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WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE DECEMBER 1979/$1.25

Fun Projects • Video Games on Oscilloscopes

• An Audio Sound-Effects Machine

• LED Traffic Lights for Model Cars

Listening to the New Super-LP Records

Facsimile Transmission by Telephone

How Electronics Delivers Documents and Illustrations

[redacted]

KR-6050 AM-FM Stereo Receiver

issue

echnics RS-M33 Cassette Deck

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Popular Electronics

Technics

From the grandest opera to the Grand Ole Opry. A lot of FM stations play a lot of different music yet still have one thing in common: The need for uncommonly accurate turntables. That's why so many FM stations use Technics direct drive turntables.

That professionals use Technics direct drive turntables is really not surprising. What is, is that now you can get professional performance in Technics quartz-synthesizer MK2 Series: The SL-1800 manual, the SL-1700 semi-automatic and the SL-1600 fully automatic.

Wow & Flutter	Rumble	Speed Accuracy	Start-up Time
0.025% WRMS	−78 DIN B	± 0.002%	1/4 rotation

As you can see, they all have impressive performance. But with Technics MK2 Series, you also get impressive advances in electronics. Like a quartz-synthesizer pitch control. As you vary the pitch it's instantaneously displayed by 13 LED's in exact 1% increments. That makes life easy.

So does the SL-1600 MK2's infrared disc-size sensor. Just place a disc on the platter, press the start button and immediately an infrared ray activates the micro-computer. Then the Technics precision gimbal-suspension tonearm automatically sets down in the lead-in groove.

And for double protection against acoustic feedback, Technics precision aluminum diecast base has a double-isolated suspension system. One damps out vibration from the base, the other from the tonearm and platter.

The MK2 Series. You don't have to be a radio station to afford performance good enough for a radio station.

Your next turntable should be as accurate as the ones many radio stations use.

CIRCLE NO. 56 ON FREE INFORMATION CARD

STEREO BREAKTHROUGH

Bone Fone
T.M.

A new concept in sound technology may revolutionize the way we listen to stereo music.

The Bone Fone surrounds your entire body with a sound almost impossible to imagine.

You're standing in an open field. Suddenly there's music from all directions. Your bones resonate as if you're listening to beautiful stereo music in front of a powerful home stereo system.

But there's no radio in sight and nobody else hears what you do. It's an unbelievable experience that will send chills through your body when you first hear it.

AROUND YOU

And nobody will know you're listening to a stereo. The entire sound system is actually draped around you like a scarf and can be hidden under a jacket or worn over clothes.

The Bone Fone is actually an AM/FM stereo multiplex radio with its speakers located near your ears. When you tune in a stereo station, you get the same stereo separation you'd expect from earphones but without the bulk and inconvenience. And you also get something you won't expect.

INNER EAR BONES

The sound will also resonate through your bones—all the way to the sensitive bones of your inner ear. It's like feeling the vibrations of a powerful stereo system or sitting in the first row listening to a symphony orchestra—it's breathtaking.

Now you can listen to beautiful stereo music everywhere—not just in your living room. Imagine walking your dog to beautiful stereo music or roller skating to a strong disco beat.

You can ride a bicycle or motorcycle, jog and even do headstands—the Bone Fone stays on no matter what the activity. The Bone Fone stereo brings beautiful music and convenience to every indoor and outdoor activity without disturbing those around you and without anything covering your ear.

SKI INVENTION

The Bone Fone was invented by an engineer who liked to ski. Every time he took a long lift ride, he noticed other skiers carrying transistor radios and cassette players and wondered if there was a better way to keep your hands free and listen to stereo music.

So he invented the Bone Fone stereo. When he put it around his neck, he couldn't believe his ears. He was not only hearing the music and stereo separation, but the sound was resonating through his bones giving him the sensation of standing in front of a powerful stereo system.

AWARDED PATENT

The inventor took his invention to a friend who also tried it on. His friend couldn't believe what he heard and at first thought someone was playing a trick on him.

The inventor was awarded a patent for his idea and brought it to JS&A. We took the idea and our engineers produced a very sensitive yet powerful AM/FM multiplex radio called the Bone Fone.

The entire battery-powered system is self-contained and uses four integrated circuits and two ceramic filters for high station selectivity. The Bone Fone weighs only 15 ounces, so when worn over your shoulders, the weight is not even a factor.

BUILT TO TAKE IT

The Bone Fone was built to take abuse. The large 70 millimeter speakers are protected in flexible water and crush resistant cases. The case that houses the radio itself is made of rugged ABS plastic with a special reinforcement system. We knew that the Bone Fone stereo may take a great deal of abuse so we designed it with the quality needed to withstand the worst treatment.

The Bone Fone stereo is covered with a sleeve made of Lycra Spandex—the same material used to make expensive swim suits, so it's easily washable. You simply remove the sleeve, dip it in soapy water, rinse and let the sleeve dry. It's just that easy. The entire system is also protected against damage from moisture and sweat making it ideal for jogging or bicycling.

The sleeve comes in brilliant Bone Fone blue—a color designed especially for the system. An optional set of four sleeves in orange, red, green and black is also available for $10. You can design your own sleeve using the pattern supplied free with the optional kit.

YOUR OWN SPACE

Several people could be in a car, each tuned to his own program or bring the Bone Fone to a ball game for the play by play. Cyclists, joggers, roller skaters, sports fans, golfers, housewives, executives—everybody can find a use for the Bone Fone. It's the perfect gift.

Why not order one on our free trial program and let your entire family try it out? Use it outdoors, while you drive, at ball games or while you golf, jog or walk the dog. But most important—compare the Bone Fone with your expensive home stereo system. Only then will you fully appreciate the major breakthrough this product represents.

GET ONE SOON

To order your Bone Fone, simply send your check or money order for **$69.95** plus $2.50 postage and handling to the address shown below. (Illinois residents add 5% sales tax.) Credit card buyers may call our toll-free number below. Add $10 if you wish to also receive the accessory pack of four additional sleeves.

We'll send you the entire Bone Fone stereo complete with four AA cell batteries, instructions, and 90-day limited warranty including our prompt service-by-mail address.

When you receive your unit, use it for two weeks. Take it with you to work, or wear it in your car. Take walks with it, ride your bicycle or roller skate with it. Let your friends try it out. If after our two-week free trial, you do not feel that the Bone Fone is the incredible stereo experience we've described, return it for a prompt and courteous refund, including your $2.50 postage and handling. You can't lose and you'll be the first to discover the greatest new space-age audio product of the year.

Discover the freedom, enjoyment, and quality of the first major breakthrough in portable entertainment since the transistor radio. Order a Bone Fone stereo at no obligation, today.

*Pending FCC approval

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The World's biggest SALE of Regency®* scanners!

Communications Electronics,™ the world's largest distributor of radio scanners, is pleased to announce that all *Regency* brand scanners are on sale during our **world's biggest** scanner sale. From now until January 31, 1980, you can save hundreds of dollars during our ***multi-million dollar scanner sale!***

Even the new *Regency* models K500, M100 and R-804 are on sale. If you don't own at least one scanner, your missing all the action of police, fire, marine and government transmissions. Since you can monitor most business or government broadcasts in your area, it's like listening to a party line full of *vital* information.

Since CE distributes more scanners worldwide than *anyone* else, we can give you rock bottom prices. Our warehouse facilities are equipped to process over **1,000** *Regency* scanner orders per week and our order lines are always staffed 24 hours. We also export *Regency* scanners to more than 300 countries and military installations. Almost all items are **in stock** for **immediate shipment**, so **save now** and get a *Regency* scanner during the ***world's largest*** scanner sale!

NEW! Regency® K500

List price $399.00/**CE price $259.00**

40 Channel • Synthesized • Service Search Digital count • Weather with tone alert Search/Store • Priority Channel • AC/DC

Frequency range: 30-50, 144-174, 440-512 MHz.

The new *Regency* Touch K500 is an advanced synthesized scanner with many new features. In addition to the conventional no-crystal touch entry programming for 40 channels, there are over 500 *preprogrammed* channels for receiving selected services such as police, fire, marine and mobile phone. It's like having an accurate frequency directory built into your scanner. The K500 will also find new frequencies in your area and store them in memory so you may enjoy them later. There is a built in digital clock that also functions as an alarm clock to wake you to a 60 second beep.

When you activate the priority feature, you can program calls coming in on your favorite frequency to override all others. If you have a National Weather Service transmitter in your area, the K500 can alert you to severe weather warnings. The "count" feature, automatically counts the number of transmissions on each channel to determine the most active frequencies. The Touch K500...for those who won't settle for anything less than everything.

Regency® K100

List price $279.00/**CE price $179.00**

10 Channels • Crystalless • Searches Wood Cabinet • AC/DC • Delay feature

Frequency range: 30-50, 144-174, 440-512 MHz.

The *Regency* Touch K100 brings the versatility of a totally synthesized scanner within anyone's reach. It's the lowest cost no-crystal scanner that we have ever offered. By merely touching the pressure pads, you can receive any one of 15,757 frequencies. The possibilities are endless. Imagine putting the whole world of police, fire, weather, emergency broadcasts and more at the tip of your finger. The *Regency* Touch K100...where computer control brings new dimensions to scanning.

NEW! Aircraft Regency 720-A

NEW! Aircraft radio Regency® Touch 720-A

List price $349.00/**CE price $229.00**

16 channels • Two separate priority channels AC/DC • Search or Scan • Synthesized

Frequency range: 108-136 MHz.

The new *Regency* Digital Flight Scan uses advanced computer circuitry to put any civil aircraft navigation or communications frequency at the tip of your finger. From Lear Jet to DC-10 you'll hear it all.

You can store your favorite frequencies in the sixteen channels then watch the LED's sequentially scan for a call. There's even a two channel *priority* scan function. So you can listen for bone chilling "maydays" on 121.5 MHz., plus any other frequency of your choice.

NEW! Regency® M100

Available February – March, 1980

List price $279.00/**CE price $179.00**

10 Channels • Backlighted Program Panel Synthesized • Priority • AC/DC • Searches

Frequency range: 30-50, 144-174, 440-512 Mhz.

The *Regency* Touch M100 provides the ease of computer controlled, touch-entry programming in a compact sized scanner for use at home or on the road. Enter your favorite public service frequencies by simply touching the numbered pressure pads. You'll even hear a "beep" tone to ensure you've entered a command. The multi-function digital display shows channel numbers during the scan mode, channel and frequency when a call is received, loss of power, delay function status, channel lockout and search mode selection. In addition to scanning the programmed channels, the M100 has the ability to search through an entire band for an active frequency. When a call is received, the frequency will appear in the digital display. Special features of the M100 include: channel 1 priority, scan or search delay and a brightness switch for day or night operation. Reserve your *Regency* Touch M100 now for February – March, 1980 delivery.

Regency® E-106

List price $149.00/**CE price $99.00**

Performance and Priority in one Scanner

Frequency range: 30-50, 146-174, 450-512 MHz.

Easy. That's the word to describe the *Regency* E-106 scanner. First, easy crystal access is made possible through a special bottom panel. Second, listening to your favorite frequency is easy with the Priority feature on channel one. An all-new wood grain cabinet and smart control panel design make the *Regency* E-106 one of the best looking scanners around. Not to mention that you get ten crystal controlled channels to listen in on police, fire and emergency calls. Crystal certificates **#A-135cc** are $4.00 each.

Regency® R-106

List price $129.00/**CE price $85.00**

Hear 10 channel action at home or on the go.

Frequency range: 30-50, 146-174, 450-512 MHz.

A versatile scanner, the *Regency* R-106 is built to provide maximum reception at home or on the road. AC/DC power cords for versatility of operation from almost anywhere. External speaker jack, external antenna jack and mobile mounting bracket are standard.

New! Regency® R-804

List price $119.00/**CE price $79.00**

The first full feature budget priced scanner.

Frequency range 30-50, 146-174, 450-512 MHz.

Value. That's the word that best describes the R-804. Because this is the first full-featured scanner that has ever been offered at such a low price. You'll hear all the action of police, fire, weather, and emergency calls on a full eight channels. Crystals are easily inserted and programmed through a flip-top panel. Supplied with detachable, swivel mount antenna and AC power cord. AC only. Also order crystal certificates at $4.00 each.

INCREASED PERFORMANCE ANTENNAS

If you want the utmost in performance from your *Regency* scanner, it is essential that you use an external antenna. We have six base and mobile antennas specifically designed for receiving all bands. Order **#A60** is a magnet mount mobile antenna. Order **#A61** is a gutter clip mobile antenna. Order **#A62** is a trunk-lip mobile antenna. Order **#A63** is a ¾ inch hole mount. Order **#A64** is a ⅜ inch snap-in mount, and **#A70** is an all band base station antenna. All antennas are $25.00 and $3.00 for UPS shipping in the continental United States.

TEST A REGENCY SCANNER FREE

Test any *Regency* brand scanner purchased from **Communications Electronics**™ for 31 days before you decide to keep it. If for any reason you are not completely satisfied, return it in new condition with all parts in 31 days, for a courteous and prompt refund (less shipping and handling charges).

NATIONAL SERVICE BY MAIL

With your *Regency* scanner, you will receive a complete set of simple operating instructions and a one-year limited warranty. If service is ever required for any *Regency* scanner, just send your receiver to *Regency* at their headquarters in Indiana for prompt repair.

BUY IN QUANTITY - SAVE EVEN MORE

As incredible as our sale prices are on *Regency* scanners, you can save even more when you order in quantity or in our incentive program. Order one extra scanner with your order, save **1%**. Order two extra scanners, save 2%. You can save up to 5% when you order five or more extra scanners at the same time.

BUY WITH CONFIDENCE

All *Regency* scanners are extraordinary scanning instruments. They provide virtually any scanning function that the most professional monitor could require. To ***get the fastest delivery from CE*** of any *Regency* scanner, send or phone your order directly to our Scanner Distribution Center.™ Be sure to calculate your price using the CE prices in this ad. Michigan residents please add 4% sales tax. Written purchase orders are accepted from approved government agencies and most well rated firms at a 10% surcharge for net 30 billing. All sales are subject to availability. All sales on accessories are final. Prices and specifications are subject to change without notice. Out of stock items will be placed on backorder automatically unless CE is instructed differently. International orders are invited with a $10.00 surcharge for special handling in addition to shipping charges. All shipments are F.O.B. Ann Arbor, Michigan. No COD's please. Cashier's checks will be processed immediately and receive an order priority number. Personal checks require three weeks bank clearance.

Mail orders to: **Communications Electronics**,™ Box 1002, Ann Arbor, Michigan 48106 U.S.A. Add $5.00 per scanner for U.P.S. *ground* shipping, $9.00 for faster U.P.S. *air* shipping or $30.00 for *overnight delivery* to most major U.S. cities via Federal Express or Airborne Air Freight. If you have a Master Charge or Visa card, you may call anytime and place a credit card order. **Order toll free** 800-521-4414. If you are outside the U.S. or in Michigan, dial 313-994-4444. You may also order via TWX 810-223-2400. **Dealer inquiries invited.** All order lines at **Communications Electronics**™ are staffed 24 hours.

Since this ***multi-million dollar scanner sale*** is the world's largest, please order today at no obligation to assure a prompt order confirmation and delivery.

When you follow the leader to real excitement, your journey ends at Communications Electronics.

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Lowest Cost! Regency K100

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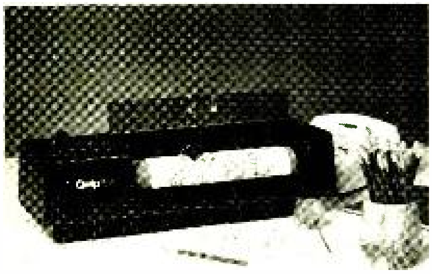
DECEMBER 1979

25TH ANNIVERSARY

Popular Electronics®

VOLUME 16, NUMBER 6

WORLD'S LARGEST-SELLING ELECTRONICS MAGAZINE



About the cover:

The electronic transmission of text and graphics over phone lines is becoming increasingly popular.

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Feature Articles

Construction Articles

Columns

Julian Hirsch Audio Reports

Electronic Product Test Report

Departments

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Editorial

DECADE OF THE HAND-HELD CALCULATOR

Can you imagine a world without hand-held calculators? They're among the most pervasive electronic products in the U.S. today. About 50-million of them, in fact, have been sold in the last two years. Yet, the first one was introduced only nine years ago—two years after Armstrong walked on the moon! And Hewlett-Packard debuted the first programmable model two years later in 1973.

So here we are with a recently developed product, based on an ever-evolving electronic technology, that is now part of our lives. There seems to be a hand-held calculator for virtually every need. Yesterday's $100 four-function model is today's $5 throwaway. There are also low-cost scientific models, programmable units that can hack it against computers, paper-thin ones to carry in a pocket; wristwatch models that are right there when you want them; learning-aid types to teach children math; you name it.

Shopping for a hand-held calculator, therefore, can be a challenging experience. Should you get an LCD or LED display? Should it have an algebraic Operating System or a Reverse Polish Notation one, the latter developed by Jan Lukasiwicz in 1951? (If it doesn't have an equal sign, it's likely to be the latter.) Would it be useful to have one with CMOS circuitry to hold memory even when the unit is switched off? How many memory registers? And what about size, key-pad type, preprogram cards, price, etc.?

Morever, new developments in calculator design continue to pour out of the labs, attracting buyers who already own a few models. For example, my family of four owns five hand-held calculators at this time, yet I'm looking hungrily at an HP-41C hand-held calculator *system* as well as Sharp's EL-5101 rolling writer model. (But then I'm also intrigued by an extension of calculators/computers—the hand-held language translator, especially Texas Instruments' model that displays foreign words and *pronounces them* for you too!)

Most people, it seems, don't take full advantage of a hand-held calculator's capability. That's a shame. The situation can be corrected, though, by investigating books relating to calculators. TI's Learning Center has a fine one, *Understanding Calculator Math*. Matrix's Sippl and Sippl *Programmable Calculators* is another interesting text. It analyzes various models. If scientific analysis is your bag, try Wiley-Interscience's *Scientific Analysis On The Pocket Calculator* by Jon M. Smith. A fine book on programming is Prentice-Hall's *How to Program Your Programmable Calculator*, with 160 examples and exercises in a variety of fields. Consider, too, TI's *Sourcebook for Programmable Calculators*, which includes large sections on using a programmable for music theory and biomedical engineering, among others.

As one who taught students how to use a slide rule (remember the "slip stick"?) many years ago, I'm especially intrigued by the utility, power, low cost, and portability of today's crop of hand-held calculators. However, the end is surely not in sight. Observing new devices in the development stage, I would be truly disappointed if the hand-held calculator did not become the hand-held computer some time in the 1980s.

Art Salsberg

Best Wishes for a Joyous Holiday Season and a Happy New Year

Step up to your next computer.

STEP UP TO A C4P FROM OHIO SCIENTIFIC

You know about computers. In fact, you probably own one now. One that you might be thinking of expanding. We have a better idea. Take a giant step into the personal computing future with an amazing, new C4P from Ohio Scientific.

SPEED SEPARATES THE COMPUTERS FROM THE TOYS

The C4P MF has execution speed that is twice as fast as Apple II or Commodore PET and over THREE times as fast as TRS-80. They are many times faster than the recently introduced flock of video game type computers. And, as if that weren't fast enough, the C4P nearly doubles its speed when equipped with the GT option.

Just look at the back panel of the C4P MF.

All the I/O you'll ever need!

SOUND

1—programmable tone generator 200 — 20KHz
1—8 bit companding digital to analog converter for music and voice output.

HUMAN INPUT EXPANSION

2—8 axis joystick interfaces
2—10 key pad interfaces

HOME INTERFACE

1—AC-12 AC remote control interface

DISPLAY

32 x 64 with upper and lower case
2048 Characters.
256 x 512 effective Graphic Points
16 Colors

SOFTWARE

Ohio Scientific offers a comprehensive library of both systems and applications software for the C4P.

The C4P is an outstanding premium computer — years ahead of the market. We know because there's nothing quite like it for the price, anywhere. And probably won't be for a very long time.

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C4P $698

8K BASIC-in-ROM, 8K of static RAM and audio cassette interface. Can be directly expanded to 32K static RAM and two mini-floppy disks.

C4P MF $1695

All the features of the C4P plus real time clock, home security system interface, modem interface, printer interface, 16 parallel lines and an accessory BUS. The C4P MF starts with 24K RAM and a single mini-floppy and can be directly expanded to 48K and two mini-floppies. Over 45 diskettes now available including games, personal, business, educational and home control applications programs as well as a real time operating system, word processor and a data base management system.

Computers come with keyboards and floppies where specified. Other equipment shown is optional.

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Apple II, Commodore PET, TRS-80, and Atari 800 are registered trade names of Apple Computer Inc., Commodore Business Machines Ltd., Radio Shack, Atari, respectively.

Letters

POCKET-SIZE COLOR ORGAN

The "Hand-Held LED Spectrum Analyzer" (September 1979) has a more common use than that mentioned in the article. By changing the display-board pattern from rows and columns to a group of concentric circles, each of a different color LED, a color organ can be produced for much less than the cost of most commercial color organs. Also, the "color organ" is small enough to fit into a pocket. —*Kenneth Lorber, Washington, DC.*

TV PROBLEMS INTERCHANGED

You have undoubtedly noticed by now that the diagram with the first problem in "Ten Uncommon TV-Receiver Problems" (October 1979) has to do with the sixth problem on page 60. —*Glen McDougal, Osage, MO.*

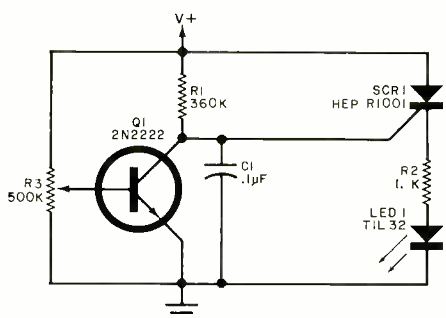
CHANGE OF SUPPLIER

Many thanks for mentioning my book, *Home Recordings for Musicians*, in the October 1979 Electronics Library column. I would like to point out, however, that Guitar Player Books, listed as the supplier, is no longer in business. Any reader who wishes to obtain this book can do so from Music Sales Co., 33 West 60 St., New York, NY 10023. —*Craig Anderton, Clayton, CA.*

MISSING DIAGRAM

In "Tips & Techniques" for October 1979, the "Low Voltage Indicator" diagram was omitted. —*S. Lay, Huntington Beach, CA.*

Sorry, Here it is. —Ed.



Out of Tune

In "NASA Motor-Control Circuit Cuts Electric Cost" (October 1979), the lengths of wire necessary to fabricate *R1* (under "Construction" on page 43) should be 9" of #22 or 10" of #24.

First aid.

When digital circuitry isn't behaving as logically as it should, you need answers—fast. A quick, unambiguous look at what's happening. To show you at a glance the state of any point or port in the circuit.

That's the logic behind our logic probes. A pocket-size, circuit-powered family of multi-family instruments that dramatically cut the time (and cost) of diagnosing logic. They're quick enough to catch narrow pulses, one-shot events and transitions—to 10 nanoseconds and past 50 MHz—that even fast scopes might miss. They help keep track of pulse trains, even approximate the duty cycles of asymmetrical waveforms.

All with higher speed, precision, versatility and economy than any other testing method (or any other logic probes, for that matter).

Available singly or in Logic Analysis Test Kits, with our Logic Monitors and Digital Pulser, CSC logic probes dramatically simplify maintenance and field service—as well as design, production and education.

CSC logic probes. When it comes to digital testing no wonder so many people come to us.

CSC logic probes capture pulses as narrow as 10 nanoseconds, to over 50 MHz. Priced from $28.00 to $77.00*.

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CIRCLE NO. 18 ON FREE INFORMATION CARD

TELESCOPIC TECHNOLOGY

Travel to the Stars

Now Americans can explore the last frontier. Here is a report on the newest concept in Space-Age Telescopes.

Do you know that only 9,000 stars can be seen in the entire sky with the naked eye. However, astronomers have studied over 500,000 stars in the universe with a telescope.

Watching the stars come out, as twilight ends, is an experience that you will never forget. Sometimes the first light you see in the sky is not a star, but a bright planet, Venus. Venus is just on the other side of the Sun from the Earth and will appear over the horizon as the sun sets in the west.

A sightseeing trip through space will help you understand the mysteries of the universe.

EARLY DISCOVERIES

Galileo, the Italian astronomer, built his first telescope in 1609. It was a crude instrument. In fact, the most powerful telescope that Galileo ever built magnified objects only 33 times. Furthermore, it was possible to see only a small field of view, less than one-fourth of the diameter of the moon. Nevertheless, Galileo made some outstanding discoveries. He was able to see the rings of Saturn, four of the satellites of Jupiter and the mountains and craters of the moon.

Today, we have come a long way since the days of Galileo. Scientists and Astronomers working together have developed the most advanced telescopes of our time to keep up with the ever increasing space activity in the heavens above.

WE ANALYZED THE MARKET

There are several Celestial/Terrestrial Telescopes on the market, but most of them cost between $480 and $2,000. A few months ago we purchased a Terra Refractor-Zoom Telescope from Tasco Incorporated and discovered a superior quality instrument at an affordable price.

The new Terra Refractor-Zoom Telescope offers several innovations in the world of Astronomy. First, it is inexpensive — only $199.95. Secondly, compared with others, its impressive specifications and its wide field of view gives you clear, bright images of the heavens or distant landscapes in any weather.

Finally, it is a product with years of major telescopic technology behind it. The manufacturer of the Terra Refractor-Zoom Telescope has become the standard of the industry with more design — invention breakthroughs than any other company in the business.

JUDGE THE QUALITY YOURSELF

The precise craftsmanship and matchless versatility makes it ideal for the amateur or professional astronomer. You will appreciate the crisp, sharp, right-side-up images with the fully coated achromatic 60mm objective lens, 20X-60X zoom eye lens and 4X15 finderscope. The new Terra Refractor-Zoom Telescope is considered by astronomers as a scope for all purposes. Its new special lens design increases the field of view at 1,000 yards from the normal 40 to 50 feet to a wide 87½ feet. The all metal telescoping tripod adjusts to 54 inches in height, while the rubber tipped feet and accessory tray add to the simplicity of operation. It keeps its celestial object centered during observation by compensating for the earth's rotation with a system of micro-adjustments for altitude and azimuth control. It is 21½ inches long and has a total weight of 15 lbs. It comes complete with "Keys To Worlds Beyond" instruction booklet and the official "Rand McNally" outer space and moon maps.

LIFE-TIME LIMITED WARRANTY

The Terra Refractor-Zoom Telescope comes with a life-time limited warranty on all parts and labor — backed by two substantial companies. Your Terra Refractor-Zoom Telescope should function properly for many years without a problem, but if it ever needs repair, there is a complete service-by-mail facility as near as your postman. Just slip it into its convenient mailer and send it back for repair — further reassurance that service and the quarantee was an important consideration in our decision.

PRICE BREAKTHROUGH

The new advanced Terra Refractor-Zoom Telescope is available from Chandler's for only $199.95 complete with telescoping tripod, maps and all components. We suggest you order yours and try it out. Test it in your own back yard. Take it with you on trips to the mountains or the shore. Explore the exciting Space Frontier, Stars and Planets that you have only heard or read about before. After you have discovered how facinating our universe can really be — then decide if you want to keep it.

If you decide the Terra Refractor-Zoom Telescope is not for you for any reason, simply return your telescope within our 30-day trial period for a full, courteous and prompt refund. There will be positively no questions asked and we will even refund our $3.50 postage and handling charge. We want you to judge for yourself the truly outstanding quality of the telescope, before you decide.

Tasco Incorporated is a substantial American company with over twenty years of manufacturing and importing the most advanced telescopic products known and Chandler's is one of America's innovative marketing companies specializing in unique products-additional assurance that your prudent investment is well secured.

The Terra Refractor — Zoom Telescope comes in Two Models for your convenience. The Model 88T Polar White has a 54 inch telescoping tripod and the Model 89T Ruby Red has a 66 inch telescoping tripod.

To order your Terra Refractor — Zoom Telescope, send your check for **$199.95** for the 88T Polar White Model with 54 inch telescoping tripod or **$219.95** for the 89T Ruby Red Model with 66 inch telescoping tripod along with $3.50 per order for postage and handling (Virginia residents, please add 4% sales tax) to our address shown below or credit card buyers may call our 24-hour Toll-Free number below.

We will promptly ship your telescope, complete instructions, life-time parts and labor limited warranty, telescoping tripod and all components. Try your own adventure in astronomy and prove for yourself how remarkable the Terra Refractor-Zoom Telescope really is.

There's no risk when you can own the best. Order your Terra Refractor-Zoom Telescope with complete confidence, at no obligation today.

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Chandlers, Inc., 1979

CIRCLE NO. 13 ON FREE INFORMATION CARD

Stocking Stuffers

Linear Tracking Turntable

An advanced gimbal suspension and linear-tracking tonearm allow Technics' Model SL-10 direct-drive turntable to be operated flat or upright on edge. The machine has the

same length and width as an LP's record jacket. Designed in two halves, the cabinet's upper half contains the tonearm, its drive system, and microcomputer control block, while the lower half has a direct-drive motor and PLL control circuit. To play, a record is loaded and the cabinet closed; operation is then fully automatic. Features include: built-in cartridge preamplifier; Technics' 310 moving-coil cartridge; auto lead-in and disc-size selection; search capability; auto repeat; auto stop and return; built-in 45-rpm adapter; and a dial scale that shows tonearm position on the record's surface. Power can be either ac line or 12 volts dc.

CIRCLE NO. 91 ON FREE INFORMATION CARD

Heath "Electronic Weatherman"

Heath's microprocessor-based Model IWD-4001 (ID-4001 kit) digital Weather Computer gives time, date and past, present, and future weather data. It stores high and low temperatures, minimum and maximum baro-

metric pressures, peak and average winds, and date and time each occurred. It also calculates wind-chill factor and the rate at which barometric pressure changes to warn of storm fronts. A compact transmitter with infrared sensing devices mounts atop a TV antenna mast, while the computer console remains indoors. Ac operation with optional external battery for memory backup. $369.95 kit; $595 wired.

CIRCLE NO. 90 ON FREE INFORMATION CARD

Sansui Digital Receiver

Sansui's Model G-7700 receiver contains a true digital FM tuner and a 120-W/ch (8 ohms) power amplifier. A quartz time base,

frequency divider, and digital comparator in the FM tuner automatically lock in the signal. The patented circuitry is claimed to have a wider lock-in range than most PLL systems. FM sensitivity is 9.8 dBf (1.7μV); S/N is 76 dB; distortion, 0.1%; capture ratio, 1 dB; and selectivity, 70 dB. The AM section's frequency, although not digitally tuned, is digitally displayed. Amplifier response is dc to 200,000 Hz +0/−3 dB, and slew rate is 60 V/μs. Phono overload is 250 mV. A 15-segment LED bar display indicates instantaneous power in each channel. Full two-way, two-deck tape dubbing is built in. $800.

CIRCLE NO. 92 ON FREE INFORMATION CARD

CSC Digital Capacitance Meter

The line-powered Model 3001 3½-digit, 0.5-inch-high LED, bench-style capacitance meter from Continental Specialties Corp. can

measure from 1 pF to 199.9 μF, in nine ranges. Basic accuracy is rated at 0.1% on all but the two highest ranges, where accuracy is 0.5% of reading. A ZERO CAL control is provided for nulling out stray or cable capacitance, and can be adjusted over a 100-pF range. A unique dual-threshold scheme is the key to the instrument's accuracy.

CIRCLE NO. 93 ON FREE INFORMATION CARD

Remote Phone Answering System

The dual-cassette Phone-mate Remote 930 telephone answering system from Communication Electronics has a built-in remote control feature that allows one to play back recorded messages via the telephone line from anywhere in the world by using a coded tone key. Other features include: a digital LED received-message counter, an Audio-Scan system that allows rapid location of messages, Controlled Voice Activation (C-VOX) that allows more messages to be recorded,

and ring adjust. A microprocessor-based fail-safe system provides self-correcting backup measures. The system, set up for automatic phone answering only, allows the user to record up to 30 seconds.

CIRCLE NO. 94 ON FREE INFORMATION CARD

Portable Video Cassette Recorder

Portability in a VHS video cassette recorder can be enjoyed with Panasonic's Model PV-2200. This four-hour color VCR has de-

tachable electronic pushbutton vhf and uhf tuners. It can be programmed with up to four selections on any channel over a seven-day period. Features include: electronic digital clock/timer with on/off for preset recording; solenoid-operated pushbutton transport controls; r-f modulator (TV channels 3 and 4); ac-line/car battery/rechargeable battery (provided) powering option. Supplied with shoulder strap. $1450.

CIRCLE NO. 95 ON FREE INFORMATION CARD

Alpine Car Tuner/Cassette Deck

Alpine's Model 7307 AM/FM tuner/cassette deck/preamplifier for cars features five-station preset tuning, Dolby noise reduction on tape, and automatic replay at end of rewind.

Stocking Stuffers

It also has a noise-eliminator switch (N.E.S.), FeCr/CrO_2 tape selector, MUSIC SENSOR in fast forward and rewind, MUTE and LOUDness switches, automatic eject at end of play and fast forward and when ignition is turned off.

Separate BASS, TREBLE, and BALANCE controls, tone-bypass switch, and DIN connector round out features. Specifications: 1.4μV FM usable sensitivity; 72 dB FM S/N ratio; 1.5 dB FM capture ratio; 40 to 16,000 Hz tape frequency response; 65 dB S/N on tape; 0.09% wow and flutter. $380.

CIRCLE NO. 106 ON FREE INFORMATION CARD

Crown 11-Band Equalizer

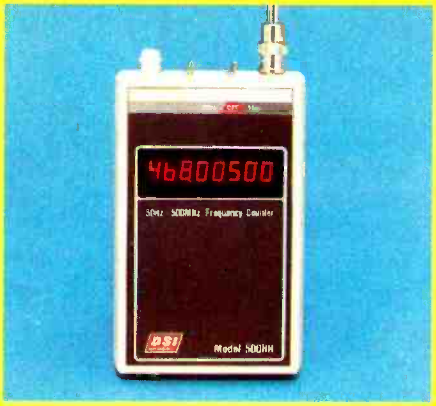
Eleven bands of equalization are available from Crown's Model EQ-2 two-channel synergistic equalizer. Center frequencies are set at 20, 40, 80, 160, 320, 640, 1250, 2500, 5000, 10,000, and 20,000 Hz. Boost/cut

range is ±15 dB, and each channel has its own frequency adjust control. The tone controls have ±20-dB ranges, with bass hinge points adjustable from 180 to 1800 Hz and treble hinge points adjustable from 1000 to 10,000 Hz. There are also equalizer- and tone-cancel master controls and overload indicators. Specifications: 20 to 20,000 Hz ±0.1 dB frequency response with controls flat; 90 dB below rated output hum and noise; 0.01% IM distortion at rated output; 2.5 volts rms rated output. $1095.

CIRCLE NO. 96 ON FREE INFORMATION CARD

DSI Mini Frequency Counter

The pocket-size Model 500 HH 50-Hz to 500-MHz digital frequency counter from DSI Instruments, Inc. is claimed to provide the accuracy and readability of full-size counters. Rated accuracy is 1 ppm (TCXO time base) from 17° to 40°C (31° to 71° F). An eight-digit LED display features automatic decimal point shifting and zero blanking. Sensitivity is rated at 30 mV from 100 Hz to 250 MHz and 50 mV from 250 to 450 MHz. Prescale input resolution is only 10 Hz in 0.1 second (1 Hz in 1 s). Input impedance is 1 megohm direct, 50



ohms prescaled, both into BNC connectors. The counter operates on a built-in rechargeable battery pack or ac power with an external battery eliminator/charger. 7¾"H × 3½"W × 1¼"D (197 × 89 × 32 mm). Price is $169.95.

CIRCLE NO. 108 ON FREE INFORMATION CARD

Realistic Computer-Controlled CB Base Station

Radio Shack's Realistic Model TRC-459 40-channel, digital LED readout, AM/SSB CB base station provides instant channel access by entering the channel number on a keyboard. Moreover, any five channels can be stored in memory and they or all 40 channels can be scanned for busy or clear channels. The SWR meter is digitally displayed; time in hours and minutes (12/24-hr format) is displayed separately. All controls (volume, r-f gain and tone) are slide-type potentiome-

ters. The unit also has a clock alarm, headphone jack, and PA provision. Rated sensitivity is 0.5μV on AM, 0.25μV on SSB for 10 dB (S + N)/N; adjacent-channel selectivity is 80 dB; image rejection is 80 dB or better. Requires 117 volts ac or 12 volts dc, positive or negative ground. $439.95.

CIRCLE NO. 109 ON FREE INFORMATION CARD

Hewlett-Packard Calculator "System"

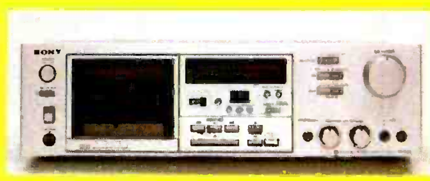
Hewlett-Packard's hand-held, LCD-display HP-41C may well be the "dream" calculator you've always wanted. It offers some 130 functions and 400 lines of program memory or 63 data-storage registers and optional plug-in Memory Modules to expand programming power. Alphanumeric capability permits labelling of programs, functions, variables, and constants and allows prompting with words or sentences. Any standard function or program can be reassigned to any desired keyboard location. Even when power is off, the HP-41C "remembers" all program, data, and key assignments. Other features include up to 6 levels of subroutines, 10 conditional and 56 external flags, specific loop control,

indirect addressing, and local and global branching. $295 for basic HP-41C; $45 each for optional Memory and Application Modules; $195 for "extra-smart" card reader; $350 for thermal printer. Optional "Wand" input device for reading "bar codes" available soon.

CIRCLE NO. 110 ON FREE INFORMATION CARD

Sony Stereo Cassette Deck

Sony's Model TC-K65 cassette deck features a metallic tape setting and a newly developed Sendust and Ferrite record/playback head. The deck has two servo motors, one for capstan drive and the other for spool rewind, and microprocessor solenoid-logic controls. Peak recording levels are displayed and held on 16-segment LED program meters. Features include: Dolby noise-reduction circuitry; Random Music Sensor for preprogramming up to 16 selections; Auto-Space mute for eliminating unwanted program material during record; master record-



level control with separate line and microphone mixing; timer-activated record/playback. Frequency response is rated at 30 to 18,000 Hz ±3 dB; wow and flutter is 0.04% wrms. $500.

CIRCLE NO. 111 ON FREE INFORMATION CARD

Ohio Scientific's Top Personal Computer

Ohio Scientific's most powerful personal computer, Model C4P MF, features a 2048-character (32 × 64) video display with

(Continued on page 13)

fact: professional studio technology comes to home hi-fi!

There is a new phono cartridge line that is the talk of the recording and broadcasting industries: the Shure SC39 Series. It is the first professionally optimized combination of true high fidelity performance, superb trackability, resistance to stylus damage under grueling conditions, and prolonged record life. These unique features make the SC39 ideal for high quality home applications as well.

if you transfer discs to tape

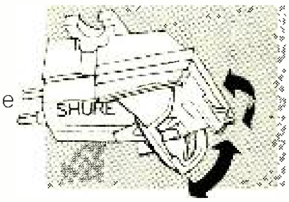
Use the cartridge developed for professional recording studios. The SC39 Series has a special strengthened internal stylus-support wire and elastomer bearing to improve stability when professional backcuing and slip-cuing techniques are employed.

In addition, the SC39 offers a unique stylus tip *not available on any other cartridge:* the MASAR™ tip, designed for playing even delicate lacquer masters, without objectionable noise buildup or "cue-burn" damage. It even helps when playing discs with high surface noise, or 45 rpm records made from reprocessed, substandard vinyl or polystyrene.

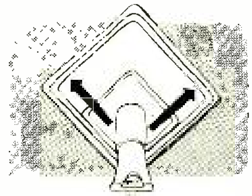
if youngsters have access to your hi-fi

This cartridge also comes close to being "butterfinger-proof." Most stylus damage is caused either by dropping the cartridge or by pushing the stylus sideways against the edge of a record. To protect against this, the SC39 is equipped with two remarkable features. The first is the *Lever-Operated* Stylus Guard, which locks the stylus guard in safety position when not in use. With the flip of a thumb, the guard snaps up and the operating lever turns into a handy cuing aid.

In addition, the SIDE-GUARD Stylus Deflector protects the stylus shank from damage by withdrawing it safely into the cartridge body in response to sideways impacts.



Lever-Operated Stylus Guard

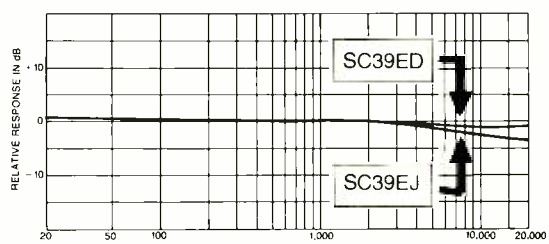


SIDE-GUARD Stylus Deflector

if you prefer professional response

The transparent sound of the SC39 Series is due to its optimized professional response which is virtually flat through the upper mid-range, with a smooth and gentle rolloff at the highest frequencies. It is especially pleasant when used with loudspeakers that tend to exaggerate the high frequencies.

There are three models in the SC39 Series: SC39ED—Biradial (Elliptical) stylus for 3/4 to 1½ gram tracking; SC39EJ—Biradial (Elliptical) stylus for 1½ to 3 gram tracking; and SC39B—Spherical stylus for 1½ to 3 gram tracking.



Typical Frequency Response

Send for brochure AL620.

SC39 series professional phono cartridges...by

SHURE®

Shure Brothers Inc., 222 Hartrey Ave., Evanston, IL 60204
In Canada: A. C. Simmonds & Sons Limited
Outside the U.S. or Canada, write to Shure Brothers Inc., Attn: Dept. J6 for information on your local Shure distributor.
Manufacturers of high fidelity components, microphones, sound systems and related circuitry.

CIRCLE NO. 54 ON FREE INFORMATION CARD

Stocking Stuffers

(Continued from page 10)

16 colors and 256 × 512 point graphics resolution. The standard model comes with 24K of static RAM and a minifloppy disk drive (directly expandable to 48K and two

drives). Features include: 64-character line width; full keyboard with upper- and lower-case characters; line printer interface; advanced disk-BASIC software; instant program loading; high speed animation; sound output; D/A converter; joystick interfaces; and home-security and fire-alarm interface.

CIRCLE NO. 112 ON FREE INFORMATION CARD

SAE "Class A" Power Amplifier

SAE's Model X-10A "Hypersonic Class-A" 100-W/channel power amplifier employs a new high-efficiency output-stage design that is said to achieve the advantages of Class A operation with Class AB efficiency. Another design innovation is the use of balanced fully complementary mirror-image amplifiers that are claimed to correct linearity problems

common to transistors. Among its features are "True Power" display indicators, gold-plated connectors, and turbo-flow heat sinking for output transistors. Specifications: 100 W/channel output power into 8 ohms at 20 to 20,000 Hz +0/−0.25 dB frequency response with 0.02% THD and IM; 120-dB S/N; 1.4 volts high-level sensitivity; 60 volts/μs slew rate; and greater than 100 kHz power bandwidth. $800.

CIRCLE NO. 113 ON FREE INFORMATION CARD

RCA "Limited Edition" Color-TV Receiver

The Contura GD930R "Limited Edition" color-TV receiver from RCA features a 25"-diagonal 100° picture tube, automatic color control, fleshtone correction, light sensing, and contrast/color tracking. It also has a BlackLock contrast circuit. ChannelLock keyboard electronic tuning with programming memory, and XL (XtendedLife) chassis. Features include Dual Dimension Sound (one each 9" and 6" oval speakers) for synthetic stereo, and Dynamic Detail Processor to improve video resolution. An electronic remote

control system controls power/volume and up/down channel selection for all 82 channels. The contemporary cabinet is made from pecan solids and veneers and simulated wood trim.

CIRCLE NO. 114 ON FREE INFORMATION CARD

Pioneer Auto-Reverse Open-Reel Tape Deck

The Model RT-909 open-reel stereo tape deck from U.S. Pioneer Electronics Corp. features three motors and a four-head automatic reversing system. It can accommodate reels up to 10½" (267 mm) in diameter. The closed-loop dual-capstan transport is operated by solenoids controlled via touch-sensitive electronic switches. Capstan drive is provided by a dc servo motor, whose playback speed can be adjusted through a range of ±6% by a "pitch control." A 24-segment

Fluroscan meter displays recording levels, and a four-digit electronic index counter monitors tape usage. Signals from MIC and LINE inputs can be mixed prior to recording. Specifications: 30 to 30,000 Hz ±3 dB frequency response at 7½ ips (20 to 18,000 Hz ±3 dB at 3¾ ips); more than 50-dB channel separation; crosstalk more than 50-dB down; greater than 60-dB S/N at 7½ ips (55 dB at 3¾ ips); 0.04% wrms wow and flutter at 7½ ips (0.08% at 3¾ ips); 1% maximum harmonic distortion at 7½ ips.

CIRCLE NO. 115 ON FREE INFORMATION CARD

Magnavox Videodisc Player

Magnavox brings the optical videodisc player to the consumer market with its Model 8000 Magnavision. The player connects to the antenna terminals of any home color or monochrome TV receiver. It employs a tiny laser beam to relay picture and sound information that are said to be equal in quality to the best broadcast TV reception and better

than videotape playback. Features include: halt (freeze frame), slow, fast, and reverse play; rapid random access; instant replay; frame-by-frame readout; and outputs for connection to AUX inputs of a hi-fi system. An extensive library of discs is available for $5.95 to $24.95 each. $775.

CIRCLE NO. 116 ON FREE INFORMATION CARD

Kloss Projection TV System

The Novabeam[T] Model One large-screen color-TV projection system from Kloss Video Corp. is claimed to offer the brightest picture ever provided by a projection system for

home use. This two-piece system consists of a receiver/projector console and a separate free-standing 6½' (2-meter) diagonal-measure screen that yields a 5½' × 4' (1.7 × 1.2 m) picture. The receiver employs a comb filter for greater picture resolution and offers random-access electronic tuning with full-function wireless remote control. Three Novatron projection tubes, operated on a modified Schmidt principle, are used. $2500.

CIRCLE NO. 117 ON FREE INFORMATION CARD

Kenwood Precision FM Tuner

Designed for the purists among FM listeners, the Kenwood L-07TII tuner employs several high-technology devices in its circuitry, including surface acoustic wave filters (for enhanced selectivity) and a pulse-counting detector (for lower distortion). Wide or narrow intermediate-frequency bandwidth can be selected to help preserve as much of the tonal

quality in the signal as possible. In addition, the tuner incorporates such niceties as signal-strength and channel-center meters, as well as a highly legible dial. Specifications: 37.2-dBf/40-µV 50-dB quieting sensitivity in stereo; 84-dB mono, 80-dB stereo S/N; 0.7-dB WIDE, 1.3-dB NARROW capture ratio; 30-dB WIDE, 100 dB NARROW alternate-channel selectivity; 20-to-15,000-Hz +0.2/−1-dB frequency response; 120-dB spurious and image response ratio; 110-dB i-f-response ratio; 45-dB WIDE, 38-dB NARROW separation, 50 to 10,000 Hz.

CIRCLE NO. 118 ON FREE INFORMATION CARD

Telequipment Oscilloscope

Telequipment's Model D1016, from Tektronix, is a moderately priced, dual-trace 15-MHz scope that offers automatic, normal, and TV triggering, X-Y display capability, and X5 magnifier to meet a wide range of servicing and experimenting needs. It has sensitiv-

ity ranges of from 5 mV to 20 volts/division and switchable 0.2-µs to 200-ms/division time-base sweep speed (40 ns/division with magnifier). An uncalibrated sweep control is used for variable sweep rates between positions of the time/division switch and extends the slowest sweep speed to 500 ms/division. Suggested retail price is $895.

CIRCLE NO. 119 ON FREE INFORMATION CARD

Chafitz Modular Game System

Chafitz's BORIS 2.5 modular game system, is designed so that a control panel slides into a storage position under the playing board. Chess pieces are displayed electronically on the board. It analyzes its next best move while waiting for its opponent's response and even gives game-related mes-

sages, such as "MATE IN THREE." A backspace control allows erasure of up to three moves per side to remedy blunders and evaluate varying response strategies. It can also evaluate up to five full moves ahead and if you haven't time to finish a game, piece position will be held in memory indefinitely on ac and for five days in battery mode. Other features: seven playing levels; tournament timer; audio alert tones for various modes; rank display and position verification; position programming; handicapping; move monitor; and alphanumeric display. Can be operated on ac-line power or up to six continuous hours on optional rechargeable battery pack. Updating modules will be available.

CIRCLE NO. 120 ON FREE INFORMATION CARD

The logic behind the Revox B77.

The logic is the logic which is built-in.

It's an ingenious and highly sophisticated system—much like the human nervous system—which controls the deck's functions.

You can push any button in any order with no chance of damaging your tapes. Our motion sensing system constantly feeds status reports to the logic circuitry which activates your commands in proper sequence.

The logic also permits full-function remote control, and an editing mode that keeps the playback circuitry live, even when the motors are stopped. You can make your splices right on-the-beat, and our built-in splicing block makes it easy.

The design and construction of the Revox B77 further guarantee smooth and accurate operation. To get the long-life advantage of ferrite without static build-up or heat degradation, we use Revox's exclusive Revodur heads, made of metal to dispel heat and static, and vacuum-coated with permalloy for durability.

The B77 has a unique capstan motor that's monitored by a tacho head to precisely control speed and limit wow and flutter to professional studio standards.

Revox offers many options with the B77 including a full range of speed configurations from 15/16 IPS to 15 IPS, variable speed control, ¼ track record/playback and more.

All this professional quality is neatly engineered to fit in a deck you can carry. After all, if you own a machine this good, it's logical to take it with you.

Experience the B77 and the full line of Revox audio components at your franchised Revox dealer today.

REVOX

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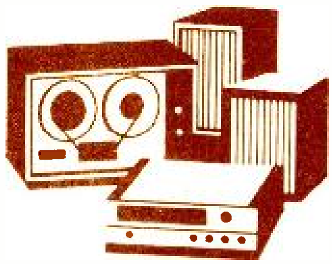


Stereo Scene

By Harold A. Rodgers
Senior Editor

SPECIFICATIONS AND BEYOND II

LAST MONTH, we started to look at some of the pitfalls inherent in excessive reliance on numerical specifications in appraising the performance of audio products. In fact, our investigation barely scratched the surface of that topic. Having dealt with amplifier power and distortion specifications, let's examine specs for some other components and see what they do or do not tell us about how the product will behave under real operating conditions. We'll begin—with appropriate trepidation—by looking at transducer specifications.

The Record's the Thing. As many readers are doubtless aware, the exact measured frequency response given for a phono cartridge depends on the test record used. As can be seen in Fig. 1, the differences are not great and are fairly well confined to the region above 10 kHz.

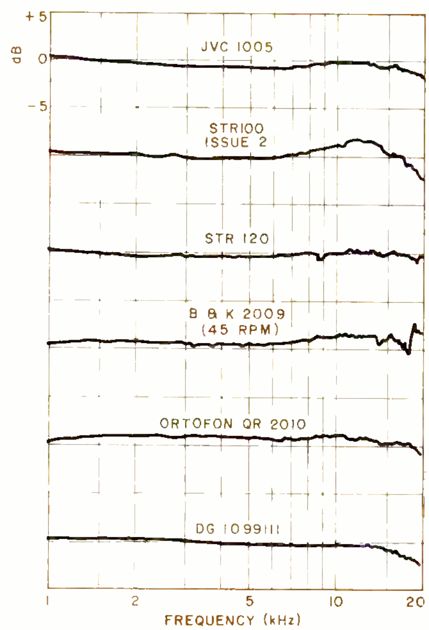


Fig. 1. Frequency response of test records using same cartridge. (Courtesy of Stanton Magnetics.)

However, they are of sufficient magnitude to make the choice of a cartridge that is flat within ±1 dB over one whose limits are ±2 dB fatuous. Clearly, when interpreting pickup frequency-response data, the best course is simply to ignore small variations. You can never be sure that they exist in practice, and they can be equalized in any case.

Separation, too, depends as much on the record as on the cartridge. First, since the modulation on one groove wall can cause the stylus to deform the modulation of the opposite wall slightly, the hardness of the vinyl is a factor. Second, not all cutters use the same geometry. Some, rather than keeping the left and right modulation mutually orthogonal, that is, 90 degrees apart, use, for technical reasons, some other angle, say 91 or 92 degrees. This difference is for all practical purposes inconsequential. It does, however, limit separation measurements to the neighborhood of 25 dB. One pickup manufacturer went so far as to optimize the geometry of a new model for a 92-degree cutting angle so that a separation spec on the order of 35 dB could be obtained with a popular test record. This does not compromise the product in any significant way, nor does it help—except for yielding that lovely data.

Of course, many of these impressive numbers represent overkill. It is generally recognized, for example, that a stereo image is not enhanced by pickup separation in excess of 17 dB or so, and few listeners can distinguish ±1 dB from ±2 dB in frequency response. By all means, take the numbers into account, but remember that tracking ability—which depends on stylus mass and geometry and a proper choice of dynamic compliance—is the sine qua non of a phono cartridge. If the stylus cannot trace the groove accurately (and without recutting it), none of the other characteristics of the pickup are apt to help matters very much.

Note also that the mass of the tonearm is a crucial factor. The more massive the arm, the less compliance there can be if the low-frequency resonance of the arm/cartridge system is to be kept out of the record-warp band.

It may prove tempting to use listening tests as the bottom line in selecting a cartridge, but great caution should be exercised. Using a pre-selected disc, it is quite possible to make a demonstrably inferior unit sound better than one that is well designed. The prudent auditioner will use his own records and double-check on a reasonably large number of them before reaching a decision.

For some audio hobbyists, it seems that the specification that a pickup is a moving-coil design is sufficient to win it a place in a highly preferred category. A few moments of consideration suggests that such a view might be misguided. It can be stated on the basis of the physics involved that a conductor moving with respect to a magnetic field has no way of "knowing" whether or not it is moving or stationary with respect to this or that frame of reference. The same relative motion between the conductor and field induces the same voltage regardless of the external frame of reference. Therefore, whatever it is, if anything, that makes the moving-coil pickup special, it is not the transduction principle per se.

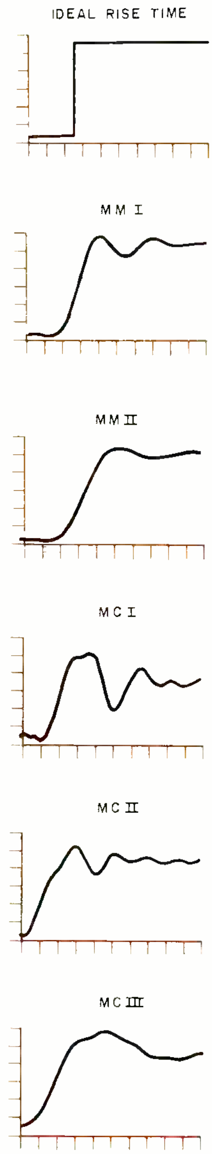
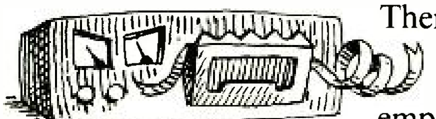


Fig. 2. Rise time of moving-magnet (MM) and moving-coil (MC) cartridges. Lateral scale: 10 microseconds/div. (Courtesy of Stanton Magnetics.)

It has been suggested that moving-coil designs are less subject to back-and-forth scrubbing motions of the stylus than are fixed-coil designs, but this point seems at least arguable. Perhaps less controversial is the idea that moving-coil pickups are less likely to interact with preamp inputs than are fixed-coil types. This property would appear to be related to their low output impedance and the fact that they are isolated from the standard phono preamp by the head amp needed to boost their low output. Even when the boost is supplied by a transformer, the impedance reflected by the secondary is in

(continued on page 21)

Even the most enlightened consumer can get eaten alive in the hi-fi jungle.



There are probably few places where the phrase "caveat emptor"– let the buyer beware–is more applicable than in high fidelity.

The average consumer walks into a hi-fi store only to be confronted by a morass of receivers, turntables and tape decks, running the gamut from the unaffordable to the unpronounceable. And to make matters worse, the salesman seems to speak some bizarre dialect about megahertz and transient response.

At Sony, we sympathize with the plight of the music lover caught in this rather distressing situation. And to this end we offer some reassurance:

Since 1949, Sony has been at the very forefront of high fidelity. (In fact, our name is derived from the Latin word "sonus" for sound.)

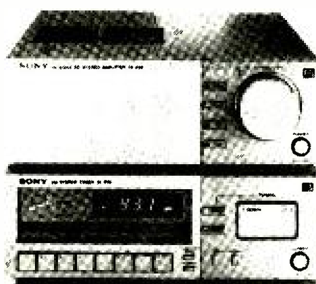
And while the technology has changed, one thing hasn't: Since the beginning we've never put our name on anything that wasn't the best.

The V4 receiver: You don't need an engineering degree to understand what makes it superior.

Put as clearly as possible, the V4 was designed for people who are as interested in getting good value as they are good sound.

In terms of power, for example, the V4 offers ample wattage to fill almost any size living room with clean, clear sound. (55 watts per channel at 8 ohms from 20 to 20,000 hertz, with less than 0.1% total harmonic distortion.)

It has absolutely no audible distortion.



The new Sony micro components: small in everything but performance.

It features the same kind of "direct coupled" circuitry used in the most expensive professional broadcast amplifiers to ensure rich bass.

It's completely encased in metal to reduce interference.

It's capable of running two sets of speakers without straining, and has something called a "phase-locked-loop IC stereo multiplex stage" that guarantees extraordinary FM reception.

All of which explains why if you pay a few dollars less for one of our competitor's receivers it's probably because you're getting less receiver.

The V4 Receiver: the latest from the company that founded the era of transistorized high fidelity.

The X30 turntable: Proof, once again, that Sony is the real pioneer in high fidelity.

Today, virtually all of the world's most expensive turntables feature "quartz lock." An electronic circuit that works like a quartz watch to ensure perfect turntable speed.

Now Sony has improved on this incredibly accurate system in the only way possible: by making it less expensive. But to buy the X30 on it's price alone would be selling it short.

Like today's most expensive turntables, the X30 features a direct-drive motor that eliminates pulleys and unreliable belts. But unlike models built by Pioneer and Technics, our direct-drive motor is both brushless *and* slotless—which means it's more accurate.

Instead of using an inexpensive particle-board base like many of our competitors, the X30's base is made of a Sony patented "bulk molding compound" that reduces acoustic feedback.

And we've even made the X30's platter mat slightly concave—so if your records are a bit warped, they won't sound that way.

SSU-2070 speakers: Sony remains one of the only hi-fi companies to produce our own speaker cones, crossover units, and even the cabinets themselves.

The X30 direct-drive turntable: it even compensates for warped records.

The law of the jungle: Survival of the smartest.

Obviously, we don't have enough space here to tell you the whole Sony hi-fi story.

Like the way our new micro components use Sony developed "pulse power supplies" that reduce distortion almost to the point of being unmeasurable.

Or the way our new SSU-2070 speaker system guarantees you'll hear every part of the music with distortion reducing carbon fiber speaker cones. And a computer-designed speaker arrangement that makes sure you hear the music exactly as it was recorded.

The point of all this, however, is that for over three decades Sony has built superior audio equipment. Extraordinary products whose reputation for quality, value and reliability is unsurpassed.

So even if you don't know watts from ohms, at least you'll be able to survive in the hi-fi jungle by knowing Sony.

For more information, or the name of your nearest Sony dealer, write us at Sony, P.O. Box CN-04050, Trenton, N.J. 08650.

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STEREO SCENE (Continued from page 16)
most cases lower than that of a fixed-coil design.

But moving-coil pickups have their problems too. Their moving structures tend to be fairly massive and their suspensions correspondingly stiff. This necessitates relatively high tracking forces if groove contact is to be maintained at high frequencies. The slower risetimes shown by many moving-coil pickups (Fig. 2) do not necessarily correspond to or indicate sonic deficiencies. They do, however, make claims of electrical superiority and better high-frequency response and tracking less supportable.

As far as we are concerned, neutrality with respect to transduction principle is proper. We have seen good and bad examples of both varieties. It should be noted, however, that in a massive tonearm, the relatively stiff (noncompliant) suspension of the cantilever may give a moving-coil pickup an advantage, though possibly at the cost of faster wearing of records.

The Ultimate Can of Worms. If there is an audio component more refractory than a loudspeaker when it comes to numerical specification of performance, I do not know what it is. For example, if we are given a frequency response curve for a speaker, under what conditions does it apply? As Dr. Amar Bose once pointed out at a press seminar, frequency response curves have meaning when we have defined the input and output ports of the unit under test. But where is the output port of a loudspeaker? At a point one meter away on axis where such curves are often taken? (Who listens from there?) At a "normal" listening position—whatever *that* may be? Or shall we try to sum the total output power; and if so, how?

Whatever method we settle on, we have to decide where to put the speaker. In an anechoic chamber? If here, how does the data relate to a real room? In a real room? Then how does data taken in that room relate to performance in my room, which almost undoubtedly has different acoustic properties. No matter what we do, we are, as the Australians might say, up a gum tree. The data will disclose only the grossest anomalies and certainly cannot be used to distinguish a good product from one that is excellent. Granted, loudspeaker engineers manage to interpret such data quite well. But in addition to their considerable knowledge and experience, they have the opportunity to take many sets of curves with all parameters under reasonably tight control.

When frequency-response data is given as, say 40-18,000 Hz ±2 dB (note that limits are included to make the numbers "meaningful"), the situation is even worse. Looking at Fig. 3, one can easily see that

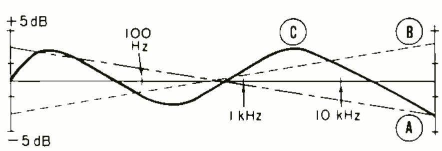


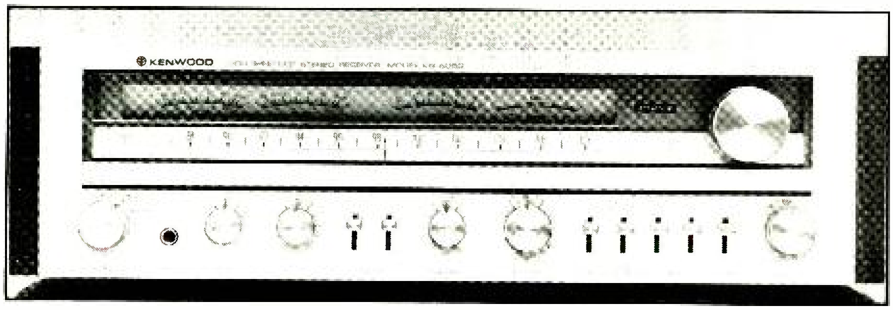
Fig. 3. Three possible speaker response curves; all ± 3 dB.

the summary description given above applies equally well to all three curves, each of which could be expected to give a different sonic effect. A more careful description would include the rms ripple across the passband, and the slope of the best straight-line approximation would help to distinguish curves two and three.

Not too surprisingly, data on loudspeaker distortion can be equally uninformative. I can recall an instance in which a speaker with an audibly defective midrange driver gave a plot of second- and third-harmonic distortion that even the manufacturer's chief engineer considered perfectly normal. The difficulty is that, as with amplifiers, the spectrum of the distortion is not adequately taken into account. A defective driver, for example, is not likely to contribute much in the way of second and third harmonics. Its unsolicited output will probably consist mainly of fifth, seventh, or even higher-order partials.

I could continue to point out serious ambiguities in specs and numerical performance evaluation *ad nauseam*, but I suspect that the point has been made. The purpose of this discussion has not been to damn specs out of hand, only to suggest that they be interpreted with care and caution. Many designers insist on the importance of correlating that which is measured with that which is heard, but I know of none who would say that the process is easy. Further, I suspect that virtually all check their handiwork in careful listening. After all, no engineer could keep a job very long by turning out products with great specs and mediocre sound.

Julian Hirsch Audio Reports



Kenwood Model KR-6050 stereo receiver with "high-speed" dc amplifiers

Kenwood's new stereo receiver line features "high-speed" dc amplifiers whose claimed slew rates exceed those of competitive receivers as well as previous Kenwood models. With a slew rate of ±100 volts/microsecond and an audio power rating of 60 watts/channel into 8 ohms from 20 to 20,000 Hz with no more than 0.02% THD, the Model KR-6050 is typical of the current Kenwood design philosophy. The FM tuner section offers selectable wide and narrow i-f bandwidths, a feature rarely found in medium-priced receivers. In most respects, the KR-6050 closely resembles the higher-priced Kenwood receivers, the chief exception being its modest output-power rating.

Housed in a walnut-grained vinyl wooden cabinet, the receiver measures 20¼"W × 16⅛"D × 6"H (516 × 409 × 154 mm) and weighs 28.7 lb (13 kg). Suggested retail price is $490.

General Description. Two of the four meters behind the upper half of the receiver's front panel indicate audio power into 8-ohm loads. Their logarithmic scales are calibrated from 0.01 to 120 watts. The other two meters are conventional tuning indicators, one for relative signal strength on AM and FM and the other for center-channel tuning on FM only.

The SPEAKER selector switch turns on and off the power to the receiver and controls two pairs of speaker outputs simultaneously. It can also silence all speakers for headphone listening.

The control complement consists of SUBSONIC and HIGH filter switches; BALANCE and VOLUME controls; and FM MODE, TAPE MONITOR, FM IF BANDWIDTH, and two TAPE MONITOR switches. The STEREO/MONO FM MODE also controls muting, which is always on in the automatic-stereo mode and always off in the mono mode. When both TAPE MONITOR switches are set to PLAY, the output of deck B is monitored while it is recording from the output of deck A. The input SELECTOR switch has positions for AM, FM, PHONO, and AUX program sources.

On the rear of the receiver are insulated binding-post speaker connectors and a hinged ferrite-rod antenna for AM and binding-post terminals for both AM and FM antennas. One of the two accessory ac outlets on the rear apron is switched. Inside the cabinet is a switch by which the time constant of the FM deemphasis can be set at 25, 50, or 75 microseconds.

Kenwood does not supply a schematic diagram with the KR-6050, but the user's manual points out the receiver's exceptional slew rate, 0.95-microsecond rise time, and use of FETs in the low-level audio stages and a MOSFET in the r-f section. The FM multiplex decoder has a pilot-signal canceller instead of the usual notch filter to remove the 19-kHz pilot carrier from the audio.

Laboratory Measurements. Following the one-hour preconditioning period at one-third rated power and five minutes at full power, the top of the receiver was moderately warm. With both channels driven at 1000 Hz into 8 ohms, distortion was a nearly constant 0.0055% to 0.008% from 0.1 to 65 watts/channel output. Clipping occurred at 70 watts/channel. With 4-ohm loads, the distortion was slightly greater, measuring about 0.016% between 0.1 and 80 watts and 0.02% at 90 watts before output clipping at 93 watts. Although the receiver is not rated to drive 2-ohm loads, tests revealed 0.028% distortion from 0.1 to 20 watts and 0.032% between 30 and 40 watts, with clipping occurring at 50 watts with such low-impedance loads.

distortion into 8 ohms was less than 0.008% from 0.1 to 65 W/channel

Driving 8-ohm loads at 60 watts, the distortion was very low at bass and midrange frequencies, dropping from 0.004% at 20 Hz to 0.0022% between 100 and 300 Hz and rising to a constant 0.009% from 1000 to 20,000 Hz. At lower power, the shape of the curve was similar, but the distortion levels were slightly lower. Although the POWER meter reads typically 10% to 50% high on continuous signals, it was about 10% low at 60 watts.

A high-level input of 90 mV drove the amplifier to a reference 1-watt output, with an A-weighted S/N ratio of better than 90 dB (our measurement limit). Phono sensitivity was 0.28 mV at 79 dB S/N referred to 1 watt. Phono preamplifier overload occurred at 225 mV at 20,000 Hz (converted to an equivalent 1000-Hz level). IHF clipping headroom at 8 ohms was 0.68 dB, and dynamic headroom was 2.07 dB, corresponding to a short-term output of 96.7 watts. Into 4 ohms, the short-term output was 144.7 watts/channel, which is consistent with Kenwood's rating of 300 watts of total dynamic output power at 4 ohms.

The IHF slew factor exceeded our measurement limit of 25. Slew rate measured about 168 volts/microsecond, and rise time was approximately 1 microsecond.

The tone controls had rather moderate characteristics, with the bass turnover frequency shifting between 100 and 500 Hz as the control was varied and the treble response hinging at about 2000 Hz. Maximum boost or cut at the frequency extremes was about 10 dB. Loudness compensation boosted only the lower frequencies, beginning at about 1000 Hz. The SUBSONIC filter had a very slight effect in the audio range (about 1 dB at 20 Hz), and the HIGH filter had a 6 dB/octave slope with −3-dB frequency at 5000 Hz. RIAA phono equalization was flat within +0.2/−0.8 dB from 20 to 20,000 Hz. When we measured the phono frequency response through the inductance of a phono cartridge, there was a broad high-frequency rise between 3000 and 17,000 Hz, wtih a maximum of +2 dB at 11,000 Hz falling off to −1 dB at 20,000 Hz. Phono input impedance was 52,000 ohms in parallel with 250 picofarads.

We measured most of the FM tuner characteristics separately for the WIDE and NARROW i-f bandwidths, which can affect many of the results. Among the few characteristics not affected by the bandwidth were the muting/stereo threshold of 17 dBf (4 microvolts), 19-kHz pilot carrier leakage of −58 dB, the tuner hum level of −70 dB, and image rejection of about 90 dB.

(Continued on page 30)

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Stopwatch display:	11:49 05 ST 6	12-hour timing to 1/10 second. Even lap and 1-2 finishes.
Alarm setting display:	9:45 AL 8 9 PM AL	Set for AM or PM. Audible beep lasts a full minute.
Calendar setting display:	12:00 25 DT 4 SU MO TU WE TH FR SA 12 PM AL	Set time/date for 2 time zones. End-of-month adjustment is automatic.
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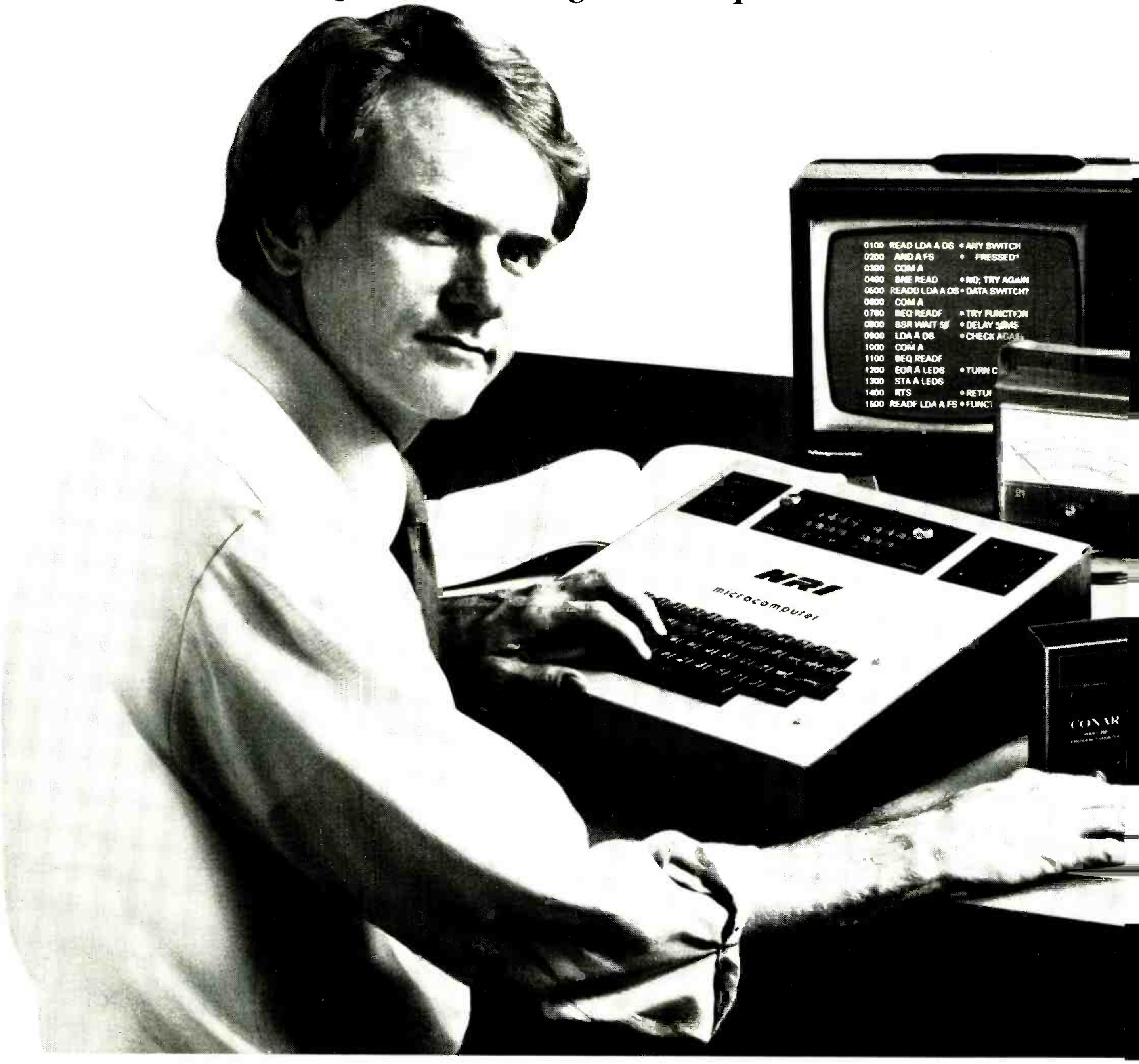

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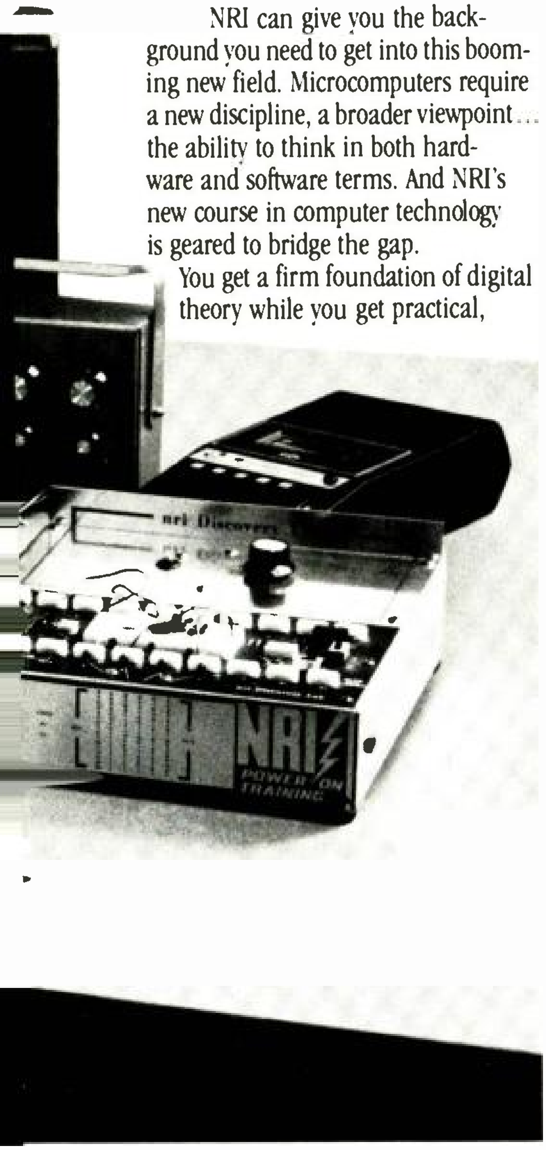

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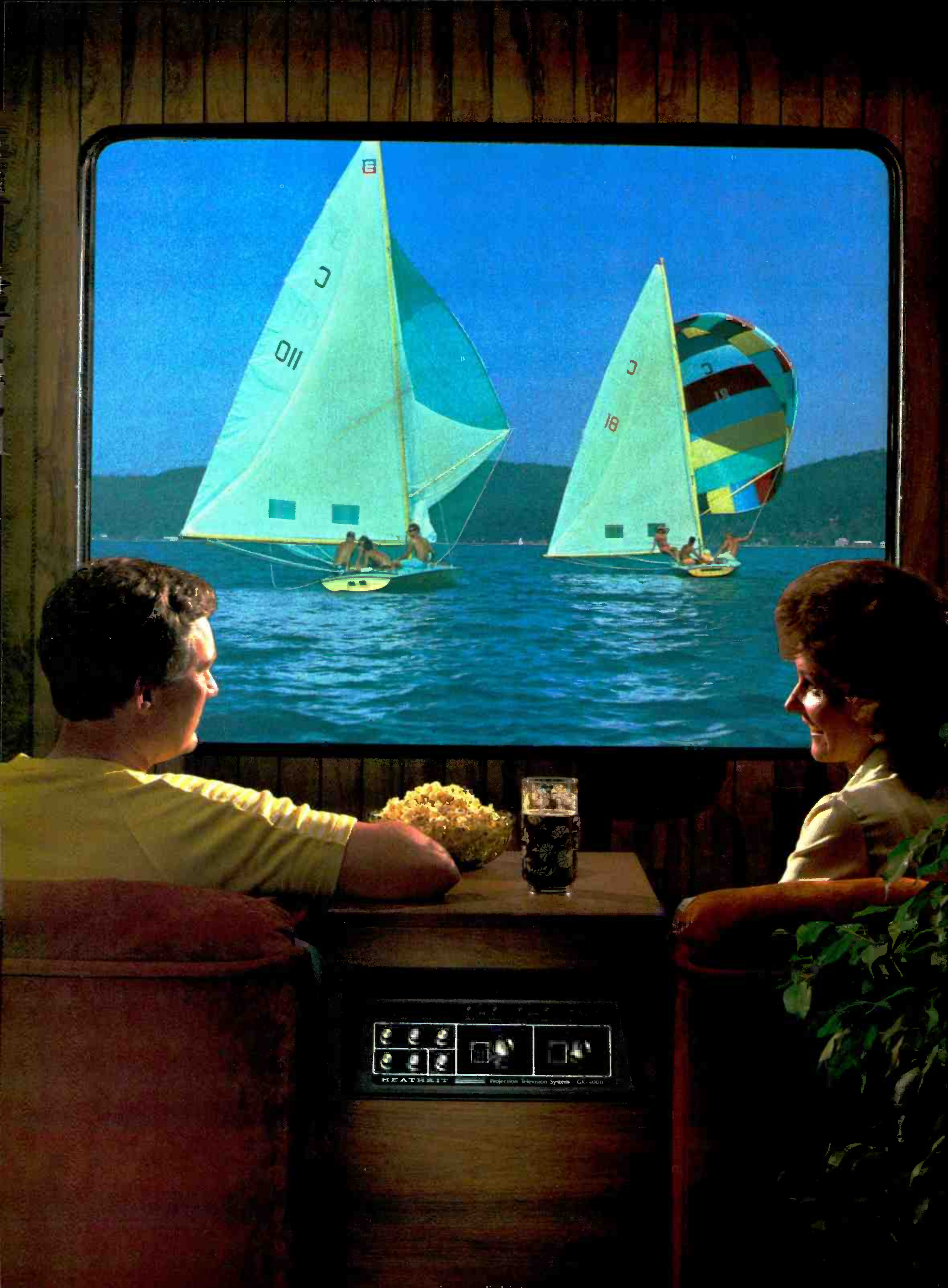
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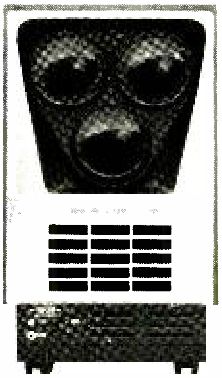

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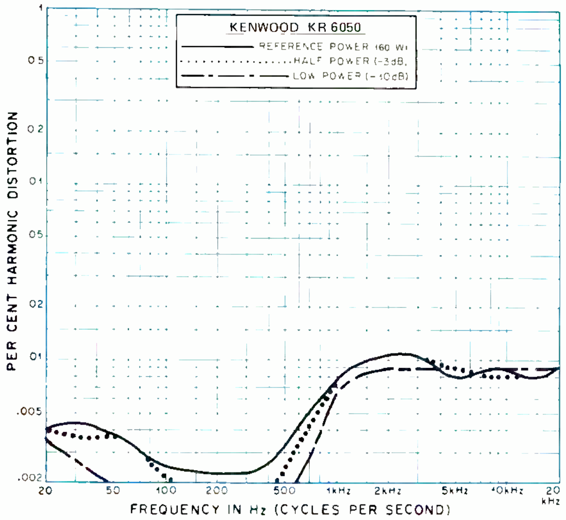
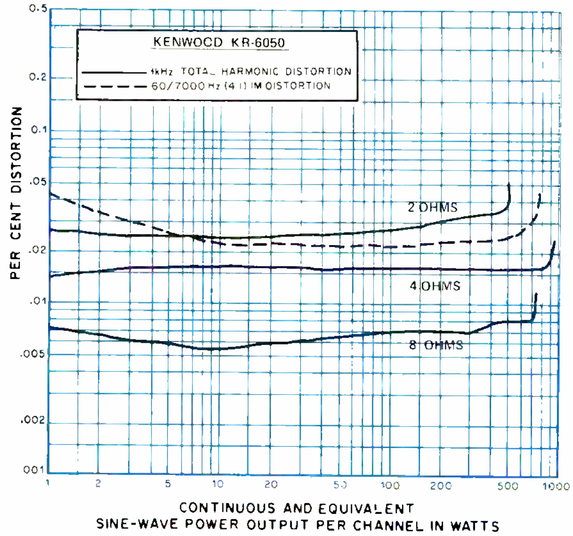


Distortion with 8-ohm load for three power levels.



1000-Hz THD, both channels driven, right measured.

(Continued from page 22)

In the WIDE mode, IHF usable sensitivity was 11 dBf (2 microvolts) in mono. The 50-dB quieting sensitivity in mono was 14.5 dBf (2.9 microvolts) with 0.63% THD and 35 dBf (30 microvolts) with 0.36% THD in stereo. Distortion at a 65-dBf (1000-microvolt) input was 0.12% in mono and 0.1% in stereo, with respective S/N measurements of 82 and 71.5 dB.

With NARROW bandwidth, mono IHF sensitivity was 14.5 dBf (2.9 microvolts). The 50-dB quieting sensitivity in mono was 14 dBf (2.7 microvolts) with 3.6% THD, and 35 dBf (30 microvolts) with 0.55% THD in stereo. The tuner's distortion at 65 dBf was 0.215% (mono) and 0.29% (stereo). The mono and stereo S/N measurements were 78.5 and 71 dB, respectively. Although tuning for minimum distortion was fairly easy with WIDE bandwidth, it was extremely critical with NARROW bandwidth. In practice, one could expect the distortion to be several times higher than we measured.

The FM tuner frequency response was almost perfectly flat up to 7000 Hz and rose to +1 dB at 15,000 Hz. Channel separation was unusually uniform with frequency. With WIDE bandwidth, it averaged about 46 dB and exceeded 42 dB over the full 30-to-15,000-Hz range. With NARROW bandwidth, separation was 24 dB from 30 to 10,000 Hz and 25.5 dB at 15,000 Hz.

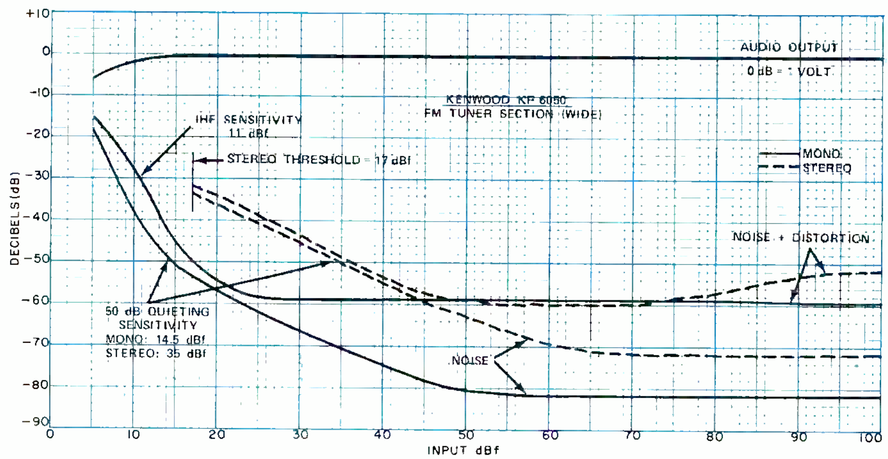
In the WIDE mode, capture ratio was an excellent 0.9 to 1 dB, depending on signal strength. AM rejection was an unimpressive 53 dB at a 45-dBf (100-microvolt) input but increased to an excellent 72 dB at 65 dBf. When we used NARROW bandwidth, the capture ratio degraded to about 2.8 dB. AM rejection, at 65 dB, was also slightly lower.

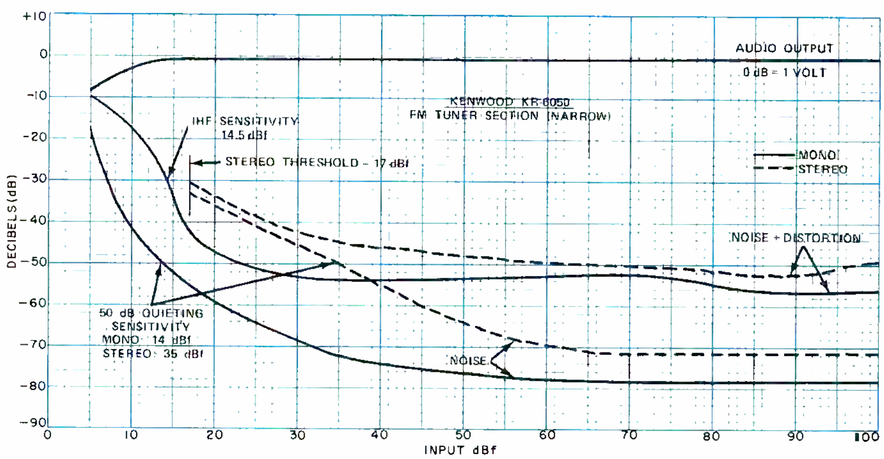
As might be expected, selectivity was directly affected by the i-f bandwidth. The i-f passband was rather asymmetrical, but the averaged alternate-channel selectivity was 72 dB in WIDE and 85 dB in NARROW. Respective adjacent-channel-selectivity readings were 4.7 and 20 dB. The only measurement we made on the AM tuner section was of its frequency response, which gradually sloped below 1000 Hz to −6 dB at 120 Hz and rapidly fell above 2000 Hz to −6 dB at 3200 Hz.

FM response was nearly flat to 15,000 Hz

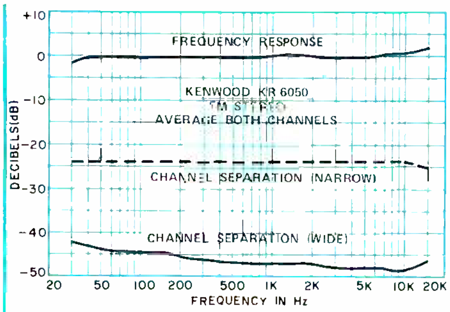
User Comment. The KR-6050 impressed us most with its superb audio section. Distortion was not only extremely low, but nearly constant with power and fre-

(Continued on page 32)





Noise and sensitivity curves with wide and narrow bandwidths.



Frequency response and crosstalk.

quency over the entire normal operating range of the receiver.

The importance of very-high slew rates in an amplifier is still a matter of controversy, but in the case of the KR-6050's high-speed amplifier, we observed very low distortion at the highest audio frequencies. An amplifier using slow, narrow-band output transistors will have a marked increase in harmonic distortion at the higher audio frequencies at almost any power level. This effect was notably absent.

The selectable bandwidth of the FM tuner section might prove to be a useful feature in some locations plagued by severe adjacent- or alternate-channel interference problems. Selectivity in NARROW is appreciably better than in WIDE, but the latter gives a very good 72-dB reading, and it would be an exceptional situation that would produce interference with 72 dB selectivity and not with 85 dB! The difference between the two adjacent-channel readings was much more striking, and the 20

Performance Specifications

Specification		Rating	Measured
AMPLIFIER SECTION			
Power output (8 ohms, 20–20,000 Hz, 0.02% THD)		60 watts	Confirmed
Dynamic power (4 ohms)		300 watts	290 watts
Slew rate		±100 V/μs	±168 V/μs
Rise time		0.95 μs	1 μs
Input sensitivity: (for 60 watts)	PHONO	2.5 mV/50k ohms	0.28 mV for 1 watt (IHF) 52k ohms/250 pF
	AUX	200 mV/50k ohms	19 mV for 1 watt (IHF)
S/N ratio (A-weighted):	PHONO	84 dB/2.5 mV	79 dB/1 watt (IHF)
	AUX	105 dB/200 mV	90 dB/1 watt (IHF)
Maximum phono level		200 mV	225 mV
Frequency response:	RIAA	20–20,000 Hz ±0.2 dB	+0.2/−0.8 dB
	AUX	5–240,000 Hz −3 dB	20–20,000 Hz ±0.1 dB
Tone control:	BASS	±9 dB at 100 Hz	+8/−9 dB
	TREBLE	±9 dB at 10 kHz	+8/−10 dB
Loudness control (volume at −30 dB)		+10 dB at 100 Hz	Confirmed
Subsonic filter		18 Hz, 6 dB/octave	Not measured
High filter		5 kHz, 6 dB/octave	Confirmed
FM TUNER SECTION			
Usable sensitivity		10.3 dBf	11 dBf
50-dB quieting sensitivity		16.1 dBf mono	14.5 dBf
		37.9 dBf stereo	35 dBf
S/N ratio at 65 dBf		83 dB mono	82 dB mono
		75 dB stereo	71.5 dB stereo
THD		0.08% mono	0.12% mono
		0.09% stereo	0.10% stereo
Capture ratio		1.0 dB	1.0 dB
AM suppression ratio		65 dB	72 dB
Stereo separation		40 dB, 50–10,000 Hz	42 dB, 30–15,000 Hz
Subcarrier product ratio		60 dB	58 dB

dB we measured in NARROW is one of the best we have found on any FM tuner. Except where a serious interference problem exists, we strongly recommend that the WIDE mode be used at all times. Not only are its capture ratio and distortion much lower than in the NARROW mode, but we found it extremely difficult to tune a station for minimum distortion in NARROW, whereas in WIDE, it is as easy as with any other receiver. Tuning "feel" is smooth, with a noise-free muting system that is positive and devoid of any signs of thumping. FM dial-scale calibration on our test sample was so accurate that frequencies could be read or set within 100 kHz with ease. Tuner noise level, too, was considerably lower than average.

Judged by our measurements and listening evaluations, the "high-speed," dc amplifier incorporated in the KR-6050 is a success. Though we cannot attest to any obvious differences between its sound and that of any other fine-quality amplifier, its distortion and noise measurements are impressively low and nicely complemented by the performance of the FM tuner section. This, of course, does not rule out audible differences, though it suggests that they are very subtle. It is noteworthy that the amplifier measurements—rise time and slew rate in particular—were made with signals injected via the AUX input. Rise time and slew rate data thus apply to low-level gain and tone-control stages as well as the power amplifier, normally the only section so rated. This can be regarded as a neat little bonus to top off the product.

CIRCLE NO. 101 ON FREE INFORMATION CARD

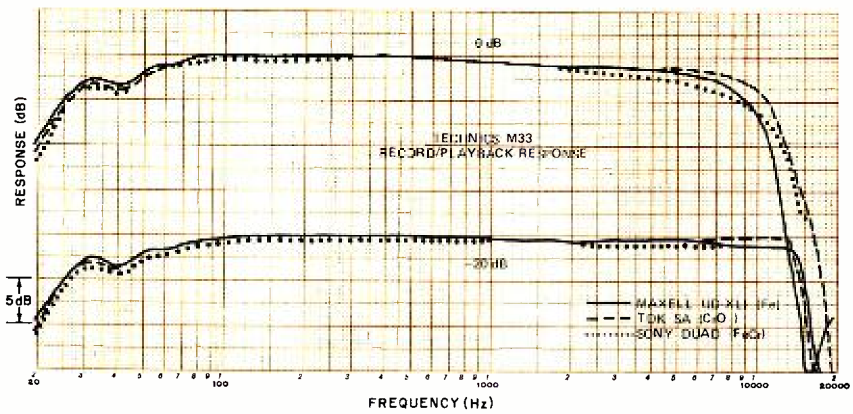
Technics Model RS-M33 cassette deck displays level on fluorescent bar graph

HIRSCH-HOUCK

Technics' medium-priced Model RS-M33 cassette deck offers operating and convenience features usually found only in more expensive decks. For example, this front-loading deck has two heads and a frequency-generator-controlled dc servo motor that drives the capstan and tape hubs. Instead of analog meters or LED overload indicators, the RS-M33 has a fluorescent bar-graph level display that responds instantaneously to program peaks, with no overshoot or lag. In the bar graphs, the 16 elements that extend from −20 to 0 dB are colored yellow, while the four that indicate from 0 to +8 dB are longer and colored orange.

(Continued on page 34)

*FEATURES	EXIDY SORCERER	TEXAS INSTRUMENTS 99/4	ATARI 800	APPLE II	COMPUCOLOR MOD III	COMMODORE PET	TANDY TRS-80
Price of Minimum Configuration	$995	$1150	$999.99	$1150	$1495	$795	$599
Computer Type	Z80	9900	6502	6502	8080	6502	Z80
Maximum RAM in Unit	48K	16K	49.1K	48K	32K	8K	16K
ROM Supplied	12K	26K	16K	8K	17K	14K	4K
Display	B/W	Color	Color	Color	Color	B/W	B/W
CHAR/Line	64	32	40	40	64	40	64/32
Line/Screen	30	24	24	24	16/32	25	16
Graphic Resolution	512/240	192/256	380/192	280/192	128/128	320/200	128/48
Keyboard	79 Key Typewriter	40 Key Calculator	57 Key Typewriter	52 Key Typewriter	77 Key Typewriter	73 Key Calculator	53 Key Typewriter
Lower Case Standard	Yes	No	No	No	No	No	No
Numeric Keypad Standard	Yes	No	No	No	Yes	Yes	No
Programmable Characters Standard	128	No	No	No	No	No	No
I/O Electronics Included	Dual Cassette RS232 Communications 8 Bit Parallel	Joystick Sound	Joystick Serial Single Cassette	Single Cassette Joystick	Single Disk RS232 Communication	Single Cassette IEEE 488	Single Cassette
Expansion Bus	S-100	No	No	Yes	Yes	IEEE 488 Daisy Chain	Yes
Disk Available	630K Byte	No	92K Byte	116K Byte	51.2K Byte	125K Byte	45K Byte
System Software Available	ROM Basic ROM Assembler ROM Word Processor CPM EXT. Basic CPM Fortran CPM Cobol CPM APL CPM Pascal	ROM Basic	ROM Basic ROM Assembler	ROM Basic Disk Basic Pascal	Disk Basic	ROM Basic Disk Basic	ROM Basic Disk Basic Cassette Assembler



Frequency responses at 0 and −20 dB for three different tape types.

Separately switchable bias and equalization permit the deck to operate with normal ferric-oxide, chromium-dioxide, and ferrichrome tapes. Dolby noise reduction, as one would expect, is built in. The recording inputs can be switched to either line or microphone sources, which cannot be mixed. With an external timer, advance set-up can be made for unattended playback or recording.

The deck measures 16⅞" W × 10½" D × 5⅝" H (430 × 267 × 142 mm) and weighs 14 lb 13 oz (6.7 kg). Suggested retail price is $350.

medium-priced deck has low 0.04% wow and flutter

General Description. From the front, the Technics RS-M33 resembles a typical front-loading cassette deck, with the cassette compartment at the left and the transport keys below it. When the EJECT key is pressed, the door swings out with a smoothly damped motion, and the cassette is lifted slightly for easy withdrawal from the door guides. Almost all of the label of a running cassette can be seen and there is backlighting to allow the amount of tape on each hub to be estimated.

The controls for INPUT LEVEL are concentric and affect the channels individually; a smaller OUTPUT LEVEL knob controls both channels together. The two MIC jacks are provided, as is a PHONES jack. A small control near the bar-graph display regulates its brightness. Lever switches control the Dolby system, select LINE or MIC recording inputs, and set the recording bias to HIGH, MED, or LOW values for CrO_2, FeCr, or NOR (ferric) tapes. A similar EQ switch gives a choice of 70-microsecond (for the first two tapes) and 120-microsecond equalization (ferric tape).

A MEMORY rewind system that can be set to stop the tape or put it into play when the index counter reaches 000 during rewind is provided. In addition, REWIND AUTO PLAY rewinds the tape to its beginning and plays it automatically. (Normally, the transport mechanism shuts off and mechanically disengages when the tape stops at the end of a cassette.)

If the fast-forward or rewind key is held down during play, the tape moves fast in the selected direction and a low-level, high-pitched sound can be heard from recorded sections of the tape. Releasing the key restores normal playback. When the tape is stopped, the fast-speed controls operate in the customary way.

Laboratory Measurements. We tested the RS-M33 with Maxell UD-XLI for NOR, TDK SA for CrO_2, and Sony Duad for FeCr bias and equalization. These were the tapes used by Technics as the basis for the deck's published ratings.

A LINE input of 60 mV or a MIC input of 0.27 mV was required to obtain a 0-dB recording level. Microphone preamplifier overload occurred at a relatively low 31-mV input. Depending on the tape used, the playback output from a 0-dB recording was 0.66 to 0.73 volt. (Maxell UD-XL I gave the highest output.)

At a 0-dB recording level at 1000 Hz, the playback signal had a third-harmonic distortion of 0.8% with UD-XL I, 1.6% with SA, and 1.3% with Duad tapes. The 3% reference distortion level was reached at inputs of +6, +3, and +4.5 dB, respectively. Referred to these levels, the unweighted signal-to-noise (S/N) ratio was 51 dB for Duad and UD-XL I tapes and 48 dB for SA tape. With A weighting, S/N was 57 dB for UD-XL I, 56.6 dB for SA, and 58.7 dB for Duad. Dolby noise reduction and CCIR/ARM weighting improved these figures to 63 dB for UD-XL I, 62.6 dB for SA, and 64.8 dB for Duad.

Through the MIC input at maximum gain, the noise level was 4.7 dB greater than through the LINE input. At reduced gain settings, however, the increase in noise was negligible. Crosstalk from right to left channel at 1000 Hz was 40 dB down.

Response of the fluorescent bar-graph indicators was virtually instantaneous, so that 0.3-second tone bursts gave the same reading as a continuous signal of the same amplitude. Standard Dolby-level tapes gave readings within 1 dB of the +3-dB reference calibration marks on the display scales. The playback frequency response had a pronounced high-frequency loss with both 120- and 70-microsecond equalization. TDK AC-337, Teac 116SP, and the new DIN test cassettes from BASF all showed this effect to some degree. This appears to be a matter of head alignment, since the record/playback frequency response was excellent.

At a −20-dB recording level, the response of Maxell UD-XL I varied by only 2 dB between 50 and 14,000 Hz. Low-frequency head-contour ripples were moderate in amplitude, and the output did not drop appreciably below 30 Hz.

Above 14,000 Hz, output fell sharply. The response of a 0-dB recording was good up to 8000 Hz; the 0-dB curve intersected the −20-dB curve at 13,000 Hz.

As expected, TDK SA and Sony Duad tapes at −20 dB behaved much like UD-XL I, but the 0-dB response extended to 10,000 Hz and never intersected the −20-dB curve. Tracking of the Dolby circuits was excellent, with no more than 1-dB change in frequency response between Dolby IN and OUT conditions at levels between −20 and −40 dB.

Flutter was 0.04% in a weighted rms (JIS) measurement and ±0.07% in a weighted-peak (CCIR) measurement. The major flutter components were in the range from 30 to 40 Hz. Tape speed was 0.2% slow at the beginning and 0.5% slow at the end of a cassette. A C-60 cassette could be fast-wound in 86 seconds.

User Comment. Mechanical operation of the transport's piano keys was silky smooth. Even so, the similarity of all the keys made it too easy to inadvertently press the wrong one, in spite of the fact that the PLAY and STOP keys are somewhat wider than the others. However, we particularly appreciated the manner in which the cassette was partially raised out of the well

(Continued on page 37)

Performance Specifications

Specification	Rating	Measured
Wow/flutter	0.05% wrms	0.04% wrms
Frequency response	CrO_2/FeCr 30-17,000 Hz (no tol.)	CrO_2 50-14,000 Hz +0/−2 dB FeCr 55-14,500 Hz +0/−2 dB
	Normal Tape 30-14,000 Hz (no tol.)	UD-XL I 50-14,000 Hz +0/−2 dB
S/N ratio (FeCr tape)	Dolby in: 67 dB (above 5 kHz) Dolby out: 57 dB	65 dB (CCIR/ARM) 58.7 dB (A-wtd)
FF/RW time (C-60)	Approx. 90 seconds	86 seconds
Input sensitivity	MIC: 0.25 mV	0.27 mV
	LINE: 60 mV	60 mV
	MIC: Overload (NA)	31 mV

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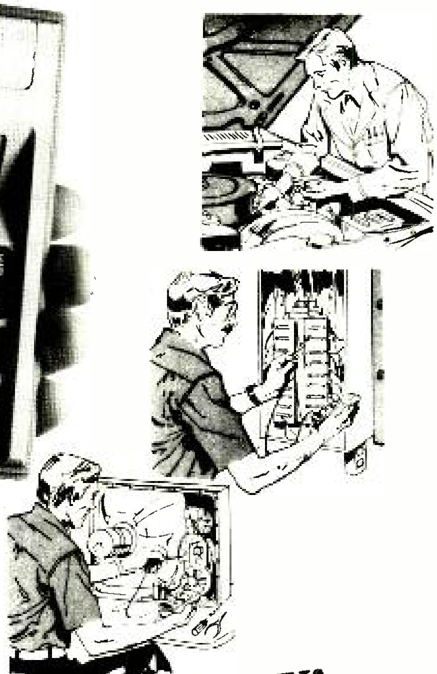

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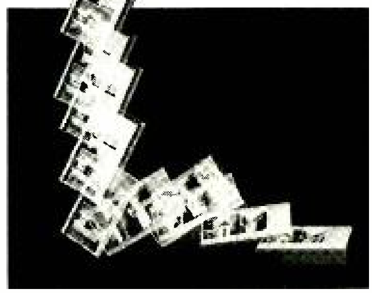

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DC Volts (5 RANGES): 200mV to 1000V full scale, RESOLUTION 0.1mV ACCURACY: ±(0.5% rdg + 0.5% f.s.): INPUT IMPENDANCE: 10MΩ: OVERLOAD PROTECTION, 1000VDC or peak AC all ranges. **AC VOLTS (40 Hz to 5kHz):** 200V to 600V full scale: RESOLUTION: 0.1V: ACCURACY: ±(1.0% rdg – 0.5% f.s.). 2.0 db at 5kHz: OVERLOAD PROTECTION: 600VDC or rms. **RESISTANCE (6 RANGES, LOW POWER):** 200Ω to 20MΩ full scale; RESOLUTION: 0.1Ω; ACCURACY: ±(0.5% rdg + 0.5% f.s.) ± (1.5% rdg + 0.5% f.s.) on 20MΩ range; OVERLOAD PROTECTION: 120VDC or rms all ranges, 240V rms for 30 sec. **DC CURRENT (6 RANGES):** 20 nA to 200 mA full scale; ACCURACY: ±(0.5% rdg + 0.5% f.s.); OVERLOAD PROTECTION: 80V on 10 nA to 10 μA ranges, 25 mA on 100 μA range and 500 mA on 100 mA range. **GENERAL:** DIMENSIONS: 5⅞ × 3⅜ × 1¾" (14.7 × 8.5 × 4.3cm); WEIGHT: 12 oz (0.33kg); POWER 9V battery (not incl.) or Hickok AC Adapter: BATTERY LIFE: Alkaline, 300 hours typical READ RATE: 3/sec.; TEMPERATURE: 0 C to 50 C operating. – 35 C to + 60 C storage.

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CIRCLE NO. 30 ON FREE INFORMATION CARD

HIRSCH REPORTS

(Continued from page 34)

door when the EJECT button was pressed.

When we recorded interstation hiss from an FM tuner and compared the playback to the incoming signal, there was a tendency toward brightness in the playback, even when the "average" recording level was as high as −5 dB. This was actually an instantaneous peak reading, and a conventional meter would have produced a much lower reading. This serves to emphasize that one can—and should—record at substantially higher indicated levels using peak meters than with a similar deck having slower meters.

At any rate, the added brightness was slight and overall fidelity was easily as good as we have found on other cassette decks in the RS-M33's price range. With musical-program material from FM broadcasts the deck did a virtually perfect job of recording. We noted that the headphone volume was too low for use with 200-ohm phones, however.

Concerned about the apparent azimuth misalignment of the record/playback head (which does not affect the overall record/playback frequency response), we played a number of high-quality commercially recorded Advent CR/70 series cassettes. The highs appeared to be all there and general sound quality was as good as we have ever heard from these cassettes. Of course, the loss of highs was less evident with the 70-microsecond equalization used with the Advent cassettes; material recorded on ferric tape might not do quite as well.

To sum up, we found the Technics RS-M33 easy to use and above average in versatility. With these characteristics and very fine sound quality, it is an excellent value in its price range.

CIRCLE NO. 102 ON FREE INFORMATION CARD

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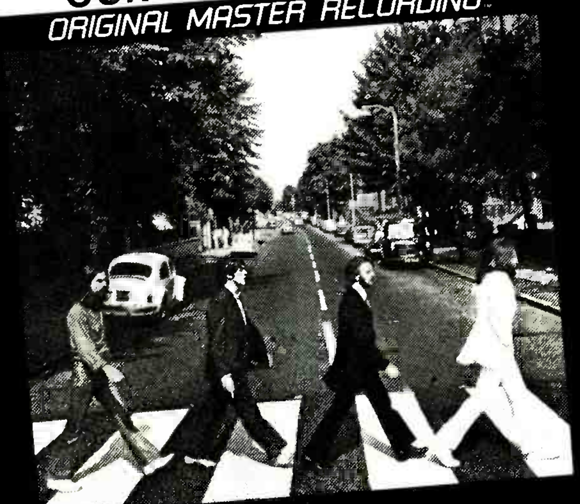

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CIRCLE NO. 63 ON FREE INFORMATION CARD

Popular Electronics
DECEMBER 1979

FAX— The Quiet Giant

How facsimile transmission by telephone speedily delivers documents and illustrations

BY DANIEL M. COSTIGAN

LONG BEFORE television became a commercial reality some 33 years ago, the electronic transmission of *still* pictures—news photos and weather charts in particular—was already an established routine. In fact, pictures were being experimentally transmitted by wire for many years before the telephone was invented in the 1870s.

Somewhere along the way, the process became known simply as "facsimile"—"fax" for short—and, as one of the more slowly evolving inventions of modern times, it has exhibited a phenomenal endurance record. It was very nearly consigned to oblivion in 1950 when the greater popular appeal of TV precluded fax's debut as a viable home news and information medium via FM radio. Instead, it asserted its tenacity and went on to become one of today's principal business communication tools.

Today's typical fax machine is a telephone-coupled transceiver capable of sending or receiving an 8½" × 11" page of text or pictures in anywhere from a few seconds to several minutes, depending on cost/legibility/speed tradeoffs. And, depending on the level of sophistication (some units automatically answer the phone or skip rapidly over blank spaces in the copy), it can cost from $1000 to $20,000 to purchase, or $39 to $400 a month to rent.

One terminal can be in New York, the

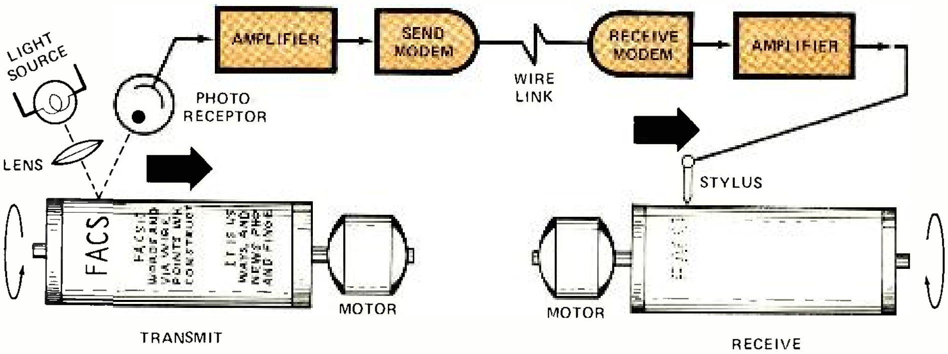

Fig. 1. Drum scanning, a concept originated in the 1850s, is still widely used in modern fax equipment.

other in San Diego. The distance between terminals depends only on the communication link (typically the telephone dial network) and government regulations.

Many (perhaps most) existing fax machines are acoustically coupled to the phone line via the telephone handset. The current trend, however, is toward direct hook-up via plugs and standard phone jacks. The FCC has an ongoing program through which fax machines can be certified for that purpose. Direct hook-up of noncertified, or unregistered, machines is strictly forbidden.

The only nonacoustic alternative to the FCC-certified plug-in arrangement is indirect connection via a certified protective phone coupler, which until recently was usually provided for a nominal monthly fee by the telephone company. But now this so-called "data access arrangement" (DAA) is in the process of being phased out in favor of direct plug/jack connections.

Makers and Users. A dozen or more domestic firms and a greater number of foreign ones currently produce some 100 different models of fax machines for use in a wide variety of applications. Among the better known names currently associated with fax are Xerox, 3M, Litton Industries, Exxon, Burroughs, Stewart-Warner, Matsushita (Panasonic), and Toshiba. Rumor has it that IBM may soon be added to this list.

At last count, there were more than 150,000 fax machines in use in this country alone, and the number is steadily growing throughout the world. Besides the Federal Government (notably the National Weather Service) and the major news agencies, publishers, banks and law-enforcement agencies are principal users of specialized fax terminals.

But the vast majority of the machines produced are of the office variety and are used to dispatch documents of every conceivable type: reports, charts, rush orders, engineering and software changes, anything that must reach its destination in less than the day or more it would take by mail. "Electronic mail" is a current buzz term that is frequently applied to fax. Indeed, it is hard to find a mail room or communication center in today's business world that doesn't have at least one fax machine.

Scanning Methods. Prevailing fax technology is a mixed bag of the old and the ultra-new. The vast majority of transmitters still use electromechanical scanning—most often a scan head consisting of a miniature incandescent lamp and photodiode, screw- or belt-driven axially along a spinning drum containing the document being sent (Fig. 1).

Scan resolution is typically slightly more than 60, or slightly less than 100 scan lines per linear inch of copy. At drum speeds of 180 rpm, this amounts to transmit times of 4 or 6 minutes, respectively, for an 8½" × 11" page—or 2 or 3 minutes, using bandwidth compression techniques. These are typical parameters for phone-coupled fax terminals, the output frequencies of which (including sidebands) must remain within the flat portion of the telephone bandpass, which is roughly 300 to 2500 Hz.

Transmitters are also available with feed-through scanners, permitting insertion of the document into a slot rather than wrapping it on a drum. These use relatively fast-moving multiple-scan heads that sweep across the slowly advancing page, or perhaps a laterally moving aperture in a fixed optical path. One of the more modern mechanical techniques uses a fiber-optic array to convert a rotary scan to a repeating linear sweep, as depicted in Fig. 2.

The most advanced fax transmitters, however, use arrays of charge-coupled

(Continued on page 47)

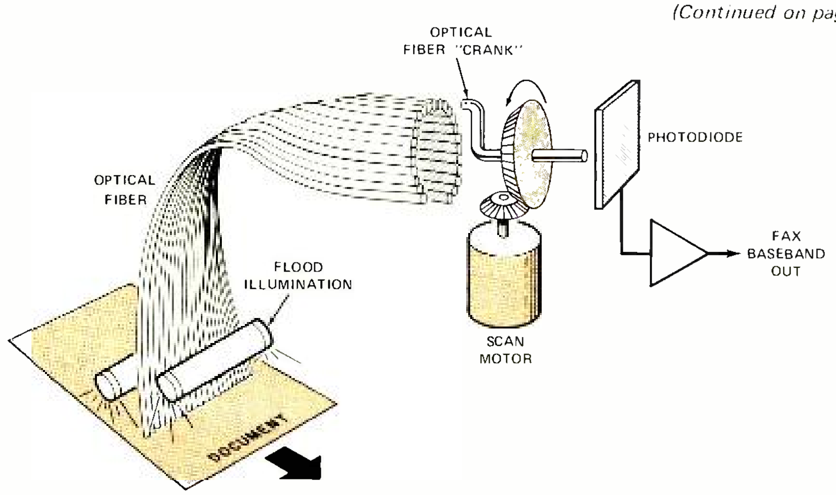

Fig. 2. Use of fiber optics to convert a linear scan to a circular path is one scanning technique used in fax. It permits the dark-light variations within a scan line to be read serially by simple rotary mechanism.

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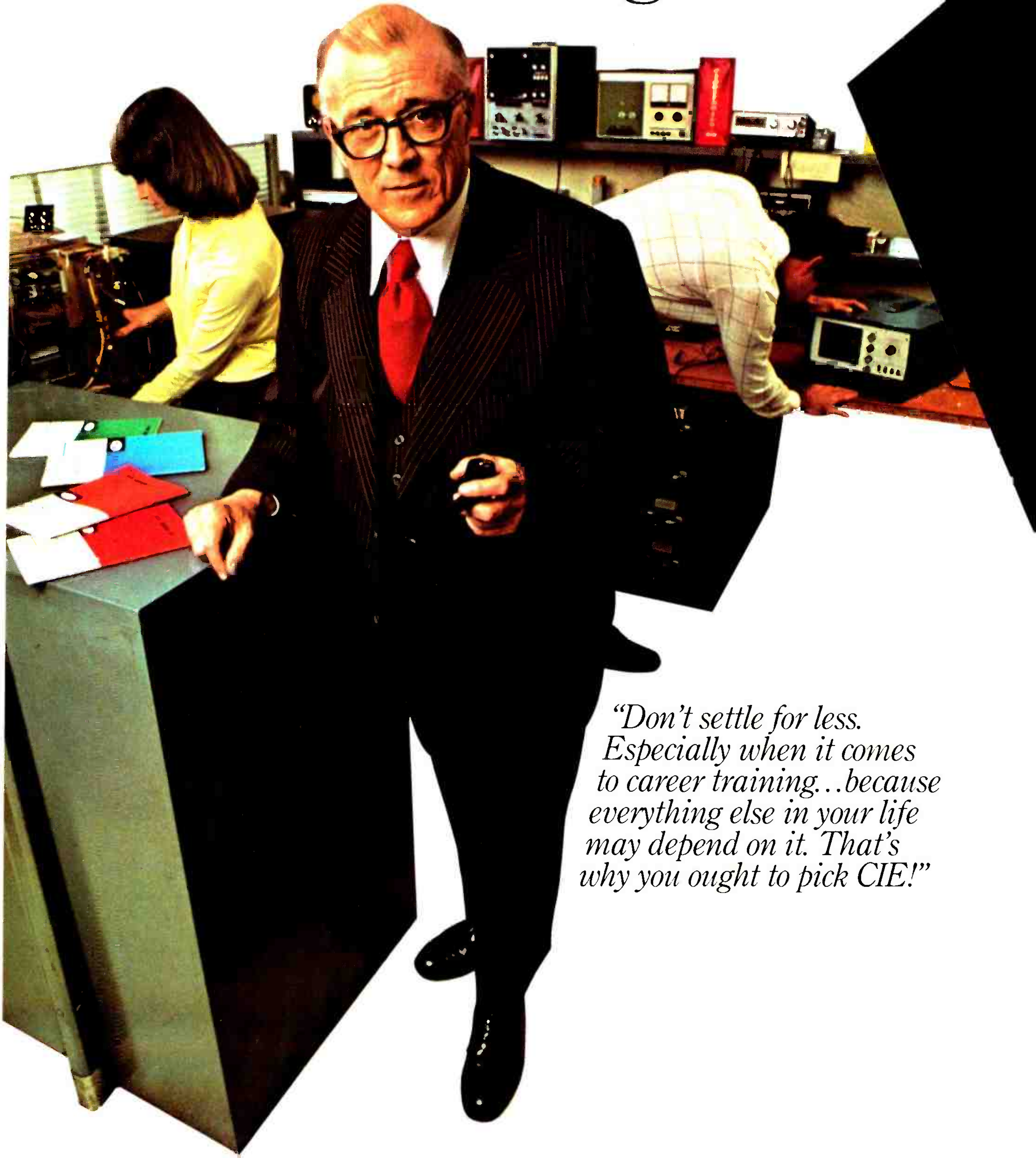

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5600A-W	$179.95									
3550	99.95	50Hz-550MHz	TCXO 1 PPM 17°-40°C	25MV	25MV	75MV	8	.5 Inch	*115 VAC or 8.2-14.5 VDC	2⅛" x 8" x 5"
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(Continued from page 40)

devices (CCDs) or similar solid-state imaging arrangements to eliminate all moving parts except those necessary to feed the document (Fig. 3).

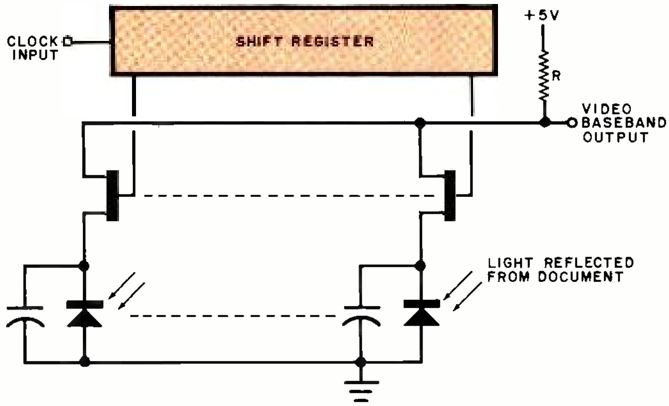


Fig. 3. Solid-state scanning uses photosensors and shift-register action to produce serial variations of output.

Signaling. The amplified dc baseband output of the scanner—or, in the latest generation of fax systems, a digital representation thereof—modulates an audio-frequency carrier for transmission over telephone circuits. Both amplitude and frequency modulation are used in analog fax systems, and phase modulation is favored for digital systems. Unlike some other types of data terminals, fax machines generally have their own built-in modems.

Some analog systems use bandwidth compression techniques to achieve a 2:1 increase in transmission speed. The basic technique resembles "duobinary," a data signaling process introduced some years ago. In essence, each white-black-white cycle of the scanner baseband triggers a flip to the opposite side of the base line. As transmitted, the flip may be in the form of either a frequency or amplitude shift. In either event, the effect is to halve the number of base-line crossings, thus, in effect, halving the output frequency. An inherent drawback of the process is that it somewhat reduces the signal-to-noise ratio, making the signal more susceptible to the effects of certain transmission impairments.

Although most fax systems currently in use are of the relatively simple analog variety, the trend is toward increasing use of sophisticated digital techniques to improve transmission efficiency. The result is an average fourfold increase in terminal cost, which, however, is offset by an average *six*fold increase in transmission speed.

Digital data compression, as applied to facsimile, utilizes a process called "run-length coding" to reduce signaling redundancy. The scanner output is first "thresholded" (Fig. 4A) to reduce the copy elements to either black or white (no grays). This "squared-off" baseband signal then enters a buffer, where the information content of each scan line is automatically analyzed for number and location of white-black-white transitions. "Transitions" is the key word here, because what is put out on the communications channel is a series of binary code words (Fig. 4B) describing the occurrence of these tonal transitions and their location within a scan line.

Naturally, if the page being scanned contains a great deal of intricate detail, the encoding process can be quite slow, and transmission speed suffers accordingly. But, on the average, the number of digital bits required to locate and identify transitions is about one-sixth the number required to transmit each and every elemental segment of a given scan line, many of which represent spaces. (In digital systems, each 8½-inch scan line is normally segmented into either 1024 or 1728 elements, or "address points.")

Skipping of unessential elements in the copy can be achieved to some degree by analog techniques as well. Xerox's recently announced Telecopier 485, for example, has a microprocessor-controlled scanner that "looks ahead" and, sensing blank space, commands the send and receive mechanisms to speed up until the next appearance of image details on the page.

Conventional analog systems, have the advantage of being able to transmit the gray tones of a picture (or various colors interpreted as grays) as well as the black and white elements. The tonal range is limited mainly by the reproduction process and by transmission characteristics. It is a capability that comes naturally to analog signaling and does not ordinarily impose additional costs.

Handshake. Besides the picture signal that conveys the content of the input document to the remote receiver, most modern fax systems exchange control signals that permit varying degrees of automatic operation. Collectively, these signals are called the "Handshake."

For example, when an unattended fax receiver responds to the telephone ringing current and, in effect, puts the phone "off-hook" to complete the connection, it sends a tone of a given frequency back to the transmitter, acknowledging that it is on-line. Recognizing the tone as that of a machine with which it is compatible, the transmitter may then return to a different tone, identifying the speed/resolution combination at which it is set to operate and, at the same time, testing the condition of the line. After the last chirps of the picture signal have been received, there is a "stop" tone from the transmitter, indicating the end of transmission and cueing the automatic receiver to hang up the phone.

Synchronization. For a document to be properly reproduced at the receive end of a fax system, the interconnected machines must be synchronized. In an analog system, this generally requires an initial "phasing" step in which one machine runs slower than the other until the "start-of-line" pulses that are generated by both machines occur simultaneously. Then the slower machine immediately accelerates to normal speed. This ensures that the copy will be properly

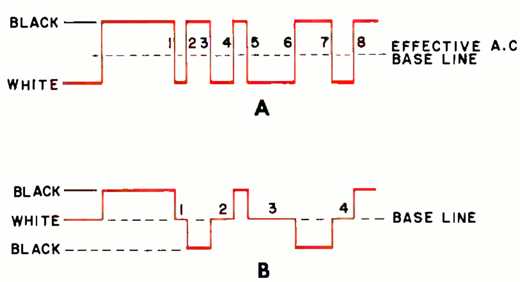


Fig. 4. In basic analog bandwidth compression concept, polarity switching of alternate black pulses (A) reduces baseline crossings by half (B).

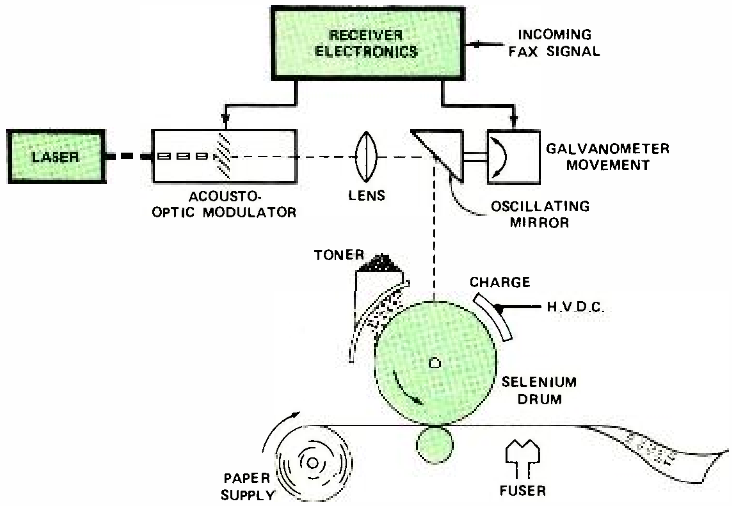


Fig. 5. Laser technology is used with Xerography to produce fax copy.

framed on the sheet of recording paper.

Thereafter, the two machines must be synchronized to prevent "skewing" of vertical copy elements, or to keep the recorded copy from gradually drifting off the edge of the page from top to bottom. This is most often achieved by the simple expedient of having the synchronous motors of each machine operate from the machine's own precision power supply. The crystal-controlled power supplies are present at the factory to ensure frequency differences no greater than a few parts per million.

Synchronization of digital fax terminals is basically no different from that of many other types of data terminals. Paper is advanced by a "stepper" motor, the size of the steps determining the scan resolution (lines per inch) of the system. At the receiver, the 1024 or 1728 separate elements of each scan line—some black, some white (as determined by received codes)—are simply "clocked out" serially from a buffer to the recorder, a line at a time. Since the recorder at the receiver does not have to track with the remote scanner in real time, the positioning of the lines on the paper is controlled locally within the receiver. The transmitter has to provide start-of-line and end-of-line codes.

Recording. The transmitted page is reproduced at the receiver by one of several processes. The oldest of these uses wet electrolytic paper on which dark marks are formed by a stylus in proportion to the strength of the picture signal current passing through it. Though inexpensive and still used extensively in weather chart recorders, this process has declined in popularity in recent years.

There are at least three processes using plain bond paper. One developed by a West German firm records with wet ink

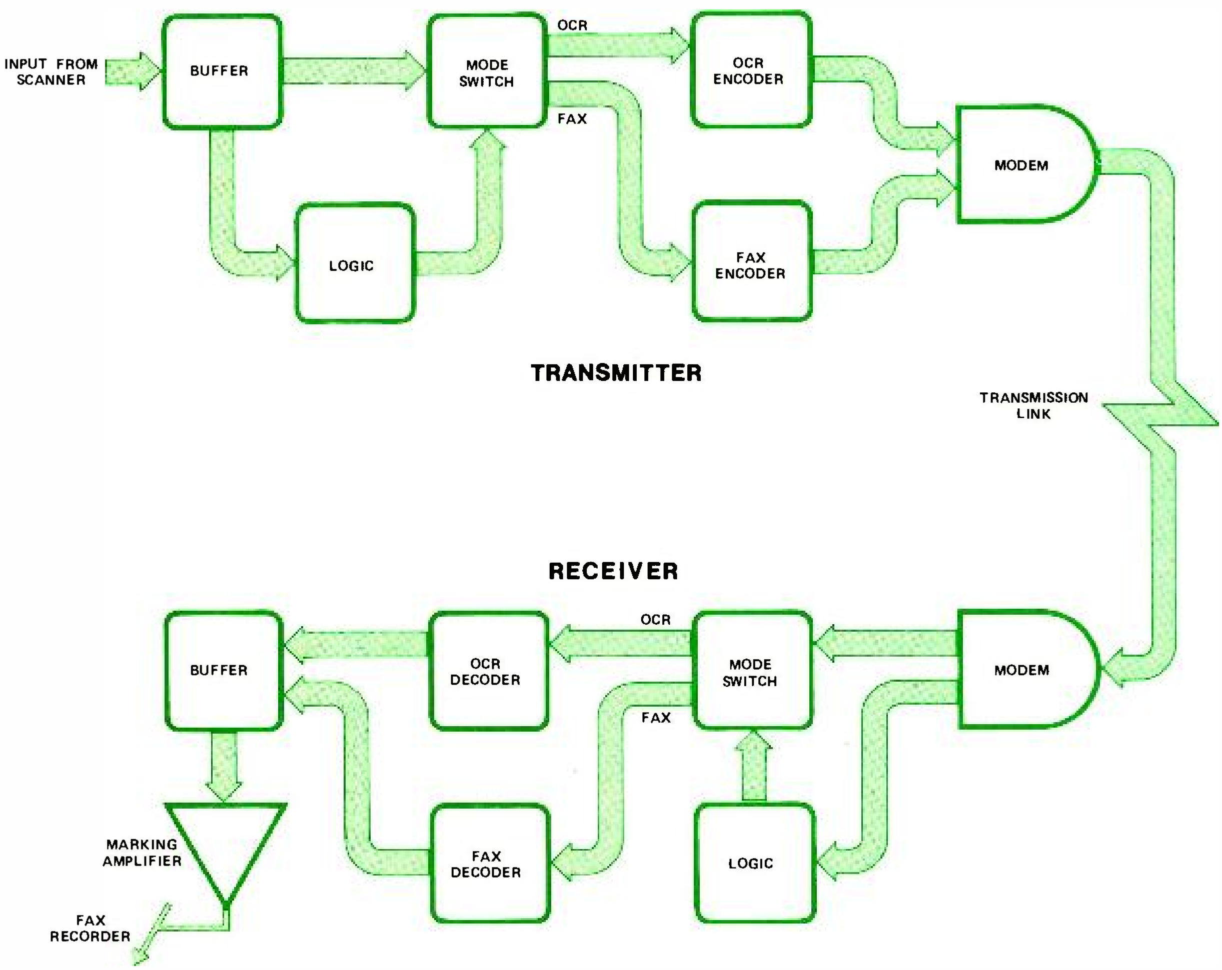


Fig. 6. Hybrid fax system uses optical character recognition (OCR) to increase transmission efficiency.

impressions on a plastic ribbon and transfers the ink to paper, line by line. Another, found only in older machines, "hammers" the marks out through carbon paper with a vibrating stylus.

The latest of the plain paper processes uses a mechanically deflected laser beam to record the picture elements as electrostatic charges on a photosensitive selenium drum. From there, the process is identical to that used in some office copiers. The latent electrostatic image is "developed" by application of "toner," an electrostatic ink that is then transferred from the drum to the paper and fused to it by heat. The basic operation of the system is shown in Fig. 5.

More prevalent are electrostatic processes in which the latent images are produced by a signal-energized stylus on specially coated paper. As in the transfer process just described, images are developed by toner. Digital fax systems use this process almost exclusively, and the stylus is usually in the form of a "pin printer," which consists of a row of fixed styli (usually 1024 or 1728 of them) successively energized by the clocked-out bits that constitute the black/white make-up of a given scan line.

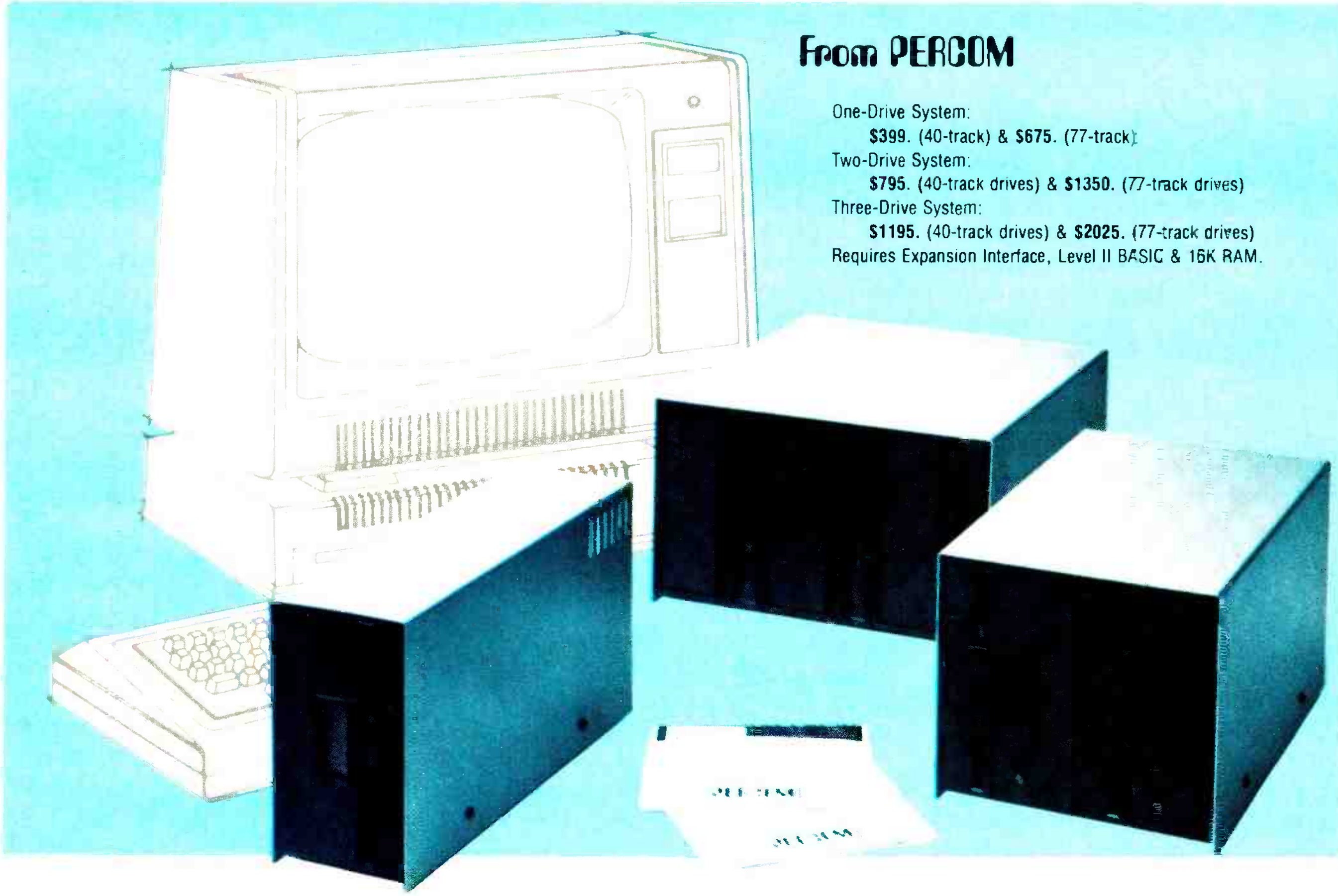
There are both wet and dry photographic processes in which light-sensitive paper is used. However, they are usually for weather, news-photo, and law-enforcement applications.

Perhaps the most widely used process at the present time is one in which images are formed when the signal-energized stylus burns away the white or metallic coating of special paper, revealing a black underlayer. The paper is comparatively expensive, running 10¢ to 12¢ a sheet, but it has indefinite shelf life, and the simplicity of the process permits the design of relatively simple and inexpensive machines.

What's Coming? Already available, but not in wide use as yet, are systems that combine fax scanning with optical character recognition (OCR) to optimize transmission efficiency (Fig. 6). Through its ability to recognize characters and symbols and convert them to simple binary codes, OCR enables transmission of alphanumeric documents with far greater efficiency than is possible with fax. Pictorial documents, however, are another matter. Combined OCR/fax systems therefore offer the best of both worlds—OCR for alphanumeric transmission and fax for graphics. In one prototype system, selection between the two modes is automatic, based on what the scanner sees. In the form of software/hardware add-ons, such systems may add up to $15,000 to the cost of a conventional fax system.

Meanwhile, on the drawing boards—and to some extent in prototype—are 2-dimensional data-compression fax and other more complex systems that do for graphics what OCR does for letters and numbers. That means digitizing not just "runs" within a scan line, but whole image features: width *and height*. Called "feature" encoding or "blob" encoding, the process requires relatively complex software, but the hoped-for payoff will be in greatly improved efficiency in the transmission of all sorts of documents.

These developments, together with the imminent merging of fax with communicating word processors, promise some interesting advances in document communication within the next couple of years. How about electronic mail? The components are there. All that's needed is for them to be assembled into an economical configuration. ◇



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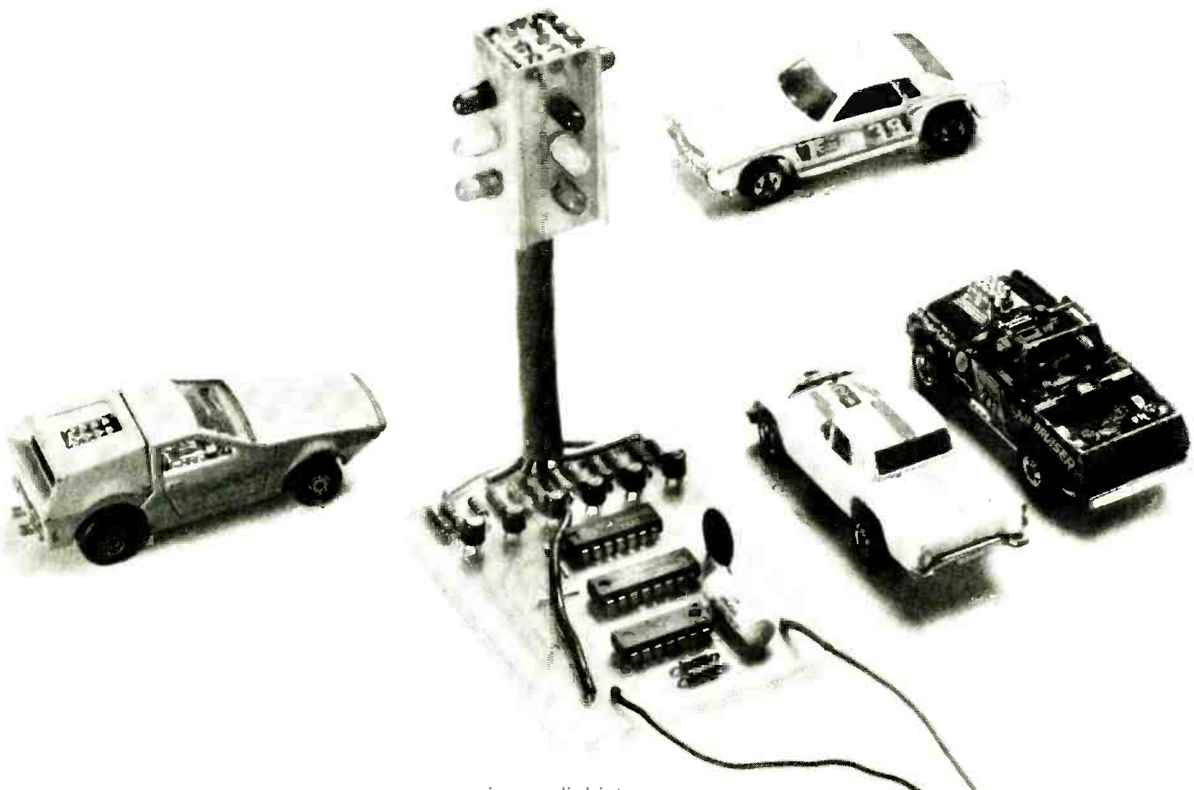
About the Circuit. The six signals required to sequentially operate the traffic lights are illustrated in Fig. 1. They are generated by the circuit shown in Fig. 2.

The basic timing oscillator in Fig. 2 is made up of *R1*, *R2*, *C2*, and two sections of *IC1*. The rate at which the LEDs sequence is determined by the value of *C2*. Therefore, if you wish to speed up or slow down the sequencing rate, simply

(Continued on page 54)



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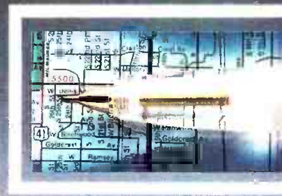

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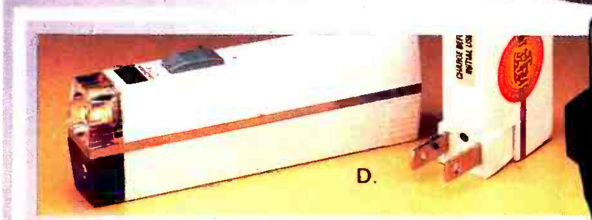

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Fun Projects
continued

(Continued from page 51)

adjust *C2*'s value accordingly. The clock signal drives CMOS decade counter/divider *IC2*, whose outputs are decoded to provide the on times for each LED.

LED driving output Y1 (Y is for yellow, G is for green, and R is for red) is on only during clock pulse 8 from pin 9 of *IC2*, while Y2 is on only during clock pulse 3 from pin 7 of *IC2*. The R1 and R2 red and G1 and G2 green LEDs obtain their longer on-time pulses from set/reset flip-flops made up of cross-coupled NOR gates in *IC1* and *IC3*. For example, G1 comes on with clock pulse 4 and goes off with clock pulse 8, for a total time on of four clock pulses.

The six signals are fed through transistor drivers *Q1* through *Q6*, each of which is capable of driving two LEDs. Hence, two traffic-light display systems can be driven by the transistor array. Current-limiting resistors *R3* through *R14* have been selected to provide additional current to the less-efficient green and yellow LEDs so that all three colors appear to be equal in brightness. The system is designed to be powered by 9-volt battery *B1*. However, you can use a standard regulated 12-volt dc supply, but you must double the values of the current-limiting resistors if you do so.

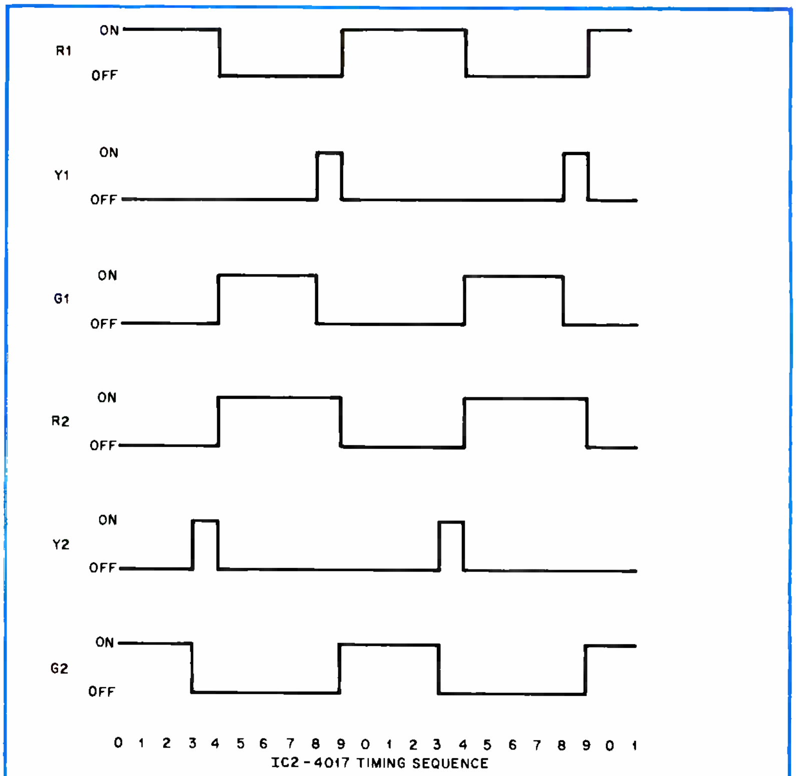


Fig. 1. Waveforms at specified outputs on main board.

Construction. To keep the project as compact as possible, it is recommended that you use printed-circuit boards for parts mounting and wiring. An actual-size etching-and-drilling guide and a components-installation diagram are shown in Fig. 3. Do NOT cut apart the etching-and-drilling guide to make the boards separately. Rather, etch and drill all nine pc boards as a single piece and

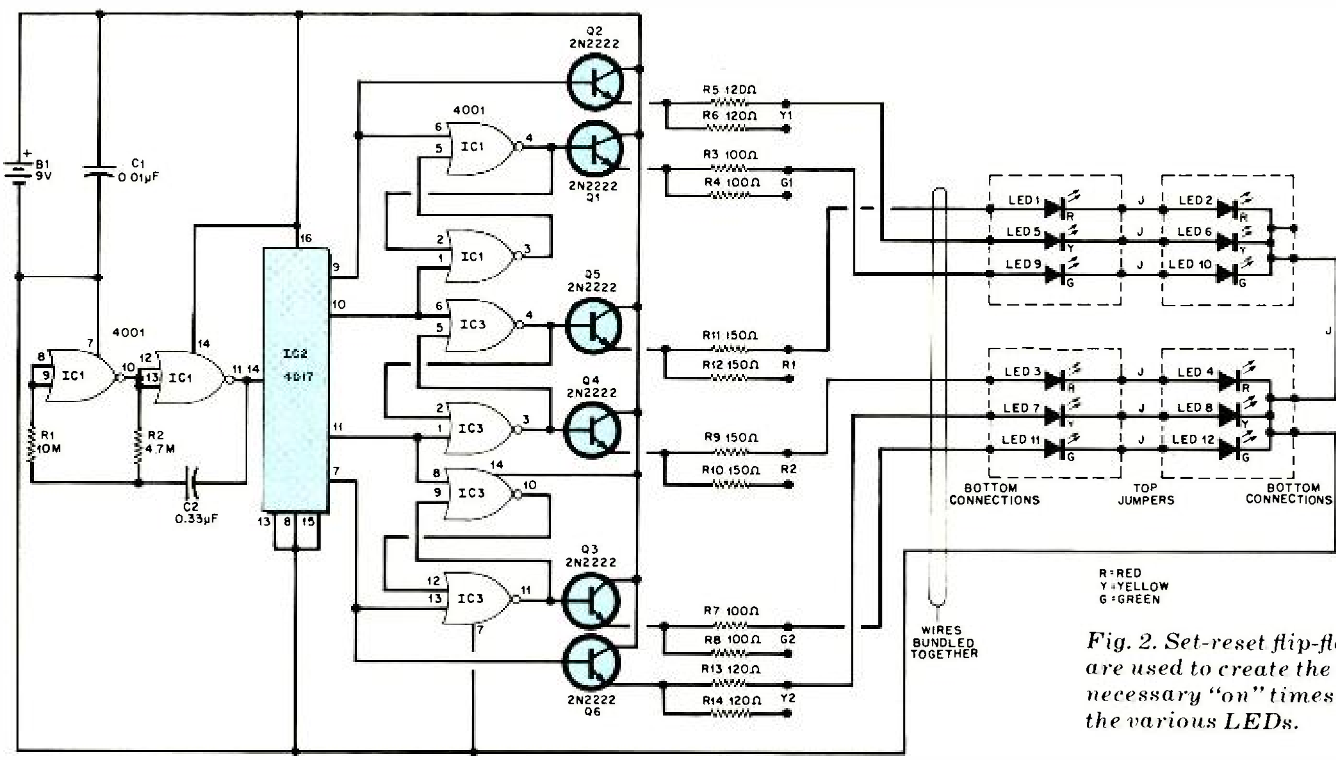


Fig. 2. Set-reset flip-flops are used to create the necessary "on" times for the various LEDs.

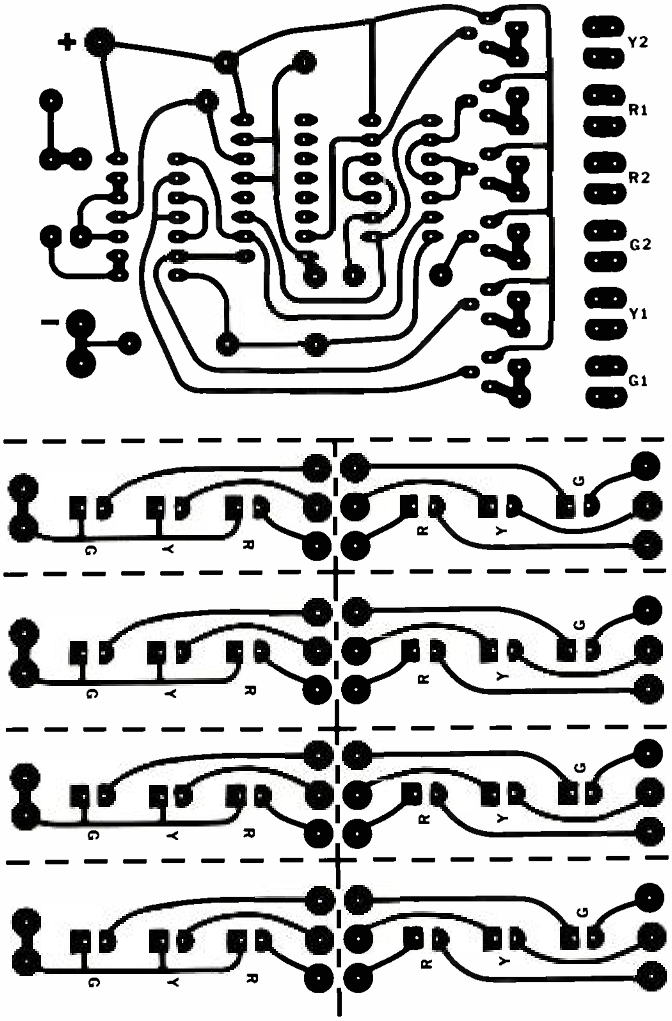


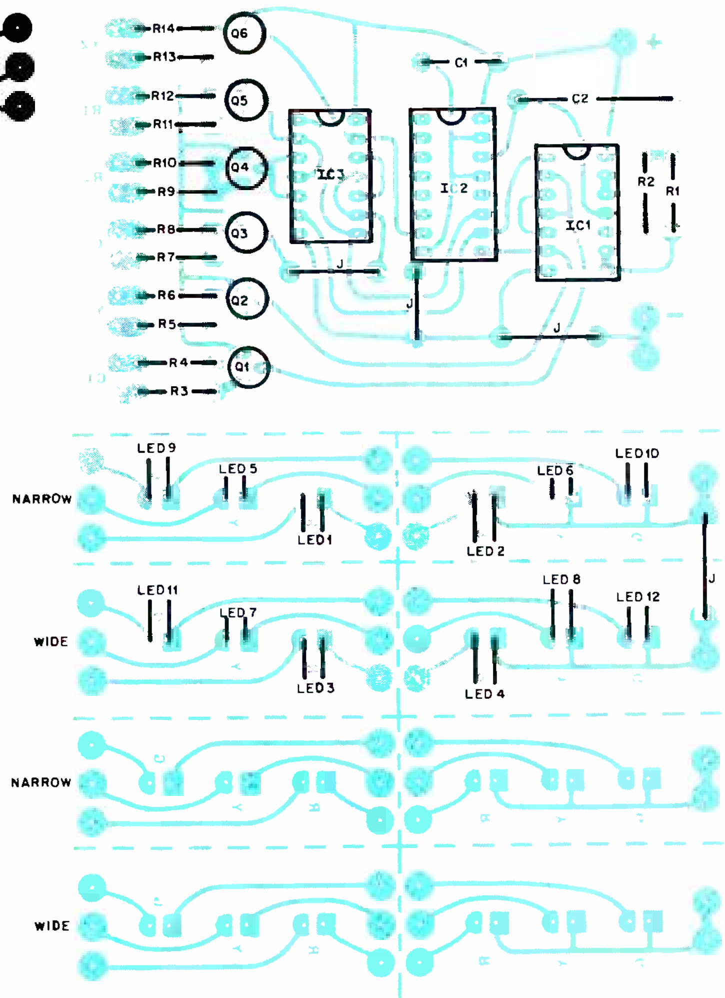
Fig. 3. Actual-size foil pattern (above) and component layout (right). Board is divided into nine sections.

then carefully cut along the dashed lines to separate the individual boards. Note that of the eight LED boards four are slightly wider than the others.

Wire the large board as shown. Do not forget the three jumpers. The eight small boards can be used to make two traffic lights, each built on two wide and two narrow boards, with the small boards propped between the larger ones. Install the LEDs in their respective locations on the boards, making certain that their cathode leads are inserted in the holes surrounded by the *square* pads.

Now, stand the two narrow and two wide boards up, positioning the red LEDs at the top and with the boards forming a square when viewed from the top. Use silicone-rubber adhesive to cement the sides together along the edges where they meet. Then set the assembly aside until the adhesive sets.

Looking down into the assembly from the red-LED top end, note at the top edge there are three solder pads on each board. Use short insulated wire jumpers to connect from one pad to the pad directly opposite it on the other



PARTS LIST

B1—9-volt battery or 7-to-12-volt dc power supply (see text)
C1—0.01-µF disc capacitor
C2—0.33-µF capacitor
IC1,IC3—4001 CMOS quad 2-input NOR gate
IC2—4017 CMOS decade counter/divider
LED1 thru LED4—Red light-emitting diode
LED5 thru LED8—Yellow light-emitting diode
LED9 thru LED12—Green light-emitting diode
Q1 thru Q6—2N4401 or 2N2222 transistor
All resistors ¼-watt, 10% tolerance:
R1—10 megohms
R2—4.7 megohms
R3,R4,R7,R8—100 ohms (see text)
R5,R6,R13,R14—120 ohms (see text)
R9 thru R12—150 ohms (see text)
Misc.—Printed-circuit boards; battery connector; silicone-rubber cement; insulated hook-up wire; on/off switch (optional); machine hardware; spacers; plastic tape; etc.

Note: The following are available from Ray Wilkins, Box 551, Hanover, NH 03775: etched and drilled glass-epoxy pc board for $7.50 and extra-bright LEDs for 75¢ each.

Fun Projects

continued

board. Repeat for the other two sets of pads on the first pair of boards. Rotate the assembly 90° and interconnect their pads in the same manner. When you are through, there should be six insulated jumpers forming a tic-tac-toe pattern with one extra horizontal and one extra vertical line.

Invert the assembly so that the green LEDs are at the top. Looking into the open end of the assembly, you will note that two of the boards have three independent solder pads while the other two boards have only two pads that are bridged together. Solder a bare-wire jumper diagonally across the corner to interconnect the common-pair pads.

Now, determine the desired distance between the decoder/driver board and traffic-light display assembly. Cut six lengths of color-coded insulated hookup wire to this length and a seventh wire to a 3½" (90-mm) longer length. Solder one end of the long wire to the diagonal jumper in the LED assembly and the other wires to the six pads on the green-LED end of the assembly.

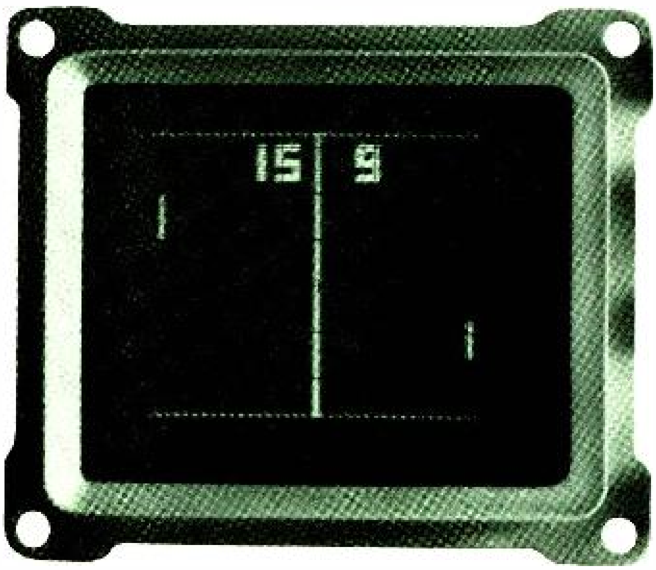
Referring to Fig. 2, connect and solder the free ends of the wires into their respective holes in the decoder/driver board. (The free end of the long wire goes to the pad labelled – on the main board.) Note that the pads on the main board are set up for two traffic-light assemblies. Use only one of each pad if you plan to use only one light assembly and, if desired, you can eliminate the unused resistors.

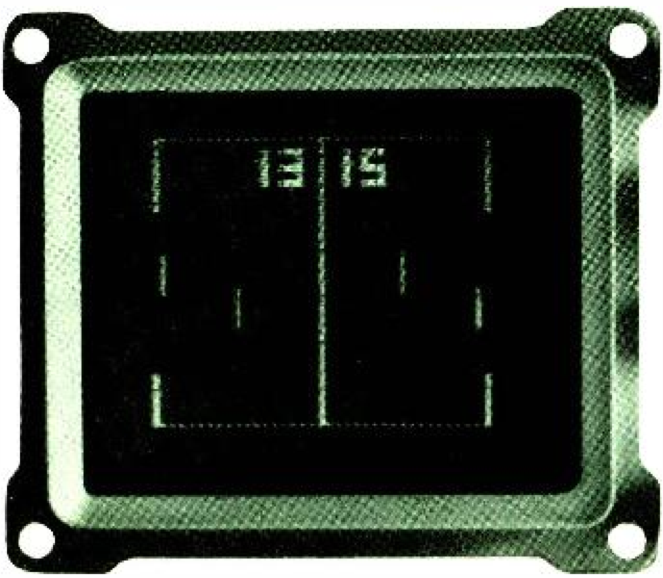
Bundle and tape together the wires to form a "lamp post." Plug a 9-volt battery into the connector or connect the project to a dc power supply and your traffic light is ready to go. ◇

Play Video Games with "SCOPE-ONG"

BY AL PLAVCAN

Now you can play hockey, tennis, and other games on your oscilloscope





THERE IS a way to build a video-game project and avoid problems meeting FCC regulations. Moreover, it frees your TV receiver for normal use. Simply use your *oscilloscope* instead of a TV receiver to display game graphics. This way, you avoid the possibility of TV interference and do not have to pay a premium for an FCC-approved Class I device (r-f modulator and isolation switch). The "Scope-Ong," described here, works just this way.

The circuit uses the readily available General Instruments AY-3-8500-1 game chip, found in many video games on the market. Programmed into this chip are squash, hockey/soccer, and tennis. Automatic on-screen scoring and user-selectable paddle size, ball angle, ball speed, and auto/manual ball serve round out the chip's features. The only requirements for the oscilloscope to be used as the graphics display are that it have provisions for external sync and a Z-axis input.

About the Circuit. Sections A and B of *IC2* in Fig. 1 are used as a crystal-controlled oscillator circuit to drive

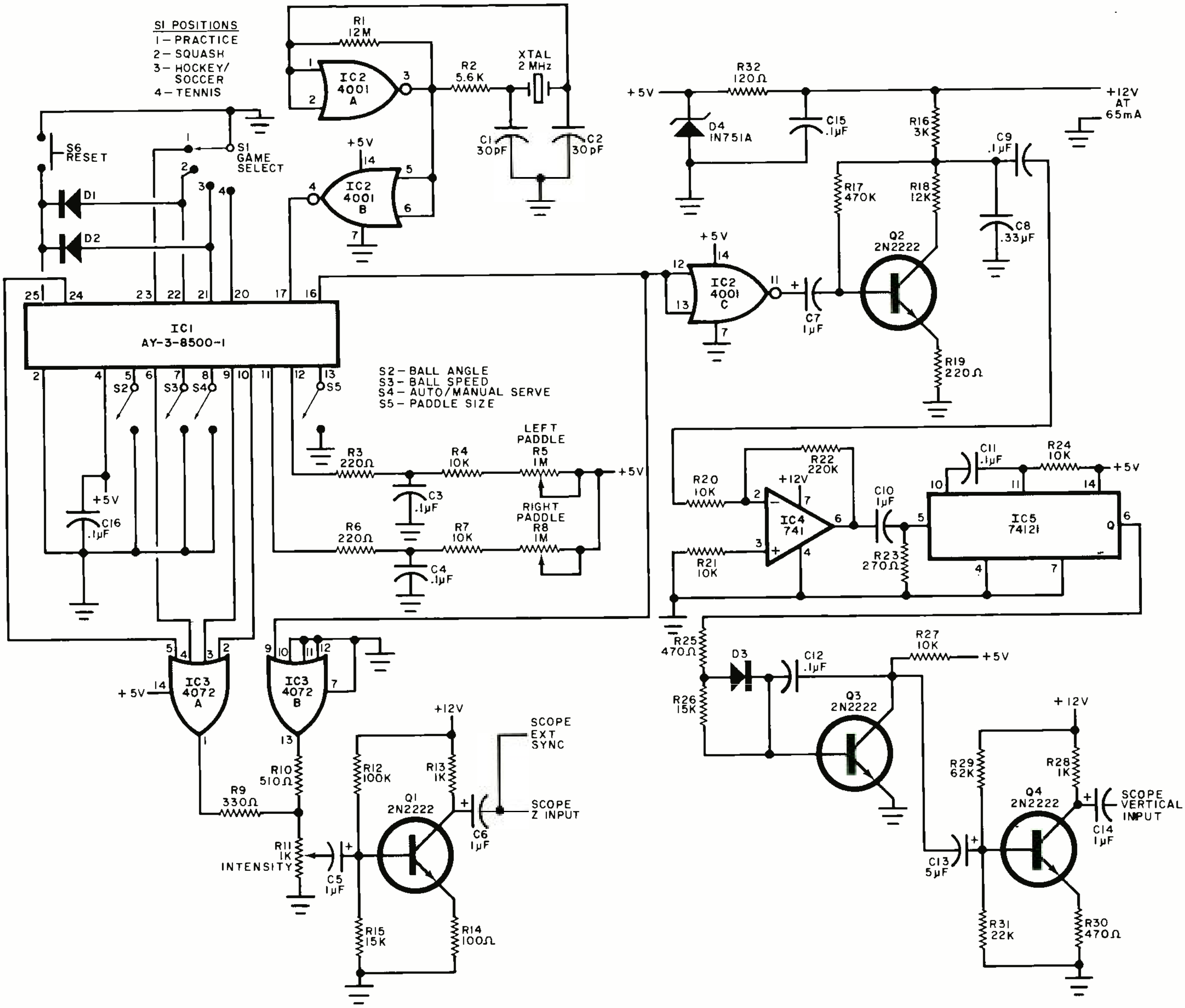


Fig. 1. Adding vertical sweep generator to basic game circuit permits use with conventional oscilloscope.

PARTS LIST

C1,C2—30-pF disc capacitor
C3,C4,C9,C11,C12,C15,C16—0.1-μF, 20-V capacitor
C5,C6,C7,C10,C14—1-μF, 20-V capacitor
C8—0.33-μF, 20-V capacitor
C13—5-μF, 20-V capacitor
D1,D2,D3—1N914
D4—1N751A, 5-V zener
IC1—AY-3-8500-1 game chip (General Instruments) (available from Poly Paks, James Electronics, and other advertisers at the back of this magazine)
IC2—4001 (or 4011) quad 2-input NOR gate
IC3—4072 dual 4-input OR gate
IC4—741 op amp
IC5—74121 monostable multivibrator
Q1 through Q4—2N2222 transistor
The following are ¼-watt, 10% resistors unless otherwise noted:
R1—12 megohms
R2—5600 ohms
R3,R6,R19—220 ohms
R4,R7,R20,R21,R24,R27—10,000 ohms
R5,R8—1-megohm potentiometer
R9—330 ohms
R10—510 ohms
R11—1000-ohm, pc-mount potentiometer
R12—100,000 ohms
R13,R28—1000 ohms
R14—100 ohms
R15,R26—15,000 ohms
R16—3000 ohms
R17—470,000 ohms
R18—12,000 ohms
R22—220,000 ohms
R23—270 ohms
R25,R30—470 ohms
R29—62,000 ohms
R31—22,000 ohms
R32—120-ohm, 1-watt resistor
S1—4-position rotary switch
S2 through S5—Spst switch
S6—Normally open pushbutton switch
XTAL—2.0-MHz crystal
Misc.—Paddle cable; scope interconnecting cable; power supply (12 V, 65 mA); suitable enclosure; dry-transfer lettering kit; machine hardware; hookup wire; etc.

game chip *IC1*. Composite sync pulses generated within *IC1* are available at pin 16; they are buffered by *IC2C* and fed to sync separator *Q2* to extract the vertical-sync pulse.

The vertical pulse is amplified by *IC4* and applied to pulse stretcher *IC5*. The output of *IC5* drives linear ramp generator *Q3*, whose output signal is inverted by *Q4* and used as the vertical input of the scope.

The video outputs from *IC1* available at pins 6, 9, 10, and 24 are combined in *IC3A* to form a composite-video signal, which is then combined with the sync pulse present at the output of *IC3B* to generate the composite sync/video signal across INTENSITY control *R11*. Am-

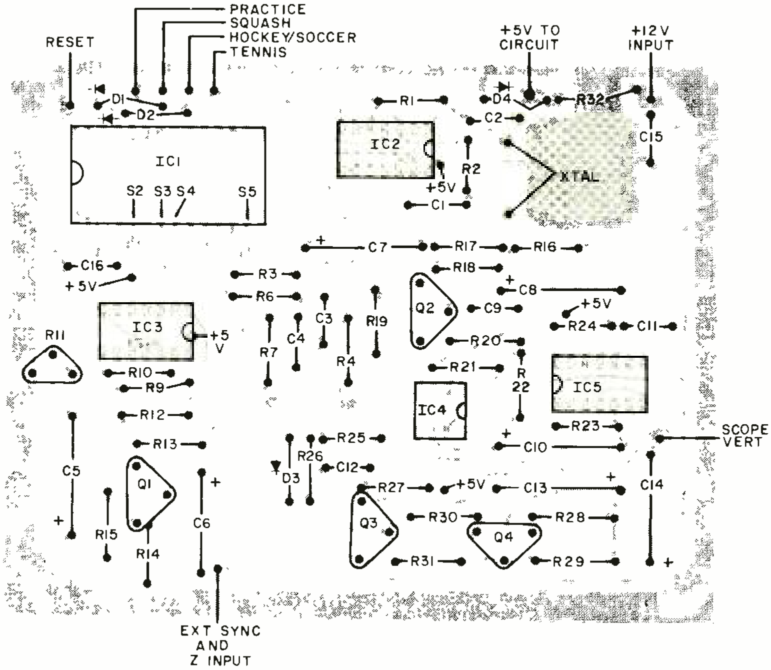
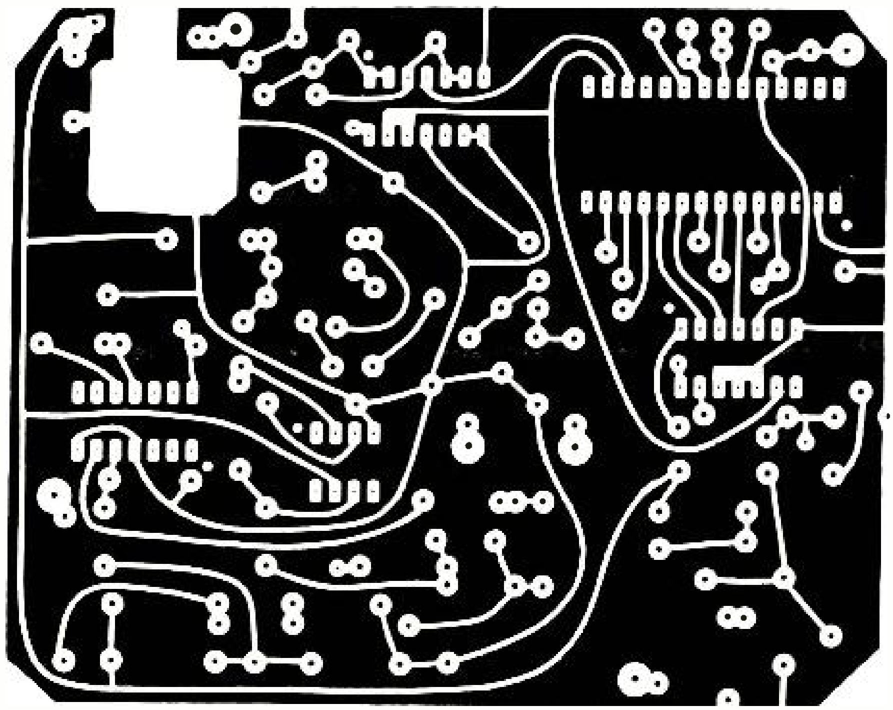


Fig. 3. Actual-size foil pattern for "Scope-Ong" is below. Component installation layout is shown above.



plification and inversion of the composite signal occurs in *Q1*, which then feeds the EXT SYNC and Z-axis scope inputs.

Available Z-axis output potential from the project is approximately 10 volts peak-to-peak. To determine if your scope can use this signal, apply at least +5 volts dc to the Z-axis input while a trace is on the screen. If the trace extinguishes or at least changes considerably in intensity, the circuit shown in Fig. 1 can be used.

Construction. The circuit can be assembled on a small printed-circuit board, the etching-and-drilling and components-placement guides for which are shown in Fig. 3. Once the pc-board assembly is wired, it and a 12-volt, 65-mA power supply (Fig. 2) can be mounted inside an appropriate enclosure. Mount the five selector switches, RESET push-

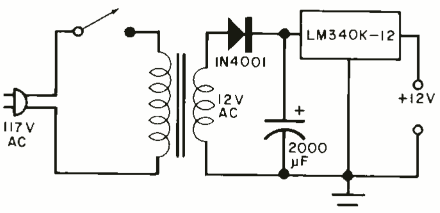


Fig. 2. This simple supply can be built to power the project.

button switch, and game "paddles" *R5* and *R8* on the top of the enclosure.

If desired, the game paddles can be housed in small separate boxes and connected into the circuit via cables and jack/plug assemblies. The jacks for the three scope signals can be mounted on the rear of the box. Finally, if you use a power supply with a power switch, mount the switch wherever convenient on the box. Label the controls, switches, jacks, etc., with dry-transfer lettering.

Checkout and Use. Set your scope's controls as follows: vertical input to 1 volt/cm, horizontal sweep to 5 µs/cm, and sync to EXT. Connect the three leads from the Scope-Ong to the X, Y, and Z inputs of the scope (don't forget the ground connection). Now, set INTENSITY control *R11* to midrange and turn on both scope and game player.

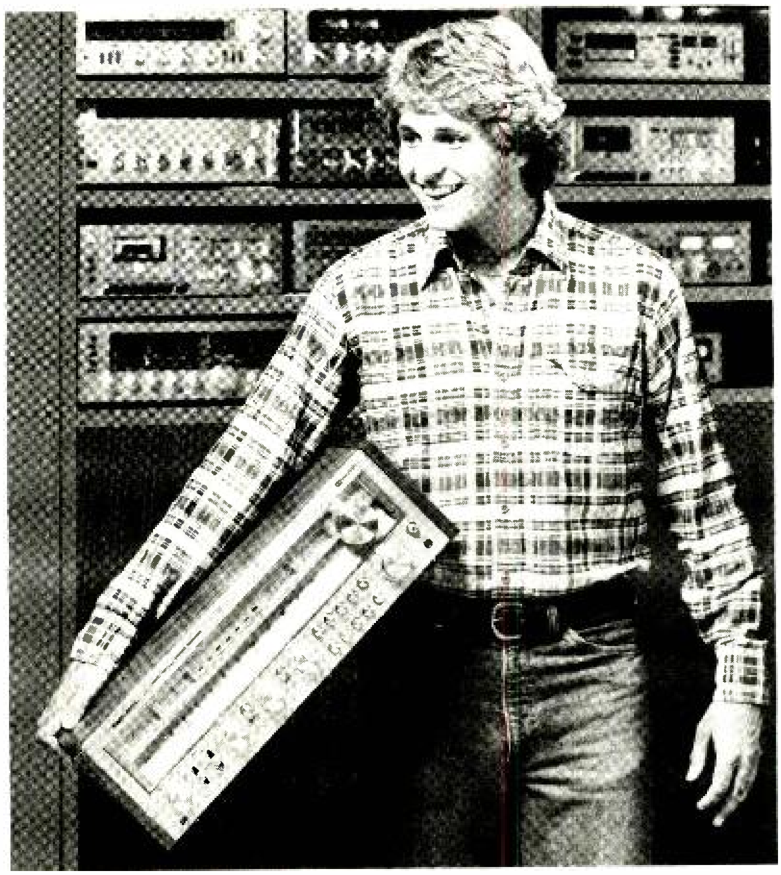
Select a game via *S1* and note the activity on the scope's screen. Adjust *R11* and the scope's horizontal and sync controls for the best image of the selected game.

Press and release RESET switch *S6*; the score displayed should be 0–0. Closing AUTO/MANUAL SERVE switch *S4* (AUTO position) causes the ball to be served automatically until the end of the game. If desired, *S4* can be opened and then closed each time you wish the ball to be served. Among the project's other options are *S2* that changes ball angle, *S3* that changes ball speed, and *S5* that changes paddle size.

In Closing. The Scope-Ong provides most of the functions and all of the features found in similar video-game devices on the market. The one thing it does not give you is possible trouble with your neighbors over TVI. ◇

(More Fun Projects on page 60)

In recent years over 500,000 music lovers chose a Realistic® receiver over Kenwood®, Pioneer® and Technics®...



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The AUDIO ARTIST Sound-Effects Machine

BY JIM BARBARELLO

You can create any of a number of sounds--from a siren's wail to a clock's tick--to enhance your tape recordings

WHETHER you're an amateur recording engineer, electronic musician, or simply a "sound bug" or chronic knob twiddler, the Audio Artist is sure to appeal to you. It's a special-effects generator which can be used to create such sounds as the wail of a siren, the bubbling splash of a rock falling into a pond, the stock Hollywood sound of a flying saucer, the complex whirring generated by some futuristic machine, and much more. The Audio Artist's five controls interact with each other, resulting in a large variety of possible sound effects.

The project can double as a metronome whose rate is variable from less than 1 Hz to more than 250 Hz. Displaying the output of the Audio Artist on an oscilloscope also creates some interesting effects. The project is easily built, and the total cost of construction is less than $25.

About the Circuit. The Audio Artist employs essentially the same circuit as that of the Cabonga Percussion Synthesizer and its Auto Trigger accessory (POPULAR ELECTRONICS, August and September 1977). It is shown schematically in Fig. 1. A comparison of the two reveals that the Cabonga's manual PITCH control has been replaced with a FET to allow voltage control of the output frequency.

That portion of the circuit built around *IC2B* is the triggering and tone-generating section. Field-effect transistor *Q1* is a voltage-sensitive device whose source-to-drain resistance varies with the magnitude of the voltage applied between its gate and source. The signal applied to the gate of *Q1* is a triangle wave which varies the effective channel resistance of the FET at a rate determined by the setting of potentiometer *R20*. Transistor *Q1*, along with op amp *IC2B*, *R11*, *R12*, and *C4* through *C7*, form a twin-T, active bandpass filter which will generate a damped sinusoidal output each time it is triggered by a positive-going pulse. Damping of the output waveform is determined by the setting of *R10*, and can be varied between the extremes of no output at all and sustained oscillation.

Dual operational amplifiers *IC1* and *IC3* each form oscillators. One (*IC1*) is used to generate trigger pulses which stimulate the active filter into oscillation. The other (*IC3*) produces triangle waves which modulate the channel resistance of *Q1* and hence sweeps the filter. In each oscillator, the noninverting stage (*IC1A* or *IC3A*) acts as a comparator and the inverting stage (*IC1B* or *IC3B*) functions as an integrator. Assuming that the output of the comparator is changing state from V− to V+, the resulting positive voltage step is integrated into a ramp with a positive slope. When the amplitude of the ramp reaches V+/2, the comparator again changes state, generating a negative-going step which is integrated into a ramp with a negative slope. The comparator changes state once more when the amplitude of this ramp reaches V−/2.

This process continues cyclically, producing a square wave at the comparator's output and a triangle wave at the output of the integrator. The slope of the ramp (triangle waveform) determines how quickly the comparator changes state and, consequently, the frequency of oscillation. That slope is determined by the current supplied to *C1* (*C8*) via *R3* and *R4* (*R19* and *R20*). Therefore, the frequency of oscillation is governed by the setting of a single control (*R4* or *R19*) over a range of from 0.5 to more than 250 Hz.

This square-wave output of the tempo generator (*IC1*) is shaped into trigger pulses for active filter *IC2B* by the RC network *R7C2C3* and diodes *D1* and *D2*. Triangle waves generated by *IC3B* are applied to the gate of FET *Q1* via DEPTH control *R18* and *R15*, causing *IC2B* to produce a constantly changing pitch. The two generators (*IC1* and *IC3*) oscillate independently of each other, and can thus be adjusted to beat, to run asynchronously, or to run synchronously for different effects. The project's controls can be adjusted to produce some very unusual sounds, in addition to a damped, repetitive sine wave whose frequency varies pseudorandomly.

Signals generated by *IC2B* are buffered by *IC2A*, a unity-gain inverting amplifier, and are presented to output jack *J1* for further amplification or recording. The output signals are of line level and should not be applied to microphone or other weak-signal inputs. The bipolar voltages required by the project's op amps can be furnished by either a line-powered supply or batteries. The author's prototype employs batteries for portability. Total current demand is relatively modest, making the use of a battery supply a practical alternative to a line-powered one.

Construction. The Audio Artist can be assembled using either a perforated or a printed-circuit board (Fig. 2). When assembling the circuit board, be sure to employ the minimum amount of heat and solder consistent with the formation of good solder joints. Take care to observe the polarities of electrolytic capacitors and the pin basings of semiconductors. Mounting the ICs in sockets or Molex Soldercons is recommended.

The project's circuit board can be housed in any suitable enclosure. One measuring 6½" × 3-¾" × 2" (15.9 × 9.5 × 5.1 cm) will provide adequate room for the circuit board, a battery power supply, and the various controls. Mount the board in the enclosure using standoffs and machine hardware. Similarly, install the potentiometers, power switch, and output jack using the hardware supplied with these components. Secure the batteries (if used) to the interior of the enclosure with home-brew or commercial brackets.

Label the various control positions us-

Photo of author's prototype shows pots on front and pc board at rear.

ing dry-transfer lettering. Once the controls, switch and jack have been mounted and identified, interconnect them with the project's circuit board using suitable lengths of flexible hookup wire. Be sure

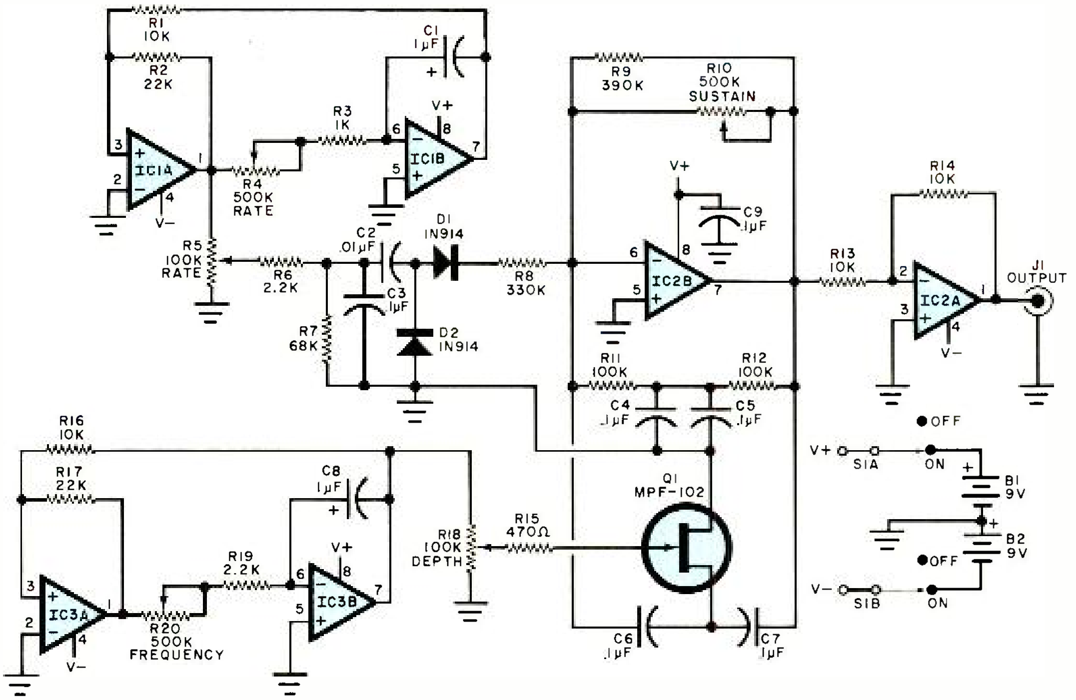

Fig. 1. The circuit around IC2B is the tone-generating section. The five controls react with each other to provide various sound effects.

PARTS LIST

B1, B2—9-volt battery
C1, C8—1-µF, 16-volt upright electrolytic
C2—0.01-µF disc ceramic capacitor
C3 through C7, C9—0.1µF disc ceramic capacitor
D1, D2—1N914 or 1N4148
IC1, IC2, IC3—MC1458N dual op amp
J1—phono jack
Q1—MPF-102 n-channel JFET
The following are ¼-watt, 10% tolerance, carbon-composition resistors unless otherwise noted:
R1, R13, R14, R16—10,000 ohms
R2, R17—22,000 ohms
R3—1000 ohms
R4, R20—500,000-ohm audio-taper pot.
R5, R18—100,000-ohm linear-taper pot.
R6, R19—2200 ohms
R7—68,000 ohms
R8—330,000 ohms
R9—390,000 ohms
R10—500,000-ohm linear-taper pot.
R11, R12—100,000 ohms
R15—470 ohms
S1—Dpdt switch
Misc.—Suitable enclosure, printed circuit or perforated board, IC sockets or Molex Soldercons, battery clips, battery holders, dry-transfer lettering, control knobs, hookup wire, machine hardware, solder, etc.

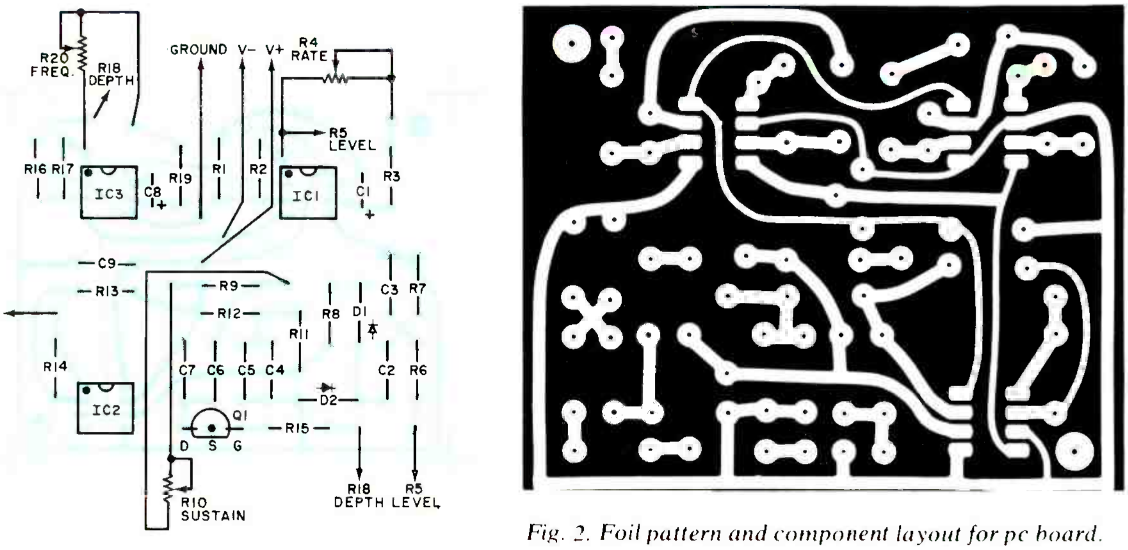

Fig. 2. Foil pattern and component layout for pc board.

to double check your wiring to catch any errors that might have inadvertently been made.

Use. Patch signals from the output jack of the Audio Artist to an audio amplifier which in turn drives a loudspeaker or pair of headphones. Depending on the settings of the Audio Artist's controls, the peak voltage across the output jack can vary from less than one to nine volts. To avoid overloads, apply drive to a line-level input and initially keep the volume low.

Apply power to the Audio Artist and the amplifier and adjust the amplifier's gain control for a comfortable listening level. Setting the SUSTAIN control at its minimum position will reduce the output signal to zero.

Begin to experiment with the Audio Artist by rotating the wiper of the SUSTAIN potentiometer to a maximum of midscale and the wipers of the other controls to their maximum settings. Slowly vary the settings of the RATE and SUSTAIN potentiometers. Vary each control in turn, noting how it affects the sound generated by the project. You will quickly be creating unusual sound effects, and will be surprised to discover how many different sounds the Audio Artist is capable of producing. ◇

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Computer-Aided Morse Code Practice

BY TERRY MAYHUGH

Here's a program for a 6800 MPU-type microcomputer that provides perfect code at virtually any selected speed

WHETHER you are a beginner or an experienced "brass pounder," this program will enable your 6800 microcomputer to give you plenty of receiving practice with machine-perfect Morse code at practically any speed you wish.

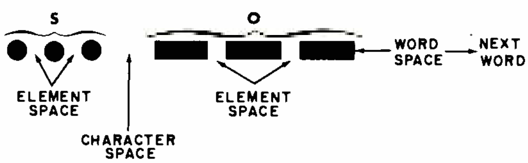


Fig. 1. Relative lengths of code characters, and word, character, and element spaces.

If you already have a ham license and are operating a CW rig, the program will allow you to create a message containing up to 1024 characters for automatic transmission. The single-bit computer output can be used to drive a keying relay that replaces the code-practice oscillator used in this project.

Morse Code. Before examining the program, a review of the basics of International Morse code should prove helpful to the novice. The Morse method of encoding letters, numerals, and punctuation marks permits messages constructed from these characters to be transmitted by wire or wireless. Although somewhat primitive in comparison to Baudot or ASCII encoding, Morse is widely used by the commercial press, ship-to-shore stations, and amateur radio operators.

Each character in the Morse-code set is uniquely defined by a senes of elements ("dots" and "dashes") in the form of ones turned on and off for prescribed periods of time. The durations of these dots and dashes, and the spaces between them are multiples of a fundamental time unit as follows:

Code Element	Time Units
Dot—	1
Dash———	3
Element space ..	1
Character space	3
Word space	7

The length of this time unit is inversely proportional to transmitting speed. Dots and dashes within a character are separated by element spaces, while whole characters and words are separated by character and word spaces, respectively. For example, as shown in Fig. 1, the word "so" consists of three dots (S) with element spaces between them, a character space, and then three dashes (O) with element spaces between them. Table I gives the complete list of characters and corresponding Morse equivalents.

Morse code's inherent efficiency is just one of the reasons it has been around for so long, even though the variable element lengths and lack of provision for error detection make it seem primitive. Another advantage is that it has a long-term energy saving factor of

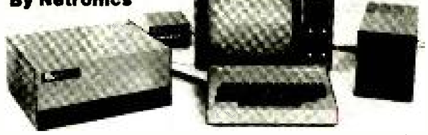
TABLE I—MORSE CODE

A .–	N –.
B –...	O –––
C –.–.	P .––.
D –..	Q ––.–
E .	R .–.
F ..–.	S ...
G ––.	T –
H	U ..–
I ..	V ...–
J .–––	W .––
K –.–	X –..–
L .–..	Y –.––
M ––	Z ––..
1 .––––	6 –....
2 ..–––	7 ––...
3 ...––	8 –––..
4 ....–	9 ––––.
5	0 ––––
Period .–.–.–	Colon –––...
Question Mark ..––..	Semicolon –.–.–
Double Dash –...–	Comma ––..––
End of message .–.–.	Fraction bar –..–.

Start Computing For Just $129.95 With An
8085-Based Professional Computer Kit—

Explorer/85

By Netronics



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No matter what your future computing plans may be, Level "A"—at $129.95—is your starting point.

Starting at just $129.95 for a Level "A" operating system, you can now build the exact computer you want. Explorer/85 can be your beginner's system, OEM controller, or IBM-formatted 8" disk small business system... yet you're never forced to spend a penny for a component or feature you don't want and you can expand in small, affordable steps!

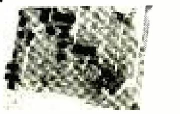
Now, for just $129.95, you can own the first level of a fully expandable computer with professional capabilities—a computer which features the advanced Intel 8085 cpu, *thereby giving you immediate access to all software and development tools that exist for both the 8085 and its 8080A predecessor (they are 100% software compatible)*—a computer which features onboard S-100 bus expansion—plus instant conversion to mass storage disk memory with either 5-1/4" diskettes or standard IBM-formatted 8" disks.

For just $129.95 (plus the cost of a power supply, keyboard/terminal and RF modulator, if you don't have them already), Explorer/85 lets you begin *computing* on a significant level... *applying* the principles discussed in leading computer magazines... *developing* "state of the art" computer solutions for both the industrial and leisure environment.

Level "A" Specifications

Explorer/85's Level "A" system features the advanced Intel 8085 cpu, an 8355 ROM with 2k deluxe monitor/operating system, and an 8155 ROM-I/O—all on a single motherboard with room for RAM/ROM/PROM/EPROM and S-100 expansion, *plus* generous prototyping space.

(Level "A" makes a perfect OEM controller for industrial applications and is available in a special Hex Version which can be programmed using the Netronics Hex Keypad/Display.)



Level "A" at $129.95 is a complete operating system, perfect for beginners, hobbiests, or industrial controller use.

PC Board: glass epoxy, plated through holes with solder mask • **I/O:** provisions for 25-pin (DB25) connector for terminal serial I/O, which can also support a paper tape reader ...provision for 24-pin DIP socket for hex keyboard/display... cassette tape recorder input... cassette tape recorder output... cassette tape control output... speaker output... LED output indicator on SOD (serial output) line... printer interface (less drivers)... total of four 8-bit plus one 6-bit I/O ports • **Crystal Frequency:** 6.144 MHz • **Control Switches:** reset and user (RST 7.5) interrupt... additional provisions for RST 5.5, 6.5 and TRAP interrupts onboard • **Counter/Timer:** programmable, 14-bit binary • **System RAM:** 256 bytes located at F800, ideal for smaller systems and for use as an isolated stack area in expanded systems... RAM expandable to 64k via S-100 bus or 4K on motherboard.

System Monitor (Terminal Version): 2k bytes of deluxe system monitor ROM located at F000 leaving 0000 free for user RAM/ROM. Features include tape load with labeling... tape dump with labeling... examine/change contents of memory ...insert data... warm start... examine and change all registers... single step with register display at each break point, a debugging/training feature... go to execution address... move blocks of memory from one location to another... fill blocks of memory with a constant... display blocks of memory ...automatic baud rate selection... variable display line length control (1-255 characters/line)... channelized I/O monitor routine with 8-bit parallel output for high speed printer... serial console in and console out channel so that monitor can communicate with I/O ports.

System Monitor (Hex Version): Tape load with labeling... tape dump with labeling... examine/change contents of memory... insert data... warm start... examine and change all registers... single step with register display at each break point ...go to execution address. Level "A" in the *Hex Version* makes a perfect controller for industrial applications and can be programmed using the Netronics Hex Keypad/Display.

Hex Keypad/Display.

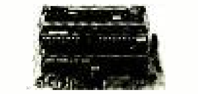
Hex Keypad/Display Specifications

Calculator type keypad with 24 system defined and 16 user defined keys. 6 digit calculator type display which displays full address plus data as well as register and status information.

Level "B" Specifications

Level "B" provides the S-100 signals plus buffers/drivers to support up to six S-100 bus boards and includes: address decoding for onboard 4k RAM expansion select-able in 4k blocks... address decoding for onboard 8k EPROM expansion selectable in 8k blocks... address and data bus drivers for onboard expansion... wait state generator (jumper selectable), to allow the use of slower memories... two separate 5 volt regulators.

Level "C" Specifications



Explorer/85 with Level "C" card cage.

Level "C" expands Explorer's motherboard with a card cage, allowing you to plug up to six S-100 cards directly into the motherboard. Both cage and cards are neatly contained inside Explorer's deluxe steel cabinet. Level "C" includes a sheet metal superstructure, a 5-card gold plated S-100 extension PC board which plugs into the motherboard. Just add required number of S-100 connectors.

Level "D" Specifications

Level "D" provides 4k of RAM, power supply regulation, filtering decoupling components and sockets to expand your Explorer/85 memory to 4k (plus the original 256 bytes located in the 8155A). The static RAM can be located anywhere from 0000 to FFFF in 4k blocks.

Level "E" Specifications

Level "E" adds sockets for 8k of EPROM to use the popular Intel 2716 or the TI 2516. It includes all sockets, power supply regulator, heat sink, filtering and decoupling components. Sockets may also be used for soon to be available RAM IC's (allowing for up to 12k of onboard RAM).

Order A Coordinated Explorer/85 Applications Pak!

Experimenter's Pak (SAVE $12.50)—Buy Level "A" and Hex Keypad/Display for **$199.90** and get FREE Intel 8085 user's manual plus FREE postage & handling!

Student Pak (SAVE $24.45)—Buy Level "A," ASCII Keyboard/Computer Terminal, and Power Supply for **$319.85** and get FREE RF Modulator plus FREE Intel 8085 user's manual plus FREE postage & handling!

Engineering Pak (SAVE $41.00)—Buy Levels "A," "B," "C," "D," and "E" with Power Supply, ASCII Keyboard/Computer Terminal, and six S-100 Bus Connectors for **$514.75** and get 10 FREE computer grade cassette tapes plus FREE 8085 user's manual plus FREE postage & handling!

Business Pak (SAVE $89.95)—Buy Explorer/85 Levels "A," "B," and "C" (with cabinet), Power Supply, ASCII Keyboard/Computer Terminal (with cabinet), 16k RAM, 12" Video Monitor, North Star 5-1/4" Disk Drive (includes North Star BASIC) with power supply and cabinet, all for just **$1599.40** and get 10 FREE 5-1/4" minidiskettes ($49.95 value) plus FREE 8085 user's manual plus FREE postage & handling!

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☐ **Explorer/85 Level "A" Kit** (Hex Version), **$129.95** plus $3 p&h.
☐ **8k Microsoft BASIC** on cassette tape, **$64.95** postpaid.
☐ **8k Microsoft BASIC in ROM Kit** (requires Levels "B," "D," and "E"), **$99.95** plus $2 p&h.
☐ **Level "B" (S-100) Kit, $49.95** plus $2 p&h.
☐ **Level "C" (S-100 6-card expander) Kit, $39.95** plus $2 p&h.
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☐ **Hex Keypad/Display Kit, $69.95** plus $2 p&h.
☐ **Deluxe Steel Cabinet** for ASCII Keyboard/Terminal, **$19.95** plus $2.50 p&h.
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☐ **RF Modulator Kit** (allows you to use your TV set as a monitor), **$8.95** postpaid.
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☐ **16k RAM Expansion Kit** (to expand any of the above up to 64k), **$139.95** plus $2 p&h each.
☐ **Intel 8085 cpu User's Manual, $7.50** postpaid.
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☐ **North Star Double Density Floppy Disk Kit** (One Drive) for Explorer/85 (includes 3 drive S-100 controller, DOS, and extended BASIC with personalized disk operating system—just plug it in and you're up and running!), **$699.95** plus $5 p&h.
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By Netronics

ASCII/BAUDOT, STAND ALONE

Computer Terminal

COMPLETE FOR ONLY... **$149.95**

The Netronics ASCII/BAUDOT Computer Terminal Kit is a microprocessor-controlled, stand alone keyboard/terminal requring no computer memory or software. It allows the use of either a 64 or 32 character by 16 line professional display format with selectable baud rate, RS232-C or 20 ma. output, full cursor control and 75 ohm composite video output.

The keyboard follows the standard typewriter configuration and generates the entire 128 character ASCII upper/lower case set with 96 printable characters. Features include onboard regulators, selectable parity, shift lock key, alpha lock jumper, a drive capability of one TTY load, and the ability to mate directly with almost any computer, including the new Explorer/85 and ELF products by Netronics.

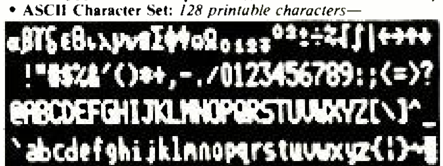
The Computer Terminal requires no I/O mapping and includes 1k of memory, character generator, 2 key rollover, processor controlled cursor control, parallel ASCII/BAUDOT to serial conversion and serial to video processing—fully crystal controlled for superb accuracy. PC boards are the highest quality glass epoxy for the ultimate in reliability and long life.

VIDEO DISPLAY SPECIFICATIONS

The heart of the Netronics Computer Terminal is the microprocessor-controlled Netronics Video Display Board (VID) which allows the terminal to utilize either a parallel ASCII or BAUDOT signal source. The VID converts the parallel data to serial data which is then formatted to either RS232-C or 20 ma. current loop output, which can be connected to the serial I/O on your computer or other interface, i.e., Modem.

When connected to a computer, the computer must echo the character received. This data is received by the VID which processes the information, converting to data to video suitable to be displayed on a TV set (using an RF modulator) or on a video monitor. The VID generates the cursor, horizontal and vertical sync pulses and performs the housekeeping relative to which character and where it is to be displayed on the screen.

Video Output: *1.5 P/P into 75 ohm (EIA RS-170)* • **Baud Rate:** *110 and 300 ASCII* • **Outputs:** *RS232-C or 20 ma. current loop* • **ASCII Character Set:** *128 printable characters—*



BAUDOT Character Set: *A B C D E F G H I J K L M N O P Q R S T U V W X Y Z - ? : • 3 $ # ( ) . , 9 0 1 4 ! 5 7 ; 2 / 6 8* • **Cursor Modes:** *Home, Backspace, Horizontal Tab, Line Feed, Vertical Tab, Carriage Return. Two special cursor sequences are provided for absolute and relative X-Y cursor addressing* • **Cursor Control:** *Erase, End of Line, Erase of Screen, Form Feed, Delete* • **Monitor Operation:** *50 or 60Hz (jumper selectable.*

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☐ **Deluxe Steel Cabinet** for Netronics Keyboard/Terminal In Blue/Black Finish, **$19.95** plus $2.50 postage and handling.
☐ **Video Display Board Kit** alone (less keyboard), **$89.95** plus $3 postage & handling.
☐ **12" Video Monitor** (10 MHz bandwidth) fully assembled and tested, **$139.95** plus $5 postage and handling.
☐ **RF Modulator Kit** (to use your TV set for a monitor), **$8.95** postpaid.
☐ **5 amp Power Supply Kit** In Deluxe Steel Cabinet (±8VDC @ 5 amps, plus 6-8 VAC), **$39.95** plus $2 postage & handling.

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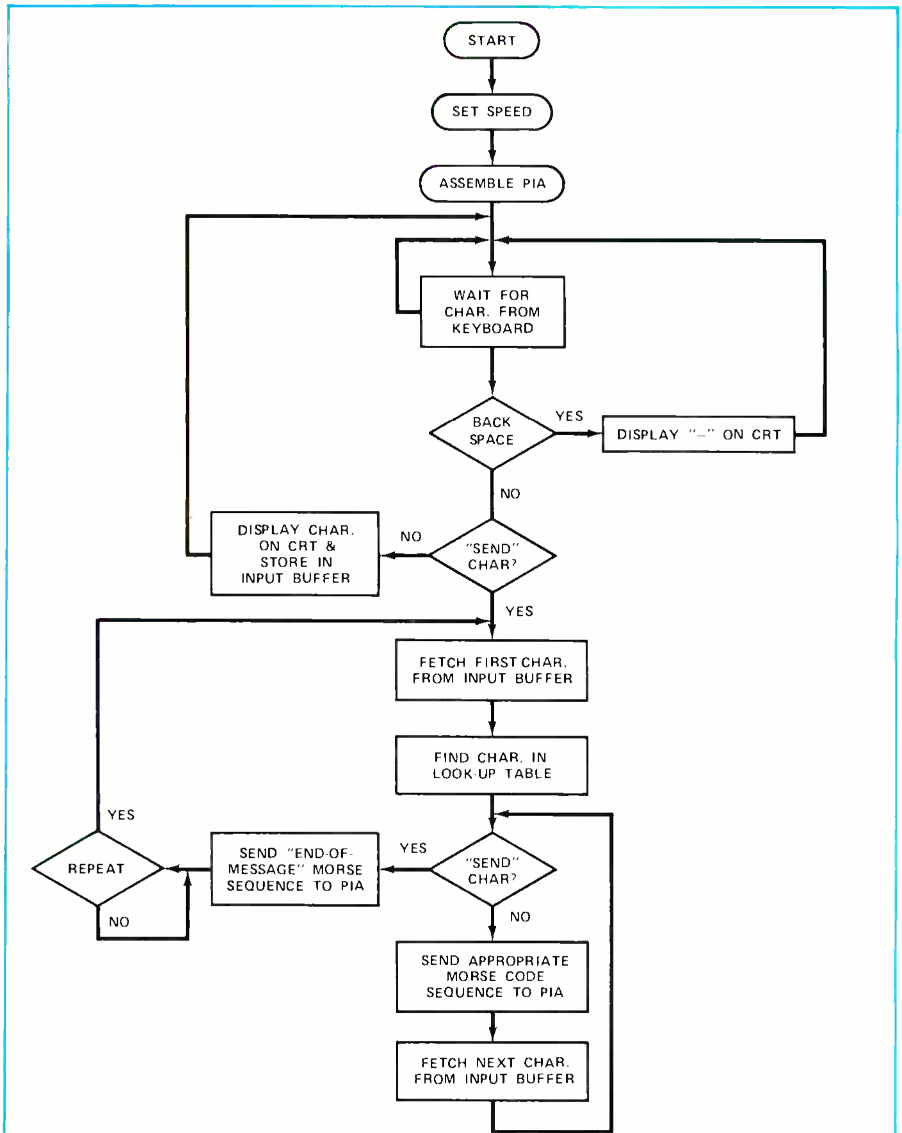

Fig. 2. Flow chart of MORSEND, the machine-language program.

about 50% when compared to other forms of transmission in which the carrier is always present. Also, the code is optimal, since the most often-used characters in the English language are assigned the shortest lengths. Finally, the simplicity of the equipment required to transmit Morse code has made it a practical, low-cost form of communication that has been popular for many years.

Learning the Code. One of the most important things to keep in mind when beginning to learn Morse code is that it is a language of *sound*. Characters must not be learned as combinations of dots and dashes. Instead, the "sound" of the character should be learned using someone (or something) to actually send the characters until the sound and rhythm of the code elements can be associated with the proper characters.

Learn the code by listening to it. Listen to a few characters at a time repeatedly and, initially, do not worry about speed. Before attempting to increase receiving speed, you must be able to recognize the characters without hesitation.

Learning the code, particularly when using a computer, is not at all difficult. With less than an hour of practice per day, an average individual will be able to receive code at a speed of 5 to 7 words per minute in less than two weeks. More information on learning Morse code is available from the American Radio Relay League, Newington, CT 06111.

About the Program. A flow chart of MORSEND, a machine language program written for a SWTP 6800 microcomputer equipped with a parallel interface board (PIA) in the number 2 interface slot, is shown in Fig. 2. Only

(Table II on pages 68 and 69)
(Text continues on page 70)

TABLE II—MORSEND PROGRAM FOR COMPUTER-AIDED

```
READY

---
PAGE  001    MORSEND
00010                          NAM    MORSEND

00020                          OPT    O,NOP
00040           E1D1   OUTEEE  EQU    $E1D1
00050           E1AC   INEEE   EQU    $E1AC
00060           8008   PIAA    EQU    $8008
00066           8009   PIAC    EQU    $8009
00068 0015                     ORG    21
00071 0015 0001        SPEED   RMB    1
00080 0016                     ORG    22
00090 0016 0400        INBUFF  RMB    1024
00095                  *DELAY ROUTINE FOR
00096                  *GENERATING THE
00097                  *FUNDAMENTAL TIME
00098                  *ELEMENT:
00110 0416 96 15       INTVRL  LDA A  SPEED
00120 0418 C6 02               LDA B  #$02
00130 041A 4A          DLY1    DEC A

00140 041B 26 01               BNE    DLY2
00150 041D 39                  RTS

00160 041E 5A          DLY2    DEC B

00170 041F 27 F9               BEQ    DLY1
00180 0421 20 FB               BRA    DLY2
00185                  *KEYBOARD ERROR
00186                  *ROUTINE:
00190 0423 09          BKSPAC  DEX

00200 0424 86 5F               LDA A  #$5F
00210 0426 BD E1D1             JSR    OUTEEE

00220 0429 7E 04AA             JMP    RESTRT

00230 042C 08          CONT    INX

00240 042D 20 7E               BRA    RESTRT

00245                  *SINGLE DOT ROUTINE.
00250 042F 86 00       DOT     LDA A  #$00
00260 0431 B7 8008             STA A  PIAA
00270 0434 BD 0416             JSR    INTVRL

00280 0437 7F 8008             CLR    PIAA
00285 043A 73 8008             COM    PIAA
00290 043D BD 0416             JSR    INTVRL

00300 0440 39                  RTS

00305                  *SINGLE DASH ROUTINE:

00310 0441 86 00       DASH    LDA A  #$00
00320 0443 B7 8008             STA A  PIAA
00330 0446 BD 0416             JSR    INTVRL

00340 0449 BD 0416             JSR    INTVRL

00350 044C BD 0416             JSR    INTVRL

00360 044F 7F 8008             CLR    PIAA
00365 0452 73 8008             COM    PIAA
00370 0455 BD 0416             JSR    INTVRL

00380 0458 39                  RTS

00385                  *ROUTINE FOR
00386                  *GENERATING SPACE
00387                  *BETWEEN CHARACTERS:
00390 0459 86 01       SPAC1   LDA A  #$01
00400 045B B7 8008             STA A  PIAA
00410 045E BD 0416             JSR    INTVRL

00420 0461 BD 0416             JSR    INTVRL

00430 0464 BD 0416             JSR    INTVRL

00440 0467 39                  RTS

00445                  *GENERATE 2 DOTS:
00450 0468 BD 042F     TODOT   JSR    DOT
00460 046B BD 042F             JSR    DOT
00470 046E 39                  RTS


00472 046F 7E 0423     ISLE1   JMP    BKSPAC

00473 0472 7E 042C     ISLE2   JMP    CONT
00475                  *GENERATE 2 DASHES:
00480 0475 BD 0441     TODSH   JSR    DASH
00490 0478 BD 0441             JSR    DASH
00500 047B 39                  RTS


00510 047C BD 042F     DOTDSH  JSR    DOT
00520 047F BD 0441             JSR    DASH
00530 0482 39                  RTS


00535                  *GENERATE DASH-DOT:
00540 0483 BD 0441     DSHDOT  JSR    DASH
00550 0486 BD 042F             JSR    DOT
00560 0489 39                  RTS


00570 048A BD 0459     FOUND   JSR    SPAC1
00580 048D 08                  INX


00590 048E 7E 04BA             JMP    TABLE
00593                  *LOCATE STACK AND
00594                  *ASSEMBLE PIA:
00595 0491 8E A042             LDS    #$A042

00600 0494 7F 8008             CLR    PIAA
00610 0497 7F 8009             CLR    PIAC
00620 049A 86 01               LDA A  #$01
00630 049C B7 8008             STA A  PIAA
00640 049F 86 04               LDA A  #$04
00650 04A1 B7 8009             STA A  PIAC
00652 04A4 73 8008             COM    PIAA
00655                  *MOVE POINTER TO
00656                  *BEGINNING OF BUFFER
00657                  *AND WAIT FOR INPUT
00658                  *FROM KEYBOARD.
00660 04A7 CE 0016     START   LDX    #INBUFF

00670 04AA BD E1AC     RESTRT  JSR    INEEE
00675                  *CHECK FOR BACKSPACE
00676                  *CHARACTER
00680 04AD 81 0F               CMP A  #$0F
00690 04AF 27 BE               BEQ    ISLE1
00700 04B1 A7 00               STA A  0,X
00705                  *CHECK FOR "START
00706                  *SENDING" CHARACTER
00710 04B3 81 5E               CMP A  #'↑
00720 04B5 26 BB               BNE    ISLE2
00730 04B7 CE 0016     REPEAT  LDX    #22
00740 04BA A6 00       TABLE   LDA A  0,X
00745                  *BEGINNING OF
00746                  *CHARACTER LOOK UP
00747                  *TABLE.
00750 04BC 81 41       LTRA    CMP A  #'A
00760 04BE 26 06               BNE    LTRB
00770 04C0 BD 047C             JSR    DOTDSH

00780 04C3 7E 048A             JMP    FOUND
00790 04C6 81 42       LTRB    CMP A  #'B
00800 04C8 26 09               BNE    LTRC
00810 04CA BD 0483             JSR    DSHDOT

00820 04CD BD 0468             JSR    TODOT
00830 04D0 7E 048A             JMP    FOUND
00840 04D3 81 43       LTRC    CMP A  #'C
00850 04D5 26 09               BNE    LTRD
00860 04D7 BD 0483             JSR    DSHDOT

00870 04DA BD 0483             JSR    DSHDOT

00880 04DD 7E 048A             JMP    FOUND
00890 04E0 81 44       LTRD    CMP A  #'D
00900 04E2 26 09               BNE    LTRE
00910 04E4 BD 0483             JSR    DSHDOT

00920 04E7 BD 042F             JSR    DOT
00930 04EA 7E 048A             JMP    FOUND
00940 04ED 81 45       LTRE    CMP A  #'E
00950 04EF 26 06               BNE    LTRF
00960 04F1 BD 042F             JSR    DOT
00970 04F4 7E 048A             JMP    FOUND
00980 04F7 81 46       LTRF    CMP A  #'F
00990 04F9 26 09               BNE    LTRG
01000 04FB BD 0468             JSR    TODOT
01010 04FE BD 0483             JSR    DSHDOT

01020 0501 7E 048A             JMP    FOUND
01030 0504 81 47       LTRG    CMP A  #'G
01040 0506 26 09               BNE    LTRH
01050 0508 BD 0441             JSR    DASH
01060 050B BD 0483             JSR    DSHDOT

01070 050E 7E 048A             JMP    FOUND
01080 0511 81 48       LTRH    CMP A  #'H
01090 0513 26 09               BNE    LTRI
01100 0515 BD 0468             JSR    TODOT
01110 0518 BD 0468             JSR    TODOT
01120 051B 7E 048A             JMP    FOUND
01130 051E 81 49       LTRI    CMP A  #'I
01140 0520 26 06               BNE    LTRJ
01150 0522 BD 0468             JSR    TODOT
01160 0525 7E 048A             JMP    FOUND
01170 0528 81 4A       LTRJ    CMP A  #'J
01180 052A 26 09               BNE    LTRK
01190 052C BD 047C             JSR    DOTDSH

01200 052F BD 0475             JSR    TODSH
01210 0532 7E 048A             JMP    FOUND
01220 0535 81 4B       LTRK    CMP A  #'K
01230 0537 26 09               BNE    LTRL
01240 0539 BD 0483             JSR    DSHDOT

01250 053C BD 0441             JSR    DASH
01260 053F 7E 048A             JMP    FOUND
01270 0542 81 4C       LTRL    CMP A  #'L
01280 0544 26 09               BNE    LTRM
01290 0546 BD 047C             JSR    DOTDSH

01300 0549 BD 0468             JSR    TODOT
01310 054C 7E 048A             JMP    FOUND
01320 054F 81 4D       LTRM    CMP A  #'M
01330 0551 26 06               BNE    LTRN
01340 0553 BD 0475             JSR    TODSH
01350 0556 7E 048A             JMP    FOUND
01360 0559 81 4E       LTRN    CMP A  #'N
01370 055B 26 06               BNE    LTRO
01380 055D BD 0483             JSR    DSHDOT

01390 0560 7E 048A             JMP    FOUND
01400 0563 81 4F       LTRO    CMP A  #'O
01410 0565 26 09               BNE    LTRP
01420 0567 BD 0441             JSR    DASH
01430 056A BD 0475             JSR    TODSH
01440 056D 7E 048A             JMP    FOUND
01450 0570 81 50       LTRP    CMP A  #'P
01460 0572 26 09               BNE    LTRQ
01470 0574 BD 047C             JSR    DOTDSH

01480 0577 BD 0483             JSR    DSHDOT

01490 057A 7E 048A             JMP    FOUND
01500 057D 81 51       LTRQ    CMP A  #'Q
01510 057F 26 09               BNE    LTRR
01520 0581 BD 0475             JSR    TODSH
01530 0584 BD 047C             JSR    DOTDSH

01540 0587 7E 048A             JMP    FOUND
01550 058A 81 52       LTRR    CMP A  #'R
01560 058C 26 09               BNE    LTRS
01570 058E BD 047C             JSR    DOTDSH

01580 0591 BD 042F             JSR    DOT
01590 0594 7E 048A             JMP    FOUND
01600 0597 81 53       LTRS    CMP A  #'S
01610 0599 26 09               BNE    LTRT
01620 059B BD 042F             JSR    DOT
01630 059E BD 0468             JSR    TODOT
01640 05A1 7E 048A             JMP    FOUND
01650 05A4 81 54       LTRT    CMP A  #'T
01660 05A6 26 06               BNE    LTRU
01670 05A8 BD 0441             JSR    DASH
01680 05AB 7E 048A             JMP    FOUND
01690 05AE 81 55       LTRU    CMP A  #'U
01700 05B0 26 09               BNE    LTRV
01710 05B2 BD 0468             JSR    TODOT
01720 05B5 BD 0441             JSR    DASH
01730 05B8 7E 048A             JMP    FOUND
01740 05BB 81 56       LTRV    CMP A  #'V
01750 05BD 26 09               BNE    LTRW
01760 05BF BD 0468             JSR    TODOT
01770 05C2 BD 047C             JSR    DOTDSH

01780 05C5 7E 048A             JMP    FOUND
01790 05C8 81 57       LTRW    CMP A  #'W
01800 05CA 26 09               BNE    LTRX
```

MORSE CODE PRACTICE

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01810 05CC BD 042F        JSR    DOT
01820 05CF BD 0475        JSR    TODSH
01830 05D2 7E 048A        JMP    FOUND
01840 05D5 81 58   LTRX   CMP A  #'X
01850 05D7 26 09          BNE    LTRY
01860 05D9 BD 0483        JSR    DSHDOT

01870 05DC BD 047C        JSR    DOTDSH

01880 05DF 7E 048A        JMP    FOUND
01890 05E2 81 59   LTRY   CMP A  #'Y
01900 05E4 26 09          BNE    LTRZ
01910 05E6 BD 0483        JSR    DSHDOT

01920 05E9 BD 0475        JSR    TODSH
01930 05EC 7E 048A        JMP    FOUND
01940 05EF 81 5A   LTRZ   CMP A  #'Z
01950 05F1 26 09          BNE    NUM1
01960 05F3 BD 0475        JSR    TODSH
01970 05F6 BD 0468        JSR    TODOT
01980 05F9 7E 048A        JMP    FOUND
01990 05FC 81 31   NUM1   CMP A  #'1
02000 05FE 26 0C          BNE    NUM2
02010 0600 BD 047C        JSR    DOTDSH

02020 0603 BD 0475        JSR    TODSH
02030 0606 BD 0441        JSR    DASH
02040 0609 7E 048A        JMP    FOUND
02050 060C 81 32   NUM2   CMP A  #'2
02060 060E 26 0C          BNE    NUM3
02070 0610 BD 0468        JSR    TODOT
02080 0613 BD 0475        JSR    TODSH
02090 0616 BD 0441        JSR    DASH
02100 0619 7E 048A        JMP    FOUND
02110 061C 81 33   NUM3   CMP A  #'3
02120 061E 26 0C          BNE    NUM4
02130 0620 BD 0468        JSR    TODOT
02140 0623 BD 047C        JSR    DOTDSH

02150 0626 BD 0441        JSR    DASH
02160 0629 7E 048A        JMP    FOUND
02170 062C 81 34   NUM4   CMP A  #'4
02180 062E 26 0C          BNE    NUM5
02190 0630 BD 0468        JSR    TODOT
02200 0633 BD 0468        JSR    TODOT
02210 0636 BD 0441        JSR    DASH
02220 0639 7E 048A        JMP    FOUND
02230 063C 81 35   NUM5   CMP A  #'5
02240 063E 26 0C          BNE    NUM6
02250 0640 BD 0468        JSR    TODOT
02260 0643 BD 0468        JSR    TODOT
02270 0646 BD 042F        JSR    DOT
02280 0649 7E 048A        JMP    FOUND
02290 064C 81 36   NUM6   CMP A  #'6
02300 064E 26 0C          BNE    NUM7
02310 0650 BD 0483        JSR    DSHDOT

02320 0653 BD 0468        JSR    TODOT
02330 0656 BD 042F        JSR    DOT
02340 0659 7E 048A        JMP    FOUND
02350 065C 81 37   NUM7   CMP A  #'7
02360 065E 26 0C          BNE    NUM8
02370 0660 BD 0475        JSR    TODSH
02380 0663 BD 0468        JSR    TODOT
02390 0666 BD 042F        JSR    DOT
02400 0669 7E 048A        JMP    FOUND
02410 066C 81 38   NUM8   CMP A  #'8
02420 066E 26 0C          BNE    NUM9
02430 0670 BD 0475        JSR    TODSH
02440 0673 BD 0483        JSR    DSHDOT

02450 0676 BD 042F        JSR    DOT
02460 0679 7E 048A        JMP    FOUND
02470 067C 81 39   NUM9   CMP A  #'9
02480 067E 26 0C          BNE    NUM0
02490 0680 BD 0475        JSR    TODSH
02500 0683 BD 0475        JSR    TODSH
02510 0686 BD 042F        JSR    DOT
02520 0689 7E 048A        JMP    FOUND
02530 068C 81 30   NUM0   CMP A  #'0
02540 068E 26 0C          BNE    PERIOD

02550 0690 BD 0475        JSR    TODSH
02560 0693 BD 0475        JSR    TODSH
02570 0696 BD 0441        JSR    DASH
02580 0699 7E 048A        JMP    FOUND
02590 069C 81 2E   PERIOD CMP A  #'.
02600 069E 26 0C          BNE    COMMA
02610 06A0 BD 047C        JSR    DOTDSH

02620 06A3 BD 047C        JSR    DOTDSH

02630 06A6 BD 047C        JSR    DOTDSH
02640 06A9 7E 048A        JMP    FOUND
02650 06AC 81 2C   COMMA  CMP A  #',
02660 06AE 26 0C          BNE    QUES
02670 06B0 BD 0475        JSR    TODSH
02680 06B3 BD 0468        JSR    TODOT
02690 06B6 BD 0475        JSR    TODSH
02700 06B9 7E 048A        JMP    FOUND
02710 06BC 81 3F   QUES   CMP A  #'?
02720 06BE 26 0C          BNE    DDASH
02730 06C0 BD 0468        JSR    TODOT
02740 06C3 BD 0475        JSR    TODSH
02750 06C6 BD 0468        JSR    TODOT
02760 06C9 7E 048A        JMP    FOUND
02770 06CC 81 2D   DDASH  CMP A  #'-
02780 06CE 26 0C          BNE    COLON
02790 06D0 BD 0483        JSR    DSHDOT

02800 06D3 BD 0468        JSR    TODOT
02810 06D6 BD 0441        JSR    DASH
02820 06D9 7E 048A        JMP    FOUND
02830 06DC 81 3A   COLON  CMP A  #':
02840 06DE 26 0C          BNE    SMICOL

02850 06E0 BD 0475        JSR    TODSH
02860 06E3 BD 0483        JSR    DSHDOT

02870 06E6 BD 0468        JSR    TODOT
02880 06E9 7E 048A        JMP    FOUND
02890 06EC 81 3B   SMICOL CMP A  #';
02900 06EE 26 0C          BNE    LPAREN

02910 06F0 BD 0483        JSR    DSHDOT

02920 06F3 BD 0483        JSR    DSHDOT

02930 06F6 BD 0483        JSR    DSHDOT

02940 06F9 7E 048A        JMP    FOUND
02950 06FC 81 28   LPAREN CMP A  #'(
02960 06FE 26 0C          BNE    RPAREN

02970 0700 BD 0483        JSR    DSHDOT

02980 0703 BD 0475        JSR    TODSH
02990 0706 BD 047C        JSR    DOTDSH

03000 0709 7E 048A        JMP    FOUND
03010 070C 81 29   RPAREN CMP A  #')
03020 070E 26 0C          BNE    FBAR
03030 0710 BD 0483        JSR    DSHDOT

03040 0713 BD 0475        JSR    TODSH
03050 0716 BD 047C        JSR    DOTDSH

03060 0719 7E 048A        JMP    FOUND
03070 071C 81 2F   FBAR   CMP A  #'/
03080 071E 26 0C          BNE    SPACE
03090 0720 BD 0483        JSR    DSHDOT

03100 0723 BD 047C        JSR    DOTDSH

03110 0726 BD 042F        JSR    DOT
03120 0729 7E 048A        JMP    FOUND
03125              *ROUTINE FOR SPACE
03126              *BETWEEN WORDS
03130 072C 81 20   SPACE  CMP A  #'
03140 072E 26 0C          BNE    SEND
03150 0730 BD 0459        JSR    SPAC1
03160 0733 BD 0459        JSR    SPAC1
03165 0736 BD 0416        JSR    INTVRL

03170 0739 7E 048A RTN    JMP    FOUND
03180 073C 81 5E   SEND   CMP A  #'↑
03190 073E 26 F9          BNE    RTN
03200              *END OF CHARACTER
03201              *LOOK-UP TABLE
03210 0740 BD 0459        JSR    SPAC1
03220 0743 BD 0459        JSR    SPAC1
03225              *END-OF-MESSAGE
03226              *CHARACTER
03230 074E BD 047C        JSR    DOTDSH

03240 0749 BD 047C        JSR    DOTDSH

03250 074C BD 042F        JSR    DOT
03255              *LOOP AND WAIT FOR
03256              *REPEAT OR RESET
03260 074F BD E1AC        JSR    INEEE
03270 0752 81 5E          CMP A  #'↑
03280 0754 7E 0487        JMP    REPEAT

03290                     END
TOTAL ERRORS 00000
```

(Continued from page 66)

MIKBUG subroutines INEEE and OUTEEE are required for input and display. The program is given in Table II.

The schematic diagram of a suitable code practice oscillator (CPO) that interfaces with the 0 output bit of the computer's PIA is shown in Fig. 3. The CPO has both volume and pitch controls and can be built very inexpensively.

The entire program requires less than 2K bytes of memory, which includes a 1K character buffer memory. The program should be entered from the keyboard (and can be taped for future use), and the program counter (addresses A048 and A049) should be loaded with

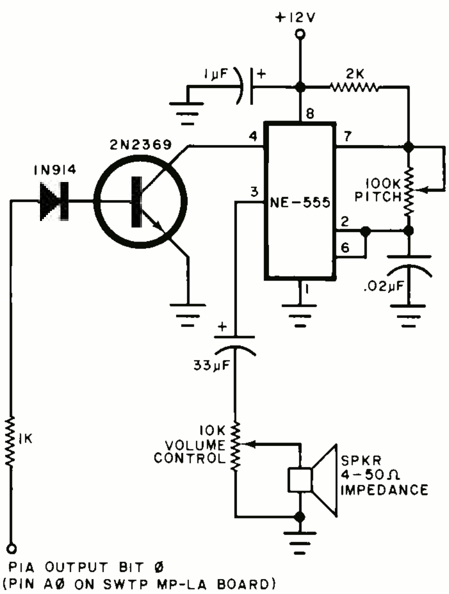


Fig. 3. Code-practice oscillator is driven by A0 from MP-LA parallel interface board.

0491, the starting address of the program. Sending speed must be entered next using the monitor's memory-change function. A hex number is entered into location 0015 (SPEED) to set the sending speed. The number to be entered will, of course, depend on the CPU clock frequency, but approximate numbers can be obtained from the formula (derived empirically for the SWTP 6800): $SPEED_{10} = 75 - 2.7 \times wpm$. Enter the *hex* equivalent of $SPEED_{10}$ into the SPEED location in the program. For example, to practice at 5 wpm (a good speed to begin learning), enter 3D into location 0015. To get more accurate speed control, it is best to measure the machine's speed with a stopwatch at two different speeds (assume five letters to a word) and then linearly interpolate for any other speed.

To start the program, type G and then the text to be sent back in code. For the novice, repeated groups of no more than five new characters should be taken per session. For the experienced individual who wants to increase his speed, five-letter code groups of random characters provide excellent practice. If an error is made in entering the text, just press and hold SHIFT and type 0 and an underline will be displayed to indicate a backspace. Release SHIFT and type the desired character. Following this procedure, the error character will not be transmitted. (Up to 1024 characters may be entered before typing "↑" to initiate the sending sequence.)

To delay the sending sequence after "↑" is typed, enter a series of spaces as the initial characters. When the machine has sent the complete text, it automatically sends the "end-of-message" sequence and stops. If you want to repeat the text already entered, key in "↑" again. If new text is to be entered, press system RESET, change speed if desired, and then type in G again. If any characters other than those shown in Table I are typed, they are stored in the character buffer, but the machine will ignore them when sending back the message in code equivalents.

Summing Up. As you practice using the program over a period of weeks, with the hints given here, you should note a marked increase in your copying speed. The more proficient you become, the faster will be your speed. ◇

"It makes the job of keeping tabs on the kids much easier."

SUPER DISCS:

A Revolution in Recording

BY HAROLD A. RODGERS
Senior Editor

IN THE early days of high fidelity, program material was regarded as a given. The signal had been engraved in the record groove, and it was up to the designers of playback equipment to extract it. This was to be done, of course, with as little loss in fidelity as possible to phono cartridges that couldn't quite track, amplifiers that gave limited power and—by today's standards—huge amounts of distortion, and speakers of limited bandwidth that insisted on adding their own not-always-pleasant personalities to the music. As home equipment got better and better, however, it became clear that a good deal of the performance of which it was capable could not be realized—it simply wasn't in the recordings to begin with. While hardware had been advancing the state of the art, phonograph records had remained on a plateau on which the sun was now beginning to set. Or so it seemed to dedicated audiophiles.

The situation was not accepted with quiet resignation or anything close to it. Audio editors railed against the deplorable quality of discs then available. Record companies countered by pointing out that the vast majority of their customers found their products eminently satisfactory and that to upgrade them for the benefit of a tiny minority who had elaborate playback equipment and could tell the difference was simply not economically justified. Further, they explained, it would be suicidal for them to produce records that only a few critically engineered phono cartridges could track. And that was that—until recently.

The Making of a Disc. To understand how the modern, high-end, specialty disc came into being, it will be necessary to digress for a time and examine the way in which records are produced. Most records begin life as tape recordings. Often, the original recording is made on 16, 24, or more separate tracks that are "mixed down" to make a two-channel version, but whatever its origins, the two-channel tape is the starting point for disc manufacture.

The signal from the tape is fed to a cutting lathe on which a lacquer blank rotates, much the way it would on any turntable. A stylus activated by the signal from the tape cuts a groove in the blank that corresponds to the signal. After this, the lacquer master, as it is now called, is plated with metal. The metal master thus formed, bearing a negative impression of the original grooves, is then stripped away. In the next step, a metal mother is grown from the metal master by further plating. The mother, which bears a positive groove impression, is checked for quality and, in another plating operation, is used to make stampers that bear, once again, a negative impression. The stampers can then be locked into presses in which vinyl discs are formed.

Re-enter Direct Cutting. Noting that some early electrical recordings—made before tape recorders were invented—had clarity, warmth, and musicality missing from latter-day discs, Lincoln Mayorga and Doug Sax, founders of Sheffield Lab Inc., began to consider the tape-recording step suspect. Accordingly, they tried eliminating it, thus returning to the "primitive" technique of the Edison era—recording directly onto the lacquer. This, they found, produced a superior recording; and, in 1970 the young company began to produce what has become a series of notable releases, featuring Thelma Houston, Harry James, and others.

As time passed, other companies, such as Crystal Clear, Miller & Kreisel, Direct-Disk Labs, Nautilus, and Telarc in the U.S.; Umbrella in Canada; and RCA, Toshiba EMI, Philips, and East Wind in Japan began to release directly mastered recordings too, and the specialty-disc revolution was under way.

Direct mastering, although it produces superior recordings, introduces numerous practical difficulties as well. One notable problem is that while recorded tapes can be cut, spliced, and edited, a lacquer disc cannot. In fact, once the cutting process begins, it must proceed without interruption or the entire side is lost. This means that the musicians have to do a complete side at a time with no possibility of correcting errors, just as if they were performing live.

The effect of this limitation is controversial. Some claim that knowing a take is "for real" and must be done perfectly produces an excitement akin to that of a real, live performance. Others object that pressure of this sort leads musicians to restrict their creativity and play in a conservative manner that results in a dull or "uptight" sound. Examples can be found to support either of these arguments.

Another potential source of trouble is that the mastering engineer has to adjust the cutting pitch—the spacing between adjacent grooves—by hand. (When a tape master is transferred to disc, an extra "preview" head on the playback tape machine feeds the signal to a computer one revolution or so before it reaches the cutter head. The computer then sets the pitch automatically.) If the engineer tries to get too much material on a single side and puts the grooves too close together, a loud signal may cause overcutting and ruin the take. On the other hand, if he is too conservative and places the grooves farther apart than necessary, he may run out of recording time before the end of the selection, also ruining the take. All of this places an additional burden on the musicians, who must not surprise the engineer with any unplanned changes in loudness or tempo.

Perhaps the most serious limitation of direct cutting is that a metal master, of which there is only one, can only produce a limited number of stampers. Since stampers often have distressingly short lifetimes, it's rare to find as many as 50,000 copies of a direct-cut edition. Here is a difficult economic situation in which the cost of a difficult and risky recording technique must be recovered from a limited amount of product. Small wonder that such limited-edition discs are expensive.

Keeping the Advantages of Tape. The problems of direct cutting being as difficult as they are, it is not surprising that some specialty-disc makers prefer to use tape for the original recording. Gale Records, for example, works on the premise that much of the signal degradation associated with tape is a result of aging, and makes the transfer to the lacquer disc immediately after the master tape is recorded. Plating of the master disc is also done right away, as this too is felt to be a point at which aging can detract from sonic fidelity. Only the metal master is deemed stable.

In another approach to the use of tape as a transfer medium, an advanced compander system operates on the signal before recording and after playback, reducing the noise level, extending dynamic range, and, by allowing lower recording levels, reducing distortion. Decibel Records implements this method by means of a Burwen Model 2000 Processor, and is not hesitant to apply other signal processing where it is deemed appropriate.

Generally, these extremely careful tape transfers produce discs whose sonic characteristics place them a good cut above those ordinarily available. Many listeners find that their sound rivals, but does not quite equal, that of a well-made direct cut. But unlike direct cuts, recordings made on tape can be edited, which allows errors to be removed.

Digital tape recording, a relative newcomer to the scene, has proved itself the most powerful tape recording system yet developed. With a 90-dB dynamic range and almost vanishingly small noise and distortion, digital recording challenges the human ear to detect its imperfections. In addition to these virtues, a digital master can be copied through an un-

A Sampler of

GORDON LIGHTFOOT: ***Sundown Mobile.*** Fidelity MFSL 1-018.

I'll bet very few Gordon Lightfoot fans have ever heard one of his albums that sounded like this. There is solid bass, exceptional treble and midrange clarity, low surface noise, and a good sense of ambience. The clear highs expose a touch of sibilance in the vocal that is obviously on the master tape, but it's not enough to be serious. It's nice to hear the instrumental parts holding their own rather than being overwhelmed by the voice.

HAMMOND CASTLE PIPE ORGAN, VOL. I. ***Douglas Marshall.*** Decibel 1000.

John Hays Hammond, the jacket notes tell us, built his medieval-style castle around a pipe organ, although, somewhat anachronistically, the organ design sounds typical of the 19th century. The registrations are a bit thick, especially for the Baroque selections, something for which I suspect the instrument rather than the artist is responsible. The recording has excellent dynamic range and enough bass to rattle your teeth. Virtual absence of hiss and a pleasant recreation of hall ambience are also characteristics of this disc.

ROBERT BAKER, ***Organist Vol. I & II.*** Sonar SD-160, 161.

Well-played, tastefully registered organ music is what you'll hear on these discs. The sound gets big in some of the romantic selections, with no loss of clarity and dynamic expression. The delicate textures and polyphonic characteristics of the Baroque selections are also well rendered in this recording. There is lots of power when it is called for, but one finds more deftness and subtlety than in your basic blood-and-thunder, room-shaking organ record.

CANTATE DOMINO: ***Oscars Motettkör, Torsten Nilsson, directing.*** Proprius PROP 7762 (Distributed by Audio Source).

A choir can be fearsomely difficult to record well, but an unusually good job has been done on this disc. The words are easily audible (which is unusual), and screechiness and sibilance are absent. Organ is used as accompaniment for the choral selections, and the overall ensemble is reproduced with excellent dynamic range. The delicate textures of organ solos show up nicely too. The repertoire, though nicely varied, may not be everyone's cup of tea, but the disc is a joy to hear.

A TRIBUTE TO ETHEL WATERS. ***Diahann Carroll and the Duke Ellington Orchestra under Mercer Ellington.*** Orinda ORC 400.

This is an elaborate, multichannel mix and doesn't have a great sense of depth and ambience, but the sound quality is just luscious. Balance between voice and instruments and bass and treble is excellent, and there is outstanding dynamic range. A trace of noise (from the thirty-odd mike preamps used) obtrudes, but just slightly. This album has received four Grammy nominations, and you can hear why.

NATURALLY: ***Mel Lewis and the Jazz Orchestra.*** Telarc DG 10044 (Distributed by Audio Technica).

This recording, like Telarc's classical releases, was made with a three-microphone pickup, except that here spot mikes are occasionally used to highlight solos. The sound is not of the ultrabrilliant close-miked variety found on many jazz discs, but it is certainly brilliant enough. In addition, it has a fine sense of detail and acoustic space, together with wide dynamic range and clean transients. An auspicious move into popular music by a company whose forte has been classical recording.

limited number of generations with each dub remaining sonically identical to the master. Although digital tapes must be edited electronically rather than by means of the time-tested razor blade and splicing block, they can be joined in a way that is virtually undetectable by any means as long as there are no tattle-tale discrepancies of musical pitch or tempo between segments.

Discs made as transfers from digital master tapes are available and have demonstrated excellent sound quality. They are so good that some observers speculate that digital transfers may drive direct cutting into obsolescence. Telarc has abandoned direct mastering for digital transfer via a Soundstream recorder, the same as that used by Orinda in making its now-famous recording of Diahann Carroll and the Duke Ellington orchestra. Studio 80 too has produced some notable digital transfers using a recorder developed by 3M Company. And London has become the first of the major companies to try the digital waters with a two-record set of Viennese waltzes.

Digital recording has also been used in Japan, where the technique is known as PCM (pulse-code modulation). Denon, one of the pioneers in the field, has produced an extensive catalog of PCM-mastered discs, many of which are available in the U.S. through Discwasher.

But not all producers and engineers of specialty discs feel that digital mastering is the total answer. Many, possibly suspicious of the sharp low-pass filtering that the digital method requires or skeptical about its high cost, remain fiercely loyal to direct mastering.

Upgrading Disc Transfers. Tape recording is not the only process that allows fidelity to leak away. One notable source of distortion is disc cutting itself. Unfortunately, the signal cut into the disc by the cutting stylus is not a perfect replica of the signal delivered to the drive coils. As is the case with playback styli, the distortion the cutter produces is a function of the velocity with which it moves in tracing the groove, not the amplitude of the signal that is being cut. A playback stylus, of course, must trace the groove as it has been cut, with the disc rotating at the proper speed. Otherwise, the music will not be heard at the correct pitch and tempo.

During the cutting process, however, no one is listening. It makes no difference what speed the cutter runs at as long as the groove in the lacquer is properly cut. Therefore, it is possible to run both the tape playback and the cutting lathe at, say, half the normal speed. When this is done, the range of velocities to which the cutting stylus is subject is reduced by one-half. Now the cutter is operating where its distortion performance is considerably better. Another benefit cutting engineers appreciate is that the power required to drive the cutter is reduced by a factor of four. The demands on the drive amplifier and cooling system are thus much reduced.

Of course, there is more involved in half-speed cutting than just running the tape recorder and cutting lathe at reduced speed. Appropriate compensation must be made in the tape playback equalization and the RIAA disc pre-emphasis. These steps turn out to be worthwhile for, as it turns out, the tape recorder too works better at half speed.

In many tape recorders, the tendency of the tape heads' inductance to roll off high-frequency response is compensated by networks that are resonant near 20 kHz. This maintains high-frequency response, but sharp transients may cause these networks to "ring" slightly and produce high-frequency smearing. At half-speed the spectra of these transients fall below the resonances, resulting in a cleaner playback.

(Continued on page 74)

Super Discs

BETTER THAN LIVE: ***Larry Coryell and the Brubeck Brothers.*** Direct Disk Labs D.D. 109.

This selection comes close to being a sonic spectacular, but somehow the synthesized sounds don't quite come off. Acoustic instruments, on the other hand, are reproduced in a most satisfying manner. The recording has good dynamic range and frequency balance as well as nice, clean transients. The music is not mind-blowing, but it surely makes for enjoyable listening.

SCHUBERT: SYMPHONY NO. 9 IN C MAJOR. ***Heinz Rogner/Berlin Radio Symphony Orchestra.*** Denon OB-7350-51 (Distributed by Discwasher).

This is a deluxe recording of the symphony, with each movement assigned to its own record side. Thanks to the absence of dynamic compression, the climaxes and crescendos have a sense of suspense—you are never sure quite how loud they will get. The sound is very clear, and there is good delineation of instrumental timbres.

BAROQUE BRASS: ***Empire Brass Quintet.*** Sine Qua Non/ dbx SNQ SA 2014.

Even where the music was originally composed for brasses, the approach taken here is very modern sounding, and the arranged selections will leave purists shaking their heads. The sound is spectacular, though. The playing is of high quality, and the dynamic range verges on awesome, so once again you must not let the silent lead-in groove tempt you to set the gain too high. Don't forget—you'll need a dbx decoder to enjoy this one.

WAGNER—DIE WALKURE: RIDE OF THE VALKYRIES; TRISTAN UND ISOLDE: PRELUDE TO ACT I; GOTTERDAMMERUNG: SIEGFRIED'S FUNERAL MUSIC; SIEGFRIED: FOREST MURMURS; ***Erich Leinsdorf/Los Angeles Philharmonic.*** Sheffield Lab 7.

Leinsdorf brings out not just the brute power of Wagner but his subtlety as well; and from what I can hear, the record captures just about all of it. One is aware of full dynamic range, good ambience, the cutting edge on the brass instruments, and the sparkle of the percussion, to mention a few things that give this disc its special quality. The gentle rise and fall of Wagner's extended phrases is especially well preserved. There is an occasional minor noise—a turning page, a tapped music stand, or whatever—that might have been repaired in a taped version, but I heard nothing I could call a fluff. This is an outstanding example of what direct mastering can do.

FRIENDSHIP: ***Lee Ritenour.*** JVC Direct Disc VIDC-3 (Distributed by Nautilus).

This disc gives an impression of startling clarity and natural frequency balance. The instruments stand out clearly in a well-defined acoustic space, and the transients sound almost too good to be true. Piano sound in particular is excellent. The Japanese-language liner notes are not very informative to an English-speaking person, but don't let that keep you from enjoying a very fine recording.

FOR DUKE: ***Bill Berry and His Ellington All-Stars.*** M & K RealTime Records RT-101.

The lead-in groove of this disc is so silent that one is tempted to boost the volume to be sure it is playing. Do that and you'll be sorry, however, for there is a lot of dynamic range. Transients are sharp and clear, and the overall frequency balance is very good. The recorded perspective is a little flat and the ambience somewhat sparse, but these factors lend a pleasing sense of intimacy to the instrumental solos.

Naturally enough, only recordings made on tape can be transferred to disc at half speed. This is done with Telarc's digital recordings, and Mobile Fidelity is leasing master tapes of important records and reissuing them as half-speed-cut versions. These do not sound quite as good as direct cuts and digital transfers, or even analog tape transfers in which the tape has not been stored for a long time. But they are demonstrably better than the original commercial versions. And half-speed cutting can be applied to *any existing master tape*.

This points up what has so far been a dilemma for the prospective buyer of discs. At one end of the scale there are discs of maximum fidelity carrying performances by relative unknowns; at the other end there is the usual run of commercial discs carrying recordings of first-line artists. Bridging the gap somewhat are the half-speed-cut releases, but these are relatively few as yet. Don't go away, though. As the Sampler included here shows, the artists and the technology are beginning to come together. And more of the major record companies are beginning to experiment with digital recording techniques.

Discs with Noise Reduction. No matter how advanced the technology used ahead of it, discs inherently have less dynamic range than music really demands. Rigorously careful manufacturing through all stages helps (that's part of what the hefty prices specialty discs command is for), but even then, the medium is limited. One interesting solution that has been tried is to apply noise reduction to the discs themselves. That is, the disc contains a highly compressed version of the recording, which, as it emerges from the phono preamp, is fed to an expander that returns the signal to its normal form, greatly reducing the noise from the disc in the bargain. The disadvantage here is that the expander is needed in the playback chain.

A system of this type—and a few encoded discs—was introduced by dbx several years ago, but never really caught on. The company has recently reintroduced the system, this time with a low-cost, disc-playback-only expander and a larger catalog of discs. It has been suggested that direct-cut and digitally-transferred discs with dbx encoding will be introduced soon. Telefunken has demonstrated that its High-Com II noise-reduction can be used in the same way, and, further, that it is more "compatible" in the sense that it is not as unpalatable to listen to undecoded as some other noise-reduction systems are. No commercial application of this system to discs has yet been made, however.

Conclusion. Specialty discs of all types have evolved to meet a need in the market—the demand for disc records capable of doing justice to a fine home music-reproduction system. That does not necessarily mean that you need a very expensive system in order to hear the difference; it is audible on equipment of quite modest capabilities. It does mean that to hear *all* of the difference, your equipment must be first rate. And the difference can be stunning!

Some audiophiles use specialty discs to challenge and test their systems. But, unless you know that your power amps and speakers are equal to the task, be judicious about volume levels. (An unexpected loud transient could cause considerable damage.)

If low recorded distortion, wide dynamic range, and excellent frequency response interest you, try a specialty disc and see if your system is up to snuff. You can probably find some at your local audio salon, or you can write directly to the companies listed in the box below. ◇

Some Sources for Super Discs

American Gramaphone Co.
24310 2nd Place West
Bothell, WA 98011

Audio Source
1185 Chess Drive
Foster City, CA 94404

Audio-Technica U.S. Inc.
33 Shiawassee Ave.
Fairlawn, OH 44313

Century Records
6550 Sunset Blvd.
Los Angeles, CA 90028

Crystal Clear
P.O. Box 3864
San Francisco, CA 94119

dbx Incorporated
71 Chapel Street
Newton, MA 02154

Decibel Records
P.O. Box 631
Lexington, MA 02173

Delos Records
855 Via de la Paz
Pacific Palisades, CA 90272

Direct-Disk Records
16 Music Circle South
Nashville, TN 37203

Discwasher
1407 N. Providence Rd.
Columbia, MO 65201

D & W Records
Great White Whale
348 E. 84th St.
New York, NY 10028

Great American Gramophone Co.
6550 Sunset Blvd.
Hollywood, CA 90028

Golden Crest Records
220 Broadway
Huntington Station, NY 11746

Gryphone Productions
157 W. 57th St.
New York, NY 10019

Halpern Sounds
P.O. Box 720
Palo Alto, CA 94302

Insight Records
7726 Morgan Ave. South
Minneapolis, MN 55423

Island Records
7720 Sunset Blvd.
Los Angeles, CA 90046

Mark Levinson Acoustic Rec. LTD.
55 Circular Avenue
Hamden, CT 06514

M & K RealTime Records
8719 Wilshire Blvd.
Beverly Hills, CA 90211

Mobile Fidelity Sound Labs.
P.O. Box 919
Chatsworth, CA 91311

Nautilus Records
761 Shell Beach Rd.
Shell Beach, CA 93449

Orinda Records
23 Altarinda Rd.
Orinda, CA 94563

Phase One Recording Studios
3015 Kennedy Rd., Unit 10
Scarborough, Ont. M1V 1E7
Canada

Philips Records
810 Seventh Ave.
New York, NY 10019

RCA LTD
225 Mutual St.
Toronto, Ont. M5B 2B4
Canada

Reference Recordings
P.O. Box 5046
Berkeley, CA 94705

Salisbury Labs.
33 Harbour Sq., Suite 2226
Toronto, Ont. M5S G2G
Canada

Sheffield Lab Inc.
P.O. Box 5332
Santa Barbara, CA 93108

Sonar Records Corp.
P.O. Box 455
Kingsbridge Station
Bronx, NY 10463

Varese International
6404 Wilshire Blvd.
Los Angeles, CA 90048

Worldway, Inc.
111 Ellis St.
San Francisco, CA 94102

Radioteletype Reader for Shortwave Receivers

BY GEORGE STEBER
WB9LVI

Part 2: Construction, Alignment and Use

LAST MONTH, in Part 1 of this article, we discussed the basics of radioteletype communications. We also gave a summary of how the circuit of the RTTY Reader works to convert the incoming signal (in Baudot or ASCII code) into moving characters on a display. In this final Part, we describe how to construct the RTTY Reader, as well its alignment and use.

Construction. The RTTY Reader is most easily constructed using printed-circuit assembly techniques. Three circuit boards, two of them double-sided, are required. The component-placement guide for the double-sided main board is in Fig. 6. Full-size etching and drilling guides are shown in Fig. 7. Similarly, the full-size, etching-and-drilling guides for the double-sided display board are in Fig. 8, with the component-placement guide in Fig. 9. Etching-and-drilling and parts-placement guides for the power-supply board are in Figs. 10 and 11, respectively.

Be sure to observe good construction practices during the assembly of this project. For example, use the minimum amount of heat and solder consistent with the formation of good solder joints. When assembling the printed circuit boards, check your work to spot any cold solder joints or solder bridges between adjacent foils that might have been inadvertently created.

Wire the main pc board first, using Fig. 7 as a guide. Start by inserting and soldering the IC sockets or Molex Soldercons. Install the smallest components next, gradually working up to the larger ones. For example, mount the ¼-watt fixed resistors, then the diodes, the small capacitors, transistors, and finally the large capacitors. Be sure to observe the pin basings of semiconductors and the polarities of tantalum and aluminum electrolytic capacitors.

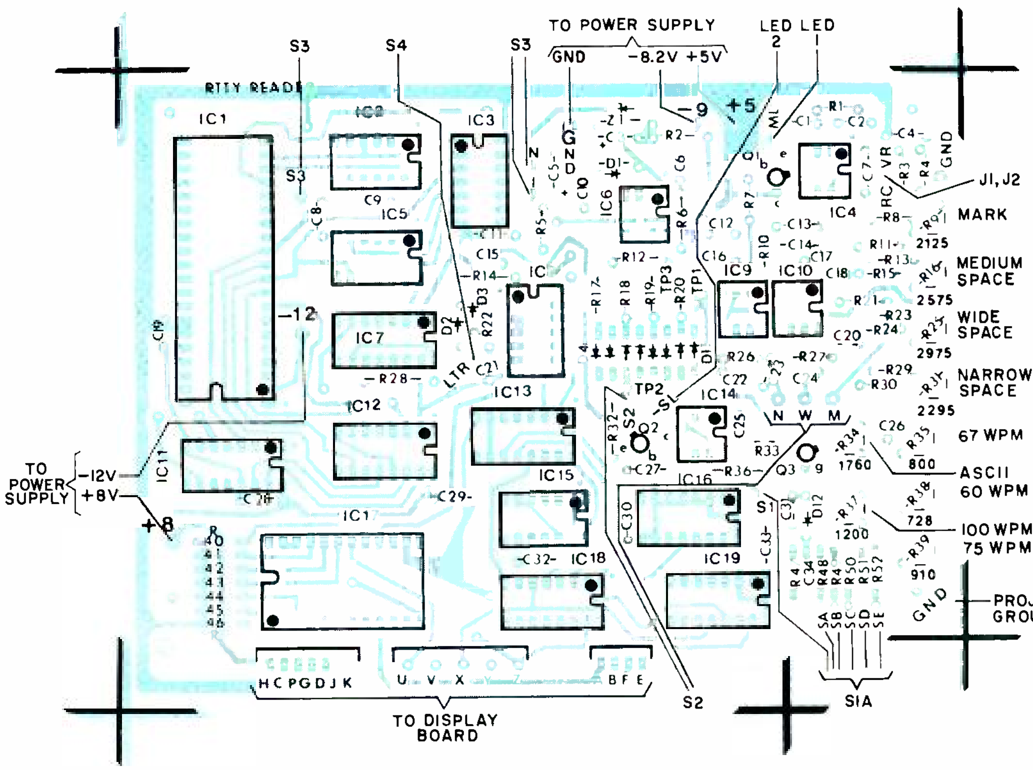


Fig. 6. Component placement guide for the double-sided main board.

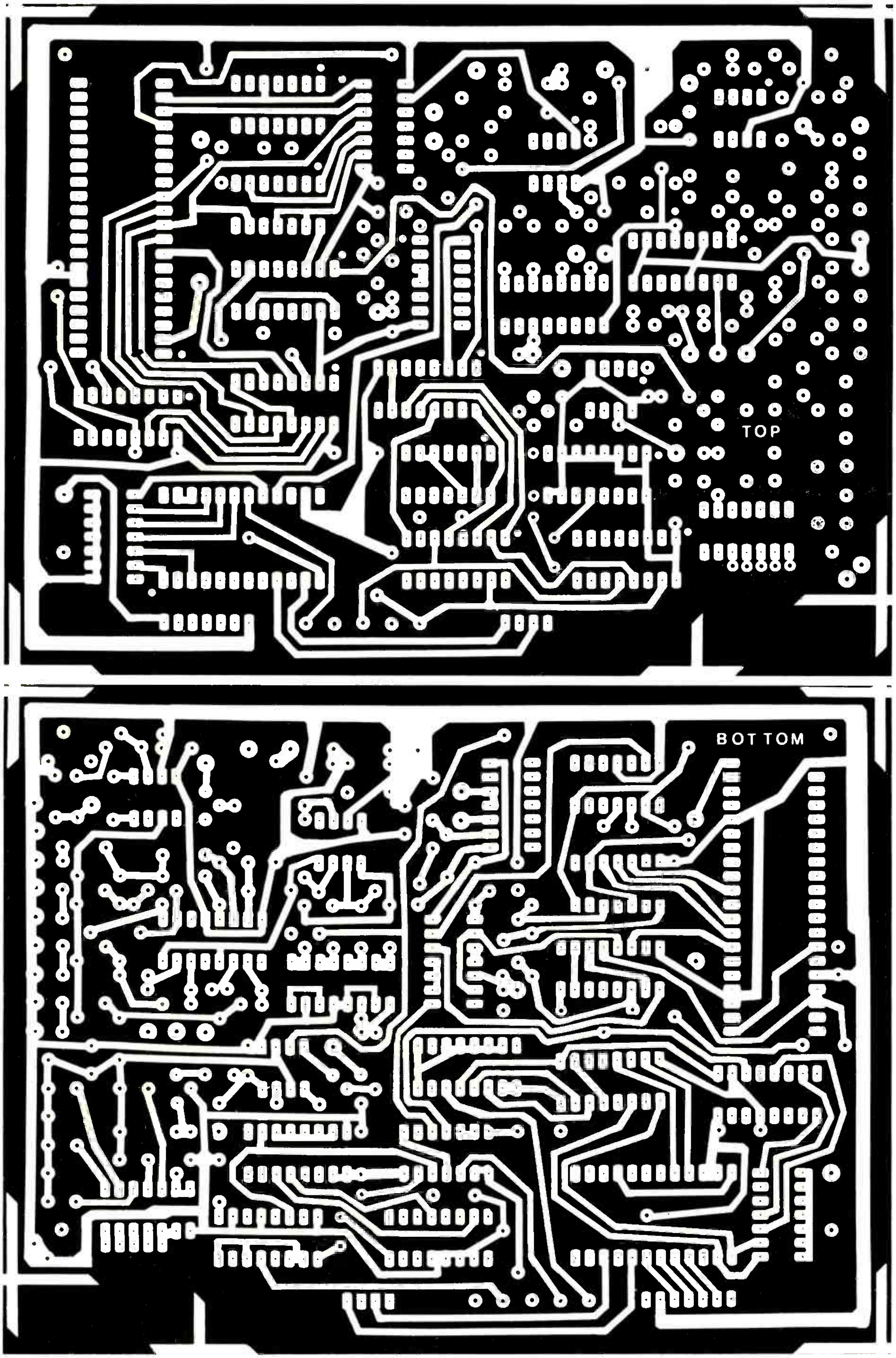


Fig. 7. Etching and drilling guides for both sides of main pc board.

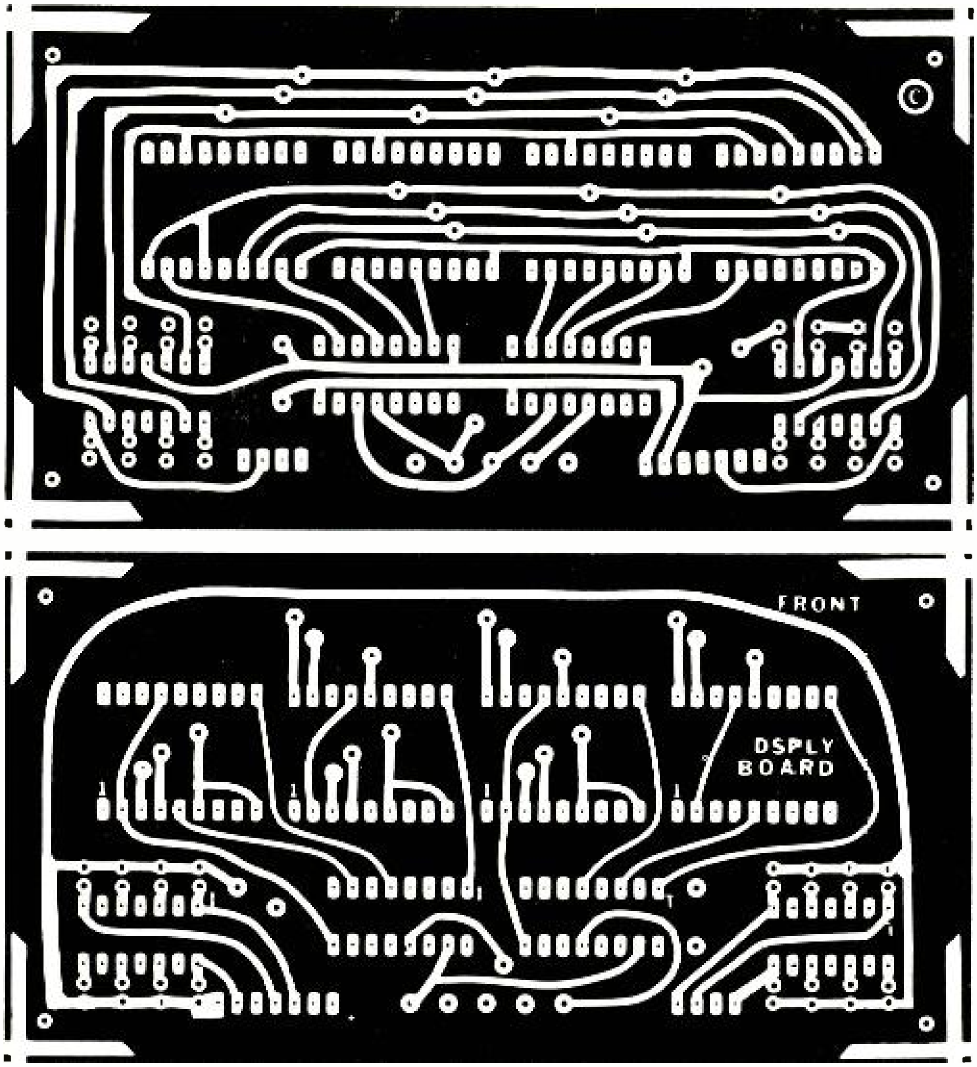


Fig. 8 Etching and drilling guides for the display pc board.

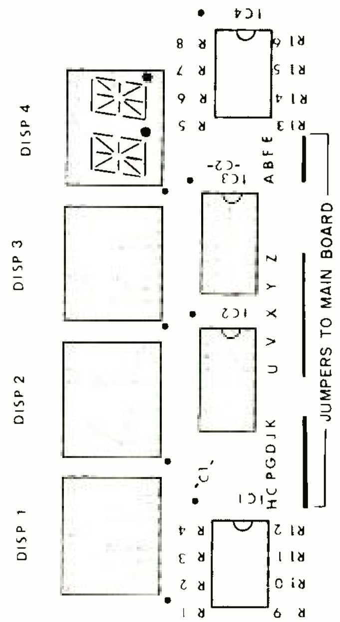


Fig. 9. Component layout for display pc board.

Note that the main and display pc boards are double-sided. Those sold by the kit supplier have plated-through holes, so you need only solder component leads to the foils on the bottom sides of such boards. Make sure that components are installed correctly before soldering them, because removing them is difficult once their leads have been soldered.

Notice that the power supply, display, input jacks, MARK and SPACE LEDs, LTRS pushbutton, speed-selector, NORMAL/INVERT, and shift-selector switches are not mounted on the main pc board. Insulated leads of necessary lengths should be soldered to the appropriate points on the pc board for connection to these items (except for the display, which is connected to the main board as described later) after the main board has been mounted in the project enclosure. Consideration should be given to mounting the off-board components on the project enclosure, which should have a cutout for the eight-character LED display and a red filter to enhance legibility.

Wire the display board next. Use Molex Soldercons to mount sockets for the dual-character IEE 3785R LED displays. Make sure they are lined up properly before soldering them to insure a good fit. Resistors, capacitors, and sockets or Soldercons for the ICs should be installed next. The resistors should be mounted in a vertical position. Note that there are a number of jumper wires which mate the display board to the main circuit board. They should be fairly heavy-gauge solid wires such as the cuttings of excess leads from resistors or other components. The jumpers should be about ½ in. (1.3 cm) long and bent into "L" shapes. Install them on the top of the display board extending parallel to it.

Mate the display board perpendicular to the main board by inserting the jumper wires from the display board through the appropriate holes on the main board. Push the display board down until it touches the main board. Check the physical alignment of the boards and then solder the jumpers to the bottom of the main board. Cut off excess lengths.

Install the four LED readouts in their sockets. Do the same for all ICs, on both boards. Make sure these are properly oriented (for example, the decimal point of each LED display should be in the lower right corner.) Observe the usual precautions with regard to bending leads and damaging MOS devices with static electricity.

The 1702A PROM, whose truth table is given in Table II, must be properly programmed. Some parts dealers (including the supplier given in the Parts List) will program the 1702A if you include the truth table with your order.

Next, build the power supply according to the component layout diagram. When you have completed it, apply line power to the supply and verify that the correct voltages are being produced. The voltages will be about five to ten percent higher than those specified (except for those regulated by the zener diode) because the supply is unloaded. Do not apply line power any longer than is necessary to avoid overheating the zener diodes. If the voltages are correct, you are ready to proceed with the final assembly.

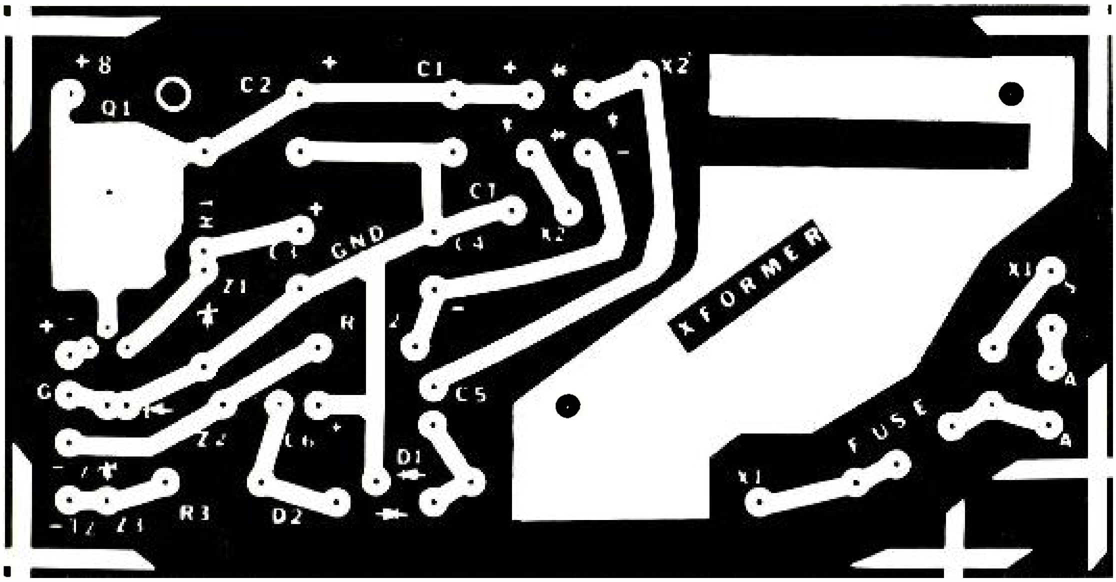


Fig. 10. Full-size etching and drilling guide for power supply pc board.

First mount the boards in the project enclosure and connect the leads from the main circuit board to the power supply, jacks, LEDs, switches, etc. Note that *S1*, the speed-selector switch, has two poles, each with six positions. One pole (*S1A*) controls the baud-rate clock. The remaining pole (*S1B*) is used as the power supply's on/off switch. See Figs. 3, 5, 7, and 11 for wiring of this switch. Be careful to avoid a wiring error that would apply 117 V to the main board.

Double check all wiring before proceeding. If everything appears to be in order, apply line power to the project. Segments of several or all of the displays should begin to glow. If they do not, immediately disconnect power and locate the source of the problem. Be on the lookout for loose wires, poor solder connections, solder bridges, etc.

Alignment. Two sections of the RTTY Reader must be aligned. They are the mark-and-space active bandpass filters and the baud-rate clock. A function generator, an ac voltmeter or oscilloscope, and a frequency counter are required for alignment.

To align the mark filter, apply a low-level (100-mV) sine wave at a frequency of 2125 Hz across the input jack. Adjust *R9* for maximum signal at test point *TP1* as indicated on the ac voltmeter or oscilloscope. The MARK LED should glow brightly at this time. Next, align the narrow-shift space filter. Set the frequency of the function generator's output waveform to 2295 Hz. With the shift-selector switch set to NARROW, adjust *R31* for maximum signal at *TP2*. The SPACE LED should glow brightly.

Now set the output frequency of the function generator at 2575 Hz and place the shift-selector switch in its MEDIUM position. Adjust *R16* for maximum signal voltage at *TP2*. To align the remaining space filter, set the function generator's output frequency to 2975 Hz and the shift-selector switch to its WIDE position. Adjust *R25* for maximum signal voltage at *TP2*. This completes alignment of the mark and space filters.

To adjust the baud-rate clock, connect a frequency counter to test point *TP3*. With the speed-selector switch set to 60 WPM, adjust *R38* for a 728-Hz reading on the counter. Then switch *S1* to its 67 WPM position and adjust *R35* so that the counter indicates 800 Hz. With *S1* in its 75 WPM position, adjust *R39* so that the baud-rate clock oscillates at 910 Hz. Next, place the speed-selector switch in its 100 WPM position and adjust *R37* for a reading of 1200 Hz at *TP3*. Finally, place the switch in its ASCII position and adjust *R34* for a reading of 1760 Hz on the frequency counter. An accuracy of two percent or better is sufficient for these adjustments because the UART can compensate for errors in the frequency of the baud-rate clock.

Those readers lacking access to the test equipment required for instrument alignment can follow an alternate (albeit coarser) procedure which employs an alignment tape offered by the kit supplier. The cassette tape has 2125-, 2295-, 2575-, and 2975-Hz tones recorded on it, as well as samples of text transmitted in Baudot at 60, 67, 75, and 100 wpm and ASCII at 110 baud. It can be used to align the mark and space filters as follows. Run a patch cord from the line-level output jack of a cassette player to the input jack of the RTTY Reader. Turn the cassette player on, insert the alignment tape and advance to the segment containing the 2125-Hz tone. Adjust *R9* for maximum brilliance of the MARK LED.

Next, advance the tape to the portion containing the 2295-Hz tone. Place the shift-selector switch in its NARROW position, play the prerecorded tone and adjust *R31* for maximum brilliance of the SPACE LED. Advance the tape to the portion containing the 2575-Hz tone and place the shift-selector switch in its MEDIUM position. Adjust *R16* for maximum brilliance of the SPACE LED. Then advance the tape to that segment containing the 2975-Hz tone, place the shift-selector switch in its WIDE position, and

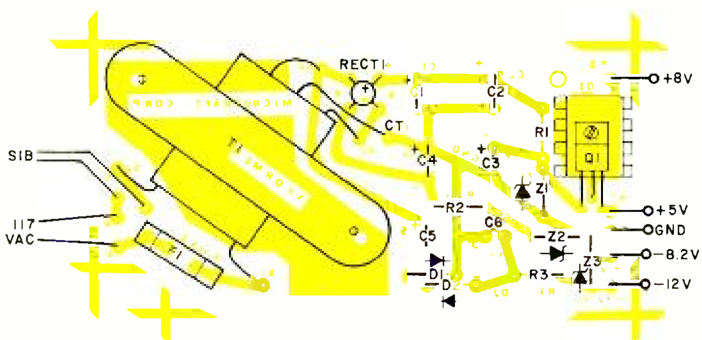


Fig. 11. Component layout for power supply board.

TABLE II—TRUTH TABLE FOR PROM IC17 (Hexidecimal Notation)

Character	Address	Data	Character	Address	Data	Character	Address	Data	Character	Address	Data
BAUDOT CODING			K	D0	49	C	7C	C1	"	5D	50
A	DC	C9		90	24		3C	80		1D	00
	9C	49	LTRS SHIFT	C0	00	D	7B	90	#	5C	59
NULL	DF	00		80	00		3B	D1		1C	98
	9F	00	5	EF	A8	E	7A	C9	$	5B	D8
T	CF	00		AF	84		3A	80		1B	99
	8F	10	9	E7	C8	F	79	C9	%	5A	6C
CR	D7	00		A7	49		39	00		1A	2D
	97	00	SPACE	FB	00	G	78	C1	&	59	A9
O	C7	C1		BB	00		38	89		19	84
	87	C1	.	E3	00	H	77	49	'	58	10
SPACE	DB	00		A3	02		37	49		18	00
	9B	00	4	F5	48	I	76	90	(	57	00
H	CB	49		B5	49		36	90		17	24
	8B	49	8	F9	C9	J	75	01	)	56	24
N	D3	61		B9	C9		35	C0		16	00
	93	45	0	E9	C5	K	74	49	•	55	3C
M	C3	61		A9	E1		34	24		15	3C
	83	61	3	FE	88	L	73	41	+	54	18
LINE FD	DD	00		BE	C9		33	80		14	18
	9D	00	6	EA	C9	M	72	61	,	53	04
L	CD	41		AA	89		32	61		13	00
	8D	80	/	E2	04	N	71	61	–	52	08
R	D5	C9		A2	20		31	45		12	08
	95	4C	2	EC	89	O	70	C1	.	51	00
G	C5	C1		AC	C8		30	C1		11	02
	85	89	7	F8	80	P	6F	C9	/	50	04
I	D9	90		B8	41		2F	48		10	20
	99	90	1	E8	10	Q	6E	C0	0	4F	C5
P	C9	C9		A8	10		2E	C5		0F	E1
	89	48	–	FC	08	R	6D	C9	1	4E	10
C	D1	C1		BC	08		2D	4C		0E	10
	91	80	$	F6	D8	S	6C	C8	2	4D	89
V	C1	45		B6	99		2C	89		0D	C8
	81	20	!	F2	B0	T	6B	90	3	4C	88
E	DE	C9		B2	30		2B	10		0C	C9
	9E	80	+	E5	18	U	6A	41	4	4B	48
Z	CE	84		A5	18		2A	C1		0B	49
	8E	A0	'	F4	10	V	69	45	5	4A	A8
D	D6	90		B4	00		29	20		0A	84
	96	D'	(	F0	00	W	68	45	6	49	C9
B	C6	90		B0	24		28	45		09	89
	86	D9	)	ED	24	X	67	24	7	48	80
S	DA	C8		AD	00		27	24		08	41
	9A	89	"	EE	50	Y	66	20	8	47	C9
Y	CA	20		AE	00		26	30		07	C9
	8A	30	:	F1	00	Z	65	84	9	46	C8
F	D2	C9		B1	88		25	A0		06	49
	92	00	;	E1	0C	[	64	00	?	40	80
X	C2	24		A1	00		24	24		00	58
	82	24	?	E6	80	\	63	20	=	42	08
W	CC	45		A6	58		23	10		02	88
	8C	45	,	F3	04	]	62	24	:	45	00
J	D4	01		B3	00		22	00		05	88
	94	C1	END BAUDOT			∧	61	04	;	44	0C
FIGS SHIFT	C4	00					21	04		04	00
	84	00	ASCII CODING			–	60	08	<	43	00
U	D8	41	NULL	5F	00		20	08		03	24
	98	C1		1F	00	SPACE	5F	00	>	41	24
Q	C8	C1	A	7E	C9		1F	00		01	00
	88	C5		3E	49	!	5E	B0	END ASCII		
			B	7D	90		1E	30			
				3D	D9						

adjust *R25* for maximum brilliance of the SPACE LED. This completes alignment of the mark and space filters. The method might strike you as crude, but actually it is very effective.

Alignment of the baud clock without instruments is, of necessity, by trial and error. The trimmer potentiometer governing the clock frequency for a given text speed should be adjusted until intelligible copy appears on the LED display. For example, with the cassette playing the sample of 60-wpm Baudot, adjust *R38* until an understandable message can be read from the display. Repeat this procedure for each position of the speed-selector switch and its corresponding trimmer potentiometer. This is a tedious procedure but it will produce useful results if performed patiently.

Use. The RTTY Reader is very easy to operate. However, because of the large number of RTTY "standards" in use today, some care and patience are required if the right combination of frequency shift, speed and mark frequency to provide readable copy is to be found. Amateur radio operators seem to have settled on the use of narrow (170-Hz) shift, 60- or 100-wpm Baudot, and "upright" or normal mark frequency. Amateurs can often be found transmitting RTTY around 3.600 and 14.080 MHz on the hf bands.

Considerably more challenging is tuning for RTTY stations on the shortwave utility bands. It is difficult to tell only by listening to any given signal which RTTY parameters (speed, shift and mark frequency) are being employed. However, they can often be discovered by a small amount of experimentation.

When tuning in an unknown RTTY signal, try to match the frequency shift of the RTTY Reader to that of the station. Don't worry yet whether the mark frequency is normal or inverted. Vary the position of the RTTY Reader's shift-selector switch and adjust the receiver's tuning knob until both the MARK and SPACE LEDs are glowing most brightly and flicker in step with the incoming signal. If only one LED can be made to flicker, you probably have selected the wrong shift. Try different shifts and retune the receiver until both LEDs flicker.

Next, try different positions of the speed-selector switch until you obtain intelligible copy on the LED display. If you cannot get meaningful copy after running through each position of the speed-selector switch, try switching your receiver to the other sideband and retuning it. Alternatively, flip the RTTY Reader's NORMAL INVERT switch. If you are seemingly copying the signal OK but only numbers or punctuation are displayed, the Reader may be in the wrong operating mode. Press the LTRS pushbutton switch to place the decoder circuit back in the letters mode.

You will find that there will be a number of signals that appear to be RTTY that the project cannot decode into intelligible copy, no matter what combination of switch positions and receiver tuning you try. There are several possible explanations for this. Some stations transmit text composed of letters of the Cyrillic instead of the Latin alphabet. Russian telegrams are an example of this. Other stations use encrypted Baudot to prevent SWLs from reading the traffic. There are also many strange signals on the hf bands that sound like RTTY signals but are really something else. Examples are twinplex, frequency-division multiplex, time-division multiplex, and messages sent by high-speed Morse or Moore code.

Some weather and military stations transmitting RTTY use special characters of five-letter/number groups to transmit information. Very often these transmissions are easy to copy but impossible to understand. Similarly, there are many commercial-press stations transmitting RTTY in French, Spanish, and other languages. Copying these stations can be lots of fun, especially if you are conversant in the language or just beginning to learn it.

Table III lists some RTTY stations you should tune in to gain experience using your RTTY Reader. To simplify matters, each station's frequency, shift, mark format, text speed and language are included. Once you have tried your hand at tuning in the stations suggested in the Table, you will be better prepared to venture out into the shortwave utility bands in search of unusual RTTY "catches."

It's fairly easy to copy a radio amateur typing on a keyboard at 20 wpm or so. However, copying text generated by a punched-paper-tape reader at 60 wpm or more requires a fair amount of concentration. Machine-generated RTTY at 100 wpm is a real challenge! Because the RTTY signals appearing at the output of your receiver are audio in nature, you can record them on a magnetic tape as they are received for subsequent playback. This also allows you to catch something you might have missed the first time around.

Finally, remember that it is illegal to disclose to third parties any information gleaned from RTTY traffic you have received. This prohibition does not apply ". . . to the receiving, divulging, publishing, or utilizing the contents of any radio communication, which is broadcast or transmitted by amateurs or others for the use of the general public, or which relates to ships in distress" (Quoted from the Communications Act of 1934, Section 605). ◇

PARTS AVAILABILITY

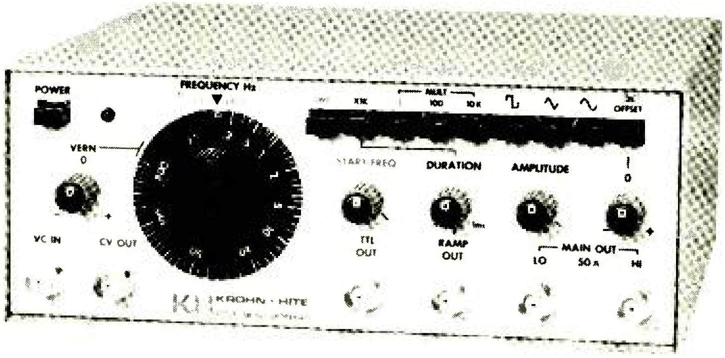
The following are available from Microcraft Corp., P.O. Box 513, Thiensville, WI 53092: complete kit of parts (No. RRK-1) including ICs, sockets, pc boards, all displays and prepunched and lettered enclosure at $189.95 plus $3.50 handling and shipping within continental U.S. Also available separately are: set of three pc boards (main, display, and power supply) (No. RB-1) at $24.00; programmed 1702A PROM (No. RPROM-1) at $10.00; one dual-character IEE 3785R LED display (No. DSP-1) at $9.00; alignment cassette tape (No. RRT-1) at $7.00. On last four items, add $1.50 shipping and handling within continental U.S. Wisconsin residents, add 4% sales tax.

TABLE III—SOME RTTY STATIONS

Frequency (MHz)	Shift (Hz)	Normal/ Inverted	Speed (wpm)	Comments
3.600	170	N	60	Various radio amateurs
3.625	170	N	60	ARRL Station W1AW
4.003	425	I	60	News (Spanish)
4.874	850	I	60	Air Force MARS
5.462	425	N	60	Voice of America News (English)
5.940	850	N	60	Weather Station WSY70
6.312	425	I	60	News (Spanish)
7.095	170	N	60	ARRL Station W1AW
7.404	425	I	67	Telegrams (Spanish)
7.767	425	I	67	News (Italian)
8.140	850	N	100	U. S. Navy Station WX10
9.052	425	I	67	Radio Havana
10.215	425	I	67	Associated Press News (English)
10.562	425	I	67	News (French)
10.787	425	I	67	News (French)
10.952	850	I	100	Weather bulletins
10.973	425	I	67	News (English)
11.016	425	N	67	News (Spanish)
12.282	425	I	67	News (English)
13.625	850	I	100	Weather bulletins
14.088	170	N	60	Various radio amateurs
14.095	170	N	60	ARRL Station W1AW
14.530	850	I	60	Telegrams (English)
14.722	850	I	67	News (French)
15.436	850	I	67	News (English)
16.372	425	N	60	News (English)

Product Test Report

Krohn-Hite Model 1200 Full-Function Sweep Generator



Krohn-Hite's Model 1200 sweep signal generator offers sine, square, and triangle wave outputs and an extended frequency range of 0.2 Hz to 3 MHz. Pushbutton switches and rotary controls permit simplified setup and operation. Flexibility is enhanced by the instrument's six BNC-type input and output connectors.

The 1200 measures 9"W × 8½"D × 3½"H (22.9 × 21.6 × 8.9 cm) and weighs 5 lb (2.3 kg). Price is $325.

Technical Details. The sweep generator's frequency range is obtained with a combination of a single-turn FREQUENCY dial; three-position ×1, ×100, and ×10K multiplier (for 1500:1 coverage); and separate vernier (VERN) control. The latter permits accurate "dialing in" of a desired frequency and has a 5% adjustment range. Frequency accuracy is rated at 5% at calibration settings of 0.2, 10, 100, and 300 on the FREQUENCY dial and 20% max. at all other settings.

The high-level output is rated to be 20 volts peak-to-peak (10 volts p-p with a 50-ohm load). The low-level output is 2 volts p-p open-circuit (1 volt p-p into 50 ohms). The output can be floated at up to 200 volts peak between outputs and instrument case. Amplitude stability is rated at 0.02% after 10 minutes warm-up and 0.1% after 24 hours of operation. An AMPLITUDE control permits the output-signal level to be adjusted down to less than 5 mV.

Frequency response in the sine-wave mode is less than 0.1 dB variation between 0.2 Hz and 300 kHz and 1 dB from 300 kHz to 3 MHz. Distortion is rated to be less than 0.5% from 2 Hz to 300 kHz and 3% from 300 kHz to 3 MHz.

Rise and fall times of the square-wave output are rated at less than 40 ns, while the triangle output's linearity is specified at greater than 99% from 0.2 Hz to 300 kHz and 95% from 300 kHz to 3 MHz.

Duration of the sweep is switch-selectable. It ranges from 1000 seconds to 1 second in one range and from 1 second to 1 ms in the other range. The ramp output is a maximum 5-volt sawtooth and is frequency adjustable with a front-panel control. It has a range of 0.001 Hz to 1000 Hz. Ramp retrace time is less than 75 μs, and output impedance is a constant 600 ohms.

External frequency control over a 0-to-3-volt range, variable ±10-volt dc offset, and a TTL-compatible output at generator frequency are also featured.

Sabtronics new counter gives you 600 MHz capability for only $89.95

This highly accurate frequency counter can be yours at the unbelievably low price of $89.95. The Sabtronics 8610A is your best buy today in a lab-quality instrument.

We spent our efforts where they count: applying Sabtronics' advanced digital technology in the design and engineering of a superior frequency counter — in simple kit form.

You count your savings: You spend a little time (and a lot less money!) for a compact bench-portable counter that measures up to 600MHz (typically even higher).

Measures up on every count: It has what you want. Guaranteed from 10Hz to 600MHz in three ranges (typically 5Hz to 750MHz). Sensitivity that holds well over the entire range. Selectable gate time for optimum resolution: 0.1, 1, or 10 seconds. With a stability of 0.1 ppm/°C. And the guaranteed frequency range has a measurement accuracy of 1 ppm + 1 digit -0.0001%.

Highly accurate time base and excellent ageing rate. 8-digit LED display with automatic decimal point placement, leading zero suppression and overflow indicator.

Start counting the day you receive it: You can assemble your 8610A in an evening with our easy-to-follow, step-by-step instruction manual.

Count on satisfaction: Keep our kit for 10 days' free trial examination. If you're not completely satisfied for any reason whatsoever, simply return it unassembled for a prompt and courteous refund of your purchase price.

BRIEF SPECIFICATIONS

• Frequency Range: 10 Hz to 600 MHz guaranteed (5 Hz to 750 MHz typical). • Sensitivity: $\leq$ 10 mV RMS, 10 Hz to 100 MHz, prescaler mode; 50 mV RMS, 100 MHz to 450 MHz; 70 mV RMS, 450 MHz to 600 MHz • Impedance: 1 MΩ, 10 MHz & 100 MHz range; 50Ω, 600 MHz • Temperature Stability: 0.1 ppm/°C • Gate Time: Switch-selectable, 0.1 sec., 1 sec., 10 sec. • Ageing Rate: $\leq$ ±5 ppm/yr • Accuracy: 1 ppm +1 digit. • Input Protection: 150 V RMS, 5 Hz to 10 kHz; 90 V RMS, 10 kHz to 2 MHz; 30 V RMS, 2 MHz to 100 MHz; 10 V RMS, 100 MHz to 750 MHz. • Power Requirement: Battery-operated, 4.5 to 6.5 VDC @ 300 mA. External power supply, 7.5 to 9 VDC @ 300 mA • Size: 8"W x 6.5"D x 3"H (203 x 165 x 76 mm) • Weight: Without batteries, 1.2 lbs. (0.54 kg).

Making Performance Affordable

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To: Sabtronics International, Inc. 13426 Floyd Cr., (M/S24) Dallas, TX 75243 USA

Please send me ______ Model 8610A Frequency Counter Kits @ $89.95 ea.	$ ______
Shipping & handling, per kit, $6.00*	$ ______
Texas residents add 5% sales tax	$ ______
Total enclosed	$ ______

I enclose ☐ check ☐ money order. (For faster delivery, send cashier's check or money order. Please allow time for personal checks to clear bank.)
Charge: ☐ Visa ☐ Master Charge
Account No. ______ Exp. Date ______
Name ______
Address ______
City ______ State ______ Zip ______
*US only. Canada: $7.50. Foreign, air mail, $21.00.

The TTL output can drive 10 TTL loads that have rise and fall times of less than 15 ns. A control-voltage output, variable over a range of 2 mV to 3V, proportional to generator frequency is provided.

All input and output connectors are arranged in a row across the bottom of the front panel, where they and the cables connected to them will not interfere with operation of the controls. Power for the instrument is from the ac line.

User Comment. We used the sweeper and an oscilloscope to check various bandpass filters in accordance with instructions detailed in the instrument's user's manual. When the waveforms were viewed on an oscilloscope screen, they were quite good. We did notice, however, that some waveforms appeared to be off-frequency. This was readily adjustable, a very simple task to perform with the display running. Adjustment yielded a much-improved response. Using the traditional point-to-point plotting technique would have consumed considerable time, but the sweeper, operated in the sweep mode, made short work of the bandpass plots.

The single-frequency function generator built into the instrument came in handy for checking both analog and digital circuits. We used the square-wave function as a variable-speed "clock" to clock speeds to more easily observe circuit operation with a logic probe.

Past experience has revealed to us that a good triangle wave is best for audio-circuit testing. This waveform readily shows amplifier clipping because its sharp tip visibly flattens even with slight clipping that would be undetectable on a sine wave. Differential and group gain and phase problems are also much easier to analyze along the straight-line ramps of the triangle wave.

The only thing lacking from this sweeper is some form of on-screen indicator to identify the selected test frequency. Like most other sweepers, the Model 1200 requires the operator to interpret the frequency using the settings of the various controls.

The Model 1200 frequency generator/sweeper would be a useful asset on any electronics workbench. It is certainly a "full-function" signal source for design, test, and troubleshooting purposes in both analog and digital electronics. In fact, for the price of a good variabe-frequency multiwaveform signal generator, you can get the Krohn-Hite Model 1200 with sweep action.

CIRCLE NO. 105 ON FREE INFORMATION CARD

Experimenter's Corner

By Forrest M. Mims

MODIFYING CALCULATORS

NOW THAT "four-banger" electronic calculators are so inexpensive, modifying them for special-purpose applications is an attractive and cost-effective possibility. This month, we'll examine several ways of adding external features to a four-function calculator incorporating an automatic constant. To determine if a calculator you are thinking of modifying has an automatic constant, enter the following keystroke sequence: 1; +; =; =; =. If the display reads 3, the calculator is equipped with an automatic constant feature.

A Calculator Event-Counter. As you discovered when you ran through the simple keystroke sequence given above, a calculator with an automatic constant can count the number of times the "=" key is pressed. To automate this counting ability, it's necessary to connect an external switch across the contacts of the "=" key.

The calculator I modified, a Texas Instruments TI-1200 purchased new for about $6.00, has a 5×4 matrix keyboard. This keyboard is readily accessible by removing the four screws which hold the calculator's front cover in place. It has nine flexible leads, four of which address the vertical columns of keys and five the horizontal rows. The "=" key is accessed by the first and eighth wires from the top left of the keyboard.

Other calculators have different keyboard arrangements, and some recent models do not have a separate keyboard at all. Unless both sides of the circuit board are visible, you'll have to determine which wires access the "=" key by trial and error. Simply enter the sequence: 1; +; =; and, with the help of a jumper, begin shorting pairs of wires or foil conductors leading to the keyboard. Shorting digit keys may overwrite the 1 in the display. If so, reenter the 1; +; = sequence before trying again.

When you find the conductors that lead to the "=" key, carefully solder an insulated wire lead to each of them using a grounded or battery-powered iron. There is room in the TI-1200 and some other calculators for one or more miniature phone jacks. If your calculator has this extra space, drill a mounting hole, install a jack and solder the leads to it. Once the calculator has been reassembled, it can be used for both calculating and event counting.

Many different devices can be used to actuate the "=" function. For manual operation, an ordinary spst pushbutton switch connected to a two-conductor cable and plug is sufficient. For automatic counting, a magnetic reed switch or phototransistor can be used.

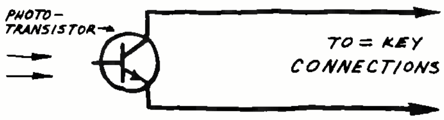


Fig. 1. A phototransistor connected to a calculator.

Figure 1 shows how a common npn phototransistor can be connected directly across the "=" key. Flashes of light will then actuate the "=" function. This permits moving objects to be counted without the need for mechanical contact. It also permits such novel applications as counting nearby lightning strokes during a nighttime storm.

A standard npn transistor can also be used as a switch. For example, to determine the maximum count rate for a TI-1200 calculator, I connected a 2N2222 across the "=" key and applied pulses from a variable-rate pulse generator as shown in Fig. 2.

The maximum usable count rate of each of these add-on circuits will be limited by the rate at which the calculator scans its keyboard to detect key closures. The TI-1200 that I modified has a multiplex rate of about 360 Hz, but that doesn't mean the unit will accept 360 closures of the "=" key each second. All twenty key locations are scanned one at a time by the multiplex circuit so, it would at first appear, the maximum number of counts per second is 20. Actually, my unit will accept a maximum of only

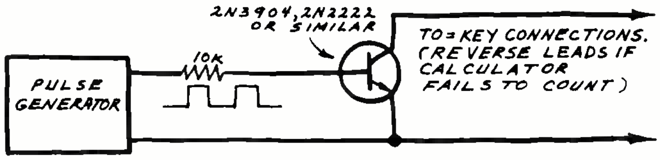


Fig. 2. Using a pulse generator with a calculator.

13.44 counts per second. That's because only those input signals present when the "=" key is in the process of being scanned are accepted. Those which arrive *and* depart between scans are *not* detected.

This can cause problems in applications where the pulse to be counted is very brief. For example, the reason I decided to modify my calculator was to count the number of times the front wheel of my bicycle rotated during specific time intervals (to determine the average speed of the bike) and during various trips (to determine the total distance travelled). A magnetic reed switch secured to the front fork was connected in parallel with the "=" key. A magnet attached to the wheel rim served as its actuator. It didn't take me long to discover that at speeds greater than about 5 mph some wheel rotations were not counted because the switch closed and opened again *between* the time intervals when the calculator was scanning its "=" key. This problem can be remedied by moving the magnet and switch closer to the hub assembly (using care to keep these components and the connecting wires away from the spokes!) or by adding a one-shot between the reed switch and the calculator to stretch out the pulses generated by the switch.

Calculator as a Timer. The addition of a simple timebase permits the TI-1200 or other low-cost calculator to function as a programmable timer. Figure 3, for example, is a simple CMOS timebase that can be assembled on a small circuit board to be tucked either between the display and keyboard or below the battery compartment of a TI-1200.

Two of the gates in a 4011 are connected as an astable multivibrator that delivers a stream of pulses to the LED in an optoisolator. The collector and emitter of the phototransistor in the optoisolator are connected directly across the "=" key.

For 0.1-second resolution, it's necessary to calibrate the timebase so that it generates pulses at a rate of 10 Hz. This can be done by using a physically small trimmer potentiometer for *R1* and connecting a frequency counter to the output of the timebase. The prototype timebase that I assembled generated a 10-Hz output when $C1$ was nominally 4.7 µF and $R1$ was adjusted to 2270 ohms.

To operate the calculator as a timer, enter the sequence: .; 1; + and then close $S1$ (Fig. 3) to allow the timebase to feed pulses to the "=" key. Release $S1$ when the event being timed is over. Read the elapsed time to the nearest one-tenth of a second from the display. You can then use the calculator to convert the time, which is displayed in seconds, into minutes or hours.

For precision timing, a crystal-controlled timebase is required. A few years ago, Charles Stanford described in this magazine a simple, external, crystal-controlled timebase that can be added to most four-function calculators having an automatic constant. (See "How to Convert a 'Four Banger' for Stopwatch Functions," August 1977.) The circuit employs a readily available 3.579545-MHz color-television crystal, a programmable counter/divider, and a divide-by-six counter to provide an accurate 10-Hz output. This pulse train actuates an analog switch connected across the calculator's "=" key.

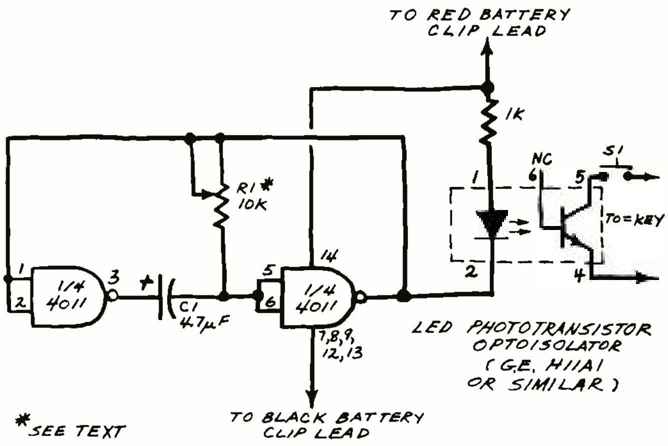


Fig. 3. CMOS time base converts calculator into timer.

Charles' circuit is excellent, and I recommend it highly if your timing applications require a high degree of accuracy. Incidentally, if you want to use the foil pattern included as Fig. 2 in the article, note that the component-location designations of $IC1$ and $IC2$ are transposed. The schematic diagram is correct.

Adding an Output Port. Upon the addition of an output port, a low-cost calculator can become a primitive, but useful, digital controller. Microprocessor chips usually have one or more pins designated as ports. The ports permit external devices to influence the microprocessor when they are functioning as input ports or to be controlled by the microprocessor when they are acting as output ports.

There are several ways to add one or more output ports to a calculator. So far, the two simplest methods I've identified are monitoring the minus sign and the decimal point in the display. Let's see how the decimal point can be monitored.

If you enter in the keystroke sequence: 10.0; −; 1.0 on a TI-1200 or similar calculator, the display will be decremented by 1.0 each time the "=" key is pressed. That is, the display will read 10.0; 9.0; 8.0; . . . 2.0; 1.0; 0.; −1.0; etc. Notice that when the count reaches zero the decimal point moves one place to the right. When the count is above or below zero, however, the decimal point stays at least one place to the left of the lowest-order digit in the display.

This makes possible the use of the lowest-order decimal point as an output port. All you have to do is find the contacts on the display that lead to the lowest-order digit and the decimal point.

The TI-1200 display has 17 connection tabs. Tab 9 is connected to the common cathode of the lowest-order digit and tab 13 is connected to the decimal point.

Figure 4 shows one way to interface an external circuit to a decimal-point output port. The LED/LASCR optoisolator provides a latching action that keeps a LED or other output device continuously on once it has been triggered. The calculator display will keep a record of the number of trigger events that occur after the LASCR has fired.

A typical application for a calculator modified to include an output port is a programmable timer (such as one for darkroom use) that is capable of controlling an external device. If the timebase is delivering pulses at a rate of 10 Hz, a maximum delay of up to 9,999,999.0 seconds (more than 115 days!) is available, assuming that the calculator is programmed to decrement the total by 0.1 per clock pulse *and* that the power supply does not fail. Using a slower clock rate or reducing the tally in much smaller increments can easily increase the longest possible time delay to *years*!

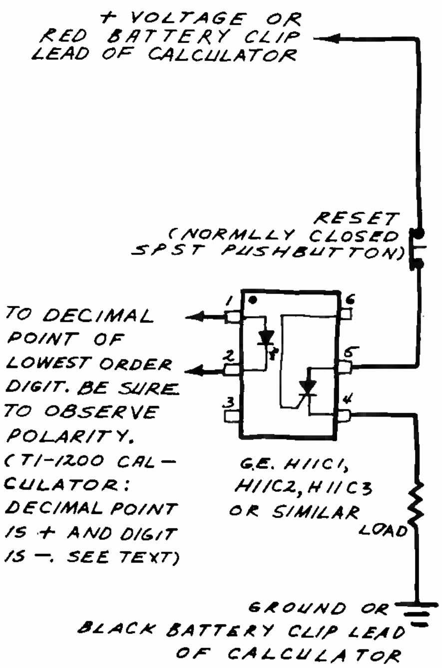


Fig. 4 Adding an output port to a calculator.

With a little care, you should be able to fit both the timebase and output-port circuits into the vacant space inside a TI-1200 or similar calculator. Alternatively, the additional circuits can be installed in a small enclosure and interfaced with the calculator using miniature phone plugs.

The output port has a number of applications other than timing. For example, you can program the calculator to count a given number of events (revolutions of a wheel, openings of a door, passing of cars, etc.) and then generate an output signal when the desired number have taken place. Unless you make special modifications which affect the use of the keyboard, the calculator can be used for its normal purpose when it's not being used for special applications.

Going Further. With a little experimentation, you will be able to come up with some clever applications of your own for modified calculators. For starters, you can remotely actuate any key on a calculator keyboard using the same techniques we've described in this column to actuate the "=" key. Keep in mind that the automatic constant feature of the TI-1200 and many other calculators works for all four primary arithmetic functions.

For advanced applications, consider modifying more powerful calculators. Some programmable calculators are now available for under $50. If you're not concerned about voiding the warranty of a programmable (or if it has expired), you might consider adding external circuits employing some of the methods described in this column. One possibility is a beeper that's automatically actuated when a long program is completed. Automatic data entry at a specified point in a program is another.

English Broadcasts Audible in No. America

by Glenn Hauser

TIME¹ EST	TIME UTC/GMT	STATION	QUAL.²	FREQUENCIES, kHz³
4:00-4.15 a.m.	0900 0915	BBC	A	11955, 9640, 9510, 6195
4:00-4:15 a.m	0900 0915	R. Japan[4]	B	9505
4:00-5·30 a.m.	0900 1030	R. Australia	B	9670
4.00-6.00 a.m.	0900 1100	AFRTS-Washington	A	11805, 9700, 9585, 9575, 6030
4·15-6·00 a.m.	0915 1100	BBC	C	17790, 17695
4:30-5 30 a.m.	0930-1030	V. of Germany	C	17780
5:00-5:05 a.m.	1000 1005	UN Radio	A	15245, 9565, (Tue-Sat.)
5.00-5 30 a.m.	1000 1030	R. Japan	B	9505
5·00-5:30 a.m.	1000 1030	R. Korea	C	11725, 9580, 9525 (frequent changes)
5:00 5.30 a.m.	1000 1030	V. of Vietnam	C	12035, 10040, 7470
5.00-fade out	1000	R. Australia	B	5995
5·00 8.00 a.m.	1000 1300	R. Moscow (via Cuba)	A	9600
5.00 11·02 a.m.	1000 1602	ABC, Perth	B	9610
5·30-6 30 a.m.	1030 1130	Sri Lanka Br. Corp.	C	17850, 15120, 11835 (not all Eng.)
5:30-7:00 a.m.	1030 1200	V. of Asia, Taiwan	C	5980 (Sun 1030-1040) (time varies)
5:55-6·55 a.m.	1055 1155	R. Thailand	C	11905, 9655
6.00 6.15 a.m	1100 1115	R. Japan	B	9505
6·00-6:56 a.m	1100 1156	R. RSA	C	25790, 21535
6:00-7:45 a.m.	1100 1245	TWR-Bonaire	A	15225 (Sat-1330, Sun-1415)
6:00-7:50 a.m.	1100 1250	R. Pyongyang	C	9977
6·00-8:00 a.m	1100 1300	R. Australia	A	9580
6:00-8.30 a.m.	1100 1330	BBC	A B	25650, 21710, 21660, 21550, (11775, 1100-1130 + 1300-1330 only) 11750, 9510, 6195
6:00 9:00 a.m.	1100 1400	4VEH, Haiti	B	11835, 9770
6:00-10:00 a.m.	1100 1500	VOA	A	11715, 9565
6:00 11.00 a.m.	1100 1600	AFRTS-Washington	A	15430, 15330, 11805, 9700
6 30-6:45 a.m.	1130 1145	R.R.I. Yogyakarta	C	5046
6·30-9.00 a m.	1130 1400	CBC Northern Service	B	9625, 6195 (not all English)
7 00-7 15 a.m.	1200 1215	Vatican R.	B	21485
7.00-7·15 a.m.	1200 1215	R. Japan	B	9505
7 00 7:15 a.m.	1200 1215	V. of Kampuchean People	C	11938, 9694
7 00-7:30 a.m.	1200 1230	Kol Israel	C	25625, 21495, 17685, 15600, 11620
7 00-7:30 a.m.	1200 1230	R. Tashkent	C	9600, 9540, 6025, 5975
7 00 7:45 a.m.	1200 1245	V of Germany	B	21600, 17875, 17765, 15410
7·00 7:45 a.m.	1200 1245	R. Berlin International	C	21540, 21465, 17700, 15165
7 00-7 55 a.m.	1200 1255	R. Peking	B	15520
7·00-8.00 a.m.	1200 1300	HCJB, Ecuador	A	15115, 11740
7 15-7.30 a.m.	1215 1230	V. of Greece	B	21655, 17785, 11730
7 20-7.50 a.m.	1220 1250	R. Ulan Bator, Mongolia	D	12070, 9553 (not Sun)
7:30-7:55 a.m.	1230 1255	Austrian R.	C	17860 (frequent changes)
7.30 7:55 a.m.	1230 1255	R. Tirana	D	11965, 9515
7:30-8:00 a.m.	1230 1300	R Sweden	C	21690
7·30-8.00 a.m.	1230 1300	BBC (English by radio)	C	21695
8:00-8·15 a.m.	1300 1315	R. Japan	B	9505
8:00-8 30 a.m.	1300 1330	R. Finland	C	15400
8:00-9:30 a.m.	1300 1430	HCJB, Ecuador	B	17890, 15115, 11740
8:00-10:00 a.m.	1300 1500	R Australia	B	11705, 9770
8:00 10·50 a.m	1300-1550	R. RSA	B	25790, 21535, 15220
8 15-8·45 a.m.	1315 1345	Swiss R. International	C	21570, 21520
8 30-9·30 a.m.	1330 1430	R. Finland	C	15400 (Sun. only)
8.30 10·00 a.m.	1330 1500	All India R	C	15335, 11810
8.30 11·00 a.m.	1330 1600	BBC	B C	25650, 21710, 21660, 21550, 15400 (from 1430), 15070
8 30 a.m. 5·00 p.m.	1330 2200	R. Moscow (via Cuba)	A	11840
8 57-11 55 a.m.	1357 1655	V. of Philippines	C	11950, 9579 (Sun 1555)
9 00-9:30 a.m.	1400 1430	R. Japan	B	9505
9 00-9:30 a.m.	1400 1430	R. Sweden	B	21615
9.00-9:30 a.m.	1400 1430	R. Norway	B	21730, 17840 (Sun only)
9:00-9:30 a m.	1400 1430	V. Rev. Party, N. Korea	D	4557, 4109
9:00 9:30 a.m.	1400 1430	R. Tashkent	C	9600, 9540, 6025, 5975
9 00-9:45 a.m.	1400 1445	R. Berlin International	C	21540, 21465, 17700
9:00-10:00 a.m.	1400 1500	V. of Indonesia	C	15200, 11789
9·00 a.m.-7.00 p.m.	1400 2400	CBC Northern Service	B	11720, 9625 (not all English)
9:30-10·00 a.m	1430 1500	R. Finland	B	15400, 21475
9·30-10:25 a.m.	1430 1525	R. Nederland	B	21480, 17855
9:30-11:00 a.m.	1430 1600	HCJB, Ecuador	A	17890, 15115
9.30-11.00 a.m.	1430 1600	Burma Br. Ser.	D	5985, 5040
9 30 a.m.-5:00 p.m.	1430 2200	UN Radio	A	21670, 15410 (also French; when in session)
10:00-10:15 a.m.	1500 1515	R. Japan	C	9505
10:00-11 00 a.m.	1500 1600	V. of Rev. Ethiopia	D	9560
10:00-11:00 a.m.	1500 1600	BBC	B	17830, 15260 (Sat, Sun)
10:00-11:30 a.m.	1500 1630	R. Australia	C	9770
10:00-12 30 a.m.	1500 1730	BSHKJ, Jordan	D	9560
10:15-10:30 a.m.	1515 1530	V. of Greece	B	21455, 17830, 11730 (last two, not Tues.)
10.30-11:00 a.m.	1530 1600	R. Afghanistan	D	4775
10:30-11:00 a.m.	1530 1600	R. Yugoslavia	C	15300, 15240
10.30-11:00 a.m.	1530 1600	Swiss R. International	B	21570
10:30-11·15 a.m.	1530 1615	R. Tampa, Tokyo	C	9595, 6055 (exc Sun)

10:30-11:30 a.m.	1530-1630	V. of Vietnam	C	12035, 10040, 7470
10:45-11:00 a.m.	1545 1600	R. Canada International	A	21695, 17820, 15325
11:00-11:15 a.m.	1600-1615	R. Japan	C	9505
11:00-11:15 a.m.	1600-1615	R. Pakistan	C	21755, 21486, 21450, 17910, 17665
11:00-11:30 a.m.	1600-1630	R. Korea	C	11830, 9720
11:00-11:30 a.m.	1600 1630	R. Norway	B	15345, 15175 (Sun only)
11:00 a.m.-12:45 p.m.	1600-1745	BBC	B	21710, 21550, 17880, 17830, 15260
11:00 a.m.-1:00 p.m.	1600-1800	AFRTS-Washington	A	17765, 15430, 15330, 11805
11:00 a.m.-6:00 p.m.	1600-2300	VOA	A	26040, 21485, 17870, 17710,
				15445, (15410 to 2200)
-11:30 a.m.	-1630	R. Singapore	C	11940 (fade-in time varies)
11:45-12:00 a.m.	1645-1700	R. Canada International	A	21695, 17820, 15325
12:00-12:15 p.m.	1700 1715	R. Japan	C	9505
12:00-12:15 p.m.	1700 1715	Vatican R.	B	17900
12:00-12:30 p.m.	1700 1730	R. Pakistan	C	15470, 11675
12:00-1:00 p.m.	1700-1800	HCJB, Ecuador	B	21480, 17825 (frequent changes)
12:00 p.m.-12:30 a.m.	1700-0530	R. New Zealand	C	17860, 15345
12:05-12:55 p.m.	1705-1755	R. France International	B	21705, 21595, 21580
12:10-12:55 p.m.	1710-1755	BRT, Belgium	C	17740
12:45-3:00 p.m.	1745-2000	BBC	C	15400, 15070, 12095
				(11820 from 1800)
12:45-5:30 p.m.	1745-2230	All India R.	C	11620
1:00-1:15 p.m.	1800 1815	R. Japan	B	9505
1:00-1:30 p.m.	1800-1830	R. Canada International	B	17820, 15260
1:00-1:30 p.m.	1800-1830	R. Norway	C	11895 (Sun only)
1:00-1:45 p.m.	1800-1845	R. Korea	C	15255, 11830
1:00-2:00 p.m.	1800-1900	V. of Nigeria	C	15119, 15185
1:00-2:00 p.m.	1800 1900	R. Uganda	C	15250
1:00-3:00 p.m.	1800 2000	R. Australia	C	11800
1:00-4:00 p.m.	1800 2100	R. Kuwait	C	11690 (frequent changes)
1:00-5:00 p.m.	1800 2200	AFRTS-Washington	A	21570, 17765, 15430, 15330, 11790
1:15-1:45 p.m.	1815-1845	Swiss R. International	C	21585, 17830, 17730
1:15-2:15 p.m.	1815 1915	R. Bangladesh	D	15285, 11765 (both vary, freq. changes)
1:30-1:35 p.m.	1830 1835	UN Radio	A	21670, 19505-SSB, 15410 (Mon-Fri)
1:30-2:00 p.m.	1830 1900	V. of Revolution, Guinea	B	15308 (varies) (Mon and Fri)
1:45-2:15 p.m.	1845 1915	Sri Lanka Br. Corp.	C	17850, 15120, 15115, 11870
2:00-2:10 p.m.	1900 1910	R. Tahiti	C	15170, 11825 (exc Sun)
2:00-2:15 p.m.	1900-1915	R. Japan	C	15270
2:00-2:30 p.m.	1900 1930	R. Canada International	A	17760, 15325, 11905
			B	17820, 15260
2:00-2:30 p.m.	1900 1930	R. Afghanistan	C	15075 (frequent changes)
2:00-3:00 p.m.	1900 2000	B.S.K. Saudi Arabia	C	11855
2:00-3:00 p.m.	1900-2000	HCJB, Ecuador	C	21480, 17895, 15225 (freq. changes)
2:30-3:30 p.m.	1930-2030	V. of Iran	C	9139 or 9022 (frequent changes)
3:00-3:15 p.m.	2000 2015	R. Japan	B	15270
3:00-3:30 p.m.	2000 2030	R. Algeria	C	11615, 9610
3:00-3:30 p.m.	2000 2030	R. Canada International	A	17820, 17760, 15325, 11905
3:00-3:30 p.m.	2000 2030	Kol Israel	B	17645, 15415, 11655
3:00-4:15 p.m.	2000-2115	BBC	A	21710, 17840, 15260, 15070, 6175
3:10-4:40 p.m.	2010-2140	R. Habana Cuba	A	17855
3:30-4:20 p.m.	2030 2120	R. Nederland	B	21640, 17695, 17605, 15220, 11730
3:30-4:30 p.m.	2030 2130	V. of Vietnam	C	15012, 10040
3:50-4:40 p.m.	2050 2140	R. Habana Cuba	C	17750, 9770
4:00-4:15 p.m.	2100 2115	R. Japan	B	15270
4:00-4:50 p.m.	2100-2150	R. RSA	B	21535, 17780, 15155
4:00-5:00 p.m.	2100 2200	V. of Nigeria	C	15185, 15119
4:15-5:00 p.m.	2115-2200	BBC	A	21710, 15420, 15260, 15070, 6175
4:15-7:00 p.m.	2115 2400	R. Free Grenada	B	15045 (time varies)
4:30-5:00 p.m.	2130-2200	R. Canada International	A	17820, 15325, 15150, 11945
4:30-5:00 p.m.	2130 2200	KGEI, San Francisco	C	15280
4:30-5:00 p.m.	2130-2200	HCJB Ecuador	C	21480, 17895, 15225 (frequent changes)
4:30-5:00 p.m.	2130-2200	R. Sofia	B	7115, 5915 (frequent changes)
4:30-5:30 p.m.	2130 2230	R. Baghdad	C	9745
4:30-6:00 p.m.	2130-2300	V. of Turkey	C	11955, 11880, 9515, 7170
4:40-5:40 p.m.	2140-2240	V. of Free China	C	17890, 15345, 11745
5:00-5:15 p.m.	2200 2215	R. Yugoslavia	C	9620
5:00-5:15 p.m.	2200-2215	R. Japan	C	17755, 15305
5:00-5:30 p.m.	2200-2230	R. Nacional, Venezuela	B	15400 (irregular)
5:00-5:30 p.m.	2200 2230	R. Norway	C	15175, 11850, 9590 (Sun only)
5:00-5:45 p.m.	2200-2245	BBC	A	21710, 15420, 15260,
				15070, 9590, 6175, 6120
5:00-6:00 p.m.	2200 2300	CBC Radio	A	11925, 9575
5:00-7:00 p.m.	2200-2400	VOA	A	21460
5:00-7:00 p.m.	2200 2400	AFRTS–Washington	A	25615, 21570, 15430, 15330, 11790
5:30-6:00 p.m.	2230 2300	Kol Israel	A	11655, 11638, 9815, 7412.5
5:45-6:00 p.m.	2245 2300	BBC	A	15420, 15260, 15070, 9590, 9410
				6175, 6120
5:45-6:00 p.m.	2245 2300	SODRE, Uruguay	C	11885, 9515 (time varies)
5:45-6:00 p.m.	2245-2300	UN Radio	A	15225, 11920 (Mon-Fri)
6:00-6:30 p.m.	2300-2330	R. Japan	C	17755
6:00-6:30 p.m.	2300 2330	R. Korea	C	15570, 15385, 11840 (frequent changes)
6:00-6:30 p.m.	2300 2330	R. Sweden	C	11705, 9695
6:00-6:30 p.m.	2300 2330	R. Vilnius	B	17870, 15405, 15180, 12060,
				11790, 11735
6:00-6:50 p.m.	2300-2350	Rdif. Argentina	C	11710 (Mon-Fri)
6:00-7:00 p.m.	2300-2400	4VEH, Haiti	B	11835, 9770
6:00-7:30 p.m.	2300-2430	BBC	A	15420, 15260, 15070, 11910, 9590,
				9580, 9410, 7325, 6175,
				6120, 5975
6:00-7:50 p.m.	2300-2450	R. Pyongyang	C	9977

6:00-8:00 p.m.	2300-0100	CBC Southern Service	A	11710, 5960 (Mon-Fri)
6:00-8:00 p.m.	2300-0200	R. Moscow	A	17720, 15425, 15140, 12050, 7440, 7205, 7195, 7130, 7115, 7105, 6125, 5940
6:05-6:20 p.m.	2305-2320	Austrian R.	C	12015, 9770, 5945 (Sun only)
6:45-7:45 p.m.	2345-2445	R. Japan	C	17825, 15270
7:00-7:15 p.m.	0000-0015	R. Japan	C	17755
7:00-7:25 p.m.	0000-0025	R. Tirana	B	9750, 7065
7:00-7:30 p.m.	0000 0030	R. Norway	C	6005 (Mon only)
7:00-7:30 p.m.	0000-0030	Kol Israel	A	11638, 9815, 7412.5
7:00-7:55 p.m.	0000-0055	R. Peking	B	17855, 17680, 15520, 15115
7:00-8:00 p.m.	0000-0100	VOA	A	21460, 15205, 11740, 9650, 6130
7:00-8:00 p.m.	0000-0100	R. Sofia	B	9705
7:00-8:00 p.m.	0000-0100	AFRTS-Washington	A	25615, 21570, 15330, 11790
7:00-9:00 p.m.	0000-0200	R. Luxembourg	C	6090
7:00-12:00 p.m.	0000-0500	FEBC Philippines	C	17810
7:00 p.m.-1:06 a.m.	0000-0606	CBC Northern Service	B	9625, 6195 (not all English)
7:05-8:55 p.m.	0005-0155	Spanish Foreign R.	B	11880, 9630
7:15-7:30 p.m.	0015-0030	V. of Greece	B	11730, 9655, 9515
7:15-8:00 p.m.	0015-0100	BRT, Belgium	C	9685, 6080
7:30-7:50 p.m.	0030-0050	SODRE, Uruguay	C	11885, 9515 (time varies)
7:30-8:00 p.m.	0030-0100	R. Sweden	C	11905
7:30-8:00 p.m.	0030 0100	R. Prague	C	6055
7:30-8:00 p.m.	0030-0100	R. Kiev	B	17870, 15180, 15100, 7215, 7150, 6020, 5980
7:30-8:00 p.m.	0030-0100	La Cruz del Sur, Bolivia	D	4875 (Mon only)
7:30-9:00 p.m.	0030-0200	HCJB, Ecuador	A	15115
7:30-9:30 p.m.	0030-0230	BBC	A	15260, 15070, 11910, 11750, 9580, 9410, 7325, 6175, 6120, 5975
7:30-12:00 p.m.	0030-0500	HCJB, Ecuador	B	11915, 9745
7:50-8:35 p.m.	0050 0135	TWR-Bonaire	B	11925
8:00-8:15 p.m	0100-0115	R. Japan	C	17755
8:00-8:15 p.m.	0100-0115	Vatican R.	B	11845, 9605, 6015
8:00-8:20 p.m.	0100-0120	RAI, Italy	B	11800, 9575
8:00-8:30 p.m.	0100-0130	Kol Israel	A	11638, 9815, 7412.5
8:00-8:30 p.m.	0100-0130	R. Canada International	A	11940, 11830, 5960
8:00-8:45 p.m.	0100-0145	R. Berlin International	C	11975, 9730
8:00-8:55 p.m.	0100-0155	R. Prague	B	11990, 9740, 9540, 7345, 5930
8:00-8:55 p.m.	0100 0155	R. Peking	B	17855, 17680, 15520, 15115
8:00-9:00 p.m.	0100-0200	VOA	A	15205, 11740, 9650, 6130
8:00-9.00 p.m.	0100-0200	V. of Free China	C	17890, 15345, 15270
8:00-11:30 p.m.	0100 0200	AFRTS-Washington	A	25615, 21570, 15430, 9755, 6030
8:00-10:30 p.m.	0100 0330	R. Australia	B	21740, 17795
8:00-11:50 p.m.	0100 0450	R. Habana Cuba	A	11930, 11725
8:00-12:00 p.m.	0100 0500	WYFR, Family Radio	A	9715
8:30-8:50 p.m.	0130 0150	V. of Germany	A	11865, 9605, 9565, 9545, 6145 6100, 6085, 6040
8.30-8:55 p.m.	0130 0155	Austrian Radio	B	9770, 5945
8:30-8:55 p.m.	0130-0155	R. Tirana	B	9750, 7120
8:30-9:00 p.m.	0130-0200	R. Budapest	B	17710, 15225, 11910, 9835, 9585, 6105 (Wed, Fri only)
8:30-9:25 p.m.	0130 0225	R. Bucharest	C	15380, 11940, 11840, 11735, 9690, 9570, 5990
8:30-9:30 p.m.	0130 0230	R. Japan	C	21640, 17825, 17725, 15270
8:45-9:15 p.m.	0145 0215	Swiss R. International	B	11715, 9725, 9660, 6135
9:00-9:15 p.m.	0200-0215	R. Japan	C	17755
9:00 9:25 p.m.	0200 0225	R. Warsaw	C	15120, 11815, 9525, 7270, 7145, 6135, 6095
9:00-9:30 p.m.	0200 0230	Kol Israel	A	11638, 9815, 7412.5
9:00-9:30 p.m.	0200-0230	R. Canada International	A	11940, 11845, 5960
9.00 9:30 p.m.	0200 0230	R. Norway	B	11870, 9590, 6005 (Mon only)
9:00-9:30 p.m.	0200 0230	R. Budapest	B	17710, 15225, 11910, 9835, 9585, 6105 (not Mon)
9.00-9:50 p.m.	0200-0250	R. RSA	B	17780, 15220, 15155, 11900
9.00-9:55 p.m.	0200-0255	R. Peking	B	17855, 17680, 15115
9:00-10:00 p.m.	0200 0300	R. Moscow	A	12050, 11960, 9700, 9685, 9600, 9530, 7440, 7205, 7195, 7115, 7105, 6125, 5940
9.00-10 05 p.m.	0200 0305	TIFC, Costa Rica	C	9645, 5055
9:00-10:30 p.m.	0200-0330	R. Cairo	B	12050, 9475
9:00-11:30 p.m.	0200 0430	AFRTS-Washington	A	21570, 17765, 11790, 9755, 6030
9:15-9:30 p.m.	0215-0230	V. of Greece	B	11730, 9650, 9515
9:30-9:45 p.m.	0230 0245	R. Pakistan	C	21590, 17830
9:30-9:55 p.m.	0230-0255	R. Tirana	B	9750, 7120
9:30 10:00 p.m.	0230-0300	R. Lebanon	D	15440 (frequent changes)
9:30-10:00 p.m.	0230 0300	R. Sweden	C	11705, 9695
9:30-10:15 p.m.	0230 0315	R. Berlin International	C	11975, 9730
9:30-10:25 p.m.	0230-0325	R. Nederland	A	9590, 6165
9:30 10:30 p.m.	0230 0330	BBC	A	11910, 11750, 9580, 9410, 7325, 6175, 6120, 5975
10:00-10:15 p.m.	0300-0315	R. Japan	C	17755
10:00-10:15 p.m.	0300-0315	Austrian Radio	C	9770, 5945 (Sun only)
10:00-10:25 p.m.	0300 0325	R. Warsaw	C	15120, 11815, 9525, 7270, 7145, 6135, 6095
10:00-10:30 p.m.	0300-0330	R. Canada International	A	11940, 11845, 11770, 9535, 5960
10:00 10:30 p.m.	0300-0330	R. Portugal	B	11935, 6025 (Mon -0320)
10:00-10:30 p.m.	0300 0330	R. Budapest	B	17710, 15225, 11910, 9835, 9585, 6105
10:00-10:30 p.m.	0300-0330	R. Kiev	B	9580, 7320, 7260, 7215, 7175, 5970

10:00-10:50 p.m.	0300-0350	V. of Free China	C	17890, 15345
10:00-10:55 p.m.	0300 0355	R. Prague	B	11990, 9740, 9540, 7345, 5930
10:00-10:55 p.m.	0300-0355	R. Peking	B	17680, 15300, 12055, 11685
10:00-11:00 p.m.	0300-0400	RAE, Argentina	C	9690 (Tue-Sat)
10:00-11:00 p.m.	0300-0400	Radiobrás, Brazil	A	15290
10:00-11:00 p.m.	0300-0400	R. Baghdad	C	11935
10:00-11:00 p.m.	0300 0400	R. Moscow	B	7440, 7205, 7195, 7115, 7105, 6125, 5940
10:00-11:15 p.m.	0300 0415	R. Uganda	B	15325
10:00-11:26 p.m.	0300 0426	R. RSA	B	17780, 15220, 11900, 9585, 7270
10:00-11:30 p.m.	0300 0430	R. Cultural, Guatemala	B	3300
10 00 p.m.-2.30 a.m.	0300 0730	VOA	A	17865, 15240, 9670, 5995
10:30-10.55 p.m.	0330 0355	R. Tirana	B	7300, 6200
10 30-10:55 p.m.	0330 0355	Austrian Radio	C	9770, 5945
10:30-11:00 p.m.	0330 0400	R. Australia	B	17795
10:30-11.15 p.m.	0330 0415	R. Berlin International	B	6080, 5955
10:30-11:45 p.m.	0330 0445	BBC	A	11910 (to 0430), 9410, 6175, 5975
10:30-11:00 p.m.	0330 0400	R. Finland	C	9675
10 30 12.00 p.m.	0330 0500	R. Tanzania	D	15435
10.30 p.m. 1:00 a.m.	0330-0600	R. Habana Cuba	A	11760
10 51 10.58 p.m.	0351 0358	V. of Yerevan	C	15180, 12000, 9735 (Sun, Wed, Thu, Sat)
11:00-11:15 p.m.	0400 0415	R. Japan	C	17755
11 00-11 15 p.m	0400 0415	R. Budapest	B	17710, 15225, 11910, 9835, 9585, 6105 (Wed & Sat) (Mon-0430)
11:00-11:30 p.m.	0400 0430	R. Bucharest	C	15380, 11940, 11840, 11735, 9690, 9570, 5990
11:00-11:30 p.m.	0400 0430	R. Canada International	A	11845, 11770, 5960
11:00-11:30 p.m.	0400 0430	R. Norway	B	11850, 9610, 5965 (Mon only)
11 00-11:45 p.m.	0400 0445	R. Korea	C	15570, 11820
11.00-11:55 p.m.	0400 0455	R. Peking	B	17680, 15300, 12055, 11685
11 00 3.00 a.m.	0400 0800	R. Moscow	B	9735, 9665, 9635, 9610, 9580, 7260, 6150, 5905
11:00 12:00 p.m.	0400 0500	R. Australia	B	17795, 15320
11 30 11:55 p.m.	0430 0455	Austrian R.	B	15260
11:30 12:00 p.m.	0430 0500	Swiss R. International	B	9725, 6045
11:30-12:00 p.m.	0430 0500	R. Sofia	B	7115 (frequent changes)
11:30 p.m.-2:00 a.m	0430-0700	AFRTS-Washington	A	15330, 11790, 9755, 6030
11.45 p.m.12.45 a.m.	0445 0545	BBC	A	9510, 6175, 5975
11.55 p.m.-1.00 a.m.	0455 0600	V. of Nigeria	B	7255
12 00 12 15 a.m	0500 0515	Kol Israel	B	15105, 11638, 9815
12 00-12:15 a.m.	0500 0515	R. Japan	C	15270
12:00 12:30 a.m.	0500 0530	R. Portugal	B	11935, 6025 (Mon -0520)
12 00-1:00 a.m.	0500 0600	R. Australia	C	21680, 17890, 17870, 17725
12:00-2:00 a.m.	0500 0700	HCJB, Ecuador	B	11915, 9745, 6095
12.15-1.15 a.m.	0515 0615	Spanish Foreign R.	B	11880, 9630
12.22 12.30 a.m.	0522 0530	UN Radio	A	9540, 6055 (Tue-Sat)
12:30-12:50 a.m.	0530 0550	V. of Germany	A	11905, 11785, 9650, 9545, 6185, 5960
12.30-1.25 a.m	0530 0625	R. Nederland	A	9715, 6165
12 30-2:30 a.m.	0530 0730	R. New Zealand	C	17860, 6105
12:45-1 00 a.m.	0545 0600	UN Radio	A	9540, 6055, (Tue-Sat)
12.45-2.30 a.m.	0545 0730	BBC	B	15070, 11955, 11860, 9640, 9510, 6175
1:00 1.15 a.m.	0600 0615	R. Japan	C	15270
1:00 1:30 a.m.	0600 0630	R. Norway	B	9645 (Mon only)
1.00 1.30 a.m.	0600 0630	R. Australia	C	21680, 21525, 17725, 17755, 15240
1:00-2.00 a.m.	0600 0700	RAE, Argentina	C	9690 (Tue-Sat only)
1.00 2.00 a.m.	0600 0700	R. RSA	C	21535, 17780
1.15 1.30 a.m.	0615 0630	R. Canada International	B	11735, 9730, 9655, 6140 (Mon-Fri)
1 25 3.55 a.m.	0625 0855	V. of Malaysia	C	15295, 12350, 9750
1.30 2:00 a.m.	0630 0700	R. Australia	B	21680, 17725, 15240, 9670
1.30 3:00 a.m.	0630 0800	R. Habana Cuba	A	9525
1:45-2:00 a.m.	0645 0700	R. Canada International	B	11735, 9730, 9655, 6140 (Mon-Fri)
1:57-4 55 a.m.	0657 0955	V. of Philippines	C	11950, 9579
2:00-2.15 a.m.	0700 0715	R. Japan	C	15270
2.00 3:00 a.m	0700 0800	Xandir Malta	D	9670 (Sat only) (frequent changes)
2 00-4 00 a.m.	0700 0900	R. Australia	B	21680, 17725, 11740, 9670, 9570
2 07-2 15 a.m.	0707 0715	UN Radio	A	11840, 6135 (Tue-Sat)
2.30 2:45 a.m.	0730 0745	UN Radio	A	11840, 6135 (Tue-Sat)
2 30-3 25 a.m.	0730 0825	R. Nederland	B	9770, 9715
2:30-4:00 a.m.	0730 0900	BBC	B	15070, 11955, 9640, 9510
2:30 6:30 a.m.	0730 1130	R. New Zealand	C	11945, 6105
2 55 a.m. fade	0755	Action Radio, Guyana	C	5950
3:00-3:15 a.m.	0800 0815	R. Japan	B	9505
3:30-4:25 a.m.	0830 0925	R. Nederland	B	9715
3:30-5:00 a m.	0830 1000	FEBC, Philippines	C	11765

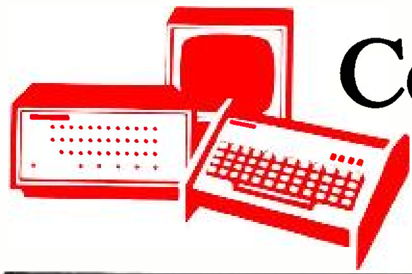
Explanatory Notes

1. Times in first column are EST For AST, add 1 hour CST, subtract 1 hour MST, subtract 2 hours, PST, subtract 3 hours Days of week are in GMT

2. Quality A strong signal and very reliable reception. B regular reception C occasional reception under favorable conditions D–rarely audible These ratings are for locations in the central USA European and African stations are in general, more reliably received in eastern North America Asian and Pacific stations are more reliably received in western North America. North American stations are received well except in areas too close to the transmitter site

3 The information in this listing is correct to press time. However, frequencies and schedules are constantly changing Listen to "DX Digest" on R Canada International for late changes, Sunday at 1807, 1915 (to Europe), GMT Mondays at 0117 and 0317, and Wednesdays at 2145

4. R Radio, V Voice



Computer Bits

By Leslie Solomon
Technical Director

NEW DEVELOPMENTS IN BUBBLE MEMORIES

A COUPLE of months back, I had the pleasure of speaking with four designers of magnetic-bubble memory chips from four different companies. My interest was in practical applications rather than the research going on. Here are some of the things I found out:

Operating speed is going up. One researcher claimed that 1-MHz operating speed with density expected to top 10^7 bits is in the foreseeable future. The price curve, of great importance to the computer experimenter, is expected to follow that of the microprocessor—down by a factor of 10 in the next three years. (Remember, that the 8080 went from over $300 in 1975 to about $10 today.)

The Bell Labs man had some very interesting things to say. The biggest piece of news is that Bell already has an experimental 1-mega*byte* chip in operation. In comparison, the largest RAM chip is 64K bits (8K bytes) and the largest ROM is 128K bits.

The experimental Bell bubble chip is 1.3" (33-mm) square and has 1792 minor loops, each of which is capable of storing 6441 bits. This yields a maximum capacity of 11.5-megabits, which provides redundancy in the event of minor-loop failure. The bubble domain has been reduced to 1.7 micrometers and separate read and write lines provide access to the minor loops. We could not get a price (which should be tremendous at this time), nor could we obtain information about when this chip will become available.

If Bell Labs continues along these lines (and if other chip manufacturers climb on the high-density, high-speed bubble bandwagon), the day of the solid-state, no-moving-parts (if you don't consider the bubbles as a mechanical element even if they do move) replacement for the sometimes troublesome mechanical disk will soon be with us.

Printer. The Model 88T dot-matrix impact printer features 100-character-per-second, bidirectional printing at 80, 96 or 132 columns, and can print at 10, 12 or 16.5 characters per inch, with an upper and lower case 96-character ASCII set on a 7×7 dot matrix. It accepts fanfold forms from one to 9.5 inches in width, or it will act as a pressure roll feed when using 8.5-inch roll paper up to 5 inches in diameter. Its continuous-loop ribbon cartridge allows the entire half-inch wide ribbon to be used with the 0.1-inch character height. It will accept RS-232CL or parallel data and has a two-line buffer. Physically, the 88T is 16¼ inches wide by 10¾ inches deep by 6¼ inches high. $749. Micro Peripherals, Inc., 2099 West 2200 South, Salt Lake City, UT 84119 (Tel: 801-973-6053).

Apple Joystick. This X- and Y-axis single joystick is plug-compatible with the Apple-II paddle connector. It has a gimbaled self-centering action and its case and color are consistent with the Apple. It has front-panel X-and Y-axis trimmers and a capacitive-activated closure switch that operates with the touch of a fingertip. This APJS device is $65 from PAIA Electronics, Inc., 1020 Wilshire Blvd., Oklahoma City, OK 73116 (Tel: 405-843-9626).

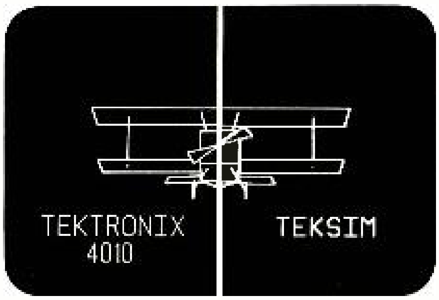
PET Toolkit. The "Toolkit" is a 2K ROM that contains 10 new commands for the PET computer. Among these are: AUTO for automatic creation of line numbers; DELETE lines; FIND, which locates lines containing a named set of characters; HELP, which prints the line where the error occurred and highlights the erroneous portion; RENUMBER lines; APPEND; and DUMP, which lists names and variables in an executing program. The plug-in version for the 8K PET (attaches to memory expansion port) is $79.95, while a plug-in Toolkit for the 16K or 32K PET is $49.95. Palo Alto IC's, 430 Sherman Ave., Palo Alto, CA 94306 (Tel: 415-327-0125).

SS-50 Video Board. The VDB-1 Smokewriter generates an 80 × 24 display with 32 graphic characters, upper and lower case (with descenders), and 128 character graphics are optional. Its programmable character set, a total of 128 characters, is in a 2K EPROM with a 256-character 4K EPROM optional. The display features reduced intensity, reverse video and has a programmable display rate of 10-5000 characters per second. It also has protected fields, an addressable cursor, 2K video RAM, 128 bytes of scratch-pad RAM, and a 1K EPROM for software drivers. $349 from Smoke Signal Broadcasting, 31336 Via Colinas, Westlake Village, CA 91361 (Tel: 213-889-9340).

Apple Speakcontrol. The Model 70 Controller card works with this firm's Model 20A Speechlab for the Apple II computer. The Model 70 provides two spdt relay closures for external control via a spoken word input. Software is available on cassette. Heuristics, Inc., 900 N. San Antonio Rd., Los Altos, CA 94022 (Tel: 415-948-2542).

Apple Graphics Tablet. The Apple Graphics Tablet requires Apple II floppy disk and 48K RAM. It uses a standard software package (BASIC) and can be customized with special symbols and functions. The tablet features a Mylar overlaid 11" by 11" drawing surface (containing the menu of tablet functions), a stylus for drawing, disk-based software and a plug-in interface board. The tablet allows freehand drawing (up to 100 points per second); a selection of black, white, magenta, green, orange and blue colors; a Calibrate function that maps a portion of the tablet to the full size of the screen; a Viewport function so that a section of the screen can be used for work with any changes affecting only the specified area; a Reduce function so that the entire tablet surface can be used for a sectioned-off area; and a Box function to allow the user to create a box merely by touching the stylus to two points that are used as the diagonal. The Tablet also allows for color separations. Functions are selected with the stylus. $795 from Apple dealers.

Apple Graphics. The TEKSIM is a ROM-based "Tektronix Simulator" that enables an Apple-II to emulate a Tektronix 4010-series graphic terminal. No modification to the host-resident program is required to display or input graphical data. The Apple has only one-



The TEKSIM enables an Apple-II to emulate a Tektronix graphic terminal.

fourth the resolution of the Tektronix terminal. Multi-colored displays, selectable erase, and standard video output are provided. $795. Cybersoft Systems, 301 S. Livernois, Rochester, MI 48063 (Tel: 313-652-9008).

TRS-80 Disk Drive. The Model TF-7 mini disk system features 77 tracks and allows up to 195K bytes of on-line storage with the TRS-80, compared with 80K bytes on 35-track models and 100K bytes found on most 40-track versions. The MTI/APPARAT DOS+ disk operating system is also available. $625. Microcomputer Technology Inc., 2080 South Grand Ave., Santa Ana, CA 92705 (Tel: 714-979-9923).

EPROM Programmer. The PB1 is designed for 2708 and 5-volt 2716 EPROM's. Two easy-insertion sockets are provided and no external high-voltage supply is required. Programming sockets are addressable to any 4K boundary. A special LED indicator is provided to prevent accidental programming. Software listings are included for checking EPROM erasure, programming and verification. The board also includes four additional EPROM's independently addressable to any 4K (2708) or 8K (2716) boundary above

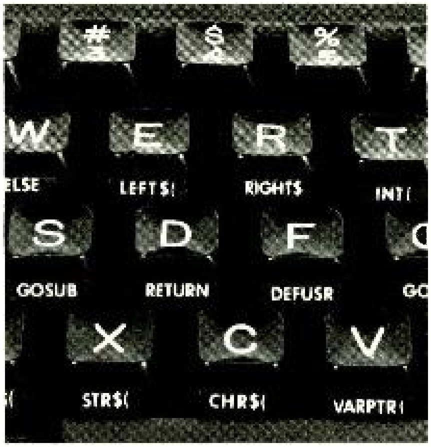
8000 hex. The board is fully buffered and 0 to 4 clock cycle wait states are available. Kit is $145, and $219 assembled and tested. Solid State Music, 2116 Walsh Ave., Santa Clara, CA 95050 (Tel: 408-246-2707).

Apple/PET/Kim Interface. The Model 4609 is a peripheral interface "breadboard" that allows the construction of custom circuits for the Apple-II and Superkim computers. It may also be used with the PET if it is provided with an "Expandamem" adapter. This new board has provisions for three I/O connectors, and features a large board area, and dual heavy-duty power busses between the IC leads. The board is 7.7-inches long to take advantage of the unused space within the Apple and PET enclosures; 14-to-40-pin sockets may be installed in the solder-coated holes, which are also arranged for Wire Wrap. A third bus on the rear may be used at the designer's discretion. Gold-flashed nickel-plate is used on the edge connectors. $21.50. Vector Electronic Co. Inc., 12460 Gladstone Ave., Sylmar, CA 91342 (Tel: 213-365-9661).

TRS-80 Printer Interface. The TRS-80 Print Module plugs directly into the back of the keyboard and eliminates the need for the Expansion Interface when driving such printers as Centronics (P1, 779, and 703), Telpar, and Axium. All line print commands in Level-II BASIC are compatible; and the print module draws power from the printer. The interface module is $99.95. American Micro Products, 6550 Tarnef, M/S 11, Houston, TX 77074 (Tel: 713-777-2759).

Apple Talker. Supertalker plugs into an Apple slot and generates speech signals for an external audio system. Initially, spoken words (via the microphone) are digitized into the RAM. Speech data is then manipulated like other stored data. The Supertalker DOS permits speech output under program control with direct I/O routines. You can create voice files on the diskette. BASIC one-line statements are used to output a word or phrase. $279. Mountain Hardware, Inc., 300 Harvey West Blvd, Santa Cruz, CA 95060.

BASIC Shorthand. TSHORT is a Level-II BASIC shorthand that allows 32 BASIC commands to be entered with a single keystroke. Immediately after the keystroke, the entire command is spelled out on screen in its normal format. TSHORT features a Kustom key.



A set of decals can be affixed to keys to indicate command locations.

changeable at any time, for user-defined functions up to 64 characters of instruction, as well as a GOTO 10 function (line 10 may contain the RUN statement). Comes on cassette with one side for Level-II BASIC and the other for TRS DOS/NEWDOS. A set of pressure-sensitive decals (white letters on clear) are easily affixed to the front surface of each key. It requires 580 bytes of low memory and does not interfere with BASIC, DOS V2.1, 2.2 or user machine-language routines. $9.95. Web Associates, P.O. Box 60 EA, Monrovia, CA 91016 (Tel: 714-559-6249).

Apple ROM Board. The ROMPLUS+ board for the Apple-II offers six individually addressable sockets for 2K ROM's or EPROM's plus scratchpad RAM. On-board firmware allows two or more 2K ROM's to be simultaneously utilized. The board also provides two TTL input connections. One socket contains Keyboard Filter, a 2K program that offers upper/lower case, multiple user-defined character sets, colored or inverse-colored letters, keyboard macros, improved cursor control, graphics and editing functions. Compatible with Integer and Applesoft BASIC and DOS. $169. Mountain Hardware, Inc., 300 Harvey West Blvd., Santa Cruz, CA 95060 (Tel: 408-429-8600).

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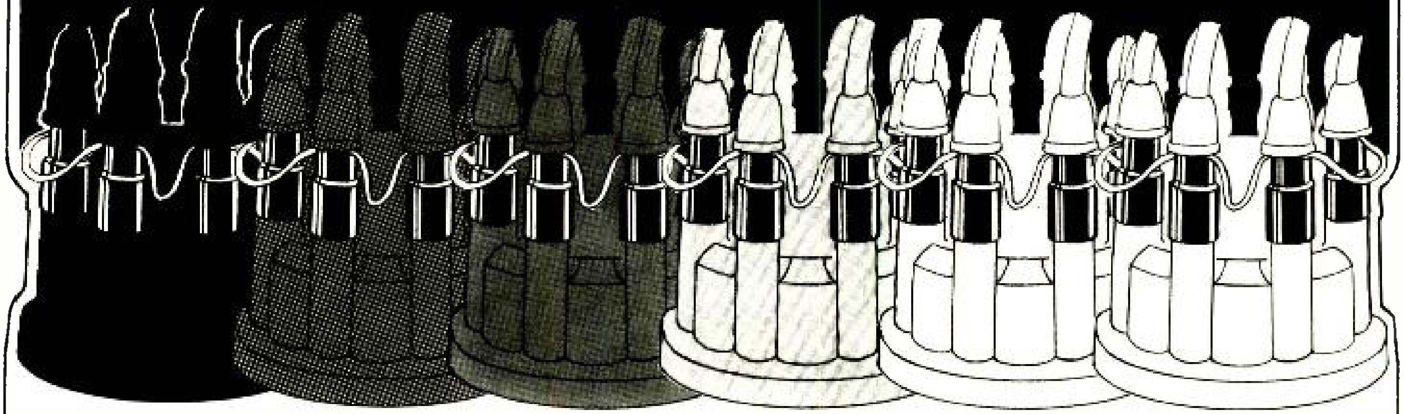

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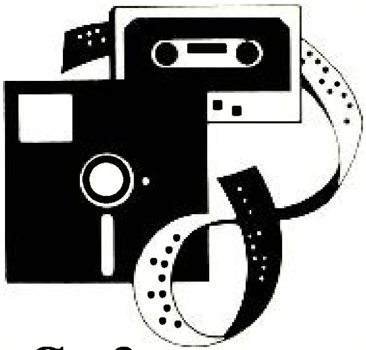

Software Sources

By Leslie Solomon
Technical Director

BASIC Compiler. For 8080 and Z80 CP/M systems, this compiler supports Microsoft BASIC-80, and is in their binary format. Thus, compiled BASIC programs can be loaded and linked with subroutines generated by Microsoft's FORTRAN-80 and COBOL-80 compilers and MACRO-80 macro assembler. The language includes double precision trigonometric functions, full PRINT USING for formatted output, extensive disk file capability, WHILE/WEND and IF/THEN/ELSE conditionals, error trapping, long variable names and a CALL statement to call FORTRAN, COBOL or assembly language subroutines. It comes on CP/M diskette with Microsoft's MACRO-80 macro assembler and LINK-80 linking loader. Single copy is $395. Microsoft, 10800 NE 8th, Suite 819, Bellevue, WA 98004, (Tel: 206-455-8080).

TRS-80 Management System. Used by a TRS-80 Level-II with at least one disk drive, the Project Management System can be used by engineers, architects or general contractors for project planning, bid preparation, budget control and cost management. $69.95. Charles Mann & Associates, Micro Software Div., 7594 San Remo Trail, Yucca Valley, CA 92284 (Tel: 714-365-9718).

Elf Programs. Written for the 1802, the ASM4 is a free-field absolute assembler supporting symbolic addresses, operation codes and operands (manual $12.95, with cassette $19.95); ASM6 is an upgraded ASM4 that supports operand expressions and six pseudo ops (symbols may be as long and as many as space permits) (manual $19.95, with cassette $26.95); EDIT2 is a line-oriented text editor (manual $12.95, with cassette $19.95); CHECKOUT is a set of routines that permit saving, displaying, and restoring all programmable registers and dumping storage in hex (manual $12.95, with cassette $19.95); and TTYPRINT transliterates ASCII to Baudot and drives a teleprinter via the Q line (manual $12.95, with cassette $19.95). Cassettes are in KC form and a loader program is supplied. The Elfry, Box 802P, Clarksville, MD 21029.

6502 Compiler. XPLO is a simplified PASCAL-type language and is available for the 6502 user with less than 32K of memory. According to the 6502 Program Exchange, XPLO runs 2.5 to 16 times faster than OSI's speedy 8K BASIC. Versions for the 20K Apple II, KIM, TIM, and SYM systems are available for under $70. The 6502 Program Exchange, 2920 Moana, Reno, NV 89509.

Apple Text Processor. The Apple II Personal Text Processor is a disk-based fast-operating package of chained BASIC programs that allows for the entry, editing and printing of letter and reports. The program includes page numbers and copy identification. It generates its own line feed, or may be operated with normal carriage returns. The editing functions include line correction, under cursor control, string find routines, and embedded text replacement elements. The program also allows for text merging including text merge in both directions within the text body. Centering and tabulation are also provided. The Apple paddles are used to roll over text and control display speed. The system includes elements for use of multiple or single disk drives and lower case display. $69.95. Charles Mann and Associates, Micro Software Div., 7594 San Remo Trail, Yucca Valley, CA 92284 (Tel: 714-365-9718).

CP/M Pascal. Pascal/M combines the language power of Pascal with the file-handling capabilities of CP/M. It allows the user to access data files in other languages (such as BASIC) stored under CP/M. Pascal programs can be invoked in CP/M SUBMIT files. The package includes diskette with compiler, interpreter and runtime library: Pascal User Manual, and Pascal/M User Reference Manual. Available on 5¼- or 8-inch diskettes. $350. Manuals only, $35. Digital Marketing, 2670 Cherry Lane, Walnut Creek, CA 94596 (Tel: 415-938-2880).

TRS-80 Video Plotter. Written for Level-II BASIC, the SIMPLEX VIDEO PLOTTER accepts input in the form of one or two continuous functions, along with the various control parameters and option selections to produce a two-dimensional plot on the screen. Continuous interaction with the user is provided. Automatic scaling is a selectable option as are scan speed and direction. Two visual markers can be placed at any point and the options can be "called" at any time permitting parameters to be changed and a new plot produced. Plot resolution is selectable as is width and height and if zero is included, both x and y axes are displayed. Cassette plus manual is $22.50. Stephen E. Gregory, 3217 Celanese Rd., Rock Hill, SC 29730.

Electronics Library

OSCILLOSCOPE APPLICATIONS & EXPERIMENTS

by Edward M. Noll

This book tells you how to get the most performance from your oscilloscope. It starts off with a review of fundamentals and a discussion of the basic types of instruments available. Next, it explains how the scope is used to check a typical audio amplifier and AM/FM receiver, TV receivers in general, and two-way communication systems. The last two chapters are devoted to aspects of dual-trace scopes and applications in digital electronic circuits. The text is well illustrated with equipment photos, circuit diagrams, and actual scope-trace photos.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. Soft cover. 223 pages. $8.95.

MODERN AMATEUR RADIO LICENSE STUDY GUIDE FOR NOVICE, TECHNICIAN & GENERAL CLASS

by William A. Hunter

Hundreds of detailed answers to questions covered by all FCC amateur radio exams in every subject area are given in this new book. In addition to providing help for taking the ham exam, it also provides a comprehensive general introduction to electronics. Part I deals with Novice class exam preparation, while Part II is devoted to Technician and General class exams. The text is profusely illustrated with schematic diagrams, illustrations, and tables and charts.

Published by Tab Books, Blue Ridge Summit, PA 17214. Soft cover. 335 pages. $6.95.

DESIGNING MICROCOMPUTER SYSTEMS

by Udo W. Pooch & Rahul Chattergy

This microcomputer hardware book provides hobbyists and engineers with the background information needed to build and design microcomputer systems. It discusses microprocessor architecture, I/O ports, interrupt systems, programmable clocks, memory units, etc. Timing diagrams are provided to explain operating sequences in detail. Focus is on the popular 8080, Z80, and 6800 micro-processors. Also covered are designs of interfaces for peripheral devices and information on building microcomputer system kits.

Published by Hayden Book Co., Inc., 50 Essex St., Rochelle Park, NJ 07662. Soft cover. 214 pages. $8.95.

THE ARRL ANTENNA ANTHOLOGY

Contained in this large-format, soft-cover book is a compilation of antenna construction articles for the beginner and experienced radio amateur interested in maximum performance at minimum cost. With the aid of clear and detailed photos and diagrams, the book conveys all the information necessary for building, tuning, and installing more than two dozen antennas. A section is devoted to related equipment, such as bridges, transmatches, etc.

Published by American Radio Relay League, 225 Main, Newington, CT 06111. Soft cover. 151 pages. $4.00.

HANDBOOK OF ELECTRONIC COMMUNICATION

by Gary M. Miller

This book covers the basics of radio communication. It leads off with a discussion of noise and bandwidth, proceeding to amplitude modulation transmission and reception. Single-sideband communication is then introduced, followed by frequency modulation transmission and reception. Next comes digital communication. The book closes with a long chapter on television. Fully illustrated throughout, the book has a number of questions and problems keyed to the appropriate chapters for review purposes.

Published by Prentice-Hall, Inc., Englewood Cliffs, NJ 07632. Hard cover. 338 pages. $14.95.

IC CONVERTER COOKBOOK

by Walter G. Jung

IC converters are being used in a variety of applications, ranging from digital meters to hospital thermometers. Presented in this book are a multitude of practical circuits to give the reader an understanding of the versatile IC converter. The text begins with data conversion fundamentals and includes explanations of binary and BCD numbering systems. It then proceeds through available data conversion ICs and their specifications. Next comes a focus on voltage and current references used with converters. This is followed by discussing peripheral components used in data conversion and D/A and A/D converters. Also covered are waveform generators, pulse converters, and programmed oscillators.

Published by Howard W. Sams & Co., Inc., 4300 West 62 St., Indianapolis, IN 46268. Soft cover. 576 pages. $13.95.

ALL ABOUT TELEPHONES

by Van Waterford

Just about everything you should know about your telephone is contained in this handy new book. Among the subjects covered are what the FCC says you can and cannot do, what telephone equipment you can get now, and what you need to know to use your telephone. As you read this book, you will learn how each part of your telephone system works, how telephones and computers work together, and which FCC rules and regulations apply to you and which apply to the telephone company and manufacturer.

Published by Tab Books, Blue Ridge Summit, PA 17214. Soft cover. 190 pages. $4.95.

PROJECT OF THE MONTH

BY FORREST M. MIMS

PSEUDORANDOM NUMBER GENERATOR

MANY GAMES and statistical calculations require the generation of random numbers. Spinners and dice are often employed as mechanical random-number generators in games. Software routines are commonly used to generate random numbers for computer games and statistical computations.

A simple way to generate random numbers electronically is to manually apply a brief burst of high-speed clock pulses to a counter as shown in Fig. 1. Although this method utilizes electronic components, the "random" number selection is in large part dependent upon the interval of time that the switch allowing clock pulses to reach the counter is pressed. Ideally, the clock pulses will occur much too rapidly for the person closing the switch to anticipate the output when the switch is opened.

Figure 2 is a working version of the block diagram shown in Fig. 1. The counter is a 4017 CMOS chip with a built-in decoder that activates one of ten LEDs numbered 0 through 9. The clock could be a 555-timer or simple, two-inverter astable multivibrator. I decided to use an LM331 voltage-to-frequency converter to permit the addition of a gradual slowdown feature that reinforces the impression of randomness in the typical observer.

With a conventional clock circuit, the pulse train to the counter will be interrupted immediately upon the opening of *S1*, and the random number will be displayed before the operator's finger is lifted from the switch. In the circuit in Fig. 2, however, depressing *S1* for a second or two charges *C1* through *R1* to a voltage less than or equal to the supply voltage. The voltage across *C1* controls the output frequency of the LM331. Once *S1* has been released, *R2* begins to discharge *C1*, and the decreasing voltage across *C1* decreases the oscillation frequency of the LM331.

When the frequency of the LM331 is high, the LEDs connected to the counter switch on and off so rapidly that to the human eye they all appear to be glowing. As the clock slows down, however, the LEDs begin to flicker. Only one LED glows at any instant when the clock rate slows to a few pulses per second. Eventually, *C1* is completely discharged, the clock stops and a single LED remains glowing. If the LEDs are arranged in a circle, the overall visual effect is reminiscent of a wheel of fortune.

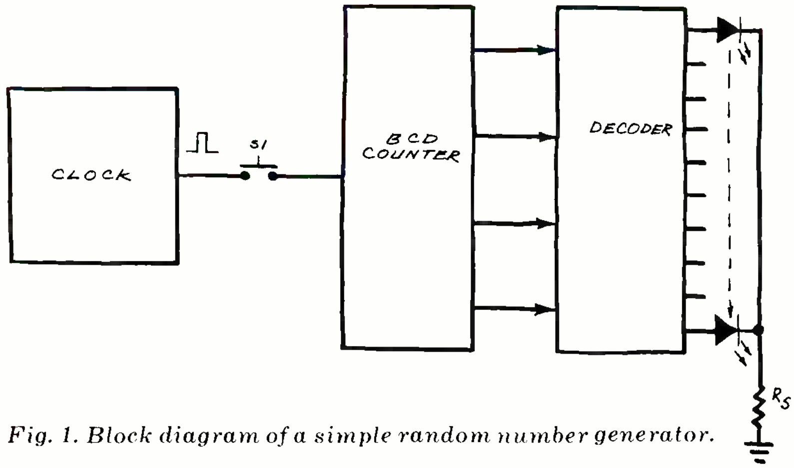

Fig. 1. Block diagram of a simple random number generator.

The critical components in this circuit are *C1*, *R1* and *R2*. Larger values of *C1* and *R1* will increase the time required to charge *C1* as well as the likelihood that *C1* will have charged to a random voltage after *S1* has been closed for an arbitrary time. Increasing the value of *R2* will increase the time required for the flickering LEDs to gradually settle down, thus enhancing the visual impression of apparent randomness. If *R2* is too large, however, *C1* may take a long time to fully discharge.

Is the output of this circuit genuinely random? The average of 100 trials should be 4.5 if the resulting numbers are perfectly random. I obtained an average of 4.38, a difference of 2% on the low side. The standard deviation of a perfectly random sample would be 3.03. Mine was 2.95.

Actually, a more careful analysis will reveal that the results are not nearly as random as might be desired. If the results were perfectly random, each of the ten LEDs would be selected an equal number of times or ten times each for a sample of 100 trials. Here are my results:

LED Number:	0	1	2	3	4	5	6	7	8	9
Observed*:	8	15	8	14	10	8	10	3	12	12
Expected*:	10	10	10	10	10	10	10	10	10	10

**Number of times observed or expected in 100 trials.*

As you can see, my operation of the circuit favored 1, 3, 8 and 9 and discriminated against 0, 2, 5 and especially 7. While Chi-square and other statistical tests can be used to determine how random the selected numbers are, clearly the results are not nearly as random as the simple averaging test initially indicated. Thus, the circuit is called a *pseudorandom* number generator.

Perhaps you can improve the randomness of the circuit's output by increasing the number of trials and experimenting with the values of *C1*, *R1* and *R2*. You might also want to add a digital readout to the circuit. This can be done by substituting a BCD counter, 7-segment decoder, and 7-segment LED display for the 4017 counter/decoder and string of LEDs. ◇

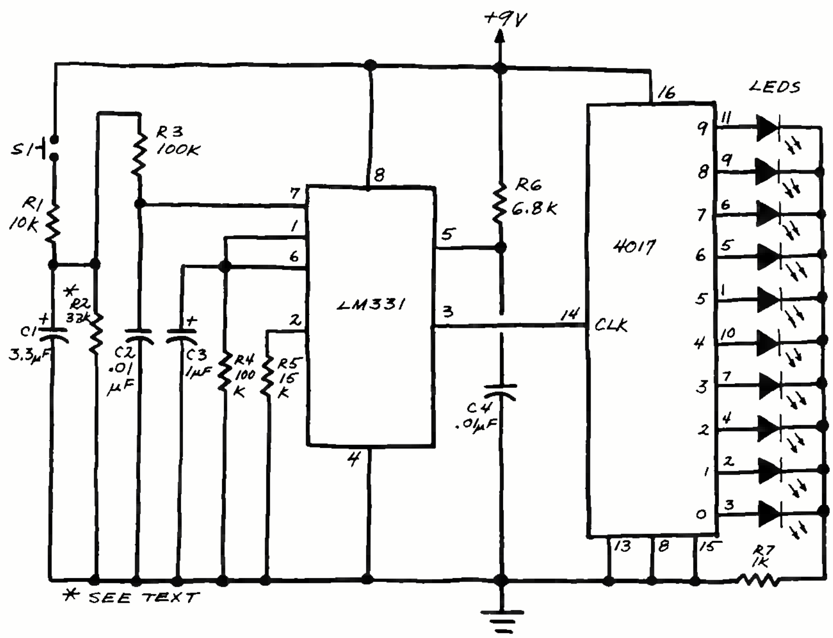

Fig. 2. Schematic diagram for a random generator circuit.

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MA1026C	Conventional Switch Set for applications where MA1026P is not used	3.95
MA1026X	Includes MA1026M clock module, MA1026C conventional switch set, MA1026T special transformer, two LM34 temperature sensors, and two KO432 trimpots	29.95
LM334	Temperature transducer for MA1026M module	1.30
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MA1023B	Alarm Buzzer for MA1023	2.25
MA1023K	Includes MA1023M, P, T & B	19.95
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RS225	Set of 5 each of 72 standard 5% 1/4 watt carbon film resistors through 910 kilohm (360 total pcs.)	$9.90

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6-32 1/2 SCREW	.99/C
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8-32 5/8 SCREW	1.39/C
2-56 HEX NUT	.75/C
4-40 HEX NUT	.75/C
6-32 HEX NUT	.75/C
8-32 HEX NUT	.75/C
NO. 2 LOCKWASHER	.85/C
NO. 4 LOCKWASHER	.55/C
NO. 6 LOCKWASHER	.55/C
NO. 8 LOCKWASHER	.55/C

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1N4002	.80	7.00
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1N4004	.80	7.90
1N4005	1.00	9.00
1N4006	1.00	9.00
1N4007	1.00	9.00
1N4148	.60	5.00

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ATTENTION ELF OWNERS: QUEST SUPER BASIC

Quest, the leader in inexpensive 1802 systems announces another first. Quest is the first company worldwide to ship a full size *Basic* for 1802 systems. A complete function Super Basic by Ron Cenker including floating point capability with scientific notation (number range ± .17E³⁸), 32 bit integer ±2 billion, Multi dim arrays, String arrays, String manipulation, Cassette I/O, Save and load, Basic, Data and machine language programs and over 75 Statements, Functions and Operators.

Easily adaptable on most 1802 systems. Requires 12K RAM minimum for Basic and user programs. Cassette version in stock now. ROM versions coming soon with exchange privilege allowing some credit for cassette version.

Super Basic on Cassette $40.00

Tom Pittman's 1802 Tiny Basic Source listing now available. Find out how Tom Pittman wrote Tiny Basic and how to get the most out of it. Never offered before. $19.00

S-100 Slot Expansion $9.95

Coming Soon: Assembler and Editor; Elf II Adapter Board. High resolution alpha/numerics with color graphics expandable up to 256 x 192 resolution for less than **$100.**

16K Dynam. RAM bd. expand. 32K; less than $150.

RCA Cosmac Super Elf Computer $106.95

Compare features before you decide to buy any other computer. There is no other computer on the market today that has all the desirable benefits of the **Super Elf** for so little money. The Super Elf is a small single board computer that does many **big** things. It is an excellent computer for training and for learning programming with its machine language and yet it is easily **expanded** with **additional memory, Full Basic, ASCII Keyboards, video character generation, etc.**

Before you buy another small computer, see if it includes the following features: ROM monitor; State and Mode displays; Single step; Optional address displays; Power Supply; Audio Amplifier and Speaker; Fully socketed for all IC's; Real cost of in warranty repairs; Full documentation.

The **Super Elf** includes a **ROM** monitor for program loading, editing and execution with **SINGLE STEP for program debugging** which is not included in others at the same price. With **SINGLE STEP** you can see the microprocessor chip operating with the **unique Quest** address and data bus displays **before, during and after** executing instructions. Also, CPU mode and instruction cycle are decoded and displayed on 8 LED indicators.

An RCA 1861 **video graphics** chip allows you to connect to your own TV with an inexpensive video modulator to do graphics and games. There is a **speaker system** included for writing your own music or using many music programs already written. The speaker amplifier may also be used to drive relays for control purposes.

A 24 key **HEX keyboard** includes 16 HEX keys plus **load, reset, run, wait, input, memory protect, monitor select** and **single step**. Large, on board displays provide output and optional **high and low address**. There is a 44 pin standard connector slot for PC cards and a 50 pin connector slot for the Quest Super Expansion Board. Power supply and sockets for all IC's are included in the price plus a detailed 127 pg. instruction manual which now includes over 40 pgs. of software info. including a series of lessons to help get you started and a music program and graphics target game.

Many schools and universities are using the Super Elf as a course of study. DEM's use it for training and research and development.

Remember, other computers only offer Super Elf features at additional cost or not at all. **Compare before you buy. Super Elf Kit $106.95, High address option $8.95, Low address option $9.95. Custom Cabinet** with drilled and labelled plexiglass front panel **$24.95.** Expansion Cabinet with room for 4 S-100 boards **$41.00. NiCad Battery Memory Saver Kit $6.95.** All kits and options also completely assembled and tested.

Questdata, a 12 page monthly software publication for 1802 computer users is available by subscription for $12.00 per year.

Tiny Basic Cassette **$10.00,** on ROM **$38.00,** original Elf kit board **$14.95. 1802 software:** Moews Video Graphics **$3.50.** Games and Music **$3.00,** Chip 8 Interpreter **$5.50.**

Super Expansion Board with Cassette Interface $89.95

This is truly an astounding value! This board has been designed to allow **you** to decide how you want it optioned. **The Super Expansion Board comes with 4K of low power RAM** fully addressable anywhere in 64K with built-in memory protect and a **cassette interface**. Provisions have been made for all other options on the same board and it fits neatly into the hardwood cabinet alongside the **Super Elf**. The board includes slots for up to 6K of **EPROM** (2708, 2758, 2716 or TI 2716) and is **fully socketed.** EPROM can be used for the monitor and Tiny Basic or other purposes.

A 1K Super ROM Monitor $19.95 is available as an on board option in 2708 EPROM which has been preprogrammed with a program loader/editor and error checking multi file cassette read/write software, (relocatable cassette file) another exclusive from Quest. It includes register save and readout, block move capability and video graphics driver with blinking cursor. Break points can be used with the register save feature to isolate program bugs quickly, then follow with single step. The Super Monitor is written with subroutines allowing users to take advantage of monitor functions simply by calling them up. Improvements and revisions are easily done with the monitor. If you have the **Super Expansion Board** and **Super Monitor** the monitor is up and running at the push of a button.

Other on board options include **Parallel Input and Output Ports with full handshake.** They allow easy connection of an ASCII keyboard to the input port. **RS 232 and 20 ma Current Loop** for teletype or other device are on board and if you need more memory there are two **S-100** slots for static RAM or video boards. Also a 1K Super Monitor version 2 with video driver for full capability display with Tiny Basic and a video interface board. **Parallel I/O Ports $9.85, RS 232 $4.50, TTY 20 ma I/F $1.95, S-100 $4.50. A 50 pin connector set** with ribbon cable is available at $12.50 for easy connection between the **Super Elf** and the **Super Expansion Board.**

Power Supply Kit for the complete system (see Multi-volt Power Supply below).

Multi-volt Computer Power Supply

8v 5 amp, ±18v .5 amp, 5v 1.5 amp, −5v .5 amp, 12v .5 amp, −12 option. ±5v, ±12v are regulated. Kit $29.95. Kit with punched frame $37.45, $4.00 shipping. Woodgrain case $10.00, $1.50 shipping.

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INTEGRATED CIRCUITS

7400TTL

7400N	17
7402N	18
7404N	19
7409N	23
7410N	18
7414N	70
7420N	18
7422N	39
7430N	20
7442N	50
7445N	69
7447N	60
7448N	69
7450N	18
7474N	.35
7475N	49
7485N	88
7489N	1.85
7490N	43
7492N	43
7493N	43
7495N	69
74100N	90
74107N	35
74121N	34
74123N	59
74125N	45
74145N	.69
74150N	95
74151N	69
74154N	1 00
74157N	69
74161N	87
74162N	87
74163N	87
74174N	96
74175N	90
74190N	1 15
74192N	87
74193N	85
74221N	2.00
74298N	1.65
74365N	66
74366N	66
74367N	66

74LS00 TTL

74LS00N	35
74LS02N	35
74LS04N	35
74LS05N	35
74LS08N	35
74LS10N	35
74LS13N	55
74LS14N	1 10
74LS20N	35
74LS22N	35
74LS28N	41
74LS30N	35
74LS33N	75
74LS38N	55
74LS74N	1 25
74LS75N	1 00
74LS90N	85
74LS93N	70
74LS95N	1 10
74LS107N	45
74LS112N	45
74LS113N	35
74LS132N	89
74LS136N	45
74LS151N	85
74LS155N	85
74LS157N	85
74LS162N	1 15
74LS163N	1 15
74LS174N	2 00
74LS190N	1 06
74LS221N	1 95
74LS258N	.67
74LS367N	1.35

LINEAR

CA3045	90
CA3046	1 10
CA3081	1 80
CA3082	1 90
CA3089	2 95
LM301AN/AH	35
LM305H	87
LM307N	35
LM308N	89
LM309K	1 50
LM311H/N	90
LM317T/K	3.75
LM318	1 35
LM320K-5	1 50
LM323K-5	5 95
LM320K-12	1 50
LM320K-15	1 50
LM320T-5	1 60
LM320T-8	1 60
LM320T-12	1 50
LM320T-15	1 60
LM324N	1 15
LM339N	1 55
LM340K-5	1 35
LM340K-8	1 35
LM340K-12	1.35
LM340K-15	1 35
LM340K-24	1 35
LM340T-5	1 25
LM340T-8	1 25
LM340T-12	1 25
LM340T-15	1 25
LM340T-18	1 25
LM340T-24	1 25
LM343H	4 50
LM350	7.50
LM370	1.15
LM377	3.00
LM379	5.00
LM380N	1.00
LM381	1 60
LM382	1 60
LM703H	40
LM709H	28
LM723H/N	50
LM733N	67
LM741CH	35
LM741N	32
LM747H/N	75
LM748N	35
LM1303N	1 75
LM1304	1 10
LM1305	1 27
LM1307	2.00
LM1310	2 75
LM1458	47
LM1800	1 75
LM1812	7 50
LM1889	3 00
LM2111	1 75
LM2902	1 50
LM3900N	60
LM3905	1 75
LM3909N	.89
MC1458V	50
NE550N	1 00
NE555V	39
NE556A	85
NE565A	1 00
NE566V	1 50
NE567V	1 00
NE570B	5 00
78L05	60
78L08	60
78M05	85
75108	1 75
75491CN	50
75492CN	55
75494CN	89

A to D CONVERTER

8038B	4 50
8700CJ	13 95
8701CN	22 00
8750CJ	13 95
LD130	9 95
9400CJV/F	7 40
ICL7103	9 50
ICL7107	14 25

CMOS

CD34001 Fair.	50
CD4000	16
CD4001	28
CD4002	28
CD4006	1 10
CD4007	28
CD4008	28
CD4009	45
CD4010	45
CD4011	28
CD4012	.28
CD4013	39
CD4014	1 00
CD4015	1 00
CD4016	45
CD4017	1 05
CD4018	94
CD4019	45
CD4020	1 02
CD4021	1.25
CD4022	1 10
CD4023	28
CD4024	75
CD4025	28
CD4026	2 00
CD4027	.66
CD4028	85
CD4029	1 02
CD4030	45
CD4035	1 02
CD4040	1 02
CD4042	85
CD4043	85
CD4044	85
CD4046	1 67
CD4049	45
CD4050	49
CD4051	1 13
CD4060	1.42
CD4066	71
CD4068	.40
CD4069	40
CD4070	50
CD4071	28
CD4072	28
CD4073	28
CD4075	28
CD4076	1 45
CD4078	40
CD4081	.28
CD4082	28
CD4116	47
CD4490	5.50
CD4507	1 00
CD4508	4 25
CD4510	1 02
CD4511	94
CD4515	2.52
CD4516	1 10
CD4518	1 02
CD4520	1 02
CD4527	1 51
CD4528	79
CD4553	3 50
CD4566	2 25
CD4583	4 50
CD4585	1 10
CD40192	3 00
74C00	28
74C04	40
74C10	28
74C14	2 10
74C20	28
74C30	28
74C48	1 95
74C74	75
74C76	1.40
74C90	1 15
74C93	1 40
74C154	3.00
74C160	1 44
74C175	1 35
74C192	1 65
74C221	2 00
74C905	6 00
74C906	75
74C914	1 95
74C922	5 50
74C923	5 50
74C925	6 95
74C926	6 95
74C927	6 95

INTERFACE

8095	65
8096	65
8097	65
8098	65
8T09	1 25
8T10	4 50
8T13	3 00
8T20	5 50
8T23	3 10
8T24	3 50
8T25	3 20
8T26	1.69
8T28	2 75
8T97	1 69
8T98	1 69

MOS MEMORY RAM

2101-1	3 95
2102-1	95
2102AL-4	1 25
2102AN-2L	1 60
21L02-1	1 18
21L02-1	1.18
21F02	1.25
2104A-4	4.95
2107B 4	3 75
2111-1	3 75
2112-2	3 95
2114L-1	7 40
2114L-3	7 90
4116	10 95
2513B	6 30
MM5262	40
MM5280	3.00
MM5320	9 95
MM5330	5 94
PD411D-3	4 00
PD411D-4	5 00
P5101L	13.95
4200A	9 95
82S25	2 90
91L02A	1 50
HD0165-5	6 95
MM57100	4 50
GIAY38500-1	9 95
MCM6571A	9 95
9368	3 50
410D	10.00
416	16 00

CLOCKS

MM5314	3 90
MM5315	4 00
MM5369	2 10
MM5841	14 45
MM5865	7 95
CT7001	5.80
CT7010	8.95
CT7015	7 25
MM5375AA/N	3 90
MM5375AG/N	4.90
7205	16.50
7207	7 50
7208	15 95
7209	4 95
DS0026CN	3 75
DS0056CN	3 75
MM53104	2 50

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6800	17 50
6802	18 75
8080A	8 95
8085	27 00
Z80	14.75
Z80A	19 75
8212	2 90
8214	8 00
8216	2 90
8224	2 90
8228	5 35
8251	8 50
8253	15 00
8255	9 25
8257	19.50
8259	19.50
1802CP plas	13 95
1802DP plas	17 95
1861P	11 50
CDP1802CD	19 95
CDP1802D	25 00
CDP1861	12 95
6820	9 95
6850	12 95
6502	12 50
6504	16 50
6522	13 60

UART/FIFO

AY5-1013	5 50
AY5-1014	7 50
3341	6 95

PROM

1702A	3 95
2708	10 50
2716T1	29 50
2716 Intel	48 00
2732	115 00
2758	22 50
8741A	85 00
8748	75.00
8748-8	60 00
8755A	65 00
N82S23	2 95
N82S123	3 50
N82S126	3 75
N82S129	3.75
N82S131	3 75
N82S136	8 75
N82S137	8 75
DM8577	2 90
8223	2.90

CONNECTORS

30 pin edge	2 50
44 pin edge	2 75
100 pin edge	4 50
100 pin edge WW	5 25

IC SOCKETS

Solder Tin PIN	1 UP	Low Profile PIN	1UP
8	15	22	30
14	14	24	35
16	16	28	.42
18	27	36	58
20	29	40	57

2 level 14 pin ww 20

WIRE WRAP LEVEL 3

PIN		PIN	
14	32	24	86
16	33	28	1 00
18	57	40	1 23

CRYSTALS

1 MHz	4 50
2 MHz	4 50
4 MHz	4 25
5 MHz	4 25
10 MHz	4 25
18 MHz	3 90
20 MHz	3 90
32 MHz	3 90
32768 MHz	4 00
1 8432 MHz	4 50
3 5795 MHz	1 20
2 0100 MHz	1 95
2 097152 MHz	4 50
2 4576 MHz	4 50
3 2768 MHz	4 50
5 0688 MHz	4 50
5 185 MHz	4 50
5 7143 MHz	4 50
6 5536 MHz	4 50
14 31818 MHz	4 25
18 432 MHz	4 50
22 1184 MHz	4 50

KEYBOARD ENCODERS

AY5-2376	$12 50
AY5-3600	17 95
74C922	5 50
74C923	5 50
HD0165-5	6 95

D Connectors RS232

DB25P	2 95
DB25S	3 95
Cover	1 50
RS232 Complete Set	6 50
DE9S	1.95
DA15P	2 10
DA15S	3 10

TRANSISTORS

2N1893	40
2N222A	27
2N2369	30
2N2904A	20
2N2907A	25
2N3053	40
2N3638	25
2N3643	25
2N3904	18
2N3906	18
2N3055	69
2N4400	.25
2N4401	.75
2N4402	20
TIP31	60
TIP33A	1 00

RESISTORS ¼ watt 5%

10 per type .03   1000 per type .012
25 per type .025   350 piece pack
100 per type .015   5 per type 6.75
½ watt 5% per type .05

KEYBOARDS

56 key ASCII keyboard kit	$67 50
Fully assembled	77 50
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Fully assembled 70.00 Enclosure	14 95

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Red T018	15
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(specify red, amber, green, yellow, clear)

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Complete line of breadboard test equip.
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Switches Mom. Pushbutton	27
3 pos. slide	25
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Paratronics 100A Logic Analyzer Kit	$224.00
Model 10 Trigger Expander Kit	$229 00
Model 150 Bus Grabber Kit	$369 00
Sinclair 3½ Digit Multimeter	$59 95
Clock Calendar Kit	$23 95
2.5 MHz Frequency Counter Kit	$37.50
30 MHz Frequency Counter Kit	$47.75

TRANSFORMERS

6V 300 ma	3 25
12 Volt 300 ma transformer	1 25
12 6V CT 600 ma	3 75
12V 250 ma wall plug	2 95
12V CT 250 ma wall plug	3 50
24V CT 400 ma	3 95
10V 1 2 amp wall plug	4 85
12V 6 amp	12 95
12V 500 ma wall plug	4 75
12V 1 amp wall plug	6 50
12V 3 amp wall plug	8 50

DISPLAY LEDS

MAN1	CA	270	2 90
MAN3	CC	125	39
MAN72/74	CA/CA	300	1 00
DL704	CC	300	1 25
DL707/DL707R	CA	300	1 00
DL727/728	CA CC	500	1 90
DL747/750	CA CC	600	1 95
DL750	CC	600	1 95
FND359	CC	357	70
FND500/507	CC/CA	500	1 35
FND503/510	CC/CA	500	90
FND800/807	CC/CA	800	2 20
3 digit Bubble			60
4 digit Bubble			80
DG8 Fluorescent			1 75
DG10 Fluorescent			1 75
5 digit 14 pin display			1 00
NSN69 9 digit display			60
7520 Clairex photocells			39
TIL311 Hex			9 50
MAN3640	CC	30	1 10
MAN4610	CA	40	1 20
MAN4640	CC	40	1 20
MAN4710	CA	40	95
MAN4740	CC	40	1 20
MAN6640	CC	56	2 95
MAN6710	CA	60	1 35
MAN6740	CC	60	1 35
MA1002A		8.95	
MA1012A		8.95	
102P3 transformer		2 25	

Rockwell AIM 65 Computer

6502 based single board with full ASCII keyboard and 20 column thermal printer. 20 char. alphanumeric display, ROM monitor, fully expandable. $375.00. 4K version $450.00. 4K Assembler $85.00, 8K Basic Interpreter $100.00. Power supply assy. in case $60.00. AIM 65 in thin briefcase with power supply $485.00.

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Includes everything except case. 2-PC boards. 6-.50" LED Displays. 5314 clock chip, transformer, all components and full instructions. Orange displays also avail. **Same kit w/.80" displays.** Red only. **$21.95** Case **$11.75**

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Convert your TV set into a high quality monitor without affecting normal usage. Complete kit with full instructions.

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16K Static RAM Kit	265.00
24K Static RAM Kit	423.00
32K Dynamic RAM Kit	310.00
32K Static RAM Kit	**$475.00**
64K Dynamic RAM Kit	470.00
8K/16K Eprom Kit (less PROMS)	**$89.00**
Video Interface Kit	**$139.00**
Motherboard **$39.** Extender Board	**$8.99**

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Complete IC data selector, 2500 pg. master reference guide. Over 50,000 cross references. Free update service through 1979. Domestic postage $3.50. No foreign orders.

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DC clock with 4-.50" displays. Uses National MA-1012 module with alarm option. Includes light dimmer, crystal timebase PC boards. Fully regulated, comp. instructs. Add $3.95 for beautiful dark gray case. Best value anywhere.

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Opens shorted cells that won't hold a charge and then charges them up, all in one kit w/full parts and instructions. **$7.25**

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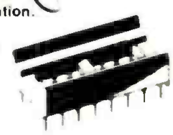

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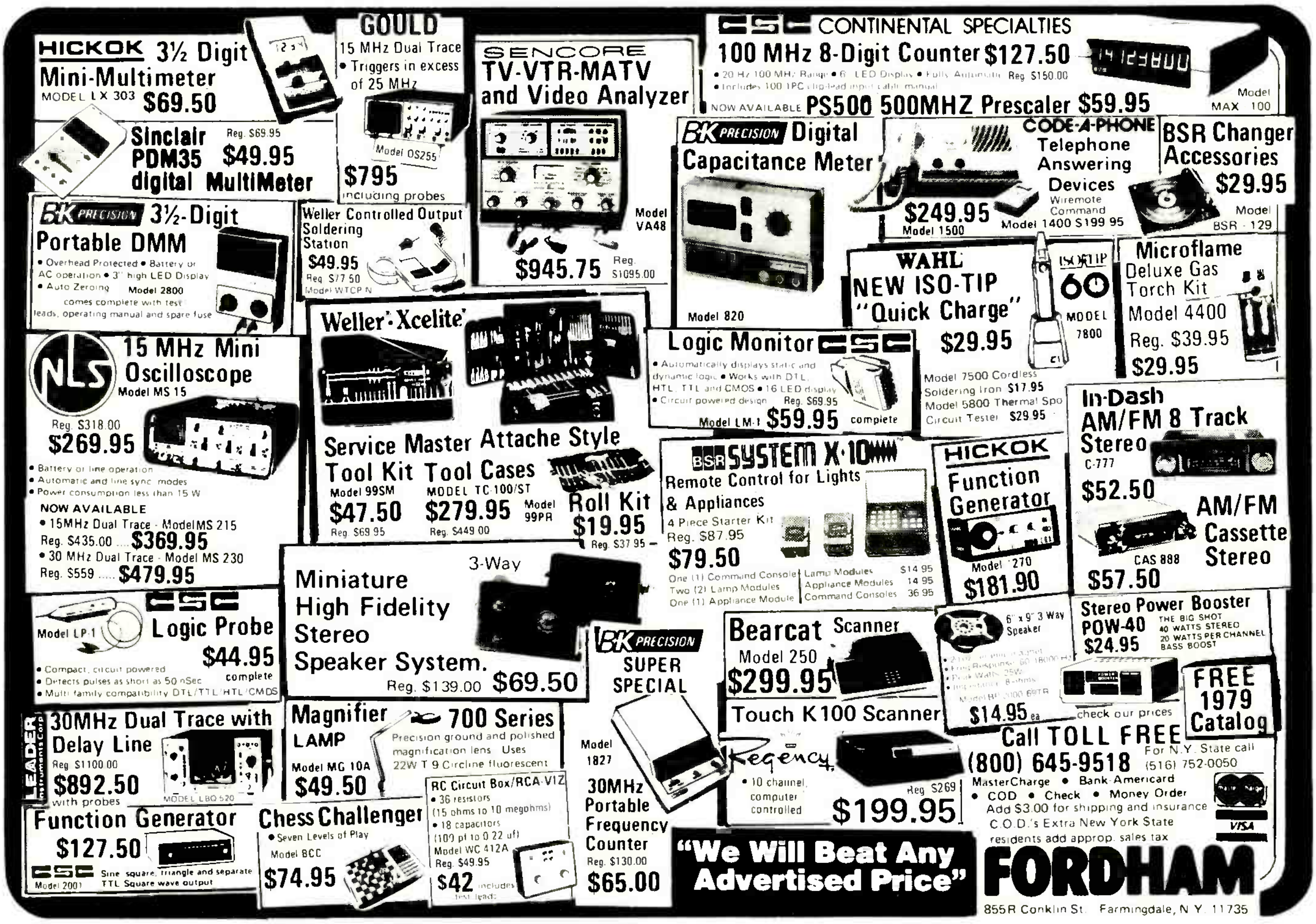
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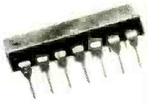

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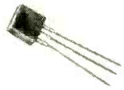

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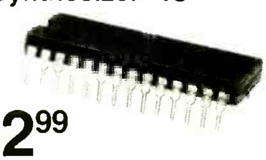

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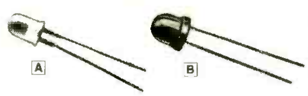

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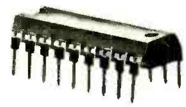

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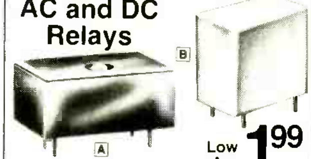

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SN7426N	29	SN74107N	35	SN74188N	3 95
SN7427N	.25	SN74109N	59	SN74190N	1 25
SN7429N	.39	SN74116N	1 95	SN74191N	1 25
SN7430N	.20	SN74121N	35	SN74192N	79
SN7432N	25	SN74122N	39	SN74193N	79
SN7437N	25	SN74123N	49	SN74194N	89
SN7438N	25	SN74125N	49	SN74195N	69
SN7439N	25	SN74126N	49	SN74196N	89
SN7440N	.20	SN74132N	75	SN74197N	89
SN7441N	89	SN74136N	75	SN74198N	1 49
SN7442N	.49	SN74141N	79	SN74199N	1 49
SN7443N	75	SN74142N	2 95	SN74S200	4 95
SN7444N	.75	SN74143N	2 95	SN74251N	99
SN7445N	75	SN74144N	2 95	SN74279N	79
SN7446N	69	SN74145N	79	SN74283N	2 25
SN7447N	59	SN74147N	1 95	SN74284N	3 95
SN7448N	79	SN74148N	1.29	SN74285N	3 95
SN7450N	20	SN74150N	89	SN74365N	69
SN7451N	20	SN74151N	59	SN74366N	69
SN7453N	.20	SN74152N	59	SN74367N	69
SN7454N	20	SN74153N	59	SN74368N	69
SN7459A	25	SN74154N	99	SN74390N	1 95
SN7460N	20	SN74155N	.79	SN74393N	1 95
		SN74156N	.79		
		SN74157N	65		

C/MOS

CD4000	23	CD4028	89	CD4070	55
CD4001	23	CD4029	1 19	CD4071	23
CD4002	23	CD4030	49	CD4072	49
CD4006	1 19	CD4035	99	CD4076	1 39
CD4007	25	CD4040	1 19	CD4081	23
CD4009	49	CD4041	1 25	CD4082	.23
CD4010	.49	CD4042	99	CD4093	99
CD4011	23	CD4043	89	CD4098	2 49
CD4012	25	CD4044	89	MC14409	14 95
CD4013	39	CD4046	1 79	MC14410	14 95
CD4014	1 39	CD4047	2 50	MC14411	14 95
CD4015	1 19	CD4048	1 35	MC14419	4 95
CD4016	49	CD4049	49	MC14433	19 95
CD4017	1 19	CD4050	49	MC14506	75
CD4018	.99	CD4051	1 19	MC14507	99
CD4019	49	CD4053	1 19	MC14562	14 50
CD4020	1 19	CD4056	2 95	MC14583	3 50
CD4021	1 39	CD4059	9 95	CD4508	3 95
CD4022	1 19	CD4060	1 49	CD4510	1 39
CD4023	23	CD4066	79	CD4511	1 29
CD4024	79	CD4068	39	CD4515	2 95
CD4025	23	CD4069	45	CD4518	1 29
CD4026	2.25			CD4520	1 29
CD4027	69			CD4566	2 25

74C00

74C00	39	74C85	2 49	74C163	2 49
74C02	.39	74C90	1 95	74C164	2 49
74C04	39	74C93	1 95	74C173	2.60
74C08	49	74C95	1 95	74C192	2 49
74C10	39	74C107	1 25	74C193	2 49
74C14	1 95	74C151	2 90	74C195	2 49
74C20	39	74C154	3 00	74C922	7 95
74C30	39	74C157	2 15	74C923	6 25
74C42	1 95	74C160	2 49	74C925	8 95
74C48	2 49	74C161	2.49	74C926	8 95
74C73	.89			80C95	1 50
74C74	89			80C97	1.50

LINEAR

78MG	1 75	LM340K-18	1 35	LM710N	.79
LM106H	99	LM340K 24	1 35	LM711N	39
LM300H	80	LM340T-5	1 25	LM723N/H	55
LM301CN/H	35	LM340T-6	1.25	LM733N	1 00
LM302H	75	LM340T-8	1 25	LM739N	1 19
LM304H	1 00	LM340T-12	1 25	LM741CN/H	35
LM305H	.60	LM340T-15	1 25	LM741-14N	39
LM307CN/H	.35	LM340T-18	1 25	LM747N/H	79
LM308CN/H	1 00	LM340T-24	1 25	LM748N/H	39
LM309H	1 10	LM358N	1 00	LM1310N	1 95
LM309K	1 25	LM370N	1 95	LM1458CN/H	59
LM310CN	1 15	LM373N	3 25	MC1488N	1 95
LM311N/H	90	LM377N	4 00	MC1489N	1 95
LM312H	1 95	LM380N	1 25	LM1496N	.95
LM317K	6 50	LM380CN	99	LM1556V	1 75
LM318CN/H	1.50	LM381N	1 79	MC1741SCP	3 00
LM319N	1.30	LM382N	1.79	LM2111N	1 95
LM320K-5	1 35	NE501N	8 00	LM2901N	2 95
LM320K-5.2	1 35	NE510A	6 00	LM3053N	1 50
LM320K-12	1 35	NE529A	4 95	LM3065N	1 49
LM320K-15	1.35	NE531H/V	3 95	LM3900N(3401)	59
LM320K-18	1 35	NE536T	6 00	LM3905N	1 49
LM320K-24	1.35	NE540L	6 00	LM3909N	1 25
LM320T-5	1 25	NE544N	4 95	MC5558V	59
LM320T-5 2	1.25	NE550N	1.30	8038B	4 95
LM320T-8	1 25	NE555V	39	LM75450N	49
LM320T-12	1 25	NE556N	99	75451CN	39
LM320T-15	1 25	NE560B	5 00	75452CN	39
LM320T-18	1 25	NE561B	5 00	75453CN	39
LM320T-24	1 25	NE562B	5 00	75454CN	39
LM323K-5	5.95	NE565N/H	1.25	75491CN	79
LM324N	1 49	NE566CN	1 75	75492CN	89
LM339N	.99	NE567V/H	99	75493N	89
LM340K-5	1 35	NE570N	4 95	75494CN	89
LM340K-6	1 35	LM703CN/H	69	RC4136	1 25
LM340K-8	1.35	LM709N/H	.29	RC4151	3 95
LM340K-12	1.35			RC4194	4 95
LM340K-15	1 35			RC4195	4.49

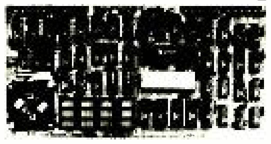
74LS00TTL

74LS00	29	74LS47	89	74LS138	.89
74LS01	29	74LS51	29	74LS139	89
74LS02	29	74LS54	29	74LS151	89
74LS03	29	74LS55	29	74LS155	89
74LS04	35	74LS73	45	74LS157	89
74LS05	35	74LS74	45	74LS160	1 15
74LS08	29	74LS75	59	74LS161	1 15
74LS09	35	74LS76	45	74LS162	1 25
74LS10	29	74LS78	49	74LS163	1 15
74LS11	75	74LS83	89	74LS164	1 25
74LS13	59	74LS85	1 25	74LS175	99
74LS14	1 25	74LS86	45	74LS181	2 49
74LS15	35	74LS90	59	74LS190	1 15
74LS20	29	74LS92	75	74LS191	1 15
74LS21	35	74LS93	75	74LS192	1 15
74LS22	35	74LS95	99	74LS193	1 15
74LS26	35	74LS96	1.15	74LS194	1 15
74LS27	35	74LS107	45	74LS195	1 15
74LS28	35	74LS109	45	74LS253	99
74LS30	29	74LS112	45	74LS257	89
74LS32	35	74LS123	1 25	74LS258	1 75
74LS37	45	74LS125	89	74LS260	69
74LS40	35	74LS132	99	74LS279	75
74LS42	89	74LS136	49	74LS367	75
				74LS368	75
				74LS670	2 49

Cromemco

incorporated

Z80-4MHz Single Card Computer



Cromemco's Single Card Computer is a complete computer which brings the power of the Z 80 and the flexibility of the S 100 bus to the dedicated computer environment.

The card offers 4 MHz operation, 8K bytes of on-board 2716 PROM, and 1K byte of static RAM memory. This stand alone card also provides an RS 232 (or 20mA current loop) serial interface with programmable baud rates to 76,800, vectored interrupts, 24 bits of bidirectional parallel I/O, and 5 programmable timers. Only a power supply and PROM software are required for operation. The Single Card Computer is assembled and tested (Model SCC-W) for $450. The Monitor and Control BASIC are available in two ROM's (Model MCB 216) for $90

SCC-W (Assembled) **$450.00**

Processor 4MHz Z 80
Instruction Set 158 instructions incl. the 78 instructions of the 8080
ROM Capacity 8K Bytes located from address 0000 to 1FFF
ROM Type Intel 2716 PROM or equivalent
RAM Capacity 1K Bytes located from address 2000 to 23FF
RAM Type 4045 Static

Serial I/O Ports
I O Levels RS 232 or 20mA current loop
Baud Rates 110 to 76 800 (software selectable)
Parallel Ports
Input Port 24 bits bidirectional
Output Port 24 bits bidirectional
Input Load One TTL equivalent
Output Drive 20 TTL loads
Interval Timers
Number of timers 5

Timer range 0 16 32m seconds (software sel.)
Timer resolution 64 microseconds
Vectored Interrupts
No. of restart locations (Z 80 mode) 65 536
General Information
UART type 5501 Bus S 100
Power requirements +8V at 1.4A, +18V at 70mA, 18V at 25mA
Operating environment 0 55°C

DISCRETE LEDS

.200" dia.			**.125" dia.**		
XC556R	red	5/$1	XC209R	red	5/$1
XC556G	green	4/$1	XC209G	green	4/$1
XC556Y	yellow	4/$1	XC209Y	yellow	4/$1
XC556C	clear	4/$1			
.200" dia.			**.185" dia.**		
XC22R	red	5/$1	XC526R	red	5/$1
XC22G	green	4/$1	XC526G	green	4/$1
XC22Y	yellow	4/$1	XC526Y	yellow	4/$1
			XC526C	clear	4/$1
.170" dia.					
MV10B	red	4/$1			
.085" dia.			**190" dia.**		
MV50	red	6/$1	XC111R	red	5/$1
			XC111G	green	4/$1
			XC111Y	yellow	4/$1
			XC111C	clear	4/$1

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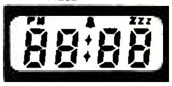
FIELD EFFECT



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T1001A-Reflective 8.25

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MAN 1	Common Anode-red	270	2 95	MAN 6730	Common Anode-red ± 1	560	99
MAN 2	5 x 7 Dot Matrix-red	300	4 95	MAN 6740	Common Cathode-red-D D	560	99
MAN 3	Common Cathode-red	125	.25	MAN 6750	Common Cathode-red ± 1	560	99
MAN 4	Common Cathode-red	187	1 95	MAN 6760	Common Anode-red	560	99
MAN 7G	Common Anode-green	300	1 25	MAN 6780	Common Cathode-red	560	99
MAN 7Y	Common Anode-yellow	300	99	DL701	Common Anode-red ± 1	300	99
MAN 72	Common Anode-red	300	99	DL704	Common Cathode-red	300	99
MAN 74	Common Cathode-red	300	1.25	DL707	Common Anode-red	300	99
MAN 82	Common Anode-yellow	300	49	DL728	Common Cathode-red	500	1 49
MAN 84	Common Cathode-yellow	300	.99	DL741	Common Anode-red	600	1 25
MAN 3620	Common Anode-orange	300	49	DL746	Common Anode-red ± 1	630	1 49
MAN 3630	Common Anode-orange ± 1	300	99	DL747	Common Anode red	600	1 49
MAN 3640	Common Cathode-orange	300	99	DL749	Common Cathode-red ± 1	630	1 49
MAN 4610	Common Anode-orange	300	99	DL750	Common Cathode-red	600	1 49
MAN 4640	Common Cathode-orange	400	99	DL338	Common Cathode-red	110	35
MAN 4710	Common Anode-red	400	99	FND70	Common Cathode	250	69
MAN 4730	Common Anode-red ± 1	400	99	FND358	Common Cathode ± 1	357	99
MAN 4740	Common Cathode-red	.400	99	FND359	Common Cathode	357	75
MAN 4810	Common Anode-yellow	400	99	FND503	Common Cathode(FND500)	500	99
MAN 4840	Common Cathode-yellow	400	99	FND507	Common Anode (FND510)	500	99
MAN 6610	Common Anode-orange-D D	560	99	5082-7730	Common Anode-red	.300	99
MAN 6630	Common Anode-orange ± 1	560	99	HDSP-3400	Common Anode-red	800	1 50
MAN 6640	Common Cathode-orange-D D	560	99	HDSP-3403	Common Cathode red	800	1 50
MAN 6650	Common Cathode-orange ± 1	560	99	5082 7300	4 x 7 sgl Digit-RHDP	600	19 95
MAN 6660	Common Anode-orange	560	99	5082-7302	4 x 7 Sgl Digit-LHDP	600	19 95
MAN 6680	Common Cathode-orange	560	99	5082-7304	Overrange character (±1)	600	15 00
MAN 6710	Common Anode-red-D.D	560	99	5082-7340	4 x 7 Sgl Digit-Hexadecimal	600	22.50

RCA LINEAR

CA3013T	2 15	CA3082N	2 00
CA2023T	2 56	CA3083N	1 60
CA3035T	2 48	CA3086N	85
CA3039T	1 35	CA3089N	3 75
CA3046N	1 30	CA3130T	1.39
CA3059N	3 25	CA3140T	1 25
CA3060N	3 25	CA3160T	1 25
CA3080T	.85	CA3401N	59
CA3081N	2.00	CA3600N	3 50

CALCULATOR CHIPS/DRIVERS

MM5725	$2 95
MM5738	2 95
DM8864	2 00
DM8865	1 00
DM8887	75
DM8889	75
9374 7 seg	
C A LED driver	1 50

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MM5309	$4 95
MM5311	4 95
MM5312	4 95
MM5314	4 95
MM5316	6 95
MM5318	9 95
MM5369	2 95
MM5387/1998A	4 95
CT 7001	6 95

MOTOROLA

MC1408L7	$4 95
MC1408L8	5 75
MC1439L	2 95
MC3022P	2 95
MC3061P	3 50
MC4016(74416)	7 50
MC4024P	3 95
MC4040P	6.95
MC4044P	4 50

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	1-24	25-49	50-100		1-24	25-49	50-100
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14 pin LP	20	19	18	24 pin LP	38	.37	36
16 pin LP	22	21	20	28 pin LP	45	44	.43
18 pin LP	29	28	27	36 pin LP	60	59	58
20 pin LP	34	32	30	40 pin LP	63	62	61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin ST	$ 27	25	24	28 pin ST	$ 99	90	81
16 pin ST	30	27	25	36 pin ST	1 39	1.26	1.15
18 pin ST	35	32	30	40 pin ST	1 59	1 45	1 30
24 pin ST	49	45	42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin SG	$ 30	27	24	24 pin SG	$ 70	.63	57
14 pin SG	35	32	29	28 pin SG	1 10	1.00	90
16 pin SG	38	35	32	36 pin SG	1 65	1.40	1.26
18 pin SG	52	47	43	40 pin SG	1 75	1.59	1.45

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	1-24	25-49	50-100		1-24	25-49	50-100
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10 pin WW	45	41	37	24 pin WW	1 05	.95	.85
14 pin WW	39	38	37	28 pin WW	1 40	1.25	1 10
16 pin WW	43	42	41	36 pin WW	1 59	1 45	1.30
18 pin WW	75	68	62	40 pin WW	1.75	1 55	1.40
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ASST. 3	5 ea	470 OHM, 1 2K	560 OHM, 1.5K	680 OHM, 1 8K	820 OHM, 2.2K	1K, 2.7K	50 PCS	1.75
ASST. 4	5 ea	3.3K, 8 2K	3.9K, 10K	4 7K, 12K	5 6K, 15K	6.8K, 18K	50 PCS	1.75
ASST. 5	5 ea	22K, 56K	27K, 68K	33K, 82K	39K, 100K	47K, 120K	50 PCS	1.75
ASST. 6	5 ea	150K, 390K	180K, 470K	220K, 560K	270K, 680K	330K, 820K	50 PCS	1.75
ASST. 7	5 ea	1M, 2.7M	1 2M, 3.3M	1 5M, 3 9M	1.8M, 4.7M	2.2M, 5 6M	50 PCS	1.75

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XR1488	1.95	XR2212	4.35	XR4739	1.15
XR1489	1.95	XR2240	3.45	XR4741	1.47

DIODES

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				1N4002	100 PIV	1 AMP	12/1.00
				1N4003	200 PIV	1 AMP	12/1 00
1N746	3 3	400m	4/1 00	1N4004	400 PIV	1 AMP	12/1 00
1N751	5 1	400m	4/1 00	1N4005	600 PIV	1 AMP	10/1 00
1N752	5 6	400m	4/1 00	1N4006	800 PIV	1 AMP	10/1 00
1N753	6 2	400m	4/1 00	1N4007	1000 PIV	1 AMP	10/1.00
1N754	6.8	400m	4/1 00	1N3600	50	200m	6/1 00
1N757	9 0	400m	4/1 00	1N4148	75	10m	15/1 00
1N759	12 0	400m	4/1 00	1N4154	35	10m	12/1.00
1N959	8 2	400m	4/1.00	1N4733	5 1	1w	28
1N965	15	400m	4/1 00	1N4734	5.6	1w	28
1N5232	5 6	500m	28	1N4735	6 2	1w	28
1N5234	6 2	500m	28	1N4736	6 8	1w	28
1N5235	6 8	500m	28	1N4738	8 2	1w	28
1N5236	7 5	500m	28	1N4742	12	1w	28
1N5242	12	500m	28	1N4744	15	1w	28
1N5245	15	500m	28	1N1183	50 PIV	35 AMP	1 60
1N456	25	40m	6/1 00	1N1184	100 PIV	35 AMP	1.70
1N458	150	7m	6/1 00	1N1185	150 PIV	35 AMP	1 70
1N485A	180	10m	5/1 00	1N1186	200 PIV	35 AMP	1 80
1N4001	50 PIV	1 AMP	12/1 00	1N1188	400 PIV	35 AMP	3 00

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MPSA06	5/1 00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1 00	2N3392	5/1.00	2N4013	3/1 00
TIS98	6/1 00	2N3398	5/1 00	2N4123	6/1 00
40409	1 75	PN3567	3/1.00	PN4249	4/1 00
40410	1 75	PN3568	4/1.00	PN4250	4/1 00
40673	1 75	PN3569	4/1 00	2N4400	4/1 00
2N918	4/1 00	MPS3638A	5/1.00	2N4401	4/1 00
2N2219A	2/1 00	MPS3702	5/1.00	2N4402	4/1 00
2N2221A	4/1 00	2N3704	5/1 00	2N4403	4/1 00
2N2222A	5/1 00	MPS3704	5/1 00	2N4409	5/1 00
PN2222 Plastic	7/1 00	2N3705	5/1.00	2N5086	4/1 00
2N2369A	4/1 00	MPS3705	5/1 00	2N5087	4/1 00
MPS2369	5/1 00	2N3706	5/1 00	2N5088	4/1 00
2N2484	4/1 00	MPS3706	5/1 00	2N5089	4/1 00
2N2906	4/1 00	2N3707	5/1.00	2N5129	5/1 00
2N2907	5/1 00	2N3711	5/1 00	PN5134	5/1 00
PN2907 Plastic	7/1 00	2N3724A	.65	PN5138	5/1 00
2N2925	5/1 00	2N3725A	1.00	2N5139	5/1 00
MJE2955	1 25	2N3772	2 25	2N5210	5/1 00
2N3053	2/1 00	2N3823	1.00	2N5449	3/1 00
		2N3903	5/1 00	2N5951	3/1 00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
10 pf	.05	04	03	001μF	05	04	035
22 pf	.05	04	03	0047μF	05	.04	035
47 pf	05	04	03	01μF	05	.04	035
100 pf	05	04	03	022μF	06	05	04
220 pf	05	04	.03	047μF	06	05	04
470 pf	05	04	.035	.1μF	12	.09	075

100 VOLT MYLAR FILM CAPACITORS

	1-9	10-99	100+		1-9	10-99	100+
001mf	12	10	07	022mf	13	11	08
0022	12	10	07	047mf	21	17	13
0047mf	.12	10	07	.1mf	27	23	17
01mf	.12	10	07	.22mf	33	27	22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

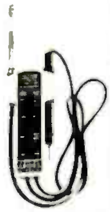
	1-9	10-99	100+		1-9	10-99	100+
1/35V	28	23	17	1 5/35V	.30	.26	.21
.15/35V	.28	23	.17	2.2/35V	.35	.31	.27
22/35V	28	23	17	3 3/25V	.35	.31	.27
33/35V	28	23	17	4.7/25V	.33	.28	.23
47/35V	28	23	17	6 8/25V	.49	.45	.35
68/35V	28	23	17	15/25V	.75	.68	.59
1 0/35V	28	23	17	22/6V	.75	.60	.50

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead	1-9	10-99	100+	Radial Lead	1-9	10-99	100+
.47/50V	15	13	.10	47/25V	15	13	.10
1 0/50V	16	14	11	47/50V	16	14	11
3.3/50V	14	12	09	1 0/16V	15	13	10
4 7/25V	15	13	10	1 0/25V	16	14	.11
10/25V	15	13	10	1 0/50V	16	14	11
10/50V	16	14	12	4 7/16V	15	13	10
22/25V	17	.15	12	4 7/25V	15	13	10
22/50V	24	.20	18	4 7/50V	16	14	11
47/25V	19	17	15	10/16V	14	12	09
47/50V	25	21	19	10/25V	15	13	10
100/25V	24	20	18	10/50V	16	14	12
100/50V	35	30	28	47/50V	24	21	19
220/25V	32	28	25	100/16V	19	15	14
220/50V	45	41	38	100/25V	24	20	18
470/25V	.33	.29	27	100/50V	35	30	28
1000/16V	55	.50	45	220/16V	23	17	16
2200/16V	70	62	55	470/25V	31	28	26

CIRCLE NO. 35 ON FREE INFORMATION CARD

ETCON AC/DC Voltage Tester



- High visibility voltage indicator 120, 208 to 240, 277, 440 to 600 VAC; 120, 240, 400, 600 VDC.
- Positive or negative DC pole identified by neon lamps.
- Provision for quick prod storage in case.
- Case serves as prod holder for one-hand operation. Self-extinguishing, high-impact case for long life.
- Continuous duty rated thru 480V.
- Dimensions: 4-9/16" x 2-1/16" x 7/8". Color: Orange.

VT200 .... **$12.95**

Custom Cables & Jumpers

NEW NEW

DB 25 Series Cables

Part No.	Cable Length	Connectors	Price
DB25P-4-P	4 Ft	2-DP25P	$15.95 ea.
DB25P-4-S	4 Ft	1-DP25P/1-25S	$16.95 ea.
DB25S-4-S	4 ft	2-DP25S	$17.95 ea

Dip Jumpers

DJ14-1	1 ft	1-14 Pin	$1.59 ea
DJ16-1	1 ft	1-16 Pin	1.79 ea
DJ24-1	1 ft	1-24 Pin	2.79 ea
DJ14-1-14	1 ft	2-14 Pin	2.79 ea
DJ16-1-16	1 ft	2-16 Pin	3.19 ea
DJ24-1-24	1 ft	2-24 Pin	4.95 ea

For Custom Cables & Jumpers, See JAMECO 1979 Catalog for Pricing

25 PIN-D SUBMINIATURE CONNECTORS

(Meets RS232)

PART NO.	DESCRIPTION	PRICE
DB25P	PLUG (as pictured)	$2.95
DB25S	SOCKET	3.50
DB51226-1	CABLE COVER for DB25P or DB25S	1.75
DB25P-831	PLUG – Right Angle – P.C. Mount	4.95
DB25S-831	SOCKET – Right Angle – P.C. Mount	5.25

Printed Circuit Connectors

.156 Spacing-Tin-Double Read-Out
Bifurcated Contacts
Fits .054 to .070 P.C. Boards

PART NO.	DESCRIPTION	PRICE
15/30 SE	15/30 Contacts – solder eyelet	$1.95
18/36 SE	18/36 Contacts – solder eyelet	2.49
22/44 SE	22/44 Contacts – solder eyelet	2.95
22/44 WW	22/44 Contacts – wire wrap	3.95
50/100 WW	50/100 Contacts – wire wrap (R681-1) (.125 Spacing)	6.95

Jumbo 6-Digit Clock Kit

- Four .630"ht. and two .300"ht. common anode displays
- Uses MM5314 clock chip
- Switches for hours, minutes and hold functions
- Hours easily viewable to 30 feet
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hour operation
- Includes all components, case and wall transformer
- Size: 6¾ x 3⅛ x 1¾

JE747 .... **$29.95**

- Bright .300 ht. comm. cathode display
- Uses MM5314 clock chip
- Switches for hours, minutes and hold modes
- Hrs. easily viewable to 20 ft.
- Simulated walnut case
- 115 VAC operation
- 12 or 24 hr. operation
- Incl. all components, case & wall transformer
- Size: 6¾" x 3-1/8" x 1¾"

JE701

6-Digit Clock Kit $19.95

Micro-Miniature Joystick

new

- 2 each 100K pots (Linear Taper)
- Printed Circuit Board Mount
- Size: 1" x 1-3/16" x 1-3/16"

Micro-Miniature Joystick **$4.95**

Digital Stopwatch Kit

- Use Intersil 7205 Chip
- Plated thru double-sided P.C. Board
- LED display (red)
- Times to 59 min. 59.59 sec. with auto reset
- Quartz crystal controlled
- Three stopwatches in one: single event, split (cummulative) & taylor (sequential timing)
- Uses 3 penlite batteries
- Size: 4.5" x 2.15" x .90"

JE900 $39.95

MICROPROCESSOR COMPONENTS

8080A/8080A SUPPORT DEVICES

8080A	CPU	$7.95
8212	8-Bit Input/Output	3.25
8214	Priority Interrupt Control	5.95
8216	Bi-Directional Bus Driver	3.49
8224	Clock Generator/Driver	3.95
8226	Bus Driver	3.49
8228	System Controller/Bus Driver	4.95
8238	System Controller	5.95
8251	Prog. Comm. I/O (USART)	7.95
8253	Prog. Interval Timer	14.95
8255	Prog. Periph. I/O (PPI)	9.95
8257	Prog. DMA Control	19.95
8259	Prog. Interrupt Control	19.95

6800/6800 SUPPORT DEVICES

MC6800	MPU	$14.95
MC6802CP	MPU with Clock and Ram	24.95
MC6810API	128x8 Static Ram	5.95
MC6821	Periph. Inter. Adapt (MC6820)	7.49
MC6828	Priority Interrupt Controller	12.95
MC6830L8	1024x8 Bit ROM (MC68A30-8)	14.95
MC6850	Asynchronous Comm. Adapter	7.95
MC6852	Synchronous Serial Data Adapt.	9.95
MC6860	0-600 bps Digital MODEM	12.95
MC6862	2400 bps Modulator	14.95
MC6880A	Quad 3-State Bus. Trans. (MC8T26)	2.25

MICROPROCESSOR CHIPS—MISCELLANEOUS

Z80(780C)	CPU	$14.95
Z80A(780-1)	CPU	16.95
COP1802	CPU	19.95
2650	MPU	19.95
6502	CPU	11.95
8035	8-Bit MPU w/clock, RAM, I/O lines	19.95
P8085	CPU	19.95
TMS9900JL	16-Bit MPU w/hardware, multiply & divide	49.95

SHIFT REGISTERS

MM500H	Dual 25 Bit Dynamic	$.50
MM503H	Dual 50 Bit Dynamic	.50
MM504H	Dual 16 Bit Static	.50
MM506H	Dual 100 Bit Static	.50
MM510H	Dual 64 Bit Accumulator	.50
MM5016H	500/512 Bit Dynamic	.89
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2522	Dual 132 Bit Static	2.95
2524	512 Static	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
3341	Fifo	6.95
74LS670	4X4 Register File (TriState)	2.49

UART'S

A-Y-5-1013	30K BAUD	5.95

MICROPROCESSOR MANUALS

M-Z80	User Manual	$7.50
M-CDP1802	User Manual	7.50
M-2650	User Manual	5.00

ROM'S

2513(2140)	Character Generator(upper case)	$9.95
2513(3021)	Character Generator(lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048 Bit Read Only Memory	1.95

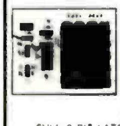
RAM'S

1101	256X1	Static	$1.49
1103	1024X1	Dynamic	.99
2101(8101)	256X4	Static	3.95
2102	1024X1	Static	1.75
21L02	1024X1	Static	1.95
2111(8111)	256X4	Static	3.95
2112	256X4	Static MOS	4.95
2114	1024X4	Static 450ns	7.95
2114L	1024X4	Static 450ns low power	10.95
2114-3	1024X4	Static 300ns	10.95
2114L-3	1024X4	Static 300ns low power	11.95
5101	256X4	Static	7.95
5280/2107	4096X1	Dynamic	4.95
7489	16X4	Static	1.75
74S200	256X1	Static Tristate	4.95
93421	256X1	Static	2.95
UPD414 (MK4027)	4K	Dynamic 16 pin	4.95
UPD416 (MK4116)	16K	Dynamic 16 pin 250ns	9.95
TMS4044-45NL	4K	Static	14.95
TMS4045	1024X4	Static	14.95
2117	16,384X1	Dynamic 350ns (house marked)	9.95
MM5262	2KX1	Dynamic	4/1.00

PROM'S

1702A	2048	FAMOS	$5.95
2716INTEL	16K*	EPROM	59.95
TMS2516 (2716)	16K*	EPROM	49.95
	*Requires single +5V power supply		
TMS2532	4KX8	EPROM	69.95
2708	8K	EPROM	10.95
2716 T.I.	16K**	EPROM	29.95
	**Requires 3 voltages, −5V, +5V, +12V		
5203	2048	FAMOS	14.95
6301-1(7611)	1024	Tristate Bipolar	3.49
6330-1(7602)	256	Open C Bipolar	2.95
82S23	32X8	Open Collector	3.95
82S115	4096	Bipolar	19.95
82S123	32X8	Tristate	3.95
74186	512	TTL Open Collector	9.95
74188	256	TTL Open Collector	3.95
74S287	1024	Static	2.95

JE600 HEXADECIMAL ENCODER KIT



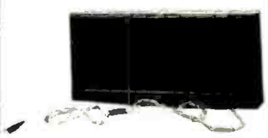
FEATURES:
- Full 8 bit latched output for micro-processor use
- 3 User Define keys with one being bi-stable operation
- Debounce circuit provided for all 19 keys
- LED readout to verify entries
- Easy interfacing with standard 16 pin IC connector
- Only +5VDC required for operations

FULL 8 BIT LATCHED OUTPUT—19 KEYBOARD

The JE600 Encoder Keyboard provides two separate hexadecimal digits produced from sequential key entries to allow direct programming for 8 bit microprocessor or 8 bit memory circuits. Three (3) additional keys are provided for user operations with one having a bistable output available. The outputs are latched and monitored with LED readouts. Also included is a key entry strobe.

JE600 .... **$59.95**
Hexadecimal Keypad only $14.95

DIGITAL THERMOMETER KIT



- Dual sensors—switching control for in-door/outdoor or dual monitoring
- Continuous LED .8" ht. display
- Range: -40°F to 199°F / -40°C to 100°C
- Accuracy: ±1° nominal
- Set for Fahrenheit or Celsius reading
- Sim. walnut case AC wall adapter incl.
- Size: 3-1/4" H x 6-5/8" W x 1-3/8" D

JE300 .... **$39.95**

62-Key ASCII Encoder Keyboard Kit

FEATURES:
- 60 Keys generate the full 128 characters, upper and lower case ASCII set
- Fully buffered
- 2 user-define keys provided for custom applications
- Caps lock for upper case only alpha characters
- Utilizes a 2376 (40 pin) encoder read only memory chip
- Outputs directly compatible with TTL/DTL or MOS logic arrays
- Easy interfacing with a 16-pin dip or 18-pin edge connector

The JE610 62-Key ASCII Encoder Keyboard Kit can be interfaced into most any computer system. The JE610 Kit comes complete with an industrial grade keyboard switch assembly (62 keys), IC's, sockets, connector, electronic components and a double-sided printed wiring board. The keyboard assembly requires +5V @ 150mA and −12V @ 10mA for operation.

JE610 .... **$79.95**
62-Key Keyboard only .. $34.95

REGULATED POWER SUPPLY

NEW

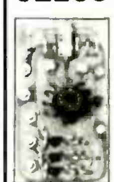
JE200 5V-1 AMP POWER SUPPLY

- Uses LM309K
- Heat sink provided
- PC Board construction
- Provides a solid 1 amp @ 5 volts
- Can supply up to ±5V, ±9V and ±12V with JE205 Adapter
- Includes components, hardware & instructions
- Size: 3½" x 5" x 2" H

JE200 $14.95

JE205 ADAPTER BOARD

– Adapts to JE200 –
±5V, ±9V and ±12V



- DC/DC converter w/ +5V input
- Toriodal hi-speed switching XMFR
- Short circ. protection
- PC Brd. construction
- Piggy-back to JE200 board
- Size: 3½" x 2" x 9/16" h

JE205 $12.95

$10.00 Min. Order – U.S. Funds Only
Calif. Residents Add 6% Sales Tax
Postage – Add 5% plus $1 Insurance (if desired)

Spec Sheets – 25¢
1980 Catalog Available – Send 41¢ stamp

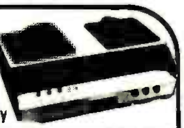
FREE 1980 CATALOG

Jameco ELECTRONICS

PHONE ORDERS WELCOME (415) 592-8097

MAIL ORDER ELECTRONICS – WORLDWIDE
1021 HOWARD AVENUE, SAN CARLOS, CA 94070
ADVERTISED PRICES GOOD THRU DECEMBER

The Incredible "Pennywhistle 103"



$139.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character)
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark.
Transmit Channel Frequencies	Switch selectable: Low (normal) = 1070 space, 1270 mark, High = 025 space, 2225 mark
Receive Sensitivity	46 dbm accoustically coupled
Transmit Level	−15 dbm nominal. Adjustable from −6 dbm to −20 dbm
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase, 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

TRS-80 16K Conversion Kit

Expand your 4K TRS-80 System to 16K.
Kit comes complete with:
- 8 each UPD416-1 (16K Dynamic Rams) 250NS
- Documentation for conversion

TRS-16K **$75.00**

OK JUST WRAP™

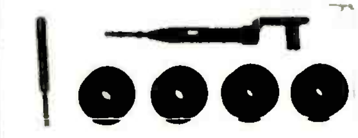
- 30 AWG wire
- .025" square posts
- Daisy chain or point-to-point
- Built-in cut off
- Includes 50 ft. wire
- No stripping or slitting required—just wrap

Part No.	Wire Color	Price
JW-1-B	Blue	$14.95
JW-1-W	White	14.95
JW-1-Y	Yellow	14.95
JW-1-R	Red	14.95

JUST WRAP™ Replacement Wire

Part No.	Color		Price
R-JW-B	Blue	50 ft. roll	$2.98
R-JW-W	White	50 ft. roll	2.98
R-JW-Y	Yellow	50 ft. roll	2.98
R-JW-R	Red	50 ft. roll	2.98

JUST WRAP™ Unwrap Tool $3.49



JUST WRAP™ Kit
- 50 ft. ea.: blue, white, red, yellow wire
- JUST WRAP Tool
- Unwrapping Tool

JWK-6 .... **$24.95**

OK Vacuum Vise

Vacuum-based light duty vise for small components and assemblies. ABS construction. 1½" jaws. 1¼" travel. Can be permanently installed.

VV-1 ...... **$3.49**

EPROM Erasing Lamp

- Erases 2708, 2716, 1702A, 5203Q, 5204Q, etc.
- Erases up to 4 chips within 20 minutes.
- Maintains constant exposure distance of one inch
- Special conductive foam liner eliminates static build-up
- Built-in safety lock to prevent UV exposure
- Compact – only 7-5/8" x 2-7/8" x 2"
- Complete with holding tray for 4 chips

UVS-11E **$69.95**

IDEAL FOR TRS 80 CASSETTE CONTROLLER

"Plug/Jack interface to any computer system requiring remote control of cassette functions"

The CC100 controls cassette motor functions, monitors tape location with its internal speaker and requires no power. Eliminates the plugging and unplugging of cables during computer loading operation from cassette.

#CC-100
$29.50

CIRCLE NO. 35 ON FREE INFORMATION CARD

WE'RE BACK WITH OUR WORLD FAMOUS INFLATION FIGHTIN' 'ONE CENTERS"

Only 2 FOR
$14.99 $15

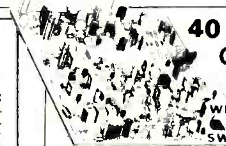
DIAL DESK TELEPHONE

Cat. No. 92CU5653

HY - GAIN ONE ARM BANDIT MIKES

Only $14.99 2 FOR $15

Take one hand command of your mobile or base rig with Hy-Gain's One Arm Bandit Mike. ON/OFF, VOLUME, SQUELCH, CHANNEL SELECTOR, SPEAKER, and DIGITAL DISPLAY are all conveniently located where your fingers do the talking. Comes with 6 ft. multi conductor, color-coded, coiled cable, (separate) for easy integration into any type of rig. Size: 4½" x 2½" x 1½". Wt. 9 oz. No. 92CU5886



40 CHANNEL CB BOARD

$12.50
WITH SWITCH 2 FOR $12.51

Poly Paks buys up factory close-out from Hy Gain so you gain! Boards have Heatsinked 9 Watt Amp Chip, RF and Mod Transistors, and Motorola MC series PLL. May be used for 10 meter conversion (see continuing series "CB to 10" in 73 magazine). The parts alone make it an offer you can't refuse. Wt. 9 oz. Cat. No. 92CU5554

LEDS! LEDS! LEDS!

YOUR CHOICE 5 for $1.29
1¢ SALE 10 for $1.30

Cat. No.	Type
1788	MICRO TOPHAT RED
1802	MICRO SINGLE PIN RED
1948	MICRO YELLOW
2135	JUMBO RED
2136	JUMBO TAPER RED
2137	MICRO RED
1944	Jumbo Yellow
2138	Jumbo Green

6 AMP EPOXY "BULLET" RECTIFIERS

Order by Cat. No. 92CU6095 and Voltage

PRV	PRICE	SALE
50	$.39	2 for .40
100	.49	2 for .50
200	.59	2 for .60
400	.69	2 for .70
600	.79	2 for .80
800	.99	2 for 1.00

25 AMP BRIDGE RECTIFIERS

PIV	SALE	2 FOR
☐ 25	1.25	1.26
☐ 50	1.95	1.96
☐ 100	2.25	2.26
☐ 200	2.95	2.96
☐ 400	3.50	3.51
☐ 600	4.25	4.26
☐ 800	4.95	4.96

Order No. 2273 & voltage

sorry, no choosing

ULTRASONIC TRANSDUCER

$3.98 2 for $3.99

Perfect for dozens of projects, including remote control devices, alarms, etc. Sends and Receives! 1" diameter, ¾" deep, with standard RCA type phono jack. Wt. 2 oz. Cat. No. 92CU5375

FANTASTIC? YOU BET IT IS! LOOK WHAT YOU GET FOR 1¢ MORE!

☐ 1-LASCR OPTO COUPLER, type H11C3, mini dip, (#5700)	1.29	2 for 1.30
☐ 3-LINE CORDS, 6 ft. 18 gauge, 2 cond. white w/plug, (#3787)	1.29	6 for 1.30
☐ 15-SINGLE PIN MICRO RED LEDS. 100% material, 3 volts @ 10 mils, (#5896)	1.29	30 for 1.30
☐ 40-FEEDTHRU CAPACITORS, used for hams, RF, UHF circuitry, (#5668)	1.29	80 for 1.30
☐ 40-PLASTIC TRANSISTORS, asst'd untested and hobby, (#2604A)	1.29	80 for 1.30
☐ 6-6V INDICATORS, w/leads, test lamp manufacturers excess, (#5893)	1.29	12 for 1.30
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Krohn-Hite model 430-A audio oscillator. Need instruction manual, schematic or any available information. J. Dunlap, 325 N. Ridgeland Ave., Oak Park, IL 60302.

Hickok model 4956 volt-ohmmeter. Need schematic and service manual. Lester Harlow, W6PSD, 5034 Mt. Gaywas Dr., San Diego, CA 92117.

Lavoie model LA260 scope with D-60 dual trace plug-in. Manual needed. J.C. Corliss, 2445 Vista Drive, Upland, CA 91786.

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Jeol model C-60 1970 spectrometer. Need schematic, operation manual and parts list. J. Simon, Box 123, Midwood Station, Brooklyn, NY 11250.

Clare-Pender I.D. #97564 keyboard. Need schematic and pin hook-up connections. Jim Jamison, Rt. 6, 2304 Tucker Lane N.E., Northfort Myers, FL 33903.

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Stromberg-Carlson 7 tube superheterodyne table model. Need schematic. W. Stanier, 725 Langside St., Apt. #8, Winnipeg, Manitoba, Can. R3B 2V1.

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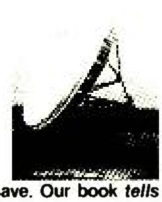

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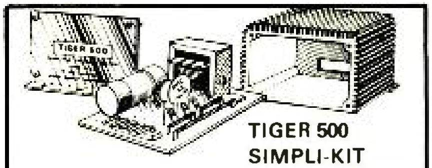

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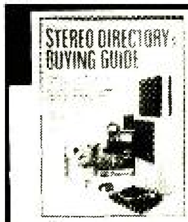

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ELECTRONICS WORLD

Personal Electronics News

● Electronic game purchases will increase 22% per annum through 1983, according to a forecast made in a "Home and Coin-Operated Electronic Games" study by Frost & Sullivan, Inc., New York City. The $518-million market in 1978 is expected to jump to $802 million this year and increase to $1.4 billion within five years. The submarkets to generate the greatest growth will include programmable-games cartridges (539%), programmable-games consoles (178%), and nonvideo electronic games (159%).

● Videotaping from TV is legal for noncommercial use. This was the decision handed down by a judge in a ruling against Universal Studios and Walt Disney Studios in their suit against Sony Corp., maker of the Betamax recorder, to stop viewers from taping movies off the airwaves. The decision is expected to be appealed.

● A patent for a reversing 8-track cartridge has been granted to K. Rey Smith, President of KRS Magnetics, Los Altos, CA. The company's REV8 cartridge's ability to rewind is expected to set a standard in the cartridge tape market. List prices for the 45- and 90-minute REV8 cartridges are $4.50 and $5.00, respectively.

● U.S. color-TV receiver production rose 3.7% during the second quarter of 1979, while imports dropped 83.9%, according to an International Trade Commission study. The bad news is that prices were also up, ranging from 3.8% to 8%, depending on screen size. Decline in imports was most pronounced in 18" and larger screen receivers.

● REACT is in the red, which may seriously curtail answering CB and traffic highway emergency services unless a nationwide appeal for funds is successful. The CB emergency organization whose income is derived from members and private contributions, is expected to fall almost 20% short of that needed to meet minimum operating expenses. Tax-deductible contributions to the nonprofit organization can be sent to: Emergency Fund, REACT International, Inc., 75 E. Wacker Dr., Chicago, IL 60601.

● Data processing jobs skyrocket, according to a Fox-Morris Personnel Consultants study. Demand for applications programmers jumped 41% over 1978 levels, software programmers grew 35.1%, and system analysts rose 28.9%. Salaries were up, too--ranging from 5.2% to 29% higher, depending on job category. Greatest increase was in the Midwest. Entry-level scientific programmers are being offered starting salaries as high as $19,300.

● Heath sold to Zenith Radio for $64.5-million. A Zenith Data Systems division has been set up to market fully-assembled Heath personal computers through computer retail stores, OEMs, chain stores, as well as Heathkit Electronic Centers and Heath's mail-order catalog. Heath, operated as a wholly-owned Zenith subsidiary, will continue to sell computer and other electronic kits. Manufacturing and service will continue to be handled by Heath.

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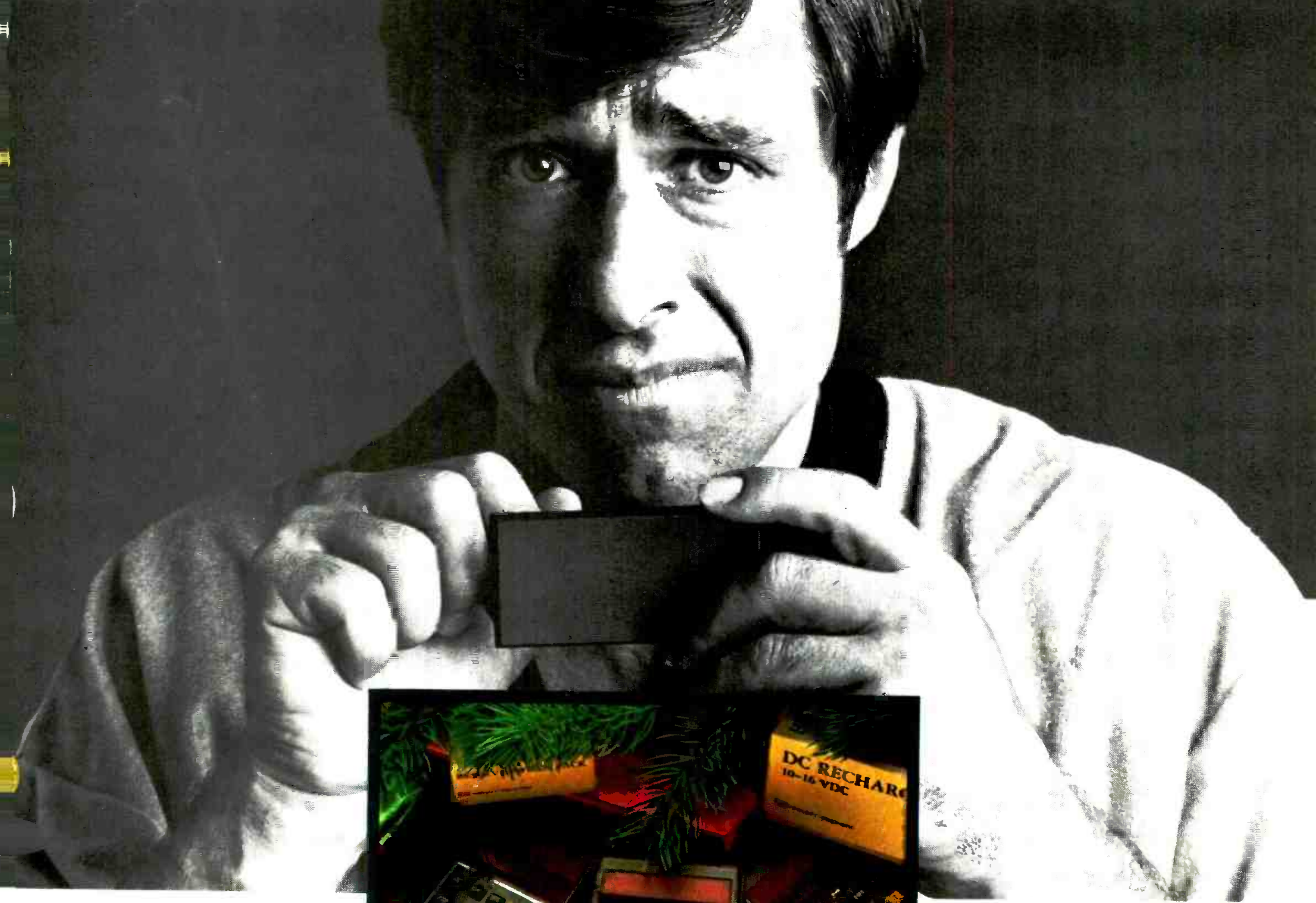

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