit is not set—i.e., if the switch is off. If this is not done, the program executes a special pair of instructions that will return control to the calling program.

Following the procedure previously outlined, enter the program in DEBUG, and save it to disk with a new name (SW2LED2.COM). Remember that you must enter the address of loop1 with the hex address, not the symbolic constant. Other than that, the program's operation is straightforward.

With this introduction, you should be able to read the documentation for DEBUG and learn how to use the rest of its commands. Although cryptic, DEBUG is a powerful tool for writing and debugging new programs and for exploring your computer system and its configuration. You might want to record all of the commands and parameters on a handy card for future reference.

The following information related to the speed difference between the assembler and BASIC versions of this program is interesting. On a standard 4.77-MHz PC, the BASIC program loop executes in about 2.25 milliseconds. By contrast, the assembler version takes about 9 microseconds. In other words, the assembly-language program ran about 250 times faster than the BASIC program!

GLOSSARY OF TERMS

Assembler—A computer program that converts or translates assembly language source code instructions into machine language.

Compiler—A computer program or circuitry that translates a high-level language into an executable program in a single operation. See *assembler* and *interpreter*.

Global variable—A variable in a computer program that can be shared by any object or subroutine within the program.

High-level language—An application-oriented programming language, as distinguished from a machine-oriented programming language. It is also termed a *computer language*. Examples are BASIC and C.

Interpreter—A computer executive routine that translates a program in high-level language or code into machine language or code. Unlike a compiler, the interpreter translates and executes one line at a time. See *assembler* and *compiler*.

Machine code—Instructions executed by a computer processor. It is also called *machine language*.

Machine instruction—An instruction written in a programming language that a computer can recognize and understand without translation.

Register—A circuit in computers or other digital circuitry that holds data in binary format for process or transfer.

Source language—The language in which a problem is programmed for a computer. It must be translated into an object program in machine language by an assembler, compiler, or interpreter.

Source program—A program that is written in source language or code.

C language programming

Earlier BASIC and assembler were defined as opposite ends of the programming-language spectrum. A broad range of other languages occupy positions all along that speed-performance spectrum. For example, C language has gained tremendous popularity during the past decade. Like BASIC, it is a high-level language, but it is really closer in many of its characteristics to assembly language. Indeed, C has been described as a "portable assembly language."

C is a compiled language like FORTRAN, COBOL, Pascal, and even some versions of BASIC. You start by writing source code that is similar to BASIC. However, C has no interpreter that runs it one line at a time. Instead, the source code is compiled into machine language that the CPU executes directly. As part of the compilation process, the compiler flags syntax errors (e.g., typos, undeclared variables, and misspelled language elements), that must be corrected before the machine code will be generated. Next, you have the option of linking the machine code with other predefined code libraries. When the process is complete, you will have a stand-alone file that will run from the DOS prompt.

Modern C development environments combine all the tools necessary for editing, compiling, and linking C code into a single, *integrated development environment* (IDE). The preeminent products in this category include Borland's Turbo C and Microsoft's Quick C. For entry-level programmers, an IDE is recommended. Even experienced programmers can significantly increase their programming productivity with an IDE.

Both Quick C and Turbo C include a special feature called *inline assembly*, which allows you to embed assembly-language programming instructions in the middle of a C program. Inline assembly thus gives you the best of both worlds: the low-level hardware

Continued on page 89

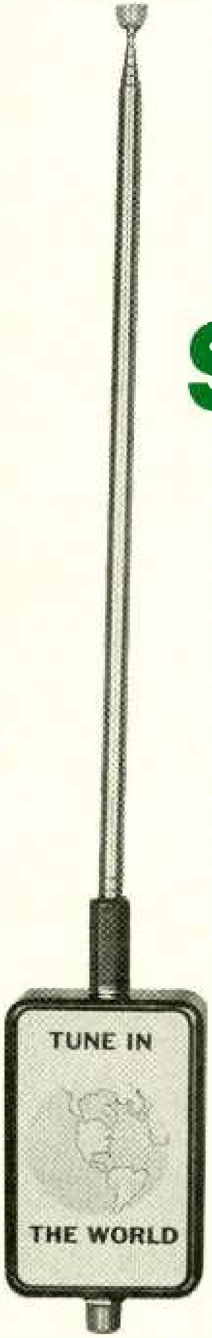
TUNABLE SHORTWAVE ANTENNA

Improve your shortwave reception with this tunable antenna.

H.J. WECKE

FOR AS LONG AS SHORTWAVE LISTENING has been popular, it has been difficult to match a random-length antenna to the typical 50- or 75-ohm input impedance of most radio receivers. The impedance of a random-length shortwave antenna can vary from a few ohms to several hundred ohms, depending on frequency. Matching that impedance to the input impedance of a receiver is possible, but it can be complicated.

Many different active-antenna designs provide effective matching, but many people believe that active antennas never work satisfactorily. An active antenna is typically a single-stage, wideband amplifier with a gain from 5 to 8 dB and a noise figure from 3 to 8 dB, making it a device of questionable merits. While active antennas provide some gain, they can also add noise to the signal, especially a signal at a low microvolt level.



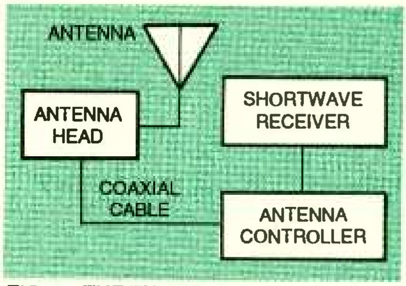


FIG. 1—THE TUNABLE SHORTWAVE antenna adds a tuned stage ahead of the 50- or 75-ohm input to your shortwave receiver.

Active antenna wideband amplifiers really lose out in the low microvolt region. The inherent noise usually kills a low-level incoming signal. Nearby transmitters might cause intermodulation in the active antennas as well. As a compromise solution, some older shortwave receivers had trimmer potentiometers on their front panels to provide impedance matches for the antenna at the received frequency. Sadly, modern receivers no longer have this control.

The author believed that a new method had to be designed to meet the following list of provisions:

1—No amplification should be needed, no noise should be generated, and no intermodulation should occur
2—It should have selectivity, but keep out strong adjacent signals
3—It should be small
4—It should be inexpensive, easy to build, and include only standard components

The solution was found by adding a tuned stage in front of the 50- or 75-ohm input to the shortwave receiver. A tuned stage has many advantages over the best wideband RF amplifiers, including preselection at resonance and elimination of both noise and intermodulation. The need for tracking the antenna from band to band is the only disadvantage this tuned stage has over a wideband active antenna. Several prototype antennas have been in service reliably for more than four years. They have been mounted on a balcony or a roof where they were exposed to a harsh climate. Figure 1 is a block diagram of the system.

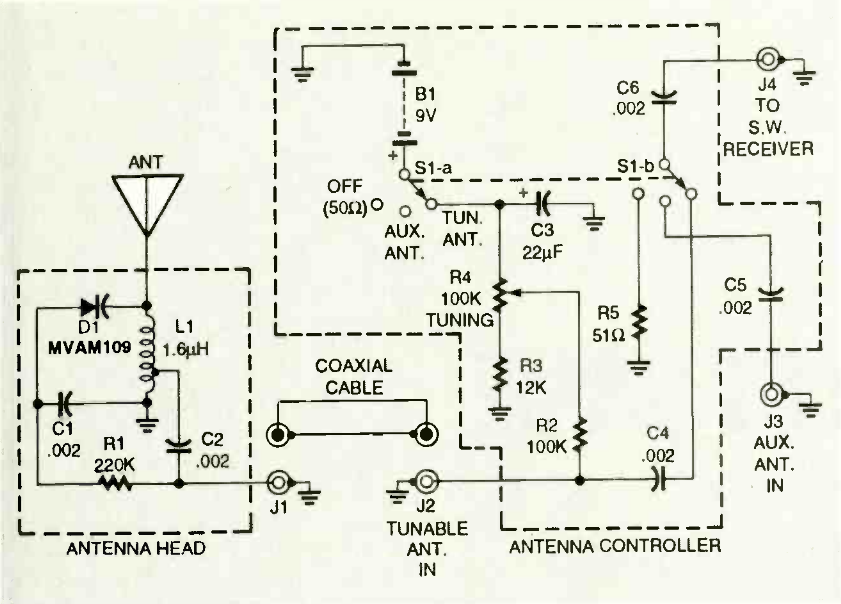


FIG. 2—TUNABLE ANTENNA SCHEMATIC. The variable element is Motorola MVAM-109 diode D1.

Circuitry

Figure 2 is the schematic for the tunable antenna system. A single monopole antenna about 3 feet long was chosen. The antenna, which has a measured capacitance of approximately 10 picofarads, becomes part of the antenna-head circuit that feeds the antenna controller. The variable element of the antenna head is a Motorola MVAM-109 diode (D1). The inductor value required to cover the shortwave spectrum from about 6 MHz to 18 MHz was calculated to be 1.6 microhenries. The inductor can easily be wound by hand on a 0.25-inch diameter form containing a ferrite slug.

The MVAM-109 requires a tuning voltage from 1 to 9 volts DC at a low current. That is provided by 100-kilohm linear potentiometer R4 located in the antenna controller section. Switch S1, when in the "off" position, places a 50-ohm termination on the tuned output. The other two positions of S1 select either an auxiliary antenna input or the tuned antenna input. A length of coaxial cable terminated with suitable connectors connects the antenna head, which might be located outdoors, to the antenna controller, which should be located in a convenient place near your shortwave receiver.

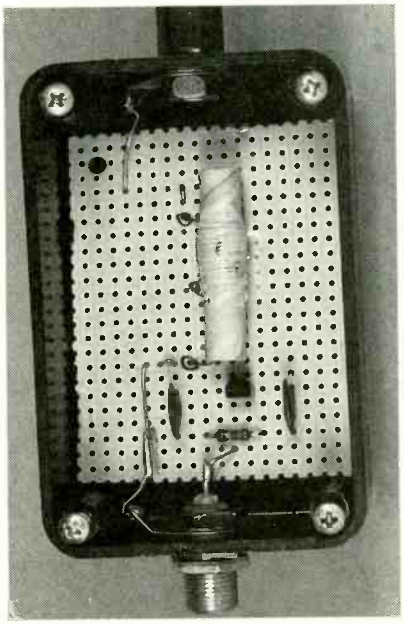


FIG. 3—THE ANTENNA SHOULD be mounted to the antenna-head case with a neoprene washer, and a bead of silicone sealant should be applied to the edge of the lid to keep out water.

FIG. 4—ANTENNA CONTROLLER unit. House the controller in a metal case to provide RFI shielding.

PARTS LIST

All resistors are ¼-watt, 10%, unless otherwise noted
R1—220,000 ohms, 10%
R2—100,000 ohms, 10%
R3—12,000 ohms, 10%
R4—100,000 ohms, linear potentiometer
R5—51 ohms, 10%

Capacitors
C1, C2, C4–C6—0.002 μF, ceramic
C3—22 μF, 16 volts, electrolytic

Semiconductors
D1—Motorola MVAM-109 varactor diode (nominal capacitance of 460 pF at V_R = 1.0 V and f = 1.0 MHz) or equivalent

Other components
L1—1.6 μH (wind by hand, see text)
J1, J2—panel-mount F connector
J3, J4—any coaxial connectors suited to your needs
B1—9-volt carbon-zinc battery (do not use alkaline)
S1—2-pole, 3-position rotary switch (optional, see text)

Miscellaneous: Antenna, two cases, silicone sealer, coaxial cable, No. 26 magnet wire, ¼-inch form with ferrite slug, 9-volt battery snap connector

Note: The following items are available from Wecke Associates, P.O. Box 3822, Ottawa, Canada K1Y 4M5:

- **A kit consisting of D1, L1, and 6 mm bolt, nut, and solder lug to accommodate a 30-inch automotive whip antenna—$6.00 + $2.00 S&H**
- **Assembled and tested antenna controller, antenna head, and aluminum mounting bracket with U-bolts and battery (does not include whip antenna or connecting cables)—$65.00 + $5.00 S&H**

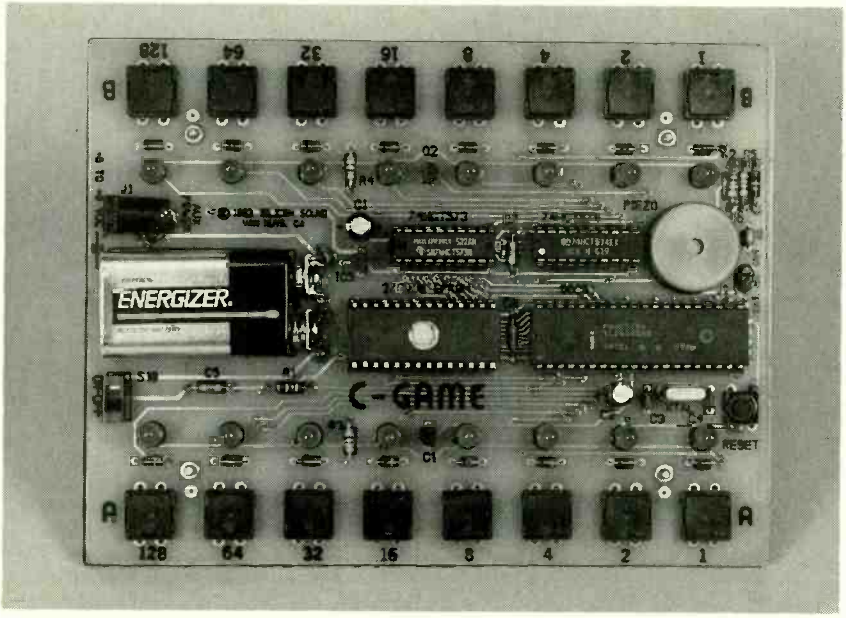
Payment required in US dollars. Canadian customers please add appropriate provincial taxes. Allow 3–4 weeks for delivery.

Construction

The antenna head can be hand wired on perforated construction board and installed in any weathertight case. Good, clean solder joints are important in the antenna head, which will probably be exposed to the weather. The layout of the parts and wiring is not critical—just avoid excessive lead lengths. The case selected for the prototype antenna head has an aluminum cover that can be used as a base for attaching a mounting bracket crafted from scrap aluminum. Coil L1 can be made by winding 16 turns of No. 26 magnet wire on a ¼-inch diame-

Continued on page 90

BUILD THIS COMPUTERIZED GAME



Learn how electronic games work; then have fun playing one that you built.

DAN RETZINGER

ALTHOUGH PLAYING COMPUTER games can be a lot of fun, operating them teaches you very little about how they work. A good way to learn how electronic games work is to build your own. This article shows you how to build the C-Game, a two-player game with a dozen different game modes. In addition to the 12 games, there are four other modes that let you generate sound effects and light-pattern displays.

The C-Game has 16 pushbuttons for player input, and it has 16 LEDs for display output. Eight LEDs and pushbuttons are arranged along each side of the device, making it convenient for two players to sit opposite each other while playing a game. The pushbuttons are installed with the same spacing as found on a standard computer keyboard, which makes them comfortable to use. A piezoelectric buzzer provides game sound effects.

Features

The games and functions of the C-Game are selected by pressing one of the 16 pushbuttons after the device is reset. A new game can be selected at any time by pressing the reset switch followed by another pushbutton. Once a game is selected, the operation of all pushbuttons and LEDs are specific to that game.

Of the twelve games, three are reaction-time (who's quickest) competitions. Four games involve skill and thought, and two others are simple memory challenges. The C-Game also has two binary arithmetic contests in which you must add, subtract, divide, and multiply two binary numbers. (It's not as difficult as it sounds!) Another game performs logic functions such as and, or, and exclusive-or. Finally, four non-game modes create sound effects and light-pattern displays.

Circuitry

Figure 1 is the schematic of the C-Game. The circuit is designed around IC3, an 80C31 ROMless, CMOS version of Intel's 8051 8-bit microcontroller. The 80C31 has four 8-bit I/O ports (0 to 3).

Port 1 is connected to 16 pushbuttons, organized as two banks of eight (Bank-A and Bank-B). The 16 1N914 diodes (D1–D16) isolate each bank from the other. Each bank has one side of each pushbutton connected in common to one pin of Port 3 of the 80C31. These two pins (12 and 13, P3-2 and P3-3, respectively) enable the switch banks separately so that they can be periodically read under software control.

Port 0 of the microcontroller communicates with the 27C256 EPROM (IC1), where C-Game's software is stored. The address and data buses of the microcontroller are multiplexed. A 74HCT573 8-bit latch (IC2) is first strobed with the ALE (address latch enable) signal from the microcontroller, and the low-order address data is latched for the EPROM. The high-order address for the EPROM is output by port 2, pins 21 to 27. The EPROM is enabled by the microcontroller's PSEN (program store enable) line.

Port 0 also connects to IC4, a 74HCT574 8 bit D-type flip-flop that drives two banks of eight LEDs. Port 3 (P3-0 and P3-1) enables each bank separately through Q1 and Q2. Each bank is multiplexed under software control and is turned on approximately 50% of the time.

Port 3 bit-4 (pin 14) connects to a transducer. Components R5, R6, and C8 provide a signal through output jack J2 for connection to the line-level input of an external amplifier to produce a louder sound output.

At power up, C2 and R1 initialize the microcontroller. Reset switch S17 will reset the circuit to power-up conditions at any time. An oscillator is

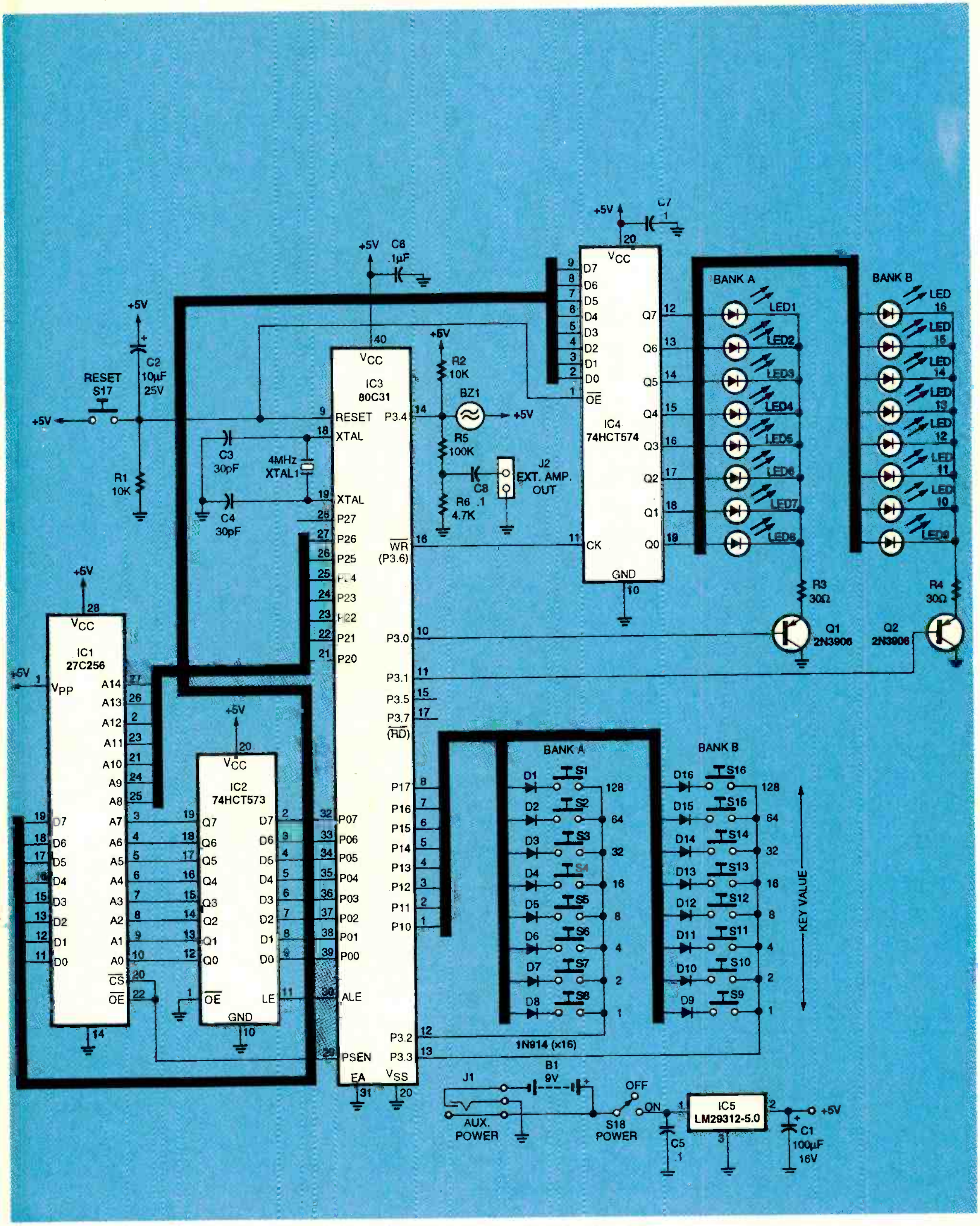
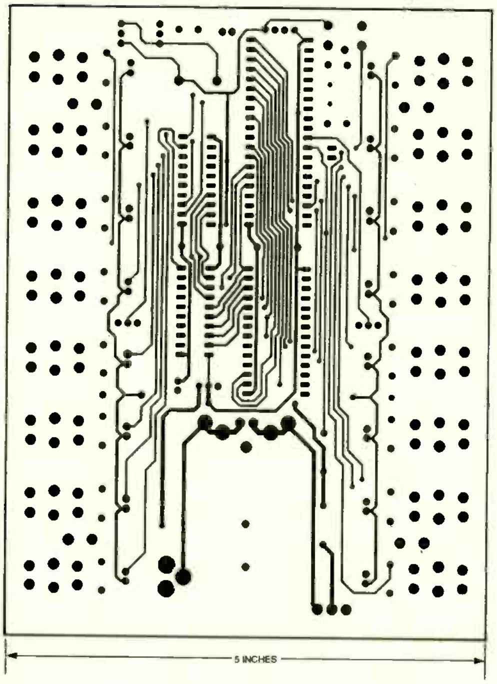
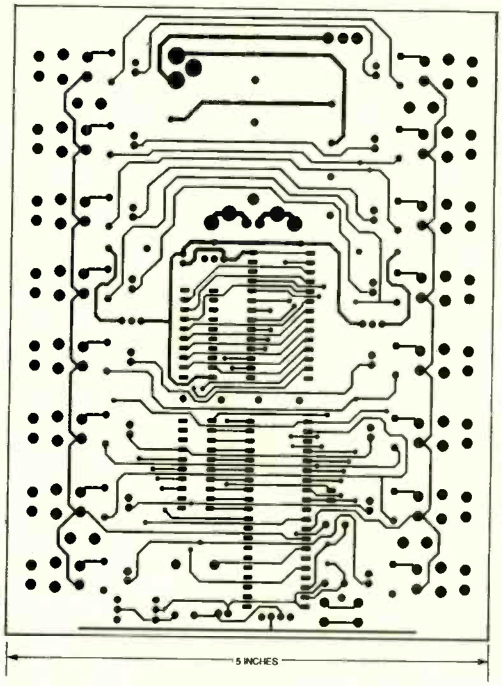


FIG. 1—C-GAME SCHEMATIC. The circuit is designed around an Intel 80C31 8-bit microcontroller.

made up of a 4-MHz crystal (XTAL1) and two 30 pF capacitors (C3 and C4). An LM2931Z-5.0 low-dropout 5-volt regulator IC5 will tolerate a reversed battery voltage of 15 volts without damage. The circuit is normally powered from a 9-volt battery, but power-input jack J1 can provide auxiliary power to the C-Game with any power adapter capable of supplying 6 to 9 volts DC at 100 milliamperes or greater.



COMPONENT SIDE OF THE PC BOARD.



SOLDER SIDE OF THE PC BOARD.

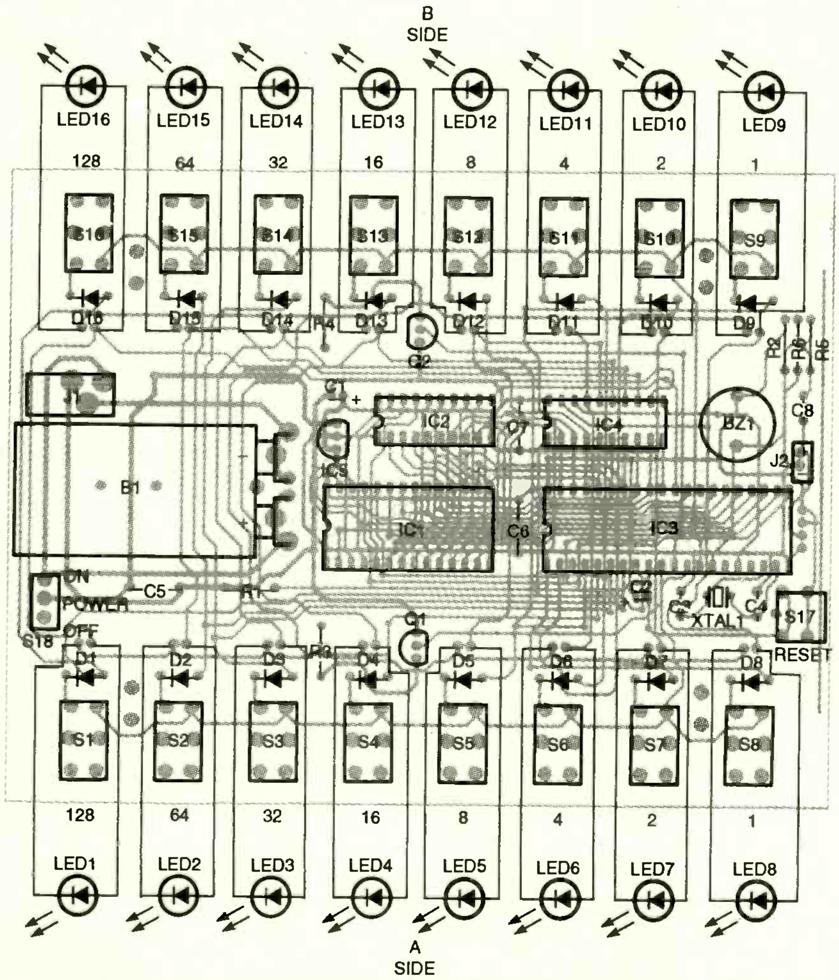


FIG. 2—PARTS-PLACEMENT DIAGRAM. Solder the 1N914 diodes first, then the resistors and capacitors.

Designing a battery-powered circuit with this many LEDs and components requires some special considerations. All ICs (except the regulator) are CMOS to conserve battery power—a non-CMOS 74LS574 would require approximately 27 milliamperes more current than the CMOS version, and the non-CMOS version of the 8031 microcontroller would need almost 100 milliamperes extra.

Second, the 80C31 is clocked by a 4-MHz crystal. Although most 80C31 controllers can operate at speeds up to 12-MHz, the lower speed keeps power consumption to a minimum. Current drain is directly related to the clock speed in this CMOS microcontroller.

Third, all LEDs in each bank share one common-cathode resistor (R3 for Bank-A and R4 for Bank-B), instead of one resistor per LED. That results in less current per LED if many LEDs are turned on, and more current per LED if fewer LEDs are turned on. When only one or two LEDs are on, current is limited by the 74HCT574. When more LEDs turn on, current is limited by R3 and R4. However, the change in brightness is barely noticeable with a differing numbers of LEDs on.

TABLE 1—GAME INSTRUCTIONS

Activation Key	2 Player Game	1 Player Game	Game Title	TABLE 1—GAME INSTRUCTIONS	Score Displayed & End
A1	X		Who's Quickest #1	First player to press the key next to his lit LED gets a Point. Most points out of 20 wins.	X
A2	X		Road Kill	Most 'hits' (press key while LED on) out of 20 wins.	X
A4	X		Tennis	Press a key to send a ball (LED) to your opponent. Fewest misses (press key before time-out) out of 40 wins.	X
A8		X	Reaction Timer	Test your reflex time. Press a key to shut off the LED. Gives an average time for 10 hits.	X
A16	X		Race Around	"A" player sends LED counterclockwise, "B" player clockwise. If LED slips past you, other player gets a point.	X
A32		X	Binary Math	Use "A128" to enter your answer for add/sub/divide/multiply on two 14 bit binary numbers. "B" LED's show progress.	
A64		X	Binary Logic	Use key "A128" to enter your answer for and/or/xor/modulus on two 4 bit binary numbers. "B" LED's show progress.	
A128		X	Count to 64	Use key "A128" to repeatedly add original number shown until you've counted to 64 or greater. "B" side keeps your time.	X
B1	X		Who's Quickest #2	First player to press all lit keys gets a point. Best out of 20.	X
B2		X	Memory #1	A number will be shown. Use key "A128" to enter each number in the "sequence" correctly. 10 total in sequence.	
B4	X		Memory #2	Alternate play. Two players build and copy a sequence. 10 total.	
B8	X		Last Player Wins	Move lit LED (press a key) toward A1, then toward B128 any number of "jumps". Alternate play. Last player able to move wins. Score is accumulative game to game.	X
B16	Special Effects			Press any key or key combinations to generate steady tones.	
B32	" "			"A" key control pitch range, "B" keys control speed range of randomly appearing LED's and tones.	
B64	" "			Sixteen different sound effects, one per key.	
B128	" "			Sixteen different sound and LED patterns, one per key.	

NOTE 1: Press RESET, then any key (left side of chart) to start a game.
NOTE 2: After a game terminates, pressing the key (other than RESET) will restart same game.

PARTS LIST

All resistors are ¼-watt, 5%.
R1, R2—10,000 ohms
R3, R4—30 ohms
R5—100,000 ohms
R6—4700 ohms

Capacitors
C1—100 µF, 16 volts, radial electrolytic
C2—10 µF, 25 volts, radial electrolytic
C3, C4—30 pF, 25 volts, ceramic disc, 20%
C5-C7—0.1 µF, 50 volts, ceramic, axial, 20%
C8—0.1 µF, 50 volts, ceramic, radial, 20%

Semiconductors
IC1—27C256 CMOS EPROM
IC2—74HCT573 octal D-type CMOS latch
IC3—80C31 CMOS microcontroller
IC4—74HCT574 octal D-type CMOS flip-flop
IC5—LM2931Z-5.0 low-dropout 5-volt regulator
D1–D16—1N914 diode
LED1–LED16—green light-emitting diode
Q1, Q2—2N3906, PNP transistor

Other components
S1–S17—PC-mount pushbutton switch
S18—SPST PC-mount slide switch
J1—DC power jack, PC mount, 2.0mm pin
J2—2-pin molex header, 0.1-inch spacing
XTAL1—4-MHz crystal, HC-18 metal case
B1—9-volt alkaline battery
BZ1—piezo-alarm (murata-erie No. PKM22EPP-40)

Miscellaneous: PC board, 9 volt battery connectors (1 each, Keystone No. 593 and No. 594), six stick-on rubber feet, two 20-pin IC sockets, one 28-pin socket, and one 40-pin socket

Note: The following items are available from Silicon Sound, PO Box 1694, Reseda, CA 91337-1694 (818) 996-5073:
- **Double-sided, silk screened PC board—$35.00**
- **Programmed 27C256 EPROM—$15.00**
- **Complete C-Game kit including all parts—$79.00**
- **Assembled and tested C-Game—$99.00**

Please add $3.50 for shipping and handling. California residents add 8.25% sales tax.

The circuit draws an average of 20 to 30 milliamperes, with a maximum drain of 65 milliamperes with all LEDs on. A 9-volt alkaline battery will last an average of 8 to 10 hours and a nickel-cadmium battery will last from 5 to 8 hours. Avoid 9-volt carbon batteries; even a fresh one can't deliver the C-Game's peak current requirements. Supplying power through jack J1 eliminates the need for a battery. This is recommended if the game is played often.

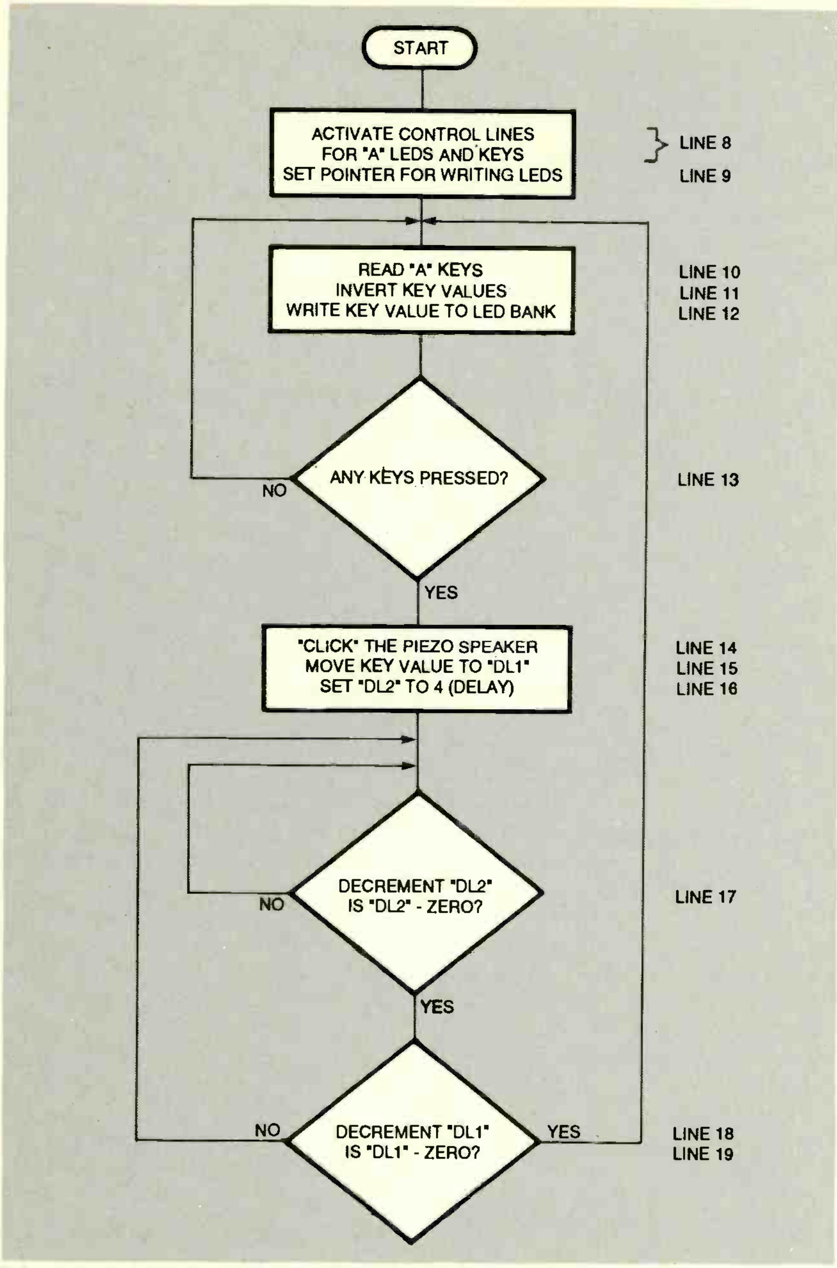


FIG. 3—THIS FLOWCHART details the operations performed in Listing 1.

Construction

All of the necessary components including the PC board are available from the source given in the Parts List. Foil patterns are provided if you want to make your own PC board. Preprogrammed EPROMs are available from the source given in the Parts List, and the hex code is posted on the *Electronics Now BBS* (516-293-2283, V.32. V.42bis) as a file called CGAME.HEX.

Using Fig. 2 as a guide, solder the components in place beginning with the 1N914 diodes, resistors, and capacitors. Next, install the sixteen LEDs flush with the PC board. Follow with the IC sockets, but do not install the ICs into their sockets until all other parts are installed.

To install the two battery connectors, align them by first snapping them onto a 9-volt battery. Be sure the battery polarity is correct. While holding the battery flush with the PC board, solder the battery connectors in place. Remove the battery after the clips are in place. Next, solder in the 16 pushbuttons, the power switch and jack, transducer, crystal, and audio output jack.

Next install six rubber feet on the bottom of the printed circuit board. These will keep the cut leads of the components from damaging your table top while you play the game. Optionally, you might want to mount a sheet of plastic to the PC board's bottom side to keep the leads from scratching your fingers. Cut it to the same size as the PC board and fasten it with machine screws and spacers. One-sixteenth inch thick styrene or black ABS plastic works well. Finish up by installing the four ICs. The completed game is shown in the opening of this article.

Checkout

Connect a 9-volt battery and turn on the power switch. You should first hear a short beep, then see the 16 LEDs light one at a time in a repeating counterclockwise pattern. If nothing happens when power is applied, check to see that +5 volts is present at the output of IC5. Also check for +5 volts on each IC's power pin, and make sure each ground pin is at zero volts. Verify that none of the address or data lines are shorted to each other.

Check to see that each of the 16 pushbuttons work. To do this, you need to press the reset switch before pressing each pushbutton. At this point, don't try to play each game; just see that every pushbutton causes a distinct change in the game's behavior. (Note that you will hear a similar start-tone sequence after each game is selected, so wait long enough for a few LEDs to turn on.)

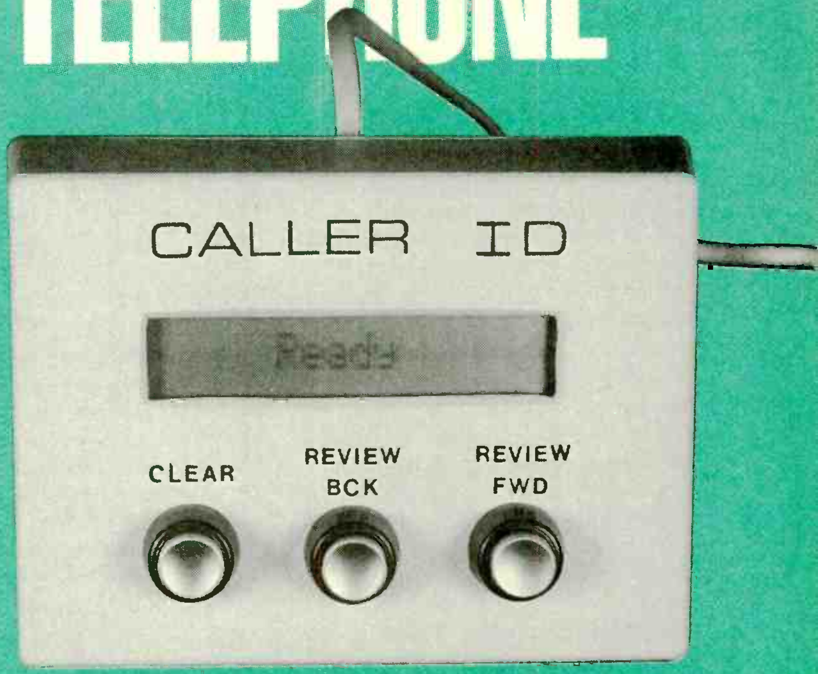
The games

Table 1 shows a complete list of the 16 game functions. Notice the designations A1, A2, A4, etc., on the left side of the chart, which correspond to the key designations shown in Fig. 2. As an example of how a particular game is selected, if after pressing reset you press the "4" key on the "A" side, you will start the tennis game.

Continued on page 70

TAKE BACK CONTROL OF YOUR TELEPHONE

Upgrade the February 1994 Caller-ID project so it works with the calling-name delivery service.



TERRY WEEDER

AN ARTICLE IN THE FEBRUARY 1994 issue of Electronics Now ("Take Back Control of Your Telephone") described the operation and construction of a calling number identifier or CDI. That circuit decodes the Caller ID data on the telephone line and displays the calling party's number. The subscriber feature that made this service possible is known calling number delivery or CND. The service is probably available from your local telephone company for a small monthly fee.

This article describes an upgrade to that circuit which provides an additional service termed calling name delivery or CNAM. Be sure to reread the February article if you want to refresh your recollection of the details of that project before you add this upgrade.

The telephone companies use two different formats to send Caller ID to your home: single data message format (SDMF) and multiple data message format (MDMF). SDMF, described in the February article, works when an initial code of 04 (hexadecimal) is sent to your telephone to identify the data stream that follows as SDMF format.

Single-data format

Figure 1 shows the order in which the data is sent with SDMF. The "message type" and "message length" are sent in binary code, while each character of the month, day, hour, minute, and telephone number are sent in standard 8-bit ASCII code. If the calling party's number is not available because it is outside your service area or originates from a phone where CND is not supported, the letter "O" is sent instead of a telephone number. If the calling party deliberately blocks the delivery of his number (done in most areas by pressing *67 prior to making the call), the letter "P" will be sent instead of the telephone number.

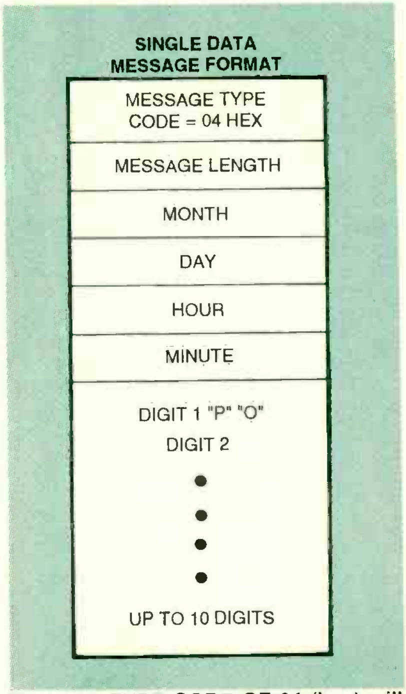


FIG. 1—A TYPE CODE OF 04 (hex) will precede the data in the single data message format (SDMF). This is the order in which each word will be sent in the SDMF format.

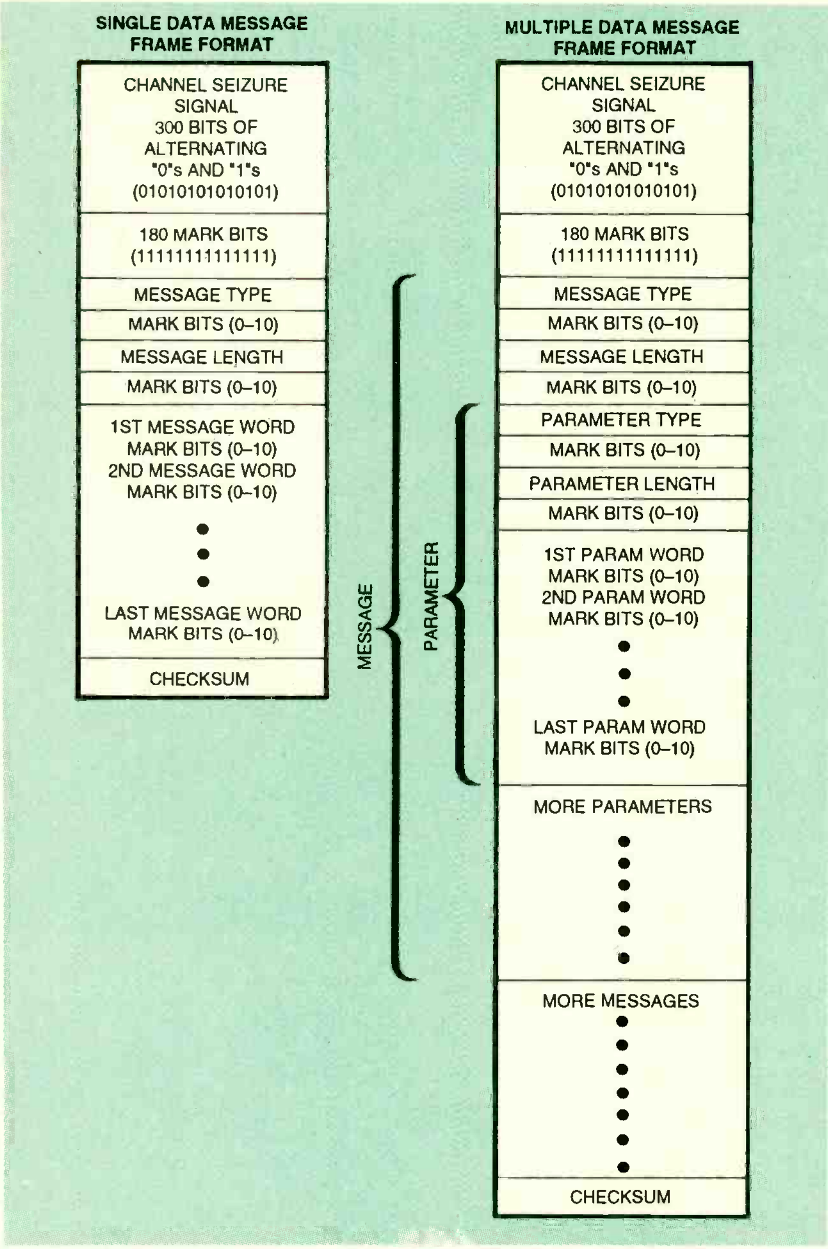


FIG. 2—DATA ARRANGEMENT IN THE SDMF frame as compared to the arrangement in the MDMF frame.

Multiple-data format

MDMF was invented to allow additions to be made to the data stream, including multiple blocks of data (messages) not necessarily related to each other. Bellcore (the Bell Communications Research Group) has suggested that SDMF might eventually be phased out in favor of MDMF.

Figure 2 shows how the structures of the two different formats coexist compatibly. The data associated with each MDMF message is divided into separate segments called parameters. For example, with CND, the information, date, and time are sent in a single segment, or parameter, and the calling number is sent in a second segment.

Each message can contain different kinds of segments in random order, depending on the service the customer has ordered. The last word to be sent is a checksum. Used for error detection, the checksum is the two's complement of the sum of the bits in *all* words in the data transmission.

The message-type word in the MDMF that indicates transmission of CND and/or CNAM is 80 (hex). That's followed by a message-length word which is the sum of all the words in all the different parameters associated with the message. Figure 3 shows each parameter that can be included in the message, and the "type" codes that are used to identify each of the multiple parameters.

Notice that each parameter also has its own "length" word. The length word is important when designing a program that will decode the message. For example, if you want the program to look only for the name of the calling party, you would want it to ignore all other parameters that have the wrong type code. When receiving each type code, the length word indicates how many words the program will have to skip before the start of the next parameter in the message.

The parameters that will be included in the message depend on whether you subscribe to CND, CNAM, or both. In all cases, either the "Number" parameter or "Reason for Absence of Number" parameter will be

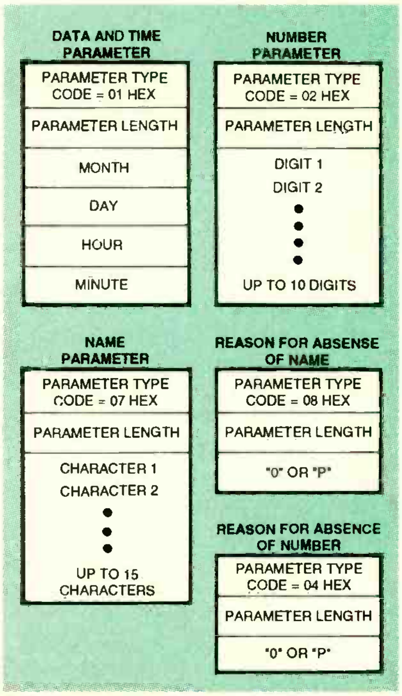


FIG. 3—MULTIPLE PARAMETERS are contained in the MDMF frame. Here's a list of those parameters with their identifying type codes.

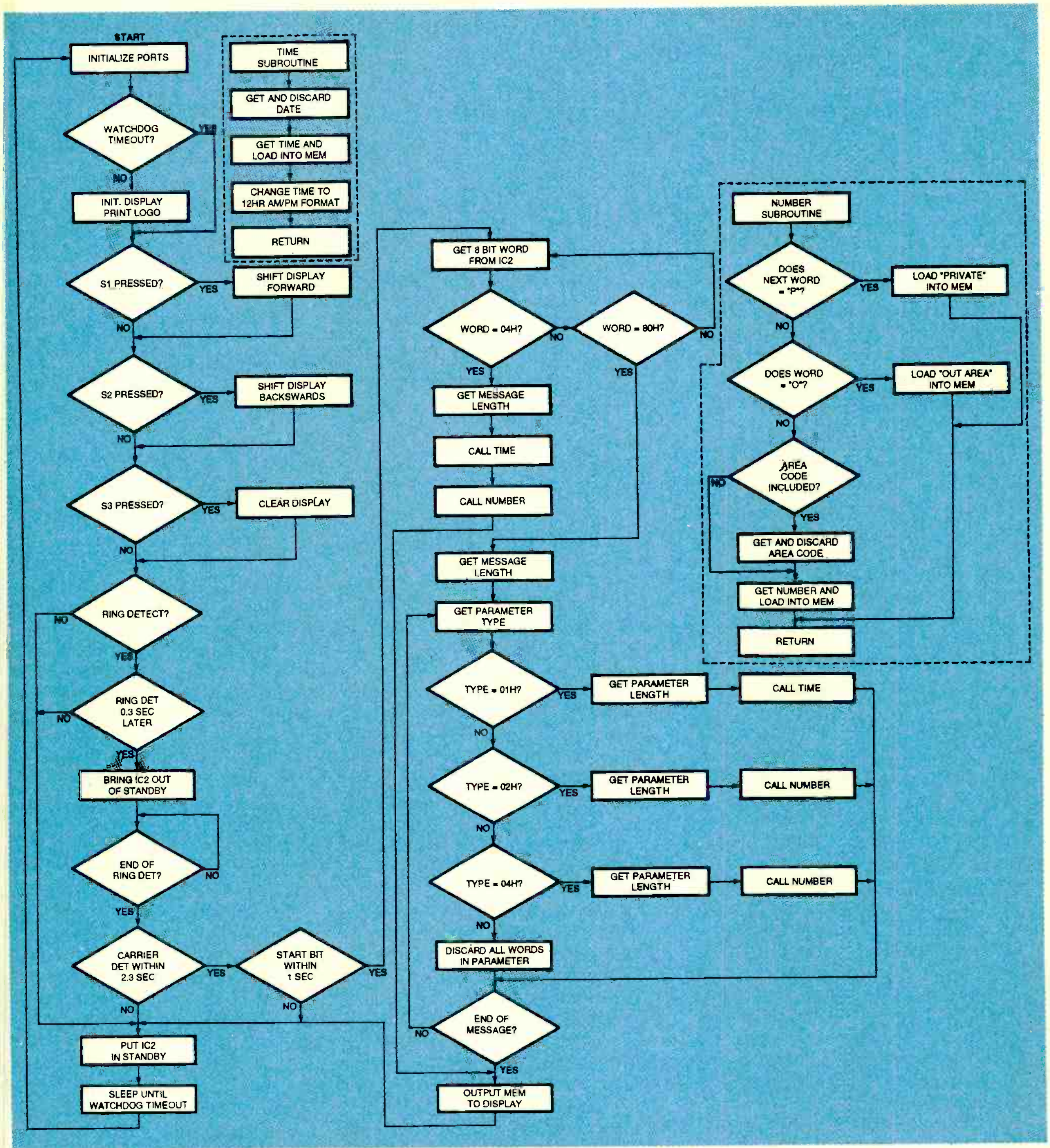


FIG. 4—FLOWCHART FOR THE UPGRADED VERSION of firmware for the PIC16C55 in the February 1994 Caller-ID project. This version is compatible with both SDMF and MDMF.

sent, but not both. The same applies to the "Name" parameter and "Reason for Absence of Name" parameter.

At the present time, the maximum number of characters in the name parameter do not exceed 15. That number is expected to increase some time in the future.

Project upgrade

The original firmware written for the PIC16C55 microcontroller in the Caller ID project was configured to work with SDMF only. If you live in a calling area that supports MDMF and not SDMF (this can be determined by calling your telephone company).

The originally programmed microcontroller will not work with this system. If you have a PIC16C55 programmed with the original version of the firmware, you can send it to the author at: PO Box 421, Batavia, OH 45103. He will exchange it for a PIC programmed to accept MDMF at no charge. You can also send him a 3½- or 5¼-inch

Continued on page 88

COMPUTERIZED GAME

continued from page 66

The second column from the left in Table 1 shows the games that require two players. Typical play is with both players sitting opposite each other, each with both hands on the keys. Games checked in the third column can be played by one player, or alternately by two or more. Game titles are shown in the fourth column, and how-to-play instructions are shown in the middle of the chart.

Be aware that the numbers in the key designation (1, 2, 4, 8, 16, 32, 64, 128) also correspond to the bit values of an 8-bit binary number. It is important to know this when playing games A32, A64, and A128. Also, after many games terminate, the score will be displayed in binary on both sides of the board. For example, if after a game ends, LEDs A8 and A4 are lit, the score is 12 for the A side.

Four of the single-player games (A32, A64, A128, and B2) require that you "enter" an answer. During those games, pushbutton A128 acts as an enter key. First hold down a combination of A keys for your answer, then enter that answer by pressing key A128.

In two games, A32 and A64, two numbers will be shown in binary. The first number will be displayed with a corresponding "low" beep, followed by the second with a corresponding "higher" beep, then a pause. The numbers keep repeating. Those are the two numbers you need to work on in those games. The object of game A32 (Binary Math), for example, is to correctly add, subtract, divide, and multiply (in any order) the two 4-bit numbers shown. Each time you enter a correct answer (enter with key A128), two B side LEDs light up. After all eight B-side LEDs are lit, you win and the game ends.

In game B8 (Last Player Wins), the game will prompt the player whose turn it is by momentarily flashing all eight LEDs on that side. You then must move an LED by pressing a key next to a lit LED to move it to an "empty" (non-lit) space. Either player can move any LED (in his turn), as long as it is in the direction of LED A1, and then finally in the direction of LED B128. The game won't let you make illegal moves. Once there are no more unlit spaces toward B128, the game is over. The last player to fill an empty space wins.

A few games are quite simple. They require only that a key be pressed when that side's corresponding LED lights. Games A1, A4, and A8 are three such games. When you are learning the C-Game, it is suggested you start with the games in the order shown in Table 1 (first A1, then A2, A3, etc.) as they are organized by order of difficulty.

The four "special effects" selections are included just for fun. When selected, C-Game produces random and pre-programmed LED displays and sound effects. In selection B16, the A-side keys and B-side keys each produce a separate tone; the frequencies are dependent on the keys held down. Selection B32 lights LEDs in a random pattern, with the A-side keys controlling the range of the tones, and the B-side keys controlling the overall cycling speed.

Refer back to Table 1 for more details about operating all of the games and functions. Don't be afraid to experiment and press the keys in any order you wish—you can't harm anything.

LISTING 1

```
1                    ;EXAMPLE SOFTWARE LISTING FOR 80C31 C-GAME
2
3  0030           DL1     EQU  30H          ;VARIABLE, INNER DELAY
4  0031           DL2     EQU  31H          ;VARIABLE, OUTER LOOP
5
6  0000                   ORG  0000H        ;SET ORIGIN OF PROGRAM
7
8  0000 75B0CA    START   MOV  P3,#0CAH     ;ENABLE "A" KEY & LED BANKS
9  0003 900000            MOV  DPTR,#0      ;SET ADDRESS FOR LEDS
10 0006 E590      START2  MOV  A,P1         ;READ PUSHBUTTON KEYS
11 0008 F4                CPL  A            ;MAKE LOWS TO HIGHS
12 0009 F0                MOVX @DPTR,A      ;WRITE TO LED'S
13 000A 60FA              JZ   START2       ;GO BACK IF NO KEYS DOWN
14 000C B2B4              CPL  P3.4         ;TOGGLE PIEZO (ONE "CLICK")
15 000E F530              MOV  DL1,A        ;MOVE A TO DL1 VARIABLE
16 0010 753104    DELAY   MOV  DL2,#04      ;SET INNER LOOP TO 4
17 0013 D531FD    DELAY2  DJNZ DL2,DELAY2   ;INNER LOOP
18 0016 D530F7            DJNZ DL1,DELAY    ;OUTER LOOP (KEY VALUE)
19 0019 80EB              JMP  START2       ;START OVER
20 001B                   END

   Errors:  None
```

Going further

For readers who want to program their own custom applications or games, a short assembly software listing is given in Listing 1. This program continuously reads the A-side keys and correspondingly lights the A-side LEDs while producing a tone from the transducer. The frequency of the square wave is directly dependent on the binary value of the keys that are pressed.

The flow chart, Fig. 3, details the operations performed in Listing 1. The line numbers in the flow chart correspond to the line numbers in the assembly listing.

Notice line 16 in the listing. The square wave's frequency is determined by the value placed in the "inner loop" (refer to the flowchart and also lines 16 and 17). By changing the value from 4 to some larger value, for example, the loop would require more time to decrement to zero, causing the overall range of frequencies of the square waves to be lower. Ω

HARDWARE HACKER

Second law violations, soliton wave rectifiers, a fine new CD-ROM directory, a Santa Claus machine update, and some unusual hacker opportunities.

DON LANCASTER

I just got a call from a graduate student who is certain that second law of thermodynamics has been proven wrong and he wanted to know what should be done about it. He said something about statistical thermal gradients nailing *Maxwell's Demon* in a driveby shooting. Naturally, the effect is purely theoretical. It is "too small to measure in the lab."

The second law says heat always *tends* to flow from a hot to a cooler body, but it does not say that it is impossible for heat to flow from a cool to a hot body.

Actually, our helpline hears about three second-law violations or so per month. So let's go over the rules one more time: True, the second law of thermodynamics ("you cannot break even") has never been proven. Moreover, it probably is *not* provable.

On the other hand, and *without exception*, every attempt to find *any* counterexample that would prove it wrong has utterly and totally failed—at least on the normal everyday scale of things. Literally billions of tests are unintentionally rerun day in and day out that overwhelmingly suggest that the law really is true. Congress is not expected to repeal the second law of thermodynamics any time soon.

If the grad student is convinced he is right, he has two options: He can go the *real science* or the *pseudoscience* route. By going the real science route, he has to create a simple and easily duplicated experiment that proves the effect conclusively to disinterested third parties. It must be done so that his explanation for what is happening seems to be the most probable and the most reasonable.

The results *must* stand up. After the results are independently duplicated and verified, then his paper can be presented to a credible scientific journal for a peer review and publication.

By going the pseudoscience route, he can go to anyone in the pseudoscience industry press and get his paper instantly published. Or else he could pick slow news days in obscure rural newspapers for his coverage. Or he could go to even more obscure semi-scholarly foreign publications of questionable pedigree. But none of these alternate routes will look good on his resume.

I've just posted lots more information on exploring pseudoscience resources as NUTS26.PS on *GEnie* PSRT. Back to the real world...

Solitons

Outside of a classic ghost town in Colorado's San Juan Mountains, there is an old free-hanging mining cable. This beast is nearly a mile long and over an inch in diameter. It leads us to some utterly fascinating real-world and real-time physics. If you grab this cable near the low end and shake it once, you can watch a solitary wave running up, reflecting, and returning several seconds later.

What is really amazing is that the solitary return wave is so violent that it will try to rip your arm right off the cable. Something unusual appears to be happening.

A century ago, a mathematician decided that certain solitary waves can indeed be special. He was riding his horse along a canal bank and was daydreaming about waves. A barge suddenly stopped and then launched a solitary wave. He immediately noticed that this wave was unique in that it kept going much farther than ordinary waves. In fact, he followed the wave for miles. After some analysis, he called this special type of wave a *soliton*.

Today, solitons are an incredibly hot research topic. One application is in fiber-optic communications, where a soliton can go much further between repeating amplifiers. In fact, soliton fiber communication has been demonstrated over distances a third of the way around the earth with a 20-gigabyte data rate.

Why will any wave die out? There are three main reasons. First, the wave will *dissipate* when it does such things as flex a resisting cable or encounters air resistance. Dissipation ultimately transforms all of the wave energy into low-grade heat.

Second, portions of the wave will *reflect* whenever they encounter any changes in the media's impedance or uniformity. In the case of that San Juan cable, the end ring is something less than a perfect short circuit, so you don't get everything reflected back.

Finally, and most important for a soliton, the wave will *disperse* if the media lets higher frequency waves go by faster or slower than lower frequency ones. Usually, the wave energy "stretches out" over time.

Any waveform can be represented as a group of high-frequency and low-frequency components. If these ever get out of step, the wave shape will change drastically, as will its detectability.

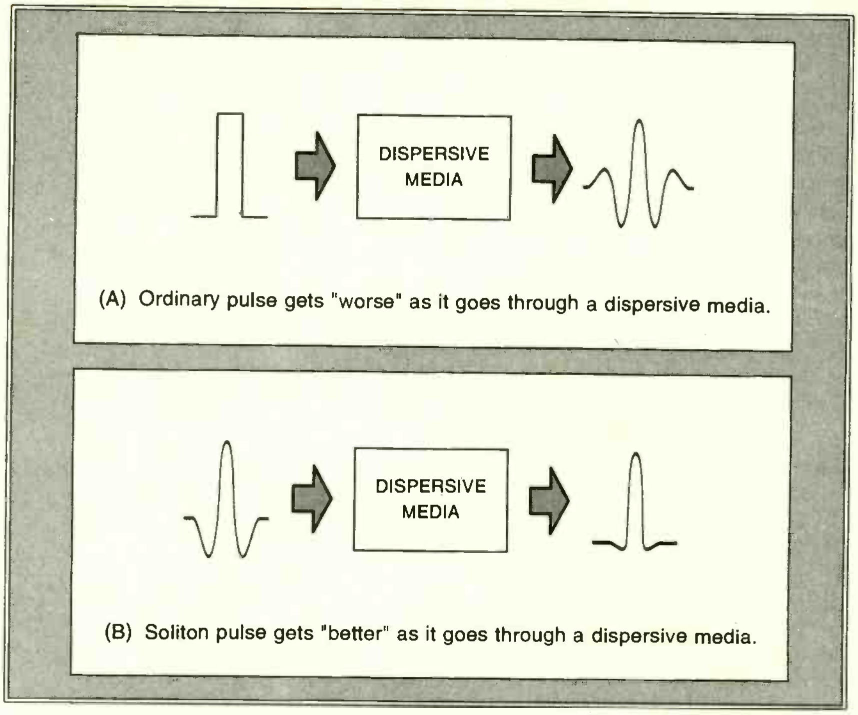
A different name for one type of dispersion is *group delay distortion*. For instance, if the frequency for a one in a modem has more delay than the frequency for a zero, there might be a time when you get a one, a zero, *both*, or *neither* at the output. Obviously, "both" and "neither" are bad news when it comes to extracting useful information.

Figure 1 shows the essentials of solitons. An ordinary pulse that is sent through a dissipative media gets worse and harder to detect. A soliton that is sent through the same media actually gets *better* and easier to detect. For the best results, the media has to be known, stable, and fixed in length. The soliton shape also has to be designed to match the media.

A soliton wave tries to *predistort* itself so that, by the time it is sent *through* the media to the intended receiver, the dispersion of the media and the "undispersion" of the initial waveform cancel out. The fast and later frequency components catch up with slow and early ones. The soliton wave in effect becomes self-reinforcing.

Bats and military radars depend on a more elaborate *chirp* scheme that works in more or less the same way as solitons. Send any swept FM signal through any media that has a linear delay versus frequency response, and you get a narrow and high-amplitude pulse out—Fourier transforms and all.

When you explore the literature, you will find 8,316 soliton papers on the *Dialog* information service alone! There are also dozens of textbooks available. Sadly, many are totally unreadable and involve horrendous math. I have posted a more or less random and rather short sampling of information sources in Fig. 2. These sources and their end bibliographies should be enough to get you started.



(A) Ordinary pulse gets "worse" as it goes through a dispersive media.

(B) Soliton pulse gets "better" as it goes through a dispersive media.

FIG. 1—SOLITONS are a special class of solitary waveforms that can travel much farther than ordinary waves. They are now a very hot research topic.

Let me know if you find any favorite soliton tutorials on your own that are easy to understand. An *Incredible Secret Money Machine II* book will be sent for your trouble.

What good are solitons for hardware hackers? Well, obviously, they are a great subject for science fair projects, student papers, or even thesis topics. But there's a possible new use for solitons that just about anybody can explore, and for which hands-on backyard testing is more important than fancy math. It is one use that is guaranteed to get your feet wet, and that might make you some big bucks.

Simply answer this question: "Can solitons improve fire streams?"

Between spelunking, *tinaja quests*, and pecan harvests, I am also a city fireman. The deck gun on a pumper has an effective fireground range of slightly over 200 feet. There are times and places when that range just isn't enough. The solitons should be able to extend this range significantly.

Ideally, all of the solitons should be generated through water pressure only, using some sort of bolt-on and pass-through flutterwumping adapter that is in series with the water supply.

But go ahead and use electronics or even high-pressure air to prove the idea works. Because of an exciting and an incredibly effective new foam firefighting technique, certain new pumpers now include a reliable compressed air supply.

Let me know what you can come up with here. Obviously, you can use an ordinary garden hose for all your initial tests. This subject appears to be an outstanding new hacker opportunity.

Santa Claus machines

The science fiction authors called them *Santa Claus machines*. These magic boxes could run off a copy of anything—a BMW, a pastrami on rye, a new girlfriend, or a duplicate $20 bill. It would start with either a sample or a set of software plans.

These days, crude approximations of the Santa Claus machine really do exist, and they are getting better every day. Today, these are often known as *desktop manufacturing* or else *rapid prototyping systems*. The pastrami on rye sandwich still leaves a distinctly acrylic after-

All-optical Waveguide Switching, Stegeman, G.I.& Wright, E.M. *Optical and Quantum Electronics* V22, no.2, p95-122 March 1990 (62 refs).

Darboux Transformations & Solitons, Matveev, V.B.; Salle, M.A., *Springer Series in Nonlinear Dynamics*, Springer-Verlag Press, 1991.

Dispersion and Nonlinear Effects in Optical Fibres, Ghatak, A. & Kumar, A., *Int. Jnl. of Optoelectronics*, V8, no.4, p299-318 July-Aug 1993 (44 refs).

Dynamical Chaos of Solitons, Spatschek, K.H., World Scientific, 1993.

Optical Solitons in Fibers, Hasegawa, A., Springer-Verlag, 1990.

Solitons and Chaos, Antoniou, I. & Lambert F., *Research Reports in Physics*, V16, Springer Verlag Press, 1991

Soliton-based Communication, Hasegawa, A., *Journal of the Institute of Television Engineers of Japan*, V47, no.8, 1088-96 Aug 1993 (23 refs).

Soliton Equations and Hamiltonian Systems, Dickey, L.A., World Scientific Publications, 1991.

Solitons in Molecular Systems, Daavydov, A.S., *Mathematics & Its Applications, Soviet Series* Kluwer Ac, 1990.

Solitons in Multidimensions, Konopelchenko, Boris G., World Scientific Publications, 1993.

Solitons, Nonlinear Evolution Equations & Inverse Scattering, Ablowitz, M.A & Clarkson, P.A. *London Mathematical Society Lecture Note Series*, #149 Cambridge University Press, 1992.

Soliton Phenomenology, Makhankov, Valdmir, G, *Mathematics & its Applications, Soviet Series*, Kluwer Ac, 1990.

Soliton Theory: A Survey of Results, Fordy, A. P. *Non-linear Science Series*, Wiley, 1992.

FIG. 2—SOME RECENT SOLITON REFERENCES. There are over 8000 more!

taste, but it definitely is low in fat and has zero cholesterol.

There are now a dozen approaches to Santa Claus machines, so I thought I would once again gather the names of several of the bigger players together into this month's resource sidebar. Most of the systems we'll look at are outrageously expensive—a house and two cars. But there is no reason why the whole kit and kaboodle of them can't be replaced with $175 worth of hacker parts, bunches of time, and a lot of imagination. Some of the major approaches to Santa Claus machines are shown in Figs. 3 and 4. Here's a brief rundown:

Direct toner method. This one is the cheapest, the most accessible, and the most hacker friendly. But it is pretty much restricted to two-dimensional work such as making instant printed circuits, front panels, or dialplates.

With this method, you laser print the toner image onto a transfer sheet. The transfer sheet is placed in contact with your printed circuit board or whatever. Heat and pressure is then applied. The toner transfers to the board and becomes the etch resist or the image.

The two leading suppliers of direct-toner materials are *DynaArt Designs* and *Techniks*, with the printed circuit supplies sold by *Kepro*.

CAD/CAM. This method has been around for a while. It works like an ordinary lathe or milling machine, machining materials to leave the desired object. The difference is software control. The machine is fed a set of plans in software form and it does the rest by itself. Low-end machines have only started to appear here. Although much lower in cost than old "industrial strength" machinery, they still remain obscenely overpriced for most hacker uses.

Typical low-end CAD/CAM suppliers include *Roland*, *Techno Isel*, and *Light Machines*. Other vendors advertise in such places as the *School Shop* and *Industrial Education* trade journals.

Custom CAD/CAM bits and pieces are available at *Stock Drive Products*. Two other material sources are *MSC Specialties* and *McMaster-Carr. John Rees* offers a hacker version here that lets you use ordinary car alternators as power stepper motors.

A CAD/CAM prototyping system can be used with a machineable wax instead of metal or plastic. The wax can then become a pattern or a mold for your final product. This is easier on tools, and mistakes can be recycled. Wax is also a good material for practice. One source of machinable wax is *Freeman Supply*, while *Kindt-Collins* provides a wide range of industrial and artist waxes.

Laser Blasting. The medium power laser is one variation on CAD/CAM that is revolutionizing crafts, model making, and smaller part manufacturing. Parts are cut quickly, accurately, and splinter free. A 20-watt carbon-dioxide laser could be used for such tasks as the precision cutting of doll-house furniture or slicing up parts for model railroad structures. More information on power laser systems appears in *Industrial Laser Review*, while two hacker-friendly sources for lasers are *Meredith* and MWK.

Water Knives. Here an ultra high pressure water stream does all the cutting. My favorite demonstration is one of these chopping up a gooey piece of chocolate cake *and* a four-inch thick steel slab at the same time. *Flow International* is one source of equipment. *Haskell* makes the special pumps.

Stereolithography. The pioneer here is a company called *3D Systems*. With stereolithography, a vat of a liquid photopolymer is hardened one layer at a time by a scanning laser. The laser is lowered slightly as each new layer is finished so that the next layer can be hardened. The process is repeated until the part is completed. Virtually any shape can be made, including ones that are difficult to machine.

The photopolymers aren't all that different from the ones used in flexographic printing and rubber stamps. Two suppliers are *Merigraph* and *Grantham Polly-Stamp*.

Selective Laser Sintering. This is a rapid prototyping method that starts with a fine powder of wax, plastic, or even certain metals. The laser selectively melts and bonds portions together in a thin layer by *sintering*. (Sintering is melting things just enough so that they stick together.) Then the part is lowered, more powder is leveled, and a second layer is imaged, building up the desired prototype.

The final objects are often sturdy enough for use as actual production parts. Unlike stereolithography, the materials used are low-cost and non-hazardous. The laser is also cheaper because it emits infrared rather than ultraviolet light. *DTM Corp* in Austin seems to be the champion of selective laser sintering.

Cubital Toner Imaging. This method is related to the direct-toner method. An *unfused* toner laser image is contact-printed onto a photopolymer. After the uncovered photopolymer is hardened by exposure to ultraviolet light, the unhardened photopolymer is sucked up and recycled, as is the toner image. Voids are then replaced with a wax filling.

The surface is carefully milled flat and another layer is created. Unlike stereolithography, an entire layer rather than a single spot is formed at one time. Cubital toner imaging also requires far less photopolymer, since only a thin layer is used. First developed in Israel, one source is *Cubital America* and one service bureau is *Stature Machining Technologies*.

Sticky Strings This approach seems well suited for forming such hollow objects as shampoo bottles or similar packaging containers. The correct name for the process is *fused deposition modeling*, and *Stratasys* is its main source.

In use, a large reel of thermoplastic rod is unwound along a path. The rod is deposited at a temperature just hot enough so that the outside is liquid, causing it to stick to the previous layer of the pattern.

The results look sort of like corduroy, but you could trade off wire diameter against smoothness. A final polish or filler or solvent spray can improve the surface finish.

It appears to me that a hacker might easily fake this with a hot glue gun by substituting polyethylene for the glue sticks. One obvious use is custom cast house number or name plates.

Laminated Paper Shims. This method works just like the contour lines on a topographical map. It is also known as *laminated object*

NAMES AND NUMBERS

Aero/Skyways
15 Crescent Road
Poughkeepsie, NY 12601
(914) 473-3679

Buddy Products
117-A Commercial Drive
Thomasville, GA 31792
(912) 225-9758

Burman Industries
1441 Covello Street, Ste 6A
Van Nuys, CA 91405
(818) 782-9833

Dialog
3460 Hillview Avenue
Palo Alto, CA 94304
(415) 858-2700

First Light Video Publishing
8536 Venice Blvd
Los Angeles, CA 90034
(800) 777-1576

Fluorescent Mineral Society
PO Box 2694
Sepulveda, CA 91343
(818) 786-4885

GEnie
401 N Washington St
Rockville, MD 20850
(800) 638-9636

The Calculator Collector
Intl Assn Calculator Collectors
10445 Victoria Avenue
Riverside, CA 92503

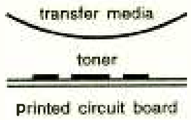
Morph's Digital Outpost
PO Box 578
Orinda, CA 94563
(510) 238-4545

Polytek Development
PO Box 384
Lebanon, NJ 08833
(908) 534-5990

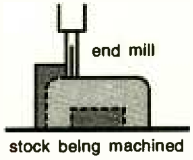
Save the Planet Software
Box 45
Pitkin, CO 81241
(303) 641-5035

Sony Semiconductor
10833 Valley View Street
Cypress, CA 90630
(800) 288-SONY

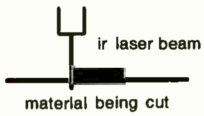
Telecom Library
12 West 21st Street
New York, NY 10010
(800) LIBRARY



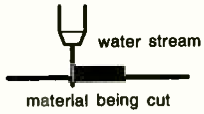
DIRECT TONER METHOD uses heat and pressure to transfer toner to a flat substrate for pc board etching or dialplate artwork.



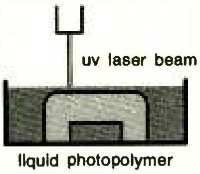
CAD/CAM METHOD uses a programmable lathe or milling machine to remove scrap from around the prototype object.



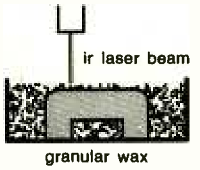
LASER BLASTING METHOD uses a medium to high power laser to physically cut out the parts to their desired shapes.



WATER KNIFE METHOD uses an ultra high pressure water stream to cleanly and quickly slice materials such as food or fabrics.



STEREOLITHOGRAPHY METHOD uses an ultra violet laser to selectively harden certain areas out of a liquid photopolymer.



LASER SINTERING METHOD will use an infrared laser to selectively bond certain wax, plastic, or metal granules.

FIG. 3—SOME CURRENT APPROACHES to Santa Claus machines.

manufacturing. At the present chosen elevation, a piece of adhesive-coated paper of the desired thickness is cut out with a laser.

The latest piece is then carefully aligned to the previous sheet and is then heat-set. This process repeats often enough to build up the desired part. A final surface coating can eliminate the individual steps.

Materials costs are exceptionally low, and only a low-power laser is needed. This method is particularly good for sand casting. One supplier of these systems is *Helisys*.

Ceramic Shell Casting. Originally developed at MIT, *Soligen* is now the leading proponent of this method. A thin layer of ceramic powder is put down, and a scanning head with one or more inkjets passes over the powder, selectively applying a binder.

The part is lowered and the process is repeated, causing layer upon layer of binder to build up in the desired shape. The final shell can be directly used for the high-temperature casting of chrome alloys, aluminum, and even nickel. Hollow items can be made by building up integral cores.

Wax Vacuuming This is a new hacker concept that just might revolutionize jewelry and small art object creation. Picture a hypodermic-like needle that has a hot tip that can be moved along five or six mechanical axes.

The needle works its way around a block of wax, first melting and then vacuuming the molten wax away from the pattern. Curved needles can form the internal details or hard to access points. The intended use is for casting such things as class rings, and silver ornaments. *John Rees* is one source.

By the way, anytime you are using both X and Y motions, it pays to split up the problem. Move your tool in the X direction and your workpiece in the Y direction. This can convert a thorny two-dimensional problem into simpler one-dimensional ones.

For more information, a pricey industry newsletter called the *Rapid Prototyping Report* is available. *Batelle* does fancy research on rapid prototyping. Many ongoing Santa Claus machine developments are likely to appear in the *Machine Design* and *Design News* magazines.

SANTA CLAUS MACHINE RESOURCES

Cubital America
1307F Allen Drive
Troy, MI 48083
(313) 585-7880

DTM Corp
1611 Headway Circle, Bldg 2
Austin, TX 78754
(512) 339-2922

DynaArt Designs
3535 Stillmeadow Lane
Lancaster, CA 93536
(805) 943-4746

Grantham Polly-Stamp
418 Central Avenue NE
E Grand Forks, MI 56721
(218) 773-0331

Helisys
2750 Oregon Ct Bldg M-10
Torrance, CA 90503
(310) 782-1949

Kepro
630 Axminister Drive
Fenton, MO 63026
(800) 325-3878

Light Machines
669 E Industrial Drive
Manchester, NH 03103
(603) 625-8600

McMaster-Carr
Box 54960
Los Angeles, CA 90054
(213) 692-5911

Meredith Industries
5035 N 55th Ave Ste 5
Glendale, AZ 85301
(602) 934-9387

Merigraph
Box 3064
Naperville, IL 60566
(800) 323-1832

MSC Specialties
6700 Discovery Blvd
Mableton, Ga 30059
(800) 645-7270

MWK Industries
1440 S State College Blvd 3B
Anaheim, CA 92806
(800) 356-7714

Rapid Prototyping Report
841 Turquoise Street, Ste D
San Diego, CA 92109
(619) 488-0533

John Rees
Route 1 Box 1551
Sautee, GA 30571
(706) 865-5495

Roland Digital
7200 Dominion Circle
Los Angeles, CA 90040
(213) 685-5141

Soligen
19408 Londelius Street
Northridge, CA 91324
(818) 718-1221

Stock Drive/Techno
2101 Jericho Turnpike
New Hyde Park, NY 11042
(516) 328-0200

Stratasys
14950 Martin Drive
Eden Prairie, MN 55344
(612) 937-3000

Techniks
45 J Ringo Road
Ringoes, NJ 08551
(908) 788-8249

3D Systems
26081 Avenue Hall
Valencia, CA 91355
(805) 295-5600

New tech lit

Morph's Outpost on the Digital Frontier is a unique new multimedia magazine in newspaper format. It offers the latest inside scoop on multimedia developer happenings.

Two other unusual magazines are *Skyways* and *WWI Aero* for those of you interested in early aviation.

From *Sony*, there's a new *Computer Audio & Video Multimedia* data book.

A *CD-ROM Selector* from *Save the Planet Software* is a well researched directory of 1600+ CD-ROM titles.

Laser Buddy Document Spray by *Buddy Products* offers Bakerizing in a can. You can spray this stuff on any laser-printed output and it will get blacker, smoother, and more durable. The resolution appears to improve and text becomes slightly bolder.

The spray is mostly methylene chloride, acetone, and some isobutyl acetate. It works like a champ. But use this spray outdoors only and watch out for fingerprints. No, it won't help direct-toner printed-circuit transfers much because of the residues it leaves.

The *Calculator Collector* is a new labor-of-love newsletter published by the *International Association of Calculator Collectors.*

Lots of telecommunications books are offered by the *Telecom Library*. Some useful multimedia videotapes are sold by *First Light Video.*

The *Fluorescent Mineral Society* looks at rocks in the dark.

A fine catalog on moldmaking and casting materials is available from *Polytek Development*. A similar new catalog is available from *Burman Industries*, another special effects supplier.

NEED HELP?

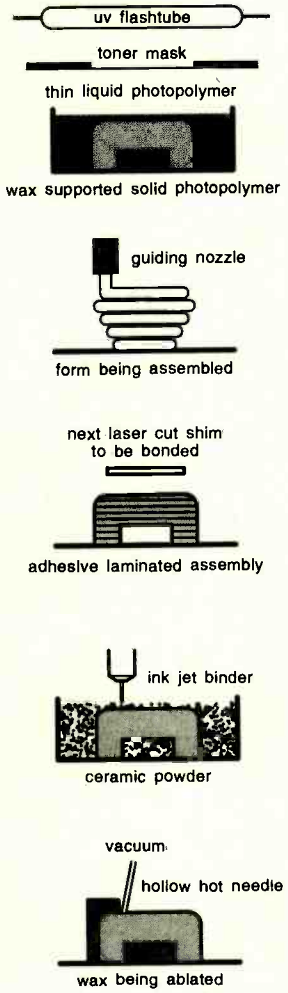
Phone or write your **Hardware Hacker** questions to:

Don Lancaster
Synergetics
Box 809-EN
Thatcher, AZ, 85552

(602) 428-4073

For fast **PSRT** access, modem (800) 638-8369, then an HHH. Then a JOINGENIE,DMD524.

Internet email access link:
SYNERGETICS@GENIE.GEIS.COM



CUBITAL TONER METHOD transfers toner images a layer at a time to a wax supported and flat milled liquid photopolymer.

STICKY STRING METHOD uses a heated roll of plastic rod to bond to previous layers for bottles and hollow objects.

SHIM LAMINATING METHOD uses laser cut thin sheets of heat bonded paper to build up a composite object with low materials cost.

CERAMIC SHELL METHOD can selectively form ceramic powders by using an inkjet to apply suitable binding agents.

HOT WAX VACUUM METHOD uses a fine heated needle to remove unwanted portions of a wax block, leaving a pattern.

FIG. 4—ADDITIONAL APPROACHES to Santa Claus machines.

I've managed to get a great *GEnie* deal specially for all you Hardware Hackers. Ten free hours with no first-month minimum. Just use the new JOINGENIE,DMD524 password that is shown in the *Need Help* box.

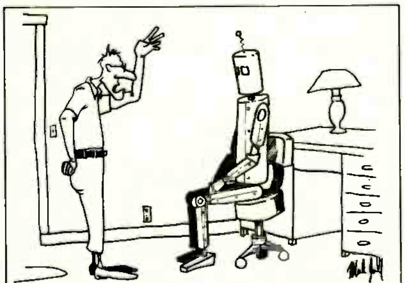
Be sure to type that HHH *quickly* after your communication program shows a connect. That is how GEnie figures out your computer's baud rate and format.

You'll find reprints of most of my previous columns and bunches of other unique stuff on Genie's PSRT Roundtable. But be sure to check out its RADIO, IBM, MAC, A2PRO, and DTP Roundtables as well. Look at the stock quotes on page 270 and the free DIALOG training area.

New graphic Mac and PC interfaces are finally on Genie.

I've also got a brand new catalog with a greatly expanded insider secret section in it. Write, call, or send E-mail to me for a free copy. You might also send me technical questions, new catalog requests, and orders to SYNERGETICS on GEnie or SYNERGETICS@GENIE.GEIS.COM via the Internet.

Most items mentioned are found in the *Names & Numbers* or *Santa Claus Machine* sidebars. Be sure to check those first before calling our no-charge technical helpline. Ω



Let me get this straight . . .You're a woman trapped in a robot's body.

EQUIPMENT REPORTS

continued from page 20

decimal point is determined by the selected range. The LED display will flash when an overrange condition is encountered. If an illegal combination of front-panel switches is selected (for example, if DC volts and the 20-megohm range are selected at the same time), all of the decimal points will light.

The unit is said to be maintain its accuracy for at least a year. After that time, it should be calibrated. That one-year period also matches the limit of the manufacturer's warranty on the BDM40.

The Wavetek BDM40 doesn't contain many "bells and whistles." Rather, it has a straightforward design that makes it right at home on a professional test bench. For reliable voltage, current, and resistance measurements, the BDM40 shines through with its ease of use, highly visible 4½-digit LED display, and wide operating ranges. Ω

Sound pressure level: damage/sonic realism

LARRY KLEIN

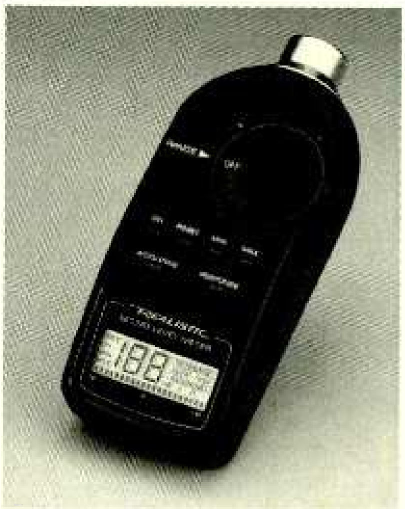
Regular readers of this column are probably aware of my strong interest in hearing preservation. Obviously, I'm swimming against the sonic tide, given the proliferation of killer car stereos, overdriven Walkmen, excessive concert-hall levels, and various other kinds of environmental noise. Recently, it all came home in an unexpected way.

One Friday during supper, my 10-year-old son announced that he'd like to attend the 5th-grade disco dance taking place in the middle-school cafeteria that evening. My wife dropped him off, and we looked forward to three or four hours of quiet, unsullied by various juvenile demands and the sounds of Sega. Alas, our dream of peace was not to be. About 30 minutes later, we got a phone call from Nathaniel asking to be picked up ASAP!

When he arrived home, Nathaniel said that the music was so loud it hurt his ears. My wife confirmed that the sound had indeed been very loud ("It must be 120 dB in there!"), and I thought it might be a good idea for me to visit the dance with my sound-pressure level (SPL) meter in hand.

Yes, things were pretty loud! At the rear of the room, opposite the platform where the DJ had set up his speakers, the measured SPL was about 95 dBa. At a distance of 10 feet in front of the speakers I measured a steady 110 dBa with the meter set to slow response. Wanting to protect whatever hearing I have left, I decided not to climb up on the platform with the speakers where a dozen or so kids were digging the vibes, literally.

Upset about the potential ear damage inflicted on my son's friends and classmates, I sought out the teacher in charge of the proceedings. I told him of my concerns, and suggested that he have the DJ turn down the level at least 15 dB. His response (delivered very po-



Radio Shack's Model 33-2055 digital SPL meter was used to measure the sound-pressure level at a middle-school dance.

litely) was: (1) He has been conducting these dances for eight years and there had never been any complaints about the sound level, and (2) if he turned the sound down too far the kids would revolt. I testily reaffirmed my point that at the existing sound levels there was a real risk of ear damage. I got nowhere and left vowing to continue the fight—but I wasn't quite sure how.

I found an unexpected and militant ally in a mother whose bright, musically talented daughter Katie is in the same grade as my son. I told her of my experience and provided some background articles on OSHA and hearing damage. She did some of her own research, became terribly concerned, and wrote a letter to the school principal outlining the situation and my SPL readings. She asked for a meeting with him and other concerned parties, including the members of the PTSA health committee.

The fuddy-duddy factor

The meeting didn't go quite as I had hoped. I opened the proceedings by distributing background material and outlining my concerns and the reasons for them. I also made the point that I've been a rock fan since the sixties. I had supplied sound equipment to a rock band, had permanent passes to the Fillmore East, the Cheetah Club, The Electric Circus, and Max's Kansas City Upstairs. In other words, I was not simply a gray-bearded fuddy-duddy complaining about the sonic excesses of our youth.

I was puzzled by the subsequent lack of support on the issue. The middle-school principal seemed mainly concerned that word of my measurements not get out to the parents. I don't know whether he envisioned hysterical reactions leading to lawsuits or simply felt that my fears of hearing damage were unwarranted. In any case, he said the older grades were having a dance the next Friday, and invited me to take more measurements.

I arrived there with Katie's mom, who had volunteered to take notes, a Heath real-time analyzer/SPL meter, a calibrated Radio Shack SPL meter—and earplugs. We found a different DJ with different equipment putting out a more moderate—but still too loud—sound level. The readings were a consistent 90 dBa at the back of the room, and about 5 dB louder up front. One of the chaperoning mothers accosted me, saying that she couldn't understand my point of view—would I rather have the kids wandering around out in the street than at the dance? Obviously, someone had spoken to her and probably to the DJ also.

Incidentally, the day after my initial meeting, I happened to run into Katie and one of her friends. I asked Katie how she enjoyed the dance, and whether the sound was okay. She said that when she left after three or four hours, she had felt a sort of pressure in her ears, but it was gone by the next morning. Her friend said that her ears were ringing after the dance, but her symptoms also faded by the next day.

When I happened to mention that to the principal, he appeared to be more upset by the fact that I had asked the question than by the kids' responses. Again, he strongly urged me not to talk to anyone about the situation.

There the matter rests for the moment. I've not yet passed on my new measurements, but I'm not at all hopeful about how gladly they will be received. To be continued ... .

Sonic reality

Last weekend I attended a gospel-music concert given in a small auditorium. The room was packed and we were seated well toward the rear. Nevertheless, I was struck once again by the very audible (to me, at least) differences between live concerts and sound reproduced in the home.

As I see it, the essential purpose of high fidelity is to create the illusion of being in the presence of a live performance. Honest audiophiles are aware of how seldom that ideal is realized, despite their endless upgrading and tweaking. The dozen or so times that I've had a legitimate "I-am-there/they-are-here" experience with reproduced sound occurred when I was listening to: (1) binaural reproduction through headphones, (2) multichannel setups, or (3) stereo "venue-appropriate" reproduction.

Let me elaborate. Binaural reproduction of sound recorded with a microphone installed in a dummy head can be impressively realistic. When it's well done, there's no sense of the sound coming from the headphones; rather, one enjoys the audible illusion of being in a totally different sonic environment.

Multichannel sound can also be extremely realistic if the recording and playback are properly executed. I've heard a four-channel tape that transported me into the presence of an invisible, but wonderfully audible, grand piano. It was being played right over there! About 15 years ago, Acoustic Research demonstrated for me an experimental 16-channel setup that, in terms of I-am-there realism, left nothing to be desired. And I've heard other impressive multichannel demos dating back at least 25 years.

What do I mean by "venue-appropriate?" During the mid-sixties, when I was loosely associated with a rock band called the Group Image, I recorded a rehearsal at a friend's loft. My equipment consisted of two reasonably good mikes plugged directly into a Teac 10½-inch open-reel recorder, and a pair of good isolating headphones. Playback was provided by my friend's stereo system in the same room. After shifting around the band members and microphones for about 15 minutes, I finally achieved a reasonable stereo balance in the phones. I started the tape and went into the adjoining room to talk to my friend while the band and singer wailed on.

The band stopped for a break, but since I knew there was plenty of tape I didn't bother to switch the recorder off. I heard the band start up again doing the same number, and I wandered back to suggest they do something different. But I wasn't hearing the live band; they were playing back the rewound tape. And listening from the adjacent room through a wide doorway, I couldn't tell the difference! To say the least, I was flabbergasted. What I heard flew in the face of everything I had read about the deleterious effects of "doubled room acoustics"—which is what happens when the normal room reverberation caught on a recording is reinforced unnaturally by playback in the same room. Since I had the band at hand, I did some quick live-versus-recorded tests. Yes, there was a discernible difference during A/B comparisons, but from the next room A and B were equally "live."

Over the years, I think I've been able to pin down the subjective differences between a live performance and a state-of-the-art commercial recording. For one thing, the extreme highs heard live have a crystalline quality that is almost always lost in reproduction. To my surprise, I can still hear that difference despite my age-induced high-frequency loss. But I believe there's a more important factor at play. I call it, for want of an established term, the Klein theory of sonic-venue appropriateness (SVA).

Somehow our ears find fault with

Continued on page 85

DRAWING BOARD

This month we build the PLL section of our tachometer.

ROBERT GROSSBLATT

Before I get started this month, there's some unfinished automotive-related business to take care of. Some months ago I mentioned that while two stroke engines had just about disappeared, they were still used in chain saws. I wondered if anyone out there knew the reason for that and, sad to say, I've gotten only one right answer in the mail so far. That's right, a lot of mail but only one correct answer.

To put the matter to rest, the reason that two-cycle engines power chain saws is simply because a chain saw has to be able to run upside down. It can't have an oil sump. During the more difficult maneuvers with the saw, the saw must be turned upside down. If it had a four-cycle engine, the oil would leave the sump bottom, the oil pump would run dry, and the engine would seize. Congratulations to John Lindsay of Paramus, New Jersey for providing the right answer. And now back to the tachometer.

Using a phase-locked loop as the basis for the tachometer does a lot to simplify the design of the circuit but, as I noted last month, it's not a totally trouble-free solution. Engine speed is never constant, and as rpm drops, the variations in engine speed become a larger and larger percentage of the mean speed. By the time it is returned to idle speed, the variation is often more than 10%. It can be even higher if the engine timing is off or something else isn't right with the engine.

This erratic behavior causes problems regardless of the design of the tachometer. It's especially a problem with a PLL-based design because the accuracy of the measurement and the stability of the output rely on the design of the loop filter. I'll go through a real example so you can see what I mean.

The first thing to do is determine the criteria for the design. You can change any of these things later on if you want.

1. The tachometer will read from 500 to 5000 rpm.
2. It will have a three-digit LED display.
3. It will update once a second.
4. It will work with any number of cylinders.

As I mentioned earlier, the heart of any PLL circuit is the design of the loop filter. To understand why, take a look at Fig. 1, the block diagram of a typical PLL. The output of a voltage-controlled oscillator (VCO) is routed to a phase detector. The phase detector compares the VCO's output with the input frequency and it outputs the difference between the two frequencies as an error voltage—the greater the difference, the higher the error voltage.

Feeding the error voltage back to the VCO forces the VCO to track the input frequency. The VCO output in a standard PLL circuit is a clean and squared-up version of the input frequency.

Any time you talk about comparing frequencies (or even voltages), two things have to be considered. The first one is a function of time. (How long should the sampling period be before the comparison is made?) The second is a function of inertia. (How quickly should the comparator respond to changes that show up during any particular sampling period?)

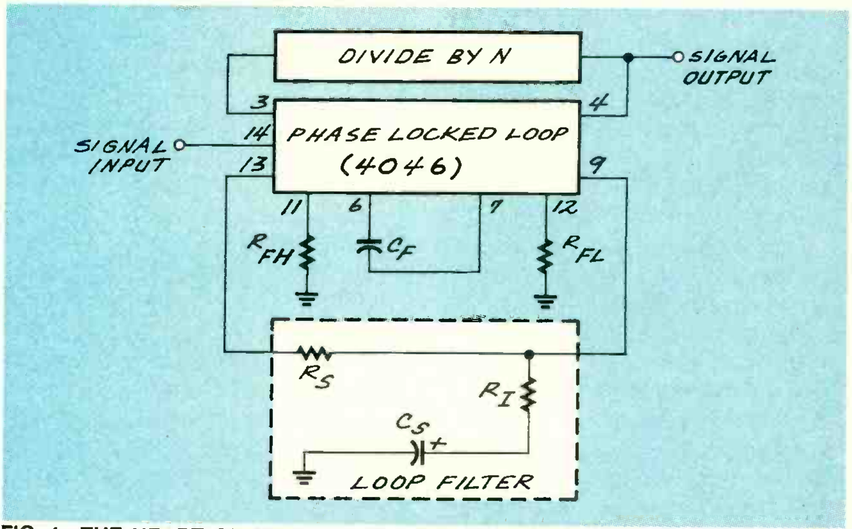


FIG. 1—THE HEART OF ANY PLL CIRCUIT is the loop filter.

# OF CYL	DEGREES/ SPARK	SPARKS/ REV	N
2	360	1	60
4	180	2	30
6	120	3	20
8	90	4	15

FIG. 2—THE SPARK RATE from the coil depends on the number of cylinders in the engine. For other engines, just divide the number of cylinders into 120 to give you the divide-by number for the PLL.

Those two factors are decided by the loop filter, which is why the filter is the most important part of the circuit. The loop filter in a 4046 is made up of just two resistors and a capacitor, but don't be fooled into taking these three components too lightly since they control the operation of the PLL. A poor design will make the tachometer worthless.

The PLL's sampling period is determined by the product of R_S and C_S, as shown in Fig. 1. If the RC period is too high, the tachometer will be sluggish, and if it's too low, the tachometer will be too erratic. The inertia of the loop is determined by R_I. If that value is too large, the tachometer will take a long time to reflect changes in the input frequency, and if it's too small, the tachometer will probably overshoot and will definitely oscillate around the input frequency.

A divide-by circuit can be installed between the output of the VCO and the input of the phase detector to make the PLL even more useful. By raising the VCO center frequency to N times the expected center of the input frequency and dividing the VCO output by N before it gets to the phase detector, the VCO output can be made equal to a frequency that is N times the test input and is also locked to the test input.

This all sounds terrific but there's a catch: you have to decide what the center of the input frequency is going to be. Since the input frequency I've been talking about is the signal from the ignition system, it's important to know what the expected spark rate from the coil is going to be. The tachometer is being designed to work with engine rpm's from 500 to 5000, and the rate of spark (from the coil, not to any particular plug) depends on the number of cylinders in the engine. I went through this last time and I've summarized the results in the table of Fig. 2.

The tricky part of designing a tachometer with a PLL is to come up with the appropriate divide-by number for engines of different sizes. Since the circuit is counting sparks and its display should be updated every second, a conversion

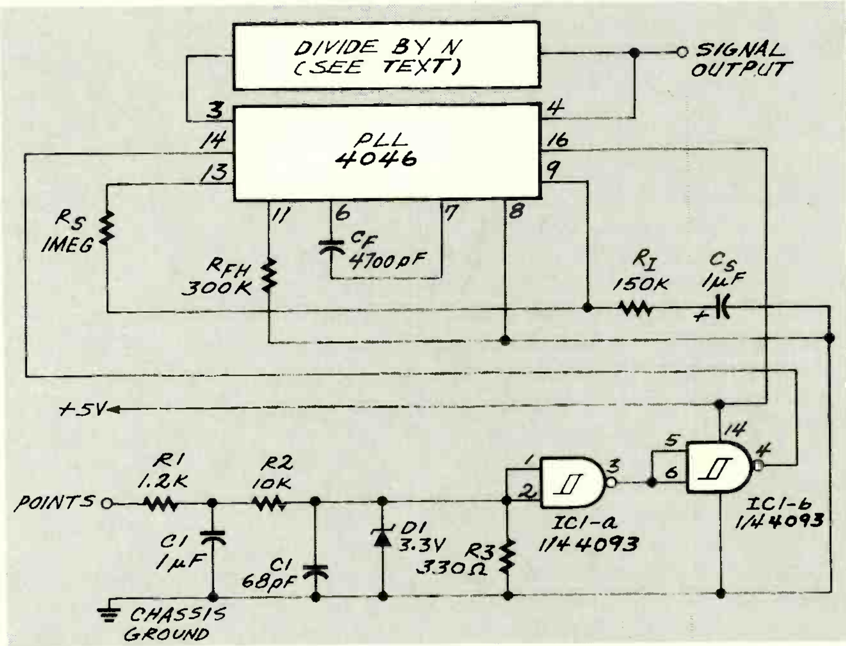


FIG. 3—THE FINAL CIRCUIT. The loop component and VCO values are good starting points for the frequency range we agreed on.

factor that will translate the number of sparks per second into engine revolutions per second is necessary. The conversion numbers for various engine sizes are shown in Fig. 2, but if you have some other kind of engine (a five-cylinder Audi, for example), you can work out the conversion number yourself. To make things easier, just divide the number of cylinders into 120 and that will give you the divide-by number for the PLL.

Now all that's missing is the timebase for the counter and the display. Both of these sections are similar to things we've done many times before, and you should be able to design them with your eyes closed. If you keep notebooks (another thing I've talked about many times before and always encourage readers to do), you'll undoubtedly find loads of timebase and display circuits.

There are lots of ways to generate an accurate 1-hertz signal, but I think the easiest way is to use the 5369EST from National Semiconductor. A colorburst crystal connected to one end of the IC produces a 100-hertz signal out the other end. By adding a pair of 4017s to the circuit, a 1-hertz timebase for the tachometer can be produced at a very low cost.

Make sure you get the "EST" version of the 5369 chip (it produces a 100-hertz signal) rather than one with an "AA" suffix (it generates a 60-hertz signal). If all you can find is the AA version, you'll have to build a divide-by-60 circuit, but that should be no problem either—the two 4017's can divide by 60 just as easily as they can divide by 100. They just have to be wired differently.

The final circuit is shown in Fig. 3. It's a good idea to build the circuit and try it out before deciding that it's the one you want to use. The loop component and VCO values shown in the schematic are good starting points for the frequency range we agreed on, but you can play around with the values and try to tweak better performance out of the circuit. I don't think there's any way to completely avoid jitter at low engine rpm, but that's something you should determine for yourself at your own testbench.

Remember that the VCO's center frequency is set by the capacitor straddling pins 6 and 7, and the upper frequency is set by the resistor between pin 11 and ground. An offset frequency can be added by putting a resistor between pin 12 and ground. If you leave out that last resistor, the VCO's minimum frequency will be 0. You can make a much more intelligent estimate of the starting component values by going through the manufacturer's data sheet.

Once you have the circuit assembled, connect an oscilloscope to the output and watch the waveforms as you experiment with different loop-filter component values to stabilize the tachometer output. If you see a lot of wild swings on the scope, chances are the PLL is going out of lock. If the scope shows that the PLL response is too sluggish, you'll have to change the components to reduce the loop settling time as was disclosed.

When we get together next time I'll work out the details of a second approach to tachometer design. I'll also put together a display circuit that can be used for both tachometer circuits. Ω

Q&A

continued from page 12

the increase in storage space that you can obtain with compression software depends on the kind of files you have on your hard disk, there's no doubt that the software works.

The heart of this type of software is the real-time compression and decompression algorithms that write and read to the hard disk. In the early days of disk doublers, the software would occasionally cause errors that resulted in the loss of data but, these days, the whole operation is virtually invisible. The technology has improved to the point where the data is just as safe as it would be if the doubling software were not used.

Just about the only disadvantage to disk compression is that you never know for sure exactly how much room is left on the drive. That's because some kinds of data can be compressed more efficiently than others. Text and data files can often be squeezed down to 10% of their original size, while executable and other binary files can be compressed only by about 30% or so. The claim of being able to double disk space is a statistical expectation, and not always a measurable reality. But as long as the algorithms are stable and the compression schemes are reliable, it would seem that the increase in storage space is well worth the cost of the software—usually less than $100. Ω

LETTERS

continued from page 18

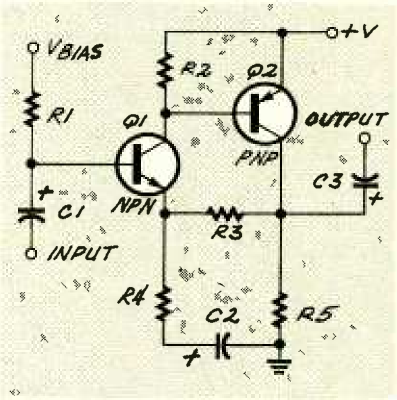


FIG. 1.

R5). The input stage collector current is easily set by R2, and the output stage collector current is easily set by R5.

The output stage operates as a current source, offering excellent power supply rejection. AC current gain is easily set with ratio of resistance values for R3 and R4. The circuit is independent of transistor characteristics, and is simple enough so that it is likely to work the first time you power it.

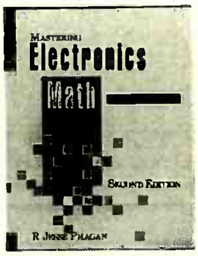
You listed no references in the article so I would like to contribute two titles: The *RCA Audio Amplifier Manual* (APA-551, 1979) is quite detailed on both with discrete components and IC's. Jack Darr's *Electric Guitar Amplifier Handbook* (Sams 21443, 1977) is even more comprehensive. It includes detailed schematics and servicing tips for various circuits.

MARK WILLIAMSON
Rockford, IL

NEW LITERATURE

continued from page 29

clear. He tells the reader when and why certain kinds of math are needed to solve electronics problems. The answers to all of the sample problems are given in an appendix.



CIRCLE 345 ON FREE INFORMATION CARD

Included in this marh book are explanations of scientific and engineering notation, sine waves, transformers, inductors and capacitors, time constants, and resistance-capacitance waveshaping. This second edition has been improved with new graphs, drawings, and four new chapters covering the math related to multimeters, oscilloscopes, transistors, and computer numbering systems.

Microterminal Catalog. Burr-Brown Corporation, 6550 South Bay Colony Drive, Tucson, AZ 85706-7148; Phone: 800-328-2526; Fax: 602-741-4240; free.

Microterminals are small, rugged units designed as operator interface/control panels and data-collection terminals. This 12-page catalog from Burr-Brown contains product specifications, pictures, and information on key features and applications for the microterminal product line. Discussions of accessories and peripherals are also included. The Microterminals are available in a wide variety of cases, functions, keyboards, and displays.

CIRCLE 346 ON FREE INFORMATION CARD

Can We Talk?. Kepco, Inc., Attn: Mrs. Alexandra Dunleavy, 131-38 Sanford Avenue, Flushing, NY 11352; Phone: 718-461-7000; Fax: 718-767-1102; free.

This six-page, four-color brochure describes Kepco's line of digitally controlled power supplies. It details the various communication and control options offered with Kepco's series MBT 360-watt, instrumentation-grade, voltage-current stabilizers.

The units permit communication over the IEEE-488 bus through a two-wire serial bus that can link up to 27 units to a host

CIRCLE 347 ON FREE INFORMATION CARD

PC, or it can communicate with an RS-232 interface. Ω

MEASURING NI-CAD RESISTANCE

Q&A's reply to T. Ng, who asked in the February *Q&A* column about measuring the internal resistance of nickel-cadmium cells and batteries, was long on sarcasm and short on solid technical fact. Although Q&A apparently does not agree, the internal resistance of a battery is one of its critical specifications.

That resistance determines the battery's terminal voltage versus load current characteristic. Therefore, it determines how much current can be drawn from the battery without an objectionable drop in voltage. That resistance also determines the external voltage that must be applied to the terminals of the battery to force a given current through it for recharging.

Furthermore, Q&A's procedure for computing the internal resistance in incorrect. In general, the proper procedure requires two loads. It is easily developed by referring to the simple schematic Fig. 2.

In that diagram, V_b is the internal or open-circuit voltage of the battery, and R_b is its internal resistance. R_L is an arbitrary load

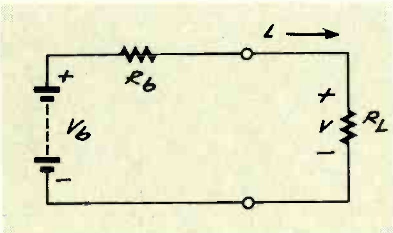


FIG. 2.

resistance, and V and I are the circuit's terminal voltage and current, respectively.

With basic circuit analysis, it can be seen that for any R_L:

$V_b = V = R_b I$.

For a sepecific load resistance, R_{L1}, the relationship becomes:

$V_b = V_1 + R_b I_1$,

Where V_1 and I_1 are the values of V and I for this load.

Similarly, for another specific load resistance R_{L2}, the relationship is:

$V_b = V_2 + R_b I_2$.

Equating the right-hand sides of the last two equations and solving for R_b give the desired result:

$R_b = (V_2 - V_1)/I_1 - I_2)$.

Thus, the internal resistance of the battery is the ratio of *differences* in voltage and current for the two loads.

Mathematically, the values of R_{L1} and R_{L2} are arbitrary, so one is free to choose them based on practical considerations. One convenient choice is to set an open circuit as one of the load conditions—say, resistor R_{L1}.

As a result, the corresponding current I_1 is zero and the corresponding voltage V_1 is V_b, the open-circuit voltage of the battery. Another choice is to set values of R_{L1} and R_{L2} that approximate the actual load anticipated for the battery. By doing that, R_b is computed as a small-signal value at the nominal operating point of the battery.

DONALD M. KELLER, Ph.D., P.E.
Blacksburg, VA

ANTENNA BOOSTER CORRECTIONS

In the article "Tunable FM Antenna Booster" (May 1994, *Electronics Now*), resistor R1 in Fig. 3 (Parts Placement, p. 50) should terminate on pad 3. Also Q1 and Q2 are specified correctly in Fig. 2 (amplifier schematic, p. 50) but incorrectly in the Parts List. Both are 2N3904 NPN transistors. Ω

AMATEUR TV STATION

continued from page 40

the oscillator frequency to change about 20 kHz per volt of applied signal. About 2 to 2.5 volts p-p is required for 25-kHz deviation of the 4.5-MHz subcarrier. About 6 to 7 millivolts of audio signal is required at the base of Q4 to obtain full deviation (25 kHz).

The FM 4.5-MHz subcarrier is taken from the source of Q5 through C42. The value of C42 sets the subcarrier level; C42 also removes the DC level present at this point. If it were not removed, it might change the effective Q point of the video amplifier. The audio subcarrier is fed to the video amplifier Q7 where it is mixed with the video signal. This design makes a separate sound transmitter/RF system unnecessary.

If desired, optional switch S2 can be inserted in series with R29 to disable the audio subcarrier. This is often done in ATV work, where a separate audio link (such as a 2-meter FM) might be used instead. With this modification, it will not be necessary to turn on the video transmitter to talk, and it is useful during test and setup procedures. If S2 is not needed, install the jumper across the switch pads on the PC board.

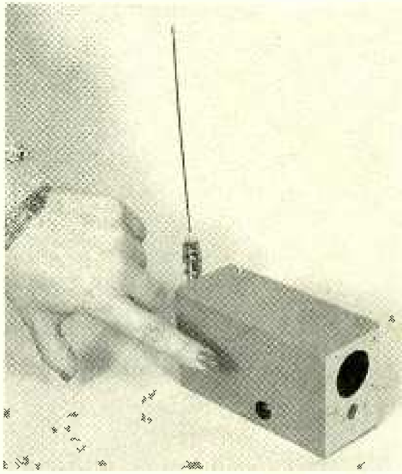
The Mini ATV has the same audio circuitry as the 5-watt transmitter circuit with one exception. The Mini-ATV requires 9 volts to operate, so the 9-volt regulator D6 in the 5-watt version is replaced with a 6-volt diode (D3) in the Mini-ATV. Also, the varactor diode (D2 in the Mini ATV) is biased to the full 6-volt regulated voltage, through R23. The ATV Jr., of course, has no audio channel so there are no audio components on the PC board.

Downconverter

The downconverter, antenna relay, and line sampler section of the 5-watt transceiver are shown in Fig. 6. If you are building only a transmitter, you can skip this section. The downconverter consists of a tuned RF stage with a low-noise, dual-gate GASFET, a double-balanced diode mixer, an IF amplifier, and a varactor-tuned local oscillator.

Signals from the antenna pass through relay RY1 to a tap on antenna coil L16. The coil is tuned to signal frequency (420 to 440 MHz) by trimmer C43. Diodes D7 and D8 protect the gate of RF amplifier Q11 from excessive RF levels that might damage it. Transistor Q11 is biased to about 10 milliamperes drain current.

Capacitor C50, a value of about 0.6 picofarads, built into the PC board layout, couples RF into the tuned circuit consisting of C51 and L18. A tap on L18 can match the input impedance of double-balanced mixer M1 to the tuned circuit. Mixer M1 is fed with a local-oscillator signal of about +7 to +10 dBm (500 to 700 millivolts). Oscillator transistor Q13 is biased by R47, R48, and R49. The collector circuit consists of oscillator inductor L21, trimmer capacitor C57, and varactor diode D9, in series with 5.6-picofarad capacitor C58. The DC bias is applied via R51, R46, and potentiometer R50.



THIS ATV UNIT contains a built-in CCD camera module and rechargeable battery pack. It's a hand-held wireless TV transmitter in itself.

The setting of R50 determines the bias on D9 (from +1 to +9V). It tunes the LO frequency from 350 to 380 MHz; this will provide 60 to 72-MHz IF frequencies over the input signal range of 420 to 445 MHz. This corresponds to channel 3 or channel 4 (VHF TV) so that a standard TV receiver can serve as an IF amplifier and display monitor for the transceiver.

Components D10, R52, C62 and C63 provide a regulated 9-volt DC source for the oscillator, and C60 provides feedback. The LO signal is fed to mixer M1 through R44 and R45 from a tap on L21. The IF signal is taken from pins 3 and 4 of M1 through lowpass filter L19 and C52, and coupling capacitor C53. The IF amplifier Q12 is biased by R43, R42, and R41. Coil L20, C56, and C57 are resonant at the IF frequency, and they match the collector circuit of Q12 to 50 to 75-ohm loads.

The downconverter has separate supply lines for the RF amplifier (TP4) and the mixer-LO-IF section (TP5). During transmit, V_{CC} is removed from the RF amplifier (Q11 and associated components), but the mixer-LO-IF is still functional. This allows the operator to pick up some transmitted signal with the downconverter and see it on the receiver—a handy feature for verifying transmission. The downconverter gain is cut from about 33 dB in its receive mode to about a 10 to 20 dB loss. If the downconverter feature is not needed and you want to disable it completely, the downconverter mixer-LO-IF lead (TP5) can be fed from +12-volts in the receive-only mode, as in the RF amplifier.

To monitor transmission quality, a line sampler circuit is included. This circuit samples the transmitted RF signal, demodulates it, and feeds the detected (demodulated) video to an emitter-follower output buffer and then to an output jack. Refer to Fig. 6. Capacitors C64 and C65 form a capacitive voltage divider across the RF power amplifier output line. About 1.5 volts of RF signal is available from the divider. Diode D11 is an envelope detector that produces a negative video signal. The video is fed through RF choke L22 to the emitter of Q14. The detected video appears across R56.

The base bias of Q14 is set at

about +3 volts through resistors R54 and R53 and bypass capacitors C66 and C67. Because Q14 is an emitter-follower, a low impedance video output is produced. Capacitor C68 couples video to the line sampler output jack. Sufficient output (about 1.5 volts) is available to drive most monitors. If more or less output is desired, change C65 to 6.8 or 15 picofarads, respectively. If a variable output is needed, substitute a trimmer with a value of 5 to 20 picofarads in place of C65. (This change was not found to be necessary in the prototypes.)

Relay RY1, a DIP reed relay, is activated through R35 and bypass C42 by voltage from the transmit supply lead. The relay has about 0.7 to 0.8 dB loss, but switching RF at 440 MHz at a reasonable cost is not easy. The relay can be omitted, and the RF output from the transmitter and the RF input to the down-converter could be brought out to separate jacks.

Next month

That's all for this month. If you want to build any ATV unit, collect all the parts you'll need for the unit you want to build. Next month's article will tell you how to build the ATV circuits. Ω

AUDIO UPDATE

continued from page 79

reproduced sound whose recorded acoustics are at odds with the acoustics of the room in which it is being reproduced. It just doesn't sound live. The sound is a lot more realistic when we are listening binaurally through headphones—which means no listening-room acoustics—when the listening-room acoustics are swamped out by multiple channels, or when the recording is played back in the same room it was made.

In any case, listen to some live, minimally-amplified performances against the best recorded material at hand. What differences do you hear? I would be interested to know if you think my SVA theory holds water. Ω

WHAT'S NEWS

continued from page 6

FIG. 2—PROTOTYPE, PLASTIC, rechargeable lithium-ion battery is held by Bellcore scientist Jean-Marie Tarascon.

weigh half as much. Moreover, they say lithium-ion technology poses none of the environmental problems of the most commonly used rechargeable cells and batteries based on nickel-cadmium or lead-acid chemistry.

"This is the first plastic, solid-state rechargeable battery," says Jean-Marie Tarascon, leader of Bellcore's battery team. "It does not contain such toxic metals as lead, cadmium, mercury, or cobalt. What's more, no liquid will leak out if the battery is cut or punctured; this makes it safer to install and use." The new power cell is a refinement of one announced by Bellcore in late 1992, which had a liquid electrolyte.

The new solid form of lithium-ion cell consists of five active layers encased in a metallized plastic bag that keeps out contaminants. Reading down from the positive side they are an aluminum mesh, a plastic anode layer containing manganese oxide (the positive pole), and then a layer of plastic that appears solid. It is actually a porous plastic structure impregnated with liquid electrolyte. Below that is the plastic cathode layer containing carbon (the negative pole), and at the bottom is copper mesh. The manufacturing process calls for fusing the layers together with heat.

When the power cell is being charged, lithium ions from the anode pass through the electrolyte layer and collect on the cathode. The reaction is reversed when current is being drawn from the cell: current flows across the terminals in the opposite direction.

According to Bellcore, their lithium-ion cell has twice the energy density of a nickel-cadmium (Ni-Cd) cell and 40% more than a nickel-metal hydride (Ni-Mhd) cell. Each cell produces a nominal voltage of

Continued on page 89

COMPUTER CONNECTIONS

And then there were none.

JEFF HOLTZMAN

This year is shaping up as an eventful one for the computer industry. So far, several new technologies have been introduced, and several significant business events have occurred. Those events that happened in the first quarter of 1994 will have a dramatic, long-term effect on the computer industry:

- Apple introduced the first PowerPC-based Macintoshes.
- AMD, NexGen, Cyrix, and IBM intensified the assault on Intel's dominance of the microprocessor market.
- Intel retaliated by introducing enhanced versions of its 486 and Pentium CPU's.
- Novell initiated a buyout of WordPerfect.

FIG. 1—APPLE'S NEW POWERPC-BASED MACINTOSH line introduces RISC-level performance at desktop prices. SoftWindows technology from Insignia Solutions lets DOS and Windows programs run in emulation mode at 486/25 speeds.

PowerPC

PowerPC is an overloaded term that can mean: 1) A microprocessor, 2) A family of microprocessors, 3) A member of IBM's RS/6000 workstation family, 4) A personal computer made by IBM, 5) A personal computer made by Apple (which calls its version Power Macintosh, shown in Fig. 1).

PowerPC started out not as a microprocessor, but as a multi-chip central processing unit (CPU) complex used by IBM in its RS/6000. When IBM, Apple, and Motorola teamed up in 1991, one of their prime objectives was to build a single-chip version of that RS/6000 processor, then dubbed the PowerPC. Power, by the way, is IBM's acronym for "performance optimization with enhanced RISC." RISC is also an acronym; it stands for reduced-instruction-set computing. In stark contrast to RISC, CISC stands for complex-instruction-set computing. To understand the difference between these terms, see the sidebar "RISC vs. CISC."

Who needs PowerPC? And why? Many analysts believe that Apple needs a RISC processor because the Motorola 680X0 microprocessor family (on which Apple's computers are based) simply ran out of steam. Without going RISC, Apple would be stuck in a dead end—or it would be faced with the prospect of moving to the Intel (or some other) platform. (That's a tactic Apple is pursuing anyway, just in case). Similarly, if Motorola were going to stay in the microprocessor market in a serious way, it would need something new.

IBM's reason for joining the PowerPC partnership is less clear. The company has a close relationship with Intel, including manufacturing rights for the 486. (IBM builds enhanced versions of the 486 and sells them as parts of both boards and systems.) Some industry observers have suggested that IBM joined the PowerPC partnership because it desparately wants to dethrone Microsoft, particularly in the operating-system market. The PowerPC could do that because one of its key technical and marketing features is emulation technology that allows DOS, Windows, and Macintosh applications to run as-is on PowerPC machines.

Both IBM and Apple are promoting the idea that RISC provides enhanced performance, lower cost, and backward compatibility. At one time, the PowerPC triumvirate seemed to be promoting the idea that a PowerPC is a PowerPC is a PowerPC—in other words, that compatibility would extend across the major players' product lines. It now appears that such is not the case. IBM's PowerPC boxes will run DOS and Windows software through emulation. They will also run native versions of AIX (IBM's version of Unix) and OS/2. IBM's PowerPCs won't run Apple's System 7 software or any applications written for that operating system.

Similarly, Apple's PowerPC boxes will run DOS and Windows software through emulation. They will also run existing System 7 applications under emulation, and they will run rewritten System 7 applications in native PowerPC mode.

In both cases, the DOS/Windows emulation software is expected to provide performance equivalent to a low-end 486—but both performance and reliability remain to be seen. Many people, including myself, question whether success is possible with either. IBM, for example, has had problems keeping OS/2 compatible with successive releases of Windows. Moreover, with Chicago looming just over the horizon, IBM seems to be in for even more trouble, especially now that it no longer has rights to Windows source code.

Who will buy PowerPC boxes? From the Apple point of view, it appears likely that the company will have no trouble converting its existing user base. Those users can benefit immediately from the extra performance that native PowerPC applications will provide, particularly for advanced graphics and multimedia development. Apple is going after the PC market as well.

Apple executives have vowed to maintain Power Mac prices several hundred dollars below those of comparable Pentium boxes. Apple can do this because a PowerPC processor can be manufactured for (by one estimate) as little as 20% of the cost of a Pentium CPU. Nonetheless, Apple will find the PC market a tough sell. This market still views Apple with suspicion. Why change hardware platforms? Is there any compelling application software? In my view, without good answers to those questions, Apple will find it tough going indeed.

From the IBM point of view, the company will have no trouble establishing PowerPC in the RS/6000 market. But IBM has also revealed plans to conquer the mainstream desktop PC market. In fact, IBM has established a separate PowerPC division whose charter is just that. Doing so, of course, pits that division against IBM's Personal Computer Co., still the largest maker of Intel-based PCs in the world.

And where is Microsoft in all of this? Quietly porting all of its major applications to run on both IBM and Apple PowerPC boxes. In addition, Microsoft is also porting its software into a Unix-like operating system, Windows NT, to run on IBM's box. In other words, regardless of who wins the hardware wars, Microsoft seems to have all bets covered.

RISC vs. CISC

Until March 1994, all PC's, Macintoshes, Amigas, Ataris, Apple II's, Commodores, Sinclairs, and CP/M machines were based on CISC processors. By contrast, all engineering workstations, such as those built by IBM, Digital, Hewlett-Packard, Sun, and Silicon Graphics were based on RISC processors.

How do RISC and CISC differ? RISC is based on a variation of the 80/20 rule. This rule assumes that most software spends 80% of its time executing only 20% of the available instructions. RISC processors attempt to optimize the performance of that 20%, and to keep chip size and cost down by eliminating the other 80%. RISC does in software what CISC does in silicon.

RISC processors are marked by the following characteristics: They have fewer than 150 instructions, and most instructions execute in a single processor cycle. They have many CPU registers and high clock rates. They provide instruction pipelining for simultaneous instruction fetching, decoding, and program execution.

RISC processors have a relatively small number of transistors, which contributes to their low cost. CISC processors, on the other hand, have a larger instruction set, fewer CPU registers, lower clock rates, larger numbers of transistors, and higher prices.

The division between RISC and CISC—both architectures and markets—was crystal clear until Intel released the 486. Intel touted it as having RISC-like features (primarily pipelining and single-cycle execution of simple instructions). In terms of performance, the Pentium is even more RISC-like, but not in terms of underlying complexity, which translates into higher cost. RISC purists strongly object to calling any member of the 80X86 family RISC-like. Regardless, Intel evidently found RISC alluring enough as a marketing concept to start using it several years ago.

The PowerPC, however, is a true RISC processor—the first one designed specifically for the high-volume personal computer market. It represents the most serious attempt in the industry to wrest control over micropricessors and operating systems from Intel and Microsoft, and to transfer that control to the Apple, IBM, and Motorola partnership.

The PowerPC microprocessor is really a family of processors that includes four members, the 601, 603, 604, and 620. The 601 is the only version shipping now. It provides Pentium-level performance, but uses less power and costs less. The 603 is a low-power version for laptop computers.

The 604, which should be released in about a year, will offer twice the performance of the 601. Following that will be the 620, which if it meets current design goals, will provide truly unprecedented power for a desktop system. Ω

Long term considerations

Hypothesize for a moment that in ten years we'll all be running RISC processors. Who'll make the chips? Who'll make the operating system?

The mainstream PC market (Intel + DOS/Windows) has one more stop—the final stop—on the highly-coupled CPU/OS line: Chicago. Chicago is going to be a better Windows than Windows. It will have a Macintosh-like user interface, along with a robust, OS/2-like, 32-bit, preemptive multitasking architecture. It will run only on Intel CISC chips. It will be highly compatible with existing DOS/Windows software.

Two or three years will probably pass before Chicago achieves the market penetration that Windows 3.1 currently enjoys. During that time, Microsoft is expected to be developing and enhancing the next version of Windows, currently code-named Cairo. Cairo will subsume everything currently part of DOS, Windows 3.1, Windows NT, and Chicago. Cairo will also be a portable operating system capable of running on Intel, PowerPC, and numerous other RISC processors. All of Microsoft's applications will also be portable among these different processors.

Against this backdrop, consider Apple and IBM with their respective PowerPC boxes and operating systems. Apple has always played to the leading-edge graphics, publishing, and multimedia markets, and it seems likely that Apple's PowerPC will provide a smooth transition for those groups now. IBM, on the other hand, has no captive market that it can develop. Whatever PowerPC gains IBM is likely to make must come at the expense of the mainstream market, the workstation market, or Apple's loyal followers.

As I see it, IBM's only hope is the mainstream market. Apple followers are unlikely to convert *en masse*. Even if IBM somehow magically converted the entire workstation market, it would still be a relatively small fraction of the mainstream desktop market.

PowerPC boxes are going to appear to the PC market just as PS/2 and OS/2 1.0 did: proprietary, closed architectures foisted for no apparent reason on a market with no compelling need. Perhaps IBM will build dual-processor PowerPC machines (with the second processor an enhanced 486). It might have standard ISA/VESA/PCI buses so that existing high-volume, low-cost peripherals will be compatible. The problem is that a dual-processor PC will be expensive. Nevertheless, IBM probably knows better than any other PC manufacturer how to manufacture efficiently, so it might be able to keep costs in line.

In short, the PowerPC is going to help keep Apple afloat. In the near term, IBM can be expected to throw lots of money into this project, but it might pay off by the time the market moves to Cairo, which is expected to run on any and all processors. By that time, the market will have coalesced into just a few high-volume hardware manufacturers, and just a few high-volume software publishers.

CPU Wars

The introduction of numerous 486 clones has forced Intel to be more competitive, and that benefits consumers tremendously. Pentium-based systems now sell for well under $3000. Systems that a year ago were high-end 486 systems now sell for under $2000.

Intel is not standing still, however. Intel recently introduced enhanced versions of both 486 and Pentium chips. The Pentiums include 90- and 100-MHz models, which are clock-tripled 30- and 33-MHz units, respectively.

Intel's DX4 CPU's are interesting devices, perhaps even more interesting than the Pentiums. Judging from the name, you might expect that they are clock-quadrupled, but they are not. They are clock-tripled, and pick up additional speed through a larger cache (16 kilobytes) than prior 486's (8 kilobytes). There are several versions: a 100-MHz model that runs on either a 33- or 50-MHz bus; a 75-MHz model that runs on a 25-MHz bus, and an 83-MHz model that runs on a 33-MHz bus. The latter uses a 2.5 × clock for internal operations. The DX4s combine Intel's most advanced architectures, including 3.3-volt operation, 5-volt tolerant input buffers, a larger cache, and Intel's SL technology, which provides a power management mode that is important in laptops and other applications where energy conservation is critical.

Business evolution

Novell, the largest network software company, bought WordPerfect, the market leader in word processing. Novell also bought Borland's Quattro Pro spreadsheet. So what? The deal shows just how scared software firms are of total domination by Microsoft. Look at another recently forged big-name alliance: Adobe (of PostScript fame) and Aldus (of PageMaker fame).

Now those two companies fit together. They're in the same business. They have the same customers. But Novell and WordPerfect? Look at it another way; see Table 1. In terms limited to the raw technologies available to them, the deal puts Novell and Microsoft on roughly equal footing. Now look at the Lotus column; there's a big gap at the top. Now look at the IBM column. There's a big gap in the middle. Hmmmm. . . . . Remember you read it here first! Ω

TAKE BACK CONTROL

continued from page 69

IBM-compatible disk, and he will return a copy of the source- and object-code files for the updated version.

The author has written another version of the firmware for the same project that will display the name of the calling party instead of the number. This is for readers who live in areas where the CNAM feature is available. Also note that the new code is available on the *Electronics Now BBS* (516-293-2283, v.32, v.42bis) as a file called CID2.ZIP.

Figure 4 is the flowchart for the updated version of the firmware. Notice that there are two separate paths, depending on whether the data is found to be SDMF or MDMF.

The program also has a few improvements. A provision has been made to determine if the area code is included in the message. (Although it's rare, one local telephone company decided to leave out the area code in its message stream.) So that the project will work with short initial ring pulses, the valid ring-detect has been decreased from 0.5 second to 0.3 second. To support longer pauses between the ring pulse and the data stream, 0.8 second has been added to the time the program is allowed to wait for a carrier detect after receiving a ring pulse.

In the original project, the channel-seize signal occasionally bled through on the data pin of the MC145447 microcontroller. Provisions have been included in the new program to fix that problem. Ω

REFERENCES

1. Bellcore "Voiceband Data Transmission Interface Generic Requirements" Technical Reference TR-NWT-000030
2. Bellcore "Calling Number Delivery" Technical Reference TR-NWT-000031
3. Bellcore "Calling Name Delivery Generic Requirements" Technical Reference TR-NWT-001188

PC I/O BREADBOARD

continued from page 59

access features of assembly, with the high-level control and error checking features of C. (Note that Turbo C requires a separate product, Turbo Assembler, to make use of inline assembly; Quick C has everything you need built in.)

The final example, Listing 6, is a Quick C version of the switches-in, LEDs-out program. The first line of the program instructs the compiler to include a standard library of functions for controlling the keyboard and screen. Every C program has a *main* function, which begins on the next line. Within the main function, two integers are defined: inp and outp. They correspond to the input port and the output port, respectively. It will loop forever (or until someone presses Ctrl-Break) reading the input port, writing that value to the output port, and then checking for a key press entry through DOS.

The call to DOS has interesting features. The purpose of DOS function 11 (0Bh) is to report if a key press entry is waiting. When engaged in that function, it checks for a Ctrl-C or Ctrl-Break; either will terminate the program.

Wrapping up

The full potential of the computer (PC or mainframe) can be realized only with effective supporting software. Your success in any technical field today requires that you have a working knowledge of software. This has been a brief, and it is hoped, painless introduction to programming. You've seen that assembly language offers power and speed, but it requires a lot of planning and intimate knowledge of its host microprocessor to be used effectively. BASIC, on the other hand, is easy to learn and use, but it suffers from low speed, and is burdened with antiquated language constructs. For many people, C is the ideal compromise. It allows low-level access to the hardware when you need it, while simultaneously providing all the advantages of a high-level language. C is, however, more difficult to write (and read) than BASIC.

In the next part of this article, you will learn how to put the hardware and software to work in a practical project: a flexible, configurable EPROM programmer. The control software is in BASIC. Ω

WHAT'S NEWS

continued from page 85

3.8 volts, compared with the 1.2 volts of the other cells.

The solid lithium-ion cells can be stacked and connected together to produce batteries with higher voltages. Because the cells are thin and flexible, they can be formed into prismatic batteries of almost any shape needed. The battery form would not be restricted by the cylindrical shapes typical of other rechargeable cells. Bellcore says that its lithium-ion cells can be discharged and charged several hundred times with less capacity loss than the other rechargeable cells.

Lithium-ion batteries with liquid electrolytes have been on the market for only about two years, but they are still developmental models for limited applications. Japan started a national project to develop distributed lithium-ion battery storage technology in 1992.

Automated hotel check-ins

Hyatt Hotel Corporation expects that its "Touch and Go Check-In" machine will do for hotels what the automatic teller machine (ATM) did for banking. The check-in machine, which looks and works like an ATM, allows guests with reservations and credit cards to bypass lines at the front desk and check themselves into their rooms directly.

AN AUTOMATED HOTEL registration machine, part of Hyatt Hotel's Touch and Go Check-In system, speeds up guest registration and checkout.

Two machines are now being tested at the Hyatt Regency O'Hare hotel in a Chicago suburb and the Hyatt Regency Atlanta in Atlanta, with an eye toward their eventual use chain-wide.

Upon arrival, a guest inserts his credit card into the machine. This causes his previous room, bed, and other check-in selections to appear on the machine's monitor for his approval. When this procedure is complete—typically in less than 90 seconds—the machine dispenses one or more room keys and a printed "passport" containing the room number.

At check-out time, the guest can use the machine to approve and pay for room charges that are displayed on screen. When that transaction is complete, the machine prints out a receipt.

Hyatt Hotel plans to expand its Touch and Go Check-In program to other hotels this year. A future service that could possibly be performed by the machine would be interactive participation in the selection and the making of reservations for local restaurants. Ω

TUNABLE ANTENNA

continued from page 61

ter form. Place a tap at the second turn from the grounded side of the coil, and insert a ferrite slug in the form. Coat the finished coil with clear nail polish or lacquer before soldering it into the circuit.

An F connector was installed at the bottom side of the antenna head for connecting the coaxial cable that runs between the head and the controller. The antenna itself should be mounted to the antenna-head case with a neoprene washer to keep water out of the unit. For the same reason, apply a bead of silicone sealant around the edge of the lid. The finished antenna head is shown in Fig. 3.

On the antenna-controller section, two-pole, three-position rotary switch S1 allows tuning, the use of an auxiliary antenna, or the ability to switch the unit off entirely. A two-position switch can be substituted if you do not want an auxiliary antenna. Also, because current consumption is so low, the switch can be omitted and the battery left in the circuit permanently where it might attain its rated shelf life. Use shielded cable to connect components S1, R4, and J2–J4 to the rest of the circuit.

Do not use an alkaline 9-volt battery because it could provide too much current for proper operation. Instead, install a carbon-zinc battery. Warning! Do not take the required 9-volt power from the internal circuitry of your shortwave receiver, even if the antenna controller is built into the receiver. House the controller in a metal case, because it will provide the best RFI shielding. Figure 4 shows the prototype controller.

When the unit is completed, allow a "burn-in" period for the tuning diode. Perform burn in by installing a battery, turning the unit on, and allowing the silicon crystal structure of the diode to settle with a few hours of operation. That step proved to be necessary for many of the units built. Ω

THE LED-HEAD

continued from page 48

to mount the circuit board in a suitable plastic box. The size of the box will, of course, be determined by your choice of power —battery or adapter. If you use the four cells, you can mount the holder in the bottom of the box; if you choose an adapter, mount the jack on the side of the box.

Where to put the Face

With appropriate packaging the Electronic Face can become:

- An novel desktop curiosity and attention getter.
- A night light for children's rooms.
- A holiday ornament to be hung on the walls, doors or even a Christmas tree.
- An novel automotive accessory to keep the guy in the car behind you amused when you are stopped at a red light.

You'll probably think of many more possibilities. Ω

RELAY OUTPUT CIRCUITS

continued from page 54

ever, the period is determined by the switch position to either electrolytic capacitors C1 (minutes) or C2 (seconds), until the relay turns off.

At that time, the control contacts reopen and break the power connections to the circuit. The timing cycle is then complete. This circuit can be turned off part way through its timing cycle by pushing RESET switch S3.

Standard aluminum electrolytic capacitors have very wide capacitance tolerance values (typically -50% to +100%). Moreover, they exhibit relatively large and unpredictable leakage currents. Consequently, their use in simple circuits such as those shown in Figs. 13 and 14 make them unsatisfactory for precise timing of relay contact functions. Also, they are unable to time periods longer than about 15 minutes.

Figures 15 and 17 show two accurate, long-period relay timer-control circuits whose functions do not depend on electrolytic capacitors. Film dielectric capacitors have been substituted. In both of those circuits, IC1 is configured as a free-running astable multivibrator.

In Fig. 15 schematic, a two-range, 1 to 10 minute and 10 to 100 minute relay timing control circuit, the astable frequency is divided down by IC2, a CD4020B CMOS, 14-stage, ripple-carry binary divider. Consequently relay RY1 turns on as soon as switch S1 is closed, and it turns off again when the 8192nd astable pulse arrives. This provides time periods from 1 to 100 minutes, depending on the position of switch S2.

Figure 16 shows the functional and pinout diagrams of the CD4020B 14-stage binary counter. All counter stages are master-slave flip-flops. The state of a counter advances one count on the negative transition of each input pulse, and a high level on the RESET line resets the counter to its all zeros state. All inputs and outputs are buffered.

The Fig. 17 circuit is similar to that of Fig. 15 except that an additonal decade-divider stage is substituted for position 3 of switch S2. This gives a maximum division ratio of 81,920, making it possible to time for periods of up to 20 hours. This circuit is found in battery chargers and area security lighting systems with time-controlled turn-off.

Figure 18 shows the functional and pinout diagrams of the CD4017B decade counter IC, a five-stage Johnson counter with 10 decoded outputs. Inputs include a CLOCK, a RESET, and a CLOCK INHIBIT signal.

Time-delay relays are coil and contact EM relays with built-in timing circuits that delay contact openings or closings for a preset interval. The time delays are generated by an internal RC circuit or by counting cycles on a 50- or 60-Hz AC power line. The time delays are set with either a knob or a DIP switch on the relay. Ω

BUYER'S MART

FOR SALE

TUBES: "oldest", "latest". Parts and schematics. SASE for lists. **STEINMETZ,** 7519 Maplewood Ave. RE, Hammond, IN 46324.

TUBES, new, up to 90% off, SASE, **KIRBY,** 298 West Carmel Drive, Carmel, IN 46032.

ACE personal security PRODUCTS, cable converters and accessories. Please have make and model number ready. Call 1 (800) 234-0726.

PRINTED circuit boards — etched, drilled, tin plated. Single sided $1.25/sq. inch. **CHELCO ELECTRONICS,** 61 Water Street, Mayville, NY 14757. 1 (800) 388-8521.

CABLE TV converters/descramblers. 2 year warranties on Jerrold, Zenith, Tocom, Scientific Atlanta. We service most converters. Money back guarantee. **NATIONAL CABLE SERVICES,** (219) 935-4128.

CALLER ID for PC systems. Displays telephone number, date, time, creates logfile. Introductory price $75.00. Dealers welcome. 1 (800) 361-5280.

CLASSIFIED AD ORDER FORM

To run your own classified ad, put one word on each of the lines below and send this form along with your check to:

Electronics Now Classified Ads, 500-B Bi-County Boulevard, Farmingdale, NY 11735

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of **$25.00.**

( ) Plans/Kits ( ) Business Opportunities ( ) For Sale
( ) Education/Instruction ( ) Wanted ( ) Satellite Television
( ) ______________________

Special Category: $25.00

PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.
(No refunds or credits for typesetting errors can be made unless you clearly print or type your copy.) Rates indicated are for standard style classified ads only. See below for additional charges for special ads. **Minimum: 15 words.**

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15 ($46.50)
16 ($49.60)	17 ($52.70)	18 ($55.80)	19 ($58.90)	20 ($62.00)
21 ($65.10)	22 ($68.20)	23 ($71.30)	24 ($74.40)	25 ($77.50)
26 ($80.60)	27 ($83.70)	28 ($86.80)	29 ($89.90)	30 ($93.00)
31 ($96.10)	32 ($99.20)	33 ($102.30)	34 ($105.40)	35 ($108.50)

We accept MasterCard and Visa for payment of orders. If you wish to use your credit card to pay for your ad fill in the following additional information (Sorry, no telephone orders can be accepted.):

Card Number ______________________ Expiration Date ______________

Please Print Name ______________________ / Signature ______________________

IF YOU USE A BOX NUMBER YOU MUST INCLUDE YOUR PERMANENT ADDRESS AND PHONE NUMBER FOR OUR FILES. ADS SUBMITTED WITHOUT THIS INFORMATION WILL NOT BE ACCEPTED.
CLASSIFIED COMMERCIAL RATE: (for firms or individuals offering commercial products or services) $3.10 per word prepaid (no charge for zip code)...**MINIMUM 15 WORDS.** 5% discount for same ad in 6 issues; 10% discount for same ad in 12 issues within one year; if prepaid (not applicable on credit card orders). **NON-COMMERCIAL RATE:** (for individuals who want to buy or sell a personal item) $2.50 per word, prepaid....no minimum. **ONLY FIRST WORD AND NAME** set in bold caps at no extra charge. Additional bold face (not available as all caps) **55¢ per word additional.** Entire ad in boldface, $3.70 per word. **TINT SCREEN BEHIND ENTIRE AD: $3.85 per word. TINT SCREEN BEHIND ENTIRE AD PLUS ALL BOLD FACE AD:** $4.50 per word. **EXPANDED TYPE AD: $4.70 per word prepaid.** Entire ad in boldface, $5.60 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD:** $5.90 per word. **TINT SCREEN BEHIND ENTIRE EXPANDED TYPE AD PLUS ALL BOLD FACE AD:** $6.80 per word. **DISPLAY ADS:** 1" × 2⅛"—$410.00; 2" × 2⅛"—$820.00; 3" × 2⅛"—$1230.00. **General Information:** Frequency rates and prepayment discounts are available. **ALL COPY SUBJECT TO PUBLISHERS 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 1st of the third month preceding the date of the issue. (i.e., March issue copy must be received by November 1st). When normal closing date falls on Saturday, Sunday or Holiday, issue closes on preceding working day. Send for the classified brochure. Circle Number 49 on the Free Information Card.

CABLE TV 50dB NOTCH FILTERS for interference removal or channel censoring. Filters are user-adjustable to desired channel # or frequency. Eight Models available, each for certain channels: 2 & 3; 4 to 6; 7 to 13; 14 to 17; 18 to 22; 23 to 29; 30 to 36; 95 to 99 plus 0 & 1. Just **$30** each or 3 for **$75**, includes shipping. ONE MONTH MONEY BACK, fast delivery. Visa, MC, check or M.O. (C.O.D. is **$5** extra) Huge discounts for higher quantities. **STAR CIRCUITS, P.O. Box 94917, Las Vegas, NV 89193. Call 24 hours 1-800-535-7827.**

DATA Acquisition for IBM compatibles. 12 bit 8 channel A-D converter $149.95, 48 line digital I/O $89.95, 8 relay board $16.95, 8 opto input board $49.95. Disk with **BASIC** programs included. Control motors, lights, measure temperature, voltage. To get flier, Call or write to **JOHN BELL,** 1381 Saratoga St., Minden, NV 89423. (702) 267-2704.

CABLE test chips. Jerrold, Tocom, S.A., Zenith. Puts cable boxes into full service mode! $29.95 to $59.95. 1 (800) 452-7090, (310) 902-0841.

ZENITH digital ST5612 converter/descrambler $189.00, with remote $199.00. Zenith cable test chips, all but PZ1, $29.00. Prepaid orders shipped free. COD's OK. **BRAEM,** 4928 Aquatic Rd., Nashville, TN 37211. (615) 331-9637 voice/fax. No TN sales.

FREE ★ **1994 CATALOG** ★ **FREE**
OF THE WORLD'S MOST FAMOUS CB ANTENNAS & ACCESSORIES
— **FIRESTIK ANTENNA** —
2614 E. Adams · Phoenix, AZ 85034
Write or Call, 602-273-7151

CONVERTER — descramblers: Examples, Zenith Ztac $225.00, Scientific Atlanta 85XX $195.00, 8600 $335.00, Tocom 5503A $210.00, Oak RTC56 $99.00, M35B $45.00. **All Pioneer test generator** $160.00. Most makes in stock, COD ok. **MOUNT HOOD ELECTRONICS,** (206) 260-0107.

CB RADIO OWNERS!

We specialize in a wide variety of technical information, parts and services for CB radios. 10-Meter and FM conversion kits, repair books, plans, high-performance accessories. Thousands of satisfied customers since 1976! Catalog $3.

CBC INTERNATIONAL, INC.
P.O. BOX 31500EN, PHOENIX, AZ 85046

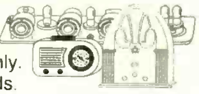
300 Experimenters Circuits — Complete in 6 practical books using diodes, relays, FET's, LED's, IC 555's, and IC CA3130's for building blocks. Only $33.00 plus $5.50 for shipping. USA and Canada only. US funds. **ETT, INC.,** PO Box 240, Massapequa Park, NY 11762-0240.

CABLE Converters, accessories below wholesale! Immediate delivery from giant stock! COD orders only. 1 (800) 995-1749.

RESTRICTED information: surveillance & schematics, locks, cable, hacking, more. Details: **MENTOR,** Box 1549-Z, Asbury, NJ 07712.

ANTIQUE RADIO CLASSIFIED

Free Sample!
Antique Radio's
Largest Circulation Monthly.
Articles, Ads & Classifieds.



6-Month Trial: $16.95. 1-Yr: $31.95 ($47.95-1st Class).
A.R.C., P.O. Box 802-L13, Carlisle, MA 01741

CABLE TV converters. Jerrold, Zenith, Pioneer, Oak, Scientific Atlanta, and many more. 12 years experience gives us the **advantage.** Visa/MC Amex COD **ADVANTAGE ELECTRONICS, INC., 1 (800) 952-3916** 1125 Riverwood Dr., Burnsville, MN 55337.

SECRET cable descramblers! Build your own descrambler for **less** than $12.00 in **seven easy steps! Radio Shack parts list and free descrambling methods that cost nothing** to try, included. Send $10.00 to: **INFORMATION FACTORY,** PO Box 669, Seabrook, TX 77586. For COD's (713) 922-3512 **any time!**

CABLE TV Descramblers most models, best prices, all guaranteed! Monthly special, Jerrold DP5 $199.00. C.O.D. orders & catalog only **1 (800) 337-CABLE.** (206) 944-9134 info. **CABLE CREATIONS.**

DESCRAMBLE cable with simple circuit added to Radio Shack RF modulator and using cable ready VCR as tuner. Instructions $8.00. **TELCOM,** Box 832E7, Brusly, LA 70719.

FULL- OR PART-TIME JOB/BUSINESS:

Learn VCR repair!

Professional-level home study program. Master easy-to-learn, high-profit repairs without investing in costly high-tech instruments. Send or call today.

Free career kit: 800-223-4542

Name________________ Age_____

Address____________ Phone (___)________

City__________ State____ Zip________

The School of VCR Repair, Dept. VVH342
6065 Roswell Road, Atlanta, GA 30328

THE Case Against the Patents. Thoroughly tested and proven alternatives that work in the real world. $24.50. **SYNERGETICS PRESS,** Box 809-C, Thatcher, AZ 85552. (602) 428-4073. Visa/MC.

TEST equipment pre-owned now at affordable prices. Signal generators from $50.00, oscilloscopes from $50.00. Other equipment including manuals available. Send $2.00 U.S. for catalog refunded on first order. **J.B. ELECTRONICS,** 3446 Dempster, Skokie, IL 60076. (708) 982-1973.

CABLE test-chips as low as $9.95, for testing cable boxes in **full service** mode. Jerrold: Starcom VI & VII, Jerrold cubes; Pioneer, clears E2 thru E5; Pioneer cubes: BA-5000 thru BA-6700; Tocom 5503/5507; Scientific Atlanta: 8500 thru 8600; Zenith: all but PZ1; remotes $10.00. **N.E. ENGINEERING,** 1 (800) 926-4030, fax (617) 770-2305.

CABLE descrambling New secret manual. Build your own descramblers for cable and subscription TV. Instructions, schematics for SSAVI, gated sync, sinewave, (HBO, Cinemax, Showtime, UHF, Adult) $12.95, $2.00 postage. **CABLETRONICS,** Box 30502R, Bethesda, MD 20824.

CABLE TV converters: Jerrold, Oak, Scientific Atlanta, Zenith & many others."New MTS" stereo add-on: mute & volume. Ideal for 400 and 450 owners! 1 (800) 826-7623, Amex, Visa, M/C accepted. **B&B INC.,** 3584 Kennebec, Eagan, MN 55122.

PAY TV AND SATELLITE DESCRAMBLING 1994
New **free BBS with sub to American Hacker** **New Titles**

Pay TV and Satellite Descrambling 1994 includes latest cable box and satellite fixes. Schematics, turn-ons, bypasses, chip files bullets, ECM's, etc. Our best yet. Other Pay TV editions, volumes 1-5 (all different). The Compleat Wizzard (Videocipher hacking), Wireless Cable Hacking, Build Satellite Systems Under $700 (includes DBS). Hacker Video. All the above $15.95 each, 3/$34.95 or 5/$52.95. American Hacker monthly now includes cable satellite, computers, phones and BBS. $29.95/yr. All our info, not all listed, $129.95. New catalog $1.

Scrambling News, 1552 Hertel Ave., #123
Buffalo, NY, 14216. **Voice/Fax/BBS (716) 874-2088**
COD'S ARE OK. ADD $6

SATELLITE TV

FREE catalog — Lowest prices worldwide. **SKYVISION,** 1012 Frontier, Fergus Falls, MN 56537. 1 (800) 334-6455. See full page ad the Shopper section.

VIDEOCYPHER II descrambling manual. Schematics, video and audio. Explains DES, Eprom, CloneMaster, Pay-per-view (HBO, Cinemax, Showtime, Adult, etc.) $16.95, $2.00 postage. Schematics for Videocypher II Plus, $20.00. Schematics for Videocypher II 032, $15.00. Software to copy and alter Eprom codes, $25.00. VCII Plus Eprom, binary and source code, $30.00. **CABLETRONICS,** Box 30502R, Bethesda, MD 20824.

SCANNERS & Secret Frequencies. Bestselling new 320 page book covers scanning from A to Z. "Useful, knowledgeable, and readable" *(Popular Communications).* "Wry, cynical, and immensely entertaining" *(Paladin Press).* "A must for the radio monitoring enthusiast" *(Radio Monitors of Maryland).* "An enormous collection of information ... plenty of great reading" *(Monitoring Times).* "You can't miss" *(American Survival Guide).* "A high point of scanner publication" *(RCMA).* Only $19.95 + $3.00 S/H/ Check/MO to **INDEX,** 3368 Governor Dr. Ste 273-E, San Diego, CA 92122. Credit cards only 1 (800) 546-6707. Free catalog of "insider" books on scanners, cellular, eavesdropping, cable, much more.

LEARN how to buy satellite systems at wholesale prices. Kingviper $629.00, Tracker 10 Plus $769.00, Monterey 95 $1,099.00, SCPC-100 audio receiver $329.00, DSZ-200 $679.00 and many more. $29.95. **SATTRONICS,** Box 832N, North Highlands, CA 95660.

INVENTORS

INVENTORS! Can you patent and profit from your idea? Call **AMERICAN INVENTORS CORP.** for free information. Serving inventors since 1975. 1 (800) 338-5656.

CABLE BOX
WHOLESALERS, INC.

BEST BOXES—BEST PRICES
Immediate Shipping—COD's
Satisfaction Guaranteed
FREE Catalog—Call Now
800-841-7835

BEST BY MAIL

Rates: Write National, Box 5, Sarasota, FL 34230

OF INTEREST TO ALL

MODERN DAY REVIVAL? Eternal Security? Send for FREE Bible Studies. Light, St. Maries, ID 83861.

HIGH SCHOOL DIPLOMA Fast New Program Credit For Experience 1-800-494-9065.

HOLLYWOOD SECRETS EXPOSED! 1-900-776-6397 Pin # 8126 $2.99/Min. 18+. Innovative 305-537-3003.

BUSINESS OPPORTUNITIES

SELL ANTI-THEFT ALARM STICKERS. Information FREE sample $2.00: ITS IMPORTS, POB 62683 N2, Virginia Beach, VA 23466.

FREE SMALL BUSINESS Success Catalog! MSP, 18653 Ventura # 321-(RE), Tarzana, CA 91356.

PLANS AND KITS

60 SOLDERLESS Breadboard Projects in two easy-to-read pocket books. Complete with circuit descriptions, schematics, parts layouts, component listings, etc. Both books (BP107 & BP113) only $11.90 plus $3.50 for shipping. USA and Canada only. US funds. **ETT, INC.,** PO Box 240, Massapequa Park, NY 11762-0240.

FASCINATING electronic devices! Vocal truth detector! FM/AM/IR transmitters! Detectors! Jammers! Hypersonics! Laser! Radar! High voltage! More! Plans/Parts/Assembled! Catalog $4.00 (refundable). **QUANTUM RESEARCH,** 17919-77th Ave., Edmonton, Alberta, Canada. T5T 2S1.

TOP quality imported, domestic kits; computers, components; surplus, discount electronics, parts; auto, home electronics; lasers. **Catalog** $2.00. **TEKTRASONIX,** 740 E. Bay Avenue, Manahawkin, NJ 08050.

CREDIT card, ATM, read systems from $140.00, read/write systems from $380.00, backup your credit cards, build a system to open door with your credit card. All systems run on PC, schematics or complete systems. Info $5.00. **CPU ADVANCE,** Box 2434 Harwood Station, Littleton, MA 01460.

BUILD Your own variable regulated power supply 0-50 volt dc adjustable dual tracking...$6.95, 0-25 volt dc adjustable (single)...$5.95. Complete schematics and instructions. **SMS ENGINEERING,** PO Box 11244, Glendale, AZ 85318-1244.

OPTOELECTRONIC schematics. Chasers, VU-meters, and both combined. Eye catching effects. $7.85 US funds. **DEAKON ENT.,** PO Box 129, Montreal, Canada H1H 5L2.

AUTOMATE your home with the Remote Interface Board. Your computer controls infrared systems. Board and info (RIB-001): $49.00 **COMPCO,** (615) 244-4444.

BUILD your own computer and save. Simple directions and color pictures make this guide easy to follow. Send $22.95 $2.95 S/H to: **A.L. ELECTRONICS,** PO Box 215, Mary Esther, FL 32569-0215.

STUDIO quality FM transmitter! Crystal controlled! Digital! Programmable to any broadcast frequency! Kit $160.00, assembled $200.00. **WAVEMACH COMMUNICATIONS,** #302-320 Dixon Road, Dept. Two, Etobicoke, Ontario, Canada M9R 1S8. (416) 243-2260.

CABLE/SATELLITE

UNDETECTABLE cable/satellite descrambler will work on all systems **guaranteed!** Send SASE/info, $94.95/kit, $14.95/plans. **MYSTICAL ELECTRONICS,** PO Box 481, Cooper Station, New York, NY 10276.

BUSINESS OPPORTUNITIES

MAKE $75,000.00 to $250,000.00 yearly. Learn **IBM monitors** repairs. (solutions most brands). New home based business program. Software available. Information: **USA-Canada** $3.00 cash (no checks), dealers wanted worldwide ($35.00) **US funds. RANDALL DISPLAY,** PO Box 2168 R, Van Nuys, CA 91404 USA.

EASY work! Excellent pay! Assemble products at home. Call toll free **1 (800) 467-5566** Ext. 5192.

START your own technical venture! Don Lancaster's newly updated **Incredible Secret Money Machine II** tells how. We now have autographed copies of the Guru's underground classic for $18.50. **SYNERGETICS PRESS,** Box 809-C, Thatcher, AZ 85552. (602) 428-4073. Visa/MC.

EXCELLENT extra income! Assemble easy products at home. Program guaranteed! 1 (800) 377-6000 Ext. 6870, open Sun.

BECOME independent. Learn how to start a small consumer electronics service business, at home. Detailed information $49.95. **TECHNICAL WORLD,** PO Box 8207, Philadelphia, PA 19101.

HIGH profits. "Intruder ID". Home/business professional alarm system. Complete protection. **Also takes a picture of intruder.** Your cost $148.00 complete — nothing else to buy — you sell $399.00. Very easy installation. **ROSTECH,** PO Box 2789, Plattsburgh, NY 12901. (514) 522-2158.

CABLE TV TURN-ON CHIPS

SUPER Cable TV "Test Chips". Provides full service activation. Excellent; instructions & illustrations. **Jerrold Starcom:** DP(V)5..DP(V)7..DPBB7. **Pioneer:** BA-5000 thru BA-6700. **Scientific Atlanta:** 8500 thru 8600. **Tocom:** 5503-VIP..5507. **Zenith:** ST-1000 thru ST-5000. **Call now!! MASTER COMPONENTS. 1 (800) 233-0570.**

PATENTING

INVENTORS: THE CONCEPT NETWORK represents people who want to patent and market their new product ideas. Schematics or prototype preferred but not required. **Free** information kit. Call 1 (800) 835-2246 ext 67.

EDUCATION & INSTRUCTION

F.C.C. Commercial General Radiotelephone license. Electronics home study. Fast, inexpensive! "Free" details. **COMMAND,** D-176, Box 2824, San Francisco, CA 94126.

ELECTRONIC engineering. 8 volumes complete. $109.95. No prior knowledge required. Free brochure. **BANNER TECHNICAL BOOKS,** 1203 Grant Avenue, Rockford, IL 61103.

PC Power supplies. What they are. How they work. Safe and easy low voltage test and repair. 96 pages, 37 illus. $19.95. **WELX TECH,** Box 34, Greenbelt, MD 20768.

"VIDEO Game Secrets of the Orient" — Genesis/ Super-Nint, etc..How in Asia they spend $1.00 for any new game...video game recorders...sources...outrageous savings...products...information game companies don't want you to know...130 juicy pages. Six years researched worldwide. Must reading for any video game player. $15.00 postpaid, **DEL WORLD PUBLICATIONS,** 2390 Crenshaw Blvd., Dept. 707-7PE, Torrance, CA 90501.

INVENTIONS

FREE invention package: DAVISON AND ASSOCIATES offers customized development, patenting, and licensing for new products and ideas. Proven results: 1 (800) 677-6382.

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Gernsback Publications, Inc.
500-B Bi-County Blvd.
Farmingdale, NY 11735
1-(516) 293-3000
Larry Steckler, EHF/CET
President

Christina Estrada
assistant to the President

For Advertising ONLY
516-293-3000
Fax 1-516-293-3115

Larry Steckler
publisher

Arline Fishman
advertising director

Denise Mullen
advertising assistant

Kelly Twist
credit manager

Subscriber Customer Service
1-800-288-0652

Order Entry for New Subscribers
1-800-999-7139
7:00 AM - 6:00 PM M-F MST

ADVERTISING SALES OFFICES

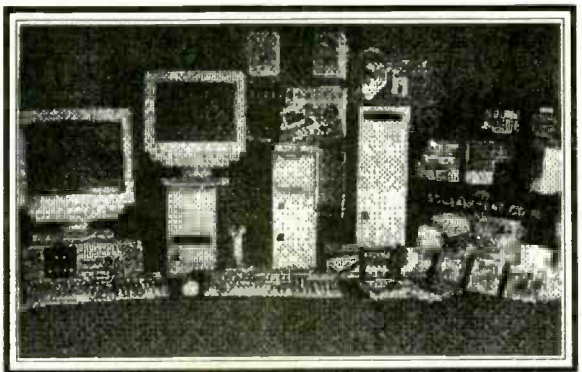
EAST/SOUTHEAST
Stanley Levitan
Eastern Advertising
1 Overlook Ave.
Great Neck, NY 11021
1-516-487-9357
Fax 1-516-487-8402

MIDWEST/Texas/Arkansas/Okla.
Ralph Bergen
Midwest Advertising
One Northfield Plaza, Suite 300
Northfield, IL 60093-1214
1-708-446-1444
Fax 1-708-559-0562

PACIFIC COAST
Blake Murphy
Pacific Advertising
Hutch Looney Assoc. Inc.
1800 North Highland Avenue
Suite 717
Hollywood, CA 90028
1-213-462-2700
FAX 1-213-463-0544

Electronic Shopper
Joe Shere
National Representative
P.O. Box 169
Idyllwild, CA 92549
1-909-659-9743
Fax 1-909-659-2469

Electronic SHOPPER™



ATC Computer

7150 Beverly Blvd. Los Angeles, CA 90036
(213) 938-6622

We configure your way!
Price subject to change without notice.
Please allow 2-6 days for delivery or call to verify date of delivery.
15% Restocking Fee on All Return.

ATC 486 VESA LOCAL BUS SYSTEM

486 VESA Local Bus Mother Board
4MB RAM w/ 256K Cache
210MB IDE Fast Hard Drive w/Controller
1.2MB & 1.44MB Floppy Drive
14" Super VGA Mon-Interlaced Monitor
16M Color Windows Accerated SVGA Display Adapter
101 Enhanced Keyboard
Mini-Tower or Desk-Top Case
2 Serial / Parallel / Game Port

$1165 / $1295 / $1495
486sx-33 / 486dx-33 / 486dx-66

ATC 386 System

386 Mother Board
4MB RAM (*128k Cache)
120MB IDE Hard Drive w/ Controller
1.2MB & 1.44MB Floppy Drive
14" Super VGA Monitor
SVGA Display Adapter
101 Enhanced Keyboard
Mini-Tower or Desk-Top Case
2 Serial / Parallel / Game Port

$875 / $915
ATC386sx-40 / ATC386dx-40

ATC 486 EISA / VESA SYSTEM

486 EISA/VESA Local Bus Mother Board
8MB RAM w/ 256k Cache
340MB IDE Fast Hard Drive
32 Bit EISA Hard Disk Controller
1.2MB & 1.44MB Floppy Drive
15" Super VGA Mon-Interlaced Monitor
VESA 16M Color Windows Accerated SVGA Display Adapter
101 Enhanced Keyboard
Mid-Tower or Desk-Top Case
2 Serial / Parallel / Game Port

$1695 / $1895
ATC486dx-33 / ATC486dx-66

ATC 486 PCI LOCAL BUS SYTEM

486 PCI Local Bus Mother Board
16MB RAM w/ 256k Cache
340MB Fast IDE Hard Drive
32 Bit PCI Hard Disk Controller
1.2MB & 1.44MB Floppy Drive
15" Super VGA Mon-Interlaced Monitor
PCI Diamond Viper w/ 2MB VRAM Display Adapter
101 Enhanced Keyboard
Mid-Tower or Desk-Top Case
2 Serial / Parallel / Game Port

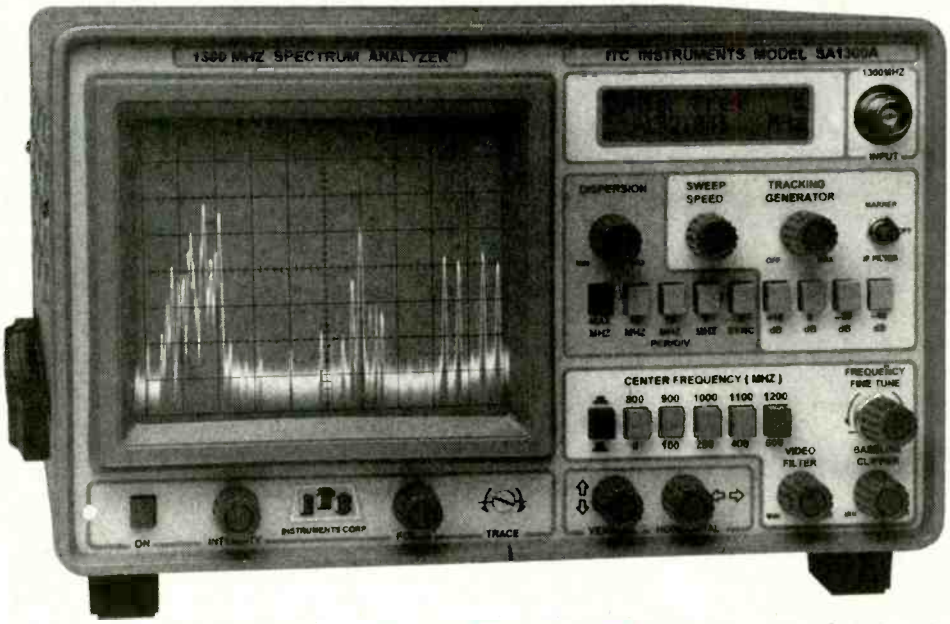
$2295 / $2395
ATC486dx-33 / ATC486dx-66

CIRCLE 285 ON FREE INFORMATION CARD

ADVERTISING INDEX

Electronics Now does not assume any responsibility for errors that may appear in the index below.

Simply A Superior
1.3 GHz Spectrum Analyzer



1-1300 MHz *In One Sweep* $1,895.

MADE IN USA -10KHz Resolution Band Width -7 Digit Center Frequency Display

MARINE, TWO-WAY, HAM, AM FM SW BROADCAST RADIO - CATV, SATELLITE. SYS., SURVEILLANCE TUNE DUPLEXERS, AMPS, FILTERS, SECURITY TRANS, & RECEIVERS - EMI, RFI, FCC, TESTING

EXCLUSIVE DISPERSION ZOOM

ITC SA Series exclusive Dispersion Zoom lets you zoom in on **any Center Frequency** signal, from any one of five calibrated Dispersion positions. Preset at >140 MHz, 50MHz, 10MHz 1MHz and zero MHz per division. The SA1300A displays greator then 1300 MHz on the screen at one time yet allows instant zoom to any Dispersion Scan Width as low as zero MHz per div. Allowing for total control over all **Dispersion Scan Widths** settings.

80 dBON SCREEN

130 dB total Dynamic range **110 dBm Sensitivity.** At Narrow and Wide Band Width settings. Performance you would expect only from a $10,000 Analyzer.

ULTIMATE *LOW COST* ANALYZER

ITC Spectrum Analyzers are the best performance to price ratio Analyzers on the market today. No other low cost Analyzer comes close to the Superior performance and quality of an ITC Analyzer. **Total flexibility and ease of operation**. SA1300A gives you full control over the Resolution Band Width and Freq. Span widths. Plus Vertical Position, Baseline Clipper, Sweep Speed, Video Filter, 4 Input Attenuator settings, 10 Frequency Select settings.

MODEL SA1800B 1800 MHz

Covers 1-1300 MHz and 850-1850 MHz in one sweep. Ideal for Satellite service. The **SA1800B** has the same general specifications as the model SA1300A.

INTRODUCTORY OFFER

SA1300A & OPT.s 1, 3, 6
ONLY $1895.00 note 1

SA1800B & OPT.s 1, 3, 6
ONLY $2295.00 note 1
$1995.00 Opt. 1, 6 ONLY

SA1300A	$1595.00
SA1800B	$1895.00
OPT. 1 50MHz MARKER	$200.00
OPT. 3 +/- 5KHz Res B.W	$350.00
OPT. 5 1000 MHz Tracking Generator	$250.00
OPT. 6 7 Digit Center Frequency Display	$300.00

Note 1: Introductory Price for limited time only.

TAKE ADVANTAGE
CALL 1-800-566-1818
To: Order - For Information & Special Intro. Offer
Terms MC, VISA, AE, Check, COD, PO (OAC), LC, Transfer

DISTRIBUTED BY: **ADVANTAGE** INSTRUMENTS CORP.
3817 S. CARSON ST. # 818 CARSON CITY NV. 89701
1-800-566-1818 702-885-0234 FAX 702-885-7600

PRICES & SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE OR OBLIGATION. F.O.B. CARSON CITY NV. NV. RESIDENTS ADD SALES TAX.

CIRCLE 301 ON FREE INFORMATION CARD

Since 1956

CAIG LABORATORIES, INC.

Electronic Chemicals
for Manufacturing, Maintenance & Service

The Next Generation Contact Cleaners, Conditioners and Preservatives

Even the finest equipment cannot guarantee noise-free operation. One "dirty" connection anywhere in the signal path can cause unwanted noise, distortion and signal loss. Considering the hundreds (if not thousands) of connections in electronic equipment today, it is only a matter of time before they begin to fail.

***ProGold** and **DeoxIT** increase the performance and reliability of electrical components and equipment. They provide long-lasting protection, reducing the expense of repeated cleaning with expensive ozone-depleting solvents. As a general rule, use **ProGold** for best performance and protection on plated surfaces and **DeoxIT** as a general purpose treatment.*

ProGold™ Conditioner & Preservative

ProGold outperforms all other contact cleaners, enhancers and lubricants. Due to its unique properties, not only does it deoxidize and clean surface contamination, but it penetrates plated surfaces and molecularly bonds to the base metals. This increases conductivity and contact surface area and reduces arcing, RFI, wear and abrasion - the major cause of intermittent signals, distortion and signal loss. ***ProGold** is the only product that conditions & protects plated surfaces and their base metals.*

DeoxIT™ & PreservIT™
Deoxidizes, Seals & Protects Electrical Connections

DeoxIT is a fast-acting, deoxidizing solution that cleans, preserves, lubricates & improves conductivity on all metal surfaces. Use as a general treatment for connectors, contacts & other metal surfaces.

PreservIT seals, lubricates and preserves metal surfaces for protection from oxidation and contamination. For use on clean/new surfaces or those pre-cleaned with ***DeoxIT***.

Both have excellent migration properties that coat the surfaces and protect them from future oxidation & contamination. These formulas contain improved deoxidizers, preservatives, conductivity enhancers, anti-tarnishing compounds, arcing & RFI inhibitors and provide extended temperature range.

OpticALL™ StaticALL™

OpticALL cleans, polishes and eliminates static electricity on optical viewing surfaces. OpticALL is also recommended as a general purpose antistatic cleaner on plastic, glass and metal surfaces. StaticALL neutralizes static build-up caused by friction & low humidity conditions. Use on carpets, floors, clothing & other static generating surfaces.

DustALL™ FreezALL™

DustALL quickly & safely removes dust, lint & particles from sensitive electronic equipment, computers, lab equip., optical grade surfaces & other mechanisms & equipment. FreezALL quickly and safely cools circuits to -54°C. Locates intermittent components due to heat failure and hairline cracks on PCBs.

MechanicALL™

High Penetrating Anti-Corrosive Anti-Tarnishing Cleaner & Lubricant. Lubricates & Protects, Displaces Moisture, Stops Squeaks, Migrates & Coats Entire Surface.

ElectricALL™

Rejuvenating Solution For All Electrical Applications. Cleans, Preserves, Improves & Protects Connections, Removes Corrosion & Oxidation, Reduces Wear, Abrasion, Arcing & RFI.

CaiKleen™ 41

Approved Freon TF replacement. Cleaning solvent for equipment and parts. Harmless to metal and most plastics & elastomeric parts. No residue, non-flammable, HCFC blend.

CaiKleen™ TRP

For degreasing, cleaning & defluxing equipment and parts. Removes oil, grease, dirt and contaminants including rosin flux from PCBs, components and metal parts. Biodegradable.

CaiKleen™ IPA

Ultra-pure isopropyl alcohol. Cleaning & degreasing solvent for removal of oil, grease & dirt from instruments, equipment & parts. Use on tape heads, discs, guides, switches, connectors, relays, and other parts for general cleaning.

CaiLube™ 360

Finest quality cutting and lubricating oil for use on various materials; cast-iron, stainless, titanium, gold, platinum, non-ferrous metals, synthetics, etc..

CaiLube™ X-10S Instrument Oil

Contains silicone. Finest quality instrument oil for use on rubber, plastics and metals. Non-gumming, rust inhibiting, long lasting lubrication.

CAIG Products ... used by those who demand the best!

Boeing
Dolby Laboratories
E.I. Dupont
Federal Express
General Electric
Hewlett Packard
Honeywell
John Fluke Mfg.
McIntosh Labs
Motorola
Nakamichi
RCA
Switchcraft
Tektronix
Texas Instruments
Wayne-Dresser
Xerox Corp.
. . . and many more!

Since 1956
CAIG LABORATORIES, INC.

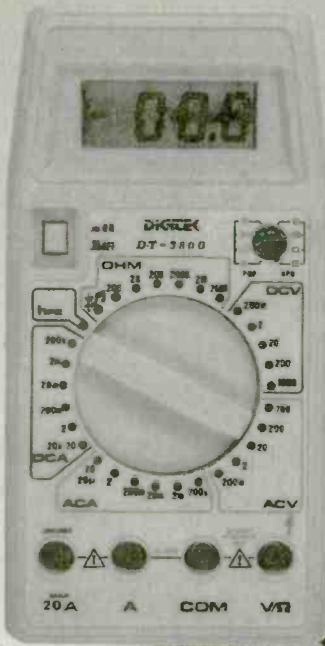
16744 West Bernardo Drive
San Diego, CA 92127-1904
TEL: (619) 451-1799
FAX: (619) 451-2799

1-800-CAIG-123

CIRCLE 292 ON FREE INFORMATION CARD

CIRCLE 234 ON FREE INFORMATION CARD

Model Close Out
Reg. $59.95
Sale $24.00*
Item # W3800 ►



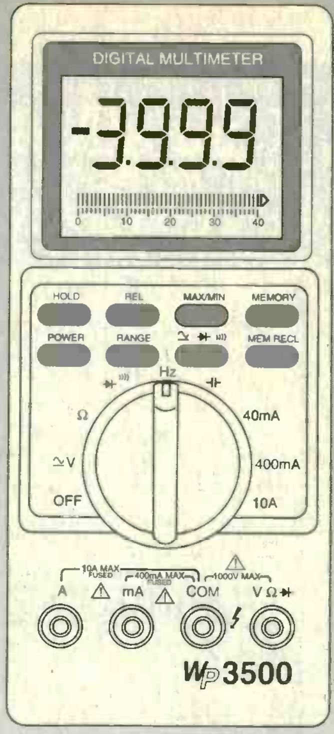
Full Range DMM

- 5 DCV ranges ±0.5%
- 5 ACV ranges ±0.8%
- 7 DCA ranges ±0.5%
- 7 ACA ranges ±1%
- 6 OHM ranges ±0.8%
- Diode Tester
- Trans. Tester
- Continuity Buzzer
- Highly Visible Yellow Color
- **1 Year Warranty**

Reg. $105.95
Sale $89.00*
Item # W3500 ►

Auto-Range DMM w/Capacitance

- CPU controlled with auto power off function
- 3.75 digit jumbo LCD (max reading 3999)
- 42 segment high speed bar graph
- Full auto-ranging measurement
- Offset adjustment
- Data hold and data memory function
- MIN/MAX hold function
- Auto capacitance measurement 1pF to 40μF in 5 ranges
- Auto frequency measurement up to 1 MHz in 5 ranges
- Safety design according to IEC Publication 348
- **1 Year Warranty**



Reg. $45.95
Sale $29.00*
▼Item # W2600

Affordable Auto-Ranging

- **Automatic AC/DC Mode Selection**
- DC voltage 0.2V to 1000V in 5 ranges
- AC voltage 2V to 700V in 4 ranges
- DC and AC current 200mA and 10A
- Audible continuity check & Diode Tester
- Yellow Case

1 Year Warranty

Reg. $39.95
Sale $29.00*
▲Item# W1000

Shoreline
INSTRUMENTS

- 2000 Count Digital Display
- 11 Ranges - AC/DC V, mA, Ω
- Diode Tester and Continuity Beeper
- Auto Shut-off
- Alligator Clip for Easy Measuring
- 1 Year Warranty
- Attractive Gray Case

Versatile DMM w/ Capacitace

- Large LCD Display
- DCV accuracy 0.5%
- Diode test, continuity check with buzzer sound
- Transistor hFE test
- All ranges overload protected
- Rugged case, drop proof
- Capacitance measurement, 1pF-20μF in 5 ranges
- Resistance measurement up to 200M
- Auto power off
- Yellow Case

1 Year Warranty

Reg. $54.95
Sale $39.00*
Item # W3910►

Orders Only Please
800-597-5929
24 hours a Day
VISA MasterCard or send Check or Money order

* CA customers please add Sales Tax
* Shipping & Handling $4.00
* Meters are shown about 1/2 Size

Technical/Product Line
408-987-7734
24 Hour Fax Order Line
408-987-7735

** Quick Delivery via U.S. Priority Mail*
** All Fax Orders -Free Shipping*
Include: Name, Add.,Ph#, Card#, Exp. Date, Item #

Don't Pay Out of This World Pricing for Your Next Voltage Meter..... Call Windward First

Windward
Products

We Stand Behind our Products
Satisfaction Guaranteed

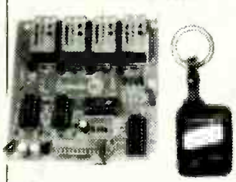
P.O. Box 378 , Moffett Field, CA. 94035

CIRCLE 314 ON FREE INFORMATION CARD

TOTAL COST FOR SHIPPING OF ANY ONE, OR AS MANY OF THE FOLLOWING ITEMS BY AIR MAIL IS $15

ALL PRICES ARE IN U.S. DOLLARS

FOUR CHANNEL UHF REMOTE CONTROL KIT



Features a 3 channel transmitter which is small enough to fit onto a key ring. The fourth channel can be accessed by a second transmitter. For example each of the two transmitters could have two common channels and one individual channel. The compact receiver employs a ready made and prealigned (304MHz) UHF receiver "front end" module. Over 100 meters range, has 12A SPDT relay contact outputs, has a user programmable security code with 6561 combinations, easy to construct, is expandable, etc. **Transmitter: $13. Receiver: $46. TWO TRANSMITTERS AND ONE RECEIVER:** **$68**

The operating frequency of the system is adjustable but you should check local regulations with regards to using this very low power remote control system.

FM TRANSMITTER MK1 KIT

This unit has most of the features of our FMTXMK2 transmitter, but is much smaller. The complete transmitter PCB (Miniature microphone included) is the size of a "AA" battery, and is powered by a single "AA" battery. We use a two "AA" battery holder (provided) for the case, and a battery clip (shorted) for the switch. Estimated battery life is over 500 hours!! **SAME PRICE AS OUR FMTXMK2:**

$8

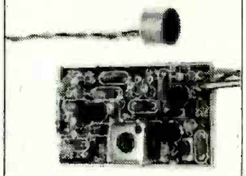
SOLID STATE "PELTIER EFFECT" COOLER - HEATER

These are the major parts needed to make a solid state thermoelectric cooler - heater. We can provide a large 12V-4.5A Peltier effect semiconductor, two thermal cut-out switches, and a 12V DC fan for a total price of:

$32

We include a basic diagram - circuit showing how to make a small refrigerator - heater. The major additional items required will be an insulated container such as an old portable cooler. Two heatsinks, and a small block of aluminium.

FM TRANSMITTER KIT - MKII



This low cost FM transmitter features pre-emphasis, high audio sensitivity as it can easily pick up normal conversation in a large room, a range of well over 100 meters, etc. It also has excellent frequency stability. Specifications: Tuning range: 88-108MHz, Supply voltage 6-12V, current comsumption @ 9V: 3.5mA, Pre-emphasis: 75µS, Frequency response: 40Hz to greater than 15KHz, S/N ratio: Greater than 60dB, Sensitivity for full deviation: 20mV, Frequency stability with extreme antenna movements: 0.03%, P.C.B. dimensions: 1" x 1.7". Construction is easy and no coil winding is necessary. The coil is preassembled in a shielded metal can. The double sided, solder masked and screened PCB also makes for easy construction. The kit includes a PCB and all the on-board components, an electret microphone, and a 9V battery clip.

$8

PASSIVE NIGHT VIEWER

This is a completed commercial monocular hand held night viewer, that employs an image intensifier tube. The viewer is of a USSR military standard (model T3C-2), and will produce useful images in very low ambient light. Has adjustable low light objective lens, adjustable eyepiece, and is supplied with a carry case.

$280

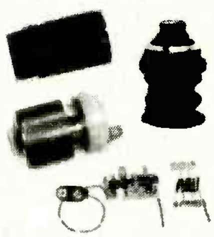
INFRA RED FILTER

A very high quality IR filter and a RUBBER lens cover that would fit over most torches including MAGLITES, and convert them to a good source of IR. The filter material withstands high temperatures and produces an output which would not be visible from a few meters away and in total darkness. Suitable for use with passive and active viewers.

$11

For the filter and the rubber lens cover.

IR "TANK SET"



ON SPECIAL is a set of components that can be used to make a very responsive Infra Red night viewer. The matching lens tube and eyepiece sets were removed from working military quality tank viewers. We also supply a very small EHT power supply kit that enables the tube to be operated from a small 9V battery. The tube employed is probably the most sensitive IR responsive tube we ever supplied. The resultant viewer requires low level IR illumination. Basic instructions provided.

$85

For the tube, lens, eyepiece and the power supply kit. When ordering specify preference for a wide angle, or a telescopic objective lens.

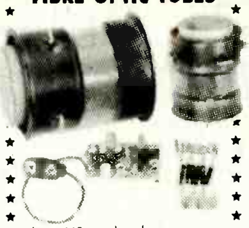
MIRACLE TV ANTENNA KIT

This combination of proven circular antenna design, and a wideband low noise amplifier produces remarkable results on VHF, UHF, and FM frequencies. Based on an IC with 20dB of gain, a bandwidth of 2GHz and a noise figure of 3dB. Can be used as a masthead amplifier on existing antennas. The cost of the complete kit of parts for the masthead amplifier PCB and components, the power and signal combiner PCB and components, a balun core and the tinplate for the antenna is priced at only:

$18

Requires a DC supply (Plugpack etc.) 7V-20V DC at approximately 25mA. Extra reinforcement for the tinplate antenna is also required.

FIBRE OPTIC TUBES



These US made tubes are "pulls" from equipment, in excellent condition. Have 25/40mm diameter, fibre-optically coupled input and output windows. The 25mm tube has an overall diameter of 57mm and is 60mm long. The 40mm tube has an overall diameter of 80mm and is 92mm long. The gain of these is such that they would produce a good image in approximately 1/2 moon illumination when used with suitable "fast" lens, but they can also be IR assisted to see in total darkness. The superior resolution of these tubes would make them suitable for low light video preamplifiers, wild life observation, and astronomical use. **INCREDIBLE PRICES:** Each of the tubes is supplied with a 9V-EHT power supply kit. **INCREDIBLE PRICES:**

$85 For the 25mm intensifier tube and supply.

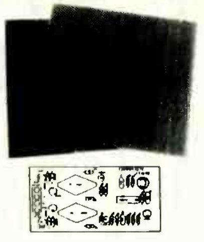
$130 For the 40mm intensifier tube and supply.

Three of these tubes can be cascaded to make a very high gain image intensifier! We should have a kit and instructions available to make these. Approximately $195 for 25mm and $320 for 40mm, three stage kits. Resellers enquiries welcome.

MISCELLANEOUS ITEMS COMPONENTS AND KITS

High Voltage Diodes 8KV-3mA, $0.80; 10KV-20mA, $1.40 **High Voltage Disc Ceramics:** 0.01uF-3KV, $0.80; 0.01uF-5KV $1.30, 1000pF-15KV, $3.50 **Electric Fence Kit:** PCB and components, $28. **Garage-Door-Gate Remote Control Kit:** Tx $13; RX $56. **Laser Beam Communication Kit** TX, RX, plus IR Laser, $39. **Plasma Ball Kit:** PCB and components kit, needs any bulb $18 **IEC Extension Leads:** 2 meters long $3.50. **High Intensity Led's:** 550-1000mCD output at 20mA, 5mm diameter, 10 for $2.80. **Triacs:** 60A-600V Stud mounted THOMPSON type TGAL606 $7.20. **Ultrasonic Transducers:** Murata brand (Japanese), 40KHz TX-Rx Pair, $1.50

UNIVERSAL SOLAR CHARGER KIT

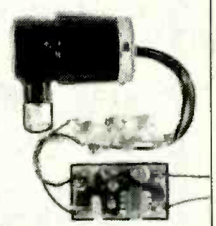


Two 6" x 6" amorphous glass solar panels, and a PCB and all on-board components kit for a solid state inverter. In normal sunlight, the combination can deliver a charging power of over 1.4 Watts into 5-12V batteries. EG 6V-230mA, 9V-150mA, 12V-120mA. The glass panels need to be terminated and have their rear waterproofed. Simple to do, instructions included.

$20

For the two panels, PCB and components, terminating clips and the instructions.

IMAGE INTENSIFIER TUBE AND SUPPLY



These are the key components needed for making a PASSIVE NIGHT VIEWER. The small prefocussed Russian image intensifier tube only requires a low current EHT power supply to make it operational, which we provide in kit form. Draws 20mA from a small 9V battery. With a suitable low light objective lens (not provided) the resultant viewer will produce useful pictures in sub-moonlight illumination, and it can also be IR assisted. **INCREDIBLE PRICE:**

$105

for the Russian image intensifier tube and an EHT power supply kit! All that is needed to make a complete passive night viewer is a lens, an eyepiece, a 9V battery, a case and a switch. We can supply a matching lens and eyepiece:
$68 for the pair.

All our kits are provided with high quality fibreglass, silk screened and solder masked, printed circuit boards

OATLEY ELECTRONICS

5 LANSDOWNE PDE., OATLEY, SYDNEY, NSW, AUSTRALIA 2223

PHONE ORDERS
East Coast between 7 pm and 2 am
West Coast between 4 pm and 11 pm
011 61 2 579 4985

FAX ORDERS
011 61 2 570 7910
Mastercard — Visacard with Telephone or Fax Orders

International Bank Drafts and Money Orders with Mail Orders
If possible include contact phone and fax number

CIRCLE 306 ON FREE INFORMATION CARD

B. G. MICRO

P. O. Box 280298 Dallas, Texas 75228
(214) 271-5546
FAX (214) 271-2462

VISA MasterCard

LCD DISPLAYS

OPTREX 2x16-DMC 16207H-8 Bit ASCII Input Dim. 3 1/8x1 3/4x3/8 Char. Height .19" **$5.99**

OPTREX 2x20-DMC 20261-8 Bit ASCII Input Dim. 4 9/16x1 7/8x3/8 Char. Height .19" **$7.99**

OPTREX 1x16 "Backlit"-DMC 16187-8 Bit ASCII Input Dim. 3 1/8x1 3/8x9/16 Char. Height .11" **$9.95**

OPTREX 1x20-DMC 20171-8 Bit ASCII Input Dim. 7 3/16x1 5/16x1/2 Char. Height .42" **$9.95**

OPTREX 2x40-DMC 40218-8 Bit ASCII Input Dim. 7 3/16x1 5/16x13/32 Char. Height .19" **$9.95**

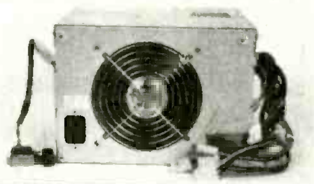
VERY EASY TO INTERFACE TO ALMOST ANY MICROPROCESSOR!!!!!!

SWITCHING POWER SUPPLIES

DELTA Switching Power Supply

Heavy duty switcher—A full 280 watts completly enclosed w/fan—UL and CSA approved— + 12V @ 7 amps— + 5V @ 37 amps -5V @ .75 amps— -12V @ .75 amps.

Measures 8 1/2"x 5 15/16"x7 3/8"



$17.95

SIRENS

Simply apply 12 volts to this little baby, then you had better hold your ears. Very loud!

$5.95

Great for car and intrusion alarms

STEREO AUDIO AMP

This 20 watt per channel, open frame, stereo audio amp comes completely assembled and tested. It also includes a self contained plug-in power supply. Less than .1 % distortion for you real "audio buffs". You supply the speakers and we will supply some of the cleanest audio you have heard. Unit includes volume, tone, and balance controls. Front panel measures 9"x3".

A steal at $12.95

DTMF

SSI-202 Decoder	2.25
8870 Decoder	2.25
5087 Generator	2.00
5089 Generator	1.25

UART

NS16450 .... 6.50
16550 .... 10.95
TR1602B (COM 2017) 1.75
IM6402 +5v High speed AY5-1013 pin out 2.45
INS 8250 .... 2.95

FANS

SANYO—BRUSHLESS
12 Volt DC at .07 Amps—
7 Blades
60 MM—2 3/8"x2 3/8"x1"
$5.95

TECHIDYNE—Brushless
12 Volt DC at .12 Amps—
7 Blades
80MM—3 1/8"x3 1/8"x1"
This size commonly used in Computer Power Supplies
$5.90

PANAFLO—Brushless—12 Volt DC at .2 Amps 5 Blades—
119MM—4 11/16"x4 11/16"x1 1/2"
$5.99

STATIC RAM

2016-2KK8 200 n.s.	1.00
2101-1 - 256X4 500 n.s.	.75
21L02-1 350 n.s.	.65
2102AL-4 L.P. 450 n.s.	.49
2111-1 256X4 500 n.s.	1.00
2112A-2	2.50
2114L-3 1KK4 300 n.s.	.45
2125A-2 1KK1 70 n.s.	1.00
2147 4KX1	1.00
2148	1.00
6116P-4	1.00
6117	1.20
6264	1.40
62256 32KX8	5.00
128KX8	15.00

EPROM SPECIAL

We bought a large quantity of 2708s, 2716s, 2532s, 2732s, 2764s, 27128s, 27256s and 27512s from a computer manufacturer who re-designed their boards. We removed them from sockets, erased and verified them, and now we offer the savings to you. Complete satisfaction guaranteed.

Your Choice

2708	1/20	10/8.00
2716	1.75	10/15.00
2532	2.00	10/17.50
2732	2.00	10/17.50
2764	2.00	10/17.50
27128	2.50	10/20.00
27256	3.00	10/25.00
27152	4.75	10/40.00
1 Meg	8.50	10/77.50

DYNAMIC RAM

2108-4 8KX1	1.50
2118-4 16KX1-5Volt	.70
4027-4KX1-260 n.s.	.80
4116-16KX1-250 n.s.	.40
4116-16KX1-200 n.s.	.75
4116-16KX1-150 n.s.	.90
4128 Piggyback	2.00
4164-150 n.s.	.49 or 9/3.50
4164-120 n.s.	1.10
4164-100 n.s.	1.40
TMS4416-16KX4-15- n.s.	2.75
4464-150 n.s.	1.40
4464-120 n.s.	1.45
4464-100 n.s.	1.45
4464-80 n.s.	1.45
41256-150 n.s.	1.25 or 9/9.95
41256-120 n.s.	1.30 or 9/10.99
41256-100 n.s.	1.30 or 9/10.99
41256-80 n.s.	1.30 or 9/10.99
41256-60 n.s.	1.85
1 Meg - 100 n.s.	4.40
1 Meg - 80 n.s.	4.40
414256-80 n.s. 256 x 4	4.60

SIPPS, SIMMS, & CACHE AVAILABLE

EPROM

8741	7.00
8742	7.00
8748	7.00
8749	7.00
8751H	12.95
8755	7.00

PROMS

82S123	1.49
82S126	1.49
82S153	1.75

8000/80000

8001	5.20	8237	1.90	8088-2	3.25	8257	1.50
8002	$2.50	8237-5	2.80	8155	2.25	8259A	1.85
8010	4.95	8243	1.75	8156	2.25	8259C-5	2.10
8031	2.95	8250	2.95	8202A	8.00	8275	10.95
8032	3.95	(16450)	6.50	8212	1.25	8279	2.25
8035	1.00	(16550)	10.95	8214	2.00	8284	1.49
8036	4.95	8251	1.10	8216	1.25	8286	3.50
8039	1.00	8253-5	1.75	8224	1.25	8287	2.49
8085	1.55	8254	1.80	8228	1.75	8288	3.50
8086	1.55	8255	1.50			8530	3.00
8088	2.20	8255-5	1.75				

NEW ITEMS! NEW PRICES! NEW ITEMS! NEW PRICES!

NEW PRICES! NEW ITEMS! NEW PRICES! NEW ITEMS!

TERMS: (Unless specified elsewhere) Add $3.25 postage, we pay balance. Orders over $50.00 add 85¢ for Insurance. No. C.O.D. Texas Res. add 8 1/4% Tax. 90 Day Money Back Guarantee all items. All items subject to prior sale. Prices subject to change without notice. Foreign order - US funds only. We cannot ship to Mexico or Puerto Rico. Canada, add $7.50 minimum shipping and handling. Countries other than Canada, add $15.00 minimum shipping and handling.

CIRCLE 219 ON FREE INFORMATION CARD

24-hour FAX Line

NEW 800-854-7118 NEW

Descramblers
10 PIECE PRICING

NEW! Super Impulse PAN

JERROLD
$65 EA.
REPLACES ALL THE REST

SCIENTIFIC ATLANTA
SA-3 .... $49
SA-DF W/SWITCH $75

PIONEER
GREEN $89

TVT 3-G $45
MINI TVT $45
TBD-P (PINK) .... DISCONTINUED
BROWN .... DISCONTINUED
DMTB .... DISCONTINUED
SB-3 (REFURB.) $29

Converters

PANASONIC	TZPC-1453G2
JERROLD	DQN-7, DQN-5
SCIENTIFIC ATLANTA	8511,8529

CALL FOR PRICING & AVAILABLITY ON NEW AND REFURBISHED EQUIPMENT

Test Kits & Chips
MINIMUM PURCHASE OF 10 PIECES

STARCOM 7BB $17.50
STARCOM 6BB $17.50
SA 8580 6-BUTTON $17.50
DP-5 CHIP $10.00
ZENITH 3-WIRE CHIP $11.00

Combination Units

JERROLD
ZENITH
SCIENTIFIC ATLANTA

HIGHLANDER
800-338-0400
6325-9 Falls of the Neuse Road Raliegh, NC 27615

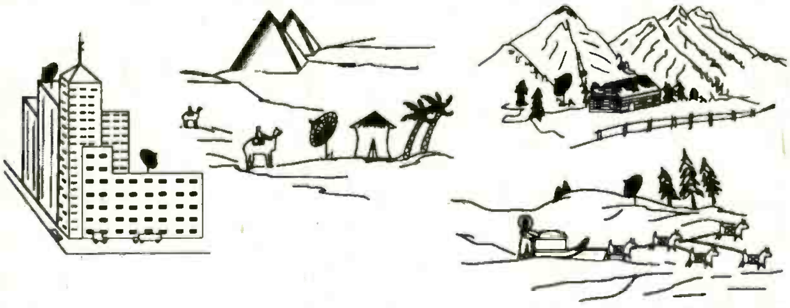
NCCA
National Consumer Cable Association, Inc.
BE SAFE!
Don't buy Cable Equipment from anyone that isn't authorized to display this seal

30 day Money Back Guarantee • 1 year warranty • Your Satisfaction is Guaranteed!

CIRCLE 300 ON FREE INFORMATION CARD

Satellite Television

Order Your FREE Catalog/Buyers Guide Today!



The World Supplier of Satellite T.V. Products. . . "Down To Earth Prices"

New Powerful Satellites = Smaller Dishes
Smaller Dish = Less $$$

KU-BAND SYSTEM

Package INCLUDES all of this:

- 3ft Quality alum dish
- Pansat BR 1100 Receiver
- Polar tracking mount
- Polarity switching feed
- Low Temperature LNB
- 100ft All in one ribbon cable
- Site data coordinate sheet

***Complete System Only $499**

C-BAND SYSTEM

Package INCLUDES all of this:

- 7ft ORBITRON mesh dish
- uniden 4400 IRD
- Polar tracking mount and motorized arm
- Chaparral Polarity switching feed
- 25°Low Temperature LNB
- 100ft All in one ribbon cable
- Optional Decoder module

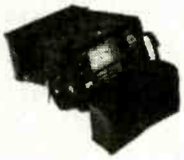
*All you need to supply is ground pole to mount dish on. (3.5" O.D.)

***Complete System Only $859**

Satellite Analysis and Antenna Aiming Software

An extremely valuable tool for designing and installing TVRO's, tailored for ease of use by professionals and dealers as well as by technically orientated TVRO owners. Demonstrates how changing parameters such as dish size or LNB noise temperature affect picture quality. The program performs both TVRO system analysis and antenna aiming. The analysis subcomponent, is especially useful for predicting performance when viewing signals from a particularly weak satellite. The aiming subcomponent calculates azimuth and elevation angles and range to all satellites within "view" of a TVRO. The names and latitudes of all world-wide C and Ku-band broadcast satellites, presently in service or to be launched by 1995, are listed. The user simply enters TVRO site latitude and longitude.

5.25" disk	$49.95
3.5" disk	$49.95



Pico dish Tuning Meter

Bulz-I-Tuning Meter Now with audio alert

TUNE YOUR DISH TO IT'S MAXIMUM!

Dish tuning meters are a must for the serious dealer or satellite system owner. Saves time, frustration and money. Use when installing a new system, moving your dish, re-alignment of a dish that has been moved by wind, frost heaves etc., gets you right on the satellite belt for the best possible pictures!

Pico meter (meter tuning)	$89.95
Bulz-I-IV meter (meter & audio alert)	154.95

LNBs

New Lower Temp's

Hemt Technology Commercial Grade

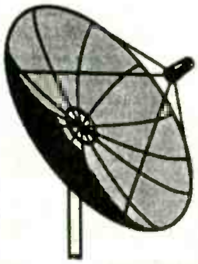
35°	LNB C-band 4GHz	$ 79
25°	LNB " "	95
0.9db	LNB Ku-band 12GHz	$ 89
0.7db	LNB " "	99
0.6db	LNB " "	119

SATELLITE SYSTEM DO-IT-YOURSELF INSTALLATION VIDEO

"Now You Can Watch It Being Done"

Install or "Tune up" your satellite system in no time flat with this professional video.

VHS or Beta (45 Min.)	$33.95



MESH DISHES by ORBITRON

Quality Demonstrated by Performance

Orbitron antennas ("size for size") are known the world over for their superior reception and picture quality.

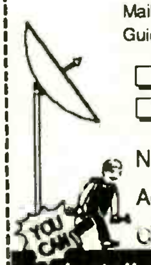
7ft	dish & polar tracking mount	$259
8.5ft	" "	319
10ft	" "	369
10ft H D.	" "	449
12ft	" "	649

All Major Credit Cards Accepted

Skyvision Inc.®

1046 Frontier Drive, Fergus Falls, MN 56537 – Toll Free 800-334-6455

Mail in coupon or call today for the SKYVISION Satellite TV Product Catalog/Buyers Guide Delivered free to your mail box in U.S. and its possessions.



☐ Send Free Domestic Satellite TV Products Catalog

☐ Send International Satellite Catalog (For International Catalog add $8.00 to cover S&H)

Name ____ SATISFACTION ____ Phone ( )

Address ____ GUARANTEED ____

City ____ State ____ Zip ____

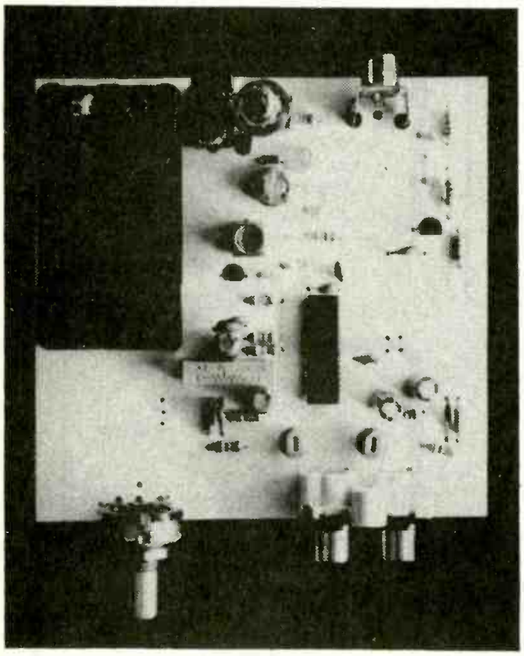
Install A System, Upgrade & Repair Yourself And Save $$$$

Call Toll Free 800-334-6455 International 1-218-739-5231 Fax 218-739-4879

CIRCLE 270 ON FREE INFORMATION CARD

DC KITS

TOLL FREE ORDER
HOT LINE
1-800-423-0070



ALL NEW -- IMPROVED STEREO FM TRANSMITTER

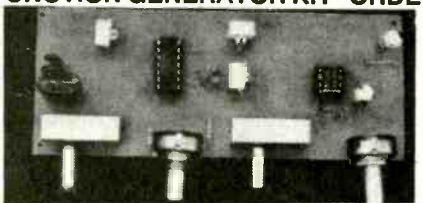
LOADED WITH FEATURES

* RF AMPLIFIER
* FRONT PANEL FINE TUNING
* STABLE OPERATION
* INPUT LEVEL ADJUSTMENTS
* WORKS WITH DIGITAL TUNED RADIOS
* 38KHz CRYSTAL MULTIPLEX CIRCUIT

DC'S all new FM Stereo Transmitter Kit based on the unique BA1404 Stereo Broadcaster Integrated Circuit that includes all the complex circuitry to generate the stereo signal. We've added an RF amplifier circuit to provided excellent transmit range. Additional features like electronic fine tuning, voltage regulation, 38KHz multiplex crystal, input level adjustment makes the Stereocaster the top of the line Stereo FM Transmitter.

ORDER STEREOCASTER $29.95

FUNCTION GENERATOR KIT ORDER FG2 KIT
$19.95



A great project to enhance your bench. This handy little function generator has a built-in buffer amplifier, a 3-decade range selector switch that covers 15 hZ to 25 khZ, output level control and function switch to select sine, square, or triangle.

MAKE CIRCUIT BOARDS THE NEW, EASY WAY

WITH TEC-200 FILM

JUST 3 EASY STEPS:

- Copy circuit pattern on TEC-200 film using any plain paper copier
- Iron film on to copper clad board
- Peel off film and etch

convenient 8½ x 11 size
With Complete Instructions

ORDER TEC200-10 (10-SHEETS) $5.95

POWER SUPPLY KIT
PS-1 $16.99

Output of this power supply is continiously adjustable from 1.2 to 25V DC . The LM317T voltage regulator provides excellent regulation and ripple rejection. Includes a 1 A transformer, PC board, LM317T, 2 binding posts, and all small parts.

MORE KITS

3 DIGIT LED DVM ONLY 3" X 3" READS 0 TO 100 V DC ORDER DVM3 $19.95
FM WIRELESS BROADCASTER FMI $ 9.95
8038 FUNCTION GEN. KIT FGI $ 9.50
SEQUENCER PROJECT SEQKIT $ 9.50

CHRISTMAS TREE PROJECT

Build this unique seasonal project and have an unusual converstion piece. Powered by two D cells, 17 LEDs flash in a seemingly random fashon. Kit includes everything except batteries. ORDER XMASKIT $16.95

UNIVERSAL DECODER IC'S
REFER TO RADIO ELECTRONICS MAY 1990

CD22402E	7.95	CD4040	.65
LM733	.99	CD4053	.59
LM7805	.50	LM7812	.50
CA3126E	1.95	LM7905	.50
74C00	.50	3.58 MHz	1.00
NE564	2.29	18 Uh	.39

DC ELECTRONICS VISA MasterCard DISCOVER AMERICAN EXPRESS
SEND MAIL ORDERS TO:
PO BOX 3203 SCOTTSDALE, AZ 85271 ADD $4.00 S&H

CIRCLE 232 ON FREE INFORMATION CARD

PC-BASED OSCILLOSCOPES OUTPERFORM STAND-ALONES IN COST AND PERFORMANCE

CHASE SCIENTIFIC INTRODUCES 2 NEW SCOPES FOR 1994

By Staff Writer

Chase Scientific Company has just introduced its new 4-Channel 60 MHz and 100 MHz PC-Based Digital Storage Scopes. These scopes compliment its already existing line of 2-channel scopes which have useful bandwidths of 20, 40, 60, and 100 MHz. Each ChaseScope™ System is completely self-contained on a single midsize add-on board (2 required for 4 channel version), at prices that will make the competition cry. Just plug in the board(s), attach your scope probes, load the ***free software*** and you're on your way.

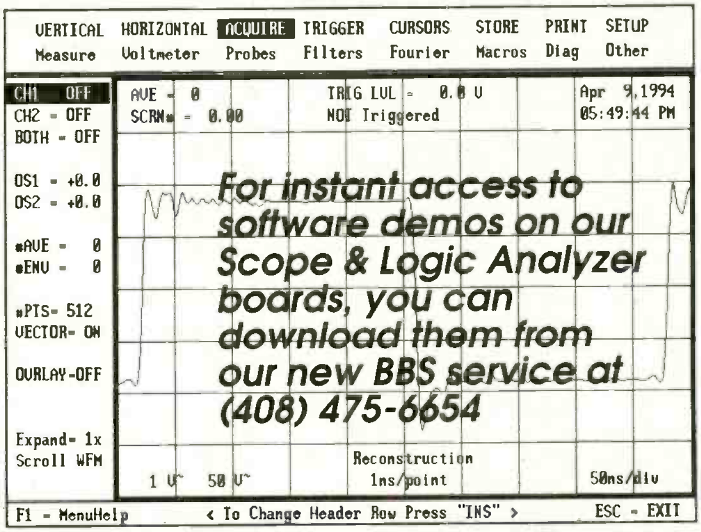
These boards have completely independent vertical channels, each with their own 25 or 40 megasample/sec 8-bit A/D converter, 32K static ram, and 10 vertical gain settings (in 1,2,5 steps). This gives you the same high performance whether you are using one channel or multiple channels simultaneously. Also, in addition to 27 timebase settings (in 1,2,5 steps), there is a user programmable mode for sweeps as slow as 1 month/division.

Post and Pre - triggering are available for time reconstructed waveforms as well as one-shot due to the board's unique ability to use ***random interleaved sampling***.

These PC based scopes are designed with the latest in Surface Mount Technology, providing better performance, reliability, and features than any other board its size on the market today. Chase Scientific also offers an unprecedented ***60 day*** money back guarantee.

STANDARD FEATURES

- Up to 40 Megasamples/second One-Shot Digitizing Rate
- 32K Words/Channel Standard
- 2 or 4 Channel Models Available
- Plot to any Epson or HP LaserJet Compatible Printer
- Built-In Functions Include FFT, Dig. Filtering, Averaging, Voltmeter Emulation, etc.
- Measures Pulse Width, Rise/Fall Time, Frequency, Harmonic Distortion, RMS, Peak, Min, Max, etc.
- Store and Retrieve Waveforms and Setups to Hard Disk
- Professional Scope Software works with VGA, EGA, CGA, or Hercules compatible monitors.



COMPARISON CHART OF PC-OSCILLOSCOPES

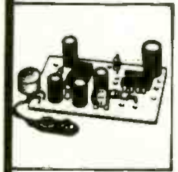
MODEL #	CS100-40A	CS60-40A	CS40-25A	CS20-25A	CS100-40B	CS60-40B
Price (probes not incl.)	**$1195**	**$995**	**$795**	**$595**	**$1895**	**$1595**
Number of Channels	2 chan	2 chan	2 chan	2 chan	4 chan (NEW!)	4 chan (NEW!)
Bandwidth						
Repetative (-3db)	100 MHz	60 MHz	40 MHz	20 MHz	100 MHz	60 MHz
Single-Shot (sample rate/4)	10 MHz	10 MHz	6.2 MHz	6.2 MHz	10 MHz	10 MHz
Maximum Digitizing Rate (two channel simultaneous)	40 Ms/sec	40 Ms/sec	25 Ms/sec	25 Ms/sec	40 Ms/sec	40 Ms/sec
Time Base Range	5ns-2sec/div	5ns-2sec/div	5ns-2sec/div	5ns-2sec/div	5ns-2sec/div	5ns-2sec/div
Maximimum Time Resolution	1ns	1ns	4 ns	4ns	1ns	1ns
Vertical Resolution	8-bit	8-bit	8-bit	8-bit	8-bit	8-bit
Vertical Sensitivity	5mV-5V/div	5mV-5v/div	10mV-10V/div	10mV-10V/div	5mV-5V/div	5mV-5V/div
Memory Depth	32K	32K	32K	32K	32K	32K

FOR FREE INFO & DEMO DISK CALL 1-800-866-7899, FAX 408-479-8572

OR WRITE TO CHASE SCIENTIFIC, 7960-B SOQUEL DRIVE, SUITE 191, APTOS, CA 95003

CIRCLE 172 ON FREE INFORMATION CARD

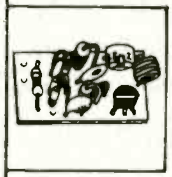
RAINBOW KITS



SUPER SNOOPER BIG EAR

Listen through walls, hear conversations across the room. Add a parabolic reflector & hear blocks away. The BIG EAR can be hidden about anywhere. Makes an ultra- sensitive intercom, Can be used as a 1.5W AMP. We supply a mini- electret mike in the kit. 1"x1.75" 6 to 12vDC

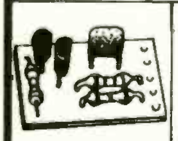
AA-1 **$10.95**



PHONE TRANSMITTER

Small but mighty, it fits anywhere. Phone line powered, never needs batteries. Transmits both sides of a phone conversation loud and clear, wireless, to any FM radio at great distances. Variable tunes from 70MHz TO 130MHz FM. You can also use it as a speaker phone. Size .5"x1"

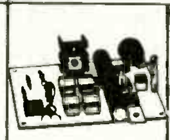
TEL-B1 **$12.95**



PHONE RECORDING SWITCH

This phone line powered switch is small enough to be installed any where. Every time the phone is picked up the recorder will record both sides of the conversation automatically. Use it in your office to record all phone calls so you don't loose important information. 1"x.6"

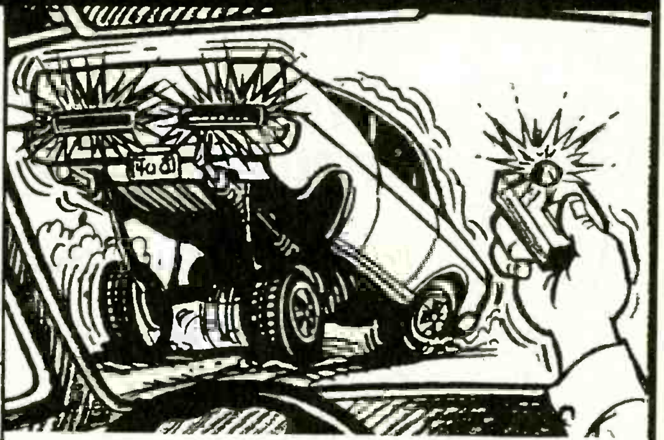
TEL-SW1 **$12.95**



STROBE LIGHT

If you need an attention getter, warning light, or flashing light for model airplanes, then this kit is for you. Use it as an emergency light for your auto, radio tower, even use it on your bicycle. Has a varible flash rate. Size 3.5"x1.8" operates on 6 or 12v DC only.

ST-1 **$9.95**



THE ZAPPER activates any radar detector within 3/4 of a mile. Check the brake lights of that sports car that just went by 90 miles an hour. Back off those 18 wheelers trying to eat your back bumper. Put the fun back in driving. THE ZAPPER is a 10GHz amateur transmitter the size of a cigarette pack, operates on a 9v battery, when the button is pushed, brake lights and radar detector light the skies. Complete with the rules of the new ROAD WARRIOR GAME... TROLLING FOR TAIL LIGHTS, America's fastest growing highway participatory sport.

Built **$49.95**
Kit **$39.95**

DIGITAL THERMOMETER

The DT-3 kit will turn your digital volt meter into an accurate digital thermometer with .1 degree resolution. Measures temperature from -40F to 250F degrees. It has a remote sensor .25" SQ. and can be mounted many feet away from the meter. Size 1.5x1.2" 9vDC

DT-3 **$8.95**

CAPACITANCE METER

This kit will turn your digital volt meter into a capacitance meter. Turn that junk box of unmarked capacitors into a fortune of usable parts. Measures capacitors from <2.2pF to 2.2uF. 1.75"x2" 9vDC

CA-1 **$12.95**

VOLTAGE MONITOR

This kit has 7 multi-colored leds to monitor your 12, 8, or 5v DC systems. Build it to work in 1v, 1/2v, or 1/4v steps. Great for nicad packs, autos, boats, mobile homes, or battery chargers. P.C.B. 1.3"X2.7"

VM-1 **$7.95**

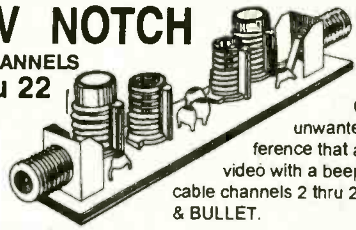
BLINKEY LIGHT

This kit is perfect for decorating hats, name badges, & model trains. Add a box, set it on the dash of your car, use it as an auto burglar alarm. Comes with 2 alternate flashing leds. Size .5"x.5" 9 to 12vDC

RB-2 **$3.95**

TV NOTCH FILTERS

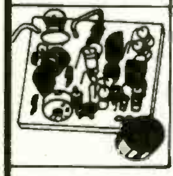
FOR CHANNELS 2 thru 22 ONLY



Our TV filters eliminate unwanted TV channels or interference that alters both sound and video with a beep beep beep. Works on cable channels 2 thru 22. and the 'SNOOPER & BULLET.

NOTE: All TV Filter Kits are sold for educational purposes only. You must obtain permission from your local cable company before using these filters on your cable system.

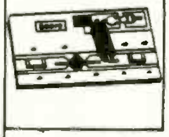
DF-222 Kit **$14.95**



WIRELESS FM MICROPHONE

Small but mighty, this little jewel will out perform most units many times its price. It really stomps out a signal. The WM-1 kit is a buffered wireless mike that operates from 80-MHz to 120MHz FM, the frequency of any broadcast FM radio. Includes a mini-electret mike. .8"x1" 6 to 12vDC

WM-1 **$14.95**



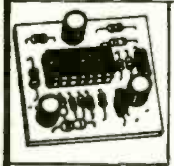
WIDE BAND PREAMP

Ideal for preamp for scanners, hand held radios, frequency counters. Amplifies low level (weak) signals. If the signal is extremely low 2 amps can be used in series. 1MHz TO 2.5MHz @ 2.8dB nf 1dB compression = +0 dBm gain: 1MGHz-20dB to 2.5GHz-6dB Requires 12vDC @ 16Ma

WBA-6 **$19.95**

This Manual contains all schematics, parts & P.C. board layouts for all of the Rainbow Kits. Use your own parts to construct any of our kits.

KIT BOOK **$14.95**
$5.00 off if you buy any kit



VOICE ACTIVATED SWITCH

This VOX circuit can be used to operate a tape recorder, ham radio, CB radio, or turn on an alarm. The VOX-1 kit has 100MA of output. That operates a relay, light, motor, or ? What could you do with a sound activated switch? Size 1.5"x1.3" 7.5 TO 18vDC

VOX-1 **$6.95**

INDUCTANCE METER

This is the kit every one has been asking for. Turn your digital volt ohm meter into an inductance meter. It will read inductors 3uH to 7MH. Size 1.5"x1.6" 9vDC

IA-1 **$14.95**
CABINET **$ 8.95**

4C

Please add sufficient postage
First lb $5.00
We will accept telephone orders for Visa or Mastercard

VISA **To Order Call 317-291-7262** MasterCard

ELECTRONIC RAINBOW INC

6254 LaPas Trail • Indianapolis, IN 46268

CIRCLE 242 ON FREE INFORMATION CARD

DO-IT-YOURSELF ELECTRONIC KITS

Mark V Electronics, Inc.
8019 E. Slauson Ave.,
Montebello, CA 90640

Sale !
Venta Especial !

Catalog & Information
213/ 888-8988
Fax 213/ 888-6868

ORDER 1-800-521-MARK / 1-800-423-FIVE

Mark V has more than 60 kits available including high-fidelity audio products, laboratory equipment, power supplies, light controllers, games and numerous projects! Audio amplifiers range from 6 to 300 watts. Kit skill levels are specified as ▲ beginner, ▲▲ intermediate, or ▲▲▲ advanced. Quality kits at unbeatable prices starting from $ 7!! Shipping within 48 hours. Foreign orders from Mexico, South America or European countries are welcome. In business since 1985.

SCHOOL PROJECT CORNER
po orders welcomed from schools

	Kit
Melody Generator ▲	$ 13.85
6W Mini-Amplifier ▲	8.50
Digital Voice Memo ▲	28.00
36W Class A Power Amp. ▲▲	28.50
Dynamic Noise Reduction ▲	26.00
Control Switch ▲	8.50
20 Bar/Dot Level Display ▲▲	38.45
Microphone Mixer ▲	19.79
1W Mini-Amplifier ▲	6.87
Digital Clock with Timer ▲	25.00
Stereo Pre-Amp with Mic Amp.▲	9.78
Walkman Booster Stereo Amp.▲	28.50

SEE OUR CATALOG FOR MORE KITS !

STEREO LOUDSPEAKER PROTECTOR

TY-25 ▲

Kit: $ 15.85

Super fast acting relay protects speakers against destructive DC voltages. Can connect directly to a power amplifier or can use a separate power supply. Has a 3 second turn-on delay to avoid turn-on thumps. (1 lb.)

REGULATED DC POWER SUPPLY

TR-503 ▲▲

Kit: $ 17.75

It is short circuit proof and has overload protection. Output voltage is variable over a range of 0-50 volts. Current limit trip is adjustable up to max of 3A. May use Mark V #002 transformer. (1 lb.)

FLUORESCENT LIGHT DRIVER

TY-2 ▲ (1 lb.)

Kit:$ 11.97

This unit drives 6-40 watts fluorescent light for portable and emergency use. Works from a 7.2 - 16 VDC battery. Includes a "Hi-Efficiency Switching Mode IC Driving Circuit" suitable for use with different lights.

120-250W MOSFET POWER MONO AMPLIFIER AF-2 (6 lbs.) ▲▲

Kit: $ 89.80 Asmb.$ 114.80

Power Output: 250W into 4 ohms RMS(42VX2 6A transformer is used). 120W into 4 ohms RMS(33VX2 4A transformer is used). Frequency Response: 3Hz-22,000Hz. THD: <0.03%. Signal to Noise Ratio: 91dB. Sensitivity: 1V RMS at 47k. Load Impedance: 4 or 8 ohms. Power Requirement: ±46VDC 4A or ±60VDC 6A. May use Mark V model 012 Transformer. Suggested Capacitor 10,000uf 100V Model 019. Suggested Metal Cabinet LG-1925.

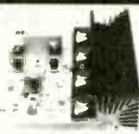
SURROUND SOUND PROCESSOR

SM-333 ▲▲ (5 lbs.)

Kit:$73.00

It has inputs for VCR, LD, CD and can also be used with tuners, tape decks and LP discs. Frequency Response: 20 Hz-20KHz. THD:Front Channel 0.05% Rear Channel <0.25%. Input signal voltage: 0.1-3.5V. Output: Front Channel 0.1-3.5V Rear Channel 6.6V. Delay Time: 5-50 ms. Input Impedance: 47K Power Requirement: 100-120VAC, 60Hz. Ready to plug when assembled. Asmb:$85.00

300W HIGH POWER MONO AMPLIFIER TA-3600 (5 lbs.) ▲▲▲



Kit 85.00
Asmb.$ 110.00

Power Output: 300W into 8 ohms RMS. 540W music power into 8 ohms. Frequency Response: 10Hz-20KHz. THD: < 0.05%. Sensitivity: 1V RMS at 47K. Power Requirement: 60 to 75 VDC at 8A. May use Mark V Model 007 or 009 Transformer. Suggested Capacitor: 10,000uf80-100V Model 019 Capacitor. Suggested Metal Cabinet LG-1925.

120W + 120W PRE & MAIN STEREO AMPLIFIER TA-800MK2 (4 lbs.) ▲▲

Kit: $ 63.92 Asmb.$ 73.95

Power Output: 120W into 4 ohms RMS. 72W into 8 ohms RMS. Frequency Response: 10 - 20 KHZ. THD: < 0.01%. Tone Control: Bass ±12dB, Mid ±8dB, Treble ±8dB. Sensitivity: Phono Input, 3mV into 47K. Line, 0.3V into 47K. Signal to Noise Ratio: 86dB. Power Requirement: 40V DC @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Metal Cabinet Model LG-1924.

AC/DC STEREO PRE & MAIN AMP.

SM-720 ▲▲ (7 lbs.)

Kit:$ 75.00

120WX2 Music Power THD: <0.2%. Input Sensitivity: Tape 300mV 47K, CD/Aux 300mV 47K, Phono 3mV 47K, Guitar/Mic 3mV (600 ohm - 47k ohm). Tone Control: Treble±8dB, Bass±8dB. Frequency Response: 20Hz-20KHz. Signal to Noise Ratio: 78dB. Power Requirement: AC 110/60Hz DC 12-16V. Ready to plug in when assembled. Asmb:$ 89.00

80W + 80W PURE DC STEREO MAIN POWER AMPLIFIER TA-802 (4 lbs.) ▲▲

Kit: $ 45.94
Asmb.$ 59.72

Power Output: 80W per channel into 8 ohms. THD: < 0.05%. Frequency Response: DC to 200 KHZ, -0 dB, -3dB @ 1W. Power Requirement: 30V AC X 2 @ 6A. May use Mark V Model 001 or 008 Transformer. Suggested Capacitor 8,200uf 50V Model 017. Suggested Metal Cabinet LG-1924

60+60W STEREO POWER AMP. ▲▲

SM-302 (11 lbs.)

Kit:$ 73.00

It provides 3 input jack pairs. One pair accept a high impedance microphone. The two remaining pairs are for high & low level input sources. Power Output: 60W per channel into 4 ohms RMS. 20Hz-20KHz. THD:<0.1%. Input Sensitivity :Mic /Guitar 10mV, Hi 380mV, Lo 640mV.Ready to plug in when assembled. Asmb.:$ 85.00

30W + 30W PRE & MAIN STEREO AMPLIFIER TA-323A (1 lb.) ▲

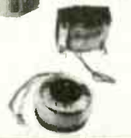
Kit: $ 29.50 Asmb.$ 38.50

Power Output: 30W into 8 ohms RMS per channel. THD: < 0.1% from 100 HZ to 10 KHZ. Sensitivity: Phono 3mV @ 47K. Tuner, Tape 130mV @47K. Signal to Noise ratio: 80dB. Power Requirement: 22 to 36V AC, 3A. May use Mark V Model 002 Transformer. Suggested Cabinet LG-1684.

METAL CABINETS
ALUMINIUM FRONT PANEL

LG-1273	3X12X7"	(4 lbs.)	$ 23.85
LG-1684	4X16X8"	(7 lbs.)	28.50
LG-1924	4X19X11½"	(10 lbs.)	34.50
LG-1925	5X19X11½"	(10 lbs.)	38.00
LG-1983	2¼X19X8"	(7 lbs.)	32.50

TRANSFORMERS (5-12 lbs.)
**TOROIDAL TRANSFORMERS



# 001	28V/30V X2	6A	$ 28.00
# 002	36V X2	3A	23.00
# 003	40V X2	6A	30.00
# 008**	28V/30V X2	6A	38.00
# 009**	48/53V X2	8A	66.00
# 012**	33/40/42V X2	6A	45.00

3½ MULTI-FUNCTION LED DPM ▲▲

SM-43 (1 lb.)

Kit: $ 34.50

AC/DC Voltage range: 1mV-1000V. Thermometer range :0-100C. DC current range: 1 microamp - 2 amp. Capacitance range: 1pf to 2 microfarads. Frequency Counter: 10HZ-20KHZ. Max indication ±1999. Power Supply: 5-6V DC, 200ma. Asmb:$ 43.00

Minimum order: $ 20.00. We accept Visa, MasterCard, Money Orders, and Checks(allow 2 weeks for clearance). We ship by UPS ground inside US (min $4.00) and ship by US mail outside US. Please call our operator for orders over 2 lbs. or foreign orders.

CIRCLE 303 ON FREE INFORMATION CARD

COMPUTER PARTS - SURPLUS ELECTRONICS - SERVICE PARTS - ACCESSORIES
SCHOOL & UNIVERSITY P.O.s ACCEPTED! - SCHOOL QTY. DISCOUNTS AVAILABLE*

CARRY CASES

A. 3.5" x 12.5" x 14". $14.95
Designed for small laptop or notebook computer. Side pockets for 12 3.5" Disks & Manual. Shoulder Strap & Handle

B. 3" x 16" x 13"..................$14.95
Laptop Computer Case with shoulder strap Outside pocket is big enough to hold a notebook computer!

C. 13" x 16.5" x 16.5"...........$19.95
IBM PS/2 Transport Case
Side keyboard pouch • Wheels & leash Can hold Mac LC or IIsi & Monitor, IIgs System. Has 3 pockets inside. Rigid Bottom Side handles. Well Constructed!

D. * 16" x 16" x 7"...............$14.95
Olivetti Carry case. Can be used to carry many different computer systems. Apple / /e, Mac II, IIx, IIfx. Mac IIcx/ci & Quadra 700/800 series. Mini Tower size too! Sturdy construction, heavy fabric, shoulder strap & handle.

E. 15.5" x 12.5" x 2.75" $19.95
Exterior pocket 13" x 9" x 1.5". Interior has positionable retainer and small "attache" panel for 3.5" disks, pens, papers. Padded case. Black with red highlights, carry handle, shoulder strap. Originally for Digital.

F. 12" x 15" x 2.75" $19.95
Zippered Exterior pocket 12" x 12" x 1". Carry handles & Shoulder Strap. Greenish color. Originally for Mitsubishi.

Printers & Accessories

Epson FX 100 ....$65.00
Epson FX286 ....$75.00
Citizen GSX 130, 140, 140+ & 200GX Manual Sheet Feeder.
AH29804-0 NEW $24.95
Citizen GSX 130, 140, 140+ & 200GX Printer Stand.
AH29806-0. NEW $7.95

Power Supplies

Mini Tower Case Power Supply.
145 Watts. Refurbished.......$20.00
New $29.00
XT Power Supply. 135W ...$25.00
IBM XT 65Watt P/ S $5.00
300W. Tower or AT Type...$49.00
AT Power Supply. 200W
Refurb $29.00

We can repair most types of power supplies. Computers & More.

Bulk Disks

52.5" DSDD Disks (100 pcs) $12.00
3.5" DSDD Disks (50 pcs) $14.50
3.5" DSHD Disk (10 pcs) $3.90
5.25" Cleaning Disk $1.00
3.5" Cleaning Disk $2.00

Backup Tapes

DC2000 Tape (Gigatek brand) $12.00
DC600 Tape (Gigatek brand).........$9.00
GC9100 (1 Gig. Gigatrend tape)..$19.00

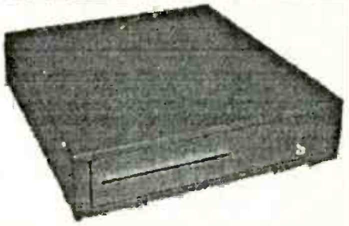
Cables & Connectors

DB25 IDC (Flat ribbon) connector
M/F...49¢
DB37 IDC (Flat ribbon) connector
M...49¢
MFM/RLL, IDE or Floppy.......$1.00

Serial Link Cable
To link two computers for data transfer. Ends. Can be DB9 to DB9 or DB9 to DB25..........................$9.95

Fujitsu Cash Drawer.

Hooks up to any receipt printer w/parallel I/O. RJ45 Has check "deposit" slot in front of drawer.



$75.00

Ask for our Apple][Related items, specials & surplus electronics.

CHIPS & ROMs

Processors
80287-8 ....$19.00
V20-8..........$2.00 V28-10 ....$6.00
MC68030-16...............................$39.00
MC68882-16...............................$39.00
16550 (Enh.serial port chip) .$13.00

RAM
4116, 4164 or short lead 41256 -12 or -15 ....50¢
41024 (1 Meg x 1) or 44256 ....$3.00
256x8 -15 SIMM...$3.00 / -12..$4.95
256x9 SIP -12..........................$5.95
256x9 SIMM -80 ....$8.00

Batteries
1/2 AA size, 3.6V lithium $4.95
AT Type "plug in" 3.6V or 6V $6.95

EPROMs

2716 or 2732.................................75¢
2764..$1.00
27128..$1.50
27256..$2.00
27512..$2.,50
271000 (32 Pin)..........................$4.00
27010..$6.00

Microcontrollers
8748..$4.00
8749..$6.00
8751..$9.00

FLOPPY DRIVES

Used 360K 5.25" Drive $14.95
Used 1.2 Meg 5.25" HH $35.00
IBM PS/2 720K Drive OEM for IBM, Mitsubishi Part...........$59.00

Alltech Electronics Co.

602 Garrison St. Oceanside, CA 92054
9-6 PM Mon.-Fri. - 9-5 PM Sat.

Orders Only:
800/995-7773

All other Inquiries: & Tech Support: 619/721-7733
Fax (School PO's, Quotes, Info.): 619/721-2823

We Buy Excess Computer Related Equipment.

SPECIALS

Dexxa Hand Scanner 300dpi
$59.00
XT System Refurbished
Mono Monitor 360K Drive
$95.00
AT System • Mono Monitor
8 Mhz • 1024K •1.2M Drive
$159.00

Monitors

9" Composite "Box" type cabinet. Green screen. Good for security monitor. Input for 75Ω (standard) or High impedance....................................$35.00
Color Composite Monitor. Not suitable for 80 column text but can be used for computer games, Nintendo, as a video monitor. Some have sound input also.
Specify...$69.00
Used/Refurbished Mono. DB9..........$35.00

Computer & Drive Cases

Desktop XT/AT Case & 150W P/S Turbo Switch & LED, 2 Exposed HH drive bays..$29.00
External Floppy Drive Case. Holds two HH drives or one FH drive. With Power Supply..$19.00
External MFM/RLL HH HD Case Holds HH 5.25" Hard disk.............$19.95
Open face SCSI Case & P/S. For SyQuest or CD ROM. Two 50 Pin Centronics Connectors...................$45.00
External SCSI Case & P/S For 5.25" or 3.5" HH Drive. Two 50 Pin Connectors & ID Selector.......................................$45.00
Full height SCSI Case & P/S. Holds 2 HH Drives or 1 FH.........................$65.00
External CD ROM Drive Case 36 or 40 Pin CD ROM Drives. To install a CD on your system externally....$45.00

Peripheral Cards & Accessories • Keyboards

AT Floppy, Serial & Par Controller $9.95
AT IDE HD Controller $9.95
Mono/Parallel Port......................................$9.95
Universal Video Card. 8 Bit
CGA/EGA/VGA $39.00
Full Length CGA w/RCA out....................$14.95
EGA Card $29.00
101 Keyboard (NEW) $29.00
5 Pin kybd to PS/2 adapter $2.95
16 Bit Backplane board.............................$10.00
Microsoft InPort Mouse Card (only).........$19.00
Winning Wordperfect 5.1 in 5 hours!.......$9.95
AT 2 Meg Mem. Exp Card w/2 Meg $39.00
101 XT/AT Keyboard...................................19.00
Keyboard Wrist Pad....................................$1.95

KESTOR SOLDER $4.95 EA.

Alloy	Dia.	Flux	Core
Sb5	.025	282	66
Sn60	.031	282	66
Sn60	.020	282	66
60/40	.031	331	40
Sn63	.031	282	66

• CA Residents please add 7.75% Sales tax.• Minimum shipping & handling charges $5.00. (This covers most orders) • Warranty: Used/Refurbished products have a 90 day warranty • ALL Returns must have an RMA #, call before shipping back to us. • No Returns without an invoice. Shipping & Handling charges are non-refundable • 20% Restocking charge, applies to products purchased in error & incompatibility problems. • School & University Purchase Orders accepted, others on AOC only. • Prices and availability subject to change at anytime without any notification whatsoever. • Some Products are refurbished product.

CIRCLE 282 ON FREE INFORMATION CARD

Parts Express
International Inc.

1" Titanium Dome Tweeter

Features a ferro fluid cooled Kapton voice coil and a rubber surround. Very natural sounding high frequency reproduction with extended response to 30KHz. •Power handling: 50 watts RMS/75 watts max •Voice coil diameter: 1" •Impedance: 8 ohms •Frequency response: 2500-30,000 Hz •Magnet weight: 5.3 oz. •Fs: 1000 Hz •SPL: 93 dB 1W/1m •Net weight: 1 lb.

#EN-275-050 .. $17.50 (1-3) ... **$15.80** (4-UP)

10" Treated Paper Cone Woofer

This 10" woofer features a non-pressed, polymer laminate cone and a rubber surround. Well suited for applications where a high level of performance is desired, but at a reasonable price. Aluminum voice coil and vented pole piece. •Power handling: 70 watts RMS/105 watts max •Voice coil diameter: 1-1/2" •Impedance: 8 ohms •Frequency response: 30-2,800 Hz •Magnet weight: 20 oz. •Fs: 31 •SPL: 91 dB 1W/1m •Vas: 4.1 cu. ft. •Qts: .35 •Qes: .39 •Qms: 3.69 •Xmax: .27 in. •Net weight: 4 lbs.

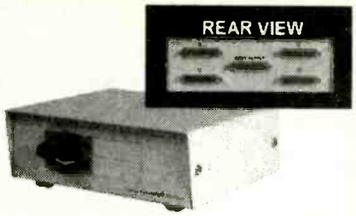
#EN-295-260 $29.80 (1-3) **$26.90** (4-UP)

12" Musical Instrument Speaker

Ribbed paper cone with treated cloth accordion surround. Vented pole piece for heat dissipation and reduced distortion. Perfect replacement for many P.A. and musical type speakers. •Power handling: 150 watts RMS/200 watts max. •Voice coil diameter: 2 inches •Impedance: 8 ohms •Frequency response: 50-5000 •Magnet weight: 50 ozs. •Fs: 50 Hz •SPL: 96 dB 1W/1m •Vas: 3.56 •Qts: .43 •Qes: .49 •Qms: 3.62 •Xmax: .129 •Net weight: 10 lbs. •Manufacturer model number: A30GC50-52FQ.

#EN-290-142 .. $49.80 (1-3) ... **$45.50** (4-UP)

RS-232 A-B Switch



Fully shielded, steel enclosed data switch with gold plated female connectors. All 25 pins switched through. High reliability rotary type switch. Compact size. Anti-skid rubber feet. Boxed. Can be used to switch multiple printers or computers. 1 year guarantee. Net weight: 1-3/4 lbs.

#EN-130-010 .... $10.50 (1-2) **$9.95** (3-UP)

High Voltage Capacitor Kit

This 85 piece kit contains a selection of 250, 350, and 450 volt electrolytic capacitors. 5 pieces each of 1, 2.2, 3.3, 4.7, 6.8, 10, 22uf and 2 pieces each of 33, and 47uf, 250V radial caps. 5 pieces each of 1, 2.2, 3.3, 4.7, 10uf and 2 pieces each of 22, 33uf, 350V radial caps. 5 pieces each of 1, 2.2, 4.7uf and 2 pieces of 10uf, 450V radial caps. Over $62.00 wholesale cost if purchased individually. Net weight: 1 lb.

#EN-020-950 .... **$49.95** EACH

22 Amp Power Supply

The perfect test bench power supply. You can run just about any 12 VDC powered product without worrying about overloading the supply. Highly regulated IC and transistor circuitry with built in crowbar protection alarm. Dual metering for voltage and current. Output adjustable between 10-14 VDC. Adjustable output current for testing amplifiers. 2 year warranty.

Specifications:

- Output voltage .... 10-14 VDC
- Output current (cont) 22 amps
- Output current (surge) 25 amps
- Dimensions .... 9"x5"x11"
- Net weight .... 19 lbs

#EN-120-504 $139.95 (1-3) **$129.90** (4-UP)

Strobe Flasher

Weatherproof red strobe flasher. Includes 9/16" mounting stud and foam gasket. Operating range 6-12 VDC. 2-3/4" (W) x 1-5/8" (dia). Net weight: 1/4 lb.

#EN-335-123 .. $12.50 (1-3) ... **$11.25** (4-UP)

Technicians' Turntable

Turntable to speed repair of VCRs, TVs and more. Allows technician to easily turn unit for convenient repair. Dimensions: 20" W x 15" D x 1-1/8" H. Black pebbled surface. Includes 4 anti-skid adhesive feet. Net weight: 9 lbs.

#EN-360-427 .... **$28.50** EACH

Multi-Speaker Distribution Box

This multi-speaker distribution box features metal construction, inputs for left and right channels, and 8 set of speaker outputs. Color coded, spring loaded pushbutton terminals accept 12 to 22 gauge wire. Built in impedance protection can be switched in or out. Power handling capacity: 300 watts (impedance protection switched off), 150 watts (impedance protection switched on). Black color. Made in the U.S.A. Dimensions: 19"W x 3-1/2"H x 2-1/4"D. Net weight: 2 lbs.

#EN-300-600 .... **$149.80** EACH

Center Off Toggle

DPDT center off toggle switch. 6A, 125VAC. (1/2" mount.)

#EN-060-087 . $1.75 (1-9) . **$1.50** (10-UP)

F-59 Deluxe Connector

Popular connector for cable TV systems. Full attached ferrule for hex crimp. Securely holds RG-59 cable.

#EN-090-355 .. 29¢ (1-49) ...... **22¢** (50-UP)

Deluxe TV Wall Mounting System

Deluxe wall bracket features heavy duty, all steel construction and the platform is adjustable from 12-1/4" to 16-3/4". Has 4 pivoting points and swivels 180 degrees for a variety of viewing angles. 60 lb. capacity. White enamel finish. Must be mounted directly to studs. Net weight: 9 lbs.

#EN-240-772 .. $36.50 (1-3) ... **$32.80** (4-UP)

Mag-Lite Focusable Flashlight

MAG-LITE

These high tech flashlight from Mag-Lite are constructed of rugged aircraft aluminum for shock resistance and are anodized inside and out to guard against corrosion. High intensity light beam can be easily focused from a flood to a spot. Rubber "O" rings provide excellent moisture resistance. The sealed switch is self cleaning to eliminate oxidation and to ensure high reliability. Don't settle for imitations. See why most police and fire departments across the country use Mag-Lite! Includes spare krypton lamp. Lifetime manufacturer warranty. Designed and manufactured in the U.S.A.

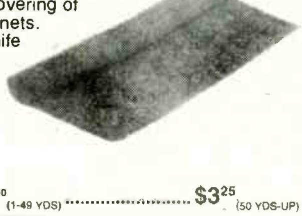
Part #	Description	Price (1-3)	Price (4-9)	Price (10-UP)
EN-361-510	2 D-cell black	$22.90	$20.50	**$19.50**
EN-361-515	2 D-cell red	22.90	20.50	**19.50**
EN-361-520	3 D-cell black	23.90	21.45	**19.95**
EN-361-525	3 D-cell red	23.90	21.45	**19.95**
EN-361-530	5 D-cell black	25.95	23.50	**21.90**
EN-361-535	5 D-cell red	25.95	23.50	**21.90**
EN-361-540	Mini AAA cell black	11.50	9.95	**9.25**
EN-361-545	Mini AAA cell red	11.50	9.95	**9.25**
EN-361-550	Mini AAA cell blue	11.50	9.95	**9.25**
EN-361-555	D-cell wall mount brackets	5.20	4.70	**3.95**

3M Super 77 Spray Adhesive

A high tack, fast drying transparent adhesive to permanently attach carpeting, cloth, foils, foams, etc. to wood, metal, painted or unpainted surfaces. High initial "grab" with sufficient time to position materials. 24 oz. can with two spray head actuators (wide and round).

#EN-340-255 .... $9.95 (1-11) .... $7.95 (12-35) **$7.50** (36-UP)

Cabinet Carpet



This high quality carpet conforms easily to sharp corners because it has no stiff backing. You can also stretch it to cover irregular shapes. This is the covering of choice for car, stage, and amplifier cabinets. Carpet is strong, yet easy to cut with knife or scissors. Adhere with spray adhesive or latex contact cements. Provides protection and good looks. Sold by the linear yard. 54" wide.

#EN-260-765 Dark Charcoal
#EN-260-767 Medium Grey
#EN-260-768 Jet Black

Per Linear Yard, 36" x 54" .... $4.50 (1-49 YDS) .... **$3.25** (50 YDS-UP)

Parts Express
340 East First St.
Dayton, Ohio 45402
Local: 513-222-0173
FAX: 513-222-4644

•30 day money back guarantee •$20.00 minimum order •We accept Mastercard, Visa, Discover, and company C.O.D. orders •24 hour shipping •Shipping charge = UPS chart rate + $1.50 ($4.00 minimum charge •Hours 8:30 am - 7:00 pm ET, Monday - Friday •9:00 am - 5:00 pm Saturday. Mail order customers, please call for shipping estimate on orders exceeding 5 lbs. •Foreign destination customers please send $6.00 U.S. funds for catalog.

CIRCLE 262 ON FREE INFORMATION CARD

Davilyn CORP.

13406 Saticoy Street
North Hollywood, CA 91605-3475

VISA — 1972 Davilyn Corporation 22 Years Anniversary 1994 — MasterCard

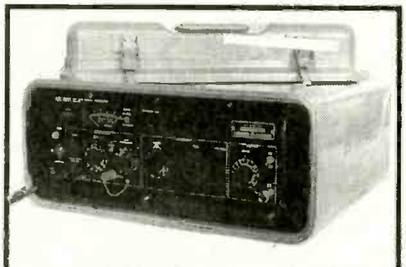
Price: $395.00

TEKTRONIX 528 SOLID STATE N.T.S.C. WAVEFORM MONITOR

NEW

AN/URM-120 50 OHM THRU-LINE RF WATTMETER

Frequency range: 2MHZ to 1000MHZ. **Power range**: 10 Watts to 1000 Watts. USWR≤ 1.08 to 1. Uses three plug-in coupler elements, (included). CU-753 2 to 30 MHZ 50 to 100 Watts CU-754 25 to 250 MHZ 10 to 500 Watts CU-755 200 to 1000 MHZ 10 to 500 Watts **Connector**: Type N. Case included. Size: 7"W × 6⅝"H × 7⅓"D Weight: 6.5 lbs. **Price: $285.00**

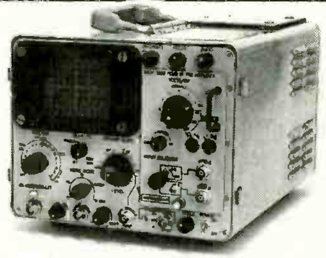


HEWLETT PACKARD 8640B-OPT 323 SOLID STATE SIGNAL GENERATOR

(w/o synchronizer) Frequency range: 450 KHz to 512 MHz, to 1100 Mhz with external frequency doubler option supplied. Ten Frequency bands in octave increments from 500 KHz; band 11 for doubler use. Accuracy: 6 digit LED read out. Stability: < 1000 ppm. Output power: −145 dBm to +10 dBm (0.013 V to 2 V) into 50 Ω. Impedance is 50 Ω, VSWR < 2.0 on 2 V and 1 V range < 1.3 on other ranges >. Modulation: Internal AM, FM and PM, external AM, FM and PM. Pulse frequency: 0.05 to 5 kHz. General: Power Requirements: 100, 120, 220, 240 V, 48 hz to 420 hz, 2 amps. Size: 6" (H) × 19" (W) × 13¼" (D). Wt. 60 lbs. Includes ruggedized case and manual.

Price: $795.00

Current Hewlett Packard Prices: $12,050.00



AN/USM-117 TRANSISTORIZED DC-6, MHz OSCILLOSCOPE

Specifications: CRT Size: 2½" × 2" - Vertical Bandwidth: DC-6 MHc - Sweep Ranges: .1 microsecond div. to 1 sec. - Horizontal Bandwidth: DC-500 Hz - Power Input: 115V/50 - 1000 Hz/1 Ph - Dimensions: 8" × 9¾"W × 18½"D (including front cover) - Weight: 23 lbs. complete. **Price: $135.00**

TEK MODEL 7603N

Oscilloscope: Mil Spec AN/USM-281C, 8 × 10 CM display, 100 mHz response which accepts standard 7000 series Plug-Ins. Vertical Plug-In: 2 ea. 7A15 (AM-6565), frequency BW 75 mHz, maximum sensitivity 5mV/DIV. Horizontal Plug-In: 1 ea. 7B53 (TD-1085), triggering to 100 mHz, minimum, sweep-time 50 NS/DIV, has delayed sweep capacity. Includes cover probes accessories. **Price: $495.00**

HP MODEL 606B

Signal Generator: Later version of 606A. Frequency range of 50 KHz to 65 MHz in size bands; accuracy ±1%. Output level is continuously adjustable from 0.1uV to 3V into 50 resistive load. Modulation level of 0 to 95% on 1V attenuator range and below, 0 to at least 20% on 3V range **Price: $375.00**

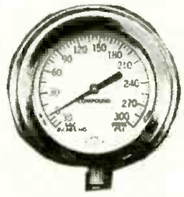
COLLINS HF8050 SOLID STATE SYNTHESIZED RECEIVER

Freq: 250KHZ to 29.99999MHZ; 10HZ steps thumb wheel tuning. Modes: SSB, USB, LSB, CW, AM. B.W.: 2.7KHZ, 16KHZ. Sensitivity: 0.7MV 10dB S+N/N. Computer controllable. Squelch. Power: 103 to 127U, 47 to 63HZ/207 to 253V, 80 watts. Size: 7"H × 19" × 20.9"D. Wt: 42 lbs.

Price: $2500.00

Collins 651S-1 synthesized, solid state HF receiver, AM, CW, SSB, FM, ISB. Freq: 250 KHZ to 29.9999 MHZ. 1MHZ, 0.1 MHZ, 100 CPS steps. IF filters: 16MHZ, 6MHZ, 3MHZ, 2.7 MHZ, 0.5 MHZ, No 0.2. Input power: 115/230v, 47 to 63hz, 70 to 110 watts.

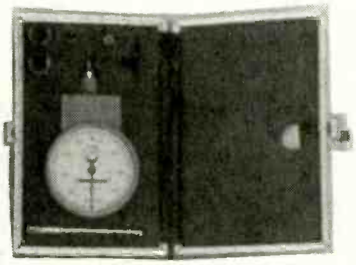
Price: $1,895.00



GENUINE U.S. NAVY

−30 vacuum to +300 PSI Bronze Encased Gauge. 5¼" diameter ¼" male NPT.

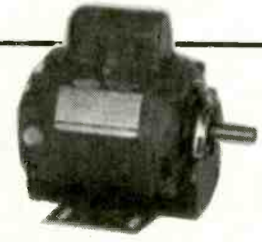
New Price: $85.00



JONES INSTRUMENT TACHOMETER

Centrifugal Mechanical tachometer. Measures RPM scale to 500 RPM. Coupling shaft ⅛". Accessories: various size rubber tipped drive couplings.

New Price: $75.00



DAYTON CAPACITOR MOTOR

5K504 ½HP capacitor start 1725 RPM 115V, 60HX, 1PH. Sleeve bearings rubber mounted open, driproof thermal protection nema 56 frame ⅝" dia. shaft 3½" shaft HT.

New Price: $75.00

ITT UHF POWER AMPLIFIER AM6155/ GRT-22

Frequency range: 225 MHZ K 399.95MHZ, Power Output: 50 watts. Impedance: 500OHMS. Modulation range: 90% ± 10%. Power Req: 105/120V/210/240 at 47 to 420 HZ, 610 watts max. Size: 5¼"H, 17¾"W, 18½"D at 70 lbs.

Price: $300.00

(818) 787-3334 (800) 235-6222 FAX (818) 787-4732

CIRCLE 236 ON FREE INFORMATION CARD

C & L ELECTRONICS

BUY — SELL — TRADE

★ 90 DAY GUARANTEE ★
10 Day Inspection Period

Assoc. Research 5040 AT	Hy Pot Tester	500.00
Datapulse 101	Pulse Generator	75.00
Fluke 332B	DC Voltage Calibrator	800.00
Fluke 540B-110	Transfer Standard	2,000.00
Fluke 721A	Lead Compensation	500.00
Fluke 845A	Null Detector	300.00
Fluke 887AB	Differential Voltmeter	400.00
Fluke 895A	Differential Voltmeter	350.00
Fluke 931PB	True RMS Voltmeter	400.00
Fluke 1953A	Frequency Counter	450.00
Fluke 6160A	Frequency Synthesizer	650.00
GR 1615A	Capacitance Bridge	1,200.00
GR 1620A	Capacitance System	2,000.00
HP 203A	Function Generator	400.00
HP 334A	Distortion Analyzer	600.00
HP 853A	Display	2,000.00
HP 1725A	Scope, 275MHZ	700.00
HP 1740A	100MHZ Scope	500.00
HP 3551A	Transmission Set	750.00
HP 3456A	Digital Voltmeter	900.00
HP 3575A/001	Phase Gain Meter	900.00
HP 3575A/002	Phase Gain Meter	1,000.00
HP 4800A/4801A	Vector Impedance Meter	450.00
HP 4815A w/Probe	Vector Impedance Meter	800.00
HP 5340A	Frequency Counter, 10HZ to 18GHZ	1,000.00
HP 5328A w/OPT 011	Counter, DC to 100MHZ, 9 digit	450.00
HP 606B	Signal Generator	350.00
HP 3325A	Synthesized Function Generator	2,000.00
HP 3330B	Automatic Synthesizer	800.00
HP 3467A	Logging Digital Multimeter	900.00
HP 3581C	Selective Voltmeter	995.00
HP 3722A	Noise Generator	1,250.00
HP 3776B	PCM Terminal Test Set	1,000.00
HP 4935A	Transmission Test Set	1,500.00
HP 4940A	Transmission Test Set	600.00
HP 5345A	Frequency Counter, DC to 500MHZ	1,000.00
HP 6111A OPT 0.5	Power Supply, 0-20V, 0-1A	225.00
HP 6112A	Power Supply, 0-40V, 0-5A	225.00
HP 7004B	X-Y Recorder	400.00
HP 7015B	X-Y Recorder	250.00
HP 7044B	X-Y Recorder	500.00
HP 7225B	Graphics Plotter	300.00
HP 8405A	Vector Voltmeter	600.00
HP 8443A	Generator (less cable)	300.00
HP 8558B	Spectrum Analyzer, 0-1500MHZ	2,000.00
HP 8620C	Sweep Oscillator Frame	500.00
HP 8620A	Sweep Oscillator Frame	400.00
HP 8650A	Storage Normalizer (less cable)	275.00
Krohn-Hite 3500	Filter	350.00
Krohn-Hite 7500	Wideband Amplifier	700.00
Keithley 225	Current Source	375.00
Keithley 247	P.S., 0-3KDVC, 6MA	500.00
Rockland 5100	Synthesizer, 2MHZ	600.00
Rod-L M25	Ground Tester	700.00
Shalltronic 817C	Decade Box, .01 to 100 Ohms	125.00
TEK C59	Camera	200.00
TEK S-4	Sampling Head	600.00
TEK 1L60	Spectrum Analyzer	300.00
TEK 465 w/DM44	Scope, 100 MHZ	650.00
TEK 465B OPT05	Scope with TV, 100 MHZ	850.00
TEK 520A	NTSC Vectroscope	1,000.00
TEK 576	Curve Tracer 220W	1,800.00
TEK 7A13	Differential Comparator LED	400.00
TEK 7A22	Differential Amplifier	500.00
TEK 7A24	Amplifier	500.00
TEK 7A29	Plug-In, 1GHZ	750.00
TEK 7B15	Time Base	500.00
TEK 7B53A OPT05	Plug-In	300.00
TEK 7CTIN	Curve Tracer, 0.5W	400.00
TEK 7D20	Programmable Digitizer	1,500.00
TEK 7L5/L3	Spectrum Analyzer	2,200.00
TEK 7L13	Spectrum Analyzer, 1KHZ to 1.8 GHZ	2,850.00
TEK 1480R	Waveform Monitor	1,000.00
TEK 2901	Time Mark Generator	350.00
TEK 7844	Dual Beam Scope, 400MHZ	750.00
Velonex 510	Transient Generator	1,000.00
Yokogawa 2524	Power Factor Meter	500.00

Test Equipment WANTED! Will Pay Within 24 Hours!

P.O. Box 52153
Philadelphia, PA 19115
(215) 426-0177
Fax (215) 464-5856

CIRCLE 173 ON FREE INFORMATION CARD

Z-MANN CABLE SUPPLY

"DEAL OF THE YEAR!"

WARRANTIED & GUARANTEED IN STOCK ITEMS

	1	5	10	20	100
REMOTES - NEW BATTERIES INCLUDED					
Jerrold 550: Scientific Atlanta (Blk) with and without volume, Zenith type or refurbished Slimline with new battery. All of the above	$11	$10	$9	Call	Call

CLEARANCE- CLOSE OUT-ITEMS

THERE MAY BE NO RESTOCKING ON THESE ITEMS.

ONCE THEY'RE GONE, THEY'RE GONE!

CONVERTERS W/BUILT-IN DESCRAMBLER IN CONVERSION MODE	1	5	10	20	100
Scientific Atlanta 8500/321 w/Remote Jerrold and SA compatible	$110.	$105.	$100.	N/A	N/A
Scientific Atlanta 8530/320 w/Remote Jerrold and SA & SA dropfield compatible	$125.	$118.	$114.	N/A	N/A
CONVERTERS/DESCRAMBLERS RAW					
Jerrold jSX-3-DIC 36 Ch. 80% plus test good	$14.	$12.	$9.	Call	Call
STRAIGHT CONVERTERS ONLY					
CONVERTERS W/BUILT IN DESCRAMBLER IN CONVERSION MODE					
Scientific Atlanta 8530/330 Basic SA & SA dropfield (Advanced SA) 6 db type **Jerrold & Hamlin** type compatible	$135.	$125.	Call	N/A	N/A
Panasonic Ch 3 w/Volume & new Remote, Feature packed	$55.	N/A	N/A	N/A	N/A
DECODERS ONLY					
Jerrold SB3-DIC General Instrument original equipment Ch 3 w/xfmr/. Raw tested and guaranteed	$19.	$16.	$14.	$12.	$9.50
Positive Traps Ch 2,3,4,16,23	$10.	$9.	N/A	N/A	N/A
REMOTES ONLY - All remotes come with new batteries.					
Panasonic original	$9.	$8.	Call	Call	N/A
Oak & Hamlin	$9.	$7.	$6.	Call	N/A
Pioneer original type with Universal Programmable TV function (for 5__& 6__series) New	$12.	$10.	Call	Call	N/A
CONVERSION KITS & CHIPS					
Zenith ZLI, 8500 310,320, 410, 420 Starcom 6 (not BB)	$12.	$10.	$9.	$8.	Call
Tocom 5503 VIP, 5507, 5507VIP (no 2R series)	$10.	$9.	$8.	$6.	Call
Scientific Atlanta 8570,6580, 8590 & 8600 (40 pin micro controller)	$45.	$39.	Call	Call	N/A
MISCELLANEOUS					
Zenith LED displays	$3.	$2.	$1.	Call	N/A
Zenith Remote Sensor Module	$5.	$4.	$3.	$2.	$1.
Zenith Slimline Remote, front bezel inlay	$1.	Call	Call	Call	Call
Zenith Cosmetic Repair Parts Call for specifics	Call	Call	Call	Call	Call
Zenith decoder board 165 type tested and guaranteed	$19.	$15.	$12.	Call	Call
Torq bits, T7 (Tocom), T10 (Hamlin), T15 (Zenith),T20 Scientific Atlanta & Pioneer) and T25. All above are security type	$6.	$4	N/A	N/A	N/A
CB Radios, broken linears, SSB, CBs, base mobile's, antennas, microphones, parts, radios and more misc.	Call	Call	Call	Call	Call

Payment Methods: Credit Card, Pre-payment or COD

Sales & Technical Assistance:

(407) 788-6277

12-5 P.M.• M-F • EST • No Holidays

FAX: 24 HRS. (407) 788-9087

NO FLORIDA SALES OR ORDERS

If you plan to steal cable, do us both a favor, don't waste your dime and my time!!! Because Z-Mann Cable Supply does not assist any company or any individual in this illegal activity!

CIRCLE 171 ON FREE INFORMATION CARD

LATEST TECHNOLOGY

• DESCRAMBLERS
• CONVERTERS
• COMBINATION UNITS

WE'LL BEAT ANY PRICE!

LATEST DESCRAMBLER MODELS

Add On Descrambler for all JERROLD Systems (Except Base Band) Guaranteed to Work Anywhere Coast to Coast (Model JD-3) — ~~$125~~ **$89** 6-10, **$119** 1-5

Add On Descrambler For All PIONEER Systems. Guarantered to Work Anywhere Coast to Coast. (Model PD-3) — ~~$125~~ **$89** 6-10, **$119** 1-5

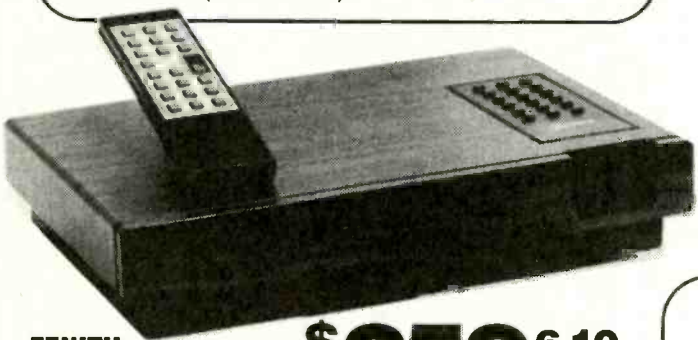
Add On Descrambler For All SCIENTIFIC ATLANTA Systems (Except 8570, 8590, 8600). Guaranteed to Work Anywhere Coast to Coast. (Model SAD-3) — **$89** 6-10, **$119** 1-5

BRAND NEW
1 YEAR
WARRANTY

SCIENTIFIC ATLANTA 8580

Features
- Wireless Remote Control
- Favorite Channel Recall
- Parental Lockout

$259 6-10
$289 1-5



BRAND NEW
1 YEAR
WARRANTY

ZENITH

Features
- Wireless Remote Control
- 550mHz (99 Channel) capacity
- Volume Control
- Parental Lock-Out
- Programmable Favorite Channel Memory

$259 6-10
$289 1-5

ADD ON DESCRAMBLERS

	1-5	6-10
FTB-3	49.00	39.00
TVT OR TBI	55.00	47.00
SA-3	59.00	49.00
KN12-3	59.00	49.00
MLD1200-3	49.00	39.00

CONVERTERS

	1-5	6-10
PANASONIC 1453G	79.00	69.00
JERROLD DQN7-3	75.00	65.00
STARGATE 2001	75.00	65.00

Call for other models

DPV7 & DBB7
8590 & 8600
Call for availability & prices

JP VIDEO
1470 OLD COUNTRY ROAD,
SUITE 315 - P.E.
PLAINVIEW, NY 11803
NO NY SALES

FREE COLOR CATALOG!

1-800-950-9145

Recognized as the two best PC-diagnostic tools on the market.

NOW AVAILABLE IN ONE GREAT PACKAGE...

ALL NEW VER. 5.0!

Micro-Scope™
UNIVERSAL DIAGNOSTICS SOFTWARE Ver. 5.0

Fully operating system independent diagnostic software.

PC UPGRADE UTILITY OF THE MONTH — Recently named as PC Upgrade Magazine's Utility of the Month.

MICRO-SCOPE Universal Computer Diagnostics was developed to satisfy the expanding need for accurate system diagnosis in the rapidly growing desktop computer market.

- CACH MEMORY—"Micro Scope" Ver. 5.0 now fully tests cache memory and the cache controller subsystem.
- LOW LEVEL FORMAT Ability to do factory style initialization of all IDE drives, together with the ability to do factory style low level formatting on all drives, including MFM, RLL, ESDI, SCSI and all IDE drives.
- O/S INDEPENDENT—Does not rely on O/S for diagnostics. Talks to PC on a hardware level regardless of the O/S or CMOS setting.
- TRUE HARDWARE DIAGNOSTICS—Accurate testing of CPU, IRQs, DMA, memory, hard drive, floppy drive, video cards, etc.
- DISPLAY DRIVE TYPE—Reads and displays the actual drive parameters for any drive type automatically.
- CPU DETERMINATION—This capability is necessary for accurate system diagnosis on 386SX, 486DX and 387 and 487 chip implementations. Because each of these specific chips has its own unique instruction set, and therefore cannot be accurately diagnosed with any program which cannot recognize these differences!
- MEMORY TEST—"Micro-Scope" 5.0 has no limitations as to the size of memory it can accurately test. Micro-Scope now also tests VIDEO MEMORY (up to 2 MB)!!
- MEMORY EXAMINE—Displays any physical bit of memory. Very useful for determining memory conflicts. Very useful for determining available memory space.
- BATCH CONTROL—All tests, even destructive, may be selected for testing.
- ERROR LOGGING—Automatically inputs errors during testing to an error log.
- AUTOMAPPING—Automatically bad sector maps errors found on hard disks.
- IRQ DISPLAY—Shows bits enabled in IRQ chip for finding cards that are software driven. (Network, Tape Backup, etc.)
- IRQ CHECK—Talks directly to hardware and shows I/O address and IRQ of devices that respond.
- SECTOR EDITOR—Allows the editing of any sector of floppy or hard disk media (even track 0).
- AND MUCH MORE...We don't have enough space here for everything this software can do!

POST-PROBE™
1ST EVER UNIVERSAL POST CARD FOR ALL PCs!

The only Power-On Self-Test card you need to debug any "dead" PC!

SERVICE NEWS PRODUCT OF THE MONTH — Named as Product of the Month in the July issue of Service News.

"This is the only card that will function in every system on the market. The documentation is extensive, and not only covers the expected POST Codes for different BIOS versions, but also includes a detailed reference to the bus signals monitored by the card." —Scott Mueller from his globally recognized book, *'Upgrading & Repairing PCs, Second Edition'*

- Includes pads for voltmeter to attach for actual voltage testing under load.
- 4 LEDs monitor +5vdc -5vdc +12vdc -12vdc.
- Monitors Hi & Lo clock and OSC cycles to distinguish between clock chip or crystal failure.
- Monitors I/O Write and I/O Read to distinguish between write and read errors.
- Monitors memory write/read to distinguish between address line failures and memory chip failures.
- Monitors ALE for proper CPU/DMA operation.
- Monitors Reset to determine if reset is occurring during POST, indicating short.
- Monitors progress of POST *without* POST codes.
- Reads POST codes from any IBM or compatible that emits POST codes. ISA/EISA/MCA.
- Compatible with Micro Channel computers.
- Dip switch allows easy selection of I/O ports to read.
- Includes tri-state LOGIC PROBE to determine actual chip failures.
- Manual includes chip layouts and detailed POST procedures for all major BIOS's.

This is the perfect package for all repair technicians and self-maintainers.

Call MICRO 2000, Inc. for volume discounts and after sales service!
•1-800-864-8008•

1100 E. Broadway, Suite 301
Glendale, California 91205
818-547-0125 • Fax 818-547-0397

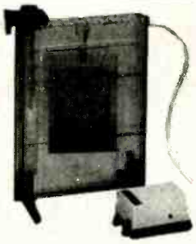
MICRO 2000

CIRCLE 304 ON FREE INFORMATION CARD

Circuit Specialists, Inc.

We've been providing electronic equipment and supplies since 1971!

Etching Tank



This attractive injection moulded designed tank is ideal for etching your PCBs. It includes a thermostatically controlled glass heater, electric agitator and PCB hanging accessories. Measuring graduations are included. Maximum PCB size is 160mm x 250mm or 200mm x 250mm w/o heater. Typical etching time is 4 minutes.

CAT NO	DESCRIPTION	PRICE
ET10EN	Etch Tank System	$48.00

Etching Chemicals

Ferric Chloride

A dry concentrate that mixes with water to make 1 pint of etchant, enough to etch 400 sq. inches of 1oz board.

CAT NO	DESCRIPTION	PRICE EACH 1	5
ER-3EN	Makes 1 pint	$3.50	$2.75

Developer

This product is used as the developer on our positive photo-resist printed circuit boards. Includes instructions. 50 gram package, mixes with water, makes 1 quart.

CAT NO	DESCRIPTION	PRICE EACH 1	10	25
POSDEVEN	Positive Developer	$ .95	$ .80	$ .50

Positive Photo Resist Pre-Sensitized Printed Circuit Boards

These pre-sensitized printed circuit boards are ideal for small production runs. They provide high resolution and excellent line width control. High sensitive positive resist coated on 1oz. copper foil allows you to go direct from your computer plot or art work layout. No need to reverse art.

Single-Sided, 1oz. Copper Foil on Paper Phenolic Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
PP101EN	100mm x 150mm/3.91" x 5.91"	$2.55	$1.90	$1.70
PP114EN	114mm x 185mm/4.49" x 7.28"	2.98	2.45	1.98
PP152EN	150mm x 250mm/5.91" x 9.84"	5.40	3.98	3.60
PP153EN	150mm x 300mm/5.91" x 11.81"	6.15	4.48	4.10

Single-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GS101EN	100mm x 150mm/3.91" x 5.91"	$ 3.90	$2.98	$2.60
GS114EN	114mm x 185mm/4.49" x 7.28"	4.80	3.49	3.20
GS152EN	150mm x 250mm/5.91" x 9.84"	8.69	5.98	5.78
GS153EN	150mm x 300mm/5.91" x 11.81"	10.20	7.20	6.80

Double-Sided, 1oz. Copper Foil on Fiberglass Substrate

CAT NO	DESCRIPTION	PRICE EACH 1	10	50
GD101EN	100mm x 150mm/3.91" x 5.91"	$ 5.07	$3.68	$3.38
GD114EN	114mm x 185mm/4.49" x 7.28"	5.95	4.29	3.99
GD152EN	150mm x 250mm/5.91" x 9.84"	10.47	7.39	6.98
GD153EN	150mm x 300mm/5.91" x 11.81"	11.95	8.69	8.30

486 CPU Cooler

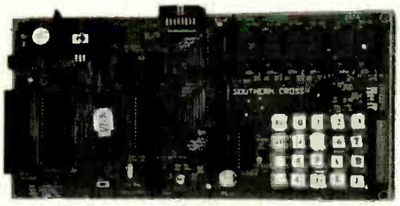
Increase Performance! Prolong Life!

COOL IT! With our easy to install miniature CPU Cooler Fan. This kit includes an omni-directional heat sink, long-life, low noise, DC fan with ready to go power hook-up. The best low-cost, high add-on value investment you can make! PERFORMANCE Typical 80486-33MHz CPU surface temperature reduces from approximately 79°C to approximately 48°C. Typical 80486-50MHz CPU surface temperature reduces from approximately 95°C to approximately 54°C.

CSI PART#	PRICE 1	5
CC-M3EN	$15.95	$14.95

Want More Info on the Southern Cross?

Use our FaxBack Automated Document Retrieval System. Dial 1-800-662-5426 (602-834-1005 in AZ) and select document #5025 on your push-button phone. You'll receive an article reprint from Australia's "Silicon Chip" magazine, reviewing the Southern Cross SBC. This is a free service available 24-hours a day. Don't forget to have your FAX# handy.



THE SOUTHERN CROSS

A Single Board Z-80-Based Computer

Here is a single board computer designed especially for the 1990's generation of students. With a series of add-on boards, smart sockets, fully commented monitor & an intelligent EPROM emulator, it can teach many aspects of micro-processor & micro-controller techniques of programming.

The Southern Cross SBC is designed to teach beginners modern code development techniques as well as assembly language. Start with machine language using the on-board 21 hex digit keypad, then progress to using a PC Assembler provided with many program examples. Serial download assembled program from PC to Southern Cross. Serial interface provided.

Simple, but powerful monitor program fully annotated. Learn to use parts of it in your own programs by 'system calls' & using a 'header file'.

Learn how to single step through your program to find errors. Both hardware & software single stepping provided & explained.

We do not fill the User Manual with pages of theory. Go straight to program examples. Starts from a very basic level anyone can follow.

The Southern Cross system includes:

- All CMOS IC's
- Hardware speed control
- 8K EPROM
- 64K RAM
- 4.00MHz Z80
- 10 year RAM backup with optional DS1213B
- Calendar/time access & RAM backup with optional DS1216B
- 9-15V AC/DC Single-sided PCB 9.75" x 5.15"

Two add-on boards available. Relay Board to connect to real world of lights & motors and 8 x 8 LED module Board to write moving displays.

SC1EN Southern Cross Kit	**$145.00**
SC2EN Assembled	**$185.00**
SC4EN 8 x 8 Board	**$49.00**
SC3EN Relay Board-1 relay	**$27.00**
SC13EN Kit to complete relay board-7 relays plus components	**$19.95**
DS1213BEN SmartSocket	**$18.00**
DS1216BEN SmartWatch	**$36.00**

Intelligent Eprom Emulator

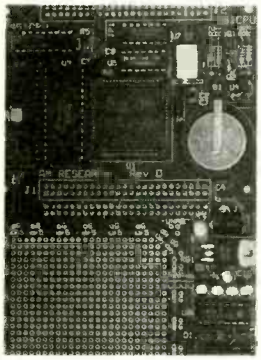
Full explanation of how to construct & use it. Uses 5 IC's & 8748 uC. Emulates 8K, 16K & 32K EPROM. Recognizes binary & Intel hex files in software. Connects to printer port 1 or 2 on a PC. Reset sent in software before file transfer. /F switch fills unused emulated ROM with any hex byte. Powered from target system. Cables included. Small 4.5" x 2.3" double-sided, PCB with overlay. Many examples provided on floppy disk.

SC5EN Kit	**$79.00**
SC6EN Assembled	**$94.00**

CIRCLE 294 ON FREE INFORMATION CARD

Superior 6811's & 8051's

AM Research supports more than 30 of the most popular embedded controllers available with both ***hardware*** and ***software.*** **SBC's from $84** with battery backed CMOS RAM, RS232, +5V regulator and a large prototyping area. Developers/training systems add a 2-line by 40 character LCD, 16 button industrial keypad, audio output, RS485, 8,10,12-bit 8-channel A/D and up to 152 I/O's



Move your application effortlessly between microcontrollers We provide FORTH for both your PC host and the Target controller, a full-screen, multiple file editor, compiler, single-step debugger, assembler, extensive libraries, disassembler, decompiler among other tools and a 300 page manual. Our integrated systems are ready to run right out of the box and provide you with ***the only complete development environment you can buy***. June will see the world's most powerful 16-bit embedded micro available. Running at a true 20MIPS, it leaves every other 16-bit controller in the dust !!!.

Call or write for a free full line brochure.

Orders (800) 949-8051
Info (916) 652-7472
fax (916) 652-6642
bbs (916) 652-7117
email sofia@netcom.com
4600 Hidden Oaks Lane
Loomis, CA 95650

AM Research
The Embedded Controller Experts

TONY TALLI'S ORIGINAL

TELEVIEW DISTRIBUTORS

WHERE OUR VALUED CUSTOMERS'
BUSINESS
IS HONESTLY APPRECIATED

ØUR PRICES

1 800 847 3773

Call Us Today

90 DAY + GUARANTEE
SCIENTIFIC ATLANTA
JERROLD PIONEER
OAK HAMLIN

HRS. M - F 9-4 PST   NO NV. SALES

SPI

SEMICONDUCTOR
STOCKING DISTRIBUTOR OF ELECTRONIC COMPONENTS

Phone (818) 884-8000
Fax (818) 704-0100
HOURS 8:00 TO 5:00

STATIC & STATIC COLUMN RAMS
DYNAMIC & VIDEO RAMS
INTEL CPU'S
MOTOROLA CPU'S
EPEROMS
EEROMS
PROMS
PALS
GALS
DALLAS BATTERIES
IBM PROPRIETARY CHIPS
UARTS
LINEAR
VOLTAGE REGULATORS
CMOS 4000 SEREIES
74 SERIES TTL
SURFACE MOUNT TTL
AMP CONNECTORS
AMERICAN & JAPANESE TRANSISTORS
VLSI
WESTERN DIGITAL
CHIPS & TECHNOLOGY

All items in this AD are a partial listing of our inventory; Please call w/Part#
All items are ready far immediate shipment
All items subject to prior sale
Prefix, Suffix & Part speeds are usually important. Please include This With Requirements.
ALL PRICES SUBJECT TO CHANGE

EPEROMS
2716
2732
2764
27C64
27128
27C128
27256
27C56
27512
27C512
27C010
27C020
68756
68766

PROMS
745 SERIES
825

PALS & GALS
16L8
16R8

UARTS
2681
8250
1640
1650

STATIC RAM
20216
2018
6116
6264
62256

DYNAMIC
4116
4148
4164
41464
41256
412642
412100
51100

CONTROLLER CHIPS
6845
6275
D765
8272

WESTERN DIGITAL
WD1010
WD1014
WD1015
WD1100
WD1200
WD2293
WD2010
WD37C65
WD90C

8000 SERIES
8031
80L31
8051
8052
8085
8086
8088
8155
8205
8224
8228
8237
8243
8253
8254
8255
8259
8272
8274
8275
8284
8288
8741
8742
8748
8749
8751
82284
82288
80286
80386
80486

74 SERIES
7400
74LS
74F
74S
74ALS
74C
74HCT
74HC00

IBM
17F
72X
73X
15F
30F

280 SERIES

JAPANESE TRANSISTORS
25A
25B
25C
25D
25K

CHIPS & TECH
82C200
82C300 SERIES

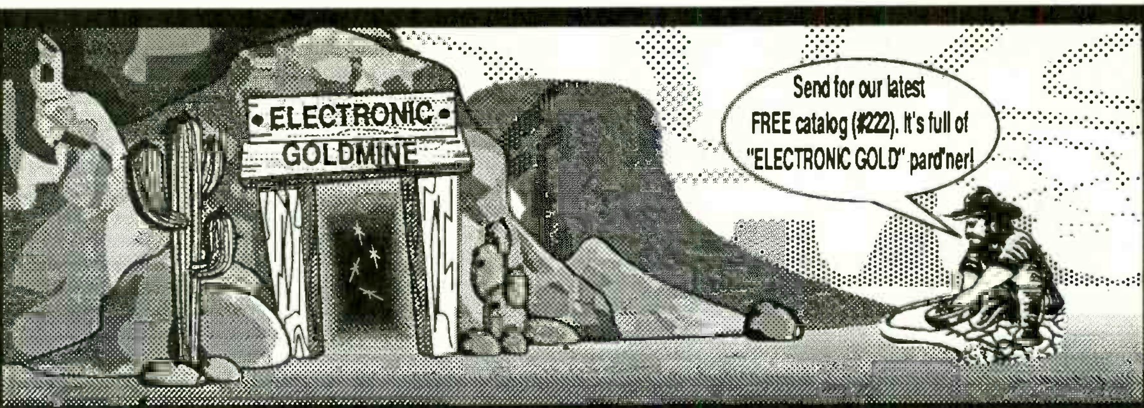
VLSI
82C100
82C300

WE HAVE PROCESSORS

CIRCLE 283 ON FREE INFORMATION CARD

CIRCLE 168 ON FREE INFORMATION CARD

CIRCLE 243 ON FREE INFORMATION CARD



ELECTRONIC GOLDMINE
P.O. Box 5408
Scottsdale, AZ 85261

For phone orders call (602) 451-7454 or Fax your orders to (602) 451-9495
Minimum Order: $10.00 plus $4.00 Shipping and Handling. We accept MasterCard, Visa and Money orders. Canadians and orders that need US MAIL send minimum $5.00 S&H.
Call or send for our FREE CATALOG!

WITH ALMOST 3,000 ITEMS!

SUPER POWER MINIATURE IR TRANSMITTER UNIT

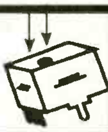
Make all kinds of I R remote activated projects with this transmitter and an I R receiver module. These were originally designed to activate a burglar alarm system (which we don't have) by remote control. The transmitter features a red activation button, a dip switch inside to change output code, operation from 9V battery (not included), red LED transmit indicator to show when IR energy is being transmitted and a compact 4 1/4" x 1 3/16" x 3/4" black stylish case. Brand new in blister pack with 2 peel and stick "premise protected" stickers. We also supply an info sheet that shows how to convert this transmitter unit into a programmable IR receiver so a pair of these transmitter units could cover both transmit and receive functions. We have no knowledge of whether or not the info sheet is accurate, but we do know that this transmitter activates our G5076 IR receiver module (shown below) from over 50 ft. away.

G5535 $1.69

2 for $3.00 • 12 for $15.00 • 120 for $140.00

SHARP GP1U5 INFRARED MODULE

Super sensitive infrared module by sharp is only 1/4" x 1/4" x 1/2". Turns on any LED or low voltage relay from over 50 ft. away when you press buttons on the above transmitter. Has only 3 hookup pins and operates from 5 to 9VDC. Module and simple hookup diagram.



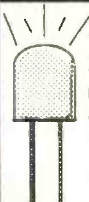
G5076 $1.49 EA. • 10/$14.00

10" THRUSTER WOOFER

You will be amazed at the great sound of this high quality 10" woofer that is perfect for upgrading your old system or new construction. We were told these were made by JBL (their model #210H). They feature 8 ohm impedance, poly foam surround and a frequency response from 25HZ to 2KHZ. Weight: 2.5 lbs. Brand new and at an incredible blowout price!!!

G3311 $15.95 EA.
PAIR FOR $30.00 (INCLUDE $5.00 S&H)

MAMMOTH LEDS



These super large, ultra high brightness leds are 10 mm in size and designed for daylight viewing. Made by Toshiba with water clear cases, long leads, and high quality brilliant output. These are so bright you can make a miniature solid state flashlight. Hurry, the last time we had these they sold out fast.

COLOR	STOCK #	TOSHIBA #	PRICE
YELLOW	G5560	TLYA190P	$2.00
GREEN	G5561	TLGC190P	$1.80

JUMBO TOSHIBA TLRC180AP ULTRABRIGHT RED LED

Jumbo T 13/4 (5mm) clear case LED produces a brilliant red output (up to 800 mcd). These are top quality, factory fresh, prime units with long leads

G5566 3/$1.00

SCANNER ANTENNA

G5681 $8.95

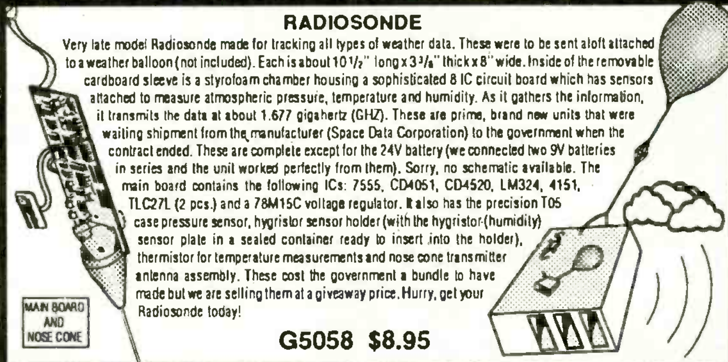
Standard "rubber duck" style scanner antenna with BNC connector. Covers range of 25Mhz - 1,000Mhz. Size: 4". Color: black.

20W+20W STEREO AMP KIT

Two separate high power amps on one PC board. Each amp has its own level control and puts out s incredible 20 watts RMS. Features red LED "on" indicator and low distortion circuitry. Great stereo booster amp for your car sound system Use with any speakers capable of handling at least 20 watts. Operates on 12 VDC. Size of board: 6" x 2.22". Complete with all parts. PC board and instructions.

C6442 $24.95

RADIOSONDE



Very late model Radiosonde made for tracking all types of weather data. These were to be sent aloft attached to a weather balloon (not included). Each is about 10 1/2" long x 3 3/8" thick x 8" wide. Inside of the removable cardboard sleeve is a styrofoam chamber housing a sophisticated 8 IC circuit board which has sensors attached to measure atmospheric pressure, temperature and humidity. As it gathers the information, it transmits the data at about 1.677 gigahertz (GHZ). These are prime, brand new units that were waiting shipment from the manufacturer (Space Data Corporation) to the government when the contract ended. These are complete except for the 24V battery (we connected two 9V batteries in series and the unit worked perfectly from them). Sorry, no schematic available. The main board contains the following ICs: 7555, CD4051, CD4520, LM324, 4151, TLC27L (2 pcs.) and a 78M15C voltage regulator. It also has the precision T05 case pressure sensor, hygristor sensor holder (with the hygristor (humidity) sensor plate in a sealed container ready to insert into the holder), thermistor for temperature measurements and nose cone transmitter antenna assembly. These cost the government a bundle to have made but we are selling them at a giveaway price. Hurry, get your Radiosonde today!

MAIN BOARD AND NOSE CONE

G5058 $8.95

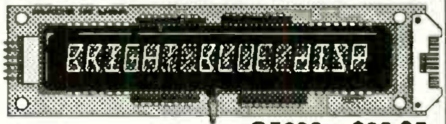
PERSONAL PERFORMANCE MONITOR/HEART PULSE SENSOR

G5551 $3.95

We were told that these were the computers to be supplied on a ski type fitnessmachine (Nordic). We really don't know for sure, but what we do know is that if you connect four AA batteries (not included) and attach our IR LED/IR Sensor to the jack marked "pulse" the unit will display your pulse in large numerals on the large LCD display. Has all kinds of other data features such as age, sex, weight, resist, but we don't have the info on how to use these or what other function the device can do. We do know that it has another jack marked "speed". The LCD lights up with MPH, calories, elapsed time, but who knows how to use these? We are selling these as an experimentor item only. They look very interesting, but the only info we have is how to construct the pulse sensor using our sensor and a stereo cable (these parts are not included) and info on which button to push to cause the monitor to display your pulse. Size of monitor: about 4" x 5" x 2 5/8". Size of LCD display 1 3/4" x 2 3/8"

OPTIONAL IR LED/SENSOR (AS DESCRIBED ABOVE) **G5668 69¢**

IEE FLIP VACUUM FLUORESCENT MODULE



This vacuuum fluorescent intelligent display module features 16 large bright blue alpha-numeric characters driven by a complete microprocessor controlled circuit. Data input is 8 bit bidirectional TTL-ASSCII data bus or TTL level serial input with one of 4 jumper selectable baud rates. Only a 5VDC supply is required for operation and display can be viewed in almost any lighting condition. Greatly simplifies applications in alarm systems, energy management, test equipment, point of sale terminals, process control, remote data entry and hundreds of others. The display features self-test mode, simple serial or parallel hookup and long life reliable operation. The IEE part number is 3700-04-016. We have the complete data sheet/hookup on these. Brand new and currently these sell for about $137.00 each from distributors.

G5633 $29.95

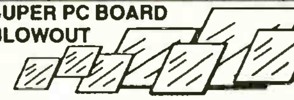
BLUE T1 3/4 JUMBO LED

Factory fresh T1 3/4 Blue LED features clear lens and long leads. We purchased these directly from the factory and are offering them to you at close to our cost to provide you with a new dimension for your projects. The blue LED is made from silicon carbide and can withstand up to 50mA current without damage. We have found that it looks best if operated close to a 4VDC limit. Very unique and colorful!

G5067 79¢

10 FOR $7.50 • 100 FOR $69.00

SUPER PC BOARD BLOWOUT



This is your chance to stock up on prime copper clad for making all types of custom PC boards. Various sizes: 2" x 7" up to 6" x 6" or larger. This is high quality glass epoxy double sided copper clad!

G3500 50/$7.95

(Add an additional $2.00 extra heavy shipping)

CIRCLE 241 ON FREE INFORMATION CARD

CIRCLE 291 ON FREE INFORMATION CARD

H&R COMPANY HERBACH AND RADEMAN

Products for Science and Industry

18 CANAL ST P.O. BOX 122 — BRISTOL, PA 19007-0122

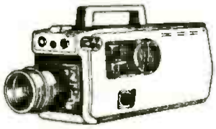
THIS MONTH

ORDERS ONLY 800-848-8001
OFFICE AND TECH 215-788-5583
FAX 215-788-9577

PORTABLE COLOR TV CAMERA

HITACHI MODEL GP-7 (NTSC)

High quality camera . . . ideal for studio, station, school, computer use with color frame grabber. Compatible with VCR's, color monitors, and with TV sets using an RF modulator. With color temperature adjustment, standard 1/4-20 tripod thread and carrying handle. **These cameras are removed from service, but fully checked before shipment. REQUIRES A STANDARD 1" C-MOUNT LENS WITH ADJUSTABLE IRIS.**



POWER REQUIRED:	12 VDC regulated. Total 8.6 Watts. Use a power supply or rechargeable battery.
PICKUP TUBES:	3 Electrodes Vidicon HS-251 or equal
SCAN LINES:	525 Lines, 2:1 Interlace
SYNCH SYSTEM:	Internal or External
VIDEO OUTPUT:	1 V P-P into 75 Ohms, BNC Connector
RESOLUTION:	More than 250 Lines at Center
MIN SCENE ILLUM:	75 to 100 Lux with F1.4 to F2 lens
SIZE:	13.3" long x 5.6 wide x 5.75" high

RE92CTV2208 ---------------------- *$99.50*

CAMERA POWER SUPPLY - Hitachi Model AP6OU (CEK) AC Power Adapter, 115 VAC, 60 Hz input; 12 VDC, 2 A output.
RE93CTV2209 ---------------------- *$29.50*

1" LENS - 25 mm f1.4 adjustable iris.
REG4-024 ---------------------------- *$99.50*

EXT POWER CONNECTOR - required when using your own power supply or battery
RE93CTV2511 ---------------------- *$11.95*

ECONOMY PRICED LASER POINTER 3 mW OUTPUT POWER

Pen sized class IIIA pointer. Features output power 3mw. Beam diameter at 20 Ft. 10mm. Visible to 150 Ft. Operating time - up to 8 hours of continuous use. Convenient momentary pen clip switch for operation. Dim 1/2" dia x 5-11/16" long. 90 day mfgrs limited warranty, Shpg Wt. 1 lb. Batteries included.
REQ6132 ------------------------------ *$49.95*

Diamond Tipped Scriber/ Engraver Pen

RE93TOL2490 ------------------------ *$2.95*

WRITE, CALL or FAX for our *FREE* 'This Month' Catalog

Over 100 pages - hundreds of products
Something for everyone - 'priced right'

Electro-Mechanical • Electronics • Optics

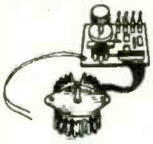
Batteries, CCTV, Lasers, Magnets, Motors, Kits

Power Supplies, Pumps, Relays, Robotics, Switches, Tools

many educational kits

STEPPER MOTOR CONTROLLER KIT

For 6 thru 30 VDC OPERATION



Kit contains all necessary components to construct this versatile device. Will operate 4 phase motors with current ratings up to 1.25 AMPS per phase continuous. Controls for direction, single step, hold, half-step, full-step and wave drive step sequences. Speed control from 1 to 1500 PPS. LED's indicate phase sequence. Operate from a battery or power supply. Includes a 12V 7.5° motor for demonstration purposes.
RE93KIT2421 ------------------ *$24.50 KIT*
Kits cannot be returned or exchanged once they have been soldered
RE93KIT2421/A -- Assembled --- *$39.50*

STEPPER MOTORS

1.8 DEG, 4 PHASE
1/4 Dia X 3/4 Long Shaft

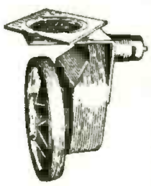
6V, 1.2A/ phase, 80 Oz-In hold torque, 2-1/4 Sq x 2-3/16"
RE93MTR2500 ----- USED ------- *$12.95*
12V, 0.6A/ phase, 83 Oz-In hold torque, 2-1/4 Dia x 2-1/8"
RE93MTR2336 ------ NEW ------- *$19.50*
12V, 0.68A/ phase, 125 Oz-In hold torque, 2-1/4 Dia x 3"
RE93MTR2337 ------ NEW ------- *$24.50*
24V, 0.2A/ phase, 50 Oz-In hold torque, 2-1/4 Dia x 1-5/8"
RE92MTR1992 ------ NEW ------- *$24.50*

STEPPING MOTOR DRIVER CHIP

Complete control and drive for a 4 phase unipolar stepping motor (6 or 8 lead motors). Can drive up to 35 V and 1.25 Amps per phase, continuous. Provides 3 different step sequences - wave drive, full step and half step. Built-in clamp diodes and thermal protection. Requires +5V Reg for chip. 16-pin in line DIP. **New, supplied with data.**
REQ5029 ----------------------------- *$12.95*
NOTE: Chips cannot be returned once used.

MOTORIZED WHEEL ASSEMBLY

Ideal for Carts, Wagons, and ROBOTS. Will carry up to 100 lbs depending upon usage. A high quality reversible motor, driving a heavy duty gearbox with low speed and high torque. Wheel is 7" Dia with wide grooved rubber tire on high impact plastic frame. Top steerable, ball bearing mounting plate is 4" square with 4 mounting holes.



Speed of unit, from 3VDC thru 12VDC, will run from 40 thru 160 RPM. 5 to 7 Amps full load down to 1 Amp no load. O/A size 9H x 7W x 6-3/4" Dp.
RE92ROB2188 -------------------- *$34.50*

Made in Russia

Night Vision Scope Lightweight Handheld Focal Range 1.5 Meters to infinity

OWL II (T3C2)...This light weight economically powered scope will work with moonlight or an IR light source operating in the 780 to 850 nm range. Unit is ideal for applications involving IR lasers. Equipped with removable neutral density filter. Viewable distance depends on available light--this unit was tested at 200 yards on a cloudy night with no moonlight or starlight. Will operate with 2 AA cells. Size: 10 long x 2.36 diameter x 7.1" high. Actual Weight, 1.9 lbs Excellent condition. Complete with storage/carrying bag and operating instructions. Shpg, 5 lbs.
RE92OPT2261 -------------------- *$395.00*

SPECIAL PURCHASE!
VHS FORMAT VIDEO TAPES

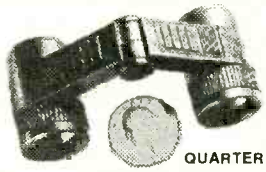
Brand New - Not Erased - Individually boxed and wrapped.

T-90 --------- $1.20 Ea. ------ *5 For $5.00*
T-120 ------- $1.75 Ea. ------ *5 For $8.00*

Miniature Folding Binoculars

2.5 x 17.5 Power - Actual Weight 2.5 Ounces

Russian Mfd....Precision ground and coated optics for excellent low light clarity, adjustable eyepieces, folds to 1-1/2" for storage in black plastic case with zipper and belt loop. New. Shpg. Wt. 8 oz.
RE94OPT2613 -- *$27.95*



QUARTER

Serving Science and Industry for Over Fifty Years
Minimum Order $20.00 in Merchandise
Add $5.00 for Shipping and Handling
PA Residents Add 6% Sales Tax

WE ACCEPT VISA MasterCard Discover

Sorry! - No COD's

BUSINESS HOURS MONDAY to FRIDAY 8 AM to 5 PM EST

CIRCLE 174 ON FREE INFORMATION CARD

Honey, I shrunk the Prices...

GATEWAY PRODUCTS CORP.
P. O. Box: 63-6397, Margate, FL 33063
Tel: (305) 974-6864, Fax: (305) 974-6818

TRANSISTORS
PN2222A ...... 5¢
PN2907A ...... 5¢
2N3904 .... 5¢
2N3906 .... 5¢
2N4401 .... 5¢
2N4403 .... 5¢
Deal 'N8': 60pcs (10 ea) $3

MORE TRANSISTORS
2N2222A ..... 21¢
2N3055 .... 62¢
TIP31C .... 40¢
MPSA13 ...... 12¢

POPULAR I.C.'s
LM324 .... 45¢
LM339 .... 45¢
LM358 .... 45¢
NE555 .... 40¢
NE556 .... 45¢
LM741 .... 35¢
Deal 'U3': 12pcs (2 ea) $5

POPULAR CMOS
CD4001B .... 25¢
CD4011B .... 25¢
CD4013B .... 30¢
CD4017B .... 35¢
CD4028B .... 35¢
CD4066B .... 30¢
CD4069B .... 30¢
Deal 'V2': 14pcs (2 ea) $4

VOLTAGE REGULATOR
7805 .... 47¢
7812 .... 47¢
7815 .... 47¢
7824 .... 47¢
Deal 'M4': 12pcs (3 ea) $5
78L05 .... 33¢
78L12 .... 33¢
Deal 'J1': 10pcs (5 ea) $3

DIODES
1N914A .... 2¢
1N4148 .... 2¢
1N4001 .... (1A/50V) ... 2¢
1N4004 ... (1A/400V) ... 3¢
1N4007 .... (1A/1kV) .... 4¢
Deal 'P7': 50pcs (10 ea) $1

MORE DIODES
1N5401 ... (3A/100V) ... 6¢
1N5404 ... (3A/400V) ... 7¢
1N5408 .... (3A/1kV) .... 8¢
6A10 ..... (6A/100V) .. 18¢
6A100 ..... (6A/1kV) .. 21¢
Deal 'H8': 25pcs (5 ea) $3

GERMANIUM DIODES
1N34A .... 10¢
1N270 .... 16¢
Deal 'G3': 10pcs (5 ea) $1

SCHOTTKY DIODE
1N5821 .... (3A/30V) .. 42¢

1 WATT ZENER DIODE
1N4728A ...... 3.3V .... 6.5¢
1N4733A ...... 5.1V .... 6.5¢
1N4739A ...... 9.1V .... 6.5¢
1N4742A .... 12V ..... 6.5¢
1N4744A .... 15V ..... 6.5¢
1N4746A .... 18V ..... 6.5¢
Deal 'Z5': 30pcs (5 ea) $2

1/4W 5% RESISTORS
1K, 4.7K, 10K, 47K, 100K, 470K
50 pcs of one value ..... 75¢
Deal 'W6': 120pcs (20ea) .. $2

T1 3/4 (5mm) Diffused LEDs
Red .... 6¢
Green .... 7¢
Yellow .... 8¢
Deal 'L3': 30pcs (10 ea) $2

I.C. SOCKETS

	Solder Tail	Wire Wrap
8 pin	4¢	30¢
14 pin	7¢	54¢
16 pin	9¢	62¢
20 pin	11¢	78¢
24 pin	14¢	94¢
28 pin	16¢	1.10
32 pin	19¢	1.24
40 pin	23¢	1.54

400V BRIDGES
DF04M ..... 35¢ (1 Amp - DIP)
W04M ...... 34¢ (1.5 Amp - round)
KBL04 ...... 85¢ (4 Amp - TL404)
Deal 'X8': 6pcs (2 ea) $3

SOLDER ROLL
SN63/37 - Multicore
21 Gage (.032" dia)
1 Lb roll - Great buy
$6.25 each

MONO CAPACITORS
.01uF/50V .... 5¢
.1uF/50V .... 5¢

TOGGLE SWITCHES
Miniature size
1/4" Panel hole
on-on .... SPDT .... 60¢
on-on .... DPDT .... 68¢
on-off-on ..... DPDT .... 86¢
Deal 'S7': 6pcs (2 ea) $4

Push-Button Mini size
N.O. .... Momentary .... 27¢
N.C. .... Momentary .... 28¢

RADIAL 'LYTIC CAPS
1uF/50V .... 5¢
2.2uF/50V .... 5¢
3.3uF/50V .... 5¢
4.7uF/50V .... 5¢
10uF/25V .... 5¢
22uF/25V .... 5¢
33uF/25V .... 6¢
47uF/25V .... 6¢
100uF/25V .... 8¢
220uF/25V .... 8¢
330uF/25V .... 9¢
470uF/25V .... 9¢
Deal 'A9': 60pcs (5 ea) $4

TANTALUM CAPS
1uF/35V .... 16¢
2.2uF/35V .... 19¢
10uF/35V .... 32¢
Deal 'T6': 15pcs (5 ea) $3

CERAMIC DISC CAPS
5¢ each
(Caps rated 50V)

10pF	220pF
22pF	330pF
27pF	470pF
33pF	1000pF
47pF	.01uF
100pF	.1uF

Deal 'R2': 60pcs (5 ea) $3

NOW AVAILABLE !!! Our 1994 catalog is hot off the press. Mail your request today.

VISA MasterCard
$10.00 minimum order. We accept VISA, MC, MO, Check, C.O.D. Cash. Please add $4.00 for shipping & handling. C.O.D. charge is $5. Foreign orders: $9.00 freight charges. Florida addresses add 6% sales tax. Hours: 9AM to 6PM - Mon-Sat. All premium, high-quality parts.

CIRCLE 298 ON FREE INFORMATION CARD

Voice Mail Cash Machine

Press 1 for sales, 2 for service, 3 for live operator

Make thousands of dollars effortlessly by installing a *BigmOuth* voice package in your 286/386. Use it to answer your home-office phone, rent pocket-pagers, advertise products or operate a pay-per-call service using major credit cards, passwords or a nationwide 900 #.

To get started, order our $25 PC **Opportunity Toolkit.** It contains all the information you need & its cost is applied to all future purchases.

A Few Home-Based Ventures Featured In Our $25 Toolkit!

- **BigmOuth** — voice mailbox/ pager rentals — $295. (Demo $25)
- **QuickLine** — write programs in QBasic — $1745. (Demo $25)
- **ClientCaller** — outbound prospector — $1450. (Demo $25)
- **KinderChek** — latchkey child monitor — $2000. (Demo $25)
- **Rise'n'Shine** — wake-up & reminder service — $1995. (Demo $25)
- **TollBridge** — sell long distance time — $1995. (Demo $25)

DemoSource[sm]
The Voice Application Superstore
8345 Reseda Bl, Ste 202
Northridge, CA 91324 USA
Trademarks belong to their publishers
Prices do not include shipping & tax

TRY our demoline! 818 718-9560

To order, call 24 hours:
800.283.4759

Professional Electronic Engineering Software

"Best bargain in the country"

Linear AC/DC Circuit Analysis
Active & Passive ckts. 50 nodes, 225 elements max. Models for active devices. Calc, Plot & Print AC voltages & currents. Calc DC current, voltage & power. More

Linear Transient Circuit Analysis
10 Input Transients. Active, passive ckts. 50 nodes, 225 elements max. Models for active devices. Calc, plot and print output Transient voltages. Calc dc current, voltage, pwr. more.

Active Filters Design & Analysis
Design & Analyze active LPF, BPF, HPF & All pass filters. Calc, plot Mag/ Phase. More.

Transient System Analysis
Calc, plot transient response of system H(s). 14 Input Transients. Inverse Laplace. More

Control Systems analysis
Calc and Plot Root Locus, Nyquist, Bode of any H(s). Determine gain and Phase Margins /stability. More

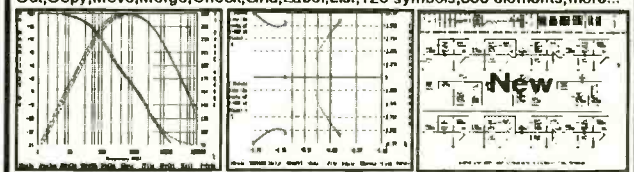
Mag & Phase Graphics
Calc, plot mag/ phase of H(s). more

Function Graphics
Calc, plot, edit any of 87 common math functions as desired. More.

Data Graphics
Plot up to 400 data points in 9 formats. Linear, log, semi, etc.more

Polynomial Operations
Calc Roots, Product & Coefficients.

New ! Circuit Schematic Draw: Both Stand-alone & Integrated
Cut, Copy, Move, Merge, Check, Grid, Label, List, 126 symbols, 300 elements, more...



PC AT, DOS, EGA/VGA

- *Extremely Easy to use*
- *Dot Matrix/Laser/Mouse Support*
- *Outstanding Graphics & Menus*
- *200 page User's Manual Included*

100% Satisfaction Guaranteed

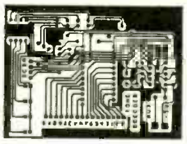
Introductory Offer: 9-program package (without Schematic Draw) $79.99
Complete 10-program package (with Schematic Draw) $129.99

Visa/MC accepted. Add $5.95 for shipping. CA add 7.25% Tax
To order or info call 1(800)645-6806 or send check or money order to:
Geoban Engineering, PO Box 658, Ridgecrest, CA 93556

ALL ELECTRONICS CORP.

QUALITY PARTS • DISCOUNT PRICES • FAST SHIPPING

Make PC Boards in Minutes...

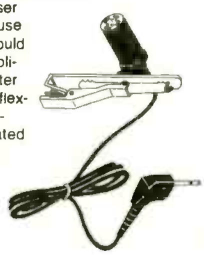


Prototypers, developers and hobbyists can now make PC boards direct from CAD, PCB layout systems or magazines using a photocopier, or laser printer. Techniks Inc's new "Press-n-Peel" copy paper allows you to photocopy PC artwork and iron it on to copper-clad board. It can then be chemically etched in the usual fashion. The process is so easy and fast you won't believe it.

Five 8 1/2" X 11" sheets and instructions.

$11.95 per pack — **CAT# TEK-5**

ELECTRET MIKE WITH VISOR CLIP

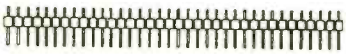


Miniature electret condenser microphone designed for use with cellular phones but could be used in other audio applications. Black 0.3" diameter X 0.43" mike and 12 foot flexible cord with 3.5 mm mini-plug. Includes chrome-plated alligator clip which can be used for attachment to auto visor or clothing.

$4.50 each — **CAT# MIKE-14**

36 PIN SNAPPABLE HEADER

SPECIAL! SPECIAL!



Arkles Corp. # 25MSS2A36GG030
Special purchase of 36 pin, single row 0.1" spacing headers. Snappable to smaller lengths. Sold only in bags of 100 pieces. Our regular price on a 40 pin header is $120.00 per 100 pieces.

CAT# SHS-36

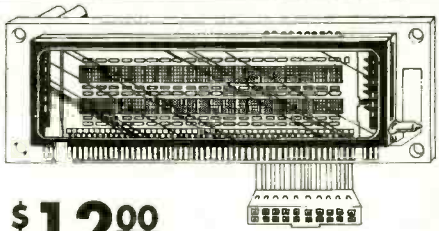
$40.00 for 100 piece bag

$350.00 for 1000 pieces

VACUUM FLUORESCENT DISPLAY

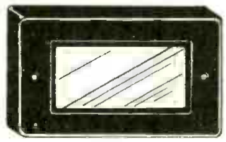
Futaba # M202SD08GL
Two rows of 20 characters displayed in a 5 X 7 dot matrix. Bright green 5 mm X 3.5mm characters. On board CPU, driver and DC-DC converter simplifies hook-up and interfacing. Operates on 5 Vdc. Displays 215 different characters including alphanumeric and other symbols. ASCII configuration. Module overall dimensions: 6.1" X 1.7" X 0.7" thick.

These displays were modified somewhat from original specifications and we do not know the exact nature of the modifications. They work fine in the test mode, but we don't know if the original interface is the same. We supply a data/ hook-up sheet for the pre-modified device which, hopefully, provides most of the information necessary to use the display.



$12.00 each — **CAT# VFM-2**

3 1/2 DIGIT LCD DIGITAL PANEL METER

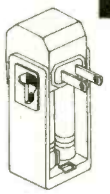


FEATURES:
- 200 MV full scale sensitivity
- Single 9 -12 Vdc operation
- Decimal point selectable
- 13 mm figure ht.
- Automatic polarity indication
- Guaranteed zero reading for 0 volt input high input impedance (>100 M ohm)

1 mA DC power dissipation. LCD size: 1.83" X 0.8". Overall size: 2.67" X 1.73" 0.28" above panel thickness.0.57" overall thickness. Add resistors and disconnect jumpers for voltage ranges to 500 Vdc. Instructions included.

CAT# PM-128 — **$18.00 each**

AA NICKEL CADMIUM BATTERY CHARGER

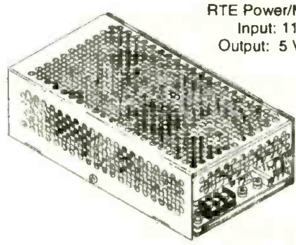


SANYO# NC-452
Battery charger for 2 or 4 AA nickel cadmium rechargeable batteries. Plugs into wall outlet and charges batteries in 8 to 10 hours. Can be folded for easy carrying and storage. 3.25" X 1.6" X 1.81" when folded. UL listed.

$2.50 each — **CAT# AAC-1**

5 Volts, 20 Amps POWER SUPPLY

RTE Power/Mate# EVS-5F
Input: 115/230 Vac.
Output: 5 Vdc, 20 amps.

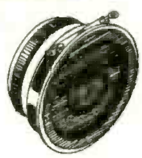


Brand new switching power supply enclosed in vented aluminum cabinet. Over-voltage, over-load, short-circuit protection. Fuse protected. Adjustable output voltage and current limiting. Inrush current limiting. Screw terminals for input and output. UL and CSA listed. 8.5" X 4.9" X 2.45."

$15.00 each — **CAT# PS-520**

1 3/4" SPEAKER

8 ohm, 1 watt speaker.
Very heavy magnet for its size.
Speaker o.d. 1.8"
Magnet o.d. 1.35"



CAT# SK-175

$1.25 each — **100 for $100.00**

MANUFACTURERS - We Purchase EXCESS INVENTORIES... *CALL, WRITE OR FAX YOUR LIST*

Call, Write or FAX FOR OUR FREE 64 PAGE CATALOG
OUTSIDE THE U.S. SEND $2.00 POSTAGE

ORDER TOLL FREE 1-800-826-5432

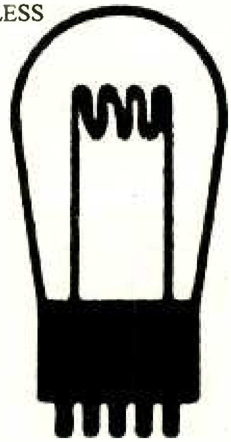
Minimum Order $10.00 • All Orders Can Be Charged To Visa, Mastercard Or Discovercard • Quantities Limited • California, Add Sales Tax • Shipping.And Handling $4.00 For the 48 Continental United States - All Others Including Alaska, Hawaii, P.R. And Canada Must Pay Full Shipping • No C.O.D. • Prices Subject to change without notice.

CIRCLE 214 ON FREE INFORMATION CARD

VACUUM TUBE DEALER PRICE LIST MAY '94

SOVTEK®

				USED BY:
5881/6L6WGC	$6.90 each	10 at $6.20 each	25 at $5.40 each	FENDER, MARSHALL, SOLDANO, VTL
5AR4/GZ34	6.90	5.90	4.90	MATCHLESS
5U4G	4.90	4.50	3.90	MESA BOOGIE DUAL RECTIFIER
5Y3GT	3.90	3.50	2.90	
6550WA	15.90	14.90	13.90	AUDIO RESEARCH, AMPEG, JADIS
6922	5.90	5.20	4.90	AUDIO RES., MELOS, CONVERGENT
6CA7	8.90	8.00	7.90	New TETRODE
6L6GC	3.25	2.60	2.20	
6V6GT	3.90	3.15	2.90	SLM
7199	10.90	9.90	8.90	
12AX7WA/7025	2.85	2.35	2.05	HARTKE,
12AX7WB/7025	3.90	3.40	3.10	BEDROCK, CARVIN, DEMETER
12AX7WXT	5.90	4.90	4.30	New SUPER **High Gain** 12AX7
EL34G	7.50	6.80	6.30	SENSATIONAL EARLY 60'S SOUND
EL84/6BQ5	3.25	2.75	2.30	PEAVEY, HUGHES & KETTNER, CRATE
EL84M/6BQ5WA	6.50	5.90	4.90	MATCHLESS



SINO, CHINA

300B	$69.00 each	10 at $64.00 each	25 at $58.00 each
807	6.90	5.90	4.90
845	21.50	18.90	16.90
2A3	12.90	11.90	10.90
6L6GC "Coke"	5.40	4.90	4.40
12AT7	3.70	3.40	3.25
12AX7a	3.45	2.65	2.30
12AU7	3.90	3.50	2.90
6550	9.90	8.90	8.40
KT88	11.90	10.90	9.50

TESLA,CZECHOSLOVAKIA

EL34	$8.90 each	10 at 8.20	25 at 7.60
E34L	9.90	9.20	8.60

SOLID STATE RECTIFIER

Built into tube socket. Direct plug-in replacement for all 5Y3, 5U4 and 5AR4 types. $5.90 each, 10 at $5.50 each

ODD BALL TUBES

2K25	22.00 each	6AQ8	5.85 each	6CG7	7.90 each	6SK7	2.90 each	12BY7	7.90 each
5749	2.40	6AS7	4.95	6CW5/EL86	2.40	6SL7	2.90	12DW7	10.90
(6BA6W industrial)		6AU6	1.95	6CX8	5.15	6SN7	2.90	12FQ8	9.00
5879	8.90	6AX5	4.90	6DR7	5.15	6SQ7	3.70	35W4	4.90
5C22	46.50	6BA6	2.25	6EA8	5.50	6U8/6KD8	4.50	7119	6.90
5R4	3.90	6BE6	3.60	6EU7	13.25	6U10	5.80	7308	8.50
5V4GT	1.75	6BH6	3.90	6FH8	15.50	6X4	4.45	50C5	4.90
6080 w Philips.	4.90	6BK11ampeg	9.90	6GW8	6.90	6X5	3.90	811A	11.90
6189W	4.15	6BM8	5.20	6J7	5.70	6X8	3.90	813	25.00
(12au7w industrial)		6BL8	1.90	6J5	5.00	7868..GE	18.50	ECC82	5.90
6267/EF86	4.20	6C33C-B...	29.50	6K6	4.75	12AU6	4.90	(RFT)	
6550GE	23.50	(Triode + ceramic socket)		6K11	6.50	12AV7	2.90	0A2	3.90
6AL5	2.40	6C4	4.60	6SC7	7.50	12AY7	7.95	0A3	2.90
6AN8	5.70	6C10	9.90	6SG7	3.50	12AZ7	4.90	0C3	3.90
6AQ5A	4.85	6CA4	4.90	6SJ7	2.90	12BH7a	9.90		

STANDARD MATCHING AVAILABLE ON MOST OCTAL POWER TUBES 75¢ extra per tube. Free on 26 tubes or more.

PLATINUM MATCHING ALSO AVAILABLE WITH 24 HOUR TEST AND BURN-IN, ENSURING PREMIUM MATCH. $2.00 extra per tube.

PAIRS, QUADS SEXTETS

MINIMUM ORDER $50.00

SURFACE SHIPPING: ADD $5.00 PER ORDER USA, $10.00 PER ORDER CANADA, HAWAII, ALASKA

NEW SENSOR CORPORATION

133 Fifth Avenue New York City, NY 10003

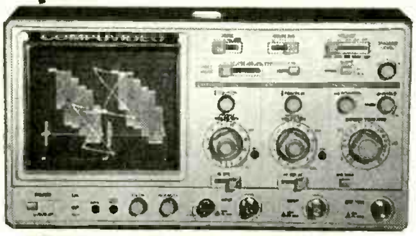
(212) 529-0466 1-800-633-5477 Fax (212) 529-0486

CIRCLE 258 ON FREE INFORMATION CARD

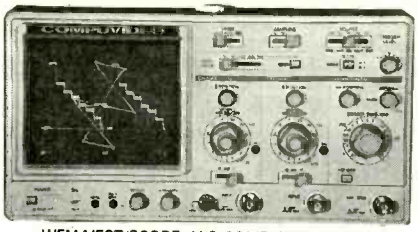
NTSC
PAL

COMPUVIDEO BROADCAST

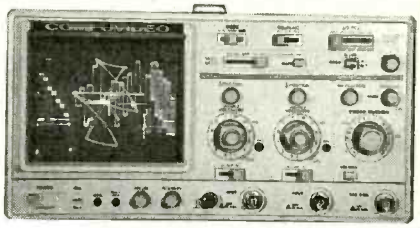
MADE IN USA



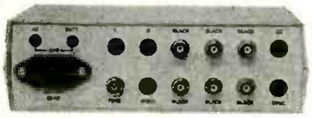
WFM/VECT/SCOPE. COMPOSITE **$1429–1895**



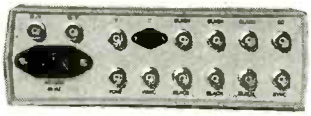
WFM/VECT/SCOPE. Y/C-COMP **$1999–2300**



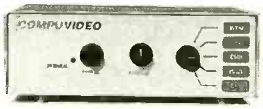
COMPONENT WAVEFORM **$1999**



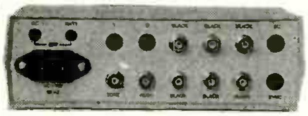
SVR-8000
6-BLACK
GENERATOR
$299



SVR-7000C.
6-BLACK/TONE
12-PATTERNS
2-VIDEO OUT.
Y/C-OUT. SYNC.
SUBCARRIER.
B-Y, R-Y, Y.
$1199

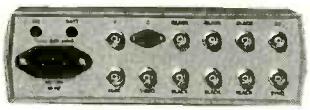


SVR-2000A.
WAVEFORM.
VECTORSCOPE.
DESK TOP.
$699

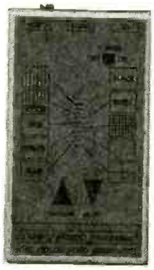


SVR-7020A
6-BLACK/TONE
SMPTE BARS
GENERATOR
$495

S-VHS.
DISTRIBUTION
AMPLIFIER.
1X10.
$499.00



SVR-7000A
6-BLACK/TONE
12-PATTERNS.
2-VIDEO. Y/C.
SYNC. SC.
$699



PocketGen.™
MICRO VIDEO/AUDIO
TEST PATTERN
GENERATOR.
10-PATTERNS, INCLUDING
SMPTE BARS AND BLACK.
WORKS MORE THAN 40 HR
ON 4-AA BATTERIES.
AC ADAPTER INCLUDED.
UNIT WEIGHT 7.5 OZ.
$299–549

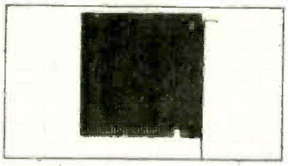
WE OFFER TOP OF THE LINE TEST EQUIPMENT AT UNBEATABLE PRICES. FREE TECHNICAL SUPPORT. ONE YEAR WARRANTY INCLUDING PARTS. CALL US, WE'RE READY TO FIND THE BEST SOLUTION FOR YOU.

VISA MasterCard C.O.D.

VIZ Technologies
(718) 714-9873
3861 Oceanview Avenue • Brooklyn, NY 11224

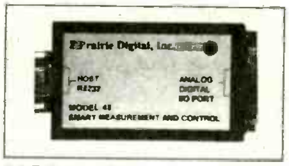
CIRCLE 295 ON FREE INFORMATION CARD

AFFORDABLE
DATA ACQUISITION



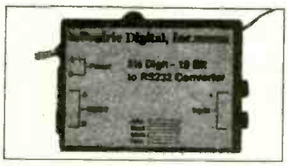
MODEL 30 ...... $79.00

- PLUGS INTO PC BUSS
- 24 LINES DIGITAL I/O
- 8 CHANNEL-8 BIT A/D IN
- 12 BIT COUNTER
- UP TO 14K SMP/SEC



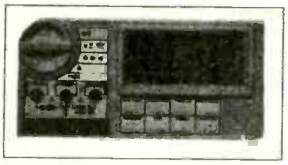
MODEL 45 .... $189

- RS-232 INTERFACE
- 8 DIGITAL I/O
- 8 ANALOG INPUTS
- 2 ANALOG OUTPUTS
- 2 COUNTERS-24 BIT



MODEL 70 .... $239

- RS-232 INTERFACE
- 18 BIT A/D
- 5.5 DIGIT
- UP TO 60 SMP/SEC

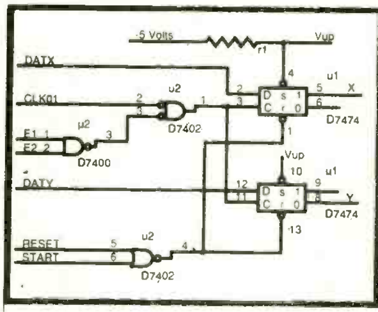


MODEL 150-02 .. $179

- RS-232 INTERFACE
- TRMS, 20 AMPS
- 12 BIT A/D
- OPTO-ISOLATED
- CHANGE RANGES, AC/OC, VIA RS-232

Prairie Digital, Inc.
846 17th Street • Industrial Park • Prairie du Sac, WI 53578
(608) 643-8599 • FAX: (608) 643-6754

CIRCLE 307 ON FREE INFORMATION CARD



SuperCAD™

Schematic Entry Software for the IBM PC & Compatibles

ONLY **$99.00**

COMPLETE PACKAGE

★ Easy-to-use schematic entry program for circuit diagrams
★ Visable on-screen and pull down menus
★ Supports popular graphic standards, mice and printers
★ Powerful editing and drawing commands
★ Extensive digital, analog and discrete part libraries
★ In-depth, readable instruction manual
★ Over 100 screens of on-line help information
★ Software includes part building and netlisting
★ Add P.C. board layout software and routing software for only $99.00 each

Write or call for FREE demo disk! ©

MENTAL AUTOMATION, INC.

ORDERS/INFORMATION:

Send check or money orders to:
Mental Automation, Inc,
5415 - 136th Place S.E.
Bellevue, WA 98006

Or Call
(206) 641-2141

MasterCard *Visa & MasterCard orders accepted!* VISA

Don't Despair...REPAIR!

Here's how to troubleshoot and repair your electronics successfully!

You Can Be Your Own Repair Expert!

For VCRs, camcorders, audio equipment, TV equipment, computer hardware, office equipment, home appliances, automobile electronics, and outdoor equipment.

- Pinpoint and analyze problems quickly.
- Successfully complete repairs with hands-on troubleshooting instructions.
- Become skilled understanding flowcharts and schematic diagrams.
- Confidently use test equipment such as oscilloscopes, frequency counters, and video analyzers.
- Keep your equipment in top condition with effective preventive maintenance techniques.

Continue to Broaden Your Repair Expertise!

You'll receive quarterly supplements, up to 160 pages, with new step-by-step repair and maintenance instructions, valuable schematics and new repair techniques. Learn how to repair a growing variety of appliances with hands-on repair projects that will keep you up-to-date with later models and technology. You'll be thrilled with your ability to repair a growing list of electronic equipment! Supplements may be returned or cancelled at any time.

SAVE $10

Call our toll-free number, pay by credit card, and mention this ad. We'll deduct $10! We'll also waive shipping and handling.

Order today for your 30-day, no-risk review of The Electronics Repair Manual.

For Faster Service Call TOLL-FREE

1-800-222-WEKA

Or Fax To: 1-800-256-5915

CIRCLE 312 ON FREE INFORMATION CARD

One Source For All Your Repair Needs!

Better organized than a magazine, more current than a book.

- 900-page manual
- easy-to-follow, detailed instructions
- trouble analysis flowcharts
- safety precaution checklists
- comprehensive replacement parts list
- directory of manufacturers

Order your copy today!

MONEYBACK GUARANTEE

There's no risk in trying the ELECTRONICS REPAIR MANUAL to see if it's right for you. If you are not delighted, simply return the manual after the 30-day trial period and receive a prompt refund.

WEKA

1077 Bridgeport Ave.
Shelton, CT 06484

☐ **YES!** Please rush me a copy of the new Electronics Repair Manual for only $59.95 + $5.50 shipping and handling. I understand that if I am not satisfied I may return the manual within 30 days for a complete refund. Supplements are sent quarterly for 25¢ per page (never more than $30) and may be returned or cancelled at any time.

☐ My payment is enclosed ☐ Bill me later

☐ Charge my ☐ Visa ☐ MasterCard

Acct. No.__________ Exp. Date______

Signature __________

Phone ( ) __________ Signature and phone number are required for all orders.

Name __________

Address __________

City______ State____ Zip____

All payments must be in U.S. funds. Canada add $10. All other countries add $15. CT residents add 6% sales tax.

Mail to: WEKA Publishing, 1077 Bridgeport Ave.
Shelton, CT 06484

400076

ALFA ELECTRONICS

HIGH QUALITY TEST EQUIPMENT
BEST PRICE

DMM 89 $199.95

Most Advanced DMM
All Purpose & Communication
-80.7 to 81.4 dBm with 4Ω -1200Ω
20 reference impedances
True RMS
Frequency counter: 0.01Hz-10MHz
Capacitance: 1pF-50,000μF
Measure AC volt to 20kHz
5000 counts, 0.1% accuracy
Auto/manual range, fast bar graph
Min/Max/Ave/DH/Relative/Zoom
Auto power off
Input warning
Splash proof
Volt, amp, ohm, logic, diode, continuity
Ruggerdized case
Rubber holster included

DMM 2360 $119.95

DMM+LCR Meter
Very Versatile DMM
Inductance: 1μH-40H
Capacitance: 1pF-40μF
Frequency: 1Hz - 4MHz
Temperature: -40-302 °F
TTL Logic Test: 20MHz
Diode, Continuity
Volt, Amp, Ohm
3999 count display
Peak Hold
Auto power off
Ruggerdized case.
Rubber Holster $8.00
Temperature probe $7.00

DMM 21 $74.95

Inductance: 1μH-40H
Capacitance: 1pF-200 F
Frequency: 1Hz-1MHz
Volt, amp, ohm, diode, continuity
3999 count display
TTL logic, HFE
Peak hold
Ruggerdized case
Rubber holster $8.00

Full line of DMMs, economy, compact, ruggerdized, solar cell, automotive, heavy duty, industrial, starts from $15.95

Fluke Multimeter

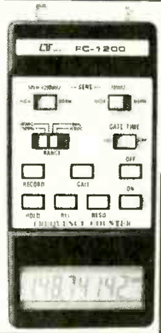
Fluke 12	$84.95
Holster C-10	$10
Fluke 70 II	$67.5
Fluke 73 II	$94
Fluke 75 II	$129
Holster C-70	$16
Fluke 77 II	$149
Fluke 79 II	$169
Fluke 29 II	$169
Fluke 83	$225
Fluke 85	$259
Fluke 87	$287
Fluke 97 Scope Meter	$1785

LCR Meter 131D $229.95

Most Advanced LCR
Dual display:L/Q or C/D
Inductance: 0.1μH-1000H
Capacitance:0.1pF-10,000μF
Impedance:1mΩ-10MΩ
0.7% basic accuracy
Dissipation factor & Q factor
Serial & parallel mode
Relative mode for comparison and to remove parasitics
Statistics, tolerance,
Best for design, incoming testing & production
SMD and chip component test probe $25.00

LCR Meter 814 $189.95

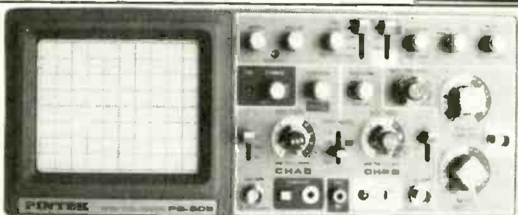
Best Resolution LCR
Inductance: 0.1μH-200H
Capacitance: 0.1pF-20,000μF
Resistance: 1mΩ-20MΩ
1% basic accuracy
Dissipation factor indicates leakage in capacitor and Q factor in inductor
Zero adjustment to reduce parasitics from test fixture
Best for high frequency RF and surface mount components.
SMD and chip component test probe $25.00, Deluxe carrying case $5.00



Frequency Counter FC-1200 $129.95

Frequency:0.1Hz-1.25GHz
Display: 8 digit LCD
Period: 0.1μs-0.1s
Records Max/Min/Average
Data hold, relative mode
Telescoping antenna $8.00
Deluxe case $5.00

Also Available:
AC/DC clamp meter,Light meter, Thermometer, pH meter, High voltage probe, Digital caliper, Anemometer, Electronic scale, Force gauge,Tachometer, Stroboscope, Humidity & EMF adapter, Sound level meter, Frequency counter, SWR/field strength/power meter, Dip meter



20 MHz Oscilloscope with Delay Sweep PS-205 $429.95

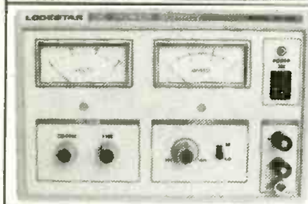
Dual Trace, Component test, 6" CRT, X-Y Operation, TV Sync, Z-Modulation, CH2 Output, Graticule Illum, 2 probes each has x1,x10 switch. Best price with delay sweep.

PS-200 20 MHz DUAL TRACE	$339.95
PS-400 40 MHz DUAL TRACE	$494.95
PS-405 40 MHz DELAY SWEEP	$569.95
PS-605 60 MHz DELAY SWEEP	$769.95

Scope Probe: 60MHz x1, x10 $13, 100MHz x1, x10 $22

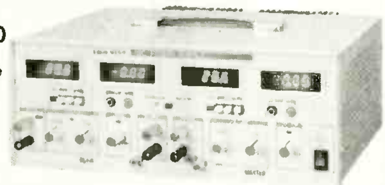
20 MHz Digital Storage Oscilloscope DS-203 $729.95

Switchable between digital and analog modes
2 K word per channel storage
Sampling rate: 10 M sample /sec
8 bit vertical resolution (25 Lerel/div)
Expanded Timebase 10ms/div - 0.5 s/div
Refresh, Roll, Save all , Save CH2, Pre-Trig
Plotter Control
250MHz x1, x10 $29, 250MHz x100 $39



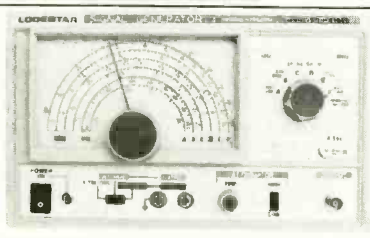
DC Power Supply PS-303 $159.00

0-30 VDC , 0-3A output
Constant voltage & constant current mode
0.02% + 2mV line regulation
0.02% + 3mV load regulation
1 mVrms noise and ripple
Short circuit and overload protected
PS-8200 with digital voltmeter $179.00
Also available: 30V/5A, 60V/3A, 60V/5A 16V/10A, 30V/10A



DC Power Supply Triple Output PS-8202 $499.95

Two 0-30 VDC , 0-3A outputs
One fixed 5VDC, 3A output
Capable of Independent or tracking operation
Constant voltage and constant current mode
Four digital meters for volt and current display
Excellent regulation and low ripple
Short circuit and overload protected
Also available: 30V/5A triple output $549.95
Dual tracking 30V/3A, 30V/5A, 60V/3A, 60V/5A



RF SIGNAL GENERATOR SG-4160B $119.00

100 kHz-150MHz sinewave in 6 ranges
RF Output 100mVrms to 35 MHz
Internal 1kHz, External 50Hz-20kHz AM modulation
Audio output 1 kHz, 1 Vrms

AUDIO GENERATOR AG-2601A $119.00

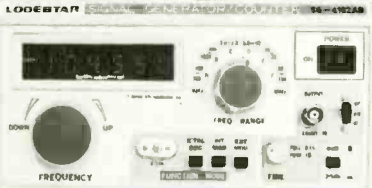
10Hz - 1MHz in 5 ranges
Output: 0-8Vrms sinewave
0-10Vp-p squarewave
Synchronization: ±3% of oscillation frequency per Vrms
Output distortion:
0.05% 500Hz - 50kHz
0.5 % 50Hz - 500kHz
Output impedance: 600 ohm

FUNCTION GENERATOR FG-2100A $169.95

0.2 Hz -2 MHz in 7 ranges
Sine, square, triangle, pulse and ramp
Output: 5mV-20Vp-p
1% distortion, DC offset ± 10V
VCF: 0-10V control frequency to 1000:1

FUNCTION GEN/COUNTER FG-2102AD $229.95

Generates signal same as FG-2100A
Frequency counter 4 digits
Feature TTL and CMOS output



RF SIGNAL GEN./COUNTER SG-4162 AD $229.95

Generates RF signal same as SG-4160B
Frequency counter 1Hz - 150 MHz for internal and external source
Sensitivity <50mV

AUDIO GEN./COUNTER AG-2603AD $229.95

Generates audio signal same as AG-2601A
Frequency counter 1Hz-150MHz for internal and external sources
Sensitivity <50mV

SWEEP FUNCTION GEN./COUNTER $329.95

0.5Hz to 5 MHz in 7 ranges
Sweep: Linear 10:1/Log 10:1 20ms to 2s
AM Modulation
Gated Burst, Voltage Control Generator
Generator Control Voltage & 6 digit counter
1Hz-10MHz for internal & external sources

ALFA ELECTRONICS

741 Alexander Rd., Princeton, NJ 08540

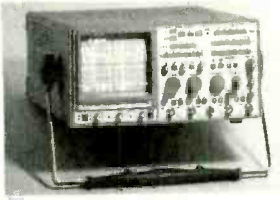
(800) 526-2532/(609) 520-2002
FAX:(609) 520-2007

15 DAY MONEY BACK GUARANTEE. 1 YEAR WARRANTY
CALL OR WRITE FOR FREE CATALOG AND BEST OFFER.
Visa, Master Card, American Express, COD, Purchase Order Welcome

CIRCLE 213 ON FREE INFORMATION CARD

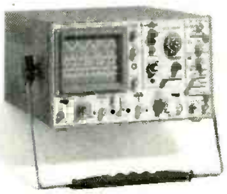
INSTEK® **Test & Measuring Instruments** ISO 9002 CERT. #934163

100 MHz Cursor Readout Scope 4 ch, 8 traces OS-6101 $1,499.95



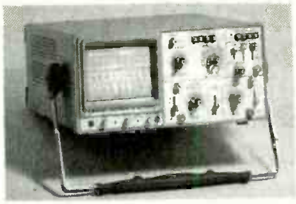
* 4 independent channels, 8 traces
* Time /Voltage cursor measurement
* ALT triggering function for 4 ch.
* Sweeps to 2ns/div, Delayed Sweep
* TV Sync., Ch. 1 output, Z-axis input
* 2 probes(x1, x10)

100 MHz Scope, 4ch. 8 traces Best value all purpose scope OS-6100B $1,329.95



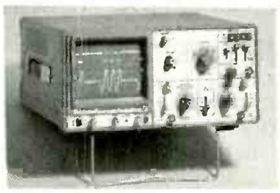
* 4 channels, 8 traces
* High sensitivity 500µV/div
* Sweeps to 2ns/div, Delayed sweep
* 20 kV accelerating voltage
* TV sync., Z-axis input
* A and B gate output
* Best price 100 MHz scope
* 2 probes(x1, x10)

50 MHz Triggering Oscilloscope OS-653 $699.95



* Dual Channel
* Hold Off Function
* Delayed Sweep
* Built-in Delay Line
* TV Sync
* ALT Triggering
* High sensitivity 1 mV/div
* Trigger level lock function
* Z-axis input, CH1 output
* 2 probes(x1, x10)

20 MHz Oscilloscope OS-622B $344.95



* Dual trace, X-Y operation
* TV Sync., Z-axis input,CH 1 output
* High sensitivity 1 mV/div
* Trigger level lock
* 2 probes (x1, x10)

OS-645B - 40 MHz Cursor readout .... $ 734.95
OS-625B - 20 MHz Cursor readout .... $ 549.95
OS-623B - 20 MHz w/Delayed Sweep .... $ 449.95
OS-935 - 5 MHz One channel .... $ 209.95

DC Linear Power Supplies Single Output

* Constant voltage and constant current mode
* Voltage regulation ≤0.01%
* Current regulation ≤0.2%
* Low ripple and noise
* Overload and reverse polarity protection
* Features 2 analog or 1 digital meter(PS series) 2 analog or 2 digital meters(PR series)

PS-1830 : (0-18V, 0-3A) $194.95
PS-1830D : Digital Display $204.95
PS-1850 : (0-18V, 0-5A) $204.95
PS-1850D : Digital Display $229.95
PS-3225 : (0-32V, 0-2.5A) $199.95
PS-3225D : Digital display $219.95
PS-6010 : (0-60V, 0-1A) $199.95

PR-1810H : (0-18V, 0-10A) $329.95
PR-3060 : (0-30V, 0-6A) $299.95
PR-6030 : (0-60V, 0-3A) $299.95
PR-6030D : Digital Display $399.95

Triple Output DC Power Supplies

* Two variable 0-30VDC, 0-3A outputs
* One fixed 5VDC, 3A output
* Auto tracking
* Auto serial and parallel operation
* Constant voltage and constant current mode
* Continuous/dynamic load can be selected
* Features 4 analog or 2 digital displays

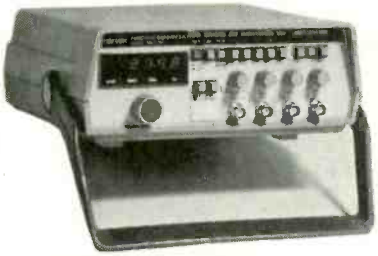
PC-3030 : (0-30V, 0-3Ax2) $479.95
PC-3030D : Digital display $509.95

Programmable DC Power Supplies

* High stability , low drift, 4 digit display
* Front/rear output-sense switch selectable
* Auto step running w/timer settings
* 100 point programmability (PPS series)
* 50 point programmability (PPT series)
* Auto serial and parallel operation (PPT series)
* Auto tracking (PPT series), IEEE-488.2 and SCPI compatible command set (optional)

PPS-1860G: (0-18V, 0-6A) $999.95
PPS-3635G: (0-36V, 0-3.5A) $999.95
PPS-6020G: (0-60V, 0-2A) $999.95
PPT-1830G: (0-18V, 0-3Ax2, 0-6V, 0-5A) $1299.95
PPT-3615G: (0-36V, 0-1.5Ax2, 0-6V, 0-3A) $1299.95

Digital Display Function Generator FG-8016G $239.95



* Frequency Range: 0.02Hz to 2MHz
* Three Instruments in one: Function generator, Pulse generator & Frequency counter.
* Sine, Triangle, Square, TTL Pulse and CMOS output
* Built-in 6 digit counter with INT/EXT function
* 1000:1 tuning range
* Variable DC offset control

FG-8015 Function Generator
* 0.02Hz-2MHz (No Counter) $189.95

FC-8131 Intelligent Counter 1.3GHz $469.95
FC-8270 Intelligent Counter 2.7GHz $599.95
UC-2010G Universal Counter $289.95

Digital Multimeter & C Meter DM-8034(3½ digits) $179.95

* 8 Function, AC/DC voltage, AC/DC current, resistance
* Built-in C meter, diode test and audible continuity check
* High voltage 1000V and 20A range
* 0.5% basic accuracy

DM-8040 (3¾ Digits, True RMS)
* Measures ACV to 50 kHz $339.95

DM-8055 (5½ Digits) $649.95
* 0.006% basic accuracy
* 1µV, 1mΩ, 1nA resolution
* dBm measurement
* Auto range, relative mode, Max/Min

DM-8055G(5½ Digits, GPIB) $889.95

Model DM-392 (3¾ digits) $109.95

* Auto/Manual ranging(38 ranges)
* 42 Segment analog bar graph
* Data Hold/Min-Max memory /Relative mode
* Auto power off
* Overload protection
* Audible continuity check /diode test
* Capacitance: 1pF-40µF
* Frequency: 0.1Hz-1MHz
* 20 Amp range
* Double high energy fused (1A, 20A)
* 0.3% DCV accuracy
* **AC True RMS** (DM-394 only)

DM-351 : 3½ Digits w/Continuity, Auto Off $54.95
DM-352 : 3½ Digits, Cap. Freq. hFE, 20 Amp $79.95
DM-353 : 3½ Digits, Cap. Freq. Temp. hFE $84.95
DM-391 : 3¾ Digits, Auto, Cap. Freq. Min/Max $99.95
DM-392 : 3¾ Digits, Hold, Min/Max 20Amp $109.95
DM-393 : 3¾ Digits, Peak, Logic, hFE, Freq $119.95
DM-394 : 3¾ Digits, TRMS, Same as DM 392 .... $129.95

ALFA ELECTRONICS
741 Alexander Rd., Princeton, NJ 08540

(800) 526-2532/(609) 520-2002
FAX:(609) 520-2007
Visa, Master Card, American Express. COD, Purchase Order Welcome

15 DAY MONEY BACK GUARANTEE. 2 YEAR WARRANTY
CALL OR WRITE FOR FREE CATALOG AND BEST OFFER.

CIRCLE 213 ON FREE INFORMATION CARD

WESTERN TEST SYSTEMS

Quality • Service • Selection

Phone: 1-303-438-9662
Fax : 1-303-438-9685

530 Compton St., Unit #C
Broomfield, CO 80020

OSCILLOSCOPES & ACCESSORIES

TEK 7603 100 MHz 3-slot frame	$250.00
TEK 7A13 100 MHz Differential Comparator	$450.00
TEK 7A18 75 MHz Dual Trace Amplifier	$100.00
TEK 7A22 1 MHz High CMRR Differential Amp	$375.00
TEK 7B53A 100 MHz Dual Time Base	$200.00
TEK 475 200 MHz Dual Channel O'scope	$750.00
TEK 485 350 MHz Dual Channel O'scope	$950.00
TEK 7704A 250 MHz 4-slot frame	$300.00
TEK 7904 500 MHz 4-slot frame	$450.00
TEK 7904 System w/7A24,7A26,7B80,7B85	$1,000.00
TEK 7A24 400 MHz Dual Trace Amplifier	$450.00
TEK 7A26 200 MHz Dual Trace Amplifier	$200.00
TEK 7A29-OPT.04 1 GHz Amplifier, variable delay	$1,150.00
TEK 7B10 1 GHz Time Base	$500.00
TEK 7B15 1 GHz Delaying Time Base	$600.00
TEK 7B80 400 MHz Delayed Time Base	$200.00
TEK 7B85 400 MHz Delta Delaying Time Base	$250.00
TEK 7834 400 MHz 4-slot Storage frame	$750.00
TEK 7834 System w/7A24,7A26,7B80,7B85	$1,000.00
E-H/DATRON 1060 1 GHz Digital Sampling Scope	$1,750.00
TEK 7854 400 MHz Waveform Proc. O'scope	$1,500.00
TEK 7S14 1 GHz Dual Channel Sampling Unit	$700.00
HP 1124A 100 MHz 10X/100X Active Probe	$100.00
TEK 1101A Active Probe Power Supply	$225.00
TEK P6007-opt.01 100X 20 MHz 1.5kV Probe, NEW	$75.00
TEK P6015-opt.10 1000X 13kV Divider Probe	$250.00
TEK P6046 100 MHz 1X/10X Diff. Probe	$750.00
TEK P6201 900 MHz FET Probe, 1X/10X/100X	$400.00
TEK P6202 500 MHz 10X FET Probe	$250.00
TEK P6230 1.5 GHz 10X FET Probe	$275.00

WAVEFORM GENERATORS

HP 3310A 5 MHz Function Generator	$325.00
HP 3312A 13 MHz Function Generator	$800.00
TEK DD501 Digital Delay Generator	$375.00
TEK FG502 11 MHz Function Generator	$325.00
WAVETEK 164 30 MHz Sweep/Function Generator	$850.00
WAVETEK 186 5 MHz Phaselock Function Gen.	$500.00
HP 214B 10 MHz Pulse Gen., 50V / 50 ohms	$2,250.00
HP 8007B 100 MHz Pulse Generator	$650.00
HP 8015A-opt002 50 MHz Dual Output Pulse Gen.	$700.00
HP 8080A 1 GHz Dual Channel Pulse Gen.	$1,400.00
HP 8082A 250 MHz Pulse Generator	$1,600.00
TEK PG502 250 MHz Pulse Generator, Tr<1nS	$700.00
HP 8165A Prog. Signal Source, 1 mHz-50 MHz	$2,600.00
TEK PFG5505 Prog. 12 MHz Pulse/Function Gen.	$1,275.00
WAVETEK 178 50 MHz Programmable Waveform Gen.	$1,500.00

VOLTAGE & CURRENT

FLUKE 8500A 5-1/2 Digit Voltmeter	$450.00
HOLT 11 AC Thermal Converter Set	$5,250.00
HP3437A System Voltmeter	$350.00
TEK DM511-opt.02 4-1/2 Digit DMM &Temp. Probe, NEW	$395.00
HP6115A Precision DC Supply, to 99.99V	$800.00
KEITHLEY 228 Prog. Voltage/Current Source	$2,250.00
KEITHLEY 230 Programmable Voltage Source	$1,275.00
KEITHLEY 414A Picoammeter, 0.1 nA-10 mA	$375.00
KEITHLEY 614 4-1/2 digit Electrometer	$1,000.00
TEK AM503/P6302 Current Probe, DC-50 MHz,w/TM501	$1,000.00
TEK CT-5 High Current Transformer	$650.00
HP 6177C DC Current Source, to 50V,500mA	$600.00
HP6186C DC Current Source, to 300V,100mA	$750.00
KEITHLEY 220 Programmable Current Source	$2,000.00
KEITHLEY 225 Current Source, 1 nA-99.9 mA	$450.00
KEITHLEY 227 Current Source, 1 uA-1 A	$750.00
KEITHLEY 261 Picoampere Source	$325.00

IMPEDANCE & COMPONENT TEST

HP 4800A Vector Impedance Meter	$550.00
BOONTON 72B 1 MHz Cap. Meter, 1-3000 pF	$500.00
HP 4342A Q-Meter, 70 kHz-22 MHz, Q=5-1000	$2,250.00
MEGURO MQ-171 VHF Q Meter, 20-230 MHz	$1,100.00
E.S.I. SR1010 Resistance Transfer Standards	$850.00
FLUKE 5450A Programmable Resistance Standard	$2,750.00
GR 1409 Standard Mica Capacitors, 0.05%	$150.00
GR 1432-N 5-Decade Resistor, 0.1 OHM-11K	$275.00
GR 1433-X 6-Decade Resistor, 0.1 OHM-111K	$550.00
HP 16470B Stable Inductor Set (4)	$500.00
ROD-L M500AV 5000 Volt AC HIPOT Tester	$700.00
TEK 576 Curve Tracer, to 220W	$1,950.00
TEK 577D1/177 Storage Curve Tracer	$2,250.00
TEK 577D2/177 Curve Tracer, to 100W	$1,750.00
TEK 7CT1N Curve Tracer, to 0.5W	$500.00
MICROTEL 4530 Waveguide TDR, 2,4,6,11 GHz	$4,000.00

POWER SUPPLIES

GLASSMAN PS/EG-05R-06 5 kV Power Supply, to 6mA	$500.00
HP 6002A-opt.01 50V/10A Power Supply, to 200 W	$875.00
HP 6207B 160V at 200mA CV/CC Power Supply	$300.00
HP 6261B-027 20V at 50A CV/CC Power Supply	$675.00
HP 6263B 20 V at 10 A CV/CC Power Supply	$375.00
HP 6264B 20V at 20A CV/CC Power Supply	$500.00
HP 6282A 10V at 10A CV/CC Power Supply	$300.00
HP 6296A 60V at 3A CV/CC Power Supply	$400.00
HP 6438B 60V at 5A CV/CC Power Supply	$375.00
HP 6255A Dual Output 40 V at 1.5 A Supply	$500.00
TEK PS5010 Programmable Triple Power Supply	$750.00
TEK PS503A Dual Power Supply	$250.00
ACME PS2L-1000 0-75 V/ 0-150 A/1000 Watt Load	$450.00
HP 59501A HPIB Power Supply Programmer	$175.00
HP 6824A Power Supply/Amplifier, 50V 1A	$450.00
KEPCO BOP 1000M Bipolar Op Amp/Supply, 1 kV 40mA	$600.00

TIME & FREQUENCY

HP 5314A 100 MHz/100 nS Universal Counter	$250.00
HP 5315A 100 MHz/100 nS Universal Counter	$550.00
HP 5316A-001 100 MHz/100 nS Univ., HPIB, TCXO	$850.00
HP5335A Univ. Counter, opt's 10,20,30,40	$1,750.00
HP5370B Time Interval Counter, to 20 pS	$1,750.00
TEK 7D15 225 MHz Universal Counter/Timer	$275.00
TEK DC5009 Programmable 135 MHz Count/Timer	$750.00
TEK DC503A 125 MHz Universal Counter/Timer	$500.00
TEK DC509 135 MHz High Resolution Counter	$700.00
TEK TVC501 Time-Voltage Converter	$700.00
EIP 351D 18 GHz Frequency Counter	$950.00
EIP 545A 18 GHz Frequency Counter	$1,750.00
EIP 548-opt2,5,8 26.5 GHz Frequency Counter	$3,850.00
HP5343A 26.5 GHz Frequency Counter	$3,500.00
TEK 7D14 525 MHz Frequency Counter	$175.00

AUDIO & BASEBAND

HP3586C Selective Level Meter	$1,750.00
TEK 7L5-opt.25 Spectrum Analyzer, with 7603	$2,250.00
HP333A Distortion Analyzer,5 Hz-600 kHz	$500.00
TEK AA5001 Programmable Distortion Analyzer	$2,250.00
TEK DA4084 Distortion Analyzer, 0.0025% THD	$1,750.00
HP3400A RMS Voltmeter, 10 Hz-10 MHz	$250.00
HP204D Audio Oscillator, w/80 dB atten.	$200.00
HP3335A Synth./Level Gen., 200 Hz-80 MHz	$3,250.00
HP3336B Synthesizer/Level Gen., 75 ohms	$650.00
HP3336C Synth./Level Gen.,10 kHz-21 MHz	$1,250.00
KROHN-HITE 3202R Dual HP/LP/BP/BR Filter,to 2 MHz	$500.00
P.A.R. 189 Filter/Amplifier, 0.1 Hz-110 kHz	$350.00
ROCKLAND 752A-opt.02 Dual Low Pass Filter, 115 dB/oct	$1,100.00
TEK AM502 Differential Amplifier	$575.00

RF & MICROWAVE

HP5371A Modulation Domain Analyzer	$5,900.00
HP8443A Tracking Generator, 0.1-110 MHz	$700.00
HP8444A-opt059 Tracking Generator, 0.5-1500 MHz	$1,500.00
HP8552B IF Section	$750.00
HP8553B RF Section, 1 kHz-110 MHz	$500.00
HP8554B RF Section, 0.1-1250 MHz	$800.00
HP8555A RF Section, 0.01-18 GHz	$950.00
TEK TR503 Tracking Generator, 0.1-1800 MHz	$1,750.00
HP8405A Vector Voltmeter, 1-1000 MHz	$700.00
HP85020A Directional Bridge, 0.01-4.3 GHz	$750.00
HP85021A Directional Bridge, 0.01-18 GHz	$1,200.00
NARDA 7000A Microwave Multimeter, 0.1-18 GHz	$1,950.00
WAVETEK 1038N10/D14A Scalar Network An., 1 MHz-26.5GHz	$1,250.00
BOONTON 1020 Synth. Sig. Gen., 0.15-540 MHz	$1,850.00
BOONTON 102C Signal Generator, 0.45-520 MHz	$850.00
HP 11720A Pulse Modulator, 2-18 GHz	$1,200.00
HP 8640A Signal Generator, 0.5-512 MHz	$950.00
HP 8640B-opt2,3 Signal Generator, 0.5-1024 MHz	$2,600.00
HP 8654B Signal Generator, 10-520 MHz	$750.00
MARCONI 2019A Synth. Signal Gen., 1.5-1040 MHz	$3,500.00
WILTRON 6742A-opt.01 Synth Sig./Swp. Gen., 18-40 GHz	$9,000.00
EIP 928-opt.9201 Programmable Sweep Gen., 1-18 GHz	$4,000.00
HP 8620C Sweep Oscillator Frame	$550.00
HP 8620C-opt011 Sweep Oscillator Frame, HPIB	$675.00
HP 86222A RF Plug-In, 10-2400 MHz	$1,500.00
HP 86222B RF Plug-in, 10-2400 MHz	$2,250.00
HP 86240A RF Plug-in, 2.0-8.4 GHz	$1,000.00
HP86290B RF Plug-in, 2.0-18.6 GHz	$2,250.00
HP8709B Synchronizer, for 8620 sweepers	$250.00
WAVETEK 1067 Sweep Gen., 1-400 MHz, 75 Ohms	$500.00
WILTRON 6617-opt.03 Prog. Sweep Gen., 0.01-8.0 GHz	$3,300.00
BOONTON 4200A Digital Power Meter, 1MHz-12.4GHz	$900.00
BOONTON 42B/41-4B Power Meter, 1 MHz-12.4 GHz	$475.00
BOONTON 42B/41-4E Power Meter, 1 MHz-18 GHz	$650.00
BOONTON 42B/42-S/3 Power Meter, 1 MHz-8 GHz	$375.00
HP 432A/478A Power Meter, 0.01-10 GHz	$375.00
HP 432B/478A Digital Power Meter, 0.01-10 GHz	$450.00
HP 435A/8481A Power Meter, 10 MHz-18 GHz	$1,000.00
HP 435A/8482A Power Meter, 0.1-4200 MHz	$1,000.00
HP 8900C/84811A Peak Power Meter, 0.1-18.0 GHz	$1,750.00
HPQ8486A WR22 Power Sensor, 33.0-50.0 GHz	$1,500.00
WAVETEK 1034A Portable Power Meter, 0.001-18GHz	$375.00
AILTECH 7615 Noise Gen., 0.01-1.3 GHz,15dB ENR	$350.00
BOONTON 82AD FM/AM Modulation Meter	$1,000.00
ENI 503L Amplifier, 3 Watts, 2-510 MHz	$850.00
ENI 600L Amplifier, 150 mW, 0.8-1020 MHz	$450.00
HP 11975A Levelled Amplifier, 2-8 GHz	$1,200.00
HP 8447F-H64 Low Noise Amp., 9 kHz-1300 MHz	$1,100.00
PANASONIC VP-8125A FM Stereo Signal Generator	$850.00

COAXIAL & WAVEGUIDE

GR 874-LK20 Variable Length Air Line,20-44cm	$200.00
GR 900-LB Precision Slotted Line	$450.00
HITACHI ME1513 Precision Attenuator, 60-90 GHz	$750.00
HP 11691D Dir. Coupler, 22 dB, 2-18 GHz	$600.00
HP 11692D Dual Dir. Coupler,22 dB,2-18 GHz	$1,000.00
HP 776D Dual Dir. Coupler, 940-1900 MHz	$250.00
HP 778D-opt.011 Dual Dir. Coupler, 20 dB,0.1-2GHz	$400.00
HP 779D Dir. Coupler,20 dB, 1.7-12.4 GHz	$375.00
HP 908A Coaxial Termination, DC-4 GHz	$50.00
HP R532A Frequency Meter, 26.5-40.0 GHz	$500.00
M/A-COM MA7700K-0104 Crystal Detector, 9-11 GHz, SMA	$35.00
MILITARY AS-1346B Double Ridge Horn, 3-8 GHz, N(f)	$75.00
NARDA 26102 Dir. Coupler, 30 dB, 2-18 GHz	$150.00
NARDA 3000-SERIES Directional Couplers	$150.00
NARDA 3090-SERIES Precision Hi Directivity Coupler	$225.00
NARDA 372NM Sliding Termination, 2-12.4 GHz	$90.00
NARDA 4000-SERIES SMA Mini Directional Couplers	$75.00
NARDA 5070-SERIES Precision Reflectometer Couplers	$300.00
NARDA 769-20 20 dB Attenuator, 150 W,DC-6 GHz	$250.00
WEINSCHEL 1515 Power Divider, DC-18 GHz, SMA	$125.00
WEINSCHEL DS109 Double Stub Tuner, 1.0-13.0 GHz	$100.00
WEINSCHEL DS109-L Double Stub Tuner, 0.4-4.0 GHz	$100.00
WEINSCHEL DS109-LL Double Stub Tuner, 0.2-2.0 GHz	$150.00

MISCELLANEOUS

HP 28687A LAN Wire Test Instrument	$750.00
HP 59401A HPIB Bus Analyzer	$700.00
HP 653A Test Osc.,10 Hz-10 MHz,Video Mod	$150.00
TEK 1411R-opt.04 PAL Test Signal Generator	$2,750.00
TEK 144 NTSC Test Signal Generator	$700.00
TEK 147A NTSC Test Signal Generator	$850.00
TEK 521A PAL Vectorscope	$1,500.00
TEK J16/J6523 Spot Luminance Photometer	$900.00
W&G RM-40 70 MHz Radiolink Measuring Set	$1,750.00
HP37204A-opt.2 2 port Fiber-Optic HPIB Extender	$400.00
HP 5006A Signature Multimeter, HPIB	$475.00
HP 59307A HPIB VHF Switch	$200.00
P.A.R. 5206 Lock-In Amplifier, 2 Hz-200 kHz	$3,000.00

• VISA • MASTERCARD • OPEN ACCOUNT • 90 DAY WARRANTY • 10 DAY INSPECTION •

CIRCLE 313 ON FREE INFORMATION CARD

DANBAR SALES COMPANY

14455 N. 79th. St. Unit C, Scottsdale AZ 85260

(602) 483-6202 FAX (602) 483-6403

QUALITY USED TEST EQUIPMENT

Tektronix 475A
Portable Oscilloscope, 250 MHz BW, dual channel, 5mV/ div sensitivity, 1 nS/ div sweep rate. Includes 2 new Probe Master Probes, operator and service manuals.
May Special $ 895.00

Tektronix 7D01/ DF2
Logic Analyzer plug-in, stores up to 1024 channels, state or timing, up to 100 MHz sample rate, includes (2) P6451 probes.
$ 500.00

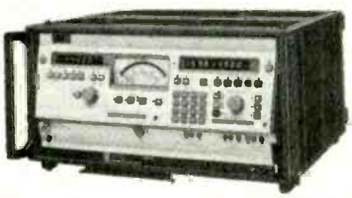
Tektronix 7904 Scope Package
500 MHz Oscilloscope mainframe with the following plug-ins; (1) 7A24 dual trace amplifier, (1) 7A26 dual trace amplifier, (1) 7B85 delaying time base, (1) 7B80 delaying time base.
$ 2000.00

Tektronix SPG-170A
NTSC Sync Generator, digitally generated RS-170A black burst, digital genlock, high stability subcarrier, flexible pulse outputs.
$ 1750.00

Tektronix SPG-271
PAL Sync Generator.
$ 1750.00

Tektronix 2213A
60 MHz Oscilloscope, 2 mV sensitivity, 5 nS/div sweep rate, advanced trigger system, lightweight large, bright CRT.
$ 675.00

Wandel & Goltermann SPM-16
Selective Level Meter, 10 Hz to 160MHz, high frequency accuracy, uncertainty less than 1 x 10-7, digital and analog display.



$ 975.00 special

Marconi 2091B & 2092B
White Noise Test Set, measures noise and intermodulation on wide-band multichannel telephony systems, suitable for 12 channel to 2700 channel systems.
Special $ 1000.00 Per Set

Tektronix 1720 Vectorscope
Simultaneous Channel A and B display, dual-filter display, one-button front-panel recall, differential phase and gain measurement. NTSC.
$ 1650.00

Tektronix 1721 Vectorscope
PAL system applications.
$ 1650.00

Tektronix 1470
Sync and Test Signal Generator, full color sync generator with genlock, composit video output, 9 test signals.
$ 1200.00

Tektronix 1735 Waveform Monitor
PAL/ NTSC dual standard applications.
$ 1850.00

Tektronix PG 2012
Programmable Pulse Generator, dual channel, selectable 250 ps, 800 ps or 1.8 ns, variable 5.5 ns to 10 ms transition time.
$ 2500.00

Tektronix 7854 Scope Package
Waveform processing oscilloscope, stores up to 400 MHz BW, IEEE-488 interface, comes with (1) 7A26, (1) 7A22, & (1) 7B85.
$ 3000.00
Above with (1) 7D15 universal counter/ timer.
$ 3500.00

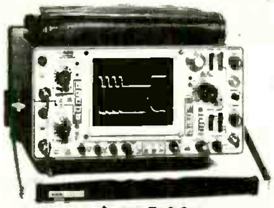
Tektronix 7834 Storage Oscilloscope
2500 cm/uS stored writing speed, stores single shot rise time as fast as 1.4 nS, DC to 400 MHz. Multimode storage. Comes with (1) 7A19, (1) 7A26, (1) 7B85, & (1) 7B80.
$ 2550.00

OUR NEW CATALOG IS HERE. PLEASE CALL OR WRITE FOR A FREE COPY.

Tektronix 7104 Scope Package
1 GHz at 10 mV/ div, 350 pS rise time, 200 pS max sweep rate. Includes (2) 7A29 amplifier, (1) 7B10 delayed time base, (1) 7B15 delaying time base
$ 9000.00

Tektronix 7704A
DC to 200 MHz, CRT readout. Comes with the following plug-ins; (2) 7A26 dual trace amplifier, (1) 7B80 delayed time base, & (1) 7B85 delaying time base.
$ 1300.00

Tektronix 466
Portable Storage Oscilloscope, 100 MHz BW, variable persistence, 3000 div/ uS stored writing speed. Special includes 2 probes and the operation manual.



$ 995.00

Tektronix DM 5010
Programmable Digital Multimeter plug-in 4.5 digit, .015% accuracy, autoranging, math functions (dB, average, offset, scale, hi/low/pass test, true RMS, diode test.
$ 875.00

Wandel & Goltermann TSA-1
Transmission System Analyzer, 100 Hz to 180 MHz, spectrum analysis, selective level, demodulation, phase jitter.

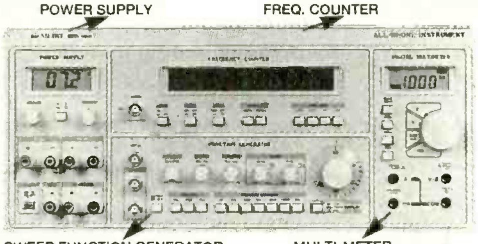
$ 2250.00 Special
same as above but includes network analyzer
$ 2750.00 Special

WANTED TEST EQUIPMENT
Call or fax us your list!

CIRCLE 235 ON FREE INFORMATION CARD

Unbeatable Discount Prices

1 YEAR WARRANTY
15 DAY MONEY BACK GUARANTEE



MT-100

Reg. $595.

$399.00

Four Instruments in One Instrument

1 Function Generator
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- 0.02 Hz ~ 2MHz

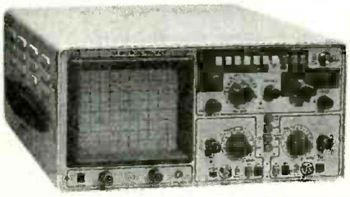
2 Frequency Counter
- 8 Digit LED
- 1 Hz ~ 100MHz
- ± (1 Hz + 1 dgt. + Time Base Error)

3 Power Supply
- 3-1/2 Digit LCD
- Triple output: #1. 0~50V, 0.5A MAX #2, 15V, 1A #3. 5V, 2A

4 Digital Multimeter
- 3-1/2 Digit LCD
- DCV, ACV, Ω, DCA, ACA
- ± (0.5% + 2 dgts)

BEST BUY! O'SCOPES

2 Yr. Parts/Labor Warranty



25 MHz Dual *Reg. $525.* **$299.00**

25 MHz Dual w/Component Test *Reg. $595.* **$379.00**

40 MHz Dual/Delay *Reg. $695.* **$499.00**

OS-3304/3324, 25 MHz
- DC to 25 MHz. Dual Channel
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 20V/div X-Y modes, Z Axis (intensity modulation)
- Rise time 14n Sec. or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 2kV

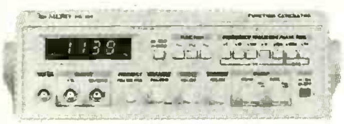
OS-3315, 40 MHz Sweep Delay
- DC to 40 MHz. Dual Channel
- Delayed Sweep 100nS to 1 Sec.
- 6" Rectangular CRT with Internal Graticule 10x8cm (Phillips P31)
- Uncalibration LED.
- High Sensitivity 1 mV/div to 20V/div X-Y modes, Z Axis (intensity modulation)
- Rise time 8.5nS or less.
- Full TV Trigger for TV-V & TV-H
- Acceleration Potential 12kV

GoldStar Oscilloscopes
OS-7020A. 20MHz Dual *Reg. $525.* **$395.00**
OS-902RB. 20MHz Dual/Read Out *Reg. $795.* **$595.00**
OS-9040D. 40MHz Delay *Reg. $695.* **$575.00**
OS-904RD. 40MHz Dual/Read Out *Reg. $895.* **$695.00**
OS-8100. 100MHz 8 Trace *Reg. $1,395.* **$1,145.00**
Other Models *Call for Price*

FG-150

Reg. $395. **$229.00**

2MHz Sweep / Function Generator w/Built-in Frequency Counter



- 4 Digit LED Display
- 0.2 Hz ~ 2.0 MHz
- Sine, Square, Triangle, Pulse, Skewed Sine, Ramp, TTL
- Linear or Logarithmic Sweep
- Variable DC Offset Control
- 10 MHz Frequency Counter

Best Buy!

1.0 GHz Counter FC-200

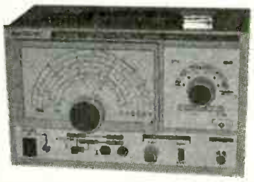
Reg. $395. **$199.00**

High Resolution Frequency Counter

- 1.0 Hz ~ 1.0 GHz
- 8 Digit LED Display
- Auto & Manual Range
- Measured Value Hold
- 4 Selectable Gate Times
- Below 20mV Input Sensitivity
- 1mΩ & 50Ω Input Impedance
- 10:1 Input Switchable Attenuator

Reg. $199. $119.00

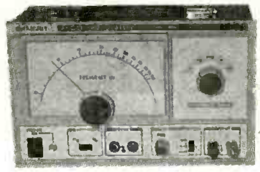
RF Signal Generator, SG-310 100KHz - 150MHz



- 100KHz ~ 150MHz, 6 Ranges.
- Accuracy : ± 5%
- RF Output: 100 m Vrms (Up to 35MHz Unloaded)
- Modulation
  Int. 1KHz (AM) 30%
  Ext. 50Hz ~ 20KHz
- Audio Output: 1KHz Min 2 Vrms

Reg. $199. $119.00

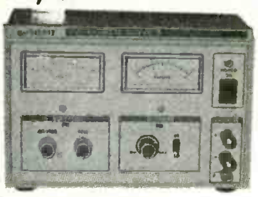
Audio Generator, AG-350 10Hz ~ 1MHz



- 10Hz ~ 1MHz, 5 Ranges.
- Accuracy : 5% ± 2
- Output Inpedance : 600Ω
- Sine Wave Output
  - Range : 10Hz ~ 1MHz
  - Output Voltage : 8 Vrms
- Square Wave Output
  - Range : 10HZ ~ 100KHz
  - Output Voltage : 15Vp-p

Reg. $249. $159.00

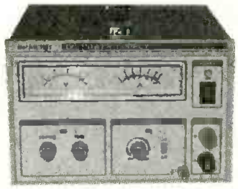
DC Power Supply, PS-500 0-30VDC, 0-3A



- 0 ~ 30VDC Continuously Variable
  - Regulation : ≦ 0.01% + 3mV
  - Ripple Voltage : p-p ≦ 2m Vrms; ≦ 1mV
- 0.1A ~ 3A Constant Current
  - Regulation : ≦ 0.2% + 3mA
  - Ripple Current : ≦ 3m Arms
- Short Circuit Overload Protection w/Indicating Lamp

Reg. $399. $289.00

DC Power Supply, PS-540 0-16VDC, 0-10A



- 0 ~ 16VDC Continuously Variable
  - Regulation : ≦ 0.01% + 3mV
  - Ripple Voltage : p-p ≦ 2m Vrms; ≦ 1mV
- 0.1A ~ 10A Constant Current
  - Regulation : ≦ 0.2% + 3mA
  - Ripple Current : ≦ 3m Arms
- Short Circuit Overload Protection w/Indicating Lamp

Oscilloscope Probes Switch Selectable X1 / X10

HP-9060, 60MHz *Reg. $29.* **$15.00**

HP-9150, 150MHz *Reg. $49.* **$22.00**

HP-9250, 250MHz *Reg. $59.* **$29.00**

Auto Bargraph w/Holster

DM3200 *Reg. $99.* **$59.00**

- Auto & Manual
- 3-1/2 Digit
- 32 Seg. Bargraph
- Diode Test
- Continuity Beeper
- Data Hold
- Auto Power Off
- Low Battery Mark
- Over Range Mark
- Holster

Multimeter Multi-Function w/Holster

DM3000 *Reg. $69.* **$44.00**

DM3050 *Reg. $99.* **$54.00**

DM3100 *Reg. $99.* **$54.00**

- 3-1/2 Digit
- 1.5" Big LCD
- Heavy Duty, 20A
- Capacitance
- TR-hFE
- Diode
- Low Battery Mark
- Over Range Mark
- Protective Holster
- Tilt Stand

DM3050 Only
- Frequency
- Continuity Beeper

DM3100 Only
- Temperature w/ Optional Probe *Reg. $15* **$8.00**
- Continuity Beeper

BMC *Your Best Source for High Standard Electronics*

13700 Alton Pkwy., Ste. 154-282
Irvine, CA 92718

Order & Free Catalog

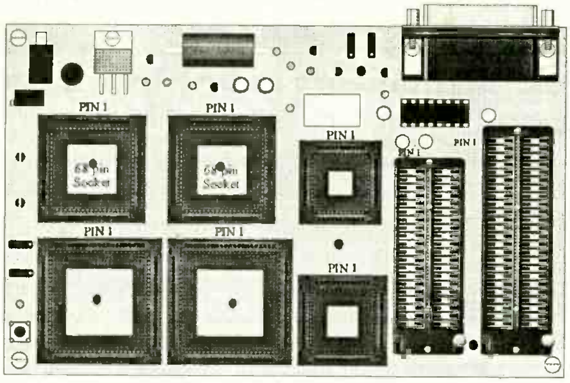
800-532-3221

(714) 586-2310 Fax (714) 586-3399

VISA. MasterCard

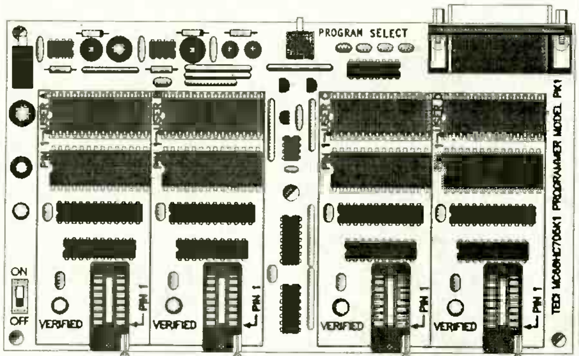
CIRCLE 315 ON FREE INFORMATION CARD

MC68HCx11 PROGRAMMER



Connects to an IBM PC serial port and provides the fastest, easiest way to read, modify, program & verify the eeprom/eprom memory and config. register of 68HCx11xx microcontrollers. Prices from $349.00 for Programmer & host PC S/W.

MC68HC705K1 GANG PROGRAMMER



Completely Programs 4 K1 chips in 5 seconds.Stands alone for production. Connects to a PC serial port for program development.

TECI The Engineers Collaborative Inc.
RR #3, Box 8C, Barton, VT 05822, USA
TEL: 802-525-3458 **FAX: 802-525-3451**

CIRCLE 274 ON FREE INFORMATION CARD

DUAL 24 VCT 8 AMP TORROID

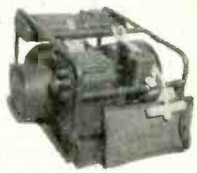
TORROID TRANSFORMER ASSEMBLY from battery charger; has 2.3"H x 4.4" dia torroid transformer with dual 24 VCT 8 amp windings, "as-is" pulse charge PC board and lower half of case. Nice basis for power supply! 6 lbs sh.
#BC-24V-ASSY $24

500 WATT DC to DC INVERTER

12.6 VDC to 120 VAC 60 Hz INVERTER, rated 500 watts continuous; 1000 W surge. Output is squarewave with zero-crossing. Has studs for input and terminal strip for output; 3.6x9.1x13.6, 17 lbs sh. **#RC-12500, NEW** **$149.50**

#RC-12200 INVERTER, 12 VDC to 115 V 60 Hz 200 W cont., 600 W surge; had 3-conductor outlet. 3x7.5x4.8, 7 lbs. NEW .... ~~$135.00~~ **$85.00**

GASOLINE GENERATOR



PE-162* POWER UNIT, military gasoline generator power source for SCR-284 or GRC-9 radio sets. GE-12-D single-cylinder air-cooled 2-cycle engine is rated 1 HP at 3000 RPM; turns GN-50 generator which puts out 6.6 V 3.5 amp and 500 VDC 250 ma. Displacement 4.72 cu-inch; 1/2 gallon fuel capacity. Mechanical adjustments may be required. 10.9x17.5x16.1, 75 lbs sh.
GOV'T RECONDITIONED **$109.50**
PE-162-COMPLETE w/TOOL & SPARES KIT ... **$135.00**

AIR PRESSURE GUAGE

MAGNAHELIC DIFFERENTIAL PRESSURE GUAGE for air and compatible gases (no hydrogen gas!). Measures pressure as 0-2 INCHES OF WATER, 0.05 increments; 15 PSI max. Accuracy +/-2%; 20 -140 F temp-range. With two pairs 1/8 NPT high and low pressure taps; 4.8" dia x 2.3"D; 2 lbs sh.
DWYER INSTR #2002C, NEW. $19.95

JBT 60 HZ REED LINE FREQUENCY METER, dual 48-52 and 58-62 Cycles Per Second scales each with 5-reeds; 3.5" dia, 2 lbs sh.
#30-FHXX, NEW **$34.50**

Prices F.O.B. Lima, O.• VISA, MASTERCARD Accepted.
Allow for Shipping • Write for latest Catalog
Address Dept. ES • Phone 419/227-6573 • Fax 419/227-1313

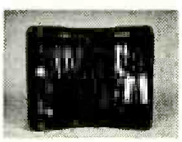
FAIR RADIO SALES
1016 E. EUREKA • Box 1105 • LIMA, OHIO • 45802

KASCO DISTRIBUTING

12338 Martin Alexander Rd., Sardinia, Ohio 45171

Your Source for Electronic Tools and Technical Aids

FREE CATALOG



Computer Care Kit
5 1/4" disk #00648400 $14.70
3 1/2" disk #00648395 $14.70
Includes mini vacuum w/ 3 attachments, cleaning disk, head cleaning fluid, cleaning cloth, spray pump, cotton swabs & carrying case.

Simcheck Memory Tester
09747205 $895.00
Identifies bad memory chips. Easy to use. Tests all SIMM & SIP memory modules 64Kx8/x9, 256Kx8/x9, 2Mx8, 4Mx8/x9, 16Mx8/x9 LCD display. AC adapter.

System Power Center
#01878805 $28.50
Protect your system from damaging power surges & spikes. Five power switches & master control switch. 15 AMP circuit breaker. 12"(W) x 13"(D)x 2"(H).

Modular Flat Telephone Wire

	1-99ft.	100-499	500+	Item No.
4 cond.	.08¢	.07¢	.06¢	#02744400
6 cond.	.09¢	.08¢	.07¢	#02744405
8 cond.	.13¢	.12¢	.10¢	#02744425
10 cond.	.20¢	.18¢	.16¢	#02747995

- **Telephone accessories**
- **Cable**
- **And more!!!**

PC Pocket Reference
#12148430 $14.90
Handy reference book for the computer technician.Codes & numeric translation, video standards, keyboard scan codes, port pinouts and much more!

Deluxe 22 Piece Tool Kit
#06248325 $33.80 (above)
Zippered carrying case includes diagonal pliers, crimper, soldering iron, screwdrivers/nutdrivers, tweezers & more. Call for more details.

Economy 11 Piece Tool Kit
05947245 $10.90

Deluxe Punch Down Tool
#04647595 $36.80 (above)
Adjustable pressure regulator with stow compartment

Economical Punch Down Tool
#04648255 $9.75

Reversable Blades
$9.65
Straight blade for 66, 110/88, modular type

Universal Modular Crimp Tool (above)
#05446515 $79.80
Cut-Strip-Crimp- all in one! Handset plugs (4 pin),RJ11/12 (4 & 6 pin), DEC/MG offset (6 pin) RJ45 (8 pin) & 10 pin plugs. Cushioned hand grips. Tough steel construction

Basic Crimp Tools
#05446495 $12.50

30 Day Money Back Guarantee!

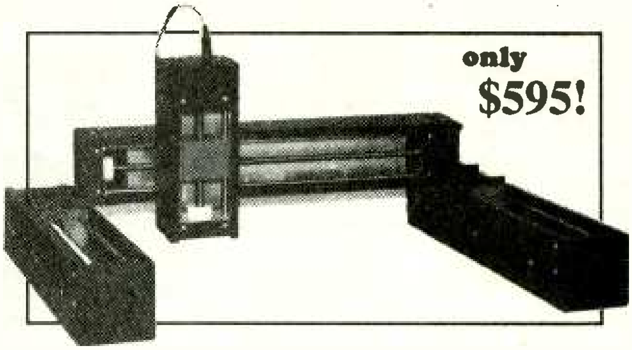
10% OFF
For New Customers
Offer expires 7/31/94

Order Toll Free
1-800-575-2726
24HR FAX (513) 446-2781

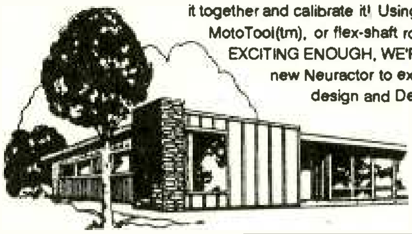
CIRCLE 170 ON FREE INFORMATION CARD

MACHINE YOUR DREAM!

THIS IS THE MACHINE YOU'VE BEEN WAITING FOR!



Have you ever dreamed of manufacturing and marketing your own products? If so, the Neuractor®CNC-4 Desktop Manufacturing System may be just the edge you need! This fourth-generation CNC machining center can automatically drill, mill and route three-dimensional products in wood, plastic and light metals DIRECTLY FROM YOUR CAD DRAWINGS! You've seen the rapid-prototyping and "Santa Claus" machines that cost thousands of dollars, but did you know that as an electronic technician you can build one yourself from this inexpensive kit? Utilizing patent pending technology the Neuractor CNC-4 kit provides you with everything you need to machine products in three dimensions with a resolution of .001". All mechanical components are pre-fabricated, pre-machined, plated and painted. Includes four 83 oz/in CY-MOTORs, interface card, 5 amp power supply, 10 pitch steel lead screws, 4 proprietary Slide Block actuactor mechanisms, 4 aluminum linear actuator channels, polished steel guide-rods, Dremel bracket, hardware, etc.. (You provide Dremel or flex-shaft router and work surface.) It's a complete kit! All you do is put it together and calibrate it! Using 32 screw-type micro-calibrators, you calibrate your machine and then TURN IT LOOSE! Designed to be used with a Dremel MotoTool(tm), or flex-shaft router for more cutting power, the Neuractor translates your 3D CAD files directly into actual working parts! IF THAT'S NOT EXCITING ENOUGH, WE'RE THROWING IN A FREE, FULL-FEATURED 3D CAD/CAM SOFTWARE PACKAGE WITH EACH UNIT! Imagine using your new Neuractor to experiment with different product designs and concepts BEFORE taking the business plunge! By working out your product's design and Desktop Manufacturing processes, you can virtually automate the "proof-of-concept" phase of your projects! Built-in fonts for custom sign-making and panel engraving, 18"x18"x4.6" cutter travel for crafts, electronics, and printed circuit board drilling, not to mention model-making, mold-making, and painting. These are but a few opportunity areas others are already exploring with their Neuractors. You build it, you calibrate it, you customize it for your applications! Don't miss out on your chance to cash-in on your own at-home business! Get started by ordering your own Neuractor CNC-4 today! ACT NOW! Kit $595 +$24.95 UPS S/H. Allow 4-8 wks for delivery. U.S. CYBERLAB, 14786 Slate Gap Rd., West Fork, AR 72774 (501) 839-8293



SHOPPER SHOPPER SHOPPER

CABLE TV DESCRAMBLER KITS

"New & Improved Version"

Universal Descrambler
Includes all the parts and an etched & Drilled PC Board. Not included is AC adaptor or enclosure....................... **$69.00**

Tri-Mode Descrambler
Includes all the parts and an etched & drilled PC board & AC adaptor. Not included is the enclosure........... **$49.00**

SB-3 Descrambler
Includes all the parts & an etched & drilled PC board & AC adaptor. Not included is the enclosure..... **$29.00**

Call Toll Free 1-800-886-8699

Visa, MasterCard, Discover, AM & COD

M & G Electronics, Inc. 2 Aborn Street, Providence, RI. 02903

It is not the intent of M & G Electronics, Inc. to assist any individual to defraud any pay TV operator or to violate any state or federal laws regarding the use of the descrambler kits. You must understand the kits being purchased for educational and or experimental use only.

PORTABLE SATELLITE ANTENNA

Complete 3´ KU Band System

For Free Information Package and Pricing

• Call 219-236-5776 •

R.C. Distributing • PO Box 552 • South Bend, IN 46624

DIGI-FIELD

FIELD STRENGTH METER

Are you worried about **electromagnetic radiation, TV coax distribution loss, poor antenna performance, or EMI/RFI?** The DIGI-FIELD field strength meter will put you at ease. With its frequency response of DC up to 12 GHZ, it readily detects potential electromagnetic radiation hazards. **It is an excellent tool for measuring TV coax distribution loss.** In addition DIGI-FIELD can easily find 60-Hz AC-line interference, as well as RFI/EMI instrumentation disrupting set-ups. Sensitivity: @ 100 MHz Model"A" 150 nano Watts. Model"B" 2 nano watts.

To order call - (800) FIELD 58 (343-5358)

I.C. Engineering 16350 Ventura Blvd. Suite 125, Encino, CA 91436 PH.(818) 345-1692 • 818-345-0517 Fax

Cable → Test Aids

Orders only 1-800-452-7090

Information (310)902-0841

Test chips for JERROLD, TOCOM, ZENITH, S.A. & more. Puts cable boxes in full service mode. Easy installation. Zenith only $39.95. Most others under $50ea.

FAX: (310)902-0851 *Quantity prices available.*

No Ca. sales. Not for use in cable co. owned equip. For use as a test aid only.

SURVEILLANCE

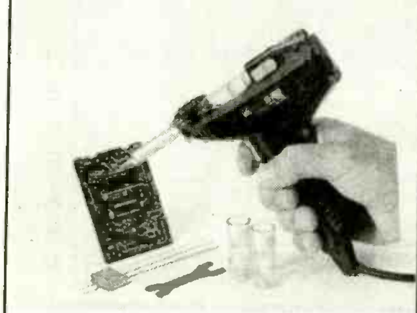
& COUNTERSURVEILLANCE Electronic Devices

Vehicle Tracking • Bug/Phone Tap Detectors • Caller ID • Covert Video• Phone Scramblers • Voice Changers Shotgun Mics • Transmitters • Locksmithing • AND MORE!

7 - Hour Telephone Recorder *$125.00*
Tapes incoming/outgoing phone calls automatically.

EDE FOR CATALOG SEND $5.00 TO... P.O. Box 337, Buffalo, NY 14226 (716) 695-8660

WANTED
Experienced Technicians



To Try Our

Truly Portable — All in the Handle
State of the Art — ESD Safe
with Built-in Diaphragm Pump
Variable Temperature Control
Quick Replacement Filter

DEN-ON SC7000
Desoldering Tool for a
FREE TRIAL

If not completely satisfied we will send UPS to pick it up at no charge to you

Regular Price $499.00

Our Price $439.00

Purchase in Advance & Receive a Desoldering Tip of your choice, FREE. (A $32.00 Value)

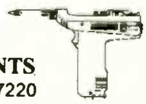
Electronic Association Members Ask for Your 10% DISCOUNT

ORDER NOW for
FREE FREIGHT—No COD Charges
No TAX (Outside of Kansas)
Visa, M/C, Discover, A/E, or COD

Toll Free 1-800-394-1984

Phone 316-744-1984
Fax 316-744-1994

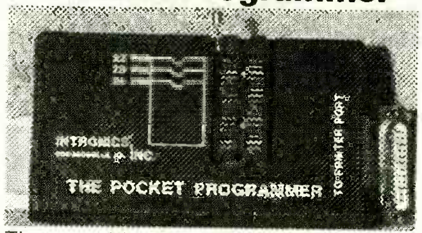
HOWARD ELECTRONIC INSTRUMENTS



6222 N. Oliver Wichita, KS 67220

Evaluated in Electronics Now Magazine, Jan. 1994

Only $129.95 for The Pocket Programmer



The portable programmer that uses the printer port of your PC instead of a internal card. The software has 24 functions and programs (E)Eprom, Flash & Ram 27/28(C)XXXX from 16K - 8 Megabit with a 32 pin socket. Adapters availble for 874X, 875X MCU's, 40-Pin & Serial Eproms and Eprom Emulation to 32K X 8.

Mac EZ Programmer

The Only Eprom programmer made for Macintosh. The software has 15 functions including File Editing with a 32-Pin socket supports (E)Eprom, (27/28(C)XXX) and Dallas Ram from 16K - 4Megabit. **Only $299.95**

Intronics, Inc.
Box 13723
Edwardsville, KS 66113 Add $4.50 COD
Tel. (913) 422-2094 Add $4.00 Shipping
Fax (913) 441-1623 Visa / Master Charge

ROMY-16
EPROM EMULATOR

- Emulates ROMs (2716-27010) or RAMs in 8- and 16- bit systems.
- Window/menu driven interface. Provides 8 hardware breakpoints for 8-bit systems.
- **$195** (2716 - 27256) or **$245** (2716 - 27010), 90 day warranty.
- Optional assembler, disassembler, and ROM debugger add $100.

Universal Microprocessor Simulator/Debugger V2.1

- Assembler, Disassembler, & Windowed Symbolic Simulator/Debugger.
- **$100** each CPU (S/H $8).

80C552 Microcontroller Development System

- 32K ROM , 64K RAM, and 10 bit A/D.
- RS232 serial protocol, 24 pin I/O.
- $120 each SBC, for complete development system add $70.

68HC11 Microcontroller Development System

- Eight channel 8-bit A/D converter.
- 32K ROM and 32K RAM. $120 each SBC, complete development system add $70.

J&M Microtek, Inc.
83 Seaman Road, W Orange, NJ 07052
TEL: 201-325-1892 FAX: 201-736-4567

Motorless Motion!

Create direct linear action with Muscle Wires®— they *actually contract* up to 5% when powered! Use them in robots, planes, railroads – anywhere you need small, strong all-electric *motion*.

Q&A

What are Muscle Wires?
Muscle Wires are highly processed strands of a nickel-titanium alloy called *nitinol*. At room temperature they are easily stretched by up to 5% of their length. When conducting an electric current they return to their original "unstretched" shape with a force *thousands of times* their weight.

How strong are Muscle Wires?
This varies with the wire's size. A single wire can lift from 35 to 930 grams (over 2 lbs)! For more strength, use several wires in parallel.

How fast can Muscle Wires activate?
They contract as fast as they are heated – as quickly as 1/1000 of a second. To relax, the wire must cool again. Rates of many cycles per second are possible with active cooling.

Flexinol Muscle Wire Specifications

Wire Diameter (μm)	50	100	150	250
Resistance (Ω/m)	510	150	50	20
Contract Force (grams)	35	150	330	930
Typical Current (mA)	50	180	400	1000

How much power do Muscle Wires need?
Power varies with wire diameter, length, and surrounding conditions. Once the wire has fully shortened, power should be reduced to prevent overheating.

What are the advantages of Muscle Wires?
Small size, light weight, low power, very high strength-to-weight ratio, precise control, AC or DC activation, long life and direct linear action and much more!

Get our new 128 page *Muscle Wires Project Book* with full plans for Boris and 14 other *motorless motion* projects, and our Deluxe Sample Kit with one meter each of 50, 100 and 150 μm dia. Muscle Wires – everything you need to get moving today!

Order Toll Free! 24-hour Voice Order Line – VISA MasterCard
800-374-5764
Request our FREE Muscle Wires Technical Brochure

Mondo-tronics
524 San Anselmo Ave. #107-63
San Anselmo, CA 94960
Questions: 415-455-9330
Fax: 415-455-9333
Internet: mondo@holonet.net

New Book & Deluxe Kit only $59.95
Plus $5.00 P&H
CA orders add tax

International Orders Welcome! First Class P&H: $11.00

CALL: 800-858-2173

C.O.D.
VISA
M/C

ANGLE TECHNOLOGY, INC.

542 Lakeside Dr., Sunnyvale, CA. 94086 Tel: 408-774-9010, Fax: 408-774-9011

FREE SHIPPING with C/C purchase over $200

BUILD PC FOR FUN
HOT NEW COMPUTER KITS

OUR DEADLY PRICES WILL PUT YOUR OLD PC IN GRAVE!

All kits include:	*Kit model*	*Price $*
Main Board & CPU	AMD 386 SX 33	295.99
2MB of FastPage RAM	AMD 386 DX 40	329.99
3.5" Floppy Drive	IBM 486 SLC 50 ISA	398.99
Super IDE controller	IBM 486 SLC 66 ISA	436.99
I/O 2s1p1g port	IBM 486 SLC 50 VLB,64k cache	495.99
SVGA card 600 x 800	IBM 486 SLC 66 VLB,64k cache	539.99
MiniTower case w/ PS	INTEL 486 DX 33 VLB,64k cache	559.99
101 Key Keyboard	INTEL 486 DX 66 VLB,64k cache	659.99
3 Button mouse		
All kits are assembled	Add another 1MB of RAM for just $37.99	

Add on:

120Mb IDE HD...add $ 175	5.25" 1.2MB FDD...add $ 49
170Mb IDE HD...add $ 189	14" SVGA color monitor...add $ 189
210Mb IDE HD...add $ 195	24/96 Fax/modem card...add $ 42
340Mb IDE HD...add $ 265	MS DOS 6.2...add $ 45
420Mb IDE HD...add $ 299	MS Windows 3.1...add $ 45

PARTS PLACE

MotherBoards w CPU

AMD 386 SX 33	$ 62
AMD 386 DX 40	94
IBM 486 SLC 50 ISA	160
IBM 486 SLC 50 VLB	225
IBM 486 SLC 66 VLB	255
Micronics MB VESA LV w/IDE/IO on board	
486 dx 33	288
486 dx 2/50	328
486 dx 2/66	455
Pentium MB 60mhz	999
IBM 486 3/75 Blue Lightning	559
IDE/IO on board	

Case with power supply

MiniTower w/200wt PS	42
MediumTower w/200wt PS	64
FullTower w/250wt PS	86
SlimLine w/200wt PS	45

Hard Drives

120MB/170MB IDE	164/188
210MB/250MB IDE	196/210
270MB/340MB IDE	216/250
420MB/540MB IDE	289/388
525MB SCSI	399
1.2 GB SCSI	795

Controllers

Super IDE/IO 2FD2HD 1p2s1g	14
IDE w/IO VESA LB	24
Adaptec 1522 ISA SCSI	137
Adaptec 1542 ISA SCSI	237
Adaptec 2842 EISA SCSI	308
DTC 3270 VLB SCSI II	175
AK47 VLB SCSI II	177

Memory & Chips

256k X 9 - 70nsec	$ 14
1MB x 3 - 70nsec	37.99
4MB x 9 - 70nsec	172
1 X 36 - 70nsec, 4MB	172
1MB x 8 - 70nsec MAC	36.99
4MB x 8 - 70nsec MAC	165
1 x 32 - 70nsec, 4MB MAC	155
Mathcoprocessors	
387 SX/SLC 25/33	33/35
387 DX/DLC 33/40	40/55
CPU	
486 DX 33	199
486 DX 40	238
486 DX 2/50	235
486 DX 2/66	404

Fax/Modems

24/96 Fax/Modem Int.	39
14.4 Fax/Modem Int.	99
14.4 Fax/Modem Ext.	125
PCMCIA 14.4 Fax/Modem	225
Pocket Fax/Modem 14.4	199

Multimedia

Mitsumi CD ROM w/Card	155
Sony CD ROM w/Card	165
Toshiba 4301 SCSI CD ROM	225
Sound Blaster	88
Sound Blaster Pro	99

Terms & Conditions:
1. One Year Parts & Labor warranty
2. Prices are subject to change w/o notice
3. Shipping, Insurance & C.O.D. charges are extra
4. Defective items repaired or replaced at our discretion
5. Return shipping must be prepaid and carry RMA #
6. All returns are subject to 15% restocking fee
7. No refunds after 10 days
8. Not responsible for typos

CIRCLE 316 ON FREE INFORMATION CARD

ORDER OUR VCR REPAIR KIT FOR JUST $49.95 AND GET AN 8 OZ. BOTTLE OF RUBBER REVITALIZER FREE

(a $5.50 value)

This professional VCR Repair Kit contains 22 tools fitted into a handy vinyl zippered carrying case. The Kit will enable you to service over 90% of VHS VCRs.

The Kit Includes:

- 2 Audio & Control Head Tools
- Tension Adjustment Tool
- Tape Guide Post Tool
- Back Tension Tool
- Video Head Puller
- 2 VCR Adjustment Tools
- Retaining Ring Remover
- Spring Hook Tool
- 3 Reversible Screwdrivers (Phillips & Standard)
- 8 Piece VCR Allen Wrench Kit
- Mini Screwdriver

If purchased separately the tools in this Kit would cost you over $90.00!

RUBBER REVITALIZER . . .

- Prolongs the life of rubber parts.
- Removes buildup on pressure rollers.
- Restores "gripping" surface of your rubber parts while cleaning and making them like new.

To receive your FREE 8 oz. Bottle of Rubber Revitalizer, Buy the VCR Repair Tool Kit Part #PAC20

For Just .... $49.95 (Plus Shipping & Handling)

To Order Call Toll Free . . .

1-800-558-9572

or for 24 hour ordering **FAX: 1-800-887-2727**

"First In Quality, Service & Delivery"

MasterCard VISA

PREMIUM PARTS+ ELECTRONICS COMPANY™

P. O. Box 28 . Whitewater, Wisconsin 53190-0028

USE ELECTRONIC SHOPPER CLASSIFIEDS

READ BY MORE THAN 100,000 ELECTRONICS BUYERS AND SELLERS AND TRADERS

INSTRUCTION FOR PLACING YOUR AD!

HOW TO WRITE YOUR AD

TYPE or PRINT your classified ad copy CLEARLY (not in all capitals) using the form below. If you wish to place more than one ad, use a separate sheet for the additional ads (a photocopy of this form works well). Choose a category from the list below and write that category number into the space at the top of the order form. If you do not specify a category, we will place your ad under Miscellaneous or whatever section we deem most appropriate.

We cannot bill for classified ads. Payment in full must accompany your order. We do permit repeat ad or multiple ads in the same issue, but in all cases, full payment must accompany your order.

WHAT WE DO

The first two words of each ad are set in bold caps at no extra charge. No special positioning, centering, dots, extra space, etc. can be accommodated.

RATES

Our classified ad rate is $1.25 per word. Minimum charge is $18.75 per ad per insertion (15 words). Any words that you want set in bold or caps are 20¢ each extra. Bold caps are 40¢ each extra. Indicate bold words by underlining. Words normally written in all caps and accepted abbreviations are not charged as all-caps words. State abbreviations must be Post Office 2-letter abbreviations. A phone number is one word.

CONTENT

All classified advertising in the **Electronic Shopper** is limited to electronics items only. All ads are subject to the publisher's approval. We reserve the right to reject or edit all ads.

DEADLINES

Ads received by our closing date will run in the next issue. For example, ads received by April 1 will appear in the July, 1993 issue that is on sale in June 3. Shopper ads will appear Jan., Mar., May etc. No cancellations permitted after the closing date. No copy changes can be made after we have typeset your ad. NO REFUNDS, advertising credit only. No phone orders.

AD RATES: $1.25 per word, Minimum $18.75.

Send your ads with payment to:
Electronic SHOPPER, 500-B Bi-County Blvd. Farmingdale, NY 11735

CATEGORIES

100 — Antique Electronics	270 — Computer Equipment Wanted	450 — Ham Gear Wanted	630 — Repairs-Services
130 — Audio-Video-Lasers	300 — Computer Hardware	480 — Miscellaneous Electronics For Sale	660 — Satellite Equipment
160 — Business Opportunities	330 — Computer Software	510 — Miscellaneous Electronics Wanted	690 — Security
190 — Cable TV	360 — Education	540 — Music & Accessories	710 — Telephone
210 — CB-Scanners	390 — FAX	570 — Plans-Kits-Schematics	720 — Test Equipment
240 — Components	420 — Ham Gear For Sale	600 — Publications	

CLASSIFIED AD COPY ORDER FORM

Ad No. 1—Place this ad in Category # ______

1 - $18.75	2 - $18.75	3 - $18.75	4 - $18.75	29 - $36.25	30 - $37.50	31 - $38.75	32 - $40.00
5 - $18.75	6 - $18.75	7 - $18.75	8 - $18.75	33 - $41.25	34 - $42.50	35 - $43.75	36 - $45.00
9 - $18.75	10 - $18.75	11 - $18.75	12 - $18.75	37 - $46.25	38 - $47.50	39 - $48.75	40 - $50.00
13 - $18.75	14 - $18.75	15 - $18.75	16 - $20.00				
17 - $21.25	18 - $22.50	19 - $23.75	20 - $25.00				
21 - $26.25	22 - $27.50	23 - $28.75	24 - $30.00				
25 - $31.25	26 - $32.50	27 - $33.75	28 - $35.00				

Ad No 1—Total words ______ × $1.25 per word = $ ______

All Caps words ______ × .20 per word = $ ______

Bold words ______ × .20 per word = $ ______

Bold Cap words ______ × .40 per word = $ ______

TOTAL COST OF AD No. 1 $ ______

Total classified ad Payment $ ______ enclosed.

[ ] Check [ ] MasterCharge [ ] Visa ($18.75 minimum credit card order)

Card # _ _ _ _ _ _ _ _ _ _ _ _ _ _ _ _

Expiration Date _ _ / _ _

Signature ____________

Name ____________ Phone ____________

Address ____________ City State Zip ____________

SHOPPER CLASSIFIED

MISCELLANEOUS ELECTRONICS FOR SALE

NEW! UNIVERSAL descrambler upgrade, improvement, modification, repair parts/instructions. Delivers better picture, performance. $15.00 Robert Snow, 22049 Lansdowne, Saint John, Canada E2K4T7.

PLANS-KITS-SCHEMATICS

ALL-IN-ONE CATALOG. AM/FM/HAM/SPY, transmitters/amplifiers, voice disguisers, descramblers, audio/TV/science projects. Start your own licensed/unlicensed radio station, books/plans/kits for import and export. 60 mouth-watering pages for $1.00. **PAN-COM INTERNATIONAL,** PO Box 130-F7, Paradise, CA 95967.

FM STEREO TRANSMITTER kit broadcasts any audio signal to FM stereo radios throughout your home. Uses unique BA1404 IC. Complete kit: PC board/components — $24.00. Visa/MC. **TENTRONIX,** 3605 Broken Arrow, Coeur d'Alene, ID 83814. (208) 664-2312.

PROJECTS $2.00 gets flyer, 100 piece grab bag. Lynn Johnson Electronics, Box 51268, San Jose, CA 95151-1268.

HOBBYISTS! FREE catalog! Magnifiers, soldering equipment, precision tools, more! Gallimore Electronics, Box 70150-L, San Diego, CA 92167.

SILK SCREEN PRINT PC Boards panels, labels, etc. Print from **COMPUTER** or pencil artwork. **EASY and low cost production work.** For complete step by step instructions, techniques, secrets send $29.95 to **Ken's Electronics,** PO Box 565, Henderson, TN 38340.

FREE PLANS Booklet, send $1.00 S&H E.A. Hall, Rt. 11, Bx 475, Lt. 13, Salisbury, NC 28144.

COMPUTER SOFTWARE

SIMULATOR FOR PIC16C5X microcontrollers, running on IBM-PC, comes with a cross assembler. $30.00. Mengjin Su, 20834 Blodgett Road, Blodgette, OR 97326-0049.

CABLE TV

"BULLET" BUSTER. Protect your cable box against the infamous cable "bullet". The "Bullet" Buster acts as an electronic shield. Installs in-line in seconds. Don't wait until it's too late! $19.95 + $3.00 S&H. **Electroman,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

CBTV DOCTOR Stop the Bullet and ID signal in cable lines. Send $17.50 and $2.50 S&H to R.R. Enterprise, PO Box 3532, Easton, PA 18043.

CABLE UNSCRAMBLED. Everything you wanted to know about cable, but were afraid to ask. $10.00. **Electroman,** Box 24474, New Orleans, LA 70184. (504) 482-3017.

CABLE TV CONVERTERS/DESCRAMBLERS. 2 year warranties on Jerrold, Zenith, Tocom, Scientific Atlanta. We service most converters. Money back guarantee. **NATIONAL CABLE SERVICES,** (219) 935-4128.

CABLE TEST CHIPS. SA8550, SA8500-310, 311, 320, 321 (specify) – $33.95. 8580/338, 8570xxx, 8590xxx, 8590 (11 button) — $69.95. Tocom 5503/07 VIP — $33.95. Zenith ZF1 — $33.95. Starcom 6 (except BB) — $33.95. Cable Hackers Bible(s) Vol. 1 or Vol. 2 — $44.45. Cellular Hackers Bible — $53.95. Cellular Cloning Video — $39.95. Cellular Programmers Bible — $84.45. Phone Phreakers Bible — $33.45. Phone Bible Box — $43.45. Superhackers Bible Vol. 1 or Vol. 2 — $33.45 each. Scanner Hackers Bible Vol. 1 or Vol. 2 — $33.45 each. Visa/Mastercard/24 hour orderline (602) 782-2316. Fax: (602) 343-2141. Catalog — $3.00. **TELECODE,** PO Box 6426-SH, Yuma, AZ 85366-6426.

TEST EQUIPMENT

ELECTRONIC TEST equipment and parts. Free catalog. EF Electronics, Box 326, Aurora, IL 60507.

BUSINESS OPPORTUNITIES

EASY WORK! Excellent pay! Assemble products at home. Call toll free 1 (800) 467-5566 ext. 11068.

EARN $339.00 per week assembling our products at home. Free details. Rush self addressed stamped envelope to LCI, POB 42201, Indpls, IN 46242.

THOUSANDS PRODUCTS. Buy lowest prices direct from factories. Free report. Melody Bush, 119-GP Bay Berry, Elizabeth City, NC 27909.

PUBLICATIONS

INTERNATIONAL CLASSIFIED Ads. Buy sell or trade electronic "stuff". Biweekly publication. Free ads, flexible subscription rates. Fax (519) 576-5172. Mail Trading CIR-IT, 86 Victoria St. S Kitchener, Ont. Can. N2G-2A9. SASE for information.

BILLABONG ELECTRONICS

1167 Bucknam Court ◊ Campbell, CA 95008-5913

Telephone Orders
408 374-6686
Fax Orders
408 374-7667

19" Rack Mount Cabinets

These industry standard 19" rack mount cabinets are made from .04" steel, with the front and rear panels being made from .06" aluminum for easier, custom fitting. The display panel is .12" thick aluminum. They have been finished in gun metal grey and come flat packed, ready for your final construction. These enclosures have die punched venting & handles are furnished on all cabinets except RC3120A. These sturdy, well-made, commercial quality cabinets are sure to make your project look its best.

MATERIALS
✓Front/Rear/Display Panels: Aluminum
✓Top/Bottom/Side Panels and Chassis: Steel

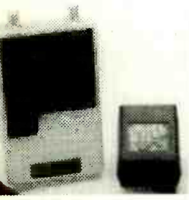
Racks B, C, D, E and H feature extruded aluminum handles

RC3120C

Order Number	Price 1-4	Price 5-99	Front Panel	External Cabinet Dimensions (HxWxD)	Handle Height	Weight
RC3120A	38.00	36.00	19" x 1.6875"	1.5" x 16.625" x 9.625"	—	8 lbs.
RC3120B	46.00	44.00	19" x 3.4375"	3.25" x 16.625" x 9.625"	2.625"	9 lbs.
RC3120C	53.00	50.00	19" x 3.4375"	3.25" x 16.625" x 13.1875"	2.625"	10 lbs.
RC3120D	58.00	55.00	19" x 5.1875"	5" x 16.625" x 13.1875"	4.25"	13 lbs.
RC3120E	63.00	60.00	19" x 5.1875"	5" x 16.625" x 16.75"	4.25"	15 lbs.
RC3120H	83.00	79.00	19" x 8.6875"	8.5" x 16.625" x 16.75"	6.5625"	20 lbs

Hand Held Frequency Counters

Rechargeable Battery Pack and Telescoping Antenna Included



INPUT	FC1000	FC2700
Frequency Range	A Range—10Hz-20MHz B Range—20MHz-1.2GHz	A Range—10Hz-20MHz B Range—20MHz
Sensitivity	A Range—10Hz-20MHz<3mV B Range—20MHz-1.2GHz<12mV 40 to 50 MHz 6mV 100 to 200 MHz 2mV 400 to 500 MHz 3mV	A Range—<15mV 50 to 100MHz 40mV 200MHz to 1GHz 21mV

FEATURES
✓6 gate rates
✓2 standard BNC inputs
✓Wide frequency range

Order #	Price	Description	Weight
FC1000	99.00	1.2GHz Digital Frequency Counter	2 Lbs.
FC2700	129.00	2.7GHz Digital Frequency Counter	2 Lbs.

C.O.D. and Prepaid Orders Only
(Sorry, no credit card facilities at this time)
For C.O.D. services, add $5.00 to order total
COD orders are payable by cash, cashier's check or money order only

○CA Residents Add Your Area Sales Tax
○Freight Charges Are As Follows

5-10 WORK DAYS:	Up to 3 lbs	$5.50
	Each Additional Pound	$0.50
3 WORK DAYS:	Up to 3 lbs	$6.50
	Each Additional Pound	$1.00
Other Services:	Call for quote	

Contact us for rates outside the Continental U.S.A.

30 DAY MONEY BACK GUARANTEE AND ONE YEAR WARRANTY ON ALL PRODUCTS
Prices subject to change without notice

Send your check or money order made payable to
"Billabong Electronics" today!!

CIRCLE 167 ON FREE INFORMATION CARD

REACH FOR THE POWER. TEACH.

No other profession has this power. The power to wake up young minds. The power to wake up the world. Teachers have that power. Reach for it. Teach. For information call:

1-800-45-TEACH.

Ad Council

Recruiting New Teachers, Inc.

SPECTRUM PROBE®

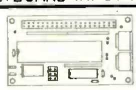
This low circuit loading *scope probe* produces a 60 dB **spectrum analyzer** display on your inexpensive scope

EMC RFI

Ask for application notes, specifications, sales & warranty info.
255 Spectrum Probe 30 KHz to 2.5 MHz $279
107 Probe 1 - 100 MHz $249 ($279 extra shielding)
Accessory Current Adapters: IA5 $19 IA7 $29
SMITH DESIGN (215) 661-9107
207 E.Prospect Ave,N.Wales, PA 19454

INTERFACE TO YOUR PC KEYBOARD INPUT !

Our KE-18 Keyboard Encoder converts contact closures into PC compatible keyboard signals.



- Replaces your PC's keyboard or works in addition to it.
- Scan 9x9 matrix or 18 inputs
- PCXT, AT, PS2 & Compatibles
- Compact 2.5" x 3.0" Size

Only $59.95 & $4 S&H

Hogstrom Electronics
2 Green Lantern Blvd.
Endicott, NY 13760
(607) 786-7523

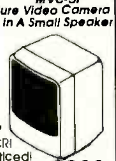
Surveillance & Recording Devices

Micro Dot Conversation Transmitter Kit

Crystal clear reception on FM radio up to 1/4 mile
SnapKit for easy assembly
Tiny-"small as a dime"

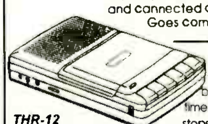
$39.95

MVC-SP Miniature Video Camera Hidden In A Small Speaker



High quality video camera can be powered by 9v battery and connected directly to VCR! Goes completely unnoticed!

$299



Ultra Miniature cassette deck with telephone recording adapter built right in! Extends normal recording time up to 12 hours! Recording starts and stops automatically when phone is used

THR-12 12 Hour Telephone Recorder

$99.95 free shipping

Visa/MC (214) 255-7490

Seymor-Radix Inc. Box 166055 - SG Irving, TX 75016

MARYMAC®

The New Realistic® PRO-43 Scanner

Radio Shack®

PHONES
Our 18th year of DISCOUNTS
Toll Free 800-231-3680
"If on sale, we are cheaper"
PRO-43 List $349.95
Our Delivered Price $288.00
We discount everything in the RS catalog

22511 Katy Fwy.
Katy (Houston), TX 77450
1-713-392-0747 FAX 713-574-4567

Dish System

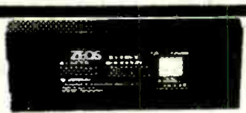
LIFETIME WARRANTY

Quality Microwave TV Antennas

WIRELESS CABLE - IFTS - MMDS - Amateur TV
Ultra High Gain 50db(+) • Tuneable 1.9 to 2.7 Ghz.

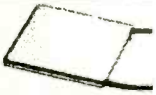
- 55-Channel Dish System $199.95
- 36-Channel Dish System $149.95
- 20-Channel Dish System $124.95
- Optional Commercial Grid Antenna (not shown) Add $50.00
- Yagi Antennas, Components, Custom Tuning Available
- Call or write (SASE) for "FREE" Catalog

PHILLIPS-TECH ELECTRONICS
P.O. Box 8533 • Scottsdale, AZ 85252
(602) 947-7700 ($3.00 Credit all phone orders)
MasterCard • Visa • American Express • COD's • Quantity Pricing



ZEOS COMPUTER BATTERY
12V, 1400mAh. Approx. size 6.875" x 2.75" x 0.75".(93E016) **$12.50**

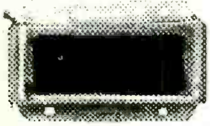
CAPACITOR GRAB BAG
DISKS, SILVERS, LYTICS, Glass, epoxy, many types. (92P082)
5 LBS for $4.95



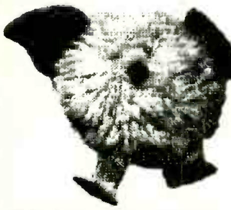
PELTIER JUNCTION
Thermoelectric heat pump. Use to cool that '486, build a drink cooler, etc. Up to 65° temperature differential. Size 1.1875" x 1.1875" x 0.125". With spec sheet. (93U004)
$24.95 each

MICROSOFT WINDOWS, 3.0
New in box, 5 1/4" disks, (94C016) **$4.95**

SILVER SOLDER
Rosin core, 60% Tin, 36% Lead, 4% Silver, 0.31" diameter, 1 lb. spool. (93Z027)
$19.95



LIQUID CRYSTAL SHUTTER/VARIABLE DENSITY FILTER
0.5" to 0.9" active area. 0% to 23% transmission. Switches at up to 250 nanoseconds. Specs included. (92L012) **Only $9.95**



SILICON VALLEY TRIBBLE
When tossed, these chirp like bats. (94T001) **$3.95 each**

ELECTRET CONDENSER LAPEL MIKE
Operating voltage 3 - 9 V. Current 50 - 100 mA. Impedance out approx. 10 KW. (93V003)
$4.95 each

Stepper Motors
Sanyo 103-49021-1, 4.3 , .9 deg./step. Measures 39mm square by 16mm deep, 5mm shaft. (94M003) **$14.95 each**

NEODYMIUM MAGNETS
100+ GAUSS EACH (92N003) 6 for **$9.95**

IR/UHF REMOTE CONTROL
Used in application which allowed control of devices beyond IR range by also broadcasting information on 418 MHz UHF. With schematics.
94A001 Used. **$7.95 each**

RESISTOR RIOT
1/8, 1/4, 1/2, Watt., precision, fixed, adjustable, etc. Thousands of pieces. (92023) **5 LBS. for $4.95**

LIQUID CRYSTAL DISPLAY
2 line by 40 characters. Specs included.
(94L005) **$14.95 each**

PRIAM MODEL 738 330 Meg SCSI Drive, with DTC55280 controller, cable,& software, formatted.
(94C017) **$349.00**

TREADMILL DISPLAY
LCD display offers speed, time, distance and scan modes as well as readout for Kcal./min. Operates on 5VDC. Uses +5V pulses to operated readout. Many applications. (93U013)
$5.95 each

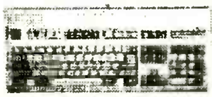
IBM486SLC2/66 VL SERIES MOTHERBOARD
Coprocessor Installed!

IBM486SLC2/66 CPU. 0K memory; supports 1-16MB. 64K internal cache. AMI Bios. Two 32-bit VESA local bus slots with bus-mastering capability. Six 16-bit and 1 8-bit ISA slot. Low base power and power management features for green machine applications. Intel 486 instructions support. Made by IBM. Coprocessor installed. Brand new. Three-year factory warranty. (93C023) **$325.00 each**

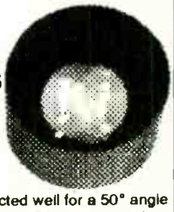
BRAND NEW SOLAR PANELS!
12 V, 1 W, 6" x 12". (92E002)
$17.95 each

4Volt, 0.5 Watt, 3" x 5" (92E003)	$ 7.95
9 Volt, 1 Watt, 5" x 5" (93E004)	12.95
12 Volt, 1 Watt, 4" x 12" (93E005)	14.95
12 Volt, 2 Watt, 6" x 12" (93E006)	24.95
12 Volt, 4 Watt, 12" x 12" (93E007)	39.95

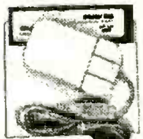
SOLID STATE MESSAGE RECORDER KIT
256k S RAM records 10-20 seconds audio imput, single shot or continuous playback
(KITSG8) **$29.95**



101-Key Keyboard
New. XT-AT switchable. (92C011) **$24.85**



TOMINON HI-POWER GLASS LENS
1:4.5, f=230mm (9"), weight, 4 lbs. Six coated glass lenses, symmetric, in black aluminum case. All aberrations are corrected well for a 50° angle of view, and especially well for macro projection. Scale range is from 1:10 through 1:1 to 10:1. Make a telescope with our "Precision Objective Lens" (92L031) and instruction sheet. Other applications include: high quality image projection at macro scales, or portrait photography in formats up to 6" x 9". Originally cost over $350.00. UNUSED. (92L034)
$39.95



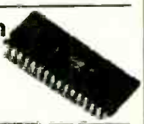
MOUSE
Microsoft and Mouse Systems compatible for IBM/compatible systems. Works with all major application software. Dynamic resolution and fast tracking speed. Opto-mechanical encoder. Model #G25200000-C. (93C019)

$9.95 MAY SPECIAL FREE MOUSEPAD, when you order the above mouse, get the mousepad free.(94C004) (reg. 99¢ each)

CERAMIC HV CAP
"Door knob" style transmitting capacitor. 1000pF ± 20%, 5 KV X5U temp. coefficient. (93P016)

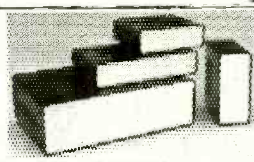
$4.95 each
10 for $39.95

BOOM MIKE
Electret condenser type. This versatile microphone may be wired for Handy Talkie, telephone, base station, aircraft radio, CB radio, motorcycle intercom, etc. An earphone or miniature speaker may be installed in either or both muffs. The microphone unit can be easily removed and installed on another headset or helmet. (92A001)
$4.95



$14.00 each

4MB EPROMs
Used, blank. (94I002)



STEEL ENCLOSURES
Features include ventilation holes, self-adhesive rubber feet. Front and real panels are 0.05" aluminum alodine painted white. Top and bottom covers are 0.04" phosphated steel painted black.

E3119A (2.5" x 8" x 7")	$12.95
E3119B (2.5" x 12" x 7")	15.95
E3119F (2.5" x 17" x 11")	19.95
E3119G (3.5" x 8" x 7")	13.95
E3119K (3.5" x 17" x 11")	24.95
E3119P (5.2" x 17" x 11")	29.95

RAPIDSYN STEPPER MOTOR
34D-9106A 2.9VDC, 3A, 1.8 Deg/step. 82 mm square 62mm deep, 10mm shaft. Used.
(94M004) **$24.95**

LATTICE- NET 10-Base-T CONCENTRATOR
SYNOPTICS model2500-01 or 2510-0IE. New in box complete with power supply, documentation (94C018) **$79.00**

20 Years In SAN JOSE 1973-1993

ALLTRONICS
2300 Zanker Road • San Jose, CA 95131
Phone (408) 943-9773 • Fax (408) 943-9776
VISA, MC, AMEX cards accepted • Minimum order $15.00.
CA & OH residents add local sales tax. • Shipping additional on all orders.

24 HOUR BBS
(408) 943-0622
2400 BAUD * N-8-1
On line ordering

CIRCLE 215 ON FREE INFORMATION CARD

ELECTRONICS BROKERS

FAX: (303) 665-1161 PH: (303) 444-8858

HEWLETT-PACKARD

141T, DISPLAY SECTION 550.00
141T/8552/8556, SPECT ANAL, 20KHZ-300KHz....1700.00
141T/8552A/8553, SPECT ANAL, 1KHz-110MHz....1800.00
141T/8552A/8554, SPECT ANAL, 100 kHz-1.25 GHz....2000.00
141T/8552A/8555, SPECT ANAL, 10MHz18GHz....2250.00
1722A, 100 MHz PORTABLE O'SCOPE....700.00
1722B, 275 MHZ PORTABLE O'SCOPE....900.00
1740A, 100 MHz PORTABLE O'SCOPE....600.00
1741A, 100 MHz PORTABLE O'SCOPE....800.00
182T, DISPLAY SECTION....650.00
204C, AUDIO OSCILLATOR, 4Hz-10MHz....250.00
313A, TRACKING GENERATOR, 10 kHz-22 MHz....250.00
3300A, FUNCTION GENERATOR, .01Hz-1000MHz....300.00
3305, SWEEP PLUG-IN, .1Hz-1000kHz....50.00
3312A, 13 MHz FUNCTION GENERATOR....800.00
331A, DISTORTION ANALYZER....225.00
3400, RMS VOLTMETER....300.00
3403C, TRMS DMM, 3.5 DIGIT, 1.6Hz-10kHz....450.00
3406A, BROADBAND SAMPLING VOLTMETER....800.00
3437A, HIGH SPEED SYSTEM DMM,1000 R/SEC HPIB....350.00
3440/3444A, DIGITAL MULTIMETER....75.00
3455A, 6-1/2 DIGITAL MULTIMETER....700.00
3467A, LOGGING MULTIMETER, 4.5....1000.00
3469B, MULTIMETER, DIGITAL/ANALOG READOUT....275.00
3490A, DMM, 5 DIGIT....275.00
3555B, TRANSMISSION & NOISE MEASUREMENT SET....200.00
3581A, WAVE ANALYZER, 15 Hz-50 kHz....1200.00
3581C, SELECTIVE VOLTMETER, 15HZ-50KHZ....1500.00
3582A, SPECTRUM ANALYZER, .02Hz-25.6Hz....5000.00
3586B, SELECTIVE LEVEL METER....1000.00
3702A, IF/BB RECEIVER....2000.00
400E, AC VOLTMETER....55.00
410C, VOLTMETER....150.00
415E, SWR METER....150.00
419, DC NULL METER....75.00
431, POWER METER....75.00
431B, POWER METER....100.00
431C, POWER METER....150.00
432A/478A, PWR MTR, 0.01-10 GHz, -20 dBm TO +10 dBm....300.00
435A, POWER METER....450.00
435A/8481B, PWR MTR W/SENSOR, 1 mW-25 W, 0.01-18 GHz...1325.00
436A/03./002 DIGITAL PM w/ HPIB....$900.00
436/8484 DIGITAL PM/SENSOR....$1500.00
461A, AMPLIFIER....200.00
4800A/4801A, VECTOR IMPEDANCE METER, 5 Hz-500 kHz....550.00
491C, AMPLIFIER, TWT. 2-4GHZ, 1W 30DB GAIN....2000.00
4935A/003, TRANS TEST SET, AC & BATT. PWR....1250.00
5004A, SIGNATURE ANALYZER w/ PROBES....250.00
5245L, 50MHz FREQUENCY COUNTER....75.00
5246L, FREQUENCY COUNTER....75.00
5253B, FREQUENCY CONVERTER, 18GHz....350.00
5300B/5305B, MEASURING SYSTEM....450.00
5302A, UNIVERSAL COUNTER, 50MHZ....150.00
5305B/5300B/001, 1.3 GHz COUNTER WITH TCXO REF....450.00
5312A, HP-1B INTERFACE....100.00
5314A, 100 MHz/100 nS UNIVERSAL COUNTER, PORTABLE....250.00
5315A, UNIVERSAL COUNTER....500.00
5326C, UNIVERSAL COUNTER, 50MHz....100.00
5328A, TIMER/COUNTER, 500MHz, DUAL CHANNEL....250.00
59500A, MULTIPROGRAMMER INTERFACE....500.00
6110A, 3000V AT 6mA DUAL POLARITY POWER SUPPLY....275.00
6111A, PRECISION POWER SUPPLY, 0-20V, 0-1A....275.00
6130B, BIPOLAR DIGITAL PROG. POWER SUPPLY, +/-500A...600.00
6131B, CVCC, PROG., +/-100@5A....1500.00
6186B, DC CURRENT SOURCE, TO 300V, 100mA....450.00
6200B, 40V/20V AT 0.3A/0.6A CVCC POWER SUPPLY....200.00
6201, 0-20V, 0-1.3A, THREE UNITS....175.00
6255A, DUAL DC POWER SUPPLY, 40V AT 1.5A....450.00
6264B, 20V AT 20A CVCC POWER SUPPLY....500.00
6267B, 0-400 AT 10A CVCC POWER SUPPLY....700.00
6282A, 10V AT 10A CVCC POWER SUPPLY....275.00
6284A, 0-20V DC AT 3A DC POWER SUPPLY....275.00
6291A, 40V AT 5A CVCC POWER SUPPLY....375.00
6299A, 100V AT 750mA CVCC POWER SUPPLY....275.00
6439B, 0-60V DC AT 15A DC....600.00
6448B, 600V AT 1.5A CVCC POWER SUPPLY....700.00
652A, AUDIO OSCILLATOR, 10Hz-10MHz....275.00
6824A, POWER SUPPLY/AMPLIFIER, 50V 1A....300.00
6940B, MULTIPROGRAMMER....500.00
6942A, MULTIPROGRAMMER....1500.00
775D, DUAL DIRECTIONAL COUPLER, 450-950MHZ....250.00
8080A/8091A/, 1 GHz CLOCK GENERATOR.... 950.0
809B/806B/444A, SLOTTED LINE SYSTEM, 2-12.4 GHz....135.0
8405A, VECTOR VOLTMETER, 1-1000 MHz....600.0
8407A, NETWORK ANALYZER, 0.1-110 MHz....300.0
8411, HARM FREQ CONV, OPT 018, 0.11-18.0GHZ....725.0
8411A, FREQ CONV for 8410, 110MHz-12.4GHz....500.0
8411A/018, FREQ CONV for 8410, 110MHz-18GHz....725.0
8412A, PHASE MAG. DISPLAY for 8410....400.0
8413A, PHASE GAIN INDICATOR for 8410 ....150.0
8414A, POLAR DISPLAY....275.0
8418A, AUX. DISPLAY HOLDER....200.0
8443A, TRACKING GEN/COUNTER, LED DISPLAY....700.0
8444A, TRACKING GENERATOR, 0.5-1300 MHz....800.0
8445B, AUTOMATIC PRESELECTOR....700.0
8447A, AMPLIFIER, 0.1-400 MHz....300.0
8552A, IF SECTION....500.0
8552B, IF SECTION, SWITCH DISP. MODES....750.0
8553B, RF SECTION, 0-110 MHz....500.0
8553L, SPECTRUM ANALYZER-RF SECTION....350.0
8554B, RF SECTION, 0.1-1250 MHz....800.0
8555A, RF SECTION, 10 MHz-18 GHz....800.0
8556A, LF SECTION, 20 Hz-300 kHz....500.0
85B, COMPUTER....350.0
8614A, SIGNAL GENERATOR, 0.8-2.4 GHz....375.0
8620A/8621A, SWEEP OSC. SYSTEM 0.1-4.2 GHz....600.0
8620C/011, SWEEP OSCILLATOR MAINFRAME, HPIB....550.0
86222A, RF PLUG-IN, 0.1-2.4GHZ....400.0
86222B, RF PLUG-IN, 0.1-2.4GHZ....1700.0
86222B/002, RF PLUG-IN, 0.01-2.4 GHz....1800.0
86230B, RF PLUG IN, 1.8-4.2 GHz....400.0
86240B, 2-8.4GHz PLUG....200.0
86241A/001, RF PLUG IN, 3.2-6.5 GHz....400.0
86245A, RF PLUG-IN, 5.9-12.4GHZ....250.0
86260A, RF PLUG-IN, 12.4-18GHZ....800.0
8640B, SIGNAL GENERATOR, 0.5-512 MHz, AM/FM....1400.0
8683B, SIGNAL GENERATOR, 2.3-6.5 GHz....4000.0
8740A/H18, TRANSMISSION TEST UNIT, DC-18 GHz....100.0
8742A, REFLECTION TEST SET 500.0
8745A, S-PARAMETER TEST SET, 0.1-2.0GHZ....675.0
9278A, PLOTTER....125.0

TEKTRONIX

1240, LOGIC ANAL W/ 2 D2 CARDS, 36 CHANNEL....1000.0
1241/D2/D2, LOGIC ANAL, 36 CHAN, 50 MHz, CLR DISP...2000.0
144, NTSC TEST SIGNAL GENERATOR....700.0
147, NTSC TEST SIGNAL GENERATOR....$600.0
184, TIME MARK GENERATOR....50.0
2213, 60MHz DUAL CHANNEL O'SCOPE....$600.0
2215, 60MHz DUAL TRACE O'SCOPE....$800.0
2235, 100MHz DUAL CHANNEL O'SCOPE....$1200.0
2245, 100MHz, CH 34 for DMM MEASURE....$1700.0
2246, 100MHz 100MHz ON SCREEN DMM....$1900.0
2445,150MHZ CURSORS....$2500.0
2465, 300MHz 4 CHANNEL 0'SCOPE....$3500.0
434, STORAGE O'SCOPE, 25MHZ....500.0
465B, 100MHz DUAL VERT./TIME O'SCOPE....675.0
466, 100 MHz VERT./TIME STORAGE O'SCOPE....1100.0
475, 200 MHz DUAL CHANNEL O'SCOPE....750.0
475A, 250MHz DUAL CHANNEL O'SCOPE....825.0
485, 350 MHz DUAL VERT./TIME O'SCOPE....900.0
491, SPECTRUM ANALYZER, 10 MHz-12.4 GHz....950.0
492, SPECTRUM ANALYZER, 50 kHz-21 GHz....5950.0
528, TELEVISION WAVEFORM MONITOR....500.0
5440/D40, 50 MHz THREE SLOT FRAME....225.0
577/D2, CURVE TRACER....1505.0
5A22N, DIFFERENTIAL AMPLIFIER....400.0
7623A, MULTIMODE STORAGE O'SCOPE, 100MHz....375.0
7633, 100 MHz STORAGE,1000cm/uS WRITING....600.0
7704, 150MHz, FOUR SLOT FRAME....250.0
7704A, 250 MHz FOUR SLOT FRAME....325.0
7834, 400 MHz STORAGE, 2500 cm/uS WRITING....750.0
7834, 400 MHz SYS, W/(1)7A24,(1)7A26,(1)7B80,(1)7B85....1150.0
7844, 400 MHz DUAL BEAM FRAME....900.0
7904, 500 MHz FOUR SLOT FRAME....450.0
7904, 500 MHz SYS, W/(1)7A19,(1)7A26,(1)7B80,(1)7B85....1000.0
7A13, DIFFERENTIAL COMPARATOR, LED DISPLAY....400.0
7A14, CURRENT PROBE AMPLIFIER, 120MHz....175.0
7A18, 75 MHz DUAL TRACE AMP....100.0
7A19, 600 MHz AMP....250.0
7A24, 400 MHz DUAL TRACE AMP....450.0
7A26, 200 MHz DUAL TRACE AMP....200.0
7A29, 16Hz VERT. PLUG....800.0
7A42, 4 CHANNEL LOGIC TRIG. VERT. AMP., 350MHz...1500.0

ELECTRONICS BROKERS

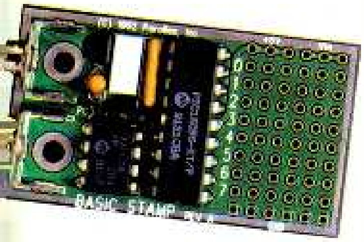
7B10, DELAY TIME 2ns/.2s/DELTA TIME	350.00
7B15, DELAY TIME 2ns/.2s	400.00
7B53A, 100 MHz DUAL TIME BASE	200.00
7B80, 400 MHz DELAYED TIME BASE	200.00
7B85, 400 MHz DELTA TIME DELAYING TIME BASE	250.00
7B92A, 500 MHz DUAL TIME BASE	450.00
7D01, LOGIC ANALYZER PLUG	200.00
7D02/PM111, LOGIC ANALYZER W/6809 POD	450.00
7D10, DIGITAL EVENT DELAY	200.00
7D13, 3-1/2 DIGIT DMM	125.00
7D15, 225 MHz UNIVERSAL COUNTER/TIMER	300.00
7D20T, PROGRAMMABLE DIGITIZER	2500.00
7M11, DELAY LINE	150.00
7S11, SAMPLING UNIT	400.00
7S12/S6/S52/7603, TDR SAMPLING SYSTEM W/S6, S52	1950.00
7T11, SAMPLING SWEEP UNIT	900.00
AM501, OPERATIONAL AMP	100.00
DC5009/01, PROG 135 MHz UNIV CTR, TCXO	750.00
DC5010, PROG. 350 MHz UNIV. COUNTER	1350.00
DC503, DIGITAL COUNTER PLUG-IN, 100MHz	350.00
DC503A, 125 MHz UNIVERSAL COUNTER	500.00
DC504, COUNTER/TIMER, .1Hz-80MHz	185.00
DC505A, 225 MHz UNIVERSAL COUNTER	250.00
DC509, 135 MHz UNIVERSAL COUNTER/TIMER	700.00
DD501, DIGITAL DELAY	350.00
DM501, DMM MODULE, 4,5 DIGIT DISPLAY	275.00
DM5010, PROGRAMMABLE 4-1/2 DIGIT DMM	350.00
DM501A, MULTIMETER, 4.5 DIGIT	300.00
DM502, MULTIMETER, 3.5 DIGIT	175.00
DM502A, MULTIMETER, 3.5 DIGIT	225.00
FG501, 1 MHz FUNCTION GENERATOR	250.00
FG502, 11 MHz FUNCTION GENERATOR	250.00
FG503, 3 MHz FUNCTION GENERATOR	250.00
FG504, 40 MHz FUNCTION GENERATOR	900.00
P6015, 1000X 40kV PROBE, AC/DC	300.00
PG501, 50 MHz PULSE GEN.	300.00
PG508, 50 MHz PULSE GEN	500.00
PS501, POWER SUPPLY	100.00
PS501-1, 0-20V PRECISION POWER SUPPLY	150.00
PS5010, PROGRAMMABLE TRIPLE POWER SUPPLY	750.00
PS503A, DUAL POWER SUPPLY	250.00
R5103N, RACK MOUNT O'SCOPE	200.00
SC502, DUAL TRACE O'SCOPE PLUG, 15MHz	475.00
SC504, 80 MHz O'SCOPE	475.00
SG502, AUDIO OSCILLATOR	300.00

MISCELLANEOUS

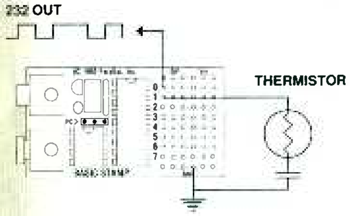
AMBITROL 4005, PWR SUP, 0-40VDC, 0-500MA	175.00
ANRITSU ML422B/31, SELECTIVE LEVEL METER	1100.00
B&K PRECISION 1850A, FREQ. COUNTER 512MHz	175.00
BAFCO 920A, FREQUENCY RESPONSE ANALYZER	750.00
BIOMATION KD101-D, LOGIC ANALYZER	400.00
BLUE MPR-336E-MP1,ENV. CHAMB w/ CTR SRVOCORDR	3000.00
BOONTON 92BD, DIG RF MV METER, 10KHz-1.2GHz	700.00
BOONTON 93A, TRMS VOLTMETER, 10 Hz-20 MHz	125.00
CLIMET CI-3100, OPTICAL PART. TRANSDUCER	250.00
DANA 9000, MICROPROCESSING TIMER/COUNTER	300.00
DELTRON SP, CVCC, 10V, 5A, METERED PWR SUP	75.00
DELTRON SP, 40V, 5A, CVCC METERED PWR SUP	150.00
E.S.I. SP-2534, 4-1/2 DIGIT LCR METER, GPIB	1000.00
EIP 451, MICROWAVE PULSE COUNTER	2000.00
FLUKE 1722, IEEE 488 CONTROLLER	750.00
FLUKE 1910A, 125 MHz COUNTER/TIMER	175.00
FLUKE 1920A, FREQUENCY COUNTER, 520MHZ	250.00
FLUKE 1952B, COUNTER/TIMER,TCXO, 2 CHAN.	250.00
FLUKE 1953A/02, UNIV TIMER/COUNTER 2 CHAN	350.00
FLUKE 4265A, BIN PROG PRECISION PWR SUP	250.00
FLUKE 6011A, FREQ. SYN. 10MHz-11MHz, .1Hz RES	2000.00
FLUKE 750A, REFERENCE DIVIDER	900.00
FLUKE 8000A, DMM, 3.5 DIGITS, 5 FUNCTIONS	175.00
FLUKE 8120A, DMM	200.00
FLUKE 845AR, HIGH IMPEDANCE VOLTMETER	300.00
FLUKE 8600A, DMM, 4.5 DIGIT,5 FUNCTION	200.00
GENERAL MICROWAVE 460B-10, 3 HEADS	350.00
GENERAL MICROWAVE 476, POWER METER	150.00
GOULD 816, DUAL PIN PORT RECORDER	350.00
GUILDLINE 91540, TRANSVOLT 4890 STAND CELLS	750.00
HARRISON LAB 6206A, POWER SUPPLY	40.00
HITACHI V-151F, PORT. O'SCOPE	600.00
HITACHI V-212F, PORT. O'SCOPE	700.00
HONEYWELL 1858/700, OSCILLOGRAPH	2000.00
IBM SYSTEM 9000, CONTROLLER	3000.00
INTERSTATE F31, 3 MHz FUNCTION GENERATOR	300.00
INTERSTATE F72, 20 MHz PULSE FUNCTION GEN	450.00
INTERSTATE P23, PULSE GENERATOR	200.00
INTERSTATE P24, PULSE GENERATOR	300.00
KAV 1/432D, ATTENUATOR	75.00
KAV 30-0, ATTENUATOR	125.00
KEITHLEY 225, CURRENT SOURCE	350.00
KEITHLEY 230, PROGRAMMABLE VOLTAGE SOURCE	875.00
KEITHLEY 260, NANOVOLT SOURCE	300.00
KEITHLEY 261, PICOAMPERE SOURCE	350.00
KEITHLEY 705/2x7158, LOW CUR SCANNING SYS, GPIB	500.00
KEPCO BOP-72-1.5M, 72V AT 1.5A BP OP AMP/PWR SUP	400.00
KEPCO BOP-72-5M, 72V AT 5A BP OP AMP/PWR SUP	600.00
KEPCO JQE, 36-3MVP, 36V AT 3A CVCC METERED SUP	300.00
KEPCO JQE, 100-2.5MVP, 1000 AT 2.5A CVCC MTR SUP	500.00
KEPCO JQE, 15-6MVP, 15V 6A	150.00
KEPCO JQE 55-10M, 55V AT 10A CVCC POWER SUPPLY	350.00
KIKUSUI 5509, O'SCOPE, 15MHz, 4 CH	250.00
KIKUSUI 5513, O'SCOPE	200.00
KIKUSUI COS6100, 5-CHANNEL 100 MHz O'SCOPE	525.00
LEADER 480-U71, TV-VIF PLUG IN UNIT	300.00
LEADER LDM 170, DISTORTION METER	400.00
LEADER LMS-3100, TV SOUND METER	300.00
LH RESEARCH 137A, PULSE GEN, 125MHz-10Hz	300.00
MAGNAVOX T-23893, CHART PRINTER	200.00
MARCONI 2304, MOD METER	400.00
MARCONI 2337A, AUTOMATIC DISTORTION METER	400.00
MARCONI TF2300B, AM/FM MOD METER	500.00
MARCONI TF2370/TK, SPECTRUM ANAL., 0-1250 MHz	3000.00
MAYNARD MAINSTREAM 150, 150MB EXT. TAPE DRIVE FOR PS/2, UNUSED & COMPLETE	300.00
MEASUREMENTS CORP 80 , SIGNAL GENERATOR	300.00
MICRO TECHNICAL INDU 358 THERMO PROBE	400.00
MICROTEL SG800, SWEEP SIGNAL GEN .1GHz-18GHz	3000.00
MILLIVAC 828A	300.00
MILLIVAC MV-823B-S1, RF MILLIVOLTMETER, 10 kHz-1.2 GHz, 1mV-10V, W/ADAPTERS	375.00
PHILLIPS 3226, O'SCOPE	300.00
PHILLIPS 5512, NTSC TV PATTERN GENERATOR	250.00
PHILLIPS PM2454B, AC MILLIVOLTMETER	200.00
PHILLIPS PM3225, O'SCOPE	300.00
PHILLIPS PM6302, RCL BRIDGE	250.00
PHILLIPS PM6611, UNIVERSAL COUNTER	250.00
POWER DESIGN 2005A, PREC PWR SRCE, 20V, 500mA	200.00
POWER DESIGN 2K-10, 0-2000V 0-10mA CV PWR SUP	200.00
POWER DESIGN 6050A, UNIV DC SOURCE, TO 60V, 5A	200.00
RACAL-DANA 1250, UNIV SWITCH CONTROLLER	300.00
RACAL-DANA SERIES 6000, MICROPROCESSING DMM	350.00
RACAL-DANA SERIES 9000, TIMER/COUNTER 9 DIGIT	250.00
RADIO RESEARCH 41, AM/FM SIGNAL GENERATOR	200.00
RADIOMETER COPENHAGE SMG1 STEREO GEN	500.00
RFL INDUSTRIES 829G, AC/DC CAL STANDARD	1700.00
SHIBASOKU AS9538, MPX TV SOUND SIGNAL GEN	600.00
SLAUGHTER 103-2.5J, 2.5 KVAC HIPOT	300.00
SLAUGHTER 205, MEGOHMMETER 20,000 MEG ELEC	200.00
SYSTRON-DONN 6244A/011, 4.5 GHz PORT CNTER, W/30 PPB/MNTH OXCO	1500.00
SYSTRON-DONNER 712-2A/809-A, SPECT ANAL	700.00
SYSTRON-DONNER M107, PREC DCV SRCE, 0-1kV/50mA	1500.00
TAUTRON MB-1A, PCM ERROR RATE MEAS RECEIVER	300.00
TAUTRON MB-302, BERT REC	300.00
TAUTRON ME-1, PSEUDO RANDOM DATA RATE MOD	250.00
TAUTRON ME-302, DATA RATE EXTENDER	300.00
TAUTRON ME-502, DATA GENERATOR	400.00
TAUTRON MN-302, BERT TRANSMITTER	500.00
TAUTRON MS-2, UHF PULSE SOURCE	600.00
TAUTRON MX-302, CRYSTAL CLOCK SOURCE	700.00
TEXSCAN 7271	250.00
TEXSCAN WB713, 0-950MHz SWEEP GENERATOR	500.00
THERMOTRON 012005, TEMP LIMIT CONTROL	150.00
TI XDS	500.00
VALHALLA 4440, DMM, AC/DC, V&C, 2K-20M OHMS	75.00
VALHALLA SCI 2000-1, AUTORANG DIG WATT-AMM	750.00
VU-DATA PS933, w/975, MINI O'SCOPE w/ COUNTER	500.00
VU-DATA PS950, w/975, MINI O'SCOPE w/ COUNTER	700.00
WANTABE SR6312, CHART RECORDER	500.00
WAVETEK 1002, SWEEP SIGNAL GENERATOR	500.00
WAVETEK 116, 1 MHz FUNCTION GENERATOR	225.00
WAVETEK 134, SWEEP GENERATOR	300.00
WAVETEK 1402A, VHF SWEEP GENERATOR FOR USE w/1502, 1-300MHz	700.00
WAVETEK 1701, UHF/VHF SWEEP GENERATOR	1500.00
WAVETEK 180 2 MHz SWEEP/FUNCTION GENERATOR	250.00
WAVETEK 1801A, SWEEP GEN, 1-950 MHz, 75 OHMS	500.00
WAVETEK 182A, 4 MHz FUNCTION GENERATOR	275.00
WAVETEK 184, 5 MHz SWEEP/FUNCTION GENERATOR	325.00
WAVETEK 185, 5 MHz LIN/LOG SWEEP/FUNCT GEN	375.00
WAVETEK 2001A, SWEEP/SIGNAL GEN, 1-1400 MHz	650.00
WAVETEK 3000, SIGNAL GENERATOR, 1-500MHZ	200.00
WAVETEK 51, UHF PROGRAMMER FOR USE w/1502	250.00
WESTON ELECTRICAL IN 759 FOOT-LAMB METER	150.00

THE BASIC STAMP™

$39 Stamp-Sized Computer Runs BASIC



The BASIC Stamp is a 1x2-inch computer that runs BASIC programs written on your PC. It has 8 I/O lines, which can easily be programmed for serial communications, potentiometer input, pulse measurement, button debounce, tone generation, PWM, etc. And all by just adding a resistor and/or capacitor, if anything. Single Stamps sell for $39, and quantity prices start at just four units.

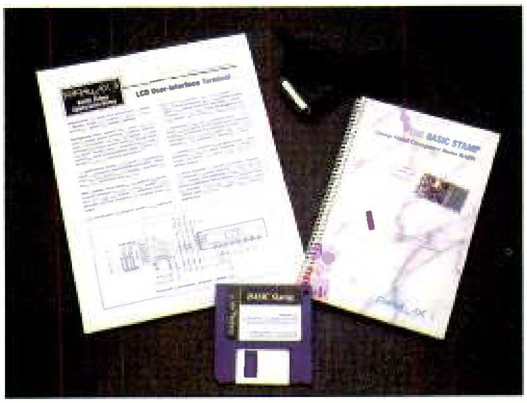


emperature Sensor

ı this application, the Stamp ses a capacitor and Radio Shack ıermistor to take temperature ɛadings. 13 BASIC instructions ɛ used to read and linearize the ıput. The result is then sent out rially.

Writing programs for the Stamp is easy. A 3-pin cable connects the Stamp to your PC's parallel port. And one piece of software is used to enter, debug, and download your programs. It's as simple as possible.

All that you need to program Stamps is included in the Stamp Programming Package. The package contains the cable and software mentioned above, as well as a manual, application notes, and free technical support. *Please note: Stamps are not included.*



Stamp Programming Package $99

PIC®16Cxx MICROCONTROLLERS and TOOLS

nexpensive and available, PICs are building a following

ʼou may already know about the PIC16Cxx series of 8-bit microcontrollers from licrochip Technology. They're the answer to many small controller needs, specially if price if an issue. A typical PIC is the PIC16C54-RC/P; it's an 18-pin DIP ackage with 12 I/O lines, 512 words of PROM, and 32 bytes of RAM, all for round $4.00 in small quantities. And the series continues to grow: new PICs have ıterrupts, A/D, and up to 33 I/O lines.

'or the past three years, we've been helping people get started with PICs. We offer ɔw-cost development tools, documentation, application notes, and technical help, s well as the PICs themselves.

PIC Chips $4 - $27

We offer PICs in the "RC" and EPROM versions.

IC16Cxx Programmer $199

upports PIC16C5x, '71, & '84. lso PIC16C64 with 40-pin adapter.

PIC16C5x Downloader $299

Plugs in place of '5x PIC in-circuit. Runs code at 8 MHz.

TrueFlight™ for '71/'84 $299

Programmer & flash UV eraser form development system for '71 & '84.

PIC Prototype Board $15

Provides an easy way to develop circuits with 18- and 28-pin PICs.

PARALLAX™ INC

3805 Atherton Road, #102 • Rocklin, CA 95765 • USA
(916) 624-8333 • Fax: 624-8003 • BBS: 624-7101

GaAs SWITCHES

DC-2GHz Immediate Delivery from $2.30 (1000 qty.)

Finaly! A line of SPDT absorptive, reflective and transfer switches that appeals to your technical side, and business side as well! It's Mini-Circuits GaAs switches...providing outstanding performance features such as very high isolation (up to 60dB), superfast 3nsec switching speed and excellent compatibility with surface mount soldering techniques. Additionally, the entire series is built extremely tough and is immediately available from stock with a 1 week shipment guarantee. At only $2.95 (qty.10), this top-of-the-line value is priced with your bottom line in mind! To order, call or Fax Mini-Circuits with your requirements today.

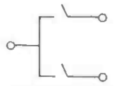
Mini-Circuits...we're redefining what VALUE is all about!

Model No.	Freq. (GHz)	Insertion Loss ① dB (max.)	1dB Comp. ① dBm (typ.)	In-Out Iso. ① dB (typ.)	Price $ea. (qty.10)
MSW-2-20 (Reflective)	DC-2.0	1.0	+24	34	2.95
MSWA-2-20 (Absorptive)	DC-2.0	1.3	+27	40	3.45
MSWT-4-20 (Transfer)	DC-2.0	1.8 TX ② 2.0 RX ③	+28 TX ② +27 RX ③	30	3.95

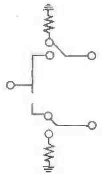
① Midband, 500-1000MHz ② Transmit ③ Receive

All Units: SOIC 8pin Package

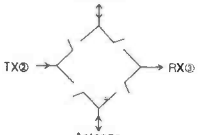
Actual Size



SPDT REFLECTIVE



SPDT ABSORPTIVE



TRANSFER

Mini-Circuits®

P.O Box 350166, Brooklyn, New York 11235-0003 (718) 934-4500 Fax (718)332-4661

For detailed specs on all Mini-Circuits products refer to • THOMAS REGISTER Vol. 23 • MICROWAVES PRODUCTS DIRECTORY • EEM • MINI-CIRCUITS' 740- pg. HANDBOOK.

CUSTOM PRODUCT NEEDS...*Let Our Experience Work For You.*

F 174 Rev Orig

CIRCLE 179 ON FREE INFORMATION CARD