SPECIAL FM TUNERS BUYERS GUIDE

$1.00 ■ OCT. 1978

Radio-Electronics

34140 IND

THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

COVER STORY

FUNCTION GENERATOR

Sine, square and triangular waveforms from 2 Hz to over 200 kHz plus external sweep mode makes this a great addition to your workbench. Turn to page 37.

BURGLAR ALARM

Protect your home and family with this feature-packed perimeter alarm. Construction starts on page 41.

FREQUENCY PROBE

Using special construction techniques, a complete frequency counter built into a probe. Story starts on page 67.

CASES AND CABINETS

Save these handy charts and use them to select the best enclosure for your next project. Turn to page 45.

VIDEO RECORDERS

Buying, installing and using VTR's. What you should know starts on page 60.

PLUS

- ★ R-E Tests
  Marantz 2265B AM/FM Receiver
- ★ R-E Tests
  Shure SME 3009-III Pickup Arm
- ★ Prototype Module System
- ★ CET Test
- ★ Computer Corner
- ★ Hobby Corner
- ★ Service Clinic
- ★ State Of Solid State

A GERNSBACK PUBLICATION

Yesterday you could admire LED digital tuning in short wave.*

Today you can afford it.

Introducing Panasonic's Command Series™ top-of-the-line RF-4800. Everything you want in short wave. Except the price. Like a five-digit LED frequency display. It's so accurate (within 1 kHz, to be exact), you can tune in a station, even before it's broadcasting. And with the RF-4800's eight short wave bands, you can choose any broadcast between 1.6 and 31 MHz. That's the full frequency range. That's Panasonic.

And what you see on the outside is just a small part of what Panasonic gives you inside. There's a double superheterodyne system for enhanced reception stability and selectivity as well as image rejection. An input-tuned RF amplifier with a 3-ganged variable tuning capacitor for exceptional sensitivity and frequency linearity. Ladder-type ceramic filters to reduce frequency interference. And even an antenna trimmer that changes the front-end capacitance for maximum reception from minimal broadcast signals.

To help you control all that sophisticated circuitry, Panasonic's RF-4800 gives you all these sophisticated controls. Like an all-gear-drive tuning control to prevent "backlash." Separate wide/narrow bandwidth selectors for optimum reception even in crowded conditions. Adjustable calibration for easy tuning to exact frequencies. A BFO pitch control. RF-gain control for increased selectivity in busy signal areas. An ANL switch. Even separate bass and treble controls.

And if all that short wave isn't enough. There's more. Like SSB (single sideband) amateur radio. All 40 CB channels. Ship to shore. Even Morse communications. AC/DC operation. And with Panasonic's 4" full-range speaker, the big sound of AM and FM will really sound big.

The RF-4800. If you had a short wave receiver as good. You wouldn't still be reading. You'd be listening.

*The ability to receive short wave broadcasts will vary with antenna size, time of day, operator's geographic location and other factors. You may need an optional outside antenna to receive distant short wave broadcasts.

Panasonic.
just slightly ahead of our time.

CIRCLE 58 ON FREE INFORMATION CARD

LCD Alarm Chronograph

The accuracy of the Greenwich observatory... with greater split-second precision than the finest Swiss stopwatch...plus the convenience of a 24-hour alarm and personal reminder system.

This new LCD Alarm Chronograph is truly extraordinary. It does more and does it better than any other watch. With a bold, impressive appearance that reflects its uncommon ability.

An Extraordinary Value

The only thing about it that's not extravagant is its price. It's actually $200.00 *less* than the only watch that comes even close to its usefulness and accuracy.

Quartz Crystal Time . . . The LCD Alarm Chronograph gives you accuracy to ± 60 seconds a year. Quartz crystal accuracy that would have been considered sensational *per month* in earlier micro-electronic watches. And is still not available in models selling for as much as $500.00 and $1000.00.

Electronic Calendar . . . So, you always have exactly the right time on display. In hours, minutes and running seconds. Without pushing a button. Touch the button and the seconds are replaced with either the day or the date. Of course, the electronic calendar adjusts automatically for the number of days in the month. Then, so you can see when it's dim or you're in the dark, the face lights up.

24 Hour Alarm

Of all the features available in digital watches today, an alarm system like this is the one that's most wanted. And no wonder. It will wake you; remind you of your appointments, phone calls and meetings (or break one up that's been going on too long). It's really important enough all by itself to warrant your getting a new watch.

You can set this alarm for any minute of any hour. Day or night. In all, 1440 positions are available — easily and instantly. Then, unless you change or deactivate it, the alarm will sound for a full minute at the same time every

Set to ring at 11:45 P.M.

day. With an insistent, though pleasant, beep. To check if the alarm is set and for what time, just touch the alarm button.

Most remarkable of all, on this direct-by-mail offer from Douglas Dunhill, it's like getting the alarm free!

Three Different Chronographs

As to the chronograph, or split-second timer, its precision is so fine, it borders on the infinitesimal. Imagine, it enables you to time an event to one-hundredth of a second. Any event. Because unlike most chronographs, which work in either one or at most two ways, this one stops time — as explained to the far right — in three different ways. This extraordinary versatility makes the LCD Chronograph with its highly sophisticated micro-computer chip the ideal instrument for doctors, pilots, motion picture directors and photographers, sound and efficiency engineers, sportsmen of course, and every executive who wants the ability to command time to stand still.

Only $100

Right now, the only other watch with all these features is the Seiko. And it regularly sells for $299.95. Over two hundred dollars more — even though its chronograph is accurate to only a tenth of a second.

This incomparable value is what convinced us. And we're one of the oldest and largest mail merchandisers in America. (Of course, only after exhaustive quality control tests.) After all, what would you say to a salesman in a store about a price comparison like this? Never mind your reaction when he tried to explain that this was a finer, more accurate fully electronic solid state watch than many that sell for as much as $1000.00.

30 Day Trial

With us, buying by mail, you can prove all this to your own satisfaction without risking one cent. You have thirty days to put it to the test:— to confirm it won't gain or lose five seconds a month, prove the convenience of the alarm, satisfy yourself that the chronograph is as useful as it is easy to operate. More, to compare it with any watch at any price, and to send it back for a complete refund if the value is not as great as we say, if it doesn't arouse the admiration and fascination of your friends, win your own pleasure and satisfaction.

Chrome or Gold Plated

So, order your LCD Alarm Chronograph today. The price, including shipping, handling, insurance and a handsome gift case is just **$100.00**. In chrome- or gold-plated stainless steel with a matching, extremely comfortable adjustable band, the LCD Alarm Chronograph comes with a full ONE YEAR Limited Warranty. We also promise to service it to your satisfaction at any time. Remember, too, the printed circuitry eliminates all moving parts and normal servicing, and assures you of years of trouble-free performance.

800-325-6400 OPERATOR #07
(Missouri residents call 800-342-6600)

To order by credit card, call the toll free number above. Send your check to Douglas Dunhill at the address below. (New York and Illinois residents add the appropriate sales tax.)

Three-Way Chronograph System

No other instrument, at any price, gives you greater precision than the 1/100th of a second accuracy of the new LCD Alarm Chronograph; or greater versatility and flexibility in timing an event from a fraction of a second to one full hour. Only with the micro-electronic revolution could you have three separate chronographs in one sleek, superbly styled timepiece.

Timed to 54 minutes and 14.85 seconds

#1 Add Time . . . is the stop watch mode. You'll use it to time everything from a phone call to the length of a meeting. How long your car's been at a parking meter, the time you've been jogging or exercising, even the time it takes a quarterback to set up and throw. With Add Time, you can stop when necessary, like a time out in basketball, and start again when the action begins. Try it the next time you prepare a speech.

#2 Split Time . . . is the mode you'll use to get the time of each contestant across the finish line, or to get the time for the ¼ or the ½ or any interim. On Split Time the chronograph is actually stopped and running at the same time, so you can use it to figure the time of a pit stop, for example, and still get the over-all time of the race.

#3 Lap Time . . . is used in a relay race, for example. It stops to measure an event and simultaneously starts again from zero. So, the instant a runner passes the baton you stop the chronograph; this gives you his time while the Lap Timer automatically starts counting the next runner's time. Any event can be split into its component parts this way, from a rocket launch to a production process. In a football game you can get the exact time it takes a punter to kick the ball, the time the ball's in the air, the time of the runback. With Lap Time, you can separate the time of elements that cannot be separated in any other way.

Within minutes, you'll be able to master each of these 3 modes. In days, find innumerable business and personal uses. Take 30 days to prove it to yourself.

Be sure to specify chrome or gold. You'll have the precise time, absolute control over time, plus ample warning when it's time to do anything. And the pride that comes with wearing a watch that's second to none.

DOUGLAS DUNHILL INC.
AFFORDABLE QUALITY

Dept. 80-5302
4225 Frontage Road • Oak Forest, IL 60452

CIRCLE 89 ON FREE INFORMATION CARD

Burglar Alarm Breakthrough

A new computerized burglar alarm requires no installation and protects your home or business like a thousand dollar professional system.

The Midex security computer looks like a handsome stereo system component and measures only 4"x 10½"x 7."

It's a security system computer. You can now protect everything—windows, doors, walls, ceilings and floors with a near fail-safe system so advanced that it doesn't require installation.

The Midex 55 is a new motion-sensing computer. Switch it on and you place a harmless invisible energy beam through more than 5,000 cubic feet in your home. Whenever this beam detects motion, it sends a signal to the computer which interprets the cause of the motion and triggers an extremely loud alarm.

The system's alarm is so loud that it can cause pain—loud enough to drive an intruder out of your home before anything is stolen or destroyed and loud enough to alert neighbors to call the police.

The powerful optional blast horns can also be placed outside your home or office to warn your neighbors.

Unlike the complex and expensive commercial alarms that require sensors wired into every door or window, the Midex requires no sensors nor any other additional equipment other than your stereo speakers or an optional pair of blast horns. Its beam actually penetrates walls to set up an electronic barrier against intrusion.

NO MORE FALSE ALARMS

The Midex is not triggered by noise, sound, temperature or humidity—just motion—and since a computer interprets the nature of the motion, the chances of a false alarm are very remote.

An experienced burglar can disarm an expensive security system or break into a home or office through a wall. Using a Midex system there is no way a burglar can penetrate the protection beam without triggering the loud alarm. Even if the burglar cuts off your power, the four-hour rechargeable battery pack will keep your unit triggered, ready to sense motion and sound an alarm.

DEFENSE AGAINST PEEPING TOMS

By pointing your unit towards the outdoors from your bedroom and installing an outside speaker, light, or alarm, your unit can sense a peeping Tom and frighten him off. Pets are no problem for the Midex. Simply put them in one section of the house and concentrate the beam in another.

When the Midex senses an intruder, it remains silent for 20 seconds. It then sounds the alarm until the burglar leaves. One minute after the burglar leaves, the alarm shuts off and resets, once again ready to do its job. This shut-off feature, not found on many expensive systems, means that your alarm won't go wailing all night long while you're away. When your neighbors hear it, they'll know positively that there's trouble.

PROFESSIONAL SYSTEM

Midex is portable so it can be placed anywhere in your home. You simply connect it to your stereo speakers or attach the two optional blast horns.

Operating the Midex is as easy as its installation. To arm the unit, you remove a specially coded key. You now have 30 seconds to leave your premises. When you return, you enter and insert your key to disarm the unit. You have 20 seconds to do that. Each key is registered with Midex, and that number is kept in their vault should you ever need a duplicate. Three keys are supplied with each unit.

As an extra security measure, you can leave your unit on at night and place an optional panic button by your bed. But with all its optional features, the Midex system is complete, designed to protect you, your home and property just as it arrives in its wellprotected carton.

The Midex 55 system is the latest electronic breakthrough by Solfan Systems, Inc.—a company that specializes in sophisticated professional security systems for banks and high security areas. JS&A first became acquainted with Midex after we were burglarized. At the time we owned an excellent security system, but the burglars went through a wall that could not have been protected by sensors. We then installed over $5,000 worth of the Midex commercial equipment in our warehouse. When Solfan Systems announced their intentions to market their units to consumers, we immediately offered our services.

COMPARED AGAINST OTHERS

In a recent issue of a leading consumer publication, there was a complete article written on the tests given security devices which were purchased in New York. The Midex 55 is not available in New York stores, but had it been compared, it would have been rated tops in space protection and protection against false alarms—two of the top criteria used to evaluate these systems. Don't be confused. There is no system under $1,000 that provides you with the same protection.

YOU JUDGE THE QUALITY

Will the Midex system ever fail? No product is perfect, but judge for yourself. All components used in the Midex system are of aerospace quality and of such high reliability that they pass the military standard 883 for thermal shock and burn-in. In short, they go through the same rugged tests and controls used on components in manned spaceships.

Each component is first tested at extreme tolerances and then retested after assembly. The entire system is then put under full electrical loads at 150 degrees Fahrenheit for an entire week. If there is a defect, these tests will cause it to surface.

PEOPLE LIKE THE SYSTEM

Wally Schirra, a scientist and former astronaut, says this about the Midex 55. "I know of no system that is as easy to use and provides such solid protection to the homeowner as the Midex. I would strongly recommend it to anyone. I am more than pleased with my unit."

Many more people can attest to the quality of this system, but the true test is how it performs in your home or office. That is why we provide a one month trial period. We give you the opportunity to see how fail-safe and easy to operate the Midex system is and how thoroughly it protects you and your loved ones.

Use the Midex for protection while you sleep and to protect your home while you're away or on vacation. Then after 30 days, if you're not convinced that the Midex is nearly fail-safe, easy to use, and can provide you with a security system that you can trust, return your unit and we'll be happy to send you a prompt and courteous refund. There is absolutely no obligation. JS&A has been serving the consumer for over a decade—further assurance that your investment is well protected.

To order your system, simply send your check in the amount of **$199.95** (Illinois residents add 5% sales tax) to the address shown below. Credit card buyers may call our toll-free number below. There are no postage and handling charges. By return mail you will receive your system complete with all connections, easy to understand instructions and a one year limited warranty. If you do not have stereo speakers, you may order the optional blast horns at **$39.95** each, and we recommend the purchase of two.

With the Midex 55, JS&A brings you: 1) A system built with such high quality that it complies with the same strict government standards used in the space program, 2) A system so advanced that it uses a computer to determine unauthorized entry, and 3) A way to buy the system, in complete confidence, without even being penalized for postage and handling charges if it's not exactly what you want. We couldn't provide you with a better opportunity to own a security system than right now.

Space-age technology has produced the ultimate personal security computer. Order your Midex 55 at no obligation, today.

Radio-Electronics®

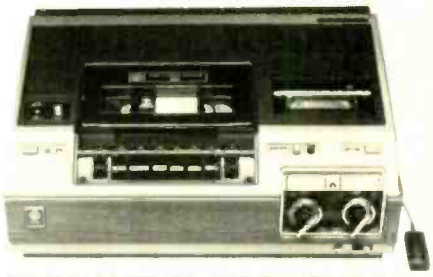
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

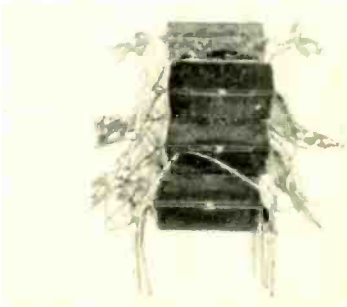
OCTOBER 1978 Vol. 49 No. 10

ON THE COVER

Compact function generator has a place on every readers bench. It delivers sine, square and triangle waves with minimal distortion. Build your unit from the details in this issue. The article starts on page 37.



VIDEOCASSETTE RECORDERS ARE IN. This Q & A story answers typical user questions about this exciting new consumer electronics product. For all the answers, fast-forward to page 62



KEEP IC PROJECTS SMALL. It's easy to do once you know the basics. This month's Hobby Corner tells all. Turn to page 80 now.

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looking ahead

U.S. VCR plant? Home videocassette recorders are now available in the United States under 15 different brand names, including those of the top American TV set manufacturers. And every blessed one of them is made in Japan. So now, with the American home VCR market on the brink of a major explosion, one company says it's going to start home VCR production in California in 1979 or 1980 for sale in the United States and throughout the world. An American company? No. A Japanese company? No. It's BASF Systems, a subsidiary of the German electronics and chemical giant, which plans to produce a lightweight, battery-operated home VCR which isn't compatible with either current format (Beta or VHS).

The new recorder will be pushed as the "8mm video recorder." It's the system which has been known as LVR (longitudinal video recording) and was described in an eyewitness report from Berlin in this column last December. It uses an extremely compact single-reel cassette with only one precision part, containing 8-mm-wide tape (just under one-third inch) which passes a fixed head at 160 ips. The narrow tape contains 48 longitudinal video tracks and 96 audio tracks, changes direction and switches tracks 47 times for 2 hours of recording time (each pass across the head takes 2½ minutes). BASF sees its initial VCR weighing about 10 pounds, envisions a future unit built into a CCD color camera.

In addition to portability, BASF sees these advantages for its system: (1) Low cost and simplicity because it uses a single fixed head. (2) Rapid duplication of pre-recorded material, since all tracks may be laid down in one pass, in effect recording at 1/48 of real time. (3) Easy adaptibility to digital recording. On this latter point, a BASF official indicated a digital version could be the second generation, and therefore the company isn't seriously considering the use of metal tape.

New color TV's: Higher-resolution large-screen picture tubes, increased use of electronic tuning and remote control, more microprocessor circuitry—those are among major trends in the 1979 TV models. Magnavox gets credit for introducing what appears to be the only completely new feature. Included in 19- and 25-inch sets with the *Computer Color 330* chassis is a comb filter system which Magnavox says has never before been used in home color TV receivers. By using this system to prevent interference between chrominance and luminance signals, Magnavox says it has increased resolution by 25%, from 260 to 330 lines horizontally, and also has gotten rid of crawling dots and swirly red patterns in scenes with vertically striped objects. Magnavox's *Computer Color 330* sets have filter switches, which make it easy for dealers to demonstrate this feature—and at the demonstration I viewed, at least, it was an impressive feature.

Slot-mask picture tubes with in-line guns, which now have completely taken over the below-19-inch field, have finally come to the large-screen area in the United States. Most of them are 100-degree tubes with tri-potential guns designed to achieve a small spot size, as pioneered by Zenith and later adopted by Sylvania. The new large-screen 100-degree tubes are featured in sets under the brand names of Admiral, Magnavox, Montgomery Ward, Quasar, Panasonic and Zenith.

Every TV brand now uses at least two different electronic tuning systems. Almost all employ the single-knob approach in the mid-cost range of their products, moving to the random-access calculator-type keyboard or simple up-down channel-scan buttons at the higher end. There's some indication that AFT (or AFC, if you prefer) may be on the way out. Several brands use frequency synthesizers, quartz crystal control or microprocessors to eliminate fine tuning altogether. Some microprocessor signal-searching sets automatically tune once to every occupied station in the area, then "remember" the frequency.

Vertical interval reference (VIR) color systems have been adopted by more manufacturers. Originally developed by General Electric, the tuning system—including new versions using chips by Matsushita and Sanyo—can now be found in sets by Panasonic, Quasar, J.C. Penney, Sanyo and Sylvania. Most of them have conventional auto-color tracking circuits designed to take over and assure color consistency in the absence of a VIR signal.

Toshiba has introduced a programmable 21-inch color console, which permits the logging of a day's viewing up to 16 shows in advance. The set switches on, changes channels and switches off automatically. The receiver may also be programmed to repeat eight program selections daily. This isn't quite a first on the American market—Heath has a programmable set.

Electronic photography: The 3,400-outlet Fotomat chain, whose entire business is based upon the nation's photographic hobby, sees electronics practically wiping out the reason for its existence in the next decade or so. Instead of trying to lick the electronic monster, it's decided to join the revolution. That may be an oversimplification, but Fotomat Chairman Richard Irwin says he expects to see the introduction of a combination color TV camera and video recorder in the next five years, probably killing home film movies and possibly still photography as well. With this frank forecast, Fotomat announced its entry into the video business—it will sell blank cassettes, prerecorded cassette programming and will transfer home movies and slides to cassette. Fotomat's 8mm-to-cassette prices are about half those of its competitors—$8.75 for eight 50-foot reels, plus the cost of the cassette, additional 50-foot reels transferred for 50 cents each. Fotomat has installed automatic equipment, will transfer film to tape on an assembly-line basis, with automatic color correction and compensation for incorrect exposure.

The largest previous entry into the field, S/T Tape Duplication Co., a Sony affiliate, said it welcomed Fotomat into the field. S/T pointed out that all of its transfers were custom jobs, as befits the nature of valuable "family archive" home-movie footage. S/T forecast the field would settle down to two different price and quality levels, "just as Kodak film processing generally costs about twice as much as what you get in the supermarket or by mail-order."

DAVE LACHENBRUCH
CONTRIBUTING EDITOR

Totally Integrated, Entirely Self-Contained

THE PET™
PERSONAL COMPUTER

With technology so advanced,
Concept so remarkable,
Operation so utterly simple,
Cost so incredibly low.
The PET has given rise to a brand new era...
The Age of the Personal Computer

HIGH SPEED PRINTER ACCESSORY

FEATURING AN IEEE-488 BUS

Immediate Delivery

THE PET has become the standard for the personal computer industry. Consumer and business publications have lauded its discovery. POPULAR SCIENCE and PLAYBOY have given special tribute to the "mind-boggling" PET.

IN A LEAGUE WITH IBM, HP AND WANG MINICOMPUTERS

THE PET is a minicomputer and should not be confused with game products that hook up to household T.V.'s. **What sets it apart from other computers is price. While others cost from $11,000 to $20,000 and more, THE PET, with similar power, costs only $795.00.**

Features an IEEE-488 Bus - like HP's mini and full size computers. This standard data and control channel permits direct connection to many peripherals. Over 120 pieces of compatible equipment such as counters, timers, spectrum analyzers, digital voltmeters and printer plotters, from HP, Phillips, Fluke, and Textronix, etc., are currently available.

ROM Magazine, January 1978, writes, "THE PET comes out of the box, plugs into the wall, and is ready to use." It is equipped with a CRT video display with reverse and blink features, an alpha-numeric keyboard with complete graphics and a built-in standard cassette tape deck.

THE PET has 8K bytes of RAM (user memory). Optional equipment permits expansion to 32K. And, it has 14K bytes of ROM (program memory).

THE PET COMMUNICATES IN BASIC. THE EASIEST COMPUTER LANGUAGE

If THE PET wants you to press a key, it will flash, "Press such and such", on the display. You speak back to it through its full size 73-key keyboard.

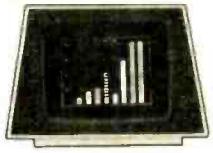
EXTENSIVE CHARACTER ORIENTED GRAPHICS

The unit features a 9-inch, high resolution, 1000 character CRT. Characters are arranged 40 columns by 25 lines on an 8 x 8 matrix for superb graphics.

WHAT IS THE PET REALLY FOR?

It is the single most important teaching device for any computer related subject. It will entertain the most sophisticated data application, or the simplest inquiry/response assignment. **IN THE LAB** it handles instrumentation, process monitoring, and more. A number of Fortune 500 companies have already made it an integral part of their lab and general office system.

As a **BUSINESS TOOL** it will; Maintain ledgers. Keep payroll records. Create P & L's. Control inventory. Store and analyze sales data. Draw bar graphs. Issue invoices. Hook up to on-line computer system. **AT-HOME** it will; Compute state and federal tax returns. Make heat and insulation analyses. Keep Christmas lists. Keep checkbook and finances up to date. A variety of games, from Blackjack to Galaxy, is currently available.


Bar Graphs


Teaching Trigonometry


Black Jack


Amortization Chart

HIGH SPEED PET PRINTER

This powerful word processor prints hardcopies, invoices, computer correspondence. Faster than an IBM Selectric, THE PET Printer delivers 60 characters per second at a sustained rate - with upper and lower case capability. Characters are one-eighth inch tall and are printed in a 7 x 8 dot matrix. The printer uses a standard 8½" wide paper roll. And, it is only $695.00.

PERIPHERAL SECOND CASSETTE

This optional component expands storage and increases flexibility. Only $99.95.

MILES OF SOFTWARE

Many programs are available now, including, "BASIC BASIC" which shows how to write a program. You can develop your own programs to meet personal requirements.

GAME PROGRAMS ARE $9.95 EACH:

☐ Black Jack ☐ Draw Poker ☐ Galaxy Games
☐ Space Flight ☐ Target Bong, Off-The-Wall
☐ Lunar Lander, Wumpus, Rotate, Tic-Tac-Toe
☐ Osero, Reverse ☐ Spacetrek ☐ Kingdom

PROGRAMS AT $14.95 EACH:

☐ Mortgage Analysis
☐ Diet Planner and Biorhythm
☐ Basic Basic-by Lodewyck and James

PROGRAMS AT $24.95 EACH:

☐ **Basic Investment Analysis**-loans, annuities, return on regular and irregular sequences of payments, calendar calculations
☐ **Stock Portfolio Recordkeeping and Analysis**-keeps track of buys, sells, and dividends. Calculates current value, rates of return
☐ **Checkbook Recordkeeping and Analysis**-keeps track of checks and deposits. Analyzes expenses by date and type

PROGRAMS AT $29.95 EACH:

☐ **Basic Math Package**-matrix addition, multiplication, determinants and inverses to 16 x 16, solution of simultaneous linear equations, vector and plane geometry calculations, integraton by trapezoidal, Simpson's rule or Gaussian quadrature, differentiation
☐ **Basic Statistics Package**-mean, median, variance, standard deviation, skewness, kurtosis, frequency distribution, linear regression, T-tests, correlation analyses

FREE ORIENTATION PACKAGE

Your PET comes complete with two programs and an easy-to-follow instruction manual. By working through the routines you will quickly discover how easy it is to gain command of your personal computer.

SERVICE WORLDWIDE

Because your PET is self-contained and compact, professional factory service is never far away. If major service is required, the unit can simply be returned by UPS to an authorized Commodore PET clinic.

To order your PET send check or money order for $795.00 plus $20.00 for shipping and insurance. To order the PET Printer, add $695.00 plus $12.00 for shipping and insurance. The Second Cassette is $99.95. No shipping and insurance charges are required when ordering a second cassette or programs with your PET. Credit card orders are invited to call our toll free number below. Orders will be accepted on our TELEX, No. 25-5268.

Use THE PET for 30 days with no obligation. If, for any reason, you are not satisfied, return it for a prompt and courteous refund.

ORDER DIRECT

CREDIT CARD ORDERS CALL TOLL FREE

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ILLINOIS RESIDENTS CALL: 312-595-0461
TELEX ORDERS: 25-5268

Order your PET, Printer Accessory, Second Cassette and Programs from Contemporary Marketing at:

790 MAPLE LANE DEPT RE-10
BENSENVILLE, ILLINOIS 60106

Contemporary Marketing Inc.
©CMI 1978185

TECHNICAL SPECIFICATIONS

MEMORY
Random Access Memory (user memory): 8K internal, expandable to 32K bytes
Read Only Memory (operating system resident in the computer); 14K bytes
8K-BASIC interpreter program, 4K-Operating system, 1K-Diagnostic routine

VIDEO DISPLAY UNIT
9" enclosed, black & white, high resolution CRT
1000 character display, arranged 40 columns by 25 lines
8 x 8 dot matrix for characters and continuous graphics
Automatic scrolling from bottom of screen
Winking cursor with full motion control
Reverse field on all characters
64 standard ASCII characters; 64 graphic characters

KEYBOARD
9½" wide x 3" deep; 73 keys
All 64 ASCII characters available without shift. Calculator style numeric key pad
All 64 graphic and reverse field characters accessible from keyboard (with shift)
Screen Control: Clear and erase
Editing: Character insertion and deletion

CASSETTE STORAGE
Fast Commodore designed redundant-recording scheme, assuring reliable data recovery
Cassette drive modified by Commodore for much higher reliability of recording and record retention
High noise immunity, error detection, and correction
Uses standard audio cassette tapes
Tape files, named

OPERATING SYSTEM
Supports multiple languages (BASIC resident)
Machine language accessibility
File management in operating system
Cursor control, reverse field, and graphics under simple BASIC control
Cassette file management from BASIC
True random number generation or pseudo random sequence

INPUT/OUTPUT
All other I/O supported through IEEE-488 instrument interface for peripherals
I/O automatically managed by operating system software
Single character I/O with GET command
Easy screen line-edit capability
Flexible I/O structure for BASIC expansion with peripherals

BASIC INTERPRETER
8K BASIC; 20% faster than most other 8K BASICS
Upward expansion from BASIC language
Strings, integers, multiple dimension arrays
10 significant digits; floating point
Direct memory access: PEEK and POKE commands

DIMENSIONS
16" wide; 18½" deep; 14" high. Weight: 44 lbs.

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Five broadcasters receive Marconi Gold Medal awards

The Veteran Wireless Operators Association (VWOA) recently presented Marconi Memorial Gold Medals to five men in honor of their efforts on behalf of the field of electronic communications.

The five Marconi Medal recipients were: John T. Wilner, M. Harvey Strichartz, George W. Bartlett, Robert J. Doherty and Dr. Joseph V. Charyk. Dr. Charyk was presented with the DeForest Audion Medal for his work in space exploration and international TV communications.

WINNER OF THE MARCONI DEFOREST GOLD MEDAL at Veteran Wireless Operators Association dinner is Dr. Joseph V. Charyk (right). Presenting the award is Jack Poppele (left), Association chairman.

The VWOA membership is drawn mainly from professional radio pioneers, many of whom started their careers in radio as wireless operators during World War I.

FCC investigates solutions to "junk" phone calls

Most of us have at one time or another received "junk" phone calls, unsolicited messages delivered either by automatic dialing equipment or "live," that are similar to the unsolicited mail that appears periodically in our mailboxes. Now, the Federal Communications Commission is pondering ways of solving this problem, and has launched an inquiry to determine what rules, if any, would be necessary to insure protection to consumers who don't wish to receive such calls.

While realizing that there are some who might want to receive information this way on goods and services, and that many charities, political organizations and candidates use either automatic dialing equipment or individuals to advertise their cause and solicit contributions, nonetheless the FCC has proposed some tentative solutions to this thorny problem:

1. Restricting the use of automatic dialing devices to certain designated users;
2. Devising a means whereby a customer can indicate that he/she does not want to receive the calls;
3. Providing penalties for those companies and/or organizations who call those customers that have indicated they don't want to receive the calls;
4. Setting higher phone rates for those using automatic dialing equipment to deliver such messages;
5. Requiring each automatically dialed message to begin with the announcement to the effect that the call is being transmitted automatically; and
6. Insuring that when a customer hangs up on an automatically dialed call, that line is left free for other incoming calls.

CB Radio Industry's 20th anniversary honored at CES Show

The Electronic Industries Association's Consumer Electronics Show (CES) held recently in Chicago was the scene of a gala birthday party honoring the CB radio industry's 20th anniversary. The Citizens Radio Section of EIA were the hosts, and guests received such goodies as champagne; birthday cake; red, white and blue mike holders; and bumper stickers.

The party was actually only one in a series of events scheduled to mark CB's anniversary. Among other special observances planned will be a traveling museum exhibit on the history of CB radio. This exhibit is a joint effort of the University of California's Lawrence Hall of Science, the FCC and the EIA, and will be shown at science and technology museums throughout the country during the next 18 months.

Digital message center provides instant advertising

Although it has been determined that it takes an average of three repetitions for an advertising message to become memorable, the *Digi-tiser*, a programmable digital advertising aid, provides an *instant* message. It was created in response to business demand by American Innovative Marketing, 2750 S. Harbor Boulevard, Suite A, Santa Ana, CA 92704.

The computerized message center comes in a 29 × 8 × 6-inch display case, along with a programmer that uses a typewriter-like keyboard. The 2-inch by 1½-inch red LED display can be read up to 150 feet away under most indoor lighting conditions. You can display any message (or series of messages) using up to 1024 letters, numbers and symbols. The unit has full editing capabilities; the memory contains a backup battery supply in case of power failures; and the programs can be changed as often as you wish.

The *Digi-tiser* is already being used by businesses, banks, hospitals, offices and other institutions, and has a list price range of $949–$1995, with many optional accessories.

Venus spacecraft mission

The NASA-sponsored Pioneer Venus spacecraft missions are expected to provide us with more information about that planet's effects on earth weather patterns. Here, finishing touches are being made on the Orbiter (background) which will take daily radar photographs of Venus' clouds; the Multiprobe (foreground) will return scientific atmospheric data. The Multiprobe contains four cone-shaped probes, each a self-contained spacecraft ejected from a transporter "bus" at predetermined points spread over Venus' upper atmosphere. The probes are not designed to survive impact, but it is hoped they will continue to transmit data after they reach the surface of the planet. The space project is managed by NASA's Ames Research Center in Mountain View, CA.

Radio/TV repair contestants vie in 1978 VICA Skill Olympics

In June, Birmingham, AL, was the host to the 1978 U.S. Skill Olympics, sponsored by the Vocational Industrial Clubs of America (VICA). The competition was designed to test and recognize the achievements of vocational students in trade, industrial, technical and occupational education. The winners have an opportunity to represent the U.S. in international competition; the top three high school and post-high school winners in each of the 28 technical categories win gold, silver and bronze medallions; many others receive such prizes as tools, textbooks and, in some cases, scholarships provided by the sponsoring labor and industrial organizations.

In the radio and TV repair category, students performed tasks and solved prob-

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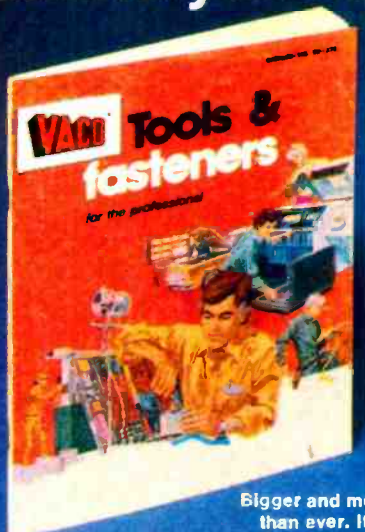

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Continued from page 6

lems they would encounter later on the job. They were judged on safe practices as well as performance. Eight different servicing problems were diagnosed and repaired under a strict time limit. Four of the projects were in the field of color TV.

A VICA technical committee was responsible for choosing both projects and qualified judges.

Fairchild's video game system uses programmable cartridges

Fairchild Camera has developed a video entertainment system called *Channel F System II* in which *Videocart* game cartridges are inserted into the Channel F console and can be programmed via an optional plug-in 16-pushbutton keyboard. With a programmable *Videocart*, keyboard numbers are used to preselect game variables such as type of play, players' speed, etc.

The system uses FM sound played through a TV receiver, and games and other formats are displayed in full color on the TV screen. Other features include remote hand controllers and a switch on the console can be used to halt play indefinitely; to restart, you just press the start pushbutton.

PROGRAMMABLE VIDEO ENTERTAINMENT SYSTEM from Fairchild Camera uses *Videocart* cartridges that can be programmed for game variables via an optional 16-pushbutton keyboard. The system incorporates FM sound that is played through the TV receiver.

The *Channel F System II* can be played on any color or black-and-white TV set. Programmable games now available are "Space Odyssey," "Pro-Football" and "Casino Poker"; standard (nonprogrammable) *Videocarts* are also available. Suggested retail prices for the system components are as follows: the console plus one *Videocart*, $149.95; the separate keyboard, $9.95; the keyboard-programmable *Videocarts*, $24.95 each; and the standard *Videocarts*, $19.95.

Bell Laboratories mobile phone service tested in Chicago

This past summer, Bell Laboratories began a two-phase trial of the FCC-approved Advanced Mobile Phone Service (AMPS) in Chicago. The purpose of the test was to demonstrate and determine whether the cellular system is economically viable when a great many mobile units are involved, and whether it has a market potential. In the second phase, which is due to take place in 1979, AMPS will be marketed as a regular mobile phone service, using however only a randomly selected sample from the business community and with a limited number of mobile units installed in selected vehicles.

The AMPS system divides a particular area into grids or "cells," each cell being served by a low-power transmitter, receiver and control system called a "cell site." The cells are linked to a central computer-controlled switching machine called a Mobile Telecommunications Switching Office. This machine senses when a car moves out of one cell into another and automatically transfers the call to the other cell site or notifies the mobile unit to switch channels.

Each cell is assigned its own frequencies, with adjacent cells having different frequencies to cut down on interference. However, cells that are far enough away from each other can use the same fequencies simultaneously, thus allowing each channel to be used many times within a given area. As the demand for calls increases, the capacity of the AMPS system can also be increased by adding new cells between existing ones.

In the Chicago test, the mobile phones were designed to Bell Labs specifications but manufactured by non-Bell companies. They have a special feature in that the user can dial the "last number called" just by pressing a button. The phones also can store information in memory, so that you can, for instance, start a call at one traffic light and finish it at the next.

If the tests are successful, Bell Labs anticipates that AMPS can have nationwide applicability, providing everyone with an economical mobile extension of regular home and business telephone service.

EIA releases first VCR/VTR sales figure

The Marketing Services Department of the Electronic Industries Association (EIA) has released the first available figures on total U.S. market sales to dealers of home video cassette/tape recorders. Because the compilation of these statistics was started only in 1978 (on an individual and confidential basis), there are no comparison figures for previous years shown in the table:

1978 SALES OF HOME VIDEO TAPE RECORDERS

Month	No. of Units
January	13,567
February	14,954
March	27,415
April	27,221
May	27,994
Year to Date	111,151

Last Intelsat IV-A communications satellite launched

The sixth, and final, Intelsat IV-A communications satellite built by Hughes Aircraft joined its sister vehicles in synchronous orbit 22,300 miles above the Equator, some 13 years after the first satellite was launched. This last satellite in the Intelsat IV-A series was placed into orbit over the Indian Ocean and is expected to provide services to over 40 countries.

INTELSAT IV-A BEING READIED FOR LAUNCH. A Hughes Aircraft engineer is giving the antenna assembly a final check. This "last-of-the-breed" satellite's orbit is over the Indian Ocean.

Technological advances over the years have helped reduce the cost of satellite transmission considerably. For example, the cost of TV transmission has fallen from $22,000-per-hour to $5000-per-hour, and the retail cost-per-channel on, say, the U.S.–London route has diminished to $6000-per-channel from an initial $18,000-per-channel. All the Intelsat IV-A vehicles have 20 broadband RF channels and can handle 6000 two-way telephone calls as well as two TV transmissions.

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The Course comes complete with 62 electronic components, including a 6820 PIA, two 2112 RAM's, a 1406 digital-to-analog converter, 741 and 301 op amps and more. Includes audio visual aids such as an audio cassette, colorful flip charts and programmed learning text material in two deluxe permanent binders.

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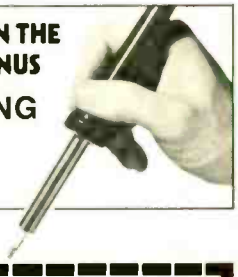

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Institute of High Fidelity opposes Senate bill on RFI control

Leonard Feldman and Robert Gur-Arie, technical director and executive vice-president, respectively, of the Institute of High Fidelity, recently appeared at hearings conducted by the Senate Committee on Commerce, Science and Transportation on bill *S. 864* (sponsored by Senator Barry Goldwater). This bill concerns proposed legislation governing the control of radio frequency interference (RFI).

Mr. Feldman's formal statement before the Committee represented IHF's view that the impact of *S. 864* on high-fidelity component manufacturers would be extremely damaging. In his statement he pointed out that the governmental requirement that every purchaser of hi-fi equipment bear the cost of multiple RFI filters and/or shielding would be not only onerous but unnecessary since only a relatively small number of RFI problems can be cured using these methods of protection. The majority of purchasers would not be affected by RFI problems.

Furthermore, Mr. Feldman emphasized that not only would RFI filters and shielding seriously degrade hi-fi performance and increase the cost of components to the consumer, but would also raise manufacturers' costs. He added that the industry has been relatively unaffected thus far by the inflationary spiral, costs having remained reasonably stable over the past 10 years. Mr. Feldman ended his statement by appealing to the Senate Committee to vote against *S. 864*.

Parker Brothers offers computer game library

The latest addition to the proliferating electronic game market is Parker Brothers' *Merlin*, a computer game with a library of six games of chance, ranging from the very simple ("Tic-Tac-Toe") to the highly challenging ("Mindbender").

SIX COMPUTER GAMES can be played using Parker Brothers' *Merlin*. Games range from very simple to advanced and can be played by anyone in 7-to-adult age range.

Designed for players in the 7-to-adult age range, *Merlin* includes among its bag of tricks the ability to "speak," a feat accomplished by the use of electronically synthesized sounds. It can offer congratulations or a "raspberry" (to the loser!), and it can counter your moves with its own maneuvers.

The *Merlin* game comprises a Texas Instruments microprocessor with 2048 bytes of ROM and 512 bits of RAM. Power is provided by six 9-volt batteries, and its operating range is 7.5–10.5 volts.

Merlin is only one of a series of computer games being readied by Parker this fall with a view toward the holiday trade.

1978 Sarnoff awards go to 16 scientists and engineers

This past June in New York City, the 1978 David Sarnoff Awards for Outstanding Technical Achievements were awarded to 16 engineers and scientists for their outstanding efforts in their chosen fields. RCA President Edgar H. Griffiths presented the awards to:

Albert Feller, for his work in large-scale integrated circuits; Fernand F. Martin, Samuel Waldstein and Jason H. Woodward, for developing a handheld laser range-finder; David W. Luz, James A. McDonald and John C. Peer for their joint efforts in developing scan and power-supply systems for color TV; and Murray A. Polinsky and Otto H. Scabe, Jr., for their work in developing BiMOS IC's. Engineers Kenneth C. Adam, Ramon H. Aires, Charles A. Clark, Jr., William J. Davis, John G. Gorski, Kazuo Katagi and Akira Sasaki won recognition for their team achievements in airborne color weather-radar indicators.

FCC endorses use of CB radio in government safety program

The Federal Communications Commission has endorsed a program developed by the Department of Transportation that increases citizen involvement in highway safety by the use of CB radio, as long as such use conforms to FCC regulations.

The National Emergency Aid Radio (NEAR) program broadens motorists' responsibilities in identifying and reporting highway incidents; makes available public-safety devices to those participating in the program; encourages citizen cooperation with professional public-safety agencies; and provides a link between such agencies and private volunteer CB groups.

Furthermore, cooperation between local government, private and voluntary organizations will help develop criteria and performance standards suitable for each state in which the NEAR program is operative. CB emergency Channel 9 could also be effectively monitored by public safety agencies, volunteer groups and individuals.

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CIRCLE 55 ON FREE INFORMATION CARD

letters

DIGITAL CLOCK

On building the 10-Function Digital Clock (August 1977 issue), I have the following questions:

Instead of using all different sizes of digit display as the author has suggested, can I use DL 750 for all 17 digits? If it is possible, do I have to omit resistors R1 and R7 on the display board? Can I use a larger-size digit to replace DL 750?

Thank you for an interesting article.
PATRICK GONG
Lansing, IL

In regards to your desire to use different readouts for the clock, it should be possible to use any type of display with the proper interfacing.

Specifically, to use all DL 750 readouts, the circuit should work without modification. However, due to the increased display current, dropping resistors R17 to R24 should be changed to ½ watt or greater. Their value may also have to be increased to keep the total power dissipation in the driver IC's below their maximum of 600 mW. This is especially important for IC4, which may become quite hot. Of course, R1 to R7 on the display board should then be omitted.

The use of any other common cathode LED is possible provided the above limitation is not exceeded. If necessary, external display-driver transistors could be used to increase the display current.
JEFF MAZUR

SUPERCONDUCTING MAGNET

Can **R-E** readers imagine the total disappearance of resistance in a superconducting (SC) wire? Many materials at liquid helium temperatures have a resistance of far less than one trillionth that of copper.

An NSF study proved the feasibility of storing electricity in an SC magnet over 500 feet in diameter, in a coiled wire more than 50,000 miles long. This magnet would store enough electricity to supply all the power needs for 100,000 people per day. An ordinary ohmmeter could not measure the tiny amount of resistance in this huge SC winding. Could we fully load this huge magnet with no resistance from a low-power battery—one that has low voltage and high current?

Did you ever see someone hold a coil across battery terminals? Did you ever grab the coil and remove it? That maneuver and an SC coil could solve our energy crisis. We learned (usually the hard way) that what we get out of an electromagnet has little to do with what we put in, and now we have SC wires.
JOHN W. ECKLIN
Alexandria, VA

ELECTRONIC CLOCKS

I read the article by Fred Blechman, "Unusual Wall Clocks" (April, 1978, page 40), with interest since Diglclocks of California is marketing a wall-table clock that is similar

to some of the clocks described.

The Digiclocks units have an outer circle of 60 LED's (seconds and minutes) and an inner circle of 12 LED "lines" (hours), each line containing four LED's. In the outer circle, yellow LED's mark the 5-minute, 10-minute, 15-minute, etc., intervals. The hours-line LED's are yellow, except for four red LED's in the 12, 3, 6 and 9 o'clock positions.

Other clock features are: the second circular row including the four red hours-line LED's is always on (useful for night viewing); the seconds LED's leapfrog each other for viewer interest; and each clock has its own unique face. The prototype had a wooden case; later a specially formed plastic case was made. It is planned to add a third, more modern case.

NAIF D. SALMAN
Digiclocks
Orange, CA

ALTERNATE ENERGY SOURCE

After reading **R-E**'s April 1978 editorial, I thought that perhaps you would be interested in the automatic self-positioning solar-cell array I have just finished constructing. Solar cells are too expensive simply to be mounted on a stationary structure. The sun changes its position during the course of a day, and so should the position of the solar-cell array.

In the array I built, I used 98 silicon solar cells (Radio Shack No. 276-120). (An output of approximately 15 volts ¼ amp is obtained between 9:00 am and 4:00 pm in the Massachusetts spring sun.) The Radio Shack cells cost $2.99 each, but other mail-order suppliers sell similar cells with equivalent outputs at a fraction of this price.

An Imsai 8080 microcomputer controls the position of the solar array. Of course, the power used by the computer greatly exceeds the power generated by the solar-cell array. The cost of constructing a low-power (CMOS logic) controller to automatically position the array to receive the maximum amount of sunlight, plus the necessary mechanical components, would be under $20.

HOWARD SCHNEIDER
Boston, MA

SABTRONICS DMM KIT

Radio-Electronics carries an ad for the Sabtronics *model 2000* DMM kit. It is an excellent kit; I've had one for months. Perhaps you could pass this information along to those readers who may also own one and have had problems.

The kit manual and circuit diagrams use "house numbers" for the IC's. Sabtronics couldn't help me when I blew out the A/D converter, which is identified only as IC 20-786. It is, in fact, the Motorola 14433P A/D converter, and I obtained the replacement from Circuit Specialists Company, P.O. Box 3047, Scottsdale, AZ 85257 ($14.25).

The op-amp used in the AC converter circuit can be replaced with a simple 741 (marked Z-3 in the manual).

The segment driver (Z-7) is MC14511B and the digit driver IC is a 75492 (marked Z-5). This information may help some of your readers to get their units working again if they were unlucky enough to zap the unit with an overvoltage as I did.

continued on page 22

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CIRCLE 9 ON FREE INFORMATION CARD

LETTERS

continued from page 17

If the unit does not autozero in the AC 10-volt mode, it is due to multiplex decimal-point noise from the selector switches. Sabtronics sells an inexpensive ($3–$4) add-on kit that removes this problem and really works.

R.B. STILLWATER
Winnipeg, Canada

ENERGY CRISIS

With reference to your recent editorial on "The Real Energy Crisis" (April, 1978, page 14) I am very much in agreement with your analysis of the real crisis. However, I cannot agree with your solution.

As soon as anyone says, "What we need is a ruling requiring the installation of such a system (solar hot-water heating) in every home," my back bristles. Rulings of this nature foster governmental bureaucracy and take away from free enterprise. When we see deregulation, reduction and elimination of federal, state and local controls on our economics and free-enterprise system, then free enterprise will develop and expand the systems necessary to handle the crisis situation. Obviously, this can only be done when it is economically feasible.

Just a few years ago, oil was a less expensive fuel than coal. As you can see, this has changed. You can also see many instances on the East Coast where it is now more economical for industry to generate its own electricity rather than buying it from utilities—all of which is part of free enterprise and a healthy economic system. When we introduce legislation to force faster development, we are tipping the scales of good economics.

RONALD L. STIER
Belden Corp.
Richmond, IN

FM TUNER SELECTIVITY

To my way of thinking, the present state of tuners with narrow- and wideband selectivity switches have gone off in the wrong direction, except for the McIntosh tuner, which, at $900, is just out of my budget.

Other manufacturers are doing nothing to solve the NY Metropolitan area selectivity problem. For example, the classical music listener in mid-New Jersey finds that Philadelphia, Trenton, Boston and all the overmodulating local stations squeeze out WQXR (96.3 on the FM dial) and WNCN (104.3). I've seen some pretty decent tuners flunk out in the Princeton-Hopewell (NJ) area.

I think we need to spell out the acceptable limits of capture ratio, distortion, etc., to put out adjacent channel selectivity of at least 45, but in a tuner costing under $400.

E. D. CROSBY
Wilton, Ct

POWER TRANSFORMERS

Over the past few years, I have constructed several **R-E** projects. Noting the international scope of your readers, I have searched for adequate power transformers.

From a line of over 1000 different transformers the Signal Transformer Company (500 Bayview Avenue, Inwood, NY 11696) builds a DPC line of transformers featuring split primaries and secondaries, rated at 115 VAC–230 VAC, 50 Hz–400 Hz in 1 to 24 VA sizes. The prices are competitive with Radio Shack and other hobby outlets, and the delivery time has been outstanding. Additionally, these transformers are rated to 105 °C and are adaptable to most hobby projects.

In my 35 years as an electronics engineer for the U.S. Navy, I must rate these transformers as truly finest quality products that may help solve some of the international hobby construction problems.

OLIVER D. STEWART
NESEA, Code 024
St. Inigoes, MD

KITS DISCONTINUED

All sales of the *model 81* AM/FM Frequency Display and the *model 302* Frequency Counter (January, March 1978 issues) have been discontinued because of price rises on parts in both kits and parts shortages (*model 81*).

Thank you to all the people who built the kits and liked them! Both my staff and I believe we have done the best we can, and will never regret what we have done. And we'll never forget that **Radio-Electronics** has some mighty fine readers. No matter how black things got there was always at least one person and usually many who took time to write and say, "thanks for the fine personal service."

GARY McCLELLAN **R-E**

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

*Limited warranty. Labor not included.

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

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

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

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

SYLVANIA **Electronic Components**

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If this is what you are looking for.

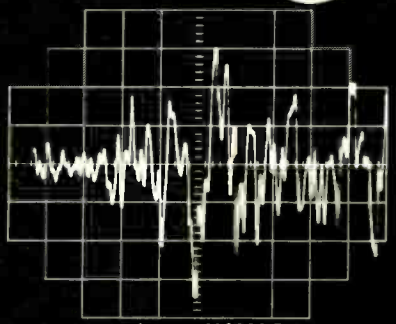
If you demand nothing less than true hi-fi performance, you'll understand the advantages and flexibility that resulted when Technics separated the basic amplifier/control/tuner functions into the five units we call the Flat Series: The automatically switchable dual IF band ST-9030 FM tuner. The SU-9070 DC preamplifier. The SH-9010 stereo parametric/graphic frequency equalizer. The SH-9020 peak/peak-hold/average metering system. And the SE-9060 stereo/mono DC power amplifier.

You'll also understand why the Flat Series challenges the performance of the most expensive professional equipment in the world. And very often surpasses it.

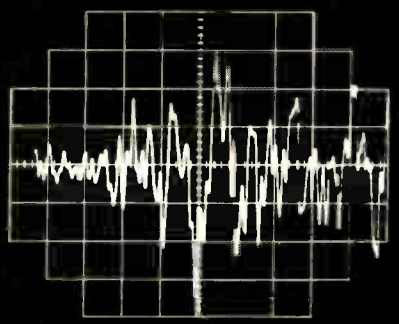
Look at the graphs. The reproduced waveform is virtually true to the original. All types of distortion—some measurable, some not—are negligible. And the linear frequency response is extremely wide.

We're confident that the truly discriminating critic will recognize the magnitude of our achievement. Especially when that achievement is offered at prices that are unprecedented for equipment of this caliber. And with the flexibility to incorporate one or more, or all five units into your system. Depending on your needs or budget.

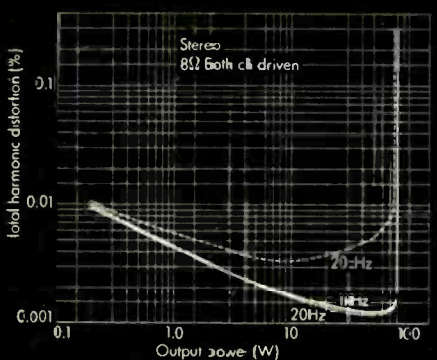
To see how Technics achieved the incredible performance shown in the graphs, you have to see and compare the incredible specifications that are typical of the Technics Flat Series on the facing page.



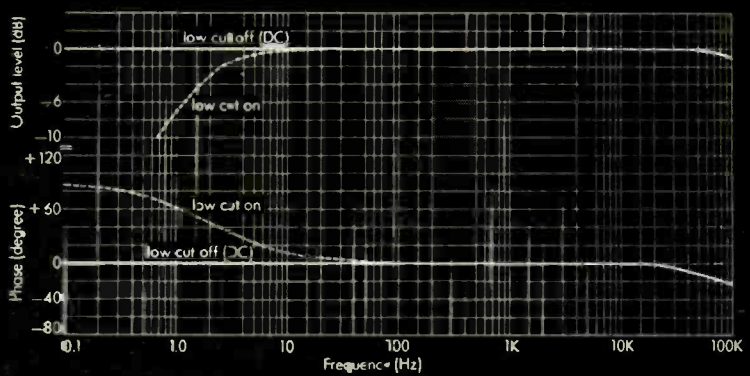
Input Waveform to ST-9030 FM Tuner.



Output Waveform from Technics Flat Series.



THD vs. Output Power in Stereo SE-9060.



Gain, Phase vs. Frequency Response. SE-9060 Amp.

TECHNICS ST-9030. THD (stereo): Wide—0.08% (1 kHz). Narrow—0.3% (1 kHz). S/N (stereo): 73 dB. FREQ. RESPONSE: 20 Hz—13 kHz +0.1, −0.5 dB. SELECTIVITY: Wide—25 dB Narrow—90 dB. CAPTURE RATIO: Wide —0.8 dB. Narrow—2.0 dB. IMAGE and IF REJECTION, SPURIOUS RESPONSE (98 MHz): 135 dB. AM SUPPRESSION (wide): 58 dB. STEREO SEPARATION (1 kHz): Wide—50 dB. Narrow—40 dB. (10 kHz): Wide—40dB. Narrow—30dB. CARRIER LEAK: Variable terminal—65 dB (19 kHz). Fixed—70 dB (19 kHz, 38 kHz).

TECHNICS SE-9060. POWER OUTPUT: 70 watts per channel (stereo), 180 watts (mono) min. RMS into 8 ohms from 20 Hz to 20 kHz with no more than 0.02% THD. INTERMODULATION DISTORTION (60 Hz: 7 kHz, 4:1): 0.02%. FREQ. RESPONSE: DC~100 kHz, +0dB, −1 dB. POWER BANDWIDTH: 5 Hz —50 kHz, −3 dB. S/N: 120 dB (IHF A). RESIDUAL HUM & NOISE: 100 μV. INPUT SENSITIVITY & IMPEDANCE: 1V/47kΩ.

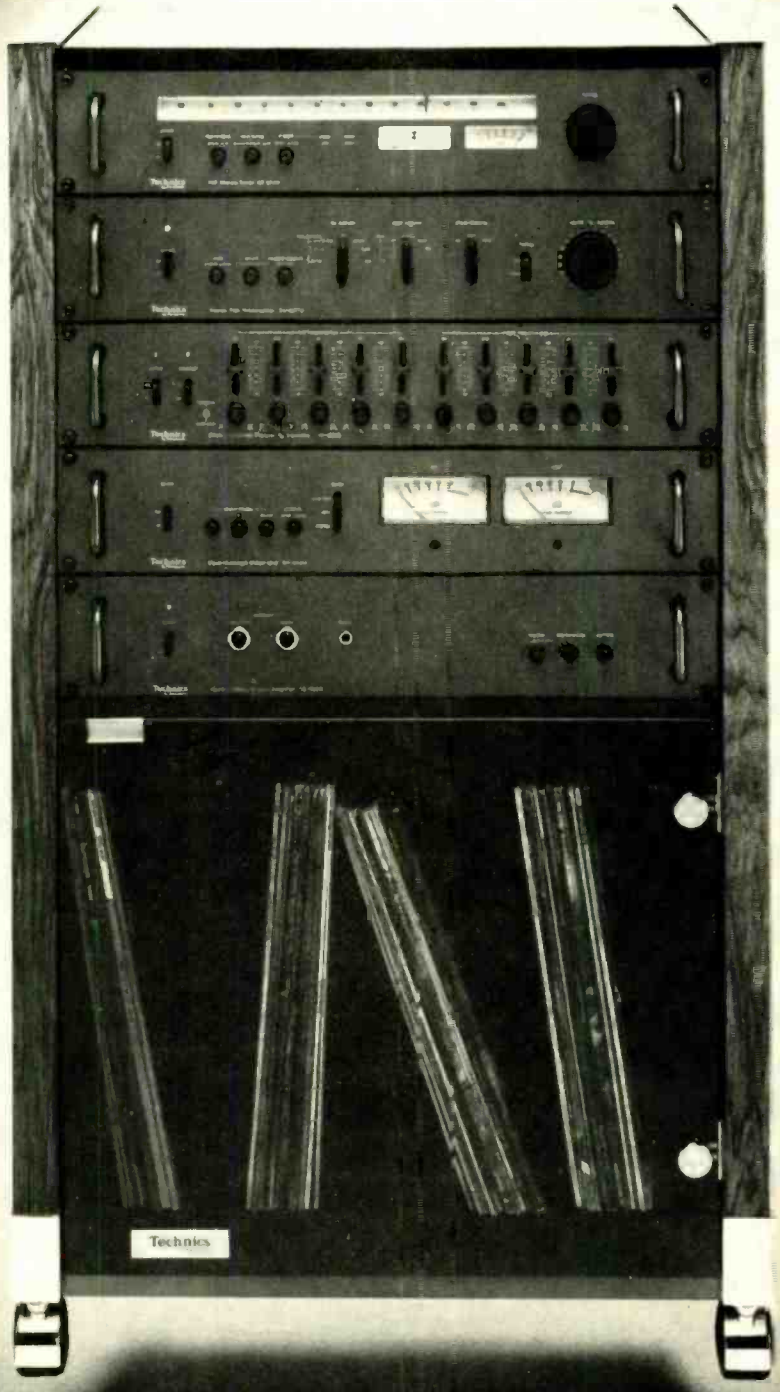
All the specifications of Technics Flat Series are too numerous and complex to list here. But their performance is too good to miss. So don't. Technics Flat Series is now available for demonstration at selected audio dealers. For very selective ears. And for very selective eyes there's Technics SH-999. A movable 19" custom rack with rosewood veneer side panels.

Technics Flat Series. A rare combination of audio technology. A new standard of audio excellence.

Technics *Professional Series*
by Panasonic

CIRCLE 36 ON FREE INFORMATION CARD

This is what you should listen to.



CIRCLE 36 ON FREE INFORMATION CARD

equipment reports

EQUIPMENT REPORT: EICO Model 242 FET-TVOM

CIRCLE 106 ON FREE INFORMATION CARD

THE ELECTRONIC INSTRUMENT COMPANY, INC. (EICO), 108 New South Road, Hicksville, NY 11801, has developed a bench or portable FET-TVOM, the *model 242*. This instrument has a large 6-inch meter that is easy to read and provides long scales. It reads AC or DC voltages from 0.01 up to 1,000. There are seven ranges in the handy 1-3-10-30 layout. The lowest voltage range is from 0 to 1; since these scales are linear, this provides a center-scale reading of 0.5 volt, or 500 mV. The *model 242* provides a total of six scales, the top scales (the longest) are used for reading DCV/MA and ACV. This feature makes it a lot easier to read the very small voltages found in solid-state equipment.

Seven ohmmeter ranges start at R × 1 and go to R × 1.0 megohm. The center scale on the ohms ranges is 10 ohms on the low range, which is helpful when you must read low-value resistors. Both alternating and direct currents can be read on seven ranges from 0–1 mA up to 0–1 amp.

The AC voltage ranges for the RMS input are the same as for DC voltage. Special scales are provided for reading peak-to-peak AC voltages—up to 2800 P-P. The AC voltage can be read on the same scales, the RMS up to 1.0 amp and the P-P voltage up to 2.8 amp.

The FET input provides the DC voltage ranges with the typical high input impedance—11 megohms. The AC voltage ranges give a 1.0-megohm input impedance. The rated specifications for the *model 242* are: DC accuracy is ±3% of full scale; the RMS AC accuracy is ±5% of full scale; the frequency response of the AC voltage ranges is 25 Hz to 2.0 MHz; an accessory RF probe, the *model PRF-11*, can extend this range to 250 MHz. The *model HVP-2* probe extends the DC voltage range to 30 kV. The input is protected by a semiconductor network to prevent damage to the FET during overload.

The *model 242* is AC-powered, with a transformer and a Zener diode regulated output of +6.8 VDC. The Zener diode also regulates the DC voltage supply when used on the

continued on page 32

Uncompromising performance.
Incredible price.
A professional 3½ digit DMM Kit for less than $70.

Incredible? True! Professionals and hobbyists alike are believers in this Sabtronics 2000, the only portable/bench DMM which offers such uncompromising performance at the astonishingly low price of $69.95.

Uncompromising performance you'd expect only from a specialist in digital technology such as Sabtronics: Basic DCV accuracy of 0.1% ± 1 digit; 5 functions giving 28 ranges; readings to ±1999 with 100% overrange; overrange indication; input overload protection; automatic polarity; and automatic zeroing.

The low price of $69.95? Simple: The Model 2000 is all solid-state, incorporating a single LSI circuit and high-quality components. You assemble it yourself, using our clear, easy-to-follow, step-by-step assembly manual. Kit is complete, including a high-impact case.

Now you too can have it! A professional-quality, 3½ digit Sabtronics Model 2000 DMM kit for only $69.95. If you don't have one in your lab, use the coupon below to order NOW.

BRIEF SPECIFICATIONS:
DC volts in 5 ranges: 100 µV to 1 kV · AC volts in 5 ranges: 100 µV to 1 kV · DC current in 6 ranges: 100 nA to 2 A · AC current in 6 ranges: 100 nA to 2 A · Resistance: 0.1 Ω to 20 MΩ in 6 ranges · AC frequency response: 40 Hz to 50 kHz · Display: 0.36" (9,1 mm) 7-segment LED · Input impedance: 10 MΩ · Size: 8" W x 6.5" D x 3" H (203 x 165 x 76 mm) · Power requirement: 4 "C" cells (not included).

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Examine the 2000 DMM kit for 10 days. If not completely satisfied, return unassembled for full refund of purchase price. (Less shipping and handling)

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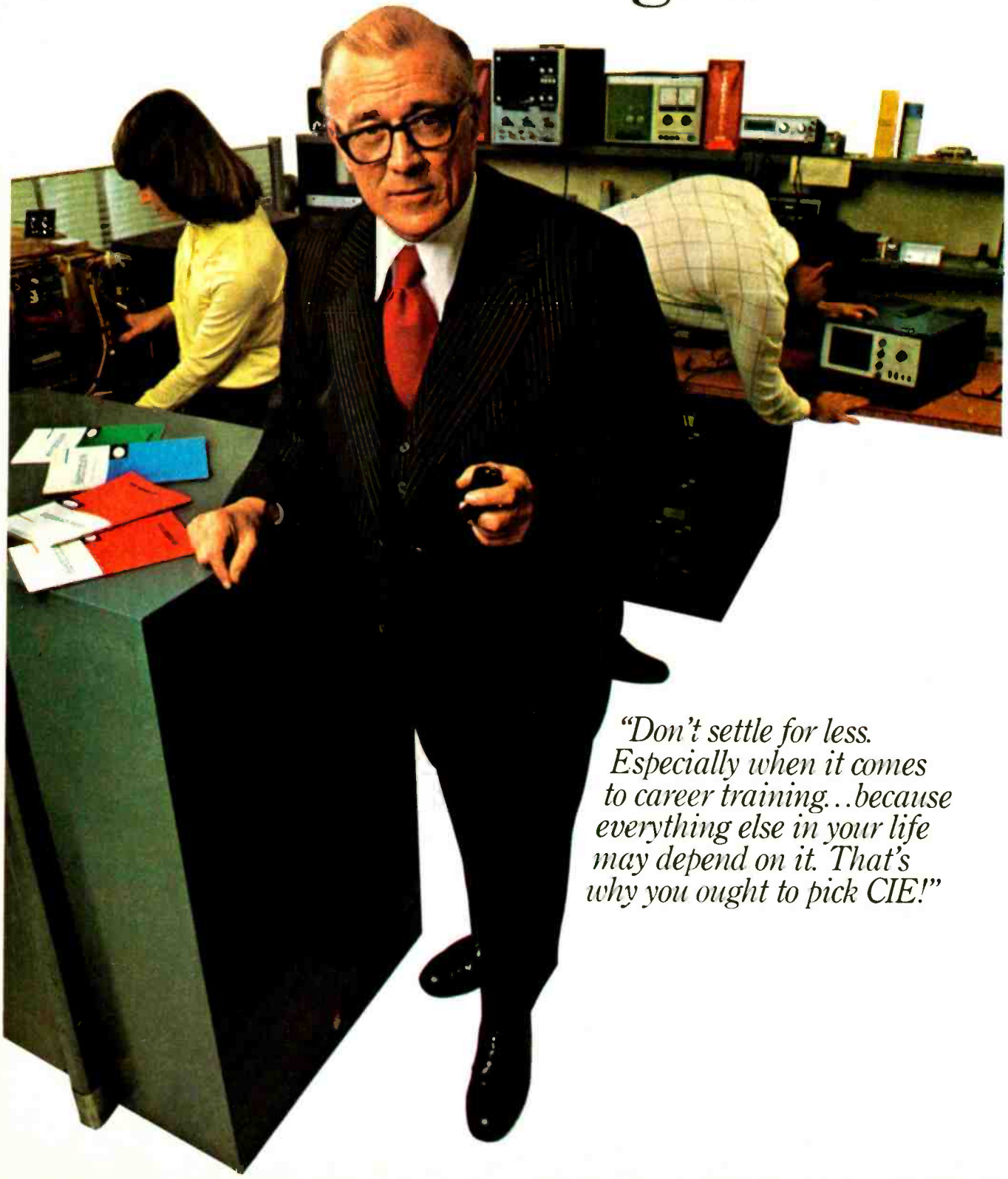
"If you're going to learn electronics, you might as well learn it right!"



"Don't settle for less. Especially when it comes to career training...because everything else in your life may depend on it. That's why you ought to pick CIE!"

You've probably seen advertisements from other electronics schools. Maybe you think they're all the same. They're not!

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At CIE, we believe theory is important. And our famous Auto-Programmed® Lessons teach you the principles in logical steps.

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internal batteries. Three 9-volt batteries mounted inside the case make the instrument completely portable, but do not have to be installed if the unit is used on the bench at all times. A battery-AC selector switch on the back panel selects the power supply in use, and the ohmmeter circuit is powered by a single 1.5-volt D-cell battery.

The *model 242* uses only two connectors for test leads. One is a phone jack for the *Multi-Probe*, which can be switched (at the probe) from VDC to AC/Ohms/mA. The other connector is a ground lead with a clip. Three clearly marked and well-separated controls are used: the ON-OFF/ AC/-DC/+DC mode switch, the FUNCTION switch and the RANGE switch. The ZERO-ADJUST and OHMS-ADJUST controls are both 10-turn potentiometers. For a zero-center voltage reading, set the needle to the center using the ZERO-ADJUST control. Doing this halves the indicated range, i.e., on the 0–1 volt range you can then read from −0.5 to +0.5, etc.

The three 9-volt batteries are connected in parallel to lengthen the time between battery replacement. In an emergency, of course, a single battery can be used to power the instrument.

The *model 242* can be purchased as a kit or a pretested ready-made unit. It comes in a metal cabinet with a plastic front-panel trim and is large enough for bench use or elsewhere. This handy test instrument cost $149.95 assembled and $119.95 as a kit and should give long reliable service. **R-E**

McKay Dymek Model DR22 Receiver

CIRCLE 107 ON FREE INFORMATION CARD

VERY FEW DOMESTIC GENERAL-COVERAGE communications receivers have appeared on the market over the past several years. Several imported units have been running in the range of $300 to $400, with high-quality receivers in the $3000 category. The introduction of the McKay Dymek *model DR22* receiver helps fill the gap. The cost of the instrument is $995.

The receiver is decorator-styled to complement a stereo system, with brushed-aluminum panel and knobs and a woodgrain cabinet. When the unit is switched on, both a giant LED frequency display and a dual-scale (showing S-units and dB) signal-strength meter illuminate the back-lighted panel. The *model DR22* is quite lightweight for its size, due largely to its miniature-component circuitry and wood cabinet.

Veteran shortwave buffs will be astounded by the simplicity of operation. Of the eight knobs on the front panel, five are for frequency selection, the others are for the volume, mode and preamplifier. There are no controls for

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RE-108

CIRCLE 29 ON FREE INFORMATION CARD

continued from page 32

antenna peaking, preselector adjustment, bandswitching, RF gain, AVC/MVC, BFO pitch, crystal phasing, or other venerable memorabilia of the old Hallicrafters days!

The receiver seems ideal for the demanding international-broadcast listener. The 5-kHz incremental frequency-stepping locks in on allocated channels faithfully; the remaining ±5-kHz knob is used as a fine-frequency adjustment, thus assuring total-frequency coverage.

The frequency stability is ±40 Hz; such exceptional stability is credited to the phase-locked-loop frequency-synthesis oscillator.

Front-end overload is minimized by the use of a high-level RF amplifier stage, followed by a high-level double-balanced mixer stage. Crystal filtering immediately follows the mixer stage to reduce unwanted-signal passband frequencies.

Lab tests

Admittedly, upon unpacking the *model DR22*, we had the impression that this unit was intended to be a cosmetic complement for a stereo installation rather than a competitive, professional general-coverage receiver. But with the *model DR22* operating, it became immediately apparent that it represents a new receiver-design philosophy—few manual adjustments required, without any compromise in performance.

The quartz-crystal oscillator provides incredible stability without the familiar backlash of tuning dials. The large frequency display leaves no doubt as to what frequency is selected. A liberal sprinkling of crystal and ceramic filters provides steep-sided selectivity, adjustable as 4-kHz or 8-kHz bandwidths.

Although the unit is normally used with its internal speaker, provisions have been made for an external speaker as well as a high-impedance output to couple into a sound system. The use of high-power front-end transistors results in a wide dynamic range; local broadcasters posed no problem with weak-signal reception. Unusual low-frequency coverage (down to 50 kHz) affords quality reception of utilities and broadcasters found in the LF spectrum, although an antenna-matching system should be used at these low frequencies rather than a random wire antenna.

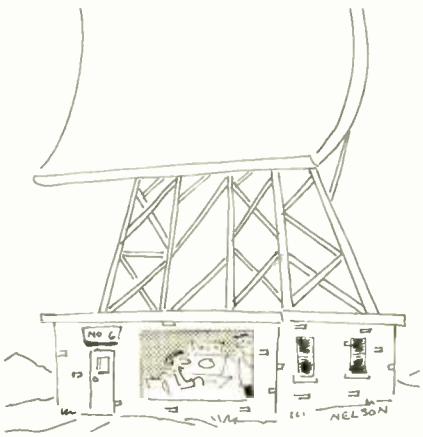
TECHNICAL SPECIFICATIONS
Frequency range: 50 kHz through 29.7 MHz
Reception modes: AM, USB, LSB, CW
Sensitivity: (10 dB S + N/N; AM mode) 1–2 μv 300 kHz-29.7 MHz 30 μv at 100 kHz
Dial accuracy: ±5 kHz
Image rejection: 70 dB
Intermodulation and crossmodulation: 65 dB referenced to 1 μv.
Audio output: 2 watts
Audio impedances at rear-apron ports: 4 ohms/5000 ohms

Model DA100 antenna

Offered as an accessory to the *model DR22* receiver, the *model DA100* active-antenna system works with any receiver designed for a 50-kHz–30-MHz range. Its performance is claimed to be equal to or better than that of a 100-foot longwire antenna, and our lab tests substantiated that claim.

The antenna system consists of two components; an outside-mounted broadband amplifier with a four-foot whip antenna and an inside control console. Fifty feet of interconnecting coaxial cable are supplied. A DC supply module is fed through the coax cable; the control console has selectable impedance matching and attentuation to prevent receiver overload. The cost of the active antenna system is $135.

For additional information, write McKay Dymek Company, P.O. Box 2100, Pomona, CA 91766. **R-E**



All I get is someone called Big Daddy who's got his hammer down.

SPECIAL REPORT:
Jack Darr, Service Editor of Radio-Electronics writes:
Oneida's Nu-Color Picture Tube Restorer 'Lives up to its name'

This device is designed to restore color to old picture tubes with one or more weak guns.

I had a trade-in Wards TV, with a picture tube so bad it had to be seen to be believed. The blue gun read almost normal emission; the green gun would come up to the bottom end of the BAD sector on the meter; and the red gun just barely wiggled the needle.

The *Nu-Color model 90A* is a plug-in device that is inserted between the picture tube and socket, like a brightener. However, it is *not a brightener, at least in the* usual sense of the word. Between its plug and socket is a little box with three color-coded slide controls, one for each color.

Starting with all controls at the OFF position, I plugged the *Nu-Color* in and turned the set on. As expected, the raster was a bright blue. I adjusted the controls of the *Nu-Color* and came up with a good- looking color-bar pattern. Twiddling the grey scale and the Nu-Color controls gave an excellent color picture. Reds saturated normally, with the color control all the way up and all other things looked very good! This device lives up to its claims and its name; it certainly did "restore the color" to this old dog.

As Oneida is careful to explain, the *Nu-Color* is not intended as a "cure-all" for color troubles, but it will help correct problems due to unbalanced picture-tube emission. The device can be installed and adjusted in the home with very little trouble.

For details write: Dalton Smith, President, Oneida Electronic Mfg. Co., Box 678, Meadville, Pa. 16335

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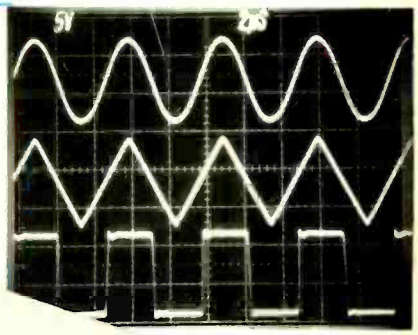
CIRCLE 49 ON FREE INFORMATION CARD

BUILD THIS

2-200,000 Hz Function Generator



Designed around the latest state-of-the-art waveform generator IC, this function generator delivers sine, square and triangle waves with precision and features not possible a few years ago.

DOUG FARRAR

THE AVAILABILITY OF LOW-COST WAVEform generator integrated circuits now makes it fairly simple to put together a function generator (see "Build 3-way IC Function Generator," **Radio-Electronics**, November, 1974). However, these waveform generator IC's suffer from a number of deficiencies that can make the resulting system "not quite good enough" for serious use. Specific complaints are: High-impedance outputs, high distortion and lack of amplitude control.

The function generator described here overcomes these deficiencies and adds features that you won't find on most other commercially available units. Its highlights are:

- Sine, square and triangle wave outputs with a frequency range of 2 to 200 kHz in decade steps.
- Output buffer amplifier puts out a 10-volt P-P signal into a 600-ohm load with rise and falltimes of less than 200 nS.
- Three-step output attenuator for 10, 1 and 0.1-volt P-P maximum output signal, variable down to zero.
- Front-panel connection for an external timing capacitor, permitting a center-frequency different from that built into the unit. It also allows the generator to measure capacitance.
- DC frequency modulation input for extremely slow frequency-sweep capability.
- The unit's 1.5-MHz buffer amplifier is front-panel available for external signal buffering.
- Built-in duty-cycle calibrator eliminates the need for an oscilloscope for minimizing waveform distortion.
- Variable-output baseline means that the function generator can be used as a pulse generator for digital circuits.

An added plus is that all of the IC's used in the generator are available in the back pages of **Radio-Electronics** as "surplus" items, which keeps the cost low. You'll also find that the mechanics of the unit minimizes the wiring nightmare often associated with a project of this size, because all pots and rotary switches mate directly to the printed-circuit board. Even the power supply is totally contained on a PC board—transformer and heat sink included!

Circuit operation

The heart of the function generator is the popular 8038 waveform generator IC. For a detailed explanation of its operation, refer to the description of the 8038 waveform generator contained in the box elsewhere in this article. Tracking current sources are required for the function generator IC (not necessarily equal, but tracking). Op-amp controlled circuitry is used to perform the trick. The additional IC's go beyond the manufacturer's recommendations but contribute to an overall performance improvement.

Referring to the schematic in Fig. 1, pot R5 taps a voltage between 0.4 and 9.1 volts which is buffered by IC1-b. This output is passed through resistors R7 and R8 to the IC1-c—Q1 level shifter. Thus, the ground-referenced current-source voltage developed by R5 is now referenced to the artificial supply voltage (V1 on the schematic). Voltage V1, about 3

FUNCTION GENERATOR SPECIFICATIONS

Output Waveforms: Sine, Square, Triangle
Frequency Range: 2—200,000 Hz in 5 decade ranges
Output Amplitude: Specified into a 600-ohm load, 3 variable ranges:
0 to 10 volts
0 to 1.0 volt
0 to 0.1 volt
} short-circuit protected
Output Offset: ± 6 volts (signal plus offset ≤ 10 volts)
Sine Distortion: ≤1% (typ) to 100 kHz
Squarewave Rise/Falltimes: <200 ns
Squarewave Symmetry: Within 1% of 50% using built-in calibrator
Front-Panel Inputs:
External Timing Capacitor: 200 pF minimum, 16-volt rating
Frequency Modulate: linear sweep, DC-coupled. 10,000-ohm impedance
External Signal Input: DC to 1.5-MHz amplifier, gain of 2. 100,000-ohm impedance

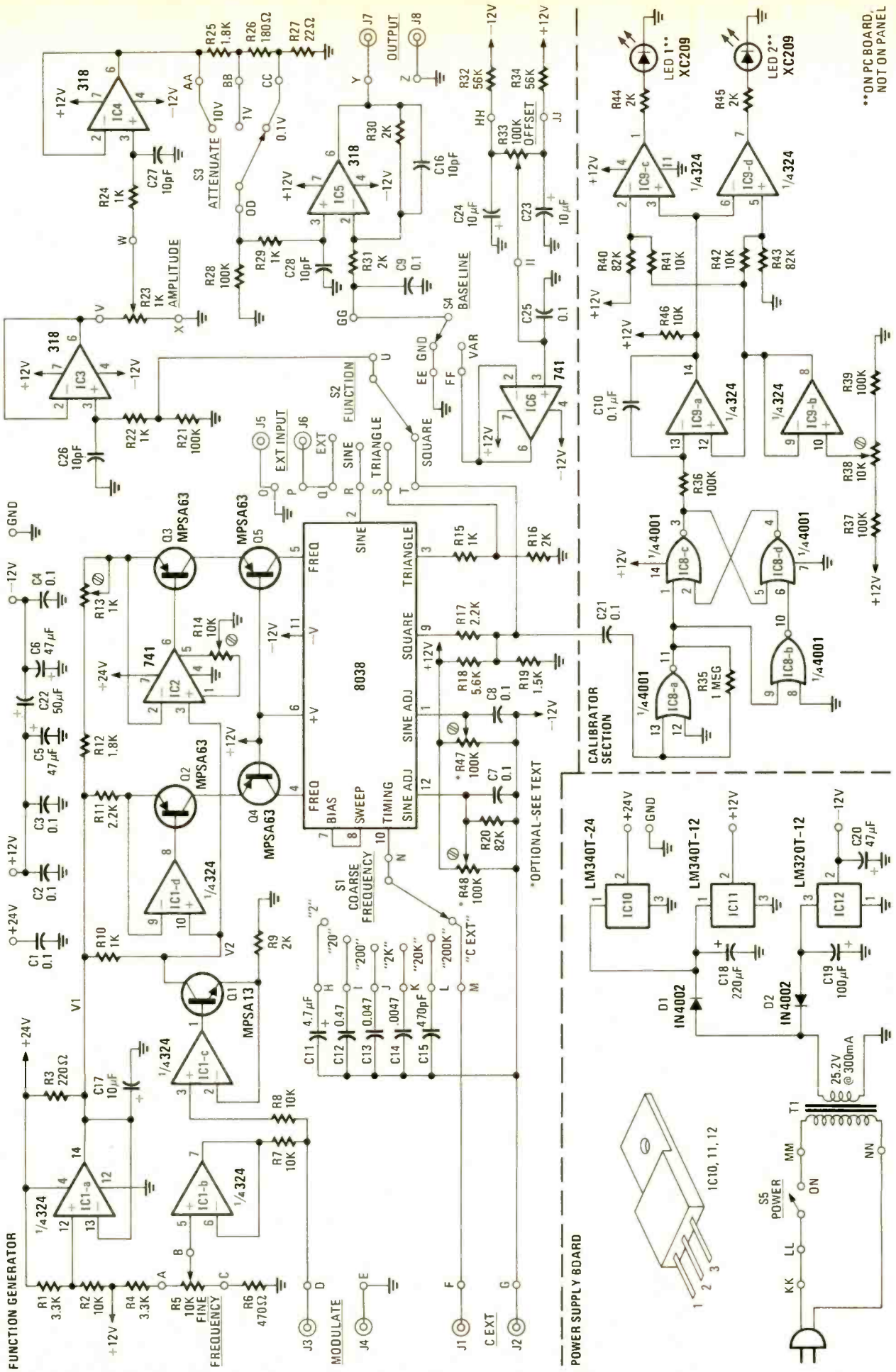


FIG. 1—COMPLETE SCHEMATIC of the function generator. Don't look for the two LED's on the panel. They're on the main board and are used only during the calibration process.

PARTS LIST

Resistors ¼ watt, 5% unless otherwise noted

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

Capacitors

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

D1, D2—1N4004, 100V, 1A diode
IC1, IC9—LM324 quad op-amp
IC2, IC6—LM341CN op-amp
IC3-IC5—LM318CN high-speed op-amp
IC7—8038 waveform generator (Intersil, Lithic Systems)
IC8—4001 CMOS quad NOR gate
IC10—LM340T-24, +24V regulator
IC11—LM340T-12, +12V regulator
IC12—LM320T-12, −12V regulator
LED1, LED2—XC209 (or equal) LED lamp
Q1—MPSA13, NPN Darlington
Q2-Q5—MPSA63, PNP Darlington
S1—1-pole 6-position miniature rotary switch (CTS T-206)
S2—1-pole 4-position miniature rotary switch (CTS T-206)
S3—1-pole 3-position miniature rotary switch (CTS T-206)
S4—SPDT miniature toggle switch
S5—SPST miniature toggle switch
T1—power transformer, 25.2-VAC 300-mA secondary, PC mount (Triad type F-148XP or Radio Shack 273-1386)
Miscellaneous—LMB 007-946 case, ½-inch aluminum angle bar, 6-32 × ½" bolts with hex nuts' ⅜" × 32 nuts, ⅜" lockwashers. Binding posts (J1-J8), power cord, strain relief, hookup wire.

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

THE 8038 WAVEFORM GENERATOR

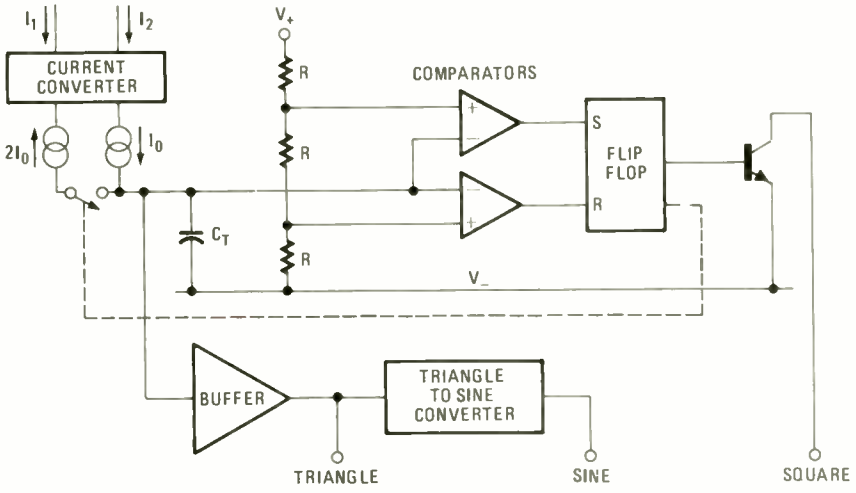
The function generator IC used here is the 8038. A block diagram of the IC is shown. Timing capacitor C_T is alternately charged and discharged by a current sink/source network. Assuming $I_1 = I_2 = I_0$, the resulting voltage across the capacitor is a triangle wave with a 50% duty cycle. The triangle wave is fed to a comparator network that sets and resets a flip-flop. When the triangle waveform reaches a voltage of $2/3(V_+ - V_-)$ the upper comparator sets the flip-flop and the $2I_0$ current source is enabled. The voltage ramps down until it reaches $⅓(V_+ - V_-)$ when the lower comparator turns the $2I_0$ current source off.

The period of oscillation is thus:

$$t = 2 \times \frac{C_T \times ⅓(V_+ - V_-)}{I_0} = \frac{2}{3} \times \frac{C_T}{I_0} \times (V_+ - V_-)$$

or

$$f = \frac{3}{2} \times \frac{I_0}{C_T} \times \frac{1}{(V_+ - V_-)}$$



The timing capacitor waveform is buffered, brought out as an output, and applied to a triangle-to-sine converter network. The relatively high-impedance sinewave output is another output. The flip-flop is a transistor whose open collector is used as the squarewave output.

volts below the +24-volt supply line, is generated by IC1-a and is necessary to keep the working voltages within the operating range of IC1-d and IC2. Current-source voltage V2 is fed to the current-source networks IC1-d—Q2—R11 and IC2—Q3—R12—R13.

Each op-amp—transistor pair forces V2 across its respective resistor. The transistor, a high-current-gain Darlington PNP, passes virtually all of the current from its emitter to its collector, so we now have two near-ideal current sources at the collectors of Q2 and Q3. Trimmer pots R13 and R14 allow the Q3 current source to be adjusted to meet the calibration needs of the waveform generator, IC7.

High-frequency switching transients appear at the current inputs of the 8038. If these voltage spikes were applied to the collectors of Q2 and Q3, they would couple into the current-regulating network via the collector-base capacitance and create a noisy current-source pair. Series-pass transistors Q4 and Q5 are therefore used to couple most of the transients into the +12-volt supply.

Switch S1, the COARSE FREQUENCY control, selects one of five timing capacitors to be applied to the 8038. A sixth switch position allows an external timing capacitor at the front panel to be used. The current sources are then switched in and out of the selected timing capacitor by the generator IC.

The three waveform outputs of the function generator IC are of different amplitudes, but the triangle and square-wave signals are attenuated to about the same amplitude as the sine output with resistors R15—R16 (triangle) and R17—R18—R19 (square). One of the

R-E TEST REPORT

LEN FELDMAN

THIS COMPACT (9 W × 4¼ H × 6¼-inches D) all-purpose function generator is extremely well designed, relatively easy to assemble and produces sine, square and triangle waveforms. Although frequency sweep is not included internally, it is possible to sweep frequencies of the three available waveforms over a 10:1 range by applying a ramp (or any other varying) voltage at the external modulation terminals. The front-panel controls permit manual frequency adjustment from 2 Hz to 200 kHz in 5 decade ranges.

We measured the frequency ranges available and found that any frequency between 3 Hz and 264,600 Hz was obtainable over the five ranges, with a good deal of overlap, as follows:

"2" range: 3 Hz to 28 Hz
"20" range: 13 Hz to 292 Hz
"200" range: 113 Hz to 2.660 kHz
"2K" range: 1.073 kHz to 27 kHz
"20K" range: 11.9 kHz to 264.6 kHz

Maximum amplitude of the sinewave output measured 3.45 volts RMS, which corresponds to a peak-to-peak value of just under 10 volts, the same value obtained for the triangular and square waveforms. The output amplitude is virtually constant from under 10 Hz to the frequency limit of the generator. As is typical of this type of generator (in which the sinewave output is derived or shaped from the basic flip-flop circuit squarewave, harmonic distortion was fairly high, measuring 2.5% at 20 Hz, 2.0% at 1 kHz and 1.5% at 20 kHz. (The author has subsequently modified the prototype to improve the performance on the 0.1-volt output range. These changes reduce the noise and, therefore, the distortion on this range. Also, squarewave overshoot is reduced. However, we have not had time to test the modified circuit—*Editor*)

Rise and falltime (for 90% of full amplitude) of the squarewave measured 175 ns, well within the 200-ns claimed specification. Figure 1 shows the full amplitude squarewave outputs from the function generator at frequencies of 10 Hz (Fig. 1-a), 1 kHz (Fig. 1-b) and 20 kHz (Fig. 1-c). Figure 2 shows the triangular waveform obtained from the generator, while Fig. 3 is a scope photo of a 1-kHz sinusoidal output obtained from the generator.

Considering the price of most commercially available function generators having similar capabilities, this unit represents extremely good value. Our estimate of construction time, working with the supplied complete kit including etched and drilled PC board, would be one evening or even less.

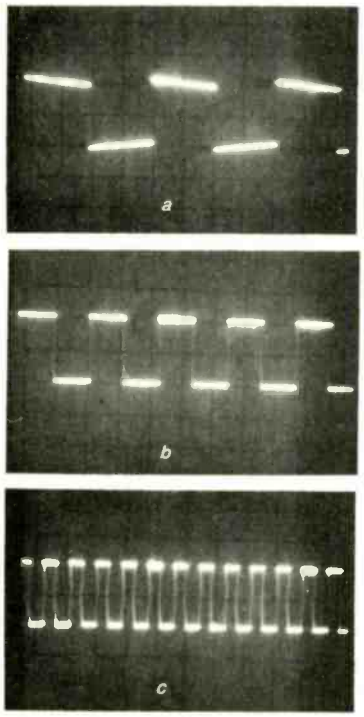


FIG. 1

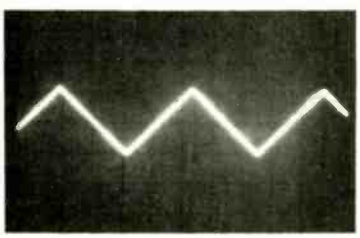


FIG. 2

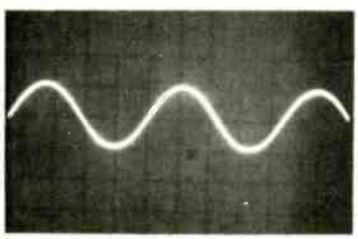


FIG. 3

three (now-equal amplitude) waveforms or the external input waveform is switched by FUNCTION switch S2 into the buffer amplifier network consisting of op-amps IC3, IC4 and IC5. These amplifiers feature extremely high slew rates (50 V/μs), necessary for minimum signal distortion.

The first op-amp, IC3, provides high-impedance buffering between the generator outputs and AMPLITUDE pot R23. The pot output is buffered by IC4, whose output feeds resistor attenuator network R25—R26—R27. The ATTENUATE switch, S3, selects the attenuated signal and routes it to IC5, a noninverting buffer with a gain of 2. If point "GG" on the PC board (and schematic) is switched to ground by BASELINE switch S4, then the waveform output of IC5 will be symmetrical about ground. However, by applying a DC voltage at this point, the output waveform will be offset by an amount equal to the *opposite* of the voltage. That is, by applying −5 volts to "GG" the output will swing around a DC voltage of +5 volts. This variable offset voltage is generated by IC6, adjusted by R33 and selected by switch S4.

The waveform IC's output amplitude is approximately 5 volts P-P. With switch S3 in the 10-volt position the output of IC5 will be about 10 volts P-P. The offset feature allows this signal to be DC-shifted ±6 volts, but signal plus offset cannot exceed ±10 volts without clipping.

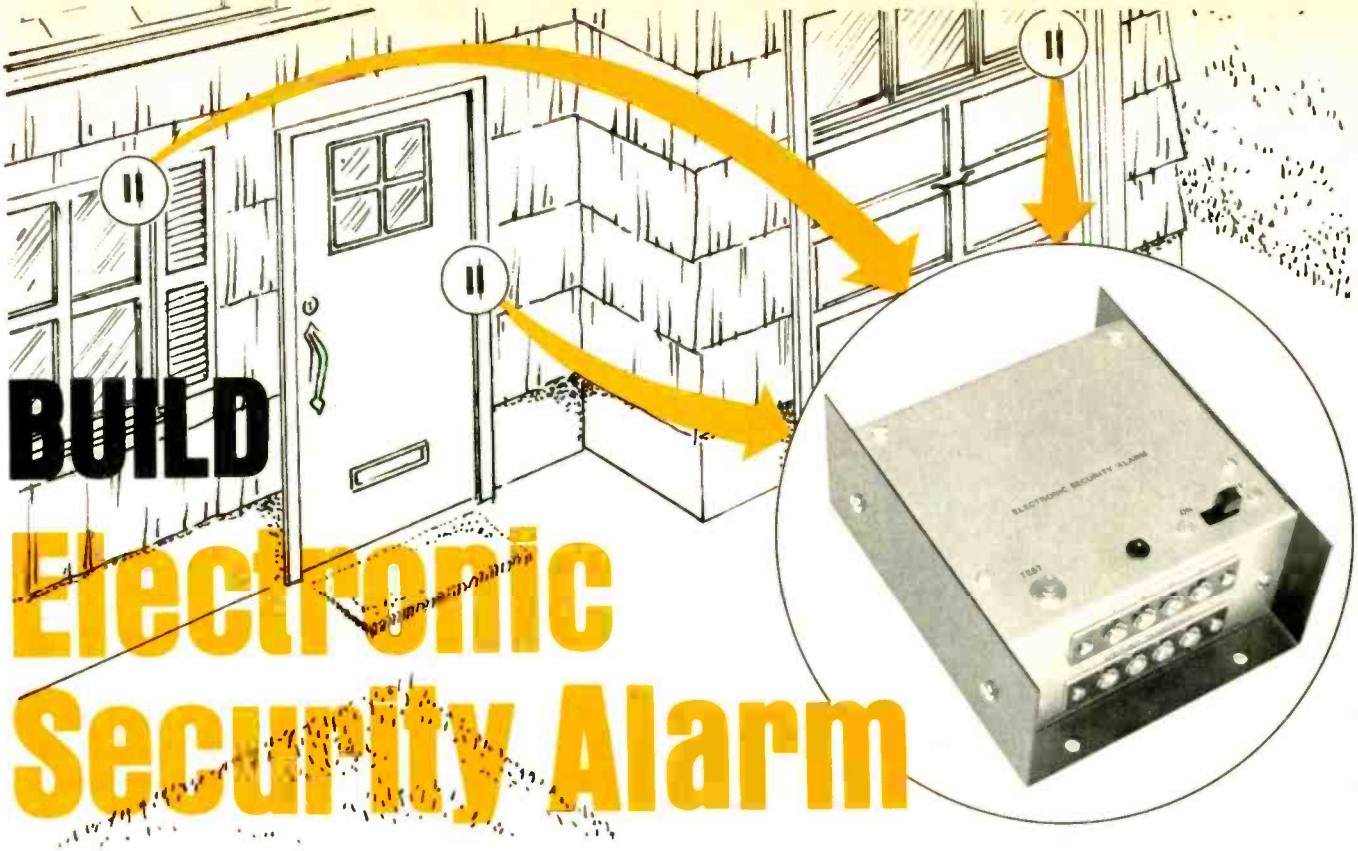
To calibrate the function generator for a 50% waveform duty cycle would normally require an oscilloscope. For those without one, this design includes a built-in duty-cycle calibrator; calibration requires nothing more than a voltmeter.

The calibrator consists of squaring circuit IC8 and integrator/comparator network IC9. The waveform IC's squarewave is capacitively applied to IC8-a, which converts the ground-symmetrical voltage to a swing between +12 volts and ground. The rest of IC8 squares the waveform. The output of the shaping circuit is applied to integrator IC9-a. *In theory, if the applied squarewave had a duty cycle of exactly 50%, the integrator output would be a triangle waveform centered around the +12-volt supply divided by 2.* The triangle amplitude is a function of the input frequency and the integrator values. This design develops a 1.5-volt P-P signal for a 200-Hz input.

However, a duty cycle greater than 50% causes the integrator output to drift up to its positive supply value; less than 50% forces it down to its negative-voltage level. So by comparing the integrator's output to see if its voltage swing stays in the middle of its active range, we can tell when we have a 50% duty cycle. Comparators IC9-c and IC9-d do this. When they detect a voltage above 6.7 volts or below 5.3 volts, they turn on their respective light-emitting diodes, LED1 and LED2. Thus, calibration requires adjusting the current-source trimmer pots until both LED's are off. Voltage-follower IC9-b applies the reference voltage to the comparators and the integrator.

The power supply consists of three monolithic voltage regulators, IC10, IC11 and IC12, that deliver +24, +12, and −12 volts, respectively. The 24-volt supply is necessary for the current-source network, while the ±12-volt supplies handle everything else. Inclusion of bypass capacitor C20 is absolutely essential to prevent IC12 from oscillating. Use only the value shown.

continued next month



BUILD Electronic Security Alarm

Protect your property against intruders with this reliable easy-to-build security system that features both open- and closed-loop detector wiring, convenient operation and CMOS IC's for long battery life.

MICHAEL S. ROBBINS

AN IDEAL BURGLAR ALARM SHOULD BE reliable, effective and inexpensive. The Electronic Security Alarm meets these requirements and more. It features low power consumption, two sensing loops and a distinctive electronic siren. Best of all, the circuit is easy to build from readily available components or from a kit.

For maximum reliability and power-failure protection, the alarm is powered by a 12-volt lantern battery. CMOS integrated circuits insure a battery life that is equal to its shelf life. A unique turn-off circuit also helps to prolong the battery's life by turning off the alarm after a predetermined period of from 1 to 15 minutes.

The two-loop circuit of the alarm allows it to be used with normally closed sensors, such as conductive tape, fine wire grids, and window and door switches, in the closed loop. The open-loop circuit is designed for use with panic buttons, fire, smoke and water-level sensors and other normally open switches.

The closed-loop circuit incorporates several features rarely found in low-cost alarm systems. This circuit includes a latch that insures that the alarm cannot be defeated once an intrusion is detected unless the alarm itself is shut off. Closing the window or door that initially triggered the alarm will not do the job. Since the alarm is usually hidden, the latch provides a high degree of security.

Two 15-second delay generators form part of the closed loop. One delay mechanism allows you to shut off the alarm before the siren is triggered. Since this means you won't be crying "Wolf" each time you enter your house at 2 AM, your neighbors will (1) talk to you the next morning, and (2) be alert and cooperative if the alarm does go off. This trigger-delay feature simply delays the triggering of the siren, it does not allow an intruder to stop a series of events that have already been initiated.

The other 15-second delay feature, the glitch delay, helps to eliminate problems caused by noisy sensor switches. It allows you about 15 seconds to reopen the door and turn off the lights (in case you've forgotten) without resetting the alarm.

The alarm contains a built-in siren circuit that drives an external 8-ohm paging horn that has an equivalent of 10 to 15 watts of squarewave audio. The output consists of a frequency-modulated tone from about 1300 Hz to 700 Hz at a 2-Hz rate; a tone that is difficult to ignore. As an option, the tone generator can be disabled, and the output circuit can be used to drive a relay to operate a telephone dialer, signal light or any combination of bells and whistles.

The alarm is usually installed in a coat closet or other location near the front door or other entranceway. The sensor wires and the leads from the outdoor speaker are run to the alarm. The battery should be located within a few feet of the alarm.

Typical operation of the alarm is as follows:

- Close all the windows and doors.
- Press the test button on the alarm. If the closed-loop circuit is actually closed (that is, the doors, windows, etc., are shut properly) the LED indicator on the alarm will glow.
- Turn the alarm on.
- Open the door (any door in the loop will do) and leave the house.
- Shut the door.

Fifteen seconds after the the door is *shut*, the alarm will be ready for action. This 15-second glitch delay insures that switch bounce or dirty switch contacts will not erroneously trigger the alarm. Any subsequent opening of any door or window in the loop will start another 15-second delay generator. If the loop is broken by an intruder, in 15 seconds the siren will sound and the whole neighborhood will be alerted. The siren will continue to sound for from 1 to 15 minutes (predetermined) or until the alarm is shut off.

The sensors in the open loop are inde-

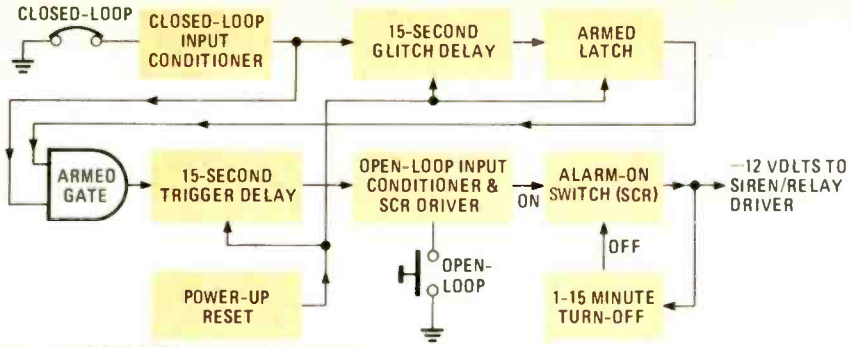


FIG. 1—ELECTRONIC SECURITY ALARM.

pendent of the arming and delay circuits. If the alarm on-off switch is on, any open-loop sensor immediately starts the siren. This feature is useful for personal protection when you are in the house or shop, while the closed-loop sensors are most valuable for property protection when you are not on the premises.

How it works

Figure 1 shows the block diagram of the alarm. The signal path flows from left to right and from top to bottom. Any activity in the closed loop is cleaned up and squared in the input conditioner and sent on to the 15-second glitch delay and the armed gate of the device. When the door is first opened and then shut upon leaving the premises, the input to the armed gate from the armed latch holds a signal and does not allow the input signal to trigger the 15-second trigger delay. After the glitch delay times-out, the armed latch is set and the armed gate passes any subsequent pulse that is generated by opening the closed loop.

When that signal is generated, it activates trigger delay. When it times-out, the SCR driver turns on the alarm-on switch in the ground leg of the tone-generator power supply. The siren starts to wail, and simultaneously the 1- to 15-minute turn-off timer is activated. After a preset period, it shuts off the timer and turns on the test light to indicate that the alarm is off. The test light will stay on until the on-off switch is turned off.

The diagram of Fig. 1 shows how the open-loop sensors bypass the delays and the armed gate. The power-up reset circuit insures that both of the delays and the latch will be reset to the off position whenever the alarm is turned on.

The alarm circuit

The complete alarm circuit is shown in Fig. 2. All the logic blocks are built of CMOS NAND gates. The input conditioner is composed of IC1-a and IC1-c, and the integrator is formed by R3 and C1.

Since the closed-loop input terminal, Z, is normally grounded through the closed-loop sensors, the logic level at the input to IC1-a is normally 0. (Logic level 0 is ground, logic level 1 is a positive voltage level of about 12 volts.) If the loop is opened, the logic level at the input is pulled to 1 by R1 and D4. The output of IC1-a goes to logic 0 and begins to discharge C1. Capacitor C1 is discharged in about 1 ms. The input to IC1-c is now logic 0 and its output is logic 1.

The glitch delay is a monostable multivibrator comprised of IC2-b and IC1-d. It does not respond to an input logic-level change from logic 0 to logic 1 but does respond to a logic-level change from 1 to 0. In operation, the first closing of the door causes the logic-level change from 1 to 0 that the glitch delay responds to. The output of the glitch delay (IC2-b pin 4) goes from logic 0 to logic 1 as soon as its input goes from logic 1 to logic 0. This change is coupled to pin 9 of IC1-d by

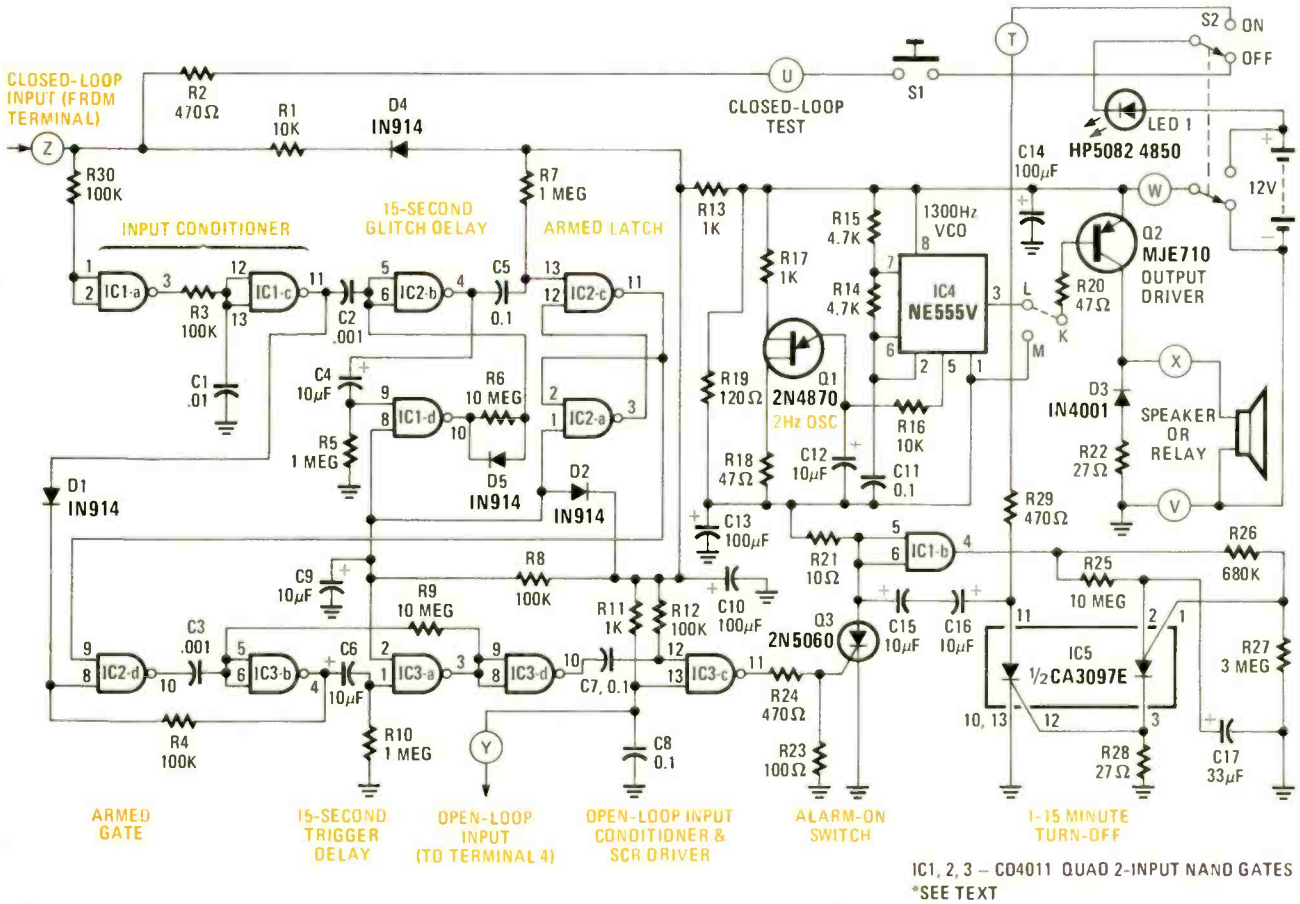


FIG. 2—ALARM FEATURES glitch prevention and automatic alarm shutoff. Note that IC1-B is a NAND gate instead of AND gate as shown.

capacitor C4 causing IC1-d pin 10 to go from logic 1 to logic 0. This pulls the glitch delay input to logic 0 through D5 and R6, and causes everything to remain in this state until C4 charges through R5. The charging time of approximately 15 seconds is the delay time. During this interval, the input to the glitch delay is insensitive to any change.

Once C4 charges, IC1-d pin 9 goes to logic 0, pin 10 goes to logic 1, pins 5 and 6 of IC2-b also go to logic 1, and the glitch-delay output (IC2-b pin 4) goes to logic 0. This change at the output causes the armed latch (IC2-a and IC2-c) to be set.

The armed latch is an R–S flip-flop (bistable miltivibrator) with two stable states. It is reset each time the power is applied to the alarm (as are the two delay circuits) by C9, R8 and D2. When the armed latch is set by the 1 to 0 logic-level change at the output of the glitch delay (it remains set until the alarm is shut off), it enables the armed gate (IC2-d and D1).

The armed gate has three inputs: One from the input conditioner through D1, one from the trigger delay through R4 and one from the armed latch. When the armed latch is set, an input signal from the input conditioner caused by an break in the closed loop will cause IC2-d pin 10 to go from logic 1 to logic 0. Until the armed latch is set, this cannot happen.

The output of the armed gate is transmitted through C3 to the trigger delay (IC3-a and IC3-b). The trigger delay is a monostable multivibrator that operates similar to the glitch delay, and has two outputs; the IC3-b pin 4 output is fed through R4 to the armed gate. Once the trigger delay begins, no signal flows through the armed gate. The other trigger-delay output (IC3-a pin 3) is inverted by IC3-d and fed to IC3-c. This NAND gate drives Q3 (the SCR). Either an output from inverter IC3-d or an input (ground) on open-loop input terminal Y causes IC3-c to trigger Q3.

Figure 3 shows the circuits of the alarm-on switch and the turn-off switch. The SCR, Q3, and the SCR section of IC5 form an anode-commutated latch. When DC power is applied (the alarm is turned on) both SCR's are in the off state. After the trigger delay times-out or after the open loop is activated, a pulse is applied to the gate of Q3, turning it on. With Q3 on, the voltage at the junction of R19 and R21 drops from 12 volts to almost 0 volts, turning on the tone generator. Two additional events occur: The nonpolar capacitor formed by the series combination of C15 and C16 charges to 12 volts with the end connected to IC5 positive and the end connected to IC3 negative. The output of inverter IC1-b goes positive and supplies the B+ supply to the Programmable Unijunction Transistor (PUT) timer (part of IC5).

The PUT timer fires after C17 has charged to a voltage determined by R26 and R27 (hence the term "programmable"). The time it takes C17 to charge to this voltage can be controlled by varying R25. The PUT section of the CA 3097E used for IC5 has characteristics that make it possible to build a 15-minute timer using inexpensive components.

When the PUT fires, the pulse generated across R28 turns on the SCR in IC5. The voltage at the anode of this SCR goes to 0, pulling the positive side of the capacitor combination C15–C16 with it. This causes a 12-volt negative pulse to be applied to the anode of SCR Q3, shutting it off. The IC1-b output again goes to ground, and the only part that is still on is the SCR section of IC5. Since it draws its current through R29, LED1 remains on.

Construction

Figure 4 is the photograph of the assembled circuit board. Perforated board with solder-type or wire-wrap hardware can be used, but using the curcuit board makes it easier to duplicate the prototype. The foil pattern for the circuit board is shown in Fig. 5 and the foil pattern of Fig. 6 shows the components placement.

None of the parts values are critical.

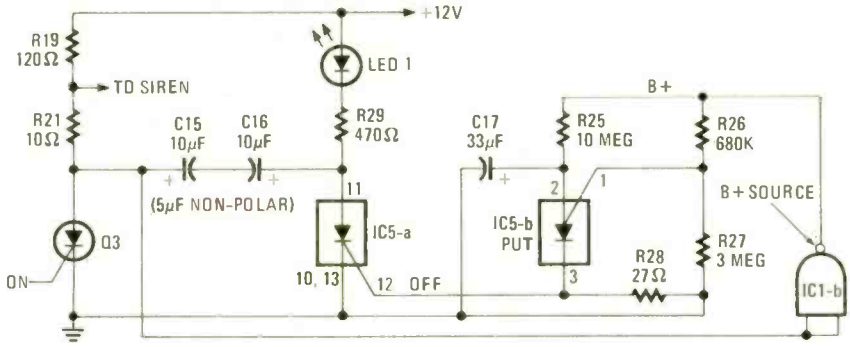


FIG.3—ALARM-ON SWITCH and turn-off circuit diagram.

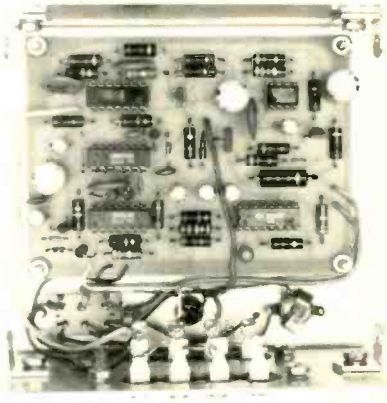


FIG. 4—PRINTED-CIRCUIT BOARD COMPONENTS and connections.

PARTS LIST

All resistors ½ watt, 10% unless noted. Capacitors as indicated, at least 16-volt rating.

R1, R16—10,000 ohms
R2, R24, R29—470 ohms
R3, R4, R8, R12, R30—100,000 ohms
R5, R7, R10—1 megohm
R6, R9—10 megohms
R11, R13, R17—1000 ohms
R14, R15,—4700 ohms
R18, R20—47 ohms
R19—120 ohms, 1 watt
R21—10 ohms
R22, R28—27 ohms
R23—100 ohms
R25—10 megohms (See text.)
R26—680,000 ohms
R27—3 megohms

C1—0.01-μF, ceramic disc
C2, C3—0.001-μF, ceramic disc
C4, C6, C9, C12, C15, C16—10-μF, 16-volt electrolytic
C5, C7, C8, C11—0.1-μF, ceramic disc
C10, C13, C14—100-μF, 16-volt electrolytic
C17—33-μF, 16-volt tantalum electrolytic
D1, D2, D4, D5—1N914 diode
D3—1N4001 diode
LED1—light-emitting diode (HP 5082-4850, or equiv.)
Q1—2N4870 unijunction transistor
Q2—MJE710 PNP power transistor
Q3—2N5060 silicon-controlled rectifier
IC1-IC3—CD4011, quad 2-input NAND gate
IC4—NE555V timer, or equiv.
IC5—CA3097E, thyristor/transistor array
S1—normally open pushbutton switch
S2—DPDT slide switch
Misc.—hardware, PC board, cabinet, wire, solder, 12-volt lantern battery, speaker, and required door and window switches.

The following are available from Caringella Electronics, Inc., Box 727, Upland, CA 91786:
Order No. ESA-2PC—PC board, drilled and etched, $6.95 postpaid in U.S.
Order No. ESA-2K—complete kit, including cabinet, wire, etc., $29.95, plus $2 shipping and handling.
California residents add state and local taxes as applicable.

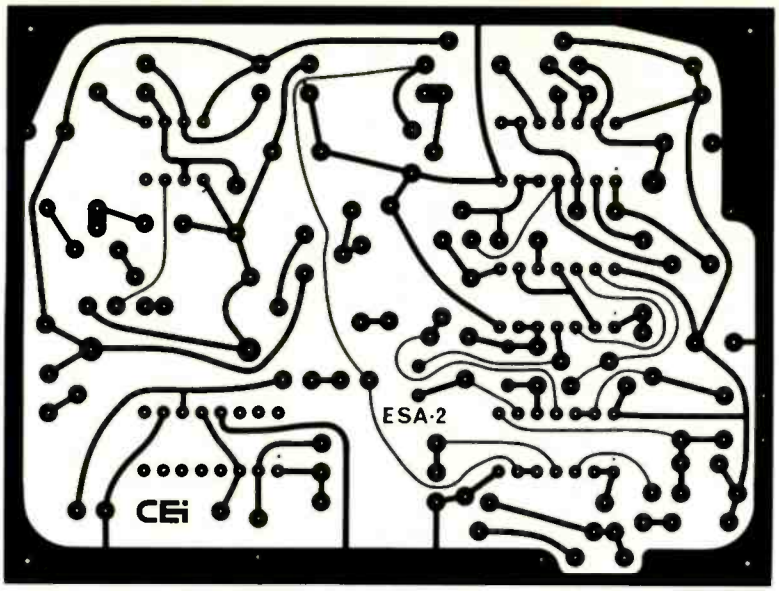


FIG. 5 (top left)—FULL-SIZE foil pattern for PC board.

FIG. 6 (center left)—HOW COMPONENTS ARE PLACED ON circuit board.

FIG. 7 (bottom left)—INSTALLATION WIRING diagram.

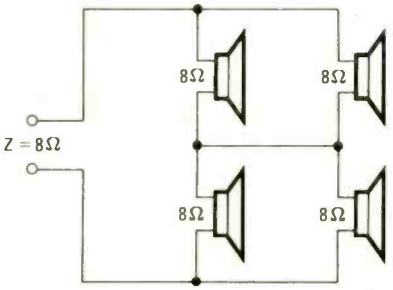
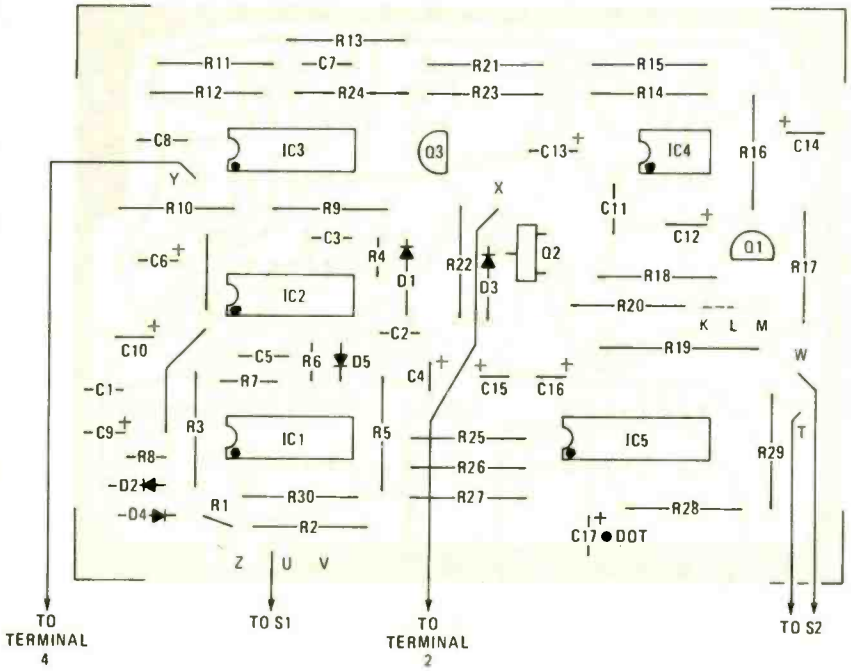
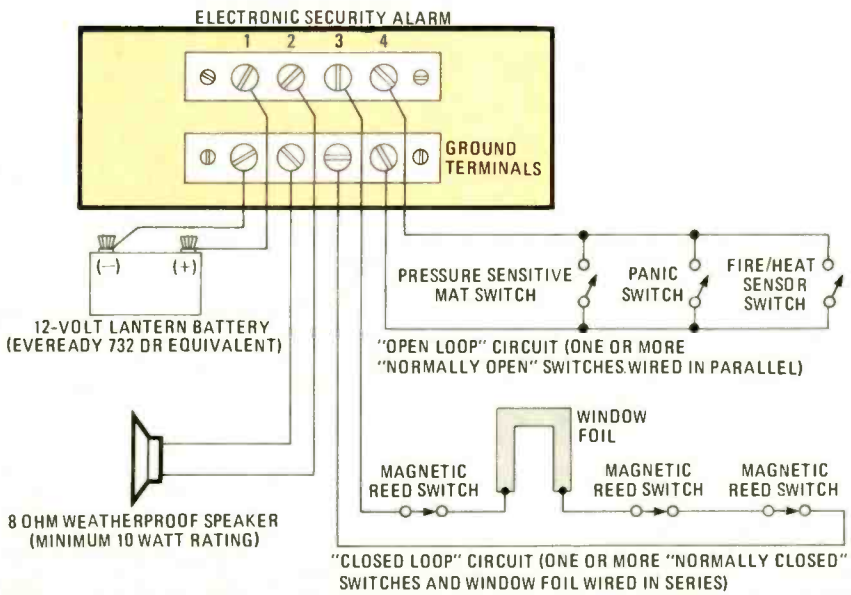


FIG. 8—MULTIPLE SPEAKER CONNECTIONS.





Five % or 10 % resistors and 20% capacitors are satisfactory. Values are standard and readily available.

The three CMOS IC's (CD4011AE or the equivalent) can be damaged by static electricity. Therefore, they should be stored in carriers or conductive-plastic foam, or wrapped in aluminum foil. The IC's should be plugged into their sockets on the circuit board only after all the other components have been soldered and the board is mounted in the cabinet. The power switch should be *off*.

Set the turn-off time by adjusting the value of R25. Any value from 1 megohm to 22 megohms will work. A 10-megohm resistor gives a turn-off time of about 10 minutes, and longer times require higher values. Check your city ordinances. Some cities limit the time that an alarm may sound to 3–5 minutes.

Installation

The complexity of the installation depends upon the size of the area to be protected, the number of doors and windows and the number of special sensors. Figure 7 shows a typical system layout. Any number of switches can be added to either loop.

Wire for the two loops can be of any convenient size or type since only very low currents are involved. Bell wire, No. 18 zip cord or the minizip cord sometimes used for speakers are all suitable. Wire that will go to the speaker and the battery should be No. 18 or larger. All wires should be inside the protected area so that the alarm cannot be defeated. The alarm itself, the battery and the speaker should not be visible or easily damaged from the outside. The speaker impedance should be no less than 8 ohms. If more than one speaker is required, the series or series-parallel arrangements shown in Fig. 8 should be used. One final suggestion. Install the alarm *before* you are burglarized! **R-E**

ROUNDUP

Cases And Cabinets For Your Projects

ONE OF THE MAJOR CONSIDERATIONS FACING THE amateur electronic experimenter and constructor is the physical layout and appearance of the finished project. In the days of vacuum tube and 12 by 16 in. chassis, most projects could be finished off nicely by adding a front panel and slipping the whole thing into a cabinet that could be handcrafted from wood or readily available sheet metals. Today, most electronic projects are assembled on printed-circuit boards or similar materials and are sometimes only one-tenth the size of its old vacuum-tube equivalent.

To select a case or enclosure that is most suitable for your project, you must have a pretty good idea as to what is available. Too, if your make and model specified in a magazine article is not available through your usual supplier, you should be aware of equivalents and possible substitutes. These charts list off-the-shelf enclosures, cases and chassis boxes in various material combinations, colors and sizes.

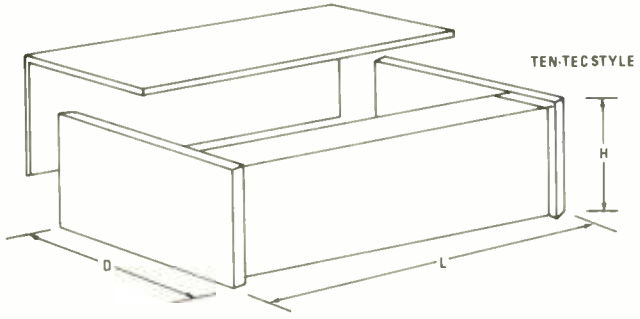
These charts list cases and cabinets not covered in the June 1978 issue of Radio-Electronics. While every effort has been made to ensure that these charts are as complete as possible, it is not always possible to include all the options and ordering information. It is, therefore, a good idea to obtain catalogs from the manufacturers.

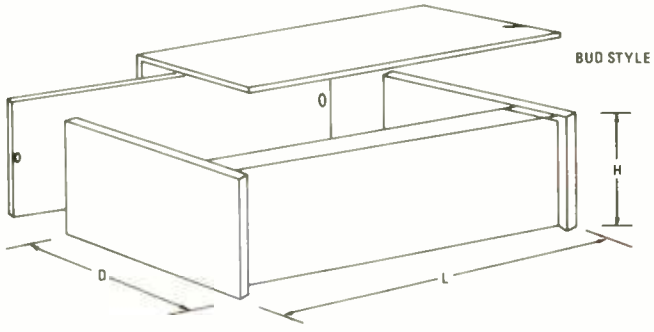
To find out more about the products or distributors, a list of addresses of each manufacturer follows. To obtain a catalog, simply circle the corresponding No. on the Free Information card.

Apollo – Industrial Park, Hauppauge, NY Circle No. 136
Buckeye – 555G Marion Road, Columbus, OH 43207. (614) 445-8433. Circle No. 137
Bud Electronics – Dept G , 4605 East 355 Street, Willoughby, OH 44094. (216) 946-3200. Circle No. 138
GC Electronics – Division of Hydrometals, Inc., Rockford, IL 61101. Circle No. 139
Intra Fab, Inc., – 660 Lenfest Rd. San Jose, CA 95133. (408) 251-1600. Circle No. 140
Lafayette Electronics – 111 Jericho Turnpike, Syosset, NY 11791. (516) 921-7700. Circle No. 141
La France, – Enterprise and Executive Avenues, Philadelphia PA 19153. (215) 365-8000. Circle No. 142
LMB Products – 725 Ceres Avenue, Los Angeles, CA 90021. (213) 627-9310. Circle No. 143
Premier Metals – C/O Sunshine Mining Co., 337 Manida St., Bronx, NY 10474. (212) 993-9200. Circle No. 144
Radio Shack – 2617 West 7th Street, Ft. Worth, TX 76107. (817) 390-3272. Circle No. 145
Rose/Stahlin – 500 Maple Street, Belding, MI 48809. (616) 794-0700. Circle No. 146
Scientific-Atlanta – Optima Enclosures-2166 Mountain Industrial Road, Tucker, GA 30084. (404) 939-6340. Circle No. 147
TenTec, Inc. – Dept G., Industrial Park, Sevierville, TN 37862. (615) 453-7172. Circle No. 148
Vector Electronics Co., – 12460 Gladstone Ave., Sylmar, CA 91342. (213) 365-9661. Circle No. 149
Zero Mfg. – 777 Front Street, Burbank, CA 91503. (213) 846-4191. Circle No. 150

EQUIPMENT ENCLOSURES

Provides accessibility through top and front. Most have molded Cycolac plastic end-pieces for a professional look.





Length	Height	Depth	Mfr.	Model No.	Case Material	Comments	Options	Color
3-5/8	2-1/8	5-9/16	Ten-Tec	JW-4	Cycolac panels Al case	–	–	walnut/white
3-5/8	2-1/8	5-9/16	Ten-Tec	JG-4	Cycolac panels Al case	–	–	grey/black
3-5/8	2-15/16	6-11/16	Ten-Tec	LW-4	Cycolac panels Al case	–	–	walnut/white
3-5/8	2-15/16	6-11/16	Ten-Tec	LG-4	Cycolac panels Al case	–	–	grey/black
4-11/16	2-1/8	5-9/16	Ten-Tec	JW-5	Cycolac panels Al case	–	–	walnut/white

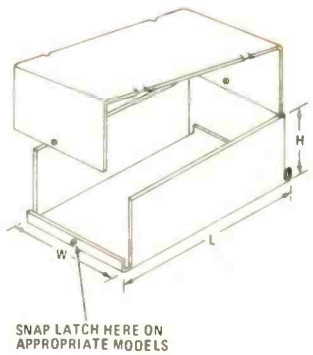
chart continued on following page

EQUIPMENT ENCLOSURES

Length	Height	Depth	Mfr.	Model No.	Case Material	Comments	Options	Color
4-11/16	2-1/8	5-9/16	Ten-Tec	JG-5	Cycolac panels Al case	–	–	grey/black
4-11/16	2-15/16	6-11/16	Ten-Tec	LW-5	Cycolac panels Al case	–	–	walnut/white
4-11/16	2-15/16	6-11/16	Ten-Tec	LG-5	Cycolac panels Al case	–	–	grey/black
4-3/4	4-3/16	6-5/16	Ten-Tec	MG-5	Cycolac panels Al case	–	–	grey/black
4-3/4	4-3/16	6-5/16	Ten-Tec	MW-5	Cycolac panels Al case	–	–	walnut/white
4-3/4	4-3/16	6-5/16	Bud	MB-1670	Cycolac panels Al case	tie bar support	–	grey
4-3/4	4-3/16	6-5/16	Bud	MW	Cycolac panels Al case	tie bar support	–	walnut/white
4-11/16	2-1/8	5-9/16	Lafayette	12-P-03033V	Al	tie bar	–	walnut/white
5-3/4	4-3/16	5-5/6	Lafayette	12-P-03066V	Al	tie bar	–	walnut/white
5-11/16	2-1/8	5-9/16	Ten-Tec	JG-6	Cycolac panels Al case	–	–	grey
5-11/16	2-1/8	5-9/16	Ten-Tec	JW-6	Cycolac panels Al case	–	–	walnut/white
5-11/16	2-15/16	6-11/16	Ten-Tec	LG-6	Cycolac panels Al case	–	–	grey
5-11/16	2-15/16	6-11/16	Ten-Tec	LW-6	Cycolac panels Al case	–	–	walnut/white
5-3/4	4-3/16	6-5/16	Ten-Tec	MG-6	Cycolac panels Al case	–	–	grey
5-3/4	4-3/16	6-5/16	Ten-Tec	MW-6	Cycolac panels Al case	–	–	walnut/white
5-3/4	4-3/16	6-5/16	Bud	MB-1671	Cycolac panels Al case	tie bar support	–	black/grey
5-3/4	4-3/16	6-5/16	Bud	MW-3221	Cycolac panels Al case	tie bar support	–	walnut/white
6-11/16	2-1/8	5-9/16	Ten-Tec	JG-7	Cycolac panels Al case	–	–	grey
6-11/16	2-1/8	5-9/16	Ten-Tec	JW-7	Cycolac panels Al case	–	–	walnut/white
6-11/16	2-1/8	5-9/16	Lafayette	12-P-03041V	Al	tie bar	–	walnut/white
6-11/16	2-15/16	6-11/16	Ten-Tec	LG-7	Cycolac panels Al case	–	–	grey
6-11/16	2-15/16	6-11/16	Ten-Tec	LW-7	Cycolac panels Al case	–	–	walnut/white
6-3/4	4-3/16	6-5/16	Bud	MB-1672	Cycolac panels Al case	tie bar support	–	black/grey
6-3/4	4-3/16	6-5/16	Bud	MW-3222	Cycolac panels Al case	tie bar support	–	walnut/white
6-3/4	4-3/16	6-5/16	Ten-Tec	MG-7	Cycolac panels Al case	–	–	grey/black
6-3/4	4-3/16	6-5/16	Ten-Tec	MW-7	Cycolac panels Al case	–	–	walnut/white
7-3/4	2-1/8	5-9/16	Ten-Tec	JW-8	Cycolac panels Al case	–	–	walnut/white
7-3/4	2-1/8	5-9/16	Ten-Tec	JG-8	Cycolac panels Al case	–	–	grey/black
7-3/4	4-3/16	6-5/16	Bud	MB-1673	Cycolac panels Al case	tie bar support	–	black/grey
7-3/4	4-3/16	6-5/16	Bud	MW-3223	Cycolac panels Al case	tie bar support	–	walnut/white
7-3/4	4-3/16	10-7/32	Bud	DB-1680	Cycolac panels Al case	tie bar support	–	black/grey
7-3/4	4-3/16	10-7/32	Bud	DW-3230	Cycolac panels Al case	tie bar support	–	walnut/white
7-3/4	4-3/16	10-7/32	Ten-Tec	DG-8	Cycolac panels Al case	–	–	grey/black
7-3/4	4-3/16	10-7/32	Ten-Tec	DW-8	Cycolac panels Al case	–	–	walnut/white
7-13/16	4-3/16	6-5/16	Ten-Tec	MG-8	Cycolac panels Al case	–	–	grey/black
7-13/16	4-3/16	6-5/16	Ten-Tec	MW-8	Cycolac panels Al case	–	–	walnut/white
7-13/16	4-3/16	6-5/16	Bud	MB-1673	Cycolac panels Al case	tie bar support	–	black/grey
7-13/16	4-3/16	6-5/16	Bud	MW-3223	Cycolac panels Al case	tie bar support	–	walnut/white

EQUIPMENT ENCLOSURES

Length	Height	Depth	Mfr.	Model No.	Case Material	Comments	Options	Color
7-13/16	4-3/16	5-5/16	Lafayette	12-P-03082V	Al	–	–	walnut/white
9-3/4	4-3/16	10-7/32	Bud	DB-1681	Cycolac panels Al case	tie bar support	–	black/grey
9-3/4	4-3/16	10-7/32	Bud	DW-3231	Cycolac panels Al case	tie bar support	–	walnut/white
9-3/4	4-3/16	10-7/32	Ten-Tec	DG-10	Cycolac panels Al case	–	–	black/grey
9-3/4	4-3/16	10-7/32	Ten-Tec	DW-10	Cycolac panels Al case	–	–	walnut/white
9-7/8	2-1/8	5-9/16	Ten-Tec	JG-8	Cycolac panels Al case	–	–	grey/black
9-7/8	2-1/8	5-9/16	Ten-Tec	JW-8	Cycolac panels Al case	–	–	walnut/white
9-7/8	2-1/8	5-9/16	Lafayette	12-P-03058V	Al	tie bar	–	walnut/white
9-7/8	2-15/16	6-11/16	Ten-Tec	LG-10	Cycolac panels Al case	–	–	grey/black
9-7/8	2-15/16	6-11/16	Ten-Tec	LW-10	Cycolac panels Al case	–	–	walnut/white
9-15/16	4-3/16	6-5/16	Ten-Tec	MG-10	Cycolac panels Al case	–	–	grey/black
9-15/16	4-3/16	6-5/16	Ten-Tec	MW-10	Cycolac panels Al case	–	–	walnut/white
9-15/16	4-3/16	6-5/16	Bud	MB-1675	Cycolac panels Al case	tie bar support	–	black/grey
9-15/16	4-3/16	6-5/16	Bud	MW-3225	Cycolac panels Al case	tie bar support	–	walnut/white
11-3/4	4-3/16	10-7/32	Bud	DB-1682	Cycolac panels Al case	tie bar support	–	black/grey
11-3/4	4-3/16	10-7/32	Bud	DW-3232	Cycolac panels Al case	tie bar support	–	walnut/white
11-3/4	4-3/16	10-7/32	Ten-Tec	DG-12	Cycolac panels Al case	–	–	grey/black
11-3/4	4-3/16	10-7/32	Ten-Tec	DW-12	Cycolac panels Al case	–	–	walnut/white
11-15/16	4-3/16	6-5/16	Ten-Tec	MG-12	Cycolac panels Al case	–	–	grey/black
11-15/16	4-3/16	6-5/16	Ten-Tec	MW-12	Cycolac panels Al case	–	–	walnut/white
11-15/16	4-3/16	6-5/6	Lafayette	12-P-03082V	Al	tie bar	–	walnut/white
11-15/16	4-3/16	6-5/16	Bud	DB-1682	Cycolac panels Al case	tie bar support	–	black/grey
11-15/16	4-3/16	6-5/16	Bud	DW-3232	Cycolac panels Al case	tie bar support	–	walnut/white
13-3/4	4-3/16	10-7/32	Bud	DB-1683	Cycolac panels Al case	tie bar support	–	black/grey
13-3/4	4-3/16	10-7/32	Bud	DW-3233	Cycolac panels Al case	tie bar support	–	walnut/white
13-3/4	4-3/16	10-7/32	Ten-Tec	DW-14	Cycolac panels Al case	tie bar support	–	walnut/white
13-3/4	4-3/16	10-7/32	Ten-Tec	DG-14	Cycolac panels Al case	tie bar support	–	black/grey



INTERLOCKING TOP AND BOTTTOM

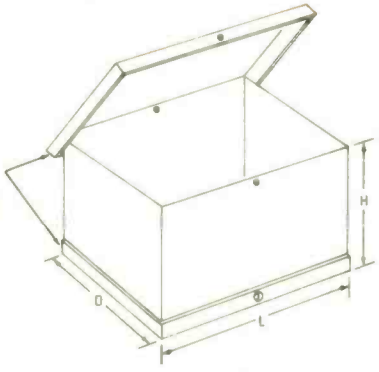
Rugged, sturdy and simple to assemble and take apart—only two set screws hold it together.

Length	Height	Depth	Mfr.	Model No.	Case Material	Comments	Options	Color
2-1/4	1-3/8	1-1/2	LMB	M00	Al	–	Order SL-M00 for snap latch	N, blk, gry, brwn

chart continued on following page

INTERLOCKING TOP AND BOTTOM

Length	Height	Depth	Mfr.	Model No.	Case Material	Comments	Options	Color
2-1/4	1-3/8	2-1/4	LMB	SL-002	Al	snap latch		N, blk, gry, brwn
2-3/4	2-1/8	2-1/8	LMB	103	Al	–	Order SL for snap latch	N, blk, gry, brwn
2-3/4	2-5/8	2-1/8	LMB	100	Al	–	Order SL for snap latch	N, blk, gry, brwn
2-15/16	1-3/4	2-1/8	LMB	002	Al	–	Order SL for snap latch	N, blk, gry, brwn
3	5	4	LMB	140	Al	–	Order SL for snap latch	N, blk, gry, brwn
3-1/4	1-5/8	2-1/8	LMB	000	Al	–	Order SL for snap latch	N, blk, gry, brwn
3-3/4	2-1/8	3	LMB	135	Al	–	Order SL for snap latch	N, blk, gry, brwn
4	1-5/8	2-1/8	LMB	00	Al	–	Order SL for snap latch	N, blk, gry, brwn
4	2-3/4	2	LMB	102	Al	–	Order SL for snap latch	N, blk, gry, brwn
4	4	2	LMB	143	Al	–	Order SL for snap latch	N, blk, gry, brwn
4	2-1/4	2-1/4	LMB	107	Al	–	Order SL for snap latch	N, blk, gry, brwn
4-1/4	1-1/4	2-1/4	LMB	101	Al	–	Order SL for snap latch	N, blk, gry, brwn
5	2-1/4	2-1/4	LMB	108	Al	–	Order SL for snap latch	N, blk, gry, brwn
5-1/4	2-1/8	3	LMB	136	Al	–	Order SL for snap latch	N, blk, gry, brwn
6	3	5	LMB	141	Al	–	–	N, blk, gry, brwn
6	5	4	LMB	142	Al	–	Order SL for snap latch	N, blk, gry, brwn
6-1/4	3-1/2	2-1/8	LMB	138	Al	–	Order SL for snap latch	N, blk, gry, brwn
6-1/2	1-5/8	2-1/8	LMB	650	Al	–	–	N, blk, gry, brwn
7	3	5	LMB	145	Al	–	Order SL for snap latch	N, blk, gry, brwn
8	2-3/4	3	LMB	137	Al	–	Order SL for snap latch	N, blk, gry, brwn
8-1/2	1-5/8	2-1/8	LMB	850	Al	–	Order SL for snap latch	N, blk, gry, brwn
10	2-1/2	4	LMB	144	Al	–	Order SL for snap latch	N, blk, gry, brwn
12	1-3/4	2	LMB	15	Al	–	Order SL for snap latch	N, blk, gry, brwn



UTILITY BOX

Both top and bottom panels are removable, providing easy accesibility.

Length	Height	Depth	Mfr.	Model No.	Case Material	Comments	Options	Color
4	2	4	LMB	U-C-970	Al	.040 gauge	–	grey
4	3	5	LMB	U-C-971	Al	.040 gauge	–	grey
5	3	7	LMB	U-C-974	Al	.040 gauge	–	grey
5	4	6	LMB	U-C-972	Al	.040 gauge	–	grey
6	5	9	LMB	U-C-975	Al	.051 gauge	–	grey
6	6	6	LMB	U-C-973	Al	.040 gauge	–	grey
7	6	12	LMB	U-C-977	Al	.051 gauge	–	grey
8	7	10	LMB	U-C-976	Al	.051 gauge	–	grey
9	7	15	LMB	U-C-980	Al	.051 gauge	–	grey
10	8	10	LMB	U-C-978	Al	.051 gauge	–	grey
11	12	8	LMB	U-C-979	Al	.051 gauge	–	grey

Buyers Guide To FM Tuners

Special Len Feldman Report

How To Choose The Right FM Tuner

The performance of an FM tuner or receiver can be predicted from a study of technical specifications in the manufacturers' literature. Understand the specifications and you can select the tuner that's best for you.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

FM RADIO, ONCE THE ORPHAN OF THE broadcasting world, now rivals AM radio in listener acceptance and commercial success. To the high-fidelity enthusiast, FM and stereo FM programs are a free, always available program source that provides endless hours of listening pleasure. To record companies, FM offers the best means to demonstrate their new products to the listening public for possible addition to permanent collections. In a component hi-fi system, FM and stereo FM programming can form part of an integrated, one-piece stereo receiver, or can be a separate tuner that can be plugged into the appropriate terminals on either a separate preamplifier or an integrated preamplifier/power amplifier. Regardless of which approach is selected, it is necessary to understand the basic operation of FM and how a good FM tuner (or tuner section) can be expected to perform. This will also help you understand the technical specifications describing this important component and thus select the right system for your own listening requirements.

How FM radio differs

FM radio has been described as static-free (when compared with AM broadcasting). Another attribute is its ability to convey "higher fidelity," or better audio frequency response than AM radio. Oddly enough, neither of these qualities is inherent in FM transmission (nor is it specifically limited in AM radio). As anyone who has tried to listen to very distant FM stations on a less-than-high quality FM tuner or radio with a poorly designed antenna knows, FM reception can be as (or more) noisy than AM. Furthermore, a few AM stations in the United States broadcast as much "fidelity" (or wide frequency response) as their FM counterparts (although most AM tuners or receivers cannot reproduce all those frequencies for reasons of economy). What, then, makes FM a noise-free, high-fidelity program source?

The main difference between FM and AM is the way in which audio information is applied to the radio waves. In AM transmission, the intensity or amplitude of the station's radiated waves (within the AM frequency band from 535 kHz to 1605 kHz) is varied in accordance with the audio information to be broadcast, as shown in Fig. 1. In the case of FM transmission, the *frequency* of the station actually varies in response to the audio waveforms being conveyed or broadcast (see Fig. 2).

When AM received signals are amplified by an AM tuner, differences in amplitude of the incoming waves must be maintained throughout the amplification process, since these differences convey the audio information to be recovered by the AM set's detector circuits. Since what we call "noise" or "static" is also amplitude-varying, atmospheric storms, nearby electrical appliances (such as fluorescent lights, shaving motors, etc.) also add noise to the total incoming AM signal amplitude and interfere with AM reception (see Fig. 3).

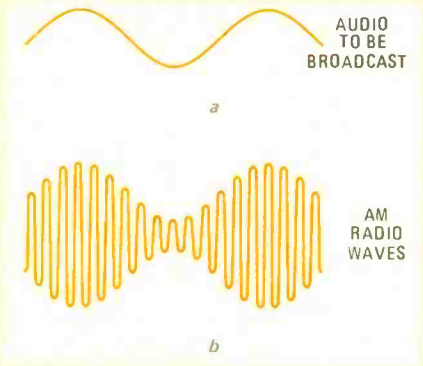


FIG. 1—AMPLITUDE MODULATION. The audio signal shown in *a* modulates the amplitude of the carrier wave as shown in b.

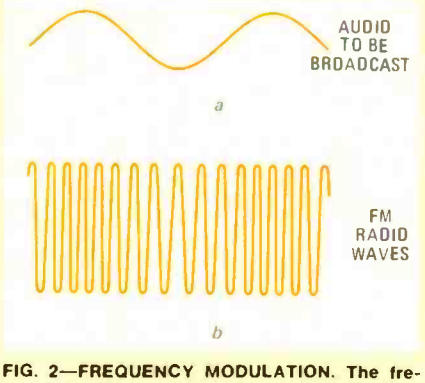


FIG. 2—FREQUENCY MODULATION. The frequency of the carrier wave is modulated by the audio signal shown in *a*. The resultant waveform shown in *b* is transmitted.

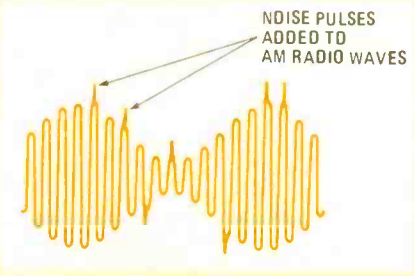


FIG. 3—NOISE SIGNALS are added to the amplitude of the AM wave and interfere with reception.

In the case of FM reception, since the audio information is conveyed in the form of changing *frequency*, it is possible to strip away the AM-type noise (as shown in Fig. 4), using a circuit known as a limiter without altering the recoverable audio content of the composite received radio signals. However, if the signal is too weak, the noise riding on top of it may not be stripped away, which is why listeners in weak-signal areas hear background noise, hiss and static even on FM sets.

The higher frequency-response capability of FM, was brought about in the early days of the two broadcast systems. When AM radio first appeared, audio equipment was hardly capable of hi-fi performance, and it was general practice to limit AM fidelity to around 5000 Hz (both at the broadcast studio and in home receivers). Greater frequency response would require greater spacing on the AM dial between stations to avoid spillover from one station to another.

In the case of FM, when broadcast

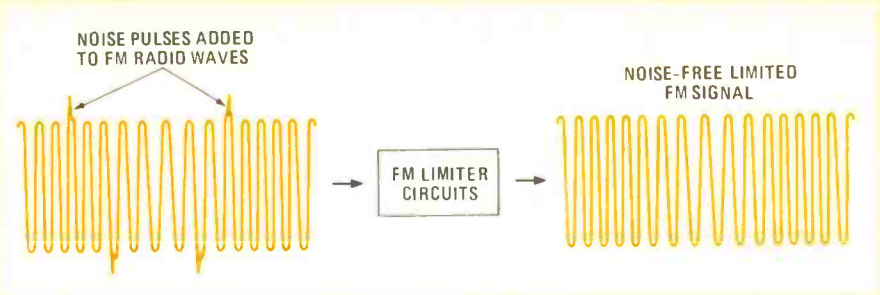


FIG. 4—NOISE SIGNALS are added to the amplitude of the FM wave, but since the wave is frequency modulated, the noise can be eliminated by a simple amplitude limiter circuit.

rules for this service were first established, response out to 15,000 Hz was authorized (and in fact required) by the FCC. The FM broadcast band is much higher in frequency than the AM band (in the U.S., from 88 MHz to 108 MHz), and the spacing between adjacent channels is a comfortable 200 kHz (0.2 MHz). Audio enthusiasts who think that hi-fi has a frequency response from 20 Hz to 20,000 Hz may, in fact, be surprised and somewhat disappointed to learn that the highest audio frequency that can be transmitted by an FM station *is* only 15 kHz; however, such response still represents excellent fidelity. Few program sources such as discs or tapes contain any program information that exceeds that high frequency.

FM tuner elements

Figure 5 is a block diagram of the various circuits that constitute a stereo FM tuner. The so-called front end of the tuner receives the minute electrical signals reaching the FM antenna, selects the

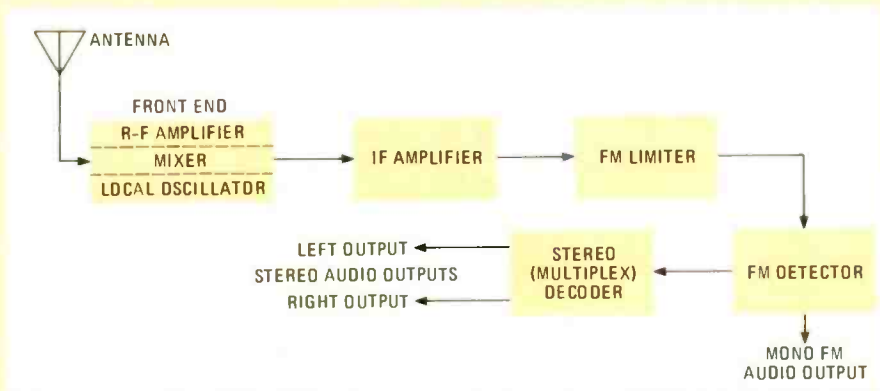


FIG. 5—FM STEREO TUNER. An FM monophonic tuner is identical but without the stereo decoder circuit.

frequency of the desired station (by using several resonant circuits that amplify only those frequencies and exclude others), amplifies them, and combines them with signals generated by a self-contained oscillator permanently tuned to a frequency that is just 10.7 MHz higher than the incoming signal. The difference signal is extracted from a circuit known as a mixer stage, and is always at a frequency of 10.7 MHz, known as the IF frequency. This technique is called superheterodyning. It simplifies the succeeding IF amplifying section, which must be sensitive only to 10.7-MHz frequencies and does not therefore have to be tuned individually.

From the IF section, the greatly amplified signals are transmitted to the limiter stages (those circuits that strip away unwanted noise and static), and then are applied to the FM detector stage, which converts the varying 10.7-MHz *frequencies* back into the audio information originally broadcast. If we were just concerned with monophonic or single-channel FM broadcasting (and, of course, many FM radios still provide just that), our circuit description could end right here, and the recovered audio would only have to be connected to your audio amplifier for further amplification and application to the system's loudspeakers to complete the receiver.

Stereo FM broadcasting

In 1961, the FCC approved a new form of FM broadcasting in which the two halves or channels of a stereo program could be broadcast compatibly over a single FM station transmitter. Prior to that time, stereo broadcasts involved the use of an AM station for one of the channels and an FM station for the other. Listeners desiring to hear programs in stereo had to set up two different radios, and, even more unfortunately, listeners who had only one radio were treated to "half a program"—hearing only the left channel or right channel transmission.

The stereo broadcast system authorized by the FCC is a compatible one; that is, a mono FM set owner hears the combined "left-plus-right" mono equivalent of the stereo performance, while the owner of a stereo FM set recovers separate left and right programs over the appropriate left and right speakers in the normal stereo setup. Let's take a look at how this is accomplished.

Figure 6 shows how the available 75-kHz channel bandwidth (actually, the bandwidth is ±75 kHz, on either side of carrier's center frequency, but only one-half of the symmetrical signal is shown) is used to broadcast a stereo composite signal. First, the *sum* of the left (L) and right (R) program signals is combined (L + R) and used to modulate the main carrier in much the same way that a monophonic signal would be used, over an audio frequency range from 30 Hz to 15 kHz. In addition, the *difference* signal

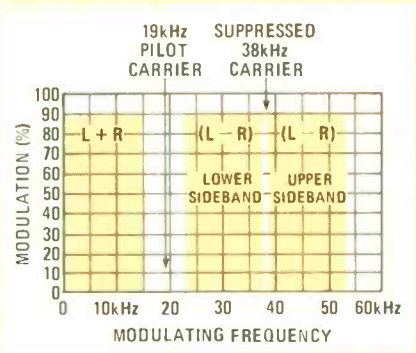


FIG. 6—FREQUENCY SPECTRUM of transmitted FM stereo signal.

derived by subtracting R program signals from L program signals (L − R) is used to modulate a 38-kHz subcarrier. This subcarrier is *amplitude*-modulated, and the subcarrier itself is suppressed, so that only its upper and lower sidebands are, in turn, used to frequency-modulate the main carrier frequency. Since L − R audio signals may contain frequencies from 30 Hz to 15 kHz (similar to L + R audio information), the resulting sideband signals may extend from 23 kHz (38 kHz − 15 kHz) all the way up to 53 kHz (38 kHz + 15 kHz). As with any sideband transmission system, a synchronizing signal must be transmitted along with the sidebands so that the missing or suppressed carrier can be reconstituted at the receiving end. In the case of stereo FM signals, a 19-kHz constant pilot carrier is transmitted for this purpose.

Mono/stereo compatibility

At the receiving end, the entire composite signal (L + R audio signal, plus the super-audible sidebands and 19-kHz pilot signal) is recovered by a conventional FM detector. If this signal is applied to an audio amplifier, only the equivalent monophonic program (L + R) is heard, since L − R is still in the form of super-audible sideband modulation. The FM decoder or multiplex section of the tuner or receiver then recovers the L − R audio signals just as an AM double-sideband receiver would.

Once both L + R and L − R signals

are available as audio signals, a couple of algebraic manipulations called matrixing take place. Specifically, the L + R signal is simply added to the L − R signal, to yield

$$(L + R) + (L - R) = 2L$$

and, in another circuit, the L − R signal is *subtracted* from the L + R signal to yield

$$(L + R) - (L - R) = 2R.$$

This simple sum-and-difference technique results in recovering separate L and R signals. (The factor of "2" represents amplitude and can be disregarded.) If the circuits are all adjusted perfectly, the L output will contain no R-signal content and the R output will be free of any L-signal content. In actual practice, separation figures in excess of 40 dB are attainable at mid-audio frequencies, and better multiplex decoder circuits can maintain values greater than 30-dB even at the more critical high and low frequencies.

The wider bandwidth required for transmitting and receiving stereo FM signals, plus the fact that the L − R information is transmitted as *amplitude*-modulated sideband signals of a 38-kHz subcarrier, results in poorer S/N ratios for stereo FM transmission than for monophonic FM transmission. However, as signal strength increases, the difference in S/N ratios becomes less.

Specifications

The many FM tuner specifications describing its performance can tell you much about that tuner's quality and indicate whether or not it will fit your needs. While many people have little difficulty understanding amplifier specifications, they seem intimidated by the technical-sounding terms associated with FM tuner performance. The following summary of important tuner specs will not only define each specification but give you some idea of what "good" and "not so good" numbers you can expect and how important (or unimportant) each specification may be in terms of your own location (relative to the stations you hope to receive) and listening habits.

Sensitivity

Usually, the first specification listed for any tuner is *sensitivity*. This spec is sometimes called *usable sensitivity*, or *IHF sensitivity* (IHF stands for the *I*nstitute of *H*igh *F*idelity, which has established measurement standards for FM tuners and other audio components). Sensitivity describes the ability of a tuner to receive very weak signals and turn them into listenable audio programs. This specification may be stated in microvolts (millionths of a volt, usually written as μV) or, in a more recently approved term known as dBf. (The dBf figure is referenced to power rather than a voltage. Thus, the dBf figure automatically takes into account the input impedance at the tuner's antenna terminals and eliminates confusion when comparing the sensitivity of different tuners. For example, a tuner with a 75-ohm input impedance and a 1-μV sensitivity spec would have the same sensitivity as a tuner with a 300-ohm input impedance and a 2-μV sensitivity spec. Both these tuners have the same IHF sensitivity rating of 11.2 dBf.) The lower the microvolt or dBf number, the more sensitive the tuner.

Since, as we said, stereo signals are noisier than mono signals, a complete sensitivity specification will list numbers for *both* mono and stereo reception, which may differ widely. A tuner that has a "2.0-μV (or 11.2-dBf) sensitivity" will, when it is fed an incoming signal of that strength, produce a recovered audio signal that is exactly 30 times louder than the combined residual background noise and distortion. Noise and distortion that is 30 dB lower than the desired program level means that 3% of what is heard is noise and distortion. Admittedly, that's not a very good listening situation, but sensitivity is really designed to tell you how much signal is needed for *barely* acceptable listening. Differences between a set that has a 2.0-μV sensitivity and one with a 1.8- or 1.7-μV sensitivity are really not important unless other specifications are also considered.

50-dB quieting

For a received signal to be acceptably noise-free (in the hi-fi sense of the word), it should be strong enough to suppress noise by at least 50 dB (noise would then constitute only 0.3% of the total sound heard). Newly approved standards require that manufacturers list the signal strength, in microvolts (μV) or dBf, required to produce such background noise quieting, both in mono and stereo. The lower the 50-dB quieting signal strength, the better the product.

S/N ratio

Figure 7 shows what happens to the desired signal and the residual noise (in mono and stereo) as signal strength is increased at the antenna terminals of a receiver or tuner. After just a few microvolts of input signal, the audio level reaches a constant amplitude and does not become louder for any further increase in signal strength. However, noise level becomes lower and lower as signal strength increases, until it attains its lowest possible value—usually well before signal strength has reached 1000 μV (or 65 dBf). The specification known as *ultimate signal-to-noise ratio* or just *S/N ratio* (now given for both mono and stereo modes) tells just how low that noise level is, and is quoted in dB, with higher values being better. In Fig. 7, the ultimate S/N ratio for mono turns out to be 70 dB; while in stereo, the best S/N ratio obtained is 65 dB.

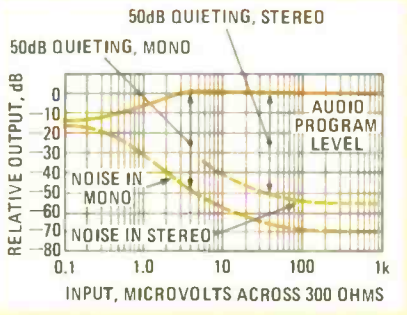


FIG. 7—S/N RATIO for a given tuner varies with signal strength.

Harmonic distortion

As in the case of audio amplifiers, tuners can and do produce *harmonic distortion* that was not present in the original audio program and is therefore undesirable. Note from Fig. 8 that the total harmonic distortion (THD) tends to *decrease* as signal strength is increased until it reaches its lowest (or best) levels. Again, the THD should be specified for both mono and stereo modes, and, for full compliance with the new standards, it must be quoted for three different audio frequencies in each operating mode: 100 Hz, 1 kHz and 6 kHz. (As in most audio devices, distortion tends to be lower at mid-frequencies, around 1 kHz, but it may be significantly greater at the audio frequency extremes; hence the added information is useful in comparing products.) As indicated in Fig. 7 (plotted only for the 1-kHz distortion test), mono THD is usually a bit lower than stereo THD. In our example, mono THD decreased to 0.2% for strong mono signals, while it measured 0.4% for strong stereo signals; these are both rather good values, by the way.

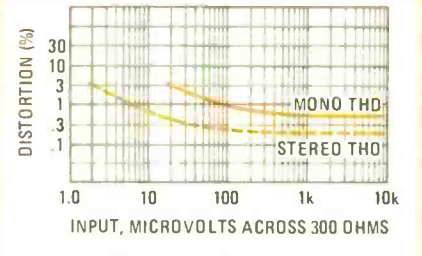


FIG. 8—DISTORTION for a given tuner varies with signal strength.

Selectivity

Another important FM tuner specifi-

FM PRE-EMPHASIS AND DE-EMPHASIS

The frequency response of audio signals broadcast over an FM radio station is anything but flat. In the United States, the response of audio signals is altered in accordance with the curve shown in Fig. 1. Treble or

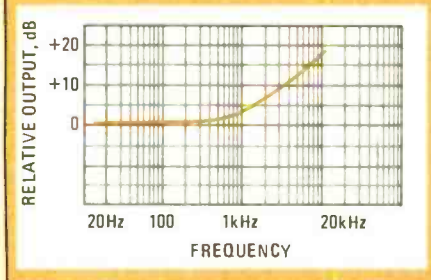


FIG. 1

high audio frequencies above 1 kHz are deliberately boosted before they are allowed to frequency-modulate the station's main carrier frequency. This process is known as pre-emphasis and, in most cases, the pre-emphasis is defined as having a value of 75 μs (the time constant of a simple R–C or L–C network in which the product of "R" and "C," or "R" and "L" equals 75 × 10^{-6}). A simple pre-emphasis network that produces this amount of treble boost is shown in Fig. 2.

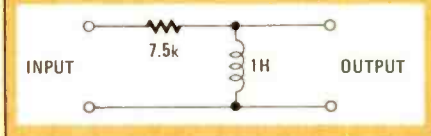


FIG. 2

The reason for pre-emphasis (and corresponding de-emphasis, or treble *attenuation* as incorporated in all FM tuners or receivers) becomes apparent when we consider the nature of noise in FM reception. In an FM tuner or receiver, noise generated by transmission and reception increases with frequency between the carrier and interfering signals, so that high-frequency hiss is louder than low-frequency noise (see Fig. 3). By deliberately pre-emphasizing the treble content of a given program during transmission, the broadcaster pushes the audio signal farther above the noise threshold. However, in order to reproduce the program with all tones at their correct relative amplitudes, it is necessary to de-emphasize the highs in the tuner or receiver, in accordance with the reciprocal de-emphasis curve shown in Fig. 4. In this way, all tones are restored to their correct relative intensities, while the background noise is reduced in much the same way as it would be if you

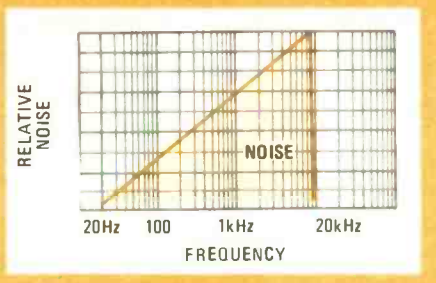


FIG. 3

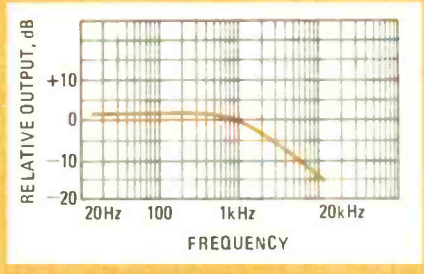


FIG. 4

turned down the treble control on your amplifier, but without any loss in fidelity.

European emphasis standard

In most European countries, the amount of pre-emphasis and de-emphasis is somewhat lower than that used in the United States. The pre-emphasis and de-emphasis value used is defined by a time constant of 50 μs instead of 75 μs.

The benefits of pre-emphasis and de-emphasis are in part negated by the fact that extreme values of treble boost applied to signals before main-carrier modulation tend to limit the maximum modulation level that can be applied to a given program. When the 75-μs pre-emphasis value was selected many years ago, most program sources lacked much high-frequency content, so boosting the highs by such a large degree did not normally result in overmodulation at high frequencies. By the time European countries adopted their own FM broadcast standards, program quality had improved somewhat, and the Europeans decided upon a more moderate pre-emphasis (and de-emphasis) value in setting their standards. In the U.S., improved high-frequency program material has forced many stations to install compressors and peak limiters in the audio chain. These devices limit the maximum modulation levels and thereby permit higher overall *average* modulation levels. Unfortunately, such limiting or compression also detracts from the fidelity of the reproduced music signals.

Those who are familiar with the popular Dolby noise-reduction system commonly found in most home stereo cassette tape decks will recognize that the Dolby scheme lends itself to FM broadcasting as well. Today, many stations around the U.S. do, in fact, use Dolby noise reduction for improved S/N performance in stereo and regular FM reception.

In order to take full advantage of the Dolby noise-reduction system in FM broadcasting, Dr. Ray Dolby (who developed the system) proposed that whenever Dolby noise reduction was used, the pre-emphasis and de-emphasis values should be changed to a low 25-μs value (resulting in less treble boost during transmission and correspondingly less treble cut at the receiving end). This modification permits higher modulation levels at the broadcast end and reduces the need for compression or limiting. The end result is greater dynamic range.

For proper Dolby reception, two things are required. First, of course, you must have a Dolby decoder (either built into your system, or connected externally). But, in addition, the de-emphasis network in the tuner or receiver must be modified to the correct 25-μs value. Many new tuners and receivers now come with a de-emphasis selector switch to alter the de-emphasis value from 75 μs to 25 μs, as required by the Dolby FM broadcast system. Alternatively, small adaptors are now available that can be connected externally (in addition to the required Dolby decoder) to accomplish the same change in de-emphasis.

cation is *selectivity*, or the tuner's ability to receive a desired station signal while simultaneously rejecting signals that are close in frequency to the desired station. Ordinarily, the FCC assigns frequencies to stations in the same geographical area so that they are not too crowded on the dial. Ironically, though, the increased sensitivity of modern tuners makes this careful spacing somewhat academic, and, on a good receiver, it is sometimes possible to receive signals that are only one or two channel widths apart (a channel width is 200 kHz on the FM dial). A tuner with good selectivity (measured in dB, with higher values preferred) can latch on to a desired signal without encountering interference from any neighboring station. Moderately good selectivity these days would be around 50 to 55 dB, while some tuners actually boast selectivity figures of 100 dB! (The selectivity specification refers to the attenuation of an undesired station located 400-kHz away from the desired station. For example, if a tuner has a 50-dB selectivity specification, the tuner will attenuate an undesired station located 400-kHz away by 50 dB.)

Selectivity is not equally important to all listeners. In remote rural areas where you can only receive a few widely spaced FM signals, a high selectivity figure is less important than in a crowded metropolitan area where stations are closely spaced on the dial. It should also be point-

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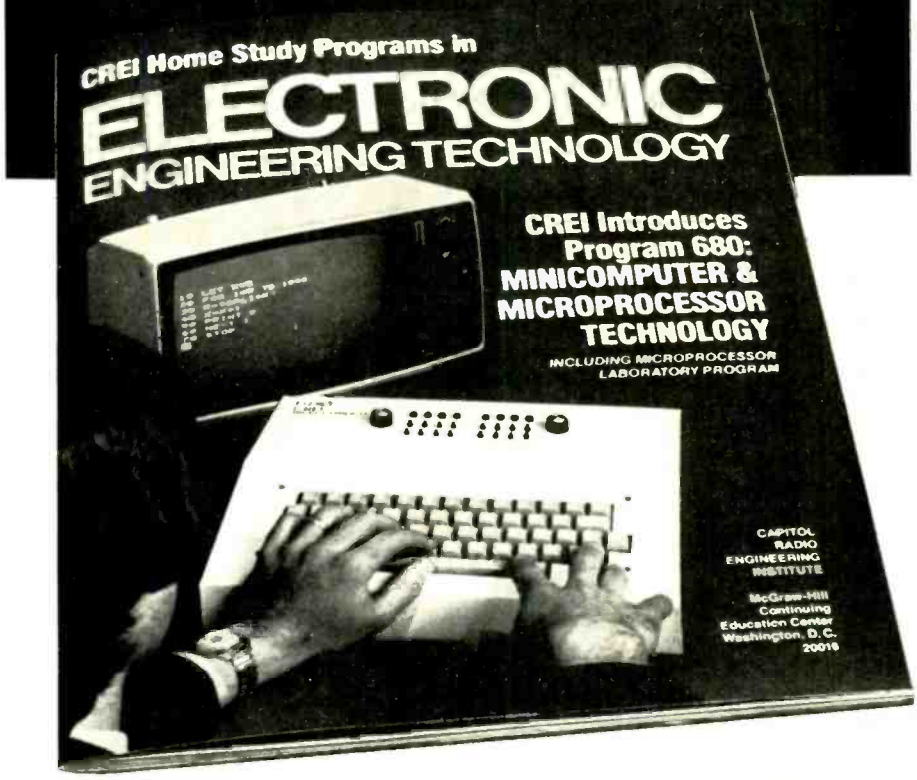

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ed out that very high selectivity may, at times, be bought at the expense of poorer distortion figures, since narrowing a tuner's bandwidth tends to increase audio distortion (especially in stereo reception). The mark of a truly superior tuner is one that has both very low distortion levels in mono and stereo and high selectivity values.

Capture ratio

The *capture ratio* specification is somewhat related to selectivity. It indicates an FM tuner's capability of zeroing in on the stronger of two stations that might be operating at the *identical* frequency. Such a situation might seem rare, but it could occur if you live mid-way between two remote metropolitan areas, each having stations assigned to the same frequency. More important, good capture ratio (quoted in dB, but this time *lower* values are better) can help to alleviate a problem known as "multipath distortion."

Figure 9 shows a direct signal arriving from a station transmitter to the home FM antenna plus a delayed signal transmitted via a reflected path from a nearby water tower (or other signal-reflecting surface). The two signals can be considered as two different "stations" operating at the same frequency and tend to cancel each other out or cause audible distortion, particularly during stereo transmission. We are all familiar with this problem in TV reception, in which the condition is called "ghosts." A good capture ratio helps to reduce the problem, although a properly oriented directional outdoor FM antenna connected to your tuner's AM antenna terminals can help even more.

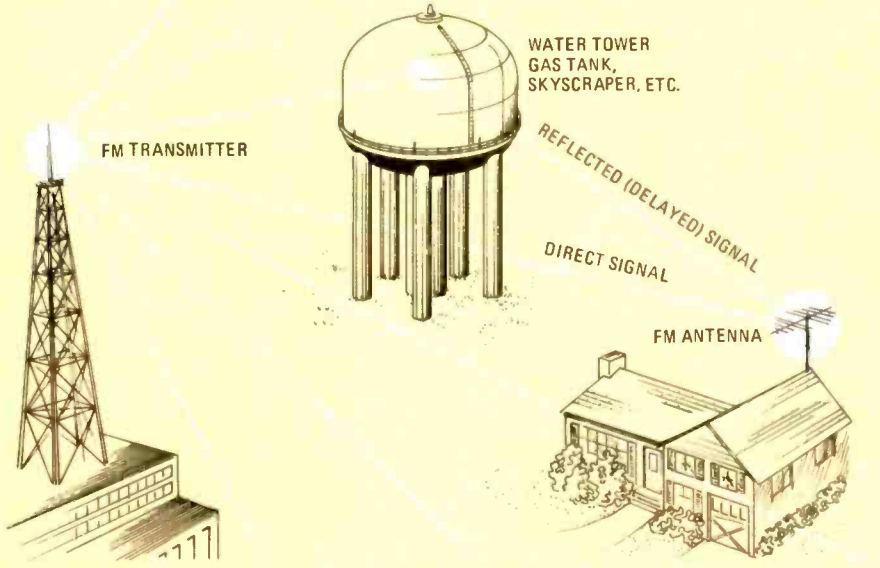


FIG. 9—MULTIPATH DISTORTION results from reflected, and thus delayed, signals being received and decoded by the tuners.

AM suppression

Even the best FM tuners respond to some degree to amplitude (AM) variations in signal reception. Interference caused by electrical noise and signal reflections can be reduced by good *AM suppression*, a specification quoted in dB, with higher values being better. Typically, an AM suppression figure of 50 dB or greater should be expected from a quality high-fidelity FM tuner.

Frequency response

As with all other hi-fi equipment specifications, frequency response should be considered when selecting a good FM tuner. Frequency-modulated response should be as uniform as possible—from 30 Hz (the lowest frequency broadcast) to 15 kHz. A properly listed frequency-response specification states the frequency limits as well as the maximum deviation, in dB, within those limits. For example, a specification that states, "Frequency Response: 30 Hz to 15 kHz, ±1.0 dB" is a better specification than one reading "Frequency Response: 30 Hz to 15 kHz, ±2.0 dB."

Stereo separation

The *stereo separation* value tells you how well the tuner's stereo decoder (and other portions of the circuit) are able to keep the left-channel and right-channel segments of the program isolated from each other. The FCC requires that *broadcasters* maintain at least 30-dB of separation between stereo channels at every broadcast frequency. Most good-quality tuners are able to maintain at least that degree of channel separation at mid-frequencies, and some perform as well at the audio-frequency extremes. According to the latest measurement standards, stereo separation should be given (in dB, with higher values being better) at three frequencies. These are 100 Hz, 1 kHz and 10 kHz.

Subcarrier rejection or suppression

It was mentioned earlier that in the course of broadcasting stereo signals, many high-frequency signals are also generated. If these super-audible tones are allowed to appear at the tuner's output, they could have an adverse effect on recording FM programs on a home tape recorder (the high tape bias frequency of the tape recorder might beat with the equally high subcarrier tuner outputs to create audible beat tones in the recording). Accordingly, manufacturers must inform you how successfully high-frequency signal components have been prevented from reaching the tuner's output. Quoted in dB, the higher the subcarrier suppression the less problem you will have recording directly from FM broadcast programs onto tape.

Muting threshold

One of the convenient features many FM tuners offer is interstation muting—a circuit that permits you to tune across the FM dial without encountering that jarring noise between stations. If the muting circuitry is set at too high a threshold, however, it also blocks very weak signals, since they will be interpreted as noise rather than receivable signals. *Muting threshold* (given in microvolts or dBf), specifies how much signal strength is required to overcome the muting feature. Although in most tuners muting is defeatable by a front-panel switch, it is helpful if the manufacturer carefully sets the muting threshold so that signals that would otherwise be perfectly listenable in terms of quieting and distortion are not blocked by the muting circuitry.

Additional specifications

Other specifications include *image rejection, IF rejection* and *spurious-response rejection*. All three specifications indicate the tuner's ability to reject the variety of unwanted signals that sometimes pop up on the dial. Acceptable values for all these specifications are values over 60 or 70 dB, and some modern tuners claim values of 80, 90, or even 100 dB and more.

A word about Dolby FM

If you own a cassette deck you are probably already familiar with the Dolby noise-reduction system. As in the case of tape recording, Dolby can improve signal-to-noise ratios in FM broadcasting, effectively increasing the useful reception range of a station that uses the system. It *cannot*, however, decrease existing noise in the program material being broadcast by the station (i.e., noisy discs, hissing tapes, etc.).

Many stations around the U.S. use the Dolby system during part or all of their broadcast schedules. To take advantage of this technique, your tuner or receiver must be equipped with a suitable Dolby decoder circuit and a front-panel switch

TABLE I—Major FM Tuner Specifications and their ranges in low, medium and high priced equipment

Specification	Low-Cost Range	Mid-Cost Range	High-Priced Range
Usable sensitivity, mono, μV (dBf)	3.0–5.0 (15.0–20.0)	2.0–3.0 (11.0–15.0)	1.6–2.0 (9.3–11)
Usable sensitivity, stereo, μV (dBf)	20.0–40.0 (31–37)	5.0–20 (20–31)	2.5–5.0 (13–20)
50-dB quieting, mono, μV (dBf)	10–20 (25–31)	5–10 (20–25)	2.3–5 (12.4–20)
50-dB quieting, stereo, μV (dBf)	45–100 (38–45)	35–45 (36-38)	30–35 (34.7–36)
Signal-to-noise, mono, μF	55–65	65–70	Over 70
Signal-to-noise, stereo, μV	50–60	60–67	Over 67
Distortion, mono % 100 Hz. 1 kHz 6 kHz	0.5–1.0 0.5–0.8 0.5–1.0	0.2–0.5 0.2–0.5 0.2–0.5	Under 0.2 Under 0.2 Under 0.2
Distortion, stereo, % 100 Hz 1 kHz 6 kHz	0.8–1.6 0.6–1.3 0.8–2.0	0.4–0.8 0.3–0.6 0.5–0.8	Under 0.4 Under 0.3 Under 0.5
Alternate channel selectivity, dB	50–60	60–75	Over 75
Capture ratio, dB	5.0–3.0	3.0–1.5	Under 1.5
Image rejection, dB	40–60	60–80	Over 80
IF rejection, dB	50–70	70–85	Over 85
Spurious response rejection, dB	60–80	80–95	Over 95
AM suppression, dB	45–50	50–60	60 or over
Stereo separation, dB 100 Hz 1 kHz 10 kHz	20–30 25–30 15–20	30–35 30–40 20–30	Over 35 Over 40 Over 30
Frequency response, 30 Hz to 15 kHz, ± dB	2.0–3.0	1.0–2.0	Less than 1.0

to activate it. A separate Dolby decoder can also be added to your system, in case your tuner does not already have one. However, if such a decoder is added separately, the tuner's frequency response must be altered, either internally or by a small accessory that must be inserted at the tuner's output (before the signal is fed to the separate Dolby decoder) to take care of the somewhat different frequency response characteristics used during Dolby program broadcasts. The response characteristic (known as pre-emphasis at the broadcast station, and de-emphasis in a tuner) is standardized in the U.S. as "75 microsecond pre-emphasis and de-emphasis" in non-Dolby broadcasting, but is changed to "25 microsecond de-emphasis and pre-emphasis" during Dolby broadcasts. A tuner equipped with a built-in Dolby decoder automatically switches the de-emphasis value to the correct one when Dolby is selected.

Convenience features

In choosing a hi-fi component tuner, you may want to investigate those convenience features which, while they do not directly contribute to signal quality, make the tuner easy to operate and enable you to use it optimally.

Tuners are often equipped with one, two or even three meters. Center-of-channel tuning meters help you tune to the precise center of the received signal frequencies (only then are distortion figures as low as manufacturers claim), while signal-strength and multipath-indicator meters help you orient your FM antenna for best possible reception. Some tuners have blinking lights to indicate when you are properly tuned in. A few new and expensive tuners use a station tuning system known as frequency synthesizing, in which tuning accuracy is determined by a self-contained highly accurate crystal oscillator circuit. Such tuners may also come with digital-frequency readout tubes that display the frequency in illuminated numbers rather than by a conventional tuning-dial pointer and printed scales.

Some tuners even make provision for programming-in your favorite stations in special computer-like memory circuits that can then be called upon to tune to your favorite station at the touch of a button. Some tuners permit you to tune to only stereo stations if you desire, while the most expensive units actually use a built-in oscilloscope to provide a visual display of tuning accuracy, signal strength and audio levels.

With all these convenience features, you should remember that the kind of high fidelity you can expect from even the most expensive and sophisticated FM tuner will depend upon the quality of the

THE MODEL T75, SERIES 2 TUNER by Rogers High Fidelity is a British product.

programs and signals broadcast by your local FM stations. It is fair to say that high-fidelity tuners and receivers are often capable of better sound reproduction than is being transmitted by less-than-conscientious stations. Happily, most areas have at least a few stations delivering signals that are consistent with the high-fidelity potential of FM radio.

Summary

Before using Table 1, which itemizes major tuner specifications and guides you as to what constitute average, good and superior values for each published tuner specification, it is important to discuss an element of good FM reception that is all-too-often ignored—a proper FM antenna, preferably mounted outdoors and as high up as possible.

Like TV, FM is a line-of-sight form of transmission, so the higher up your antenna is, the greater the distance to the horizon and the stronger the signal received from distant stations. As you know, FM reception really improves when signal strengths increase. Also a directional antenna (one that favors signals coming from the direction into which it is pointed while rejecting signals from other directions) can alleviate multipath problems. Antennas specifically designed for FM use are readily available and quite inexpensive. Alternatively, you can hook into your outdoor TV antenna by using an inexpensive two-set coupler. Finally, if you simply cannot install an outdoor FM antenna, you should consider one of those simple, adjustable rabbit ear indoor antennas. These antennas can be carefully positioned for best reception and will be an improvement over the "drooping wire" so many use people in lieu of a proper FM antenna. **R-E**

FM TUNER ROUNDUP

MANUFACTURER	MODEL	PRICE	STEREO SPECIFICATIONS											MONO SPECIFICATIONS														
			FREQUENCY RESPONSE 50Hz TO 15kHz (±dB)	SENSITIVITY µV (dBf)	50-dB QUIETING µV (dBf)	MAX S/N RATIO (dB)	HARMONIC DISTORTION (%) 100Hz	HARMONIC DISTORTION (%) 1kHz	HARMONIC DISTORTION (%) 6kHz	DISTORTION AT 50-dB QUIETING (%)	SEPARATION (dB) 100Hz	SEPARATION (dB) 1kHz	SEPARATION (dB) 10kHz	IHF SENSITIVITY µV (dBf)	50-dB QUIETING µV (dBf)	MAX S/N RATIO (dB)	HARMONIC DISTORTION (%) 100Hz	HARMONIC DISTORTION (%) 1kHz	HARMONIC DISTORTION (%) 6kHz	DISTORTION AT 50-dB QUIETING (%)	CAPTURE RATIO (dB)	AM SUPPRESSION (dB)	IMAGE REJECTION (dB)	IF REJECTION (dB)	SPURIOUS REJECTION (dB)	ALTERNATE CHANNEL SELECTIVITY (dB)	MUTING THRESHOLD µV (dBf)	DIAL CALIB ACCURACY (1kHz AT MHz)
ARMSTRONG	624		3	4.5	35	65	.2	.2	.2	.2	40	40	28	1.5	2.5	65	.2	.2	.2	.2	1.75	50	50	100	50	5.6	30	200
CRAIG	S685	$279.95	4	11.0 (26.0)	16.0(29.3)	50	1.5	1.5	1.5	2	30	35	20	5.3(19.7)	5.6(20.1)	58	1	1	1	1.5	2.0	43	59	110	89	>71	0-35	800
DENON	TU501		.5	1.8	50	75	.38	.15	.36	.35	45	54	45	1.8	3.8	75	.13	.1	.23	.9	1.2	60	90	90	90	78	2.8	30
	TU85		+.2 −1	1.7	40	84	.15	.08	.18	.33	47	54	48	1.7	3.5	84	.08	.05	.09	.5	.8 1.5	65	120	110	110	65	9.5	30
DYNACO	2501	$799.00	1	7(22)	35(36)	65	.4	.25	.4		45	45	30	1.7(9.8)	3.5(16)	70	.19	.19	.19		1.75	50	100	100		80		
FISHER	FM2110	$160.00	1	4.6 (18.5)	38(36.8)	66	.1	.2	.4	.5	35	40	30	1.8(10.3)	2.8(14.2)	72	.15	.15	.2	.4	1.0	60	60	75	85	70	2(11.21)	
	FM2310	$250.00	1	4.3 (17.9)	34(35.9)	70	.15	.15	.25	.4	40	46	36	1.7(9.8)	2.5(13.2)	75	.1	.1	.15	.3	.8	65	80	100	100	75	2(11.21)	
H.H. SCOTT	570T	$249.95	2		3.3(35.6)	70								1.8(10.3)	3.5(16.1)	75		50			1.0		60	90	90	70		
	530T	$199.95	2		.35(36)	67								1.9(10.8)	3.8(16.8)	72		45			1.5		40	85	80	60		
	590T	$299.95	2		32(35)	75								1.6(9.3)	3.0(14.8)	80		50			1.0		65	100	100	80		
HITACHI	FT-440B	$279.95	1	19.2	37	68	.3	.25	.35	37		50		9.8	16.1	75	.2	.1	.25	16.1	1.0	55	75	100	100	80	19.2	
JVC	JT-V11G	$149.95			(38.3)	65	.45	.45	.45		30	35	30	2.1(11.6)	(17.2)	70	.25	.25	.25		1.5	45	55	90	75	55		
	JT-V22	$169.95			(38.3)	65	.45	.35	.55		30	40	30	2.0(11.2)	(17.2)	73	.2	.2	.2		1.5	45	58	90	75	70		
	JT-V77	$289.95	+0.5 −0.8		(36.8)	72	.15	.1	.15		45	50	40	1.8(10.3)	(16.8)	78	.1	.08	.15		1.0	60	90	95	95	75		
	T-3030	$599.95			19(36.8)	72	.1	.1	.1		45	50	45	1.0(11.2)	1.9(16.8)	75	.1	.08	.1		1.0	65				80		
KENWOOD	KT-5500	$155.00	+.2 −2		45(38.3)	68		.2				45		1.9(10.8)	4.0(17.2)	72		.15			1.0	65	50	90	80	60		
	KT-6500	$200.00	+.2 −1.5		43(37.9)	70	.2	.15	.15			50		1.8(10.3)	3.6(16.3)	75	.1	.1	.15		1.0	65	50	95	89	75		
	KT-7500	$310.00	+.2 −1.5		35(36.1)	70	.13 .4	.1 .3	.1 .3			50 45		1.7(9.8)	2.8(14.1)	75	.08 .1	.08 .2	.08 .3		1.0 2.0	60	105	110	110	30 100		
	KT-8300	$450.00	+.2 −1.5		30(34.8)	75		.1 .4				50 45		1.6(9.3)	2.8(14.2)	78		.08 .15			1.0 1.5	60	110	110	110	40 110		

			STEREO SPECIFICATIONS												MONO SPECIFICATIONS															
								HARMONIC DISTORTION (%)			SEPARATION (dB)							HARMONIC DISTORTION (%)											
MANUFACTURER	MODEL	PRICE	FREQUENCY RESPONSE 50Hz TO 15kHz (±dB)	SENSITIVITY µV (dBf)	50-dB QUIETING µV (dBf)	MAX S/N RATIO (dB)	100Hz	1kHz	6kHz	DISTORTION AT 50-dB QUIETING (%)	100Hz	1kHz	10kHz	IHF SENSITIVITY µV (dBf)	50-dB QUIETING µV (dBf)	MAX S/N RATIO (dB)	100Hz	1kHz	6kHz	DISTORTION AT 50-dB QUIETING (%)	CAPTURE RATIO (dB)	AM SUPPRESSION (dB)	IMAGE REJECTION (dB)	IF REJECTION (dB)	SPURIOUS REJECTION (dB)	ALTERNATE CHANNEL SELECTIVITY (dB)	MUTING THRESHOLD µV (dBf)	DIAL CALIB ACCURACY (1kHz AT MHz)
LUX	T-2	$345.00	1	2.8(14.2)		75	.3	.3	.5		40	46	38	1.9(10.8)			.2	.2	.3		1.5	55	55	80	80	70		
	T-4	$495.00		3.0(14.7)		75	.2	.15	.3 .5		45	50 80	40	1.8(10.3)			.8	.8	.15 .2		2	60	55	80	80	85	5-300	
	110	$545.00	+.2 −1.5		34(35.8)	72	.15	.08	.3		38	48	38	1.6(9.3)	2.2(12)	78	.1	.08	.1		1.3	53	100	100	100		5	
	5T10	$795.00	−.5	2.8(14.5)		80	.05	.05 .2	.7		45	50	45	1.8(10.3)			.07	.06 .5	.1		.8 .2	62	100	100	100	90 30	10-500	1.6-31
	T-12	$645.00	−.5	2.8(14.2)		80	.07	.06 .5	.1		45	30 50	45	1.8(10.7)			.05	.05 .2	.07		.8 2	62	100	100	100	90 30	10-500	
	5T50	$1595.00	+.2 −1	4.5	35(36.1)	70	.15	.1	.2		40	45	40	1.7(9.8)	2.5(13.2)		.1	.08	.15		1.1	55	100	100	100	72	1.6-3.1	.003%
MARANTZ	2020	$179.95	+.2 −1.5		42(37.7)	65	.35	.3	.5	.6	40	45	35	1.8(10.3)	2.5(13.2)	74	.25	.15	.3	.6	1.0	50	50	90	90	65	12.5	
	2100	$219.95	+2 −1.5		40(37.3)	65	.35	.3	.5	.6	40	45	40	1.8(10.3)	2.5(13.2)	74	.25	.15	.3	.6	1.0	50	60	80	90	70	12.5	
	2110	$339.95	+.2 −1.0		40(37.3)	72	.35	.3	.5	.6	40	45	40	1.8(10.3)	2.5(13.2)	76	.25	.15	.3	.6	1.0	50	60	90	90	70	12.5	
	2120	$319.95	+2 −1.0		35(36.1)	70	.04 .25	.3 .15	.5 .3	.6	42 45	50 50	42 45	1.8(10.3)	2.5(13.2)	80	.15 .1	.15 .1	.2 .1	.6	1.4 1.0	55	90	100	100	80 50	12.7	
	2130	$529.95	+.2 −1.0		25(33.2)	75	.20 .09	.15 .07	.3 .2	.6	45 45	50 55	42 45	1.5(9.1)	2.5(13.2)	82	.07 .05	.07 .05	.13 .1	.5	1.5 .8	65	120	120	120	80 50	7-50	
McINTOSH	MR-78	$899.00	± .5	4.5(18)	26(33.5)	70	.2	.2	.2	.3	37	40	30	2.5(13.2)	3(14.7)	75	.2	.2	.2	.3	2.5		100	>120	100	>>90	5-20	150
	MR-74	$699.00	±1		26(33.5)	68	.5	.5	.5	.5	33	40	13	2.5(13.2)	3(14.7)	70	.3	.3	.3	.3	1.5		95	>120	90	88	3-10	150
MITSUBISHI	DA-F10	$260.00	1	7.8(23)	55(40)	70		.08				45	40	2.5(13.2)	5.5(70)	75		.05			.8	55	75	80	90	55 50		
	DA-F20	$380.00	1	7.5(22.7)	50(39.2)	75		.08	.12			50	40	2.0(11.2)	5.0(19)	80		.05			.8	65	100	100	100	45 75		
	M-F01	$320.00	1	7.5(22.7)	50(39.2)	77		.1				50	40	2.0(11.2)	5.0(19.2)	80		.08			1.0	65	100	100	100	70		3/100
NAKAMICHI	430	$440.00	1		40(37.3)	68		.09				.06		1.8(10.5)	4.0(17.3)	70	35	50	35		1.5	60	100	100	100	90 60		
	630	$730.00	1	25(33)	50(39)	68	.08	.08	.08		.05	.05	.15	2.5(13)	5(19)	70	40	50	35		1.0	60	100	100	100	80 40	17(30)	
NIKKO	GAMMA-V	$649.95 $669.95	+.4 −.8		(34)			.06 .1		70	35 32	45 40	35 32	1.8(10.3)	(14)	75	.04 .07	.04 .07			1.0 1.5	60	>120	>110	>120	30 85		
OPTONICA (SHARP)	ST-3636	$300.00	1.5	4.5(18.3)	44.5(38.2)	70	.2 .35	.15 .3	.3 .4	.551 .65	40 35	50 45	40 35	1.6(9.3)	4.5(18.3)	75	.1 .2	.1 .2	.15 .3	.41 .5	1.0 2.0	50	120	110	110	35 80	10(25.2)	100/98
	ST-1515	$190.00	1.5	4.5(18.3)	44.5(38.2)	65	.35	.3	.4	.6	35	45	35	1.7(9.8)	5.5(20)	72	.2	.2	.3	.45	1.2	50	82	90	80	60	10(25.2)	120/98
PHILIPS	A4673	$499.95	+.5 −1	30	30			.1			50	50	38	1.6	2.2	72		.09			1.0	50	110	110	110	110	2-20	200

FOR A LIST OF MANUFACTURERS AND THEIR ADDRESSES, CIRCLE NUMBER 129 ON FREE INFORMATION CARD

			STEREO SPECIFICATIONS												MONO SPECIFICATIONS												
								HARMONIC DISTORTION (%)			SEPARATION (dB)							HARMONIC DISTORTION (%)										
MANUFACTURER	MODEL	PRICE	FREQUENCY RESPONSE 50Hz TO 15kHz (±dB)	SENSITIVITY µV (dBf)	50-dB QUIETING µV (dBf)	MAX S/N RATIO (dB)	100Hz	1kHz	6kHz	DISTORTION AT 50-dB QUIETING (%)	100Hz	1kHz	10kHz	IHF SENSITIVITY µV (dBf)	50-dB QUIETING µV (dBf)	MAX S/N RATIO (dB)	100Hz	1kHz	6kHz	DISTORTION AT 50-dB QUIETING (%)	CAPTURE RATIO (dB)	AM SUPPRESSION (dB)	IMAGE REJECTION (dB)	IF REJECTION (dB)	SPURIOUS REJECTION (dB)	ALTERNATE CHANNEL SELECTIVITY (dB)	MUTING THRESHOLD µV (dBf)	DIAL CALIB ACCURACY (1kHz AT MHz)
PIONEER	TX-5500II	$150.00	+.2 −1.0		44(38.0)	68	.3	.3	.6		30	35	30	1.9(10.7)	2.8(14.0)	72	.15	.15	.2		1.0	50	60	90	75	60	1.7 (10.0)	
	TX-6500II	$200.00	+.2 −1.0		44(38.0)	68	.3	.3	.6		30	40	30	1.9(10.7)	2.8(14.0)	75	.15	.15	.2		1.0	50	60	90	75	60	1.7 (10.0)	
	TX-8500II	$300.00	+.2 −.5		40(37.2)	75	.15 .4	.1 .4	.5 .9		35 30	45 45	35 30	1.8(10.3)	3.5(16.1)	79	.1 .15	.08 .15	.1 .15		.8 2.0	55	85	100	90	35 80	5 (19.2)	
	TX-9500II	$400.00	+.2 −.5		35(36.1)	77	.1 .3	.07 .25	.2 .5		35 30	50 45	35 30	1.5(8.8)	2.5(13.2)	82	.05 .07	.05 .07	.07 .1		.8 2.0	65	120	105	110	35 85	5(19.2) 28(34.1)	
RADIO SHACK	TM-100	$179.95						.2 .4			38 30	40 35	32 28	1.7(8.8)	3.0	70		.1 .2			1.0		70	90			8	
ROGERS	T.75		1	1.8	35	65	.9	.7	.8		30	40	30	1.0	3	70	.5	.3	.4		1.5	50	60	80	60	60	1	
ROTEL	RT-2100		.5		(29)							50		1.5(8.8)		80					.8	55	110	110	110	80	(13)	
	RT-2000		+.5 −1.0		(30)							45		1.6(9.3)		80					1.0	55	110	110	110	75	(13)	
	RT-725		+.5 −1.0		(50)							40		(10.3)		70					1.5	55	65	75	80		(14)	
	RT-425		+.5 −1.0		(50)							40		(10.7)		70					1.5	50	60	75	75		(14)	
S.A.E.	8000	$700.00	.5	15(28.8)	30(34.8)	68	.2	.15	.2		42	45	35	1.6(9.3)	5(19.9)	70	.2	.5	.2		1.5	100	100	100	120	10 (25)	.0025	
	3200	$400.00	.5	6.5(21.5)	40(37)	68	.2	.15	.3		38	40	35	1.8(10.3)	3.8(16.8)	70	.2	.5	.3		1.5	100	100	100	100	10 (25)	.0025	
SANSUI	TU-9900	$570.00	+.5 −.8	3.9(17)	34.7(36)	76	.08 .8	.08 .8	.15 1.2	.4	40 30	50 30	40 30	1.5(8.8)	2.9(14.5)	80	.06 .5	.06 .5	.08 .8	.4	1.0 3.0	58	100	110	110	90 55	4.4 (18)	150
	TU-717	$370.00	+.2 −1.0	4.9(19)	27.5(34)	78	.1 .22	.07 .2	.1 .25	.6	45	48	38	1.7(9.8)	2.24(12.5)	81	.06 .18	.06 .15	.08 .2	.6	1.0 1.5	60	90	95	95	80 50	5.5 (20)	200
	TU-517	$300.00	+.2 −1.0	4.9(19)	27.5(34)	78	.1 .21	.07 .15	.1 .2	.6	45	48	38	1.7(9.8)	2.24(12.5)	82	.06 .15	.06 .12	.08 .18	.6	1.0 1.5	60	90	105	95	80 50	5.5 (20)	200
	TU-317	$240.00	+.5 −1	4.9(19)	36.5(36.5)	73	.22	.09	.29	.9	35	40	30	1.8(10.3)	2.6(13.5)	79	.12	.07	.27	.7	1.0	50	60	100	88	50	3.1 (15.0)	200
	TU-217	$190.00	±1	5.5(20)	39.2(37)	70	.23	.13	.25	.85	35	40	30	1.85(10.6)	2.7(13.8)	71	.13	.12	.23	.8	1.0	55	60	100	85	50	2.8 (14)	200
SANYO	FMT611K	$159.95		1.9(10.8)		65		.2				45				75		.08			1.0	50	55	55	80	70		
SEQUERRA	I	$3040-3190	.2	(15.5)	(29)	72	.4	.4	.4	.07	51	52	38	(8.75)	(10)	75	.3	.3	.3	.07	.75	>70	>100	95	>100	(12.2)		
SERIES 20	F-26	$1000	+.1 −.3		33.5(35.7)	84	.05	.05	.07		40	55	40	1.9(10.8)	2.5(13.2)	87	.03	.03	.05		2	65	120	120	120	65 >80	5.5(20) 55(40)	
	F-28	$690	+.1 −.3		35(36)	81	.06	.05	.05		50	55	50	1.8(10.3)	2.8(14.1)	84	.05	.04	.06		.08 1.5	65	120	120	120	35 70	5(19.2) Absolute	
SETTON INTL	TUS-600	$439.95	.5	(18)	(38)	67	.3	.15	.15	.35	40	50	40	(10.3)	(17)	72	.1	.1	.15	.35	1	60	85	95	100	80	(14)	±25/98
SHE	3200	$400.00			40(37.2)			.2			35	35	35	1.8(10.3)				.15										
	5000	$700.00	+.5					.2				45	35	1.6(8.5)		70		.15			1.5	100	100		100	120		

MANUFACTURER	MODEL	PRICE	FREQUENCY RESPONSE 50Hz TO 15kHz (±dB)	SENSITIVITY μV (dBf)	STEREO SPECIFICATIONS: 50-dB QUIETING μV (dBf)	MAX S/N RATIO (dB)	HARMONIC DISTORTION (%): 100Hz	1kHz	6kHz	DISTORTION AT 50-dB QUIETING (%)	SEPARATION (dB): 100Hz	1kHz	10kHz	MONO SPECIFICATIONS: IHF SENSITIVITY μV (dBf)	50-dB QUIETING μV (dBf)	MAX S/N RATIO (dB)	HARMONIC DISTORTION (%): 100Hz	1kHz	6kHz	DISTORTION AT 50-dB QUIETING (%)	CAPTURE RATIO (dB)	AM SUPPRESSION (dB)	IMAGE REJECTION (dB)	IF REJECTION (dB)	SPURIOUS REJECTION (dB)	ALTERNATE CHANNEL SELECTIVITY (dB)	MUTING THRESHOLD μV (dBf)	DIAL CALIB ACCURACY (1kHz AT MHz)
SONY	ST-A7B	$900.00	+.2 −.5		30(34.6)	75	.08	.08	.3		50	55	40	1.5(8.8)	2.8(14.2)	80	.04	.04	.05		.8 1.8	60	90	120	120	50 120	VARI	
	ST-A6B	$310.00	+.2 −1.5		39(37.1)	74	.15	.15	.3		43 40	45 40	40 35	1.7(9.8)	3.4(15.9)	79	.08	.08	.08		1.0	60	120	120	120	55 85	5	
	ST-A3A	$200.00	+1 −2		43(37.9)	65	.5	.5	.8		30	40	30	1.8(10.3)	3.6(16.4)	70	.2	.2	.5		1.0		40	95	75	50	5	
STUDER REVOX	B760	$1275.00	1	1.2	<20	75		.15				42		.8	<2	78		.15			.9	70	106	110	106	>95	<2	
TECHNICS	ST-9038	$550.00	+.1 −.5		22(38.1)			.15				45	35	1.2(12.8)	2.2(18.1)	75		.1			1.0	55	105	105	105	75		Absolute
	ST-9030	$460.00	+.2 −.8		22(38.1)			.08				50 40	40 30	1.2(12.8)	2.2(18.1)	80		.08			.8 .2	58	135	135	135	90 25		
	ST-8080	$280.00	+.2 −.8		28.4(34.3)			.3				45	35	1.9(10.8)	2.6(13.6)	75		.15			1.0	55	85	100	95	85		
	ST-8600	$330.00	+.2 −.8		28.4(34.3)	72		.25				45	35	1.9(10.8)	2.6(13.6)	80		.15			1.0	55	95	105	100	85		
	ST-7300	$200.00	+.2 −1.0		45(38.3)	70	.4	.4	.5			45	35	2(11.2)	3(14.8)	75	.2	.2	.5		1.0	55	55	82	80	75		
TOSHIBA	ST-420	$229.00	1			68		.3				45		1.9(10.7)		72		.2			1.0	55	85	90	100	60		
	ST-335	$149.95	1			65		.4				40		2.0(11.2)		73		.2			1.0	45	50	80	70	60		
	ST-910	$1300.00	.05			65		.15				40		1.8(10.3)		75		.15			1.0	65	100	110	100	70		
WINTEC	T-3		+0.5			80	.15 .2 .25	.15 .2 .25	.15 .2 .25		45 40 35	45 40 35	45 40 35	1.5-11.5	11.5	85	.1 .15 .2	.1 .15 .2	.1 .15 .2		0.8 1.5 2.0		125	125	125	30 50 110	5-100	
YAMAHA	CT-610II	$215.00	+0.5 −1.0		40(37.2)	75	.1	.1	.2			45	40	1.6(9.3)	3(14.8)	80	.07	.1	.2		1.0	65	55	80	75	85	5(18.2)	
	CT-410II	$175.00	+0.5 −1.5		40(37.2)	69	.2	.15	.2			40	35	1.8(10.3)	3(14.8)	74	.1	.1	.2		1.0	60	45	80	75	82	5(19.2)	
	T-2	$700.00	+0.3 −3		28(34.2)	85	.05	.05	.07			55		1.5(8.8)	2.5(13.2)	88	.03	.05	.08		1.0	60	120	120	120	100	3(14.8)	
	T-1	$355.00	0.5		35(36)	78	.05	.05	.08			55	45	1.7(9.8)	3(14.8)	80	.05	.05	.08		1.0	65	90	100	100	92 55	5(19.2)	
	CT-810	$275.00	0.3	10.3	37.2	75	.15	.1	.2		35	50	45	1.8	15.3	80	.08	.08	.15		1.0	65	90	90	100	80		
	CT-1010	$375.00	0.3	40(37.2)	37.2	75	.09	.07	.15			50	45	1.9(10.8)	15.3	80	.07	.07	.15		1.0	65	110	110	110	85		

FOR A LIST OF MANUFACTURERS AND THEIR ADDRESSES, CIRCLE NUMBER 129 ON FREE INFORMATION CARD

VIDEOTAPE RECORDERS

Buying - Installing - Using

If you are a newcomer to the world of home video tape recorders, you probably have many questions that need answering before you purchase your machine and can feel at home with it. Here are answers to typical user questions.

FRED BLECHMAN, K6UGT

I HAVE BEEN WATCHING THE PROGRESS OF VIDEOTAPE RECORDERS (VTR's) for the last few years, and from all indications the big breakthrough into mass consumer marketing has finally happened. Newspaper, magazine and TV ads are increasing at an alarming rate, and VTR's are appearing in some better audio equipment stores. Also, video stores devoted exclusively to video products are appearing.

There have been a number of newspaper and magazine articles comparing the features of different VTR's and discussing the battle in the marketplace between the Sony *Betamax* format and the noncompatible *Video Home System* (VHS) format developed by Matsushita. However, I wanted to know whether there were any pitfalls in buying and installing VTR's, and what were some *unusual* ways they were being used?

So, I visited the home office of the L.A. Video Center (8624 Wilshire Boulevard, in Beverly Hills, CA) to ask some questions. I spoke with Ron Domont, the store president, and the following are some of the more important questions and Ron's answers to them.

Q. What are the typical warranties on VTR's?

A. Ninety days' labor and a year on parts. Basically, we've found that if anything goes wrong, it goes wrong in the first 90 days. The manufacturers do not want to hurt the customer, they just want the machine to be used in the first 90 days, so that you can see what it's like and tell everybody else how great it is!

Q. How important is the installation of a VTR? Can the purchaser do it himself?

A. Generally, the booklet that comes with the machine provides enough information for the purchaser to install a VTR himself, if it's a straightforward setup. However, some customers purchase a Sony *Betamax* and two ¾-inch commercial video recorders. When they want to play these machines through any of their TV sets, they will run into different impedances, various types of cables and connectors and line losses. So, if you really don't know what you're doing, it's better to have an expert install the system.

Q. How can a buyer judge a dealer? What should he look for?

A. He should feel comfortable with the store. He should pay attention to the store's layout. Does it carry all the VTR accessories? Do the people in the store have the knowledge to answer his questions? And is there a service department? I really think that's a key feature to look for.

Q. How about buying by mail order or from discount houses?

A. First, a prospective customer should decide if he needs help or if he knows exactly what he wants and is just shopping for a better price. It is possible to buy a VTR from a discount house and save in terms of price. *But* you don't get any information on how to hook it up, except for the booklet. Most of the

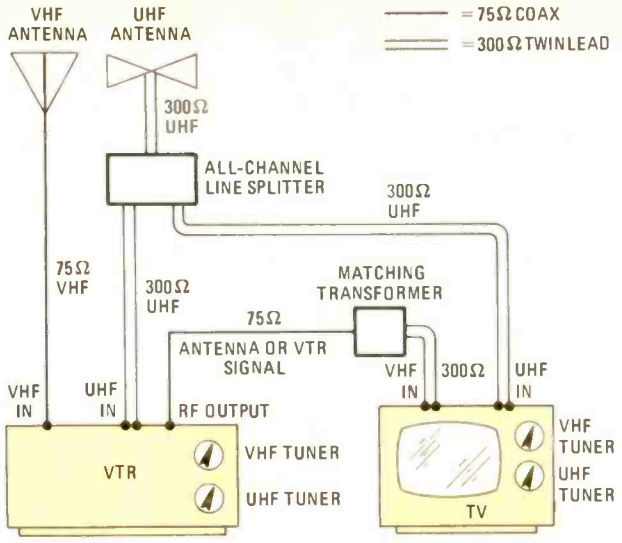


FIG. 1—TYPICAL VTR CONNECTIONS with separate VHF and UHF antennas.

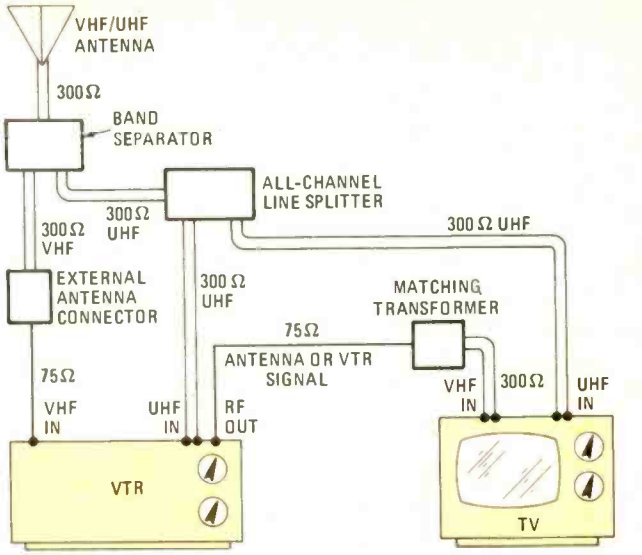
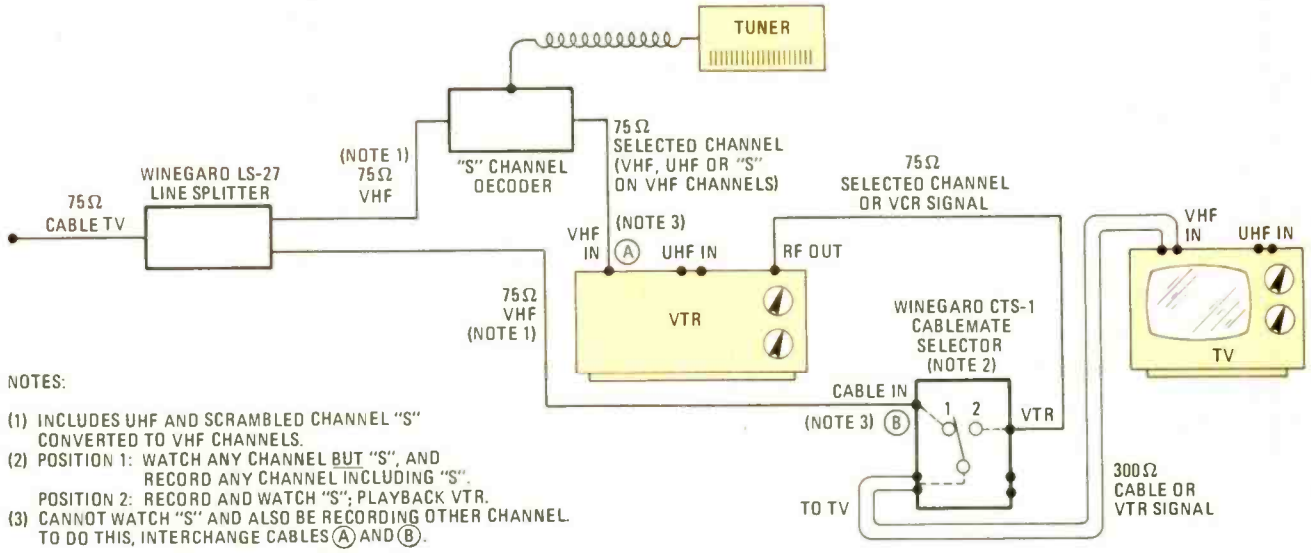


FIG. 2—TYPICAL CONNECTIONS with combination VHF/UHF antenna.



NOTES:

(1) INCLUDES UHF AND SCRAMBLED CHANNEL "S" CONVERTED TO VHF CHANNELS.
(2) POSITION 1: WATCH ANY CHANNEL BUT "S", AND RECORD ANY CHANNEL INCLUDING "S".
POSITION 2: RECORD AND WATCH "S"; PLAYBACK VTR.
(3) CANNOT WATCH "S" AND ALSO BE RECORDING OTHER CHANNEL. TO DO THIS, INTERCHANGE CABLES (A) AND (B).

FIG. 3—VTR CONNECTIONS in a cable-TV system with a program decoder/tuner.

discount house salespeople don't know how to hook the VTR's up themselves. And you don't receive servicing from these stores. VTR dealers like us not only sell video products but also sell video service to the customers—information, installation and repair when needed—not just a recorder in a box! If a customer is looking for information, service, the ability to trade at a later date, and wants to know about new and future products, he should to go a dealer he's comfortable with.

Q. How do you feel about the market for VTR's?

A. I see a phenomenal increase in all types of video equipment. In less than five years, Sears, J.C. Penney's and K-Marts, for example, will carry VTR's with their own names on them, for under $500.

Q. Have you any additional comments?

A. Yes. One thing I really want to impress upon everyone is that a VTR is basically an entertainment item. Ninety percent of VTR customers use them to record what they want to, and play them back when they want to. That's the major use.

VTR uses

We then discussed some common, as well as unusual, uses for a VTR:

1. Recording one program while watching another—for later viewing.
2. Recording while away, or asleep, using a built-in or auxiliary timer.
3. Watching prerecorded tapes of speeches, lectures, sports, plays, movies, etc., strictly for entertainment.
4. Watching prerecorded educational tapes for instructional use.
5. Watching a recording of an orchestra or band and playing or singing along for practice. Ron told me of a symphony violinist who does this and claims it's far more effective to see and hear the music being played.
6. Dubbing in your own sound; most VTR's have a microphone input for this. A foreign language can be dubbed in for commentary or narration, or you can use your own script.

If you add a video camera to your VTR, you can

7. Correspond by video tape; this requires a tape-format and speed compatibility at both sender and receiver ends.
8. Create home "movies." You can then either keep the movies or use the tape over, something you can't do with film!
9. Make an audition tape to send to talent agencies, many of which have VTR's.
10. Keep a surveillance record using time-lapse controls that record at short intervals, so that a 24-hour period can be compressed and played back in an hour or so.
11. Record sales trainees giving their "pitch" so they can see and hear themselves in action and receive appropriate correction.

Installation

Next, for information about potential installation difficulties in less-than-ideal circumstances, I asked Theodore Charles, video installation engineer for L.A. Video Center, the following:

Q. Are there any special antenna requirements when using a VTR?

A. A VTR tuner is better than many TV tuners, and more sensitive than many older TV's, so a VTR will sometimes provide a *better* picture from your antenna than when the TV program is received directly from the antenna! For the best picture, of course, the antenna should provide signals free of snow, noise and ghosts. And remember, the TV set used for playback should operate properly; the VTR could be providing a better picture than the TV set is capable of displaying.

Q. Can impedance mismatch cause a poor picture?

A. Yes, especially with 300-ohm antenna cable. If we install an antenna, we use 75-ohm coaxial cable.

Q. Do you use any special cable type?

A. We use Belden 8241 RG-59/U coaxial cable for the quality of its braid and its flexibility; it is also easy to strip, feed through and generally work with.

Q. How critical is the cable length? Is there any maximum length?

A. Anything over 75 feet might produce RF losses that could cause a significant signal-strength drop.

Q. Are standing waves a problem?

A. No.

Q. Is it OK to use line splitters, band separators and matching transformers in the regular fashion?

A. Yes.

Q. Are there any special considerations when several TV's are hooked up to one antenna?

A. Under these circumstances, a signal-level meter is really needed. After making the initial connections, readings are taken to find dB losses from set to set. Losses through cable lengths and connectors might require using an RF amplifier at the antenna.

Q. Are there any special considerations when using cameras to record?

A. Proper lighting plays a very important part. Use the video output rather than the RF output of the camera.

Q. Is the quality of the video signal better?

A. Yes! This is especially critical when transferring from one machine to another—dubbing or making a copy. Go from the video output of one VTR to the camera (video) input of the other. For normal use, RF signals are satisfactory but video signals are better.

GE'S NEW VHS video cassette recorder features two speeds.

Figures 1 and 2 show two typical installations with standard antenna configurations and cable impedances. Most VTR's have 75-ohm VHF inputs, 300-ohm UHF inputs and 75-ohm RF outputs, so matching transformers are usually needed at least between the VTR RF output and the TV VHF input.

In Figures 1 and 2, the VHF signal goes into one VTR input, while the UHF signal goes into another input. From these inputs, the signals go to separate VHF and UHF tuners in the VTR, where you then select the channel to be recorded, just as on a TV set. The VTR has a monitor switch that allows you to see the selected channel (without recording) on your TV set though the VTR output. This output is a RF signal on Channel 3 or 4, whichever channel is not active in your locality. (This feature is switch-selectable on most VTR's but some units use separate plug-in converters.) Once you've tuned in the picture (on Channel 3 or 4), you can record a program on the VTR as you watch it on the TV set. However, you can also flick a VTR switch that directs the antenna signals to the VTR output, unconverted. Thus you can watch your TV set in the regular

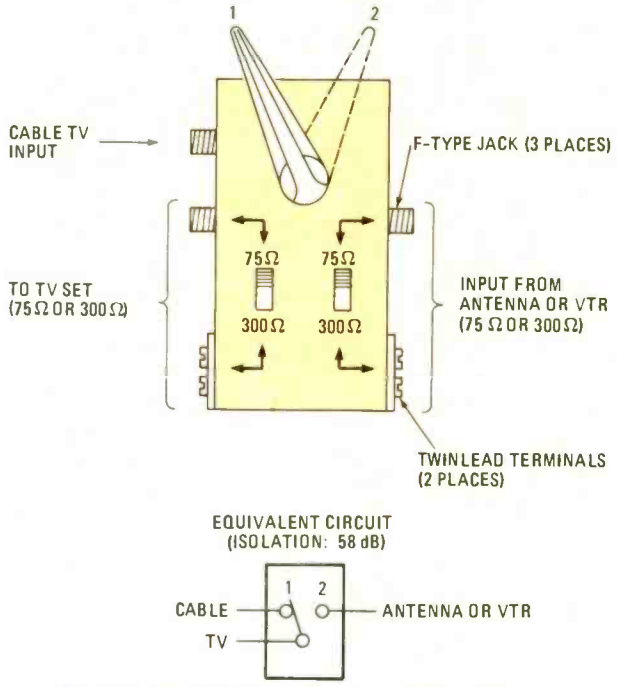


FIG. 4—WINEGARD (3000 Kirkwood, Burlington, IA 52601) model CTS-1 Cablemate TV signal selector.

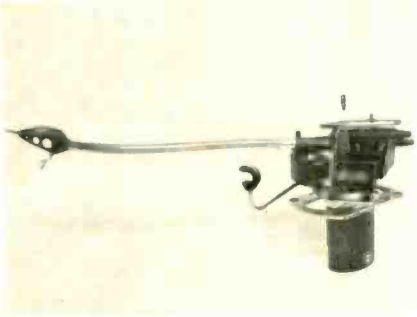
fashion, using the TV tuners to select the channel, while the VTR records on the channel *its* tuner is set to.

Incidentally, an interesting side-benefit of having two sets of tuners—is that you can use the VTR as a *remote* tuner. By having the VTR near you and in the monitor mode, you select the channel at the VTR, while the TV set stays tuned to Channel 3 or 4!

In many parts of the country, cable TV is becoming quite popular. For details on what would be involved in VTR installations where there was cable television, I visited The Video Center in Woodland Hills, CA. Here I met Paul Perez and Kim Knudson (store manager), who provided me with some hardware details.

There are various types of cable TV systems. Figure 3 shows a connection to a cable that provides VHF channels, UHF channels (converted to locally unused VHF channels) and a scrambled special "Channel S." In order to receive Channel S you need a decoder/tuner whose output is on, say, Channel 3. By setting your VTR tuner to Channel 3, the VTR receives whatever channel (including Channel S) the cable decoder/tuner selects. Simultaneously, if you set the *Cablemate* selector switch (Fig. 4) to position 1, you can watch any other channel (except Channel S) on your TV set. For playback from the VTR, the selector switch is moved to position 2. This allows you to record Channel S through its special decoder circuitry as you watch another channel. If you want to watch Channel S and record another channel, interchange the cables at points A and B. Although the *Cablemate* selector switch was not designed for this use, Fig. 3 shows how it can be used in this, or similar, installations, with 58-db isolation between inputs. **R-E**

Radio-Electronics Tests Shure SME 3009-III Pickup Arm



1

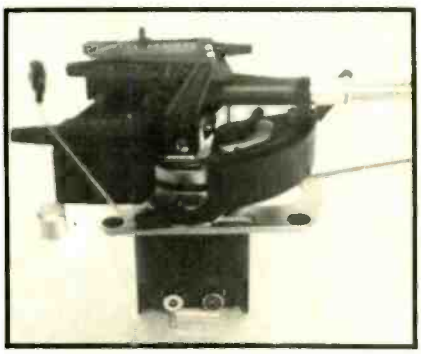
LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

THOSE OF YOU WHO ARE FAMILIAR WITH EARLIER versions of the SME pickup arm distributed in the U.S. by Shure Brothers, Inc. (222 Hartrey Avenue, Evanston, IL 60204) will be pleased to learn that the newest version of the arm, the *model SME 3009-III* (Fig. 1) has incorporated many new features that improve performance and add versatility.

Perhaps the most significant difference between the *model SME 3009-III* and earlier versions is the S-shaped tubular carrying arm itself, which contains a fixed headshell but can be completely removed from the rest of the structure. Thus, it is possible to purchase several of these carrier arms for permanent mounting of your favorite cartridges. Changing cartridges then simply involves unplugging one carrier arm and plugging in an alternate arm. In this way, the cartridge overhang is permanently established for each pickup, as are those delicate terminal connections. A small quantity of cartridge-bonding compound is supplied with the arm, so that cartridges remain perfectly aligned relative to each carrier shell once they are installed.

The main balancing system of the *model SME 3009-III* has also been redesigned. It consists of lead and plastic laminations contained in a separate weight housing. As supplied by the factory, the combination of weights and spacers can handle cartridges weighing from 6 grams to 10.5 grams, but it is relatively easy to remove the entire weight housing and to arrange a different combination to suit other cartridge weights. Once the arm is statically balanced by moving this angled weight-housing lengthwise, the required tracking force is set by a calibrated fine adjustment at any desired tracking force up to 1.5 grams. If forces greater than this value are required, a coarse weight on the opposite side of the main pillar and pivot structure is pushed forward, adding one gram (exactly) to the readings obtained on the fine adjustment.

The antiskate adjustment is similar to that of earlier SME models. Figure 2 shows the system, consisting of a tiny weight, nylon thread and pulley arrangement. A nylon thread loop is attached to a calibrated adjustment, providing the necessary antiskating force in increments of one-tenth of a gram, shown on the scale in Fig. 3. In addition, the antiskating system actually compensates for the minute variation in antiskating force at different radial distances from the center of the disc.



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Perhaps the most important difference between this version of the SME arm and its predecessors is the incorporation of a viscous fluid-damping system for the entire pickup arm. A curved tank, just under the junction of the carrier arm and the point to which it is affixed (see Fig. 2) is filled with a silicone fluid (the filling process takes several hours because of the high viscosity of the fluid). A tiny paddle is suspended from the rear section of the pickup arm and rides in the tank of damping fluid as a recording is played. Three different paddles are actually provided to insure the correct degree of damping for phono cartridges having different compliance ranges. This unique system provides vertical as well as lateral damping of the pickup arm. The damping rate assumes that records are in fairly good condition and that realistic tracking forces at 1 gram or so are used. The operator's manual states that a certain amount of tuning (best accomplished by removing some of the damping fluid) may be necessary if a badly warped record is to be played using this system.

3

Laboratory measurements and tests

We tested the *model SME 3009 III* pickup arm in conjunction with the new Shure *model V-15 Type IV* cartridge (see the Sept. 1978 issue of **Radio-Electronics**). Using Shure's new *model TTR-115 Era IV* test record, we attempted to evaluate the effects of both the cartridge damping system and the pickup arm damping system. This test record permitted us to measure system resonance with various combinations of arm and cartridge damping. Without the pickup arm's fluid-damping system and with the cartridge damper brush disengaged, there was a pronounced 12-Hz resonance. Engaging the destaticizer/damper-brush arrangement of the *model V-15 Type IV* cartridge reduced the resonant effect (which remained at a 12-Hz frequency) to a much lower value. Under these test conditions, the arm's damping system was still not used. Final-

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Dimensional Characteristics:
Nominal pivot-to-stylus length: 9 inches. **Distance from bedplate center to turntable center:** 8.48 inches. **Tracking adjustment range:** ±0.5 inch. **Height above mounting surface:** 2⅜ inches to 3¼ inches maximum. **Height of turntable surface above mounting surface:** 1 inch to 1⅝ inches. **Depth below mounting surface:** 1⅞ inches. **Clearance required for balance weights:** 2½ inches. **Clearance required between turntable surface and cabinet lid:** 1¾ inches.

Performance Characteristics:
Cartridge weight accommodated: 0 gram to 12 grams. **Pivotal friction:** Less than 0.02 grams applied at stylus deflects arm either horizontally or laterally. **Tracking force range:** 0 gram to 2.5 grams. **Bias adjust (antiskate) range:** 0 gram to 2.5 grams. **Cable supplied:** 4-foot dual audio cable. **Total cable capacitance plus wiring capacitance** (including discrete 200-pF padding capacitor, supplied): 293 pF.

Suggested Price: $294.

ly, after we filled the damper tank with the silicone fluid, we repeated the tests and this time the 12-Hz resonance was barely noticeable whether the cartridge damper system was used or not.

With both damping systems in use, we measured the trackability of the system using the Shure *model TTR-103* test record. At high frequencies, trackability was maintained up to velocities of 30 cm-per-second. At the mid-frequencies, trackability was even higher, with readings of 40 cm-per-second and at low frequencies, the trackability was maintained to at least 30 cm-per-second groove velocities.

Once the arm was properly balanced, we checked the accuracy of the calibrated tracking-force scale on the arm. Using a separate tracking-force gauge, the Shure *model SFG-2*, which is accurate to better than 0.1 gram, we found that calibration was absolutely accurate. The same held true for the antiskating-force scale of *model SME 3009 III* pickup arm.

Summary

Our overall product analysis together with summary comments will be found in Table 1. The serious audiophile who prefers a turntable without an integral pickup arm will find that this SME unit is capable in every way of delivering its best performance when used with a high-quality cartridge rated to track at low downward forces of 1 gram or so. While certainly not inexpensive (fairly good complete turntable systems including pickup arm, base and dust cover cost less than this pickup arm alone), the *model SME 3009 III* offers a performance level that is as close to perfection as any we have ever tested or used, and it should find its way into some of the more sophisticated high-fidelity systems in the U.S. as it has in Great Britain (where it is manufactured) and in other countries. **R-E**

TABLE 1

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Shure Bros.** Model: **SME 3009 III Pickup Arm**

OVERALL PRODUCT ANALYSIS

Retail price	$294
Price category	High
Price/performance ratio	Very good
Styling and appearance	Excellent
Sound quality	Superb
Mechanical performance	Superb

Comments: In addition to the tests and measurements discussed in this report, such design features as ease of setup and adjustment were also judged. Ease of setup was rated "fair"; and the manual must be read carefully for the correct assembly and installation of both cartridge and arm. Ease of adjustment was rated "good"; this unit is the most accurate and well-calibrated pickup arm we have tested. The interchangeable carrier arms are superior to interchangeable headshells if you wish to stock (and use) more than one phono cartridge. Needless to say, sound quality is largely determined by the cartridge with which this arm will be used, but in our tests the combination of the Shure *model V-15 Type IV* and the *model SME-3009 III* offered about as fine a sound from records as we have ever heard. Additionally, we imagine that other high-quality pickups would work well when mounted in this pickup arm.

Marantz 2265B AM/FM Receiver

CIRCLE 109 ON FREE INFORMATION CARD

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

ALTHOUGH SOME SUBTLE PANEL DESIGN changes have been made in Marantz's entire receiver line, a single glance at the front panel of the *model 2265B* stereo AM/FM receiver reveals that it is unmistakably a Marantz unit. The elegant machine-turned metal knobs, the thumbwheel tuning mechanism and the generally rich layout are all very much in the Marantz tradition.

Figure 1 shows the front panel of the *model 2265B*. The old blackout dial has been replaced by a highly visible background color behind the AM and FM frequency notations in the large dial area opening. Above the frequency calibrations (which are linear for the FM scale) small lights indicate the selected program source and stereo FM reception. Signal-strength and tuning meters are located to the left of the frequency scales.

1

Just below the dial area, on the same level as the edge-mounted thumbwheel flywheel tuning arrangement, are 11 pushbuttons. These controls handle two tape monitor circuits, tape-to-tape dubbing, mono/stereo selection, FM muting, high-cut and low-cut audio filtering, loudness-compensation circuitry and selection of one or both pairs of connected loudspeakers.

Along the lower section of the panel are seven rotary knobs, plus a pair of tape-in and tape-out jacks, a stereo phone jack and a power on/off pushbutton switch. The three centermost knobs are actually dual-concentric types that permit individual bass, treble and midrange tone control of each channel. Balance and volume control knobs are to the right of the three tone controls, while at the left are the main program selector switch and a switch identified as TONE MODE. This switch can defeat tone-control circuitry, introduce conventional bass and treble action (with hinge points at or near the mid-frequency range) or provide alternate crossover points at around 100 Hz and 10 kHz. Most other manufacturers providing such tone-control versatility in a receiver usually add two extra controls or more for this purpose.

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

FM Tuner Section:
IHF Usable Sensitivity: mono, 1.8 μV (10.3 dBf). **50-dB Quieting:** mono, 3.0 μV (14.8 dBf); stereo, 35 μV (36 dBf). **S/N Ratio:** mono, 76 dB; stereo, 70 dB. **Distortion:** mono, 0.15% at 1 kHz; 0.25% at 100 Hz; 0.3% at 6 kHz; stereo, 0.3% at 1 kHz; 0.35% at 100 Hz; 0.5% at 6 kHz. **THD at 50-dB Quieting:** 0.6%, mono and stereo. **Frequency Response:** stereo, 30 Hz to 15 kHz, ± 1.5 dB. **Capture Ratio:** 1.0 dB. **Selectivity:** 80 dB. **Image Rejection:** 90 dB. **IF and Spurious Rejection:** 100 dB. **AM Suppression:** 55 dB. **Stereo Separation:** 50 dB at 1 kHz; 42 dB at 100; and 10,000 Hz.

AM TUNER SECTION:
IHF Usable Sensitivity: 12 μV. **THD:** 0.4%. **S/N Ratio:** 54 dB. **Selectivity:** 46 dB. **Image and IF Rejection:** 75 dB. **Spurious Rejection:** 75 dB.

AMPLIFIER/PREAMP SECTION:
Power Output: 85 watts-per-channel into 8 ohms, 20 Hz to 20 kHz (83 watts at 4 ohms). **Rated THD:** 0.05% at 8 ohms; 0.1% into 4 ohms. **IM Distortion:** 0.05% at 8 ohms; 0.1% at 4 ohms. **Damping Factor:** 55. **Input Sensitivity:** phono, 1.8 mV; high level, 180 mV. **Phono Overload:** 200 mV at 1 kHz. **Frequency Response:** phono, RIAA ± 0.5 dB; high level, 10 Hz to 60 kHz, ± 1.25 dB. **S/N Ratio:** phono, 78-dB referenced to 7.75 mV; high-level: 90-dB referenced to 775-mV input.

GENERAL SPECIFICATIONS:
Power Requirements: 120 VAC 60 Hz, 50 watts (idling), 280 watts (maximum). **Dimensions:** 17⁵⁄₁₆ W × 5⅜ H × 14½ inches D. **Net Weight:** 32 lb. **Suggested Retail Price:** $550.

The rear panel is equipped with two sets of color-coded spring-loaded speaker terminals, switched and unswitched AC convenience receptacles, 75-ohm and 300-ohm antennas, AM and ground terminals and a built-in, pivotable ferrite-bar AM antenna. In addition to the required tape-input and tape-output terminals, there are a muting level control that varies the signal strength required to overcome the muting feature, plus two pairs of preamplifier-output, main amplifier-input jacks. These jacks require neither wire jumpers nor a switch for circuit completion when an accessory is not used. Circuit interruption occurs when accessory devices such as an equalizer or a noise-reduction unit are plugged in.

An FM detector jack is also located on the rear panel (Marantz calls this a QUADRADIAL jack, since sometime in the future it could be used for connecting a four-channel FM adapter.) The upper right of the rear panel contains a plastic cover plate, which, when removed, provides access to a large opening into which an optional Dolby decoder board can be inserted. This optional approach makes sense since only a very few broadcasting stations are presently using the Dolby system.

FM measurements

Our FM tuner measurements are summarized in Table 1. The results can be compared with the manufacturer's claimed specifications listed elsewhere in this report. Most FM performance specifications were met or exceeded, except for the distortion measurements, which generally turned out to be poorer than claimed. It is possible that our particular unit may have been slightly misaligned. Signal-to-noise ratios and 50-dB quieting in mono and stereo were, nevertheless, quite good, and the various signal-rejection capabilities were all as good or better than claimed.

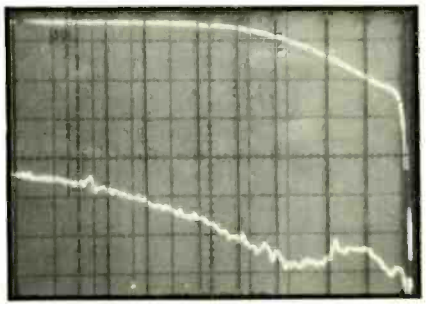

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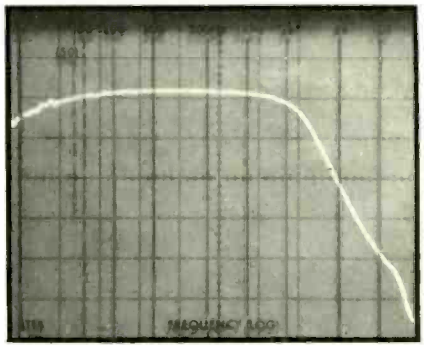
Figure 2 is a scope photo of FM frequency response (upper trace), including the required 75-μs de-emphasis, and the excellent separation characteristic is shown in the lower trace. At mid-frequencies, separation measured an extremely high 58 dB, remaining well above 40 dB even at the frequency extremes of 100 Hz and 10 kHz. Note that the vertical divisions shown in Fig. 2 are equal to 10 dB, as is true of all the other scope photos in this report.

Readers have requested that we at least measure the frequency response of the AM sections of tuners and receivers tested for these reports. Therefore, beginning with this report, we will display the AM response, as shown by a spectrum analysis. Results for the *model 2265B* are shown in Fig. 3, and the −6 dB rolloff occurred at approximately 20 Hz and 3 kHz.

Amplifier measurements

The power amplifier section of the *model 2265B* is conservatively rated as shown in Table 2. Note also that Marantz (unlike many other manufacturers) provided an FTC power rating for 4-ohm operation as well as for 8-ohm loads. In both cases, the ratings were exceeded substantially before attaining the already low-rated harmonic distortion level (specified as 0.05 for 8-ohm operation and 0.1 for 4-ohm loads).

The 66-dB signal-to-noise ratio obtained in phono does not indicate an inferior result to the one specified by Marantz. Again, this is a case of differences in reference input levels. Marantz, for some reason, references phono S/N to a 7.75-mV input (rather higher than most cartridges typically produce when tracking nominally recorded groove velocities). At least up until now, we have been using actual input sensitivity (in this case, 2.2 mV) against which to measure S/N in phono and high-level inputs. Translated to their frame of reference, the S/N actually would be 78.0 dB, or equal to the published specification.



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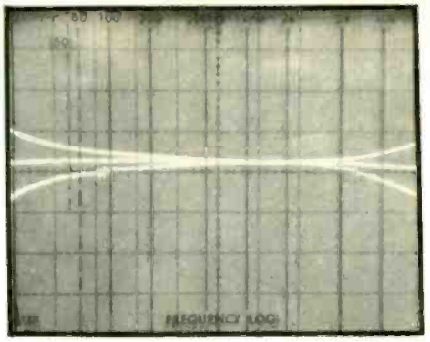

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In the case of the high-level inputs, the excellent lab figure of 94 dB (referenced to an actual input sensitivity of 180 mV) translates to 105 dB if referenced to Marantz' arbitrary 775-mV input figure. Once the new IHF standards are approved, it is hoped such specification ambiguities will be eliminated.

Figures 4 and 5 depict the control range

TABLE 1

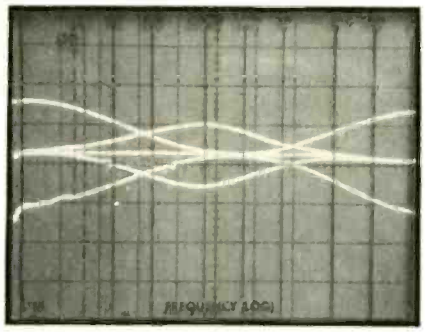
RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Marantz** Model: **2265B**

FM PERFORMANCE MEASUREMENTS

	R-E Measurement	R-E Evaluation
SENSITIVITY, NOISE AND FREEDOM FROM INTERFERENCE		
IHF sensitivity, mono (μV) (dBf)	1.8 (10.3)	Very good
Sensitivity, stereo (μV) (dBf)	10.0 (25.2)	Fair
50-dB quieting signal, mono (μV) (dBf)	2.6(13.5)	Excellent
50-dB quieting signal, stereo (μV) (dBf)	35 (36.0)	Good
Maximum S/N ratio, mono (dB)	78	Excellent
Maximum S/N ratio, stereo (dB)	71	Excellent
Capture ratio (dB)	1.0	Excellent
AM suppression (dB)	57	Fair
Image rejection (dB)	90	Very good
IF rejection (dB)	100+	Excellent
Spurious rejection (dB)	100+	Excellent
Alternate channel selectivity (dB)	82	Excellent
FIDELITY AND DISTORTION MEASUREMENTS		
Frequency response, 50 Hz to 15 kHz (±dB)	1.0	Very good
Harmonic distortion, 1 kHz, mono (%)	0.21	Good
Harmonic distortion 1 kHz, stereo (%)	0.40	Fair
Harmonic distortion, 100 Hz, mono (%)	0.26	Good
Harmonic distortion, 100 Hz, stereo (%)	0.45	Fair
Harmonic distortion, 6 kHz, mono (%)	0.22	Good
Harmonic distortion, 6 kHz, stereo (%)	0.42	Good
Distortion at 50-dB quieting, mono (%)	0.50	Very good
Distortion at 50-dB quieting, stereo (%)	0.35	Excellent
STEREO PERFORMANCE MEASUREMENTS		
Stereo threshold (μV) (dBf)	10 (25.2)	Fair
Separation, 1 kHz (dB)	58	Superb
Separation, 100 Hz (dB)	45	Excellent
Separation, 10 kHz (dB)	43	Superb
MISCELLANEOUS MEASUREMENTS		
Muting threshold (μV) (dBf)	10 (25.2)	Fair
Dial calibration accuracy (±kHz at MHz)	100 at 108	Excellent
EVALUATION OF CONTROLS, DESIGN, CONSTRUCTION		
Control layout		Excellent
Ease of tuning		Excellent
Accuracy of meters or other tuning aids		Good
Usefulness of other controls		Very good
Construction and internal layout		Excellent
Ease of servicing		Very good
Evaluation of extra features, if any		Very good
OVERALL FM PERFORMANCE RATING		Good to very good

provided by the flexible tone-control system of the *model 2265B*. Figure 4 shows the available



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range when turnovers are set for the 100-Hz and 10-kHz points (the extra midrange tone-control action is not included). In Fig. 5, the alternative turnovers were selected to which was added a sweep showing the range provided by the midrange or presence control. Proper use of these three controls and the related tone-mode switch affords nearly as much tone-control flexibility as is available with separate, five-band graphic equalizers.

Figure 6 is a scope photo of the steep, high-cut filter action. Actually, the subsonic filter switch was also turned on for this measurement, but since the filter begins to cut at below 20 Hz (the lower limit of our sweep generator), its action cannot be seen in Fig. 6. In actual listening tests, the low-cut filter was quite effective in reducing subsonic turntable rumble.

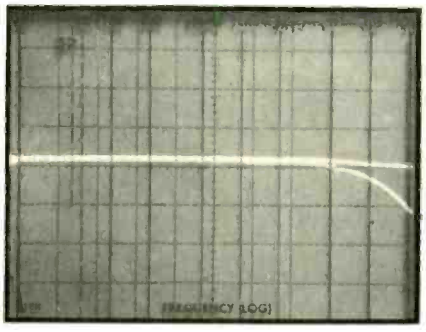

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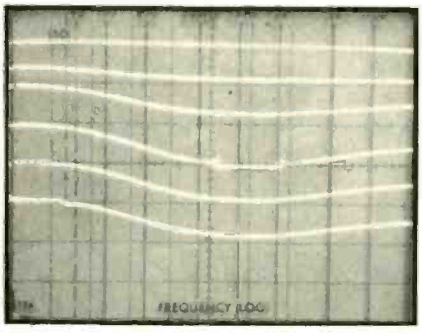
Figure 7 shows the response of the receiver at listening levels (approximately 10-dB apart) when the loudness-control circuitry is activated. Marantz provides a small amount of treble compensation as well as the usual, more heavily emphasized bass boost.



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Summary

Table 3 contains our overall product analysis. Not surprisingly, this mid-powered receiver is as well engineered and as versatile as Marantz's more powerful. At its nominal 65 watt-per-channel power rating, it would be an excellent choice for use with many speakers that work ideally with that power level. **R-E**

TABLE 2

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Marantz** Model: **2265B**

AMPLIFIER PERFORMANCE MEASUREMENTS

	R-E Measurement	R-E Evaluation
POWER OUTPUT CAPABILITY		
RMS power/channel, 8-ohms, 1 kHz (watts)	75	Very good
RMS power/channel, 8-ohms, 20 Hz (watts)	67.3	Excellent
RMS power/channel, 8-ohms, 20 kHz (watts)	70.2	Excellent
RMS power/channel, 4-ohms, 1 kHz (watts)	90	Excellent
RMS power/channel, 4-ohms, 20 Hz (watts)	87	Excellent
RMS power/channel, 4-ohms, 20 kHz (watts)	88	Superb
Frequency limits for rated output (Hz-kHz)	16-35	Excellent
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output, 1 kHz (%)	0.013	Superb
Intermodulation distortion, rated output (%)	0.03	Very good
Harmonic distortion at 1-watt output, 1 kHz (%)	0.017	Excellent
Intermodulation distortion at 1-watt output (%)	0.015	Excellent
DAMPING FACTOR, AT 8 OHMS	58.3	Very good
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ± dB)	0.3	Excellent
Maximum input before overload (mV)	220	Excellent
Hum/noise referred to full output (dB) (at rated input sensitivity)	66	Very good
HIGH-LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± dB)	10-65, 1.0	Excellent
Hum/noise referred to full output (dB)	94	Excellent
Residual hum/noise (minimum volume) (dB)	97	Very good
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls	See Figs. 4 & 5	Superb
Action of secondary tone controls	See Fig. 5	Excellent
Action of low-frequency filter(s)	See text	Excellent
Action of high-frequency filter(s)	See Fig. 6	Very good
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	2.2/2.2	
Input sensitivity, auxiliary input(s) (mV)	180	
Input sensitivity, tape input(s) (mV)	180	
Output level, tape output(s) (mV)	180	
Output level, headphone jack(s) (V or mW)	N/A	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Excellent
Adequacy of input facilities		Excellent
Arrangement of controls (panel layout)		Excellent
Action of controls and switches		Very good
Design and construction		Very good
Ease of servicing		Very good
OVERALL AMPLIFIER PERFORMANCE RATING		Excellent

TABLE 3

OVERALL PRODUCT ANALYSIS

Retail price	$550
Price category	Medium/high
Price/performance ratio	Good
Styling and appearance	Excellent
Sound quality	Excellent
Mechanical performance	Very good

Comments: Over the years, Marantz has managed to establish a product image that immediately identifies their audio components. The *model 2265B* actually offers more control flexibility than at first meets the eye. Its designers have provided every conceivable control and switching function without making the unit look like a computer. While in the past we have often felt that Marantz units were a bit high-priced for the sound they delivered, recent increases in the cost of competitive units place the *model 2265B* price just about where it belongs. As for its sound-reproduction capability, it is as good as any we have heard from other receivers in the same price and power category.

Phono reproduction was especially clean and tight, and, despite the relatively high bench-measured distortion figures in the FM tuner section, in actual listening tests, FM sensitivity was excellent as was the stereo-separation capability of the tuner. We believe that our sample unit must have been slightly misaligned and that given a properly aligned set, published distortion figures would have been met or exceeded. The tone-control mode switch takes a bit of getting used to, but it does eliminate the need for extra knobs on the front panel.

It is unfortunate that this is the first receiver test report in which AM frequency-response measurements are included (after many reader requests), since response is quite poor. But it is no poorer than that generally found on most hi-fi receivers.

In average-sized listening rooms, the *model 2265B* provides ample power for use with even relatively low-efficiency speakers. When deliberately driven to clipping, the amplifier recovers quickly and handles transients well.

Frequency Counter In A Probe

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

WALTER T. CARDWELL, JR.

MANY CONSTRUCTION ARTICLES DEAL with digital frequency meters, and some of these meters are quite small and portable. A few offer prescalers to increase the range of operation, but the increase in performance means one more box and more cables to clutter your work area.

The frequency meter described in this article is constructed using a new method (see "IC Bricklaying" in the December 1977 issue) that results in a complete crystal-controlled, dual-range, six-digit frequency meter not much larger than a pen. The meter operates from 0 to 750 kHz with 1-Hz resolution, or to 2.5 MHz with 10-Hz resolution. You can build prescalers that plug into the tip of the meter, and that can extend the range to 1 GHz. Additional circuits, combined with plug-in probe tips, greatly increase the device's capabilities and functions.

How it works

The meter is constructed by using what can best be described as a bricklaying technique. (See "IC Bricklaying", *Radio-Electronics*, December 1977.) The IC leads are cut flush with the bottom of the package. The wide section of the IC leads that remain on the side of the package is used as a bonding pad for making connections. Normal AWG No. 30 solid wire-wrap wire is used to connect the IC's, using point-to-point wiring. This quick-and-easy method allows you to change the circuit more easily than when PC boards are used. In addition, no chassis or other structural support is required. The IC's themselves are the supporting structure.

Circuit description

The meter is built around two MC14553B three-digit CMOS (*C*omplementary *M*etal *O*xide *S*emiconductor) counters. Figure 1 shows the block diagram of the IC, which incorporate three decade counters, three 4-bit (quad) latches and an output multiplexer, with multiplexer oscillator. The master reset signal not only clears the counters but also sets the multiplexer to the first digit. One MC14553B counter is used as a master whose multiplexer oscillator drives the slave multiplexer.

Figure 2 shows the schematic of the probe's main body. Two MC14553B's, IC10 and IC13, are cascaded to form a six-decade counter, and only one scan clock is used. Capacitor C2 sets the scan-oscillator frequency of IC13, which acts as the master and drives the slave IC10. Both master resets are connected to synchronize the multiplexers. By using a master/slave scheme, only one clock capacitor and one set of digit drivers are required.

The latch output is applied to the Q-outputs, and the appropriate digit select line, DS, goes low. The Q-outputs connect directly to two seven-segment, decoder-latch drivers, IC9 and IC12; the latch section is not used. Drivers IC9 and IC12 incorporate NPN pull-up transistors on the output lines so that no external segment drivers are required.

The DS-outputs of IC13 connect to PNP transistor bases Q2–Q4, which are used as emitter-follower digit drivers.

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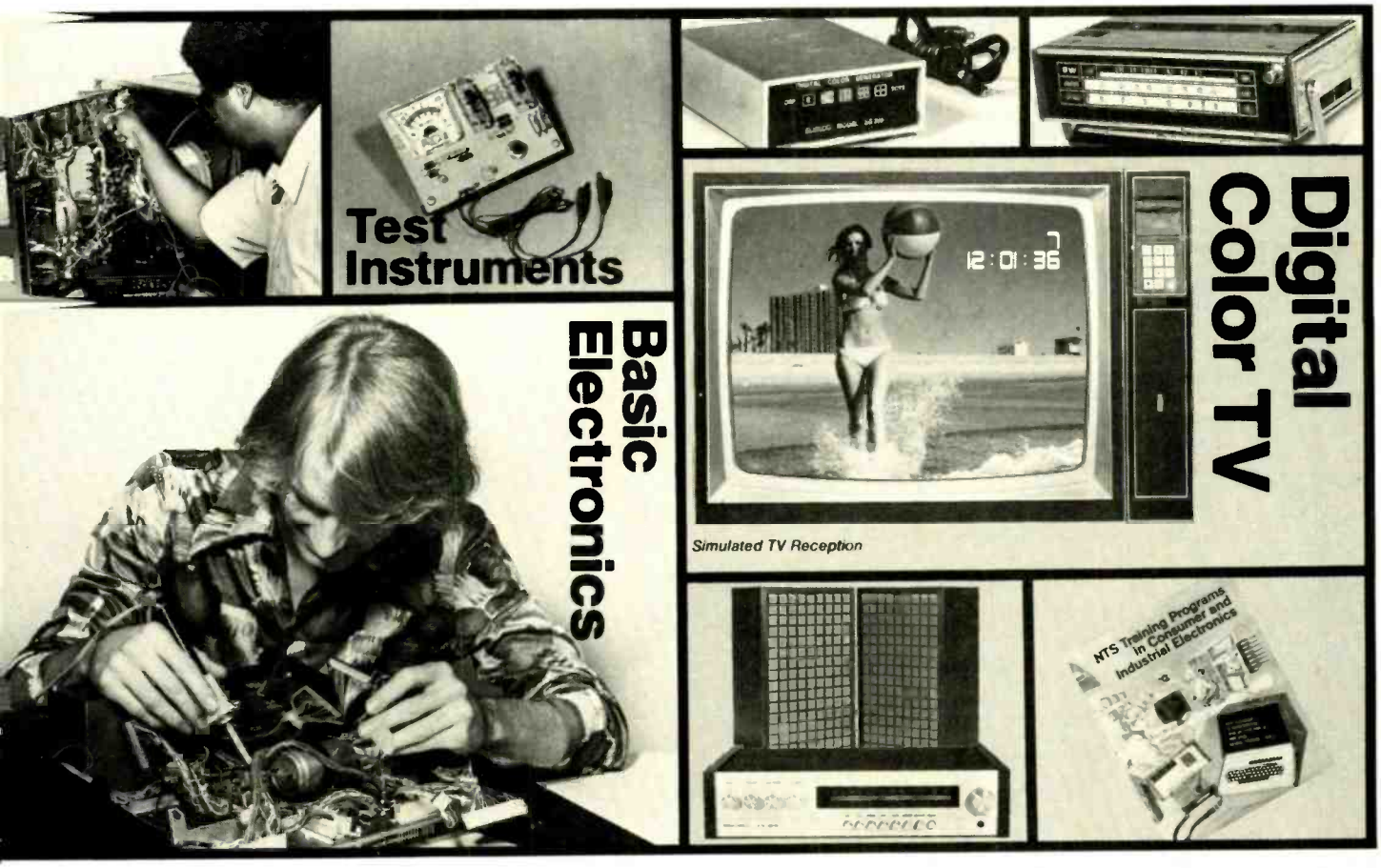

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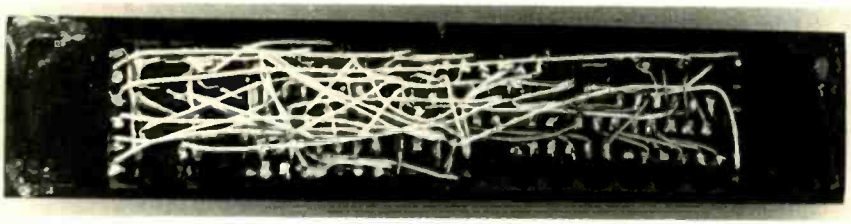
You can use any 100-mA PNP transistor, but it should be housed in a small TO-92-style plastic case. When transistors are used, the wire-wrap wire is wound around the transistor lead and soldered. The transistor lead is then clipped as close to the case as possible.

There is a design compromise in the display driver circuit. As shown in Fig. 2, there are no segment current-limiting resistors because fifteen ¼-watt resistors would be required, which would take up too much room. Instead, transistor Q5 sets the current level by setting the voltage on the driver-transistor collector. Transistor Q5 should handle about 300 mA of current. The three-digit displays are fairly well matched and the digits all have equal brightness. If both three-digit readouts are not matched to each other, use two sets of drivers to set the levels independently. So far, this modification has not been necessary. The brightness of the digits varies slightly, depending on which number is displayed. However, this variation is not objectionable.

SMALL SIZE of probe-type frequency counter is due to IC "bricklaying" construction technique. IC's are glued together for maximum use of alloted space.



POINT-TO-POINT wiring is used exclusively in construction. Wires are soldered directly to the IC pins. Discrete components are attached wherever room permits.

PARTS LIST

All resistors ¼-watt, 10%
Probe body:
R1,R5—100,000 ohms
R2–R4,R6,R12,R16—10 megohms
R8–R11—1 megohm
R13,R15—10,000 ohms
C1—25 pF, 10-volt disc
C2—.001 μF, 10-volt disc
D1–D6—1N914 diode
Q1—2N5220 (Motorola), any 100-mA NPN No. T0-92 transistor
Q2–Q5—2N5221 (Motorola), any 300-mA PNP No. T0-92 transistor
IC1,IC2—CD4013 (RCA), MC14013 (Motorola), dual type-D flip-flop
IC3—74C04 (National), hex inverter
IC4—CD4001 (RCA), MC14001 (Motorola), quad 2-input NOR gate
IC5—CD4518 (RCA), MC14518 (Motorola), dual BCD up counter
IC6—CD4017 (RCA), MC14017 (Motorola), decade counter/divider
IC7—CD4023 (RCA), MC14023 (Motorola), triple 3-input NAND gate
IC8—MM5369 (National), programmable oscillator divider
IC9, IC12—CD4511 (RCA), MC14511 (Motorola), BCD-to-seven segment latch/decoder/driver
IC10, IC13—MC14553B (Motorola), 3-digit BCD counter
IC11—74C08 (National), quad 2-input AND gate
XTAL1—3.57-MHz crystal
DSP1, DSP2—3-digit, common-cathode, 7-segment LED display (HP 5082-7433 or equal. Three 2-digit displays may be substituted.)
S1,S2—cut from 80-pin, .125-in. edge connector
Misc.—⅛-in. and 1/16-in. black opaque acrylic plastic, 1/16-in. transparent amber acrylic plastic, ABS plastic sheet (*Plastruct*) and I-section, AWG No. 30 wire-wrap wire, cyanoacrylate glue.
Battery pack:
BATT 1—(4) 20-mAH NiCad cells
R1—1000-ohm, 10-turn trimmer
IC2—MC1403 (Motorola), precision low-voltage reference (2.5V ± 25 mV)
One miniature mike connector
Misc.—Double-clad, 1/16-inch No. G-10 PC board. 1/16-in. black acrylic plastic.
Probe tip:
R1,R3—100,000 ohms
R2—10 megohms
C1,C2—0.01 μF, 50-volt disc
D1—1N914 diode
IC1—CD4013 (RCA), MC14013 (Motorola), dual type-D flip-flop
S1—SPST normally open miniature pushbutton switch
S2—2 copper nails
Misc.—1/16-in. black acrylic plastic, double-clad 1/16-in. No. G-10 PC board, ½-in. clear plastic, ⅛-in. piano wire.

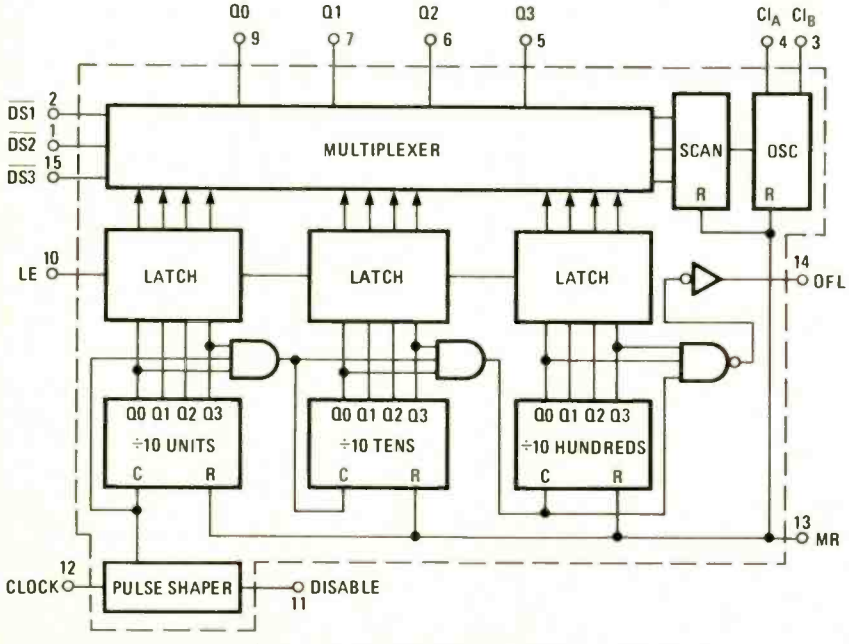
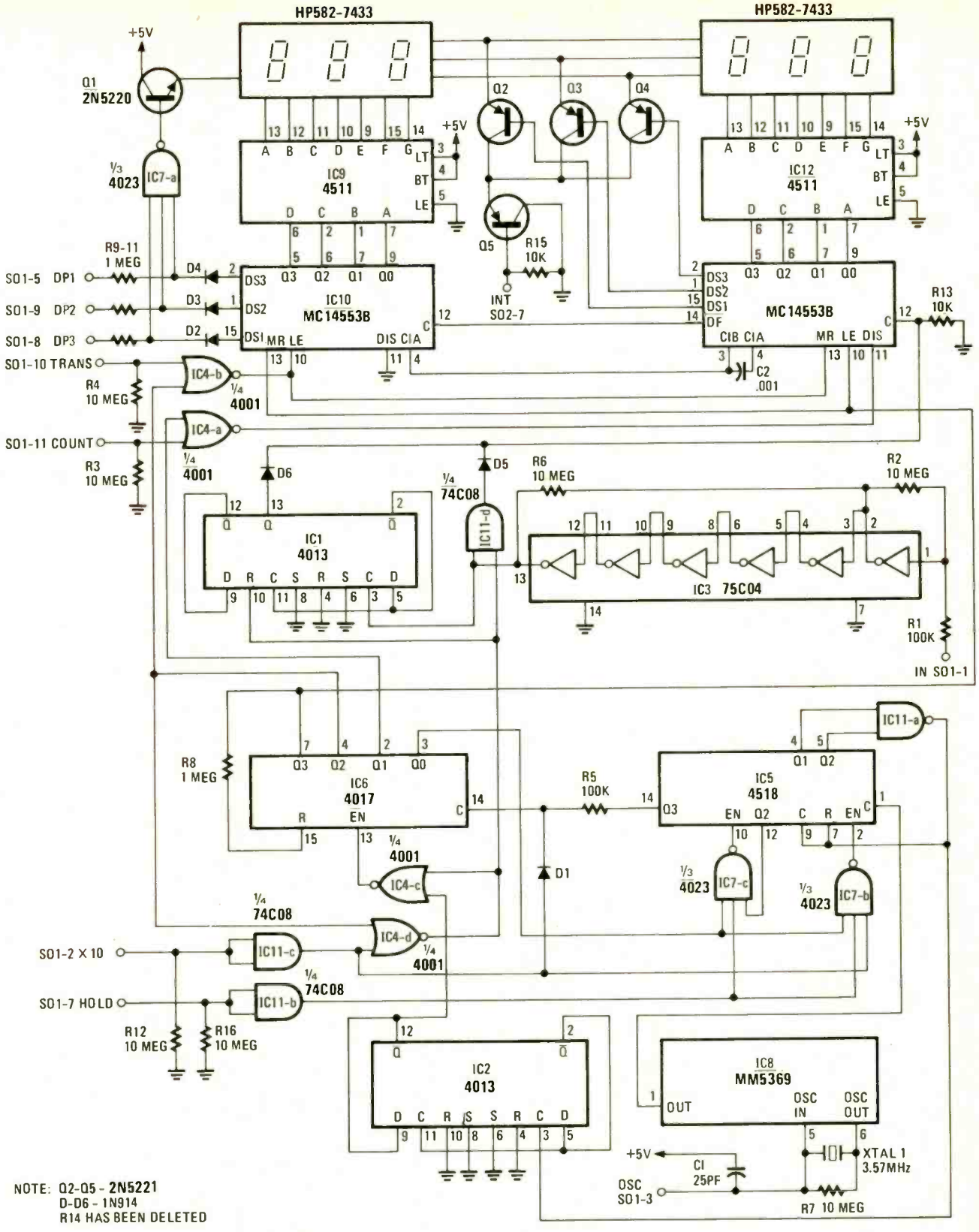


FIG. 1—BLOCK DIAGRAM of the MC14553 CMOS 3-digit BCD counter used as the heart of the frequency-counter-in-a-probe. Two are required for the 6-digit LED readout.

You can use any three-digit common-cathode seven-segment readout. With these readouts, the total current drawn by the entire meter is 35 mA, with a 10K resistor from the base of Q5 to ground. A 4.7K resistor increases the display brightness, but it also increases the current drain to 50 mA. The base lead is brought to the power-supply socket to increase the intensity when the meter is not being battery-operated.

The MC14553B IC's 10 and 13 count when the DIS signal is low. An IC13 overflow clocks IC10. The counter data is transferred to the latches when the latch signal is low. Master reset MR resets both counters and multiplexers.

The input amplifier consists of a 74CO4 hex inverter used as a linear amplifier. Each inverter has a gain of about 10 dB at 2 MHz and 5 volts. The first inverter is biased in the linear region



NOTE: Q2-Q5 - 2N5221
D-D6 - 1N914
R14 HAS BEEN DELETED

FIG. 2—FREQUENCY-COUNTER schematic shows the simplicity of this novel instrument. CMOS-type IC's and the transistors are used to reduce power consumption.

by R2. Resistor R1 limits the input current on high-level signals. The maximum input current to any CMOS input pin is 10 mA and is set by the IC's internal metallization. Higher currents can cause the device to fail, either because the metal migrates or the aluminum melts. While the CMOS input impedance is usually high, it falls to a low value when the input protection diodes conduct. This occurs when the input exceeds the supply voltages. The 100K input resistor insures that the input-current limit of 10 mA is not exceeded until the input is greater than 1000 volts. When the diodes conduct, the input impedance is 100K; when they are not conducting, the input impedance is 10 megohms.

The remaining five inverters are brute-forced for maximum gain and are biased by resistor R6 to operate in the linear region. The input sensitivity depends on the IC; sensitivities can sometimes be as

continued on page 100

BUILD THIS

Modular System for quick PROTOTYPING

Breadboarding an electronic device that uses digital or logic circuitry can be boring and time-consuming because the circuits are often repitious. Use this system of pre-wired circuit modules to speed your next prototype.

JAMES E. TEMPLE

BOTH DESIGN AND CONSTRUCTION OF working electronic circuits have come a long way in the past few years. In the past, constructing circuits for a working model was accomplished by a rats-nest-type setup. It meant soldering-in expensive components to an electrical point, plus numerous wires to jump to other areas of the circuit. Once a circuit was wired and proven, reclaiming the parts for use in the final printed circuit was a maybe situation. Most often, new components had to be used in the final circuit and the rats-nest was left as is. This method not only had its drawbacks, it was also an expensive way to experiment with a pet project.

A direct design using a PC board was time consuming, and the possibility that the layout would work correctly was chancy. One serious error in the design meant probably redesigning a new PC board. The chances of fixing up a bad board were fifty-fifty; major changes could be a disaster and the time lost to make a new board was costly.

In answer to this problem, wire-wrap sockets, wire-wrap tools and solderless sockets were introduced. But using the wire-wrap or solderless type of circuit presents an initial outlay of quite a few dollars, and for the hobbyist, that money is sometimes hard to come by. A large or complex circuit means you have to have enough sockets to go around for the components. This also means the size of the project is limited with this method of prototype construction. Additionally, once a circuit is torn apart from the socket, there is no way to trace the interconnecting wire jumpers without rebuilding the circuit. A mistake can cost you time. A true schematic must be drawn up, corrections made from the working circuit and the final circuit must still be built.

The modular system

Modular construction techniques are being used in commercial electronic gear—TV sets, computers, test equipment, etc. Modular construction consists of a bus system and modular circuits that plug into the bus system to form the total working device. Replacing or adding to the device is simply a matter of plugging in a new module.

This same principle—the use of modules—can also be applied to prototype circuit construction. This method is highly workable these days because IC's—TTL, CMOS and other logic families—are relatively inexpensive. Today, the cost of two IC's equals what one used to cost. Why not then buy two IC's and use one in a permanent modular circuit that is easily stored, easily made and fairly inexpensive to construct? This article describes a modular breadboard system that can be used as a learning tool, built in your spare time and is just plain fun to make.

To build a modular system, some form of bus structure is necessary. For IC's, the bus structure comprises the power-supply input connections, plus any internal or cross-wiring of the IC pinouts that allows them to function. Some method of interconnecting the input and output to other modules must also exist and must be of a solderless nature. The modular system described in this article meets all these specifications.

Each module consists of an IC with its

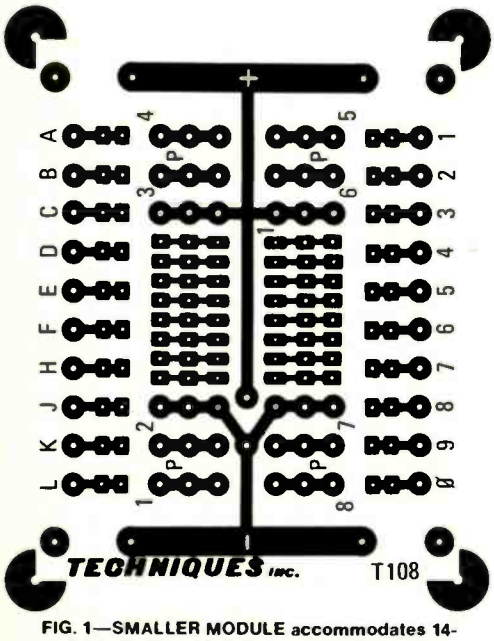


FIG. 1—SMALLER MODULE accommodates 14- and 16-pin IC's. Module uses single-pin male and female bus connectors. Foil pattern is for component side (top) of single-sided board and is shown full-size.

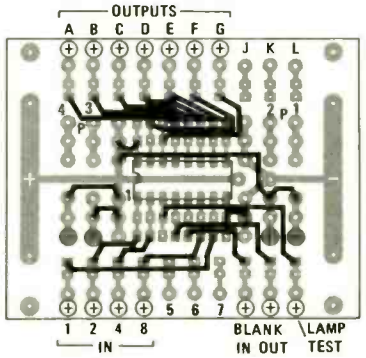
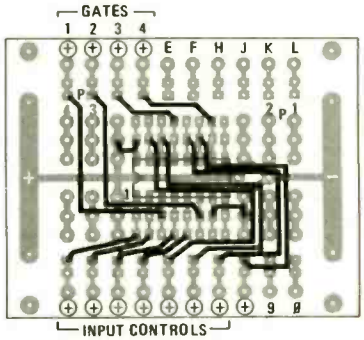
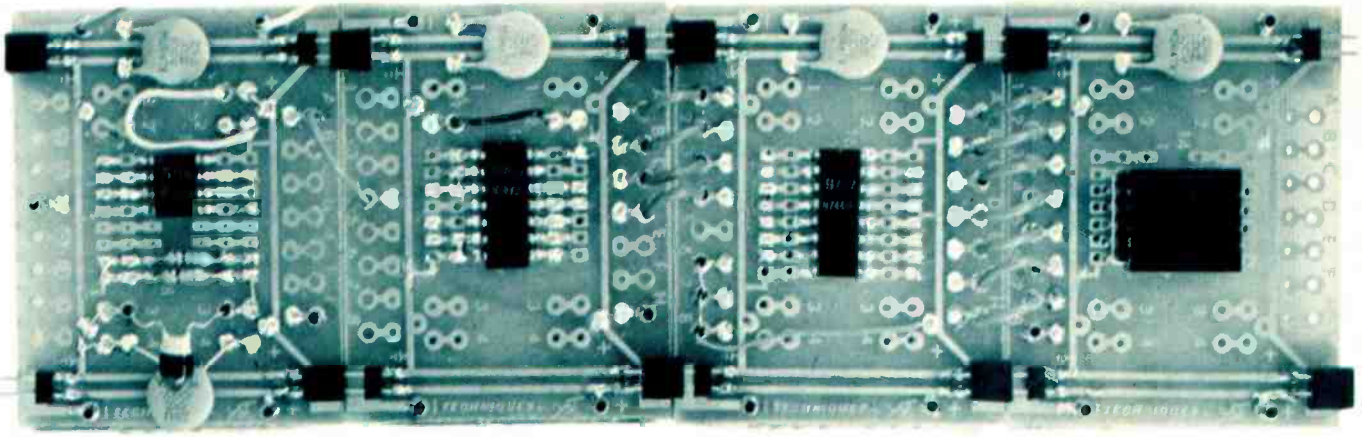


FIG. 2—WIRING DIAGRAM for module shown in Fig. 1 for use with 7448 BCD to 7-segment decoder/driver. View is from bottom (non-foil) side of board.



NOTE: "IC" IS OUTLINED – WATCH PIN NO. ONE (1)

FIG. 3—7400 QUAD 2-INPUT NAND GATE IC is wired on small module as shown. View is from bottom (non-foil) side of board.



bus power system and internal wiring. Various types of IC's, each having a particular function and each existing as an individual module, can be combined with other modules to form working prototype circuits. The bus system automatically makes the proper power connections, and individual solderless pinouts are provided for the cross-wiring of the modules to the other circuit components. The system requires building the individual modules themselves, plus storage or inventory of a number of completed units.

The modular system presents no visible drawbacks since the cost of just a single module is low. The actual building and testing of each module allows you to learn digital logic circuits by using manufacturers' design manuals or the popular IC *Cookbooks*. As the system is constructed, you learn by testing your designs for each IC that you will use in your inventory of modules.

An easy way to start building up your modular system is to build an IC project. Design the individual modules, build them and use them in the prototype circuit. From this built-up prototype circuit, you will test out the total project. And you may even spot a bug or design a better way to construct the project.

The modular system can also be built one section at a time. You can design a series of modules, purchase the components and then build the units. They are reusable in future circuits, and you can store them in a case or box. If this is the method you choose to build your system, then do it logically. Keep an inventory of the modules you have, what you would like to have in your system and what you plan to add to it from your pet projects.

What about the giant IC or LSI units? These can be costly. The answer is to use solderless sockets within the modular system. Build a module to contain the solderless socket; and when you have an expensive IC, use this module to wire up the IC. This then is a universal module. Several of these modules allow interconnections for discrete components.

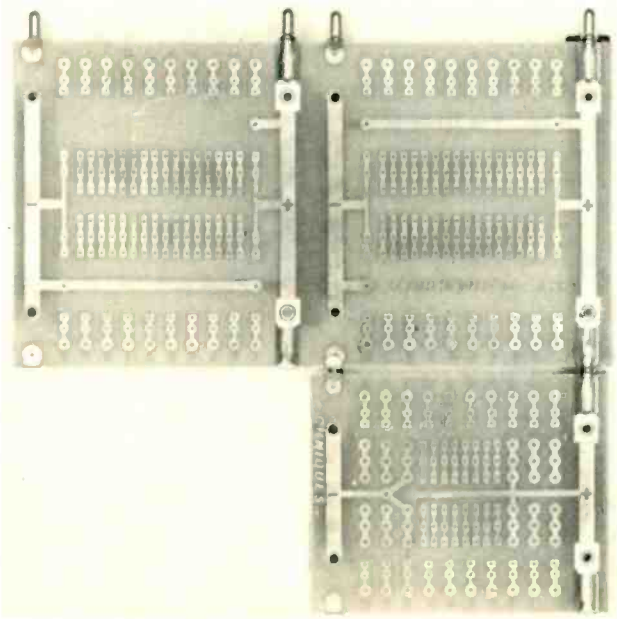
COMPONENTS AND WHERE TO OBTAIN THEM

PC board stock and etching materials are available both as individual elements and as kits from electronics parts dealers and stores and mail-order houses catering to electronics hobbyists. For the alternate-style modules shown in Fig. 5 and the photo above, you will need 2-pin male and female bus connectors which can be obtained from an electronics parts distributor or from Robinson Nugent, 800 E. 8th Street, New Albany, IN 47150. These are:

Part No. WTS-36R-4-T, tin-plated, single-row, right-angle male header.

Part No. WB-25-PR, single-row, right-angle female header.

Acceptable substitutes are manufactured by AP Products, 77 Corwin Drive, Box 110, Painesville, OH 44077: Single-strip right-angle male connectors and single-strip female connectors. (Note: you must use a wire to attach this female connector to the board, it is not available in right-angle format.)



HOW SOME PC BOARDS INTERCONNECT. Boards are etched from foil patterns in Figs. 1 and 4. Single-pin male and female connectors are from Keystone.

Once a proper system is assembled—that is, various modules are built and proven—construction of prototype circuits is accomplished quickly. Incidentally, there are no limitations on how large the circuit can be to exist within the modular system; it can be as large as you need. The only real limitation is the size of your work area. Large circuits, once assembled, can easily be broken down into convenient final designs for several PC boards. If any particular IC would be better placed in another area of the circuit, it can easily be moved.

Constructing the modules

Here's how to get started on constructing your modular system. Each 14-pin or 16-pin IC will be made into a small

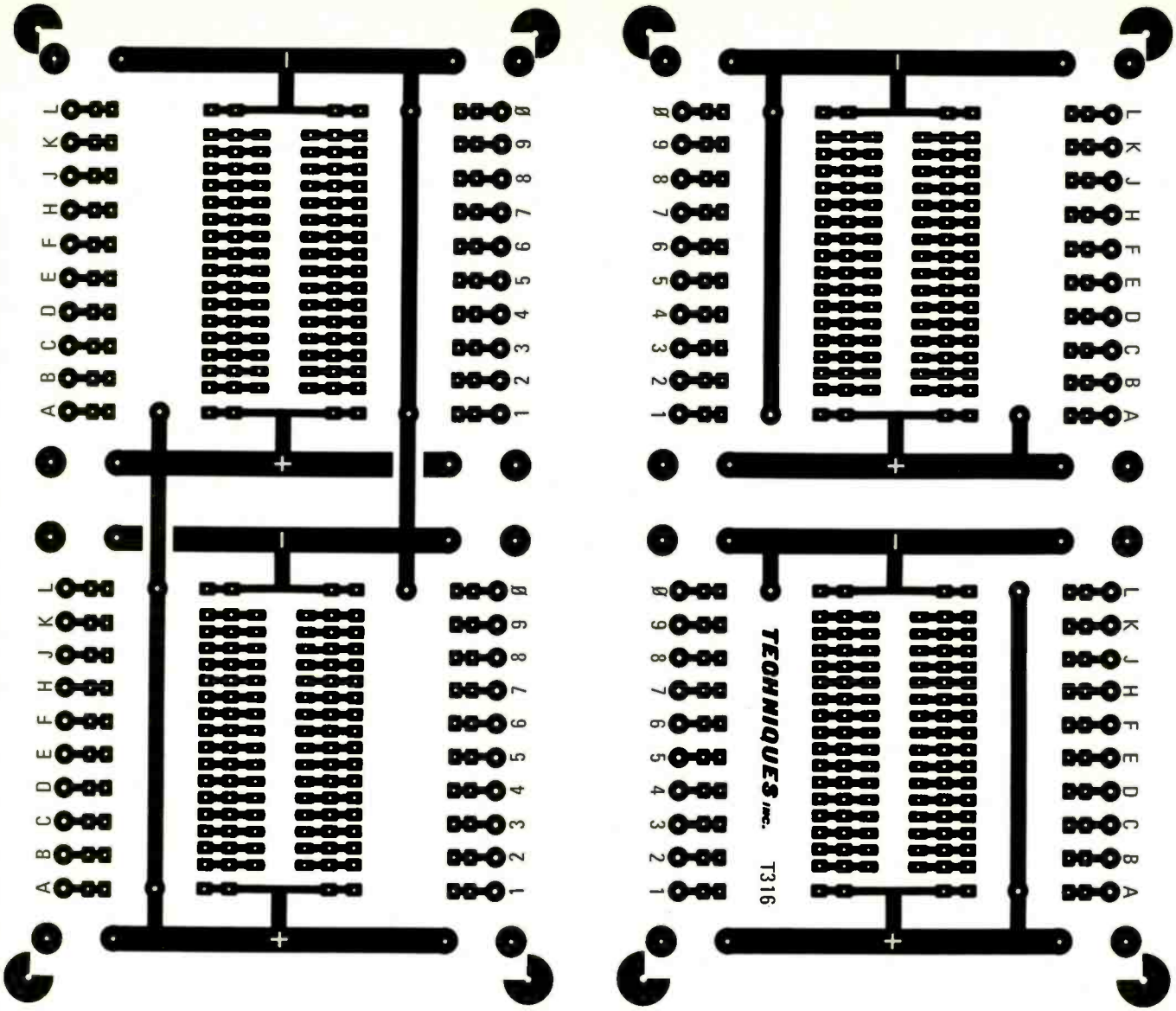


FIG. 4—LARGE MODULE accommodates up to 32-pin IC's as well as discrete components. Module uses single-pin male and female bus connectors. Foil patterns are for component and bottom side of two-sided boards and are shown full-size.

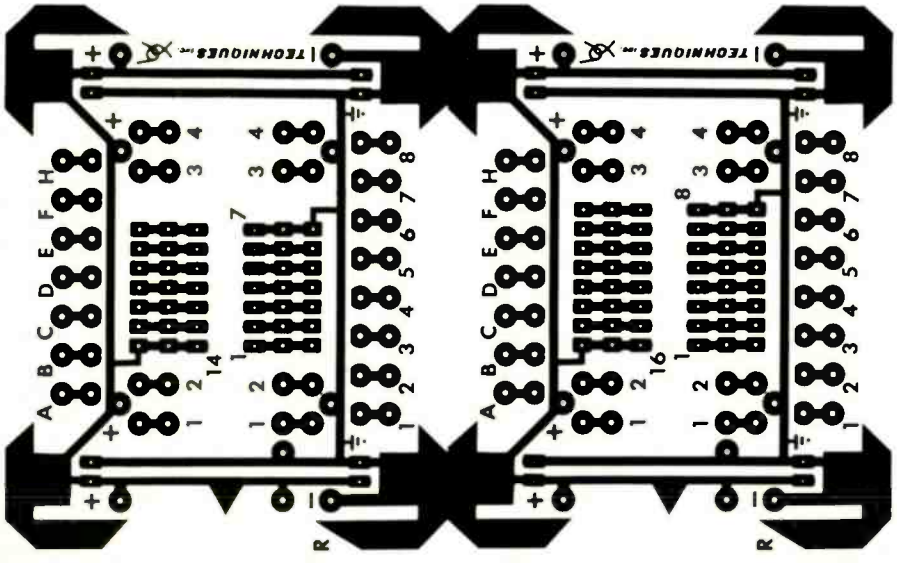


FIG. 5—ALTERNATE-STYLE MODULES require 2-pin male and female bus connectors. Foil pattern is for component side of single-sided board and is shown full-size. Pattern delivers two modules which should be separated.

module on a single-sided PC board. The IC is soldered directly to the board. A larger module will accept IC's with up to 32 pins (memories, CPU, etc.) and is double-sided. Power supply connections from module to module are made by plug-in connectors. Connections to the bus lines within each module are made by using jumper pins. Miniature tubular pins allow solderless wire connections between modules. Twenty-four-gauge wire, cut to size, stripped at the ends and pushed into the pin tubes, makes these input and output connections. Each module rests on a ¼-inch-thick piece of foam material glued to the bottom of the module. The following is a list of components that you will need to make several modules:

1. **Connectors:** These are single-pin male and female bus connectors. You can probably adapt any connector that you prefer.

continued on page 104

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SM59

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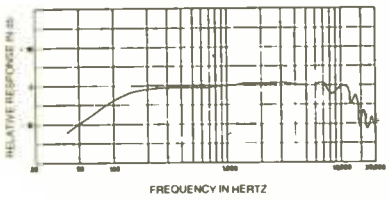
Some like it essentially flat...



SM58

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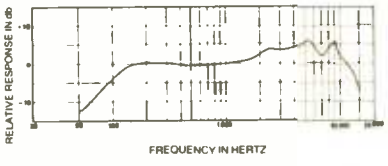
...some like a "presence" peak.



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computer corner

6800 *An overall look at the hardware and software aspects of the 6800 microprocessor.*

WILLIAM BARDEN, Jr.

THE MOTOROLA MC6800 IS ONE OF THE "big four" microprocessors that are used in hobbyist computers. For example, it is used in the Southwest Technical Products SWTP 6800, as well as in several others. The 6800 is part of a large Motorola microcomputer family that can be used to construct a versatile microcomputer system for business, experimentation, or real-time control. Let's take a look at the hardware and software aspects of the 6800.

Hardware

The 6800 requires only an external +5-volt power supply and an external clock to implement the complete CPU function. The clock input requires a two-phase nonoverlapping type that is somewhat difficult to generate compared with the single-phase clock required by other microprocessors.

Figure 1 shows the pinout of the 6800. It contains the usual 16-line address bus A15 through A0 and an 8-line bidirectional data bus, D7 through D0. External memory and I/O (*I*nput/*O*utput) devices are addressed by the address bus, and all data is transferred between internal CPU registers, external memory and I/O devices along the data bus. As usual in this generation of microprocessors, the 16 address lines can address up to 64K (65,536) bytes of external memory and I/O devices. No differentiation is made between memory addresses and I/O device addresses in a *memory-mapped I/O* addressing scheme.

The two-phase clock inputs are at $\phi 1$ and $\phi 2$. The chief control signals for reading and writing to external memory and I/O are the VMA and R/W signals. Signal VMA is issued when a valid memory (or I/O) address is present on the address bus. Signal R/W, of course, specifies the direction of the transfer. These two signals and clock input $\phi 2$ are decoded by external logic to perform transfers between external devices and the CPU.

Bus control signals TSC (*T*hree-*S*tate *C*ontrol), DBE (*D*ata *B*us *E*nable) and BA (*B*us *A*vailable) all control the CPU bus lines for direct-memory-access (DMA) applications that transfer data between external devices and external memory, thus avoiding the CPU.

There are three interrupt inputs available with the 6800: $\overline{\text{RESET}}$, $\overline{\text{IRQ}}$, and $\overline{\text{NMI}}$. The $\overline{\text{RESET}}$ input starts the CPU from a power-down condition, or resets the CPU from a locked condition. The $\overline{\text{IRQ}}$ input is the actual external interrupt request that indicates an external device is interrupting and requires service. The $\overline{\text{IRQ}}$ input will be ignored if an interrupt-enable flip-flop in the CPU has been reset. The third interrupt, $\overline{\text{NMI}}$, can never be disabled and is used to signal catastrophic system conditions such as an imminent power loss. All three interrupts cause a *interrupt vector* address to be loaded into the program counter, effectively transferring control to one of three interrupt routines.

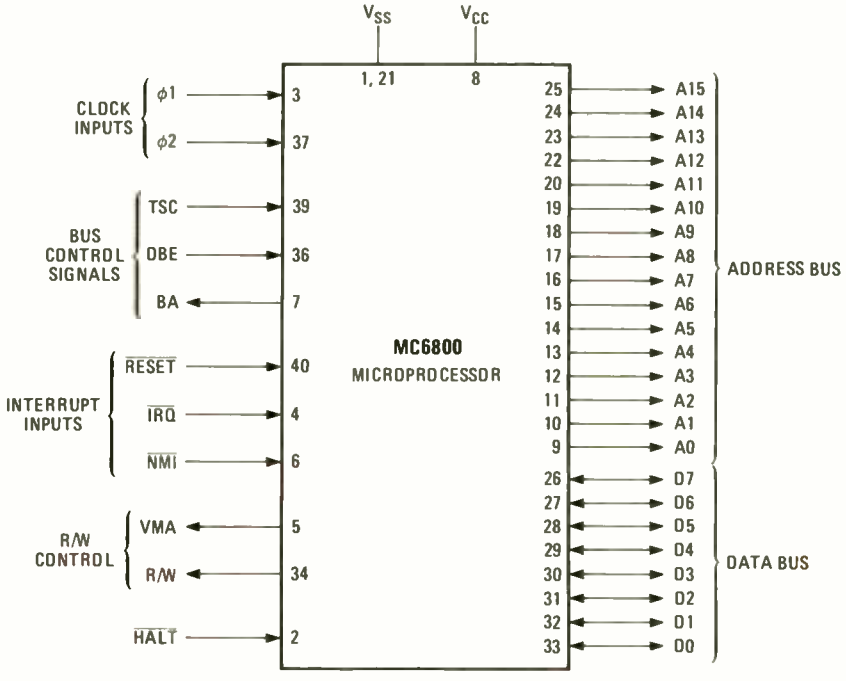


FIG. 1—PINOUT of the MC6800.

The remaining input signal, $\overline{\text{HALT}}$, is used to stop CPU activity for single-stepping and similar operations. Most of the CPU lines are three-state, reverting to a high-impedance state when disabled and allowing multiple connections to be made to the same bus or control line.

6800 architecture

Figure 2 shows the internal CPU registers of the 6800. Not shown are the nonaccessible CPU registers used in instruction fetch and execution. The program counter is a typical 16-bit register that holds the address of the instruction being executed. Addressing is performed in byte fashion, so that the program counter always holds the current external-memory address of the one- to three-byte instruction.

The stack pointer is a 16-bit register that holds the current stack address. The external memory stack is used for temporary storage of program variables and for automatic storage of CPU registers during the interrupt process. The stack can be located anywhere in external memory by properly initializing the stack pointer with the *top of stack* address.

Eight-bit accumulators A and B are used to hold one of the operands for arithmetic and logical operations in the CPU. They also serve as the registers from which data is transferred between exter-

nal memory and I/O devices and the CPU. When instructions are executed in the CPU, another set of flip-flops, the condition codes, are set according to the results. Collectively, the condition codes constitute a condition-codes register that specifies carry, overflow, arithmetic sense of the last operation and interrupt-enable. As in other microprocessors, *conditional* branches in program execution can be performed by testing the states of the condition codes using proper instructions.

Index register IX is a 16-bit register that permits an *indexed addressing* mode in instruction execution in the 6800. In this mode, the *effective address* of the instruction is formed by adding a displacement in the instruction to the contents of the index register. As instructions are available to step the index register forward or backward, the indexed addressing mode can be used to sequence through tables of data or for other processing functions.

Instruction set

The 6800 has 72 instructions. Since many of these instructions permit several addressing modes, however, the actual number of instructions is a few hundred.

The 6800 instructions are straightforward processing types: add, subtract, OR, AND, exclusive OR, shift, plus instructions to transfer data and conditionally and unconditionally branch to subroutines and other locations. (BCD arithmetic operations can also be performed.)

The instruction set's effectiveness is greatly increased by a wide range of addressing types:

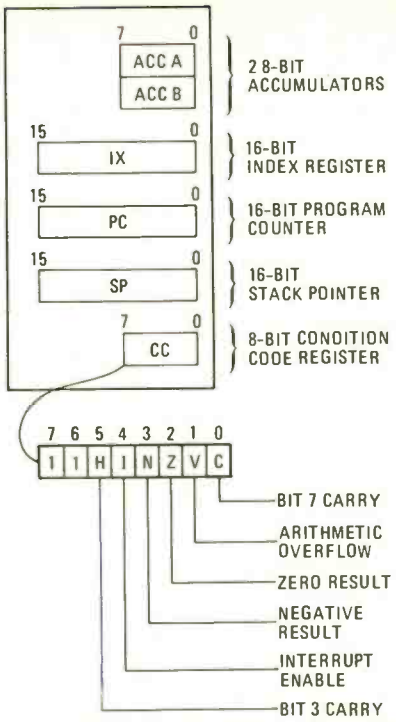


FIG. 2—INTERNAL REGISTERS of the MC6800 microprocessor.

1. In *immediate addressing*, an immediate 8-bit or 16-bit operand can be loaded into a CPU register from the instruction.
2. The first 256 locations in memory can be addressed by a *direct* instruction type that is only two bytes long.
3. Any location in memory can be addressed by *extended addressing* instructions that are three bytes long.
4. *Relative addressing* instruction modes address data within a range of −125 to +129 bytes of the current instruction in a compact two-byte instruction.
5. *Indexed addressing* instructions are also two bytes long.

The available addressing modes permit shorter instructions, which reduces memory and speed requirements in the system. Instruction speeds with a 1-MHz system clock range from 2 μs to 12 μs.

Other system components

The 6800 microprocessor interfaces to other IC's in the 6800 family. These include a general-purpose interface (MC6820), asynchronous communications interface (MC6850), modem (MC686OL), RAM's, and ROM's. Both the Motorola and second-source data and support are excellent, and devices are continually being developed in this family. **R-E**

HOBBY CORNER

If you want to make it small, this approach to preassembled IC modules might just do the trick.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

IF YOU USE A SOLDERLESS BREADBOARD as much as I do to "run up" circuits for testing, then you, too, must be tired. How many times have you wired this sequence: 7490 decade counter, 74175 latch, 7448 decoder/driver, and a 7-segment digit? And then one or two more identical sequences right beside the first one? I simply got tired of doing it, especially when I counted 50 connections in each sequence!

Being quite lazy, I devised a way to cut this wiring down to 7 connections for each digit. Now I can put a 3- or 4-digit readout on my board in almost no time and I save a lot of board space, too. You can enjoy these same advantages by building your own *"digital modules."*

The digital module or block method explained below has other applications as well. You can use it with other combinations of IC's that you breadboard frequently. In addition, you can use it in construction to save space if not time. Here is how it works on two different kinds of blocks.

Readout module

The first example is a readout module of the "piggy-back" type consisting of 7490, 74175, 7448 and digit. As you can see in Fig. 1, when these parts are wired there are only 7 connections to their outside world. All the others are within the block. Thus, all you have to do is wire the inside once and make provisions for the 7 outside connections.

A note of caution: *be sure that the IC's are good before you begin.* It is a shame to do this work only to discover a bad IC in the middle!

The module is made by cementing (with epoxy or whatever) the IC's and digit together in piggy-back fashion as shown in Fig. 2. Be sure the 7490 is on the bottom and the digit on top. If you put them in the order shown, the wiring will be easier. Note that all of the pins of the digit, 7448 and 74175 and some of those on the 7490 have been bent out to the side to facilitate wiring and prevent shorting.

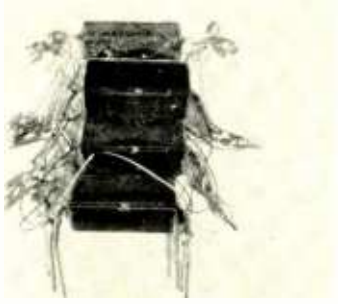


FIG. 2—END VIEW of the cemented block.

The 7448 IC and a *common cathode* digit are used so that it will not be necessary to include current limiting resistors for each segment. You can, of course, use a 7447, a common-anode digit and 7 (or 8) resistors but that is more difficult to wire and ends up more bulky.

The digits on my breadboarding modules are type FND-10. I use these because, being small, they could be placed *sideways* on top of the block. Then, when plugged into the breadboard, they read right-side up rather than sideways. You can use any common-cathode digit provided it does not require more than the listed 6.4-mA current capability of the 7448. (Actually, somewhat more demanding digits will function in this circuit. In fact, the FND-10 is listed as requiring 10 mA-per-segment, so it is just a little less bright.)

It is easier to bend the IC pins out before the block is cemented. Use small long-nose pliers or medium-duty forceps. You are less likely to break a pin if you bend just the narrower part to about 45° (though I have not broken off a pin yet). This is far enough to prevent shorting, allow wiring space and cause no trouble when you later bend them back down.

Wiring the "modules"

You may use any comfortable method of wiring pin-to-pin once the cement is dry. The wire should be fine gauge to prevent accidental shorts. You *must* use very small wire on the bottom IC pins that are used for external connections or they will not seat properly when plugged into the breadboard. Space for wiring is tight and the job can get tedious. I have found that the best method is to do all wiring with No. 30 wire in a wiring pen or pencil. They work very well in close quarters and the insulation does not have to be scraped from the wire.

For most connections you can use the entire pin in making the joint. In the case of the four "external connection" pins of the 7490 which are also wired, you must be extra careful. To leave free as much as possible of those pins (4, 5, 10, 13), make the joints close to the body of the IC.

Soldering must also be done carefully—neatly, quickly and without excessive heat. If you are sloppy, there will be shorts. If you use too much heat, you can damage the IC internally. You would do well to practice on a scrap IC with a *small*, hot iron to get the heating time down to a minimum.

The module described above is wired according to the chart in Fig. 3. You can check the pinout of each IC to determine

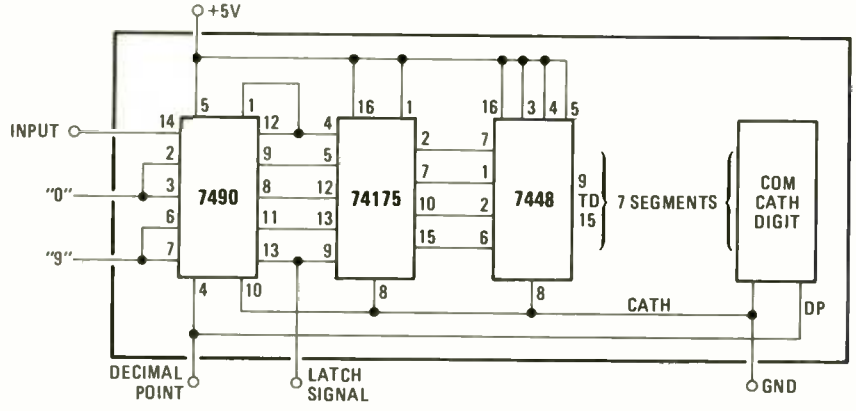


FIG. 1—THE READOUT MODULE circuit used in this Hobby Corner.

just what is being connected to what. The *resulting* pinout for the bottom IC is given in Fig. 4. Note that the two pins which were originally "no connection" pins (pins 4 and 13) are now used.

7490	74175	7448	DIGIT
5*	16—1	16—3-4-5	
10*	8	8	COM CATH
13*	9		
4*			DEC. PT.
1—12	4		
	2	7	
9	5		
	7	1	
8	12		
	10	2	
11	13		
	15	6	
		9 thru 15——SEGMENTS	

*these pins are not bent

FIG. 3—INTERNAL CONNECTIONS for the readout module.

1 - NC	14 - Signal Input
2 - 0 set	13 - Latch signal (NEW)
3 -	
4 - Decimal Point (NEW)	12 - NC
	11 - NC
5 - +5v	10 - GND
6 - 9 set	9 - NC
7 -	8 - NC

FIG. 4—PINOUT FOR THE module base (7490).

After wiring is completed, check the operation of your block to be sure that there are no errors. Then, for ease of handling and better appearance, cut a small strip of PCV insulating tape and put it on top of each row of bent pins. Except for the bottom row on each side (7490), gently push the pins down against the tape below. You can leave it as is or wrap a continuous length of tape around all sides of the block or "package" it to suit your taste.

Now you have a complete readout circuit in the form of one thick IC block. Of course, you can buy a one-block device to do this particular job, but look at the price. Your homebrew module is just as easy to use.

This same piggy-back technique can be used to make other modules. For example, if you always use a "continuous count" type of readout, you can leave out the 74175 latch. Of course, the module with the 74175 is convertible; that is, it can be made to read continuously by connecting the "latch signal" pin to the 7490 input (pin 14).

There is no limit to the types of IC's you may wish to put into a block for one-time use in a construction project.

When there are just two IC's in a module, they can be cemented back-to-back. This method requires no pin bending, but it is more difficult to package neatly.

If your block circuit includes several resistors, capacitors and/or other small components, you can put them in one or two layers within the module.

Depending upon its contents, your block may require more external pins than are available on the bottom IC. Without decreasing the contents of the module you can cement a header "caboose" to the end of the bottom IC to provide more pins. Be sure you maintain the proper pin spacing *between* the bottom units. Of course, some of the IC's may be placed on top of the header also.

Sometimes another IC configuration is necessary. I have breadboarded a 555 astable and a 7490 counter innumerable times. Even those few connections have become tiresome. Of course, a digital block was the answer.

This time, however, neither IC would serve as the bottom connector. Though both could be mounted on a header, I prefer a smaller block using the "on-edge" technique. In this configuration, one-half of the pins of two IC's are used for the external connections.

Wrap-up

Using these instructions you can construct digital modules to serve almost any purpose. They will save time and space *repeatedly* on your breadboard. In projects you can get some *real* miniaturization when using this technique. **R-E**

state of solid state

A look at integrated circuit peak-detectors and how they work, plus several new releases that are making solid-state news.

KARL SAVON, SEMICONDUCTOR EDITOR

DIODE DETECTORS IN LINEAR IC'S USUALLY do not resemble their discrete counterparts. Transistors, with various combinations of shorted or open elements, or connected as emitter followers or amplifiers, are common in IC designs. Seemingly odd schematics are the result of design experience and invention that has produced practical, area-efficient, high-performance circuits. In conventional diode detectors, the turn-on offset level is associated with the barrier potential voltage of the diode junction. Quite often this potential (0.6 volt for silicon) is larger than the signal; therefore, rectifying a signal in hundreds of millivolts or less is not possible. The answer to this problem is a DC-biasing scheme that keeps the diode slightly conductive or on the verge of conduction; another answer lies in a differential-type configuration where the characteristic of a reference device balances out the offset of the detecting device.

Interdesign's *Application Note* on IC rectifier circuits shows several approaches to this fundamental circuit function. Figure 1 shows the circuit diagram of a peak detector built from two emitter-follower transistors. The advantage to having followers in an IC is that they do not require individual collector isolations. Followers use very little chip area. The base-to-emitter junction of the input follower is analogous to the normal detector diode.

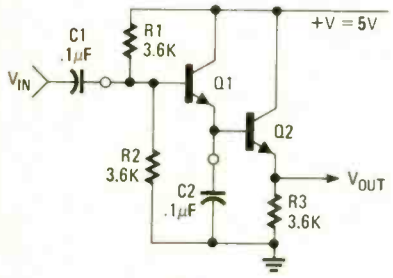


FIG. 1

The secret of the circuit is the inconspicuous input coupling capacitor, C1. Because the signal to be detected is not directly coupled to the input transistor, the transistor can be biased into its active region so it conducts and does not depend on a portion of the input swing to turn the transistor on. Equal-resistance divider R1–R2 drops the supply voltage down to one-half. The Q1 emitter is connected to detector capacitor C2. Positive input-signal swings force the capacitor above its no-signal bias point of 1 V_{be} below one-half the supply voltage. When the base of Q1 goes positive, C2 charges quickly because of the relatively low output impedance of the emitter follower. When the input signal swings negative, C2 tends to maintain the voltage on the transistor's emitter, so that the base becomes biased below the emitter, thus cutting off the transistor. There is no capacitor discharge path through Q1, and the voltage charge is lost only through the base current of output follower Q2. Output follower Q2 isolates capacitor C2 from the load so that the output current does not appreciably load the capacitor. Transistor Q2 is also biased-on by the DC bias level of 2 V_{be}'s below one-half the supply on its emitter, and the 3.6K emitter resistor.

The quick charge and slow discharge rate of capacitor C2 account for the peak detection ability of the circuit. For the values given in Fig. 1, the circuit response is flat from 10 kHz to 100 MHz. Although this particular circuit is biased-on to take care of the junction offsets, it has not been temperature-compensated. Note that the output voltage is two base-to-emitter junctions lower in voltage than the fixed DC bias on the base of Q1. Since silicon diodes have a temperature coefficient of −2 mV per °C, the output temperature coefficient for this circuit is twice that value, or −4 mV per °C.

Figure 2 shows one type of temperature-compensated detector circuit, in which the input stage is a differential amplifier. The peak-detection capacitor is connected to the base of Q2, the transistor opposite the input terminal. Transistors Q4 and Q5 in the collector circuits of the input pair are a current "mirror." Transistor Q4 is diode-connected, with its base and collector tied together (one of the most well-behaved integrated diode schemes). The common-base and emitter connections with Q5 mirror the current in Q4 to Q5. When the input signal swings positive, the current in Q1 increases, increasing the current in Q4 and Q5. Simultaneously, the current in Q2 drops by the same amount relative to the increased current in Q1.

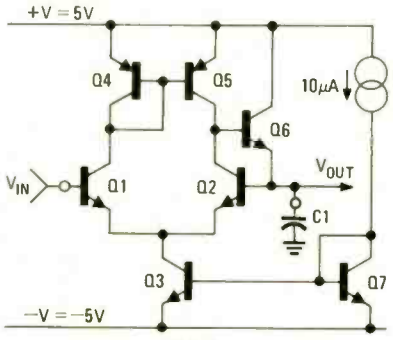


FIG. 2

The sum of the currents in differential transistors Q1 and Q2 must be equal to constant-current sink Q3. Therefore, the current output at the junction of the Q2 and Q5 collectors acts as a bidirectional collector that can either supply or source current as conditions demand. Feedback from the Q6 emitter to the base of Q2

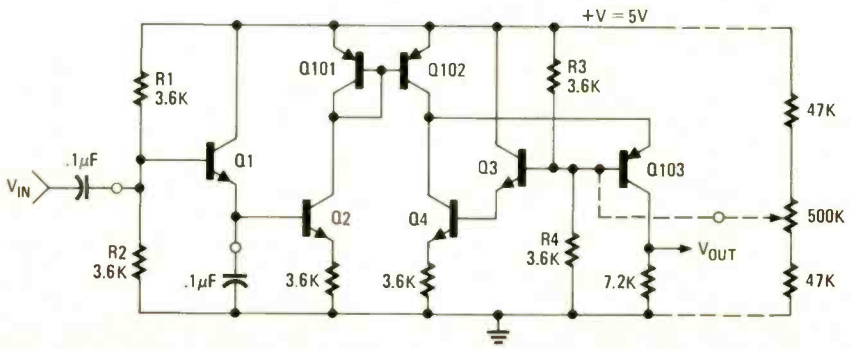


FIG. 3

dictates that the base of Q2 follow the signal on the base of Q1 within the circuit's slew-rate limitations. Current sink Q3 limits the peak current that is available at the base of Q6 and the charging rate of C1.

Emitter follower Q6 has the same desirable characteristic as the detector follower in the previous circuit: It only supplies current and does not sink it, which again helps the circuit perform as a peak detector. When the input terminal swings negative, the feedback tries to make the output follow this swing by turning Q2 on and Q5 off, causing a voltage drop on the Q6 base. However, all this does is turn off Q6, and C1 maintains the voltage just before the negative transition, within the time-constant developed by C1 and the load resistance.

This detector circuit's frequency limitations are due to the response peculiarities of integrated PNP transistors in a technology that favors NPN's. The NPN transistors are vertically layered, but PNP's are constructed horizontally or laterally, which is nonideal. The circuit is good to about 400 kHz.

A way to compensate for the frequency-response limitation is to first directly (without feedback) rectify the signal as shown in Fig. 1; then compensate for the 2 V_{be} offset. After detection, the frequency-bandwidth requirement is the narrower frequency range of the detected modulation, which is within the capability of integrated PNP transistors. Another alternative is to build a circuit using only NPN transistors. Usually, this produces a more complex circuit because the functions that are natural for PNP's must be replaced with NPN equivalents.

Figure 3 uses the direct approach. The beginning of the circuit is similar to the circuit shown in Fig. 1, except that Q101 samples the detected output current in Q2, rather than responding to the emitter voltage. This current is mirrored in Q102 and is split between Q4 and Q103. Equal voltages appear on the bases of Q1 and Q3, and this voltage (reduced by a 2 V_{be} voltage drop) is on the emitters of Q2 and Q4. The emitter resistors of Q2 and Q4 are identical. Thus for a zero input level, the current in Q4 and Q102 is the same and no current is left for Q103. Common-base output-stage Q103 feeds the 7.2K output resistor.

Positive input swings with respect to the initial bias point increase the current in Q1, Q2, and , in turn, Q101 and Q102. Any increase in Q102's current exceeds the constant-current bias in Q4, so that the excess current must flow through Q103 into the output. In perspective, Q3 and Q4 offset the voltage across the base-to-emitter junctions of Q1 and Q2. As Q1 and Q2's junction voltages change with temperature, so do the Q3 and Q4 junction voltages, thus cancelling the input-device variations within their matching tolerances.

For more details on these and other IC rectifier circuits, write for *Monochip Application Note APN-6* to Interdesign, Box 7065, 1255 Reamwood Avenue, Sunnyvale, CA 94086.

MOS 1024 × 4 static RAM

Motorola's MCM2114 is a completely static 1024 by 4-bit memory that does not need timing strobes, clocks or refreshing. The part is available in four speed ranges: 200 ns, 250 ns, 300 ns and 430 ns. Operated from a 5-volt ±10% supply, the N-channel, silicon-gate device is designed to work in systems where simple interfacing is important. The 18-pin plastic MCM2114 is priced at $12.25 each in 100 quantities. For information, write Motorola Inc., Integrated Circuit Division, 3501 Ed Bluestone Boulevard, Austin, TX 78721.

PWM voltage regulator

Texas Instruments' TL494 is a power supply control circuit containing a 5-volt regulator, error amplifier, current-limit amplifier, oscillator, dead time control comparator, pulse-steering flip-flop and output control circuitry. The circuit design prevents double-pulsing of either of its two outputs. The common-mode input-voltage range is −0.2 to V_{cc}−1.5. The device is suitable for switching regulators and DC-to-AC converters. **R-E**

service clinic

Cuttoff problems are often overlooked when troubleshooting a chassis.

JACK DARR, SERVICE EDITOR

"CUTOFFS" ARE VERY IMPORTANT IN ELECtronics, particularly in color TV. A cutoff problem is when an active device in a circuit is biased so far in the wrong direction that it doesn't do anything at all, it just sits there. If you overlook this, things can become very complicated. Unfortunately, this happens all too often.

Fortunately, there are easy tests you can make. Two instruments are needed: A scope to tell you that there is a signal on the input of the stage but none on the output; and a DC voltmeter to measure the voltages of the stage. You can then compare the readings against the ones shown on the schematic. The basic characteristics of a cutoff stage are always the same: the collector voltage is very high and the polarity of the base voltage is in the direction of cutoff (reverse bias for transistors.)

Now, here's the key test. One voltage reading can give you all the above information, the emitter voltage. (The majority of amplifier stages are common-emitter stages, and the return to ground will be through a small emitter resistor.) Since the emitter voltage is *developed* across this resistor by the collector current, the voltage can tell a lot. If the voltage is zero, the transistor isn't conducting at all. This may be because the transistor is open. It's easy to check the transistor with an ohmmeter. Check the resistor also; if it is open, the transistor will not conduct.

If the transistor or resistor don't show any problems, start checking the bias. Trace the circuit back and find out where the bias comes from. There are several ways of obtaining bias, most of them use the voltage drop across resistor networks. Quite a few voltage dividers are used. The resistors must be very close to the rated value. You should also check for shunt paths. The best way is to lift one end of each divider and check it separately.

This troubleshooting approach leads to simple tests for certain stages that have shown difficulties; for instance, TV IF's. Most transistor IF's use three amplifier stages; all are common emitters and most are NPN's. You can locate a dead IF stage with only three DC voltage readings: Just read the *emitter* voltage on each one. The normal reading will be only 3 to 4 volts; if you find one with zero voltage, there's your answer. If this is one of the first two stages, the malfunction could be due to AGC cutoff. An easy test for this is to override the AGC and observe if a signal comes through. If so, check the AGC.

This technique is used for stages that are not normally cut off. There are other cases where the stage is cut off under certain conditions—color-bandpass amplifiers and squelched audio stages in radios, for example. With no signal input, or a black-and-white signal, the bandpass-amplifier stage has a high cutoff bias on its grid. When a color signal is received, this bias is overridden and it drops to a level that permits amplification. This causes a lot of no-color problems. The bias here comes from the color killer; check it. A bad diode in the killer detector can mess things up very nicely.

Controlled cutoff stages

Now, let's discuss those stages that run at a precisely *controlled* amount of bias—sync separators, AGC, burst gates, etc. In sync separators, the device must be biased to the exact point at which only the upper 10% to 15% of the video signal causes the device to conduct. The video signal has a normal sync/video ratio of 75% video and 25% sync. Only the extreme tips of the horizontal sync pulses pass through. A properly working sync separator chops off the lower parts of the sync pulse, including the color burst! These stages use high-gain amplifier circuits so that the small sync signal is amplified to a level of about 50 volts P-P in tube circuits, and about 25 to 30 volts P-P in solid-state circuits. No video signal can be allowed through. If a video signal does come through, it causes sync problems such as jitter, etc.

Here again, the test for normal operation is easy. Use your scope to check the composite sync output for correct P-P amplitude. Checking the horizontal sync will show up any trace of video in the sync; look for "wiggling" on the downsloping parts of the normal sawtooth signal around the AFC circuits. The normal cause of a problem like this is incorrect bias voltages on the sync separator; this is due in most cases to drifting resistors. Leaking capacitors can also cause trouble, of course.

The noise-canceller circuit is a fruitful source of problems, once again due to faulty bias. In normal operations, these circuits are biased so that they are almost cut off. A normal-amplitude video signal sails on through. If a noise pulse appears, this biases the noise canceller to cutoff. Needless to say, if the bias on this stage deviates, it can cause problems. If it drifts in the wrong direction, it can cutoff the sync-separator completely.

These circuits clip off the sync as well as the noise. One popular chassis used a VDR (*V*oltage *D*ependent *R*esistor) from a low B+ voltage to set the bias on the No. 1 grid of a multigrid AGC/sync tube. If the VDR went bad, the bias went way off and so did the sync!

Here again, DC voltage readings are the confirming test for such problems. I receive quite a few letters from readers that include complete lists of DC voltage readings around a given stage. Quite often, one voltage sticks out like a sore thumb because the reading is way off normal. If you make up your own lists, it very often helps you visualize the problem.

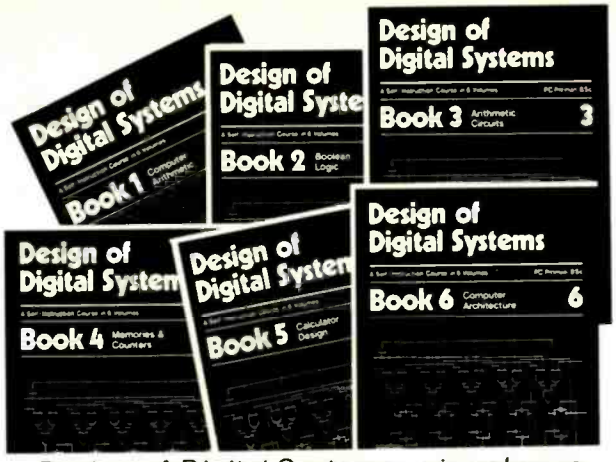
Cutoff is a simple problem, but one that is often overlooked when making a diagnosis. If you make it a habit to look for it, it just might make troubleshooting that much quicker. Happy hunting! **R-E**

service questions

MANY PROBLEMS

I've got lots of problems with a Motorola model TS908. There's no sync, the color sync is bad, the hue control doesn't work right, and the automatic-gain control is not good. I found that I could shunt

continued on page 90



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Book 4: Flip-flops; shift registers; asynchronous counters; ring, Johnson and exclusive -OR feedback counter; random access memories (RAMs); read-only memories (ROMs).

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CS-2048 Automatic Cruise Control

Set your desired cruise speed, press the button and that's it — the CS-2048 maintains your car's speed on level roads, up and down hills, around curves, anywhere, automatically. Perfect for long-distance driving. A touch of the brake pedal returns the car to pedal control instantly — an important safety feature. Fits most domestic cars, vans and trucks with open driveshafts.

NEW
GD-1114 FM Wireless Intercom

Simply plug into AC outlets and use for reliable two-way communications between units on the same AC power line. Has phase-locked loop solid-state circuitry for clean, clear transmission and reception; automatic squelch for quiet operation.

NEW
IT-7410 Logic Probe

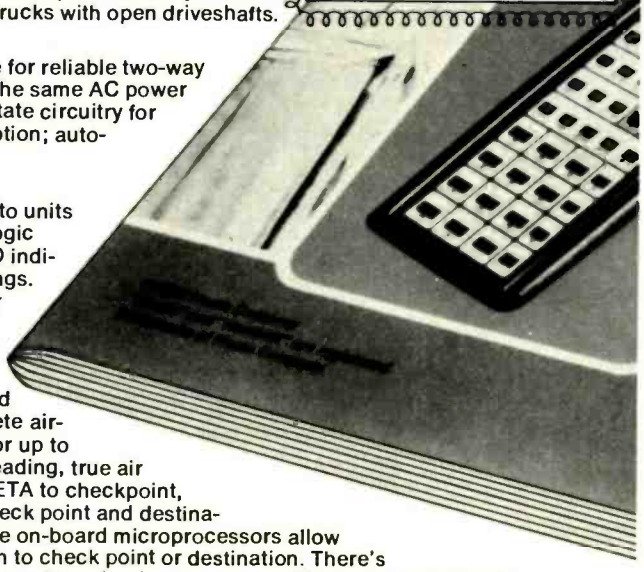
Provides performance levels equal to units costing much more. Shows TRUE logic levels at high frequencies, has TWO indicator lights for unambiguous readings. Ideal for quick testing of any TTL or CMOS digital circuits.

NEW
OC-1401 Aircraft Navigation Computer

The world's FIRST hand-held navigation computer with true, on-board computer power — provides complete airport-to-airport flight management for up to 9 flight legs. Computes magnetic heading, true air speed, ground speed, true course, ETA to checkpoint, ETA to destination, clock time to check point and destination. A built-in clock/timer and three on-board microprocessors allow real time display which counts down to check point or destination. There's even a fuel warning indicator. It's the only navigation computer with complete pre-flight, in-flight and navigation functions. Another Heath EXCLUSIVE!

NO PREVIOUS EXPERIENCE NECESSARY

Thousands of people with no electronics experience whatsoever — people who have never handled a soldering iron before — have proved that you can build any Heathkit product you want to — and enjoy every moment of it! Simple step-by-step manuals make it easy as 1-2-3, and every Heathkit product you build will be a source of pride and satisfaction for years to come as you say "I built it myself"!



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the horizontal hold coil with a 10K resistor, and it tried to lock in. But the vertical sync is still bad. I hope you can help.—A.C., Howard Beach, NY.

I hope I can! When there are so many problems all at once, it's a good idea to look for a *common cause*. The crystal ball says that with this set this could be a problem in the horizontal oscillator. If this is off that badly, all the keying pulses will be off, which can cause all the other symptoms, AGC, color sync, picture sync, etc.

Try replacing C508, .0039 μF, and C509, .0068 μF, the tuning capacitors of the Colpitts circuit in the horizontal oscillator. Be sure to use the best capacitors you can find (and for goodness sake don't get 'em in upside down! I can assure you that this doesn't work at all well.)

FLYBACK WANTED

I need a new flyback for a Bradford model WTG-95885. But no one around here seems to know anything about these. The part number is 79D146-3C. Do you know a source?—G. Q., N. Charleston, SC.

Bradford is a name that can be of any make; there are 16 different manufacturers who have built this set! However, the part number looks familiar. After cross-checking, I found the identical part number under Admiral in my *Thordarson Guide*; they recommend a Thordarson No. FLY-444.

Some time ago, I heard from a company having Bradford parts—The Marcel Companies, 57 Enfield Street, Enfield, CT 06082.

LOSS OF CONTRAST

I've got the same problem in an RCA model CTC-24 and a Zenith model 25NC38. The problem is an intermittent loss of contrast. Contrast control has no effect when it happens.—S. E., Campbell, OH.

In the RCA *model CTC-24* check for a possible intermittently open 100-μF electrolytic capacitor. This capacitor is connected to the slider of the contrast control in the cathode of the video output stage. The original component is a part of a multiple capacitor. When it opens up, we cut it loose and replace it with a 100-μF, 50-volt tubular-type component connected right to the contrast control. This may be causing the same problem in the Zenith set. It could also be an automatic-gain control problem; clamp the AGC to see if this helps.

PICTURE "SPARKLES"

After replacing the power transformer in this Quasar set with an exact duplicate, the picture came back. But now the picture has small spots and sparkles all over it! I've checked just about everything except replacing the transformer again! The voltage readings are all within 10% of normal. What is this?—K. M., West Branch, MI.

I asked a friend who works on Quasar sets and he came up with an answer that I should have thought of! Since the chassis was taken out and put back, the chances are that the sparkles on the screen are because one or more of the *ground* contacts to the dag coating of the picture tube are not making proper contact.

SERVICE HINTS

Here are a couple of service hints. In a Panasonic *model CT601/602*, if the picture looks very sick, there's AGC overload, horizontal tearing, etc., and all of these problems are intermittent, you might think it was a noise-inverter problem. No, it's not. Just replace C403, the AGC filter capacitor.

A Sony *model TV920U* has vertical sweep. This was due to a break in the ground path at the heat sink for the 2SD29 vertical output. Repairing the break brings the picture back, but now there are white lines extending from top of the screen down. It turned out there was a foldover at the top. Replacing the vertical-output transistor cleared this problem up. **R-E**

Measure resistance to .01Ω at a price that has no resistance at all.

The new B&K-PRECISION Model 2810 may well be the highest resolution 3½-digit DMM available. It is certainly the lowest cost DMM to provide .01Ω resolution. With ohms resolution ten times greater than most DMM's, the 2810 allows you to detect shorted windings in coils, transformers or motors.

You'll also be able to accurately check the low contact resistance of switches, relays, breaker points or connectors. Many poor solder connections or PC board imperfections can also be located.

The 2810 is a full-feature DMM providing selectable high-/low-power ohms, auto-zeroing and 100% overrange reading. Twenty-nine ranges provide maximum readings to 1500 volts DC, 2 amps, and 20 megohms. All ranges are fully overload protected. Typical DC accuracy is 0.5% with resolution to 100μV. And unlike many electronic voltmeters, the 2810 is RFI shielded and can be accurately used in high R-F energy fields.

B&K-PRECISION also has a full complement of optional accessories for the 2810. Accessories include a carrying case, wire tilt stand, AC adapter/charger, high-voltage probe, direct/isolation probe, NiCad batteries and 10-amp current shunt.

At $130.00, the 2810 is a standout value in today's DMM jungle. Don't resist the temptation...contact your local distributor for immediate delivery.

B+K PRECISION DYNASCAN CORPORATION

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A precision, autoranging, capacitance meter

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

Accurate
The C-meter achieves 0.1%(±1 count) up to 200 microfarads and 1% from 200 microfarads to 200,000 microfarads. It is accurate on all ranges at temperatures from 15° to 35°C. (59° to 95°F).

DORIC **$325.**

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

8010A

Model 8010A is a 3½ digit, six-function hand-held multimeter with features that qualify it as an excellent field service and troubleshooting instrument. Measurement functions include ac volts, dc volts, ac current, dc current, resistance and diode test. Each function, with the exception of diode test, has five selectable ranges for a total of 26 ranges (one range for diode test).

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

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

SPECIFICATIONS

	DC Volts	AC Volts	DC Current	AC Current	Ohms	Diode Test
Range	0.2–1000V	0.2–750V	200µA–2A	200µA–2A	200Ω–20MΩ	2.000 mV
Resolution	100 µV	100 µV	100 nA	100 nA	0.1Ω	1 µV
Accuracy	±0.1 + 1↓	±0.5 + 2↓	±0.35 + 1↓	1 + 2↓	0.2 + 1↓	±0.2 + 1↓

8020A

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

The 8020A has been designed with the user in mind and features exclusive one-hand operation. For harsh service environments, the 8020A has a ruggedized case and extensive overload/transient protection backed up by a 1-year warranty. Long term stability (1 year calibration cycle) is excellent with only three 2¢ adjustments. Up to 200 hours of continuous operation can be expected from a single 9V alkaline battery.

BASIC SPECIFICATIONS

	DC Volts	AC Volts	DC Current	AC Current	Ohms	Conductance
Range	0.2–1000V	0.2–750V	0.002–2A	0.002–2A	200Ω–20 MΩ	200 nS–2 nS
Resolution	100 µV	100 µV	1 µA	1 µA	0.1Ω	0.1 nS
Accuracy	±0.25 + 1↓	±0.75 + 2↓	±0.75 + 1↓	±1.5 + 2↓	±0.2 + 1↓	±0.3 + 1↓

8010A **$239.** 8020A **$169.**

New Low Distortion Function Generator

MODEL **3010**

- Generates sine, square and triangle waveforms
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- 0.1 Hz to 1MHz in six ranges
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- VCO external input for sweep-frequency tests

$144.95

Regular price $175.

B&K PRECISION

B&K PRECISION 520 MHz Frequency Counter

MODEL **1850**

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

$379.95

Regular price $450.

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MULTIFUNCTION COUNTERS

DISTINCTIVE PERFORMANCE FEATURES YOU CAN USE

The 1910A, 1911A And 1912A Family

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

Multifunction

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

Autorange

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

Input Signal Conditioning

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

Automatic Clean Dropout

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

Sensitivity

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

Autoreset

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

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

FLUKE®

SPECIFICATIONS

Input Characteristics

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

LEADER Instruments Corp

LCR-740

Transistorized LCR Bridge

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

$279.95

Regular price $319.

LEADER Instruments Corp

LCG-395 SOLID STATE VIDEO COLOR SIGNAL SOURCE

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

$199.95 $299.95 Regular price

Simpson

B+K PRECISION

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DATA PRECISION

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

MODEL
1474

- Rise time 11.7 nS or less
- Built-in signal delay line permits view of leading edge of high frequency pulse Rise time
- Triggers on signals up to 50 MHz
- 5mV/cm vertical sensitivity
- Mode switch provides operation between CHOP and ALTERNATE as you change sweep time
- Chop mode digital logic circuitry, including ECL
- High resistance low positive vertical input attenuator
- Fast response with smooth rolloff past 30 MHz
- P24 CRT with P31 phosphor
- Built-in high- and low-pass filters
- Illuminated calibrator accurately from over 105-130 VAC and 200-260 VAC
- 20 calibrated sweep —0.2 s/cm —0.5 s/cm

$729.95

B+K PRECISION

Probes not included in price

LBO-520
30MHz, Fixed Delay

LEADER Instruments Corp

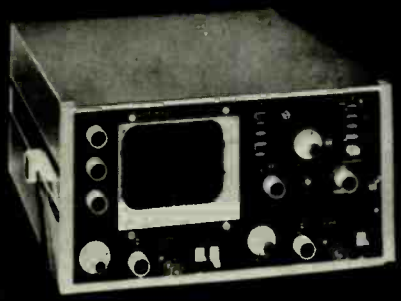
- Dual trace, 30MHz bandwidth.
- 5mV/cm Vertical Sensitivity.
- Fixed delay facilitates hi-speed readings of the leading edge of a pulse or pulse train.
- Add, subtract, alternate selection, chopped, and front panel X-Y modes broaden areas of application.
- TV-V and TV-H sync. for both CH-1 & 2.

$849.95

Regular price $999.

Model 517 Dual-Trace 15 MHz Triggered Oscilloscope

HICKOK



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Regular price $695.

- 15 MHz response flat within 3db for all signal levels. Excellent pulse response minimizes overshoot and ringing.
- 5mV/cm sensitivity, useful for solid state work.
- Foolproof triggering to 27 MHz (30 MHz typical).
- X-Y operation for vectorscope measurements.
- Bright 6 cm x 10 cm display.
- Auto mode triggering provides baseline for recurrent sweep operation.
- CHOP or ALTERNATE mode automatically selected as sweep time is changed for speedy setup.
- Algebraic sum and difference capability.
- Differential input capability.
- Digital logic circuit capability, including CMOS.
- Ample CB AM and SSB waveforms.
- TV sync separators built in.
- Regulated power supply maintains amplifier gain with changes in line voltage from 105 to 125 volts.

LBO-508
20MHz, Dual Trace

LEADER Instruments Corp

- Add, subtract modes on CH-1 & CH-2 facilitate easy checkout for simultaneous pulses, signal levels, distortion & noise cancelling.
- Front panel X-Y operation useful for phase shift measuring, sweep alignment, vector scope service.
- 17.5nSec rise time.
- Automatic chop and alternate selection for low and high frequency checks.
- Automatic trigger for CH-1 or 2 includes TV sync.
- 10mV. to 20V/cm vertical Sensitivity, 11 steps.
- 0.5μS/cm to 200mS/cm sweep speed; 18 steps. X5 magnification.

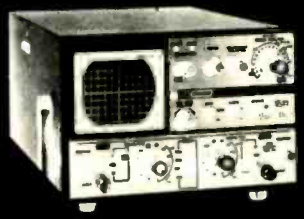
$614.95

Regular price $769.

SUPER SPECIALS

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

New 15MHz portable 3" dual-trace scope



MODEL
1432

- 15MHz bandwidth with smooth roll-off; usable response extends beyond 20MHz
- 2mV/div. vertical sensitivity
- Operates on 117VAC, 234 VAC, 12VDC or optional internal battery pack
- Fully regulated high- and low-voltage supplies
- Automatic addition and subtraction of channel A and B input signals
- Maximum calibrated sweep ranges some 0.2 microsecond to 0.2 second
- TTL Compatible Z-axis input
- Compact size, measures only 6.5 x 9.25 x 14.2
- Includes two ultra-high-Z 10:1 direct probes and accessory kits
- Built-in sync separators

B+K PRECISION

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5MHz Solid State 3" Oscilloscope

MODEL
1403A

B+K PRECISION

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

B+K PRECISION

MODEL
2810

$109.95

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PC BOARD EDGE CONNECTORS, *Series 1000,* come in 10-, 15-, 18- and 22-pin contacts in single-readout format; in 30-, 36- and 44-pin contacts in dual-readouts formats. All connectors have their contacts on .156-inch centers and accept .062 PC boards. Contacts are made of phosphor bronze with gold finish over nickel; solder eyelet or wire-wrap terminations are offered. Available are .031 × 0.62-inch long .025-inch-square, or .6-mm-square wire-wrap posts. Specifications: Current rating, 3 amp; 330 VDC operating voltage; 5000-megohm resistance; operate to temperature of −55°C to +125°C. Prices: from $3 to $5.60—**Injectorall Electronics Corp.**, 98-100 Glen St., Glen Cove, NY 11542.

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AUDIO TEST INSTRUMENT, *Sinadder 3,* combines several related functions in one unit, making it suitable for both bench and field measurements. Pressing SINAD pushbutton activates automatic distortion meter to measure sensitivity and make rapid alignment; no frequency, null or level adjustments are necessary. An internal 1-kHz tone modulates signal generator or monitors *Sinad* measurement and alignment. A built-in loudspeaker is provided for monitoring audio output. The AC voltmeter function provides 9 ranges from 10 mV to 100 volts full-scale. The *Sinadder 3* can also be used as an audio signal tracer to monitor phone lines and audio amplifiers, and to troubleshoot audio distortion and defective audio stages. Power requirements: 115–230-volt transformer plus 12-volt plug. Price: $249.—**Helper Instruments Co.**, Box 3628, Indialantic, FL 32903.

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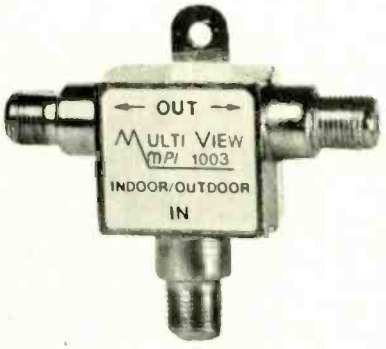

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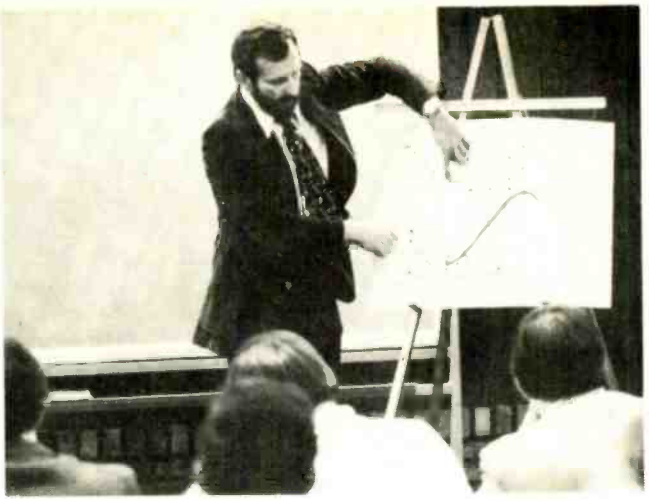

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NOTE: You need 2 years electronics training or experience to gain proper benefit from these Advanced TRAINING WORKSHOPS. NOT FOR BEGINNERS.

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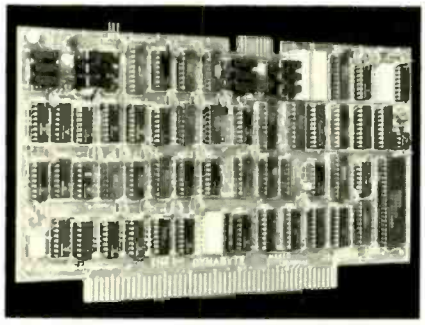
CIRCLE 91 ON FREE INFORMATION CARD

computer products

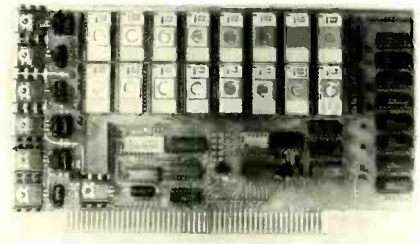
TERMINAL SYSTEM, *Naked Terminal,* functions with a keyboard and monitor. This S-100 board contains a microprocessor with memory and software drivers. Terminal features 24 lines of 80 characters-per-line; switch-selectable, half duplex, full duplex and block modes; and addressable cursor. Switch-selectable features include black-on-white, white-on-black, blinking or non-blinking underline and variable baud rates. No



software is required—DIP switch makes it compatible to existing systems. Optional cable kit is available. Suggested retail prices: *Naked Terminal,* $350; cable kit, $15.—**Dynabyte, Inc.,** 4020 Fabian, Palo Alto, CA 94303.

CIRCLE 114 ON FREE INFORMATION CARD

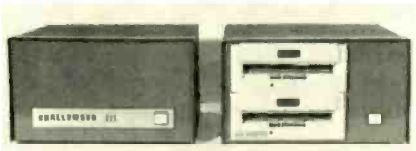
RAM-N-ROM BOARD, *model RNR-100,* comes fully assembled or as a kit. The board is designed to use with the *Prom Setter* PROM programmer, is S-100 bus compatible and accepts the 1702A, 2704, 2708, 2716 (Intel), 2716 (TI), 5204, and 6834 EPROMS's. Sockets for 16 ROM's and 1K of RAM are provided; both ROM and RAM have



separate address-select switches. The ROM is also provided with selection of up to 4 wait states. The board has 7 voltage regulators, 3 dedicated to each group of 8 ROM's and a separate 5-volt regulator is used for all logic states. Provision is made for POWER ON JUMP and RUN operations if desired. The kit includes IC sockets only (no EPROM's), components and manual. Prices: kit, $117; assembled, $168.—**Szerlip Enterprises,** 1414 W. 259 St., Harbor City, CA 90710.

CIRCLE 115 ON FREE INFORMATION CARD

CHALLENGER III COMPUTER contains a three-microprocessor CPU board to run 6800, 6502, 8080 and Z-80 software. It comes standard with *OS-65D* disc operating system, and can be used in classrooms, businesses, homes and industries. A 74-megabyte disc option, the *C-D74,* has a 35-ms average access time making it ideal for industrial and business applications. The *C-D74* drive's 10-ms single-track seek achieves a 7.3-megabit-



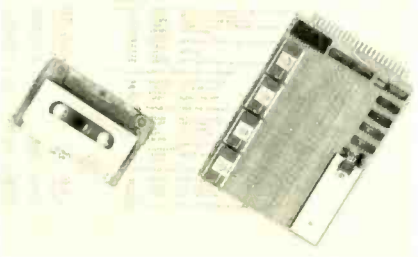
per-second data transfer rate. Available for advanced users who wish to write multiple programs is a software processor status switch, with a 1-megabyte pager and user-programmable vectors for the 6502 and 6800. A catalog is available for $1.—**Ohio Scientific,** 11681 Hayden, Hiram, OH 44234.

FLOPPY DISC SYSTEM, *EXP-1* and *EXP-2,* is either a single-drive or dual-drive package containing drives, S-100 controller and power supply. The system uses standard 8-inch diskettes and provides write-protect and indicator light. Double-headed drives to record on both sides of diskettes and optional double-density controller are also available. Drives offer full 265K byte storage in IBM 3740 soft-sectored format. Software options include CP/M, as well as either BASIC, FORTRAN or business and work-processing

packages. Optional I/O drivers make the system SOL-compatible. The *EXP-1* system sells for $1195; *EXP-2,* $1895.—**Micromation, Inc.,** 524 Union St., San Francisco, CA 94133.

CIRCLE 116 ON FREE INFORMATION CARD

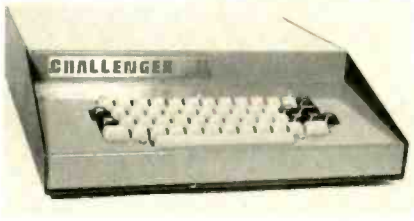
BASIC INTERPRETER, 4K BASIC with its interrupt control, direct memory read/write, assembly language subroutine and I/O oriented for industrial process-control and monitoring applications. Advanced control structures include FOR...NEXT; IF...THEN...ELSE; and ON...NOW...GOTO/ON...GOSUB. Interpreter resides in RAM or PROM. If program is also stored in PROM, RUN mode is activated, allowing unattended operation in dedicated ap-



plications. 4K BASIC is available on cassette or on a ROM module. The source listing and OEM license are also available. Prices: cassette, $95; module, $299; source listing, $95; OEM license, $2000.—**Wintek Corp.**, 902 N. 9th St., Lafayette, IN 47904.

CIRCLE 117 ON FREE INFORMATION CARD

COMPUTER, *Challenger IIP,* designed for beginning hobbyists and businessmen, is self-contained with a full-sized keyboard, 32 × 64-character video display interface and audio cas-



sette interface. Comes with BASIC in ROM and 4K RAM. The unit can be connected to a video monitor or home TV set via an RF modulator (not supplied). The *Challenger II* comes with a case and a 4-slot backplane, and sells for $598.—**Ohio Scientific,** 11681 Hayden, Hiram, OH 44234.

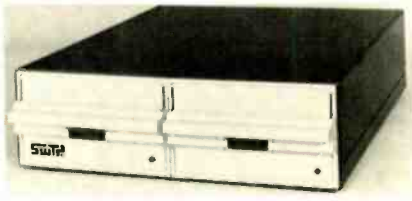
CIRCLE 118 ON FREE INFORMATION CARD

I/O WRITER INTERFACE, *Typeaway,* comes assembled or as a kit, and contains S-100-compatible PC board with solenoid drivers, I/O ports and complete PROM software; cables and connectors to interface a Selectric to an S-100 computer. *Typeaway* can be used with any factory Selectric I/O writer, and control function and code conver-

sions are preprogrammed in firmware. Tested and assembled, *Typeaway* sells for $350; the kit is $275.—**Micromation, Inc.,** 524 Union St., San Francisco, CA 94133.

CIRCLE 119 ON FREE INFORMATION CARD

DUAL-DRIVE FLOPPY DISC SYSTEM, *model DMAF1,* comes assembled or as a kit. Single-density double-sided system uses 8-inch diskettes. Hardware consists of an SS-50 bus (6800); compatible DMA controller with up to 4-drive capability; double-density disc drives; and power supply, control board, fan and cables. Each diskette holds approximately 600K bytes of data. Software is included along with 8K BASIC inter-



preter with disc-file capability and string functions. Unit comes in aluminum chassis, measures 5⅜ × 17⅛ × 20½ inches and weighs 45 lb. Prices: assembled, $2095; kit, $2000.—**Southwest Technical Products Corp.,** 219 W. Rhapsody, San Antonio, TX 78216.

CIRCLE 120 ON FREE INFORMATION CARD

stereo products

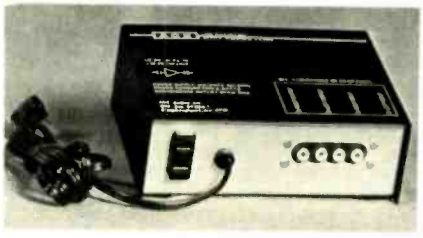
More information on new products is available from manufacturers of items identified by a Free Information number. Free Information Card is inside back cover.

AUTOMOTIVE POWER AMPLIFIERS, *models V501, V502, V503, V504* and *V505*. The *model V501* has automatic switching and a 24-watt power output. The *model V502* is compatible with 4-speaker matrix systems and has a 48-watt power output. The *model V503* features a 4-band graphic equalizer with bracket, time delay, tone defeat and power pushbuttons; it provides less than ⅓% THD and a 72-watt power output. The

model V504 is an amplifier/equalizer combination with power switch, boost/cut bass and treble controls and a 24-watt output. The *model V505* (shown) is coupled with a 4-band graphic equalizer; features less than 1% THD, power range pushbutton and OCL/CTL circuitry. Suggested retail prices: *model V501*, $49.95; *model V502*, $69.95; *model V503*, $179.95; *model V504*, $99.95; and *model V505*, $139.95.—**Craig Corp.**, 921 West Artesia Blvd., Compton, CA 90220.

CIRCLE 121 ON FREE INFORMATION CARD

AUDIO SUBSONIC FILTER, *model 4000*, comes as a kit or assembled. It is designed to remove the effects of record warp, tonearm/cartridge resonance, subsonic rumble, etc., that cause high-level distortion in direct-coupled amplifiers. Two filters are housed in a single enclosure for insertion into a stereo system. The filters provide an 18-dB-per-octave rolloff below 20 Hz,



.005% distortion at 1-volt output, and a hum and noise level of −86 dB. The circuitry features a discrete amplifier with full feedback, Class-A operation and self-contained power supply, with an output voltage of 8 volts maximum. Powered from a 117-volt AC line, 240-volt models are also available. The *model 4000* measures 6 × 4¾ × 2¼ inches and weighs 1½ lb. Prices: kit, $59.95; assembled, $89.50—**ACE Audio Co.**, 532 5th St., East Northport, NY 11731.

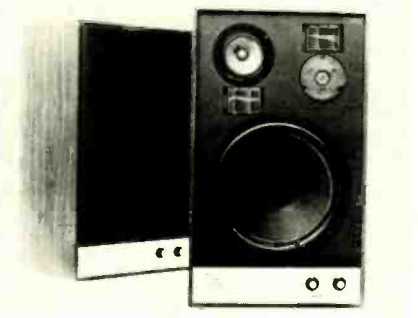
CIRCLE 122 ON FREE INFORMATION CARD

SOUND-LEVEL METER, *Realistic*, measures sound and acoustic levels in homes, schools, offices, sound studios and hi-fi installations. Features include a weighting selector for C- or A-weighting; a 60-dB–126-dB range switch; a fast/slow response switch; tripod adapter; and pho-

no-type output jack. The meter provides an accuracy of ±2 dB at 114 dB, referenced to 0.0002-μbar, and less than 2% distortion at 1 kHz, 0.5 volt. The meter measures 6¼ × 2⁷⁄₁₆ × 1¾ inches, weighs 7¾ oz and operates on a 9-volt battery. Price: $39.95.—**Radio Shack**, 1400 One Tandy Center, Fort Worth, TX 76102.

CIRCLE 123 ON FREE INFORMATION CARD

HI-FI SPEAKER SYSTEM, *model S-196*, is a three-way bookshelf system featuring a 12-inch-high woofer, a 4½-inch mid-range cone, and a 1-inch dome tweeter. The unit provides a frequency response from 40 Hz to 20 kHz ± 4 dB



and a power-handling capability of 75 watts (can be used safely with amplifier rated at 100 watts-per-channel). The *model S-196* measures 24⅛ × 13⅞ × 11 inches and weighs 40 lb. Suggested retail price: $199.95.—**H. H. Scott, Inc.**, 20 Commerce Way, Woburn, MA 01801. **R-E**

CIRCLE 124 ON FREE INFORMATION CARD

new lit

More information on new lit is available from the manufacturers of items identified by a Free Information number. Use the Free Information Card inside the back cover of this issue.

AMATEUR RADIO/SHORTWAVE CATALOG, *Tufts Radio Electronics Catalog for 1978-1979,* 24-page catalog for radio enthusiasts contains up-to-date information on practically every major brand of amateur radio and shortwave equipment. Includes receivers, transmitters, transceivers, antennas and related items along with prices and specifications.—**Tufts Radio Electronics,** 209 Mystic Ave., Medford, MA 02155.

CIRCLE 130 ON FREE INFORMATION CARD

BREADBOARDING & TEST EQUIPMENT CATALOG, 12 full-color pages covering a full line of digital design products and test equipment, including breadboards, sockets, logic monitors, frequency counters and logic probes and accessories. Complete technical specifications are given for each product. Handy order form available.—**Continental Specialties Corp.,** 44 Kendall St., New Haven, CT 06509.

CIRCLE 125 ON FREE INFORMATION CARD

TELEVISION TESTER, 6-page, full-color brochure describes the *model GTS-10* color-pattern generator that helps you perform routine checks quickly and efficiently. The unit contains a monitor, vector, crystal-controlled RF, 4.5-MHz sound carrier, primary color rasters, 6th bar marker and hatch dot functions. Complete unit specifications included.—**American Technology Corp.,** 225 Main St., Canon City, CO 81212.

CIRCLE 126 ON FREE INFORMATION CARD

CERAMIC FILTER CATALOG, *No. 52-07,* contains 8 pages of filter specifications for AM, FM-stereo, TV, CB and communications receivers; filters covered are for 455 MHz, 4.5 MHz and 10.7 MHz applications. Brochure contains section on the theoretical analysis of filters, as well as response-curve parameters and a page devoted to test circuits.—**Murata Corp. of America,** 1148 Franklin Rd., Marietta, GA 30067.

CIRCLE 127 ON FREE INFORMATION CARD

ELECTRONICS CATALOG, 48 pages of items of special interest to hobbyists, schools and business groups. Includes IC's, keyboards, capacitors, hardware, manuals, potentiometers, sockets, tools and many more. Some items available in wholesale lots. Separate price schedule included.—**Tri-Tek, Inc.,** 7808 N. 27th Ave., Phoenix, AZ 85021.

CIRCLE 128 ON FREE INFORMATION CARD

ELECTRONIC COMPONENTS CATALOG contains 144 pages listing and describing hundreds of over-the-counter items (plus prices) such as transistors, diodes, capacitors, TTL IC's, power supplies, data books, computer system supplies (includes the Zilog Z-80 microcomputer board series), and many, many more. An order form is included in the back of the book, which costs $2.50.—**Active Electronic Sales Corp.,** Box 1035, Framingham, MA 01701. **R-E**

FREQUENCY COUNTER
continued from page 73

low as 50 mV and as high as 1 mV. The input is not filtered for noise since the 74C04 gain decreases rapidly above about 2 MHz. You can add a noise filter, if necessary, to the input probe section. All IC stages are direct-coupled, so that the input blocking capacitor in the probe tip determines the low-frequency response. The capacitor is located in the tip so that add-on devices can be direct-coupled to the counters.

When the meter is used as a frequency counter, the input pulses are counted for 1 second in the normal mode or for 0.25 second in the ×10 mode. Because the MC14553B IC only counts to 750 kHz at 5 volts, dual-D flip-flop IC1 is used as a divide-by-4 prescaler in the ×10 range. The input-amplifier output is fed to the prescaler and to AND gate IC1-d. In the normal mode, the gate is on and the input is applied directly to the counter through D5. The divide-by-4 prescaler is disabled by a reset signal that overrides the clock. In the ×10 mode, AND gate IC11-d is off, and the input is divided by IC1 and applied to the counters through D6. Diodes D5 and D6 and resistor R13 form a simple OR gate since there was no room for another IC.

The time interval is generated by a crystal-controlled reference oscillator, in which XTAL1 is a 3.5795-MHz color-TV color-oscillator crystal. The 3.57-MHz frequency is divided by IC8 to produce a 60-Hz output. A trimmer can be added to the oscillator from pin 6 to +5 volts.

(A color-TV crystal usually comes in a large metal crystal can that cannot fit into the meter; therefore, the crystal case must be altered. The crystal should have a phenolic base, not a metal base. Remove the metal case carefully by cutting and peeling it with diagonal cutters. The crystal itself is supported in the center of the can by the two leads that pass through the bottom, as shown in Fig. 3-a. Once the crystal is removed from the case, glue two short plastic "I" sections to the phenolic base with the support wires sandwiched inside the channel (see Fig. 3-b). Glue a short piece of plastic to the top and then glue two flat covers to the "I" beams and the phenolic base. When the crystal is completely enclosed and protected, file the case so that it is flat and square on all sides, as shown in Fig. 3-c. You can use the ABS plastic known as *PlasTruct* available at most hobby shops in both flat sheets and structural shapes. This plastic material is easy to work with since you

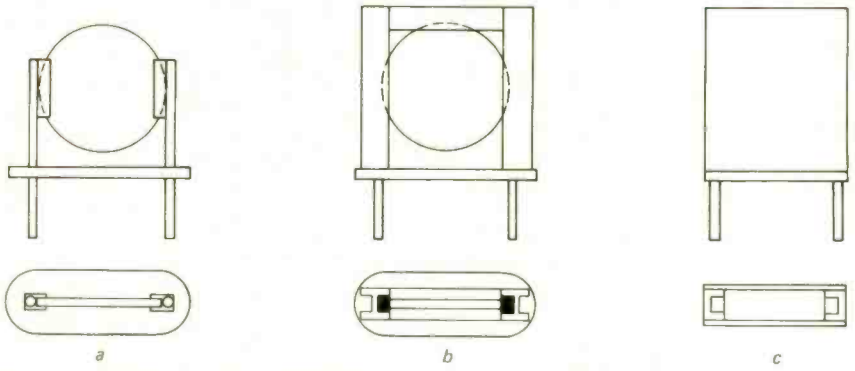


FIG. 3—HOW CRYSTAL CASE IS MODIFIED so the crystal can be fitted inside the probe case. The crystal is fragile. Be careful so you won't damage it.

can cut it either with a razor blade or with scissors. Cutting down the crystal case allows room for two extra IC's on the top of the case—IC1 and IC2. *Caution*: Even in its usual case the crystal is isolated from shocks only by the wire leads. The crystal is very delicate and can crack if it is dropped. For this reason, handle the meter carefully when it is finished.)

The 60-Hz output of IC8 goes to BCD up-counter IC5. One section is used to divide the 60-Hz output by 6. When 6 is reached, IC11-a resets the counter. The output of the divide-by-6 counter then feeds the next BCD counter to produce a 1-second clock period. It is also divided by dual-D flip-flop IC2, to produce a 0.25-second period used by the ×10 mode.

The control signals for the counters are generated by IC6, a 10-output decade counter. Each output used performs one function. Output 0 is the start of an operation. When the hold input is high, IC7-b stops the divide-by-6 clock when in the ×10 mode and when the 0 state is reached, and IC7-c stops the divide-by-10 clock when in the normal mode and the 0 state. When the hold line is low, a conversion begins on the next clock. Output 1 of IC6 is the count state and lasts for 1 second in the normal mode, or for 0.25 second in the ×10 mode. During this

continued on page 103

next month

NOVEMBER 1978

- **Build A Digital Windshield Wiper Delay**

  Digital circuit provides intermittent windshield wiper operation and is programmed automatically.

- **Build a Video Tank Game**

  Use your cannon to destroy your opponent first. Complete with cannons, barriers and sound effects.

- **Tape Recording Breakthrough**

  Complete details on a new metal-particle tape that promises ultra-performance in the near future.

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  How to isolate faults in complex digital circuits and the test equipment needed to make it easier.

PLUS:

*** Build A Function Generator, Part 2**

*** Build A Frequency Counter In A Probe, Part 2**

*** Digital Circuit Crib Sheets**

*** Hi-Fi Test Reports**

*** Hobby Corner**

FREQUENCY COUNTER

continued from page 101

time, the DIS signal of IC13 is low, which enables counters IC10 and IC13. Output 2 of IC6 is the latch state; it lasts for 0.25 second, in any mode. Output 3 is the reset state, and resistor R8 stretches the reset pulse so that the main counters will clear. If the hold line is held low, the conversions will be continuous.

To save on the number of gates used, IC6 is clocked by the 1-second clock at the clock input and is clocked by the 0.25-second clock at the enable input. For the clock input to be active the enable input must be low; for the enable input to be active the clock input must be high. Diode D1 holds the clock input high in the ×10 mode, and IC4-c and IC4-d activate the enable input for use as a clock during the ×10 mode and during the latch state of the normal mode. Both the ×10 input and hold input are buffered to allow touch control operation from the probe section.

You can use IC4-a and IC4-b to disable the control circuitry. A count line and a transfer line are carried to the front socket. A high signal on both lines, with the hold line low, causes the display to act as a counter. The meter can then be used as an event counter.

Integrated circuit IC7, along with diodes D2–D4 and resistors R9–R11 are used to control the decimal point of the display. Only the first three decimal points are used. If no decimal point is lit, the frequency is in Hz. If any decimal point is lit, the frequency is in MHz; thus the first three decimal points allow a 999.999-MHz range. Transistor Q1 is an NPN emitter-follower to match the emitter-followers of IC9 and IC12. It is not critical. Any NPN transistor should work. If any resistor (R9–R11) is grounded, that decimal point will light. The diodes charge the input capacitance when the DS-outputs of IC10 are high. This charge will remain due to the CMOS high-input impedance unless the resistors are grounded. All decimal-point resistors are left floating in the main body of the meter. *continued next month*

continued from page 76

2. **Tubular solderless pins for wire jumpers.** Keystone Electronics Corp., NY, makes these miniature push-in terminals. Each module requires one push terminal for each input or output connection of the particular IC. They require a 1/16-inch hole and a hand insertion tool to seat the terminal into the circuit board.

   The terminals are sold by various suppliers in lots of a hundred or by the thousand. They are more expensive if bought by the hundred. If a large system is contemplated, buy them by the thousand since they cost about $13 to $15 per thousand.
3. **The printed circuit board**—etched and ready for mounting components.
4. **Some foam material, and a good glue.** You can use any type of foam that can be cut to size and glued to the finished module. Check with your electronic supplier; he may provide you with some at a minimum cost. Even a small block of wood could be used, but be sure to provide clearance for the side bus connectors.

Design and construction

It might make sense to purchase one or two IC books presently on the market. These books can help in the individual module designs, and can guide you in testing the completed modules. They also come in handy for checking out special IC's, and give IC pinouts. These books are also the best source for checking out published diagrams before you plan to build.

You will have to decide on the logic family for your system; it could be TTL, CMOS, or even a combination of several logic systems. Incidentally, TTL is the least expensive of the logic families; and don't hesitate to build specialized modules from 7400 NAND gate IC's. You can use the IC *Cookbooks* for these designs. The 7400 NAND gates cost about 15 cents; so special modules using several packages could save you money over a special IC that would cost more. You can learn a lot by using only gates in creating the required logic-function modules for your system.

Figure 1 is the foil pattern of the module. Figures 2 and 3 show two examples of how you can wire a module for a specific IC. Follow the same procedure to make custom modules for any logic IC's. Figure 4 shows the pattern for the larger power module.

A variation of the modules uses RN bus connectors and a somewhat different foil structure. Some readers will prefer one arrangement over another. Both work well—the choice is one that the experi-

KITS

The following are available from Techniques, Inc., 235 Jackson St., Englewood, NJ 07631.

Order No. T100—$10.00 postage paid; includes four module boards (shown in Fig. 5), 100 Keystone terminal pins plus foam strip. However, the male and female Robinson/Nugent bus connectors are not included in this kit and are not available from this source.

Order No. T125—$12.50 postage paid; includes four T-108 module boards (shown in Fig. 1), one T-316 large module board (shown in Fig. 4), 100 Keystone terminal pins, single-pin male and female bus connectors and foam strip. The T-108 modules are completely drilled, while the T-316 module is drilled only for the connector hardware and terminal pins.

Also available is a 50-page manual in a loose-leaf binder, providing hook-up instructions for more than 30 digital 7400 TTL IC's. This manual is to be used in conjunction with the T-108 and T-316 modules.

Prices are for US sales only. Foreign orders are additional. New Jersey residents include state and local taxes as applicable.

menter must make. See Fig. 5 for the foil pattern.

Once a module is tested to your specs and proves workable, finish the project by gluing the spacers to the bottom of the board. You can also dress up the module with a little hobby paint, add additional marking, or even use transfer lettering if desired. Just as in an *Erector* set, you can build up the system in no time. Keep in mind that if you design only one module a week, build only one module a week, in a year's time you will have 52 modules. This is quite a working breadboard system and almost painless in cost.

You should not rush into a complete modular system. Take time to think out what you want in your system. Build the modules, test them, learn from them, and finally you will be constructing complex circuits for many pet projects. It is a spare-time project if done like this, and one you will be proud to have. The building adds to your logic and circuit experience, and in no time you will be constructing modules at your own pace. The PC board construction experience is also a good learning device. You learn from your mistakes.

Types of modules

Here's a list of modules you might want to build. The TTL units are listed first, but if you want to build CMOS units you can find the equivalent IC in your specification data.

1. TTL modules—All the NAND, AND, OR and NOR gates; two-input, four-input IC modules and some 8-input NAND's come in handy. Use the 7400 two-input IC packages to make special modules.

continued on page 106

You can use the *Cookbooks* as a guide. Build the Exclusive- OR circuits; exclusive-NOR circuits; or the adder circuits. Why not try some of the control circuits described in the *Cookbook*? Or the one and only one input; or edge-trigger circuits, one module for each type.

2. Try flip-flops; use 7400's to make set and reset units. These can be used with switches to provide bounceless switch circuits for your projects. Build some JK-type flip-flop modules. And how about some D-type clocked flip-flops, 7474's, or even 74175 or 74174 type of IC packages? Cascade the flip-flops to form registers.

3. The counters—decade, divide-by-five, hexadecimal and divide-by-eight. What about divide-by-twelve counters? Build them in pairs and place them onto the larger-size modules, or cascade them.

If you build counters, you might want to build the decoder modules to complement them; also some 7-segment displays to form a three-pair unit. How about a hexadecimal display? Use the HP 9368 IC's for the hexadecimal display using a 7-segment LED to show the numerals 0 to 9 plus ABCDEF letters. This IC is both a latch circuit and an LED decoder circuit.

4. What about timers? Use the 555 or the dual 556.

5. How about one-shots—a 74121 astable or the dual 74123 IC's. Find out about the trigger levels and time sequence of one-shots. This is an area that is required in complex circuits and using the modular system is a painless way to learn how to work with them. Try varying the capacitor and resistor values.

6. What about a series of discrete LED's to indicate signal levels? Try both forms: The LED is on with a positive pulse, the LED is on with negative pulses. Eight LED's make an excellent type of module.

7. Try some shift registers—how they are loaded, why they do what they do. What about walking ring circuits using a shift register? What about the giant 24-pin IC's? You can also try multiplexing and demultiplexing circuits. How can they be controlled? Try data selectors from the *Cookbook*.

8. Why not try building your own ROM with diodes and the 74154 1-of-16 data selector? There are ways to combine these ROM's for complex logic circuits. Built them on a module; you can combine several ROM's for fantastic circuits.

9. Build some modules with discrete components on them, all ready for use—switches, potentiometers, vaiable capacitors, etc. Try some modules with miniature switches. What about the 74157 type of selector IC? Select one circuit input or another electronically. Build some modules with relays in the 5-volt range. Can you build your own memory type of module? How about some that hold

smaller discrete components, such as transistor circuits, amplifiers, inverters, etc.? Other suggestions: op-amp modules, a D/A module and an A/D module.

If you feel you have a full setup of modules, why not duplicate them in another logic family? For instance, do CMOS IC's work the same as TTL IC's, and why not? Can TTL and CMOS logic be compatible? The answer is yes, but you will have to find out the ways to make them compatible.

Can you design your own microprocessor using these modular-system circuits? Yes, why not? Choose a microprocessor and connect up the modules. Who knows . . . you may find a simpler method of doing things. The objective of building this system is not to build the modules just for themselves, but to use them in working circuits. Try some games or think up a new logic game, write up the story and submit it for publication.

Some suggestions

First, obtain some logic books and read up on several **Radio-Electronics** projects. Design the project into the various working modules. Build the modules and combine them into the total working prototype. Now draw up the schematic from the prototype. Can you redesign the prototype to fit better onto a finished PC board or a wire-wrap board. Does building the prototype lead to an idea for a different setup or circuit? Why not build the additional modules you need for your idea and rebuild the new prototype circuit?

Try some of your pet ideas in this modular form. It will prove whether the circuit is workable or not. When you have a good collection of modules, try putting them together into a circuit, using a block diagram to set up the circuit. Then set down the schematic. This gives you experience not only in tracing the wires, but in how to read schematics. Use the modules to learn logic circuits and share some of your experiences gained from their use. Have fun. **R-E**

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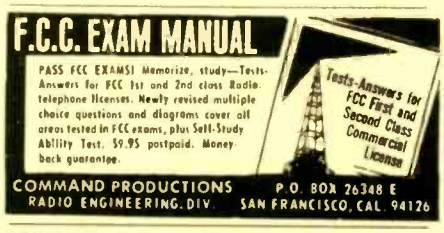

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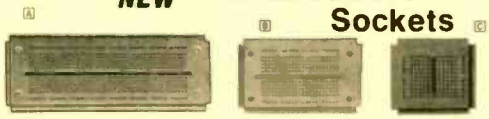

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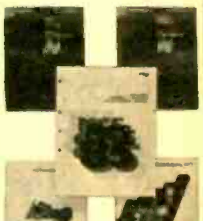

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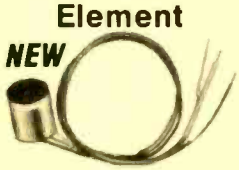

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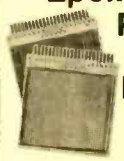

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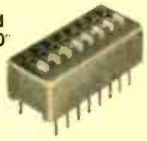

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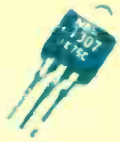

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2SA 748	1.00
2SA 750	.59
2SA 755	1.60
2SA 756	3.70
2SA 758	5.80
2SA 764	4.40
2SA 765	4.90
2SA 774	.59
2SA 777	1.00
2SA 794A	1.00
2SA 798	.70
2SA 814	1.90
2SA 815	1.00
2SA 816	.70
2SA 818	1.30
2SA 837	2.80
2SA 839	2.15
2SA 841	.59
2SA 847	.59
2SA 850	.59
2SA 872A	.59
2SA 885	.70
2SA 908	11.00
2SA 913	1.20

2SB

2SB 22	.59
2SB 54	.59
2SB 55	.59
2SB 75	.45
2SB 77	.45
2SB 173	.45
2SB 175	.45
2SB 176	.45
2SB 178	.70
2SB 186	.45
2SB 187	.45
2SB 202	1.60
2SB 220	.70
2SB 303	.59
2SB 324	.70
2SB 337	1.60
2SB 346	.70
2SB 367	1.50
2SB 368B	2.15
2SB 379	1.10
2SB 381	.59
2SB 400	.59
2SB 405	.59
2SB 407	1.40
2SB 415	.59
2SB 434	1.20
2SB 435	1.40
2SB 440	.59
2SB 449	1.60
2SB 461	1.20
2SB 463	1.20
2SB 471	1.60
2SB 473	1.20
2SB 474	1.00
2SB 481	1.20
2SB 492	1.00
2SB 507	1.60
2SB 509	1.60
2SB 511	1.10
2SB 514	1.90
2SB 523	1.00
2SB 526C	1.30
2SB 527	1.60
2SB 528D	1.60
2SB 529	.90
2SB 530	4.40
2SB 531	3.40
2SB 536	1.60
2SB 537	1.60
2SB 539	4.90
2SB 541	4.40
2SB 554	10.00
2SB 556	4.90
2SB 557	3.40
2SB 561B	.70
2SB 564	.70
2SB 595	1.90
2SB 596	1.60
2SB 600	7.00

2SC

2SC 183	.59
2SC 184	.59
2SC 281	.59
2SC 283	.59
2SC 284	1.20
2SC 317	1.20
2SC 352A	2.50
2SC 353A	2.50
2SC 367	.90
2SC 369	.59
2SC 371	.59
2SC 372	.45
2SC 373	.45
2SC 374	.59
2SC 377	.70
2SC 380	.59
2SC 381	.59
2SC 382	.59
2SC 383	.90
2SC 387A	.59
2SC 388A	1.00
2SC 394	.59
2SC 403	.59
2SC 430	.90
2SC 454	.59
2SC 458	.59
2SC 460	.59
2SC 461	.59
2SC 478	1.10
2SC 481	1.60
2SC 482	1.50
2SC 484	1.60
2SC 485	1.60
2SC 486	1.60
2SC 493	3.90
2SC 495	.90
2SC 496	.90
2SC 497	1.60
2SC 509	.70
2SC 515A	1.40
2SC 517	3.95
2SC 535	.59
2SC 536	.59
2SC 537	.59
2SC 538A	.70
2SC 562	.70
2SC 563	1.10
2SC 605	.70
2SC 619	.59
2SC 620	.59
2SC 627	2.25
2SC 631	.90
2SC 632A	.45
2SC 634A	.59
2SC 642A	5.90
2SC 644	.45
2SC 645	.70
2SC 650	1.30
2SC 665H	8.50
2SC 668	.45
2SC 680	2.80
2SC 681A	5.80
2SC 684	1.10
2SC 693B	.59
2SC 696	1.95
2SC 708	1.90
2SC 710	.45
2SC 711	.45
2SC 712	.59
2SC 717	.59
2SC 727	1.90
2SC 730	4.40
2SC 731	5.80
2SC 732	.59
2SC 733	.59
2SC 734	.59
2SC 735	.59
2SC 738	.59
2SC 756	2.80
2SC 756A	3.00
2SC 763	.59
2SC 772	.45
2SC 773	.70
2SC 774	2.00
2SC 775	1.95
2SC 776	2.65
2SC 777	3.50
2SC 778	3.60
2SC 781	2.65
2SC 783R	3.60
2SC 784	.59
2SC 785	.59
2SC 789	1.00
2SC 790	1.40
2SC 793	2.80
2SC 799	3.60
2SC 802	3.60
2SC 815	.59
2SC 828	.45
2SC 829	.45
2SC 830H	5.90
2SC 838	.59
2SC 839	.59
2SC 853	.90
2SC 867	4.25
2SC 870	.59
2SC 871	.59
2SC 895	4.90
2SC 897	3.40
2SC 898	4.40
2SC 900	.45
2SC 923	.45
2SC 929	.45
2SC 930	.45
2SC 941	.59
2SC 943	.70
2SC 945	.45
2SC 959	1.50
2SC 971	1.00
2SC 982	.90
2SC 983	1.00
2SC 984	.90
2SC 994	3.90
2SC 996	3.40
2SC 1000BL	.59
2SC 1012	1.50
2SC 1013	1.10
2SC 1014	1.10
2SC 1017	1.40
2SC 1018	1.20
2SC 1030C	2.80
2SC 1047	.70
2SC 1051	4.40
2SC 1060	1.40
2SC 1061	1.40
2SC 1076	39.00
2SC 1079	5.90
2SC 1080	4.40
2SC 1096	1.00
2SC 1098	1.10
2SC 1111	3.40
2SC 1114	3.70
2SC 1115	4.40
2SC 1116	4.90
2SC 1116A	6.60
2SC 1124	1.30
2SC 1127	1.40
2SC 1161	1.90
2SC 1162	1.00
2SC 1166	.59
2SC 1167	6.60
2SC 1170B	6.60
2SC 1172B	8.50
2SC 1173	.90
2SC 1175	.90
2SC 1177	14.00
2SC 1189	1.20
2SC 1209	.70
2SC 1211D	.59
2SC 1212A	1.40
2SC 1213	.70
2SC 1215	.70
2SC 1222	.45
2SC 1226A	.90
2SC 1237	2.25
2SC 1239	3.90
2SC 1279	.70
2SC 1306	2.90
2SC 1307	3.90
2SC 1310	.59
2SC 1312	.59
2SC 1313G	.59
2SC 1316	8.50
2SC 1317	.45
2SC 1318	.45
2SC 1325A	7.60
2SC 1327	.59
2SC 1330	.70
2SC 1335	.70
2SC 1342	.59
2SC 1344	.59
2SC 1345D	.59
2SC 1346	.70
2SC 1347	.70
2SC 1358	5.90
2SC 1359	.59
2SC 1360	1.00
2SC 1362	.59
2SC 1364	.70
2SC 1377	4.90
2SC 1383	.59
2SC 1384	.59
2SC 1396	.70
2SC 1398	1.10
2SC 1400	.59
2SC 1402	4.90
2SC 1403	4.90
2SC 1407	.90
2SC 1419	1.10
2SC 1444	2.80
2SC 1445	3.00
2SC 1447	1.60
2SC 1448	1.60
2SC 1449	1.00
2SC 1451	2.25
2SC 1454	5.60
2SC 1475	1.40
2SC 1478S	.70
2SC 1509	1.10
2SC 1567	1.10
2SC 1567A	1.10
2SC 1584	8.50
2SC 1586	7.60
2SC 1624	1.30
2SC 1626	1.10
2SC 1628	1.30
2SC 1647	1.00
2SC 1667	3.40
2SC 1669	1.60
2SC 1674	.59
2SC 1675	.59
2SC 1678	2.25
2SC 1679	4.25
2SC 1681	.70
2SC 1682	.45
2SC 1684	.59
2SC 1687	.70
2SC 1688	.70
2SC 1708	.59
2SC 1728	1.90
2SC 1730	.59
2SC 1756	1.40
2SC 1760	1.90
2SC 1765	8.80
2SC 1775	.45
2SC 1816	3.90
2SC 1846	.70
2SC 1885	.70
2SC 1908	.59
2SC 1909	3.90
2SC 1913	1.20
2SC 1945	5.60
2SC 1951	1.10
2SC 1957	1.20
2SC 1969	4.90
2SC 1973	1.10
2SC 1974	1.90
2SC 1975	4.40
2SC 2028	.90
2SC 2029	3.90
2SC 2074	1.90
2SC 2076	.59
2SC 2091	2.80
2SC 2092	3.90
2SC 2098	4.90

2SD

2SD 16	5.90
2SD 28	2.50
2SD 72	1.10
2SD 75	.90
2SD 77	.59
2SD 81	3.00
2SD 90	1.60
2SD 91	1.60
2SD 92	1.90
2SD 93	2.80
2SD 118	4.40
2SD 130	1.20
2SD 141	1.40
2SD 142	2.00
2SD 143	2.80
2SD 178	1.10
2SD 180	2.50
2SD 187	.59
2SD 188	3.00
2SD 201	3.40
2SD 202	3.90
2SD 204	1.40
2SD 205	1.40
2SD 213	5.90
2SD 217	4.40
2SD 218	4.40
2SD 220	2.50
2SD 223	1.90
2SD 224	1.90
2SD 226A	1.60
2SD 227	.45
2SD 234	1.00
2SD 235	1.00
2SD 236	1.60
2SD 255	1.60
2SD 261	.60
2SD 287	3.70
2SD 288	1.40
2SD 291	2.80
2SD 300	5.60
2SD 313	1.10
2SD 314	1.20
2SD 315	1.20
2SD 325	1.10
2SD 330	1.00
2SD 341	5.60
2SD 350	5.90
2SD 352	.90
2SD 356D	1.10
2SD 357D	1.00
2SD 358	1.30
2SD 359	1.00
2SD 360	1.20
2SD 361	1.00
2SD 370	3.00
2SD 371S	2.80
2SD 380	7.60
2SD 381	1.40
2SD 382	1.40
2SD 388	3.40
2SD 388A	4.40
2SD 389	.90
2SD 390	1.00
2SD 421	8.50
2SD 424	8.50
2SD 425	6.50
2SD 426	4.60
2SD 427	3.00
2SD 525	1.60
2SD 526	1.10
2SD 555A	6.60
2SD 610	1.90
SG 613(tv)	5.95

FET

2SK 19BL	.90
2SK 23	1.10
2SK 30	.70
2SK 33	1.10
2SK 34	1.10
2SK 40	.70
2SK 41	1.10
2SK 49	1.30
2SK 55	1.30
2SK 61	1.40
2SK 68	1.30
2SK 22Y	2.55
3SK 35	2.25
3SK 37	3.00
3SK 39	2.25
3SK 40	2.25
3SK 41	2.50
3SK 45	2.50
3SK 48	5.90
3SK 49	2.50
MK 10	2.00

IC

AN 203	2.50
AN 214Q	3.00
AN 217	1.90
AN 239	7.00
AN 247	4.40
AN 274	3.40
AN 277B	2.40
AN 315	3.00
AN 328	3.90
AN 362	3.00
BA 511	2.90
BA 521	2.90
HA 1137	4.90
HA 1138	4.40
HA 1149	5.60
HA 1151	4.40
HA 1156	3.00
HA 1158	5.30
HA 1159	5.80
HA 1196	4.90
HA 1197	3.90
HA 1201	1.50
HA 1202	2.25
HA 1211	1.50
HA 1306W	3.70
HA 1322	4.40
HA 1339	4.40
HA 1339A	4.40
HA 1342A	4.40
LA 1111P	2.50
LA 1201	2.50
LA 1364	4.40
LA 3300	3.00
LA 3301	3.00
LA 4030P	3.40
LA 4031P	3.00
LA 4032P	3.40
LA 4051P	3.70
LA 4400	3.70
LD 3120	2.50
M51513L	4.90
M5152L	2.50
M51841P	2.80
M5320P	2.25
M53273P	2.80
M53274P	2.50
M53393	7.60
M54730 P	8.80
MPS U31	1.90
STK 011	7.60
STK 014	9.50
STK 015	6.60
STK 016	8.50
STK 022	11.00
STK 032	14.00
STK 435	8.50
STK 439	11.00
STK 502	8.80
STK 503	9.60
TA 7027M	3.70
TA 7045M	3.00
TA 7054P	2.50
TA 7055P	3.00
TA 7060P	1.60
TA 7061AP	1.90
TA 7062P	1.90
TA 7063P	1.60
TA 7064P	1.90
TA 7066P	2.00
TA 7074P	4.90
TA 7075P	4.90
TA 7076P	4.90
TA 7089P	3.00
TA 7102	5.80
TA 7106P	4.90
TA 7108P	1.90
TA 7109P	3.40
TA 7120P	1.90
TA 7122AP	1.90
TA 7124P	1.60
TA 7129P	1.90
TA 7130P	2.80
TA 7136P	1.30
TA 7146P	4.20
TA 7150P	4.40
TA 7159P	2.50
TA 7200P	4.60
TA 7201P	4.60
TA 7203P	3.70
TA 7204P	3.40
TA 7205P	2.90
TA 7310P	3.95
TA 78005M	5.80
TA 78005P	5.80
TA 78012M	6.60
TA 78012P	5.80
TA 78015M	6.50
TA 78015P	5.80
TBA 810 SH	3.70
TC 5080P	5.80
TC 5081P	3.40
TC 5082	3.90
TD 3505AP	8.50
UHIC 002	5.80
UHIC 004	5.80
UHIC 005	5.80
UPC 20C	4.40
UPC 41C	3.70
UPC 554C	2.80
UPC 555H	2.25
UPC 563	3.70
UPC 566H	1.60
UPC 576	3.70
UPC 577H	2.25
UPC 592HZ	1.60
UPC 1001H	4.90
UPC 1008C	7.00
UPC 1016C	3.00
UPC 1020H	3.70
UPC 1025	3.40
UPC 1026C	3.70
UPC 1032	2.25
UPC 1152H	3.40
UPC 1156	3.00
UPD 858C	9.50
PLL 01A	8.80
PLL 02A	8.80
SN 7400	.19
SN 7490	.60

DIODES

78L05	1.10
IS 84	.60
IS 188	.25
IS 332	.45
IS 953	.25
IS 1007	.45
IS 1209	.45
IS 1211	.45
IS 1555	.25
IS 1588	.25
IS 1885	.25
IS 2076	.25
IS 2093	.45
IS 2473	.25
IN 34	.25
IN 60	.25
10D1	.40
10D10	.60
VD 6B	.40
VD 6C	.40

ZENER DIODES

WZ 050	.45
WZ 052	.45
WZ 061	.45
WZ 071	.45
WZ 075	.45
WZ 081	.45
WZ 192	.45
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☐	FND-500, .5" red, com anode, 7 seg. (= 2950)	1.50	2 for 1.51		
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☐ SN7420	.32	.33	☐ SN7485	.79	.80	☐ SN74165	.99	1.00
☐ SN7421	.49	.50	☐ SN7489	3.49	3.50	☐ SN74166	1.99	2.00
☐ SN7423	.29	.30	☐ SN7490	.99	1.00	☐ SN74173	.99	1.00
☐ SN7428	.19	.20	☐ SN7491	1.29	1.30	☐ SN74175	.99	1.00
☐ SN7430	.29	.30	☐ SN7492	.79	.80	☐ SN74177	.79	.80
☐ SN7437	.19	.20	☐ SN7493	.69	.70	☐ SN74179	1.99	2.00
☐ SN7438	.25	.26	☐ SN7494	.79	.80	☐ SN74180	.49	.50
☐ SN7440	.19	.20	☐ SN7495	.59	.60	☐ SN74182	.49	.50
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☐ SN7444	.19	.20	☐ SN7498	.79	.80	☐ SN74191	1.75	1.76
☐ SN7448	1.25	1.26	☐ SN74107	.99	.30	☐ SN74192	.85	.84
☐ SN7450	.19	.20	☐ SN74113	.38	.40	☐ SN74193	.99	1.00
☐ SN7451	.19	.20	☐ SN74114	.25	.26	☐ SN74194	1.25	1.26
☐ SN7453	.19	.20	☐ SN74121	.59	.60	☐ SN74197	.75	.76
☐ SN7454	.29	.30	☐ SN74123	.69	.70	☐ SN74199	1.50	1.51
☐ SN7455	.19	.20	☐ SN74126	.99	1.00	☐ SN74200	3.50	3.51
☐ SN7460	.35	.34	☐ SN74136	.49	.50	☐ SN74251	.79	.80
☐ SN7464	.19	.20	☐ SN74140	.49	.50	☐ SN74284	5.99	6.00
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☐ LM300N	.49	.50	☐ LM340T-24	1.49	1.50	☐ LM709N	.49	.50
☐ LM301V	.45	.46	☐ LM350N	.49	.50	☐ LM723N	.49	.50
☐ LM301N	.45	.46	☐ LM376V	.29	.30	☐ LM733N	.79	.80
☐ LM308V	.29	.30	☐ LM377N	2.25	2.26	☐ LM741N	.30	.31
☐ LM308H	.69	.70	☐ LM380N	1.39	1.40	☐ LM747H	.59	.60
☐ LM309K	1.49	1.50	☐ LM386N	1.49	1.50	☐ LM1304	1.49	1.50
☐ LM311V	.29	.30	☐ LM531H	1.49	1.50	☐ LM1310	1.79	1.80
☐ LM320T-6	1.49	1.50	☐ LM532N	.25	.26	☐ LM1312	2.49	2.50
☐ LM322N	1.19	1.20	☐ LM532H	.25	.26	☐ LM1414V	.19	.20
☐ LM339N	1.79	1.80	☐ NE540H	5.95	5.96	☐ LM1458V	.39	.40
☐ LM340K-5	1.49	1.50	☐ LM555V	.75	.76	☐ LM1800N	.79	.80
☐ LM340K-6	1.49	1.50	☐ LM556N	1.79	1.80	☐ LM3028H	.65	.66
☐ LM340K-8	1.49	1.50	☐ LM558V	.39	.40	☐ LM3900N	.49	.50
☐ LM340K-12	1.49	1.50	☐ LM558H	.39	.40	☐ LM3909V	1.25	1.26
☐ LM340K-15	1.49	1.50	☐ LM561N	1.00	1.01	☐ LM4250	1.20	1.21
☐ LM340K-18	1.49	1.50	☐ LM565N	1.00	1.01	☐ LM75451	.69	.70
☐ LM340K-24	1.49	1.50	☐ LM565H	1.00	1.01	☐ LM75453	.69	.70
☐ LM340T-5	1.49	1.50	☐ LM566	2.49	2.50	☐ LM75491	.80	.81
☐ LM340T-6	1.49	1.50	☐ LM567	2.39	2.40	☐ LM75492	.80	.81
☐ LM340T-12	1.49	1.50	☐ LM703N	.59	.60	☐ LM75494	.60	.61
☐ LM340T-15	1.49	1.50	☐ LM704H	.19	.20	☐ PA263	1.50	1.51
						☐ DM8864N	1.29	1.30

PENNIES FOR YOUR MEMORIES

Type	Description	Sale	1¢ Sale!	Order by
☐ 1103	1K Dynamic RAM	1.29	1.30	Cat. No.
☐ 5202	2K Prom	2.95	2.96	3459 A
☐ 5262	2K x 1 Dynamic RAM	.99	1.00	
☐ 1702A	256 x 8 EPROM	4.95	4.96	Type No.
☐ MM5280*	4K x 1 Dynamic RAM	3.95	3.96	

*Removed from new tested equipment

1 AMP SCR'S

TO-92 Case. 2N5060 series. 2367

Order by Cat No. and voltage			
☐ 30	4 for $1	8 for 1.01	
☐ 60	3 for $1	6 for 1.01	
☐ 100	3 for $1	6 for 1.01	
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☐ 200	1 for $1	2 for 1.01	

RIBBON CABLE!

Order by Cat. 3939 and Conductors

Cond.	Sale	1¢ Sale		
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☐ 34	3-ft. 1.98	6-ft. 1.99		
☐ 40	3-ft. 1.98	6-ft. 1.99		

ZENERS! Order by Cat. No. 5210A & voltage & wattage

Order by Cat. No. 52108

1 Watt	Sale	1¢ SALE	5 WATTS	Sale	1¢ SALE
☐ 7.5V	5 for $1.	10 for $1.01	☐ 6. V	3 for 1.	6 for 1.01
☐ 8.2V	5 for 1.	10 for 1.01	☐ 8.2V	3 for 1.	6 for 1.01
☐ 9.1V	5 for 1.	10 for 1.01	☐ 15. V	3 for 1.	6 for 1.01
☐ 10.V	5 for 1.	10 for 1.01	☐ 18. V	3 for 1.	6 for 1.01
☐ 11.V	5 for 1.	10 for 1.01	☐ 24. V	3 for 1.	6 for 1.01
☐ 12.V	5 for 1.	10 for 1.01	☐ 30. V	3 for 1.	6 for 1.01
☐ 15.V	5 for 1.	10 for 1.01			

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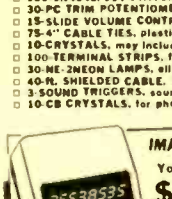

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☐ 2381	1N4005	600	10 for 1.39	20 for 1.40	
☐ 2382	1N4006	800	10 for 1.49	20 for 1.50	sture!
☐ 2383	1N4007	1000	10 for 1.59	20 for 1.60	

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☐ 50(m)	☐ 500(m)	☐ 2K(m)	☐ 10K(s)	☐ 250K(m)	☐ 1 Meg(m)

Order No. 5336 and value

10 AMP POWER TABS

1730-SCR'S
1448-TRIACS
1590-QUADRACS

PRV	Sale	2 for
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☐ 100	.69	.70
☐ 200	1.19	1.20
☐ 400	1.60	1.61

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10 AMP

Order by Cat. No.	PRV	Sale	2 for			
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	☐ 200	1.69	1.70	☐ 800	2.50	2.51
				☐ 1000	2.75	2.76

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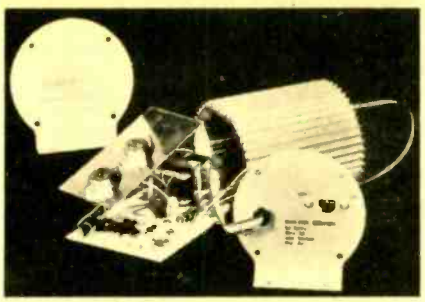

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MC1351P FM-IF AMP AND DISCRIMINATOR

USED IN FM & TV SOUND CIRCUITS. REQUIRES MINIMUM EXTERNAL COMPONENTS. 14 PIN DIP. DIRECT REPLACEMENT FOR HEPC 6060. ECG 748 and MANY OTHERS. HOUSE # WITH SPECS 50¢

LM3900 QUAD NORTON AMP

WE BOUGHT A LARGE QUANTITY OF THESE HOUSE NUMBERED PARTS AT A BARGAIN PRICE THAT ALLOWS US TO SELL THEM AT A LOW, LOW 39¢

MINI GRANDFATHER CLOCK KIT

Complete Electronics!
- Chimes the hour (let 3 times for 3 O'clock)
- Unique "swinging" LED pendulum
- Tick tock sound matches pendulum swing
- Large 4 digit .5" LED readout
- All CMOS construction
- Complete electronics including transformer & speaker; drilled and plated PC boards measure 4.5" x 6.5"

39.95

Reviewed in April 1978 RADIO ELECTRONICS

BEAUTIFUL SOLID WALNUT Custom case for above kit. Over 9¾" tall. 19.95

MK-05 MINI MOBILE CLOCK

The smallest and best priced mobile clock kit on the market. Designed to be a mobile clock from the ground up. There has been no compromise on quality.

FEATURES
- Quartz crystal timebase
- Toroid & zener noise & overvoltage protection.
- Magnified .15", 6 digit LED readout.
- Complete with presettable 24 hr. alarm.
- 8–14 VDC @ 40 to 50 ma.
- Readouts can be suppressed
- EASY, QUICK ASSEMBLY
- All components required included (you supply the speaker).
- Top quality drilled and plated PC boards Clock board: 2.6" x 2" Readout board: 2 3/8" x .75"

12.95

Small enough to mount in the instrument panel!

MJ900 - MJ1000

COMPLIMENTARY PNP, NPN DARLINGTON POWER TRANSISTORS. 8 AMPS. WE SUPPLY A SCHEMATIC TO BUILD A HIGH POWER 135W LOW DISTORTION AUDIO AMP WITH ONLY ONE ADDITIONAL TRANSISTOR AND A DOZEN INEXPENSIVE COMPONENTS! TO-3 CASE STYLE BUY A PAIR FOR $3.00!

FND510 69¢

COMMON ANODE READOUT ½" CHARACTER
LIMIT 24 PER CUSTOMER!

CAPACITORS

SMALL SIZE!

2200 MFD @ 16 VDC RADIAL 3/1.00

POWER SUPPLY METERS

Quality 3½" meters for the PS14, 0-15VDC & 0-25A. Matched set, individually packaged. NOT SURPLUS! 12.95/set

POWER SUPPLY KIT PS-14

- Better than 200MV load and line regulation
- Foldback Current Limiting
- Short Circuit Protected
- Thermal Shutdown
- Adjustable Current Limiting
- Less than 1% ripple.
- 15 amps 11.5 to 14.5V
- All parts supplied including heavy duty transformer.
- Quality plated fiberglass PC board.

Less Case, meters & jacks

UPS SHIPPING PAID!

REVIEWED IN 7/78 73 MAG.

15A CONT. 20A INT. 42.95

ALL COMPONENTS 100% GUARANTEED

CA3011	WIDEBAND IF AMP w/specs	50¢
2N3569	NPN EPOXY 1W	6/1.00
741	OP AMP 8 PIN DIP	5/1.00
723	VOLTAGE REG. 14 PIN DIP	50¢
MPS8530	NPN HOUSE #	8/1.00
725	OP AMP LOW NOISE HOUSE #	99¢
7815	15V 1A REGULATOR HOUSE #	89¢
LM340T-12	12V 1A VOLT. REG. w/specs	75¢
TCA430	QUAD OSCILLATOR t/specs	69¢
2N4343	P CHANNEL J FET	4/1.00
2N6111	PNP MED PWR 40W TO-220	3/1.00
2N6028	PROGRAMMABLE UNIJUNCTION w/specs	50¢
TRIAC	200V 8A UNMARKED	3/1.00

UNIVERSAL SOUND EFFECTS BOARD

New!

HAVE YOU EVER WISHED YOU COULD DUPLICATE THE SOUND OF A STEAM TRAIN OR A PHASOR GUN? HOW ABOUT GUNSHOTS, WHISTLES, SIRENS, BARKING DOGS AND OTHER SOUND EFFECTS? NOW YOU CAN WITH OUR PROGRAMMABLE SOUND EFFECTS KIT. IT USES THE NEW 28 PIN T.I. SOUND SYNTHESYZER CHIP, SN76477 AND SUPPORT CIRCUITRY. 5 TO 12VDC IS REQUIRED TO GIVE APPROX. 1/4 WATT OF AUDIO OUTPUT. WE PROVIDE THE P.C. BOARD, PARTS AND INSTRUCTIONS ALONG WITH A CHART TO PROGRAM SOME COMMON SOUNDS. USE YOUR IMAGINATION TO CREATE ORIGINAL SOUND EFFECTS. ORDER: SE-01 14.95 (Less Spkr.) 3/39.95

OVERVOLTAGE PROTECTION KIT 6.95

Provides cheap insurance for your expensive equipment. Trip voltage is adjustable from 3 to 30 volts. Overvoltage instantly fires a 25A SCR and shorts the output to protect equipment. Should be used on units that are fused. Directly compatible with the PS-12 and PS-14. All electronics supplied. Drilled and plated PC board. (Order OVP-1)

MK-03A CLOCK/TIMER KIT

Features 24 hour Zulu time and up to 24 hours of elapsed time on the same set of six digit LED readouts. Totally independent operation of both functions. Clock has presettable alarm with 10 minute snooze. Timer has reset, hold, and count functions. Full noise and overvoltage protection. 24 hour only. Readouts has dimmer feature or they can be turned off without disturbing the clock or timer. Timebase included (.01% accuracy). Because of the many options and mounting considerations the case and switches are not included. Switches are standard types. Will fit inside standard aircraft instrument case.

9–14VDC 28.95

CAPACITORS

.022	@ 100VDC Mylar	8/1.00
.22	@ 50VDC Mylar	6/1.00
1.5mfd	@ 400VDC Mylar	4/1.00
.1mfd	@ 35V Tant Axial	6/1.00
.47mfd	@ 35V Tant Axial	5/1.00
2.2mfd	@ 35V Tant Axial	5/1.00
22mfd	@ 20V Dip Tant	4/1.00
33mfd	@ 10V Dip Tant	4/1.00
220mfd	@ 25V Alum. Axial	7/1.00
500mfd	@ 35V Alum. Axial	5/1.00

HOUSE # PNP POWER

TO-3 IDENTICAL TO 2N3790
150 WATTS
80 VCEO
10 AMPS
1.00

LOOK! FANTASTIC SOUND EFFECTS CHIP

AVAILABLE ONLY FROM BULLET!

THIS 28 PIN MARVEL CONTAINS A LOW FREQUENCY OSCILLATOR, VCO, NOISE OSCILLATOR, ONE SHOT, MIXER AND ENVELOPE CONTROL WITH 8 PAGE MANUAL. 5 to 9VDC 3.95

WARBLE ALARM KIT

A fun EASY kit to assemble that emits an ear piercing 10 watt dual tone scream. Resembles European siren sound. Great for alarms or toys. Operates from 5–12VDC at up to 1 amp (using 12VDC+8 ohm speaker). Over five thousand have been sold. All parts including PC board, less speaker. 2.50 ORDER WB-02

IL-1 OPTO ISOLATORS

BY LITRONIX 6 PIN DIP STANDARD PINOUT LED-TRANSISTOR COMBINATION. 50¢ *WHILE THEY LAST!*

ULTRASONIC SENDER RECEIVER KIT US-02

TOTAL SECURITY! Completely invisible ultrasonic (23KHZ) Sound beam works like a photoelectric beam but is unaffected by light, heat or noise. Separate Transmitter and Receiver can be used from 6 inches to 25 feet! A solid object breaking the beam causes an output to go low that will sink up to 150 MA to Drive a Relay, TRIAC, etc. Complete electronics are provided. Works on 12VDC (unregulated) and draws less than 100 MA. Use it for burglar alarms, object counters, automatic door openers, automatic door bells, electronic rat trap(?) and more.

COMPLETE KIT LESS CASES 21.50

Optional entry delay and Alarm Timeout Circuit 3.95 will source or sink up to 200 MA DC.

- NO C.O.D.'S
- SEND CHECK M.O. OR CHARGE CARD NO.
- PHONE ORDERS ACCEPTED ON VISA AND MASTERCHARGE ONLY
- ADD 5% FOR SHIPPING
- TX. RES. ADD 5% STATE SALES TAX
- ORDERS OF $50.00 & OVER TAKE 10% DISCOUNT
- FOREIGN ORDERS ADD 10% (20% AIRMAIL) U.S. FUNDS ONLY

CIRCLE 114 ON FREE INFORMATION CARD

SALE S·100 BUS EDGE CONNECTORS SALE

NLS MS-215 DUAL TRACE MINISCOPE $435.00

NLS

1¢ SALE

LM3A 3 dig 1% DC	$134.00
LM3.5A 3½ dig .5% DC	$158.50
LM40A 4 dig .1% DC	$209.00
LM4A 4 dig .03% DC	$250.00

- Rechargeable batteries and charger included
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- Rechargeable batteries and charger
- Measures DC Volts, AC Volts, Ohms and Current
- Automatic polarity, decimal and overload indication
- No zero adjustment and no full-scale ohms adjust
- Battery-operated — NiCad batteries; also AC line operation.
- Large LED display for easy reading without interpolation
- Size: 1.9"H x 2.7"W x 4"D
  Parts & labor guaranteed 1 year
  Tilt stand option ..... $ 3.50
- Leather case $20.00

Purchase any of the LM series Meters and buy the LEATHER CASE for 1¢

NLS

$318.

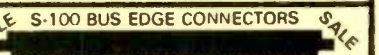
MS-15 MINISCOPE With Rechargeable Batteries & Charger Unit

- 15 megahertz bandwidth.
- External and internal trigger.
- Time base — .1 microsec. to 0.5 Sec/div - 21 settings ± 3%.
- Battery or line operation.
- Automatic & line sync modes.
- Power consumption < 15 watts.
- Vertical Gain — .01 to 50 Vdiv - 12 settings ± 3%.
- Viewing area 1.1" x 1.35"
- Case size 2.7"H x 6.4"W x 7.5"D, 3 pounds
- Parts & Labor guaranteed 1 year
- 10 to 1, 10 meg probes ..... $.27.
- Leather carrying case ..... $45.

PROBE 1¢
PROBE 1¢ with the purchase of SCOPE and the MENTION of this MAGAZINE

● MS-215 Dual Trace Version of MS-15 $435.

SALE S-100 BUS EDGE CONNECTORS SALE



$100-WWG 50/100 Cont. .125 ctrs. 3 LEVEL WIRE WRAP .025" sq. posts on .250 spaced rows. GOLD plated

1-4	5-9	10-24
$4.00	$3.75	$3.50

$100-STG 50/100 Cont. .125 ctrs. DIP SOLDER TAIL on .250 spaced rows for VECTOR and MASI motherboards. GOLD plated

1-4	5-9	10-24
$4.00	$3.75	$3.50

RG81G 50/100 Cont. 125 ctrs. DIP SOLDER TAIL on .140 spaced rows for ALTAIR motherboards. GOLD plated. $5.00

RG81-3 50/100 Cont. .125 ctrs. PIERCED SOLDER EYELET tails. GOLD $7.35

Other Popular Edge Connectors

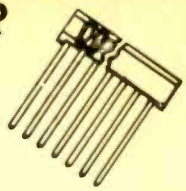
RG44-G .22/44 Cont. .156 ctrs. PIERCED SOLDER EYELES tails. GOLD plated

1-4	5-9	10-24
$3.00	$2.75	$2.50

RG44-3 .22/44 Cont. .156 ctrs. WIRE WRAP tails. GOLD $4.71

ATTN: OEM'S and Dealers, many other connectors available call or quotation.

3 LEVEL GOLD WIRE WRAP SOCKETS



	1-24	25-49	50-99	100-249	250-999	1K-5K
8 pin*	.41	.38	.35	.31	.27	.23
14 pin*	.39	.38	.36	.32	.29	.27
16 pin*	.43	.42	.39	.35	.32	.30
18 pin	.63	.58	.54	.47	.42	.36
20 pin	.80	.75	.70	.63	.58	.53
22 pin*	.90	.85	.80	.70	.61	.57
24 pin	.90	.84	.78	.68	.63	.58
28 pin	1.10	1.00	.90	.84	.76	.71
40 pin	1.50	1.40	1.30	1.20	1.04	.89

Sockets purchased in multiples of 50 per type may be combined for best price.

All sockets are GOLD 3 level closed entry *End and side stacable. 2 level, Solder Tail, Low Profile, Tin Sockets and Dip Plugs available. CALL FOR QUOTATION

- Kit includes 12 tantalum capacitors (.1 to 100 + 5 + 12 — 12 buses and insulated mounting sockets).
- Wiring side shown. Component side bare epoxy glass with white markings for component locations.
- G10 epoxy glass board with 2 ounce copper, solder plated and .038 diameter holes for leads.
- Solder mask with solder windows on etched circuits to avoid accidental short circuits.
- Mounts 11 receptacles with 100 contacts (2 rows) on .125 centers with .250 row spacing. Vector part number R88-2; or mounts 10 receptacles plus interconnections to smaller mother board for expansion.
- Includes etched circuits and instructions for option of active, pull-up, or floating terminations.
- Large buses: +5V and GND (10 AMPS). ± 12V or 16V (7 AMPS). Current ratings are per MIL-STD-275 with 10°C rise.
- Fits all Vector pak enclosures.
- Fits all IMSAI 8080 microcomputer as expander board.

8803 MOTHER BOARD FOR S100 BUS MICRO-COMPUTERS

Vector

Price: $29.50

Vector

8800V

Universal Microcomputer/Processor plugboard, use with S-100 bus. Complete with heat sink & hardware. 5.3" x 10" x 1/16"

1-4	5-9	10-24
$19.95	$17.95	$15.96

8801-1

Same as 8800V except plain; less power buses & heat sink

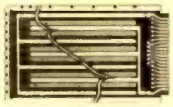
1-4	5-9	10-24
$14.95	$13.46	$11.96

Plugboards

3682 9.6" x 4.5" **$10.97**

3682-2 6.5" x 4.5" **$9.81**

HI-Density Dual-In-Line Plugboard for Wire Wrap with Power & Grd. Bus Epoxy Glass 1/16" 44 pin con. spaced .156



3677 9.6" x 4.5" **$10.90**

3677-2 6.5" x 4.5" **$9.74**

Gen. Purpose D.I.P. Boards with Bus Pattern for Solder or Wire Wrap. Epoxy Glass 1/16" 44 pin con. spaced .156

3662 6.5" x 4.5" **$7.65**

3662-2 9.6" x 4.5" **$11.45**

P pattern plugboards for IC's Epoxy Glass 1/16" 44 pin con. spaced .156

3690-12 CARD EXTENDER

Card Extender has 100 contacts-50 per side on .125 centers-Attached connector-Is compatible with S-100 Bus Systems $25.00

3690 6.5" 22/44 pin .158 ctrs. Extenders $12.00

1/16 Vector BOARD
.042 dia holes on 0.1 spacing for IC's

Phenolic PART NO.	SIZE	PRICE 1-9	10-19
64P44XXXP	4.5x6.5"	$1.49	1.34
169P44XXXP	4.5x17"	$3.51	3.16
Epoxy Glass			
64P44	4.5x6.5"	$1.70	1.53
84P44	4.5x8.5"	$2.10	1.89
169P44	4.5x17"	$4.30	3.87
169P84	8.5x17"	$7.65	6.89

SLIT-N-WRAP

Wraps insulated wire on .025" square posts
FOUR TIMES FASTER

$24.50

Vector

NO PRE-STRIPPING
NO PRE-CUTTING"
SPOOL-FED WIRE"

*The spooled wire passes through the tool past a slitting edge next to the wrap post. A narrow longitudinal cut is made as the insulation wraps it presses into square post corner. The bared conductor is indented by the sharp edge (7 turns = 28 contacts).

Insulation is left where stripped but not removed. Machine goes on or off the wire.

P180 with two 100" spools of 28 ga. wire

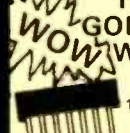
P180-AT includes charger, wire **$75.00**

"Daisy chain" runs available and adds to cost. Manual or power operation

SLIT-N-WRAP WIRE NO. 28 GAGE INSULATED WIRE. 100' SPOOLS

W28-2 A Pkg. 1 Green W28-2 C Pkg. 3 Clear
W28-2 B Pkg. 2 Red W28-2 D Pkg. 3 Blue

2708
8K 450 ns
EPROM
FACTORY PRIME
$ 9.00 EA.
25 + Call For Price



14 & 16 PIN GOLD 3 LEVEL WIRE WRAP SOCKETS

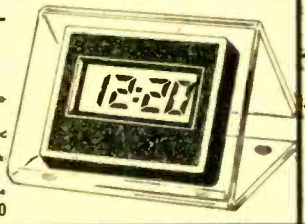
14 - G3 100 for **$30.00**

16-G3 100 for **$30.00**

50 of each for **$32.00**

Sockets are End & Side stackable, closed entry

LIQUID CRYSTAL DIGITAL CLOCK-CALENDAR



- For Auto, Home, Office
- Small in size (2x2½x¾)
- Push button for seconds release for date.
- Clocks mount anywhere with either 3M double-sided tape or VELCRO, included.
- 2 MODELS AVAILABLE
  LCD-101, portable model runs on self-contained batteries for better than a year.
  LCD-102, runs on 12 Volt system and is back lighted.
- LCD-101 or LCD-102 your choice ..... $34.95 ea.
- Clear desk stand for $2.00

LEDU MG 10A List $72.

Perfectly balanced, fluorescent lighting with precision magnifier lens. For profit, techn'l & hobbist. Has die cast protective shade, inst. start 3 diopter lens 42" reach

$44.95

with T8 Fluorescent lamp (required) $48.95
colors: Grey or Black
Choose by color

2 shipping weights

$44.95

SPECIAL

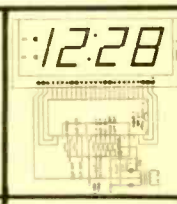
SC-5 With Rechargeable Batteries & Charger Unit **$98**

FM-7 With Rechargeable Batteries & Charger Unit **$215**

Features include: • By using the new NLS SC-5 Prescaler, the range of the FM-7 Frequency Meter, which is 10 Hz to 60 MHz, may be extended to 512 MHz (the upper VHF & UHF frequency bands). • The FM-7 utilizes an LED readout, providing 7-digit resolution. • The FM-7 can be calibrated to an accuracy of 0.00001%. • The SC-5 is accurate to one part per million. • Each unit has 30 milliwatts sensitivity, is battery powered and has a charger unit included. • Dimensions of each are 1.9" H x 2.7" W x 3.9" D. • The units may be obtained separately or as a "Frequency Duo." • Parts & Labor guaranteed 1 year.

Tilt stand option ..... $ 3.50
Leather case $20.00

MICRO-KLIP
for .042 dia. holes
(all boards on this page)
142-1 pkg. 100 $ 1.50
142-1 pkg. 1000 ..... $11.00
P-149 hand installing tool ..... $ 2.03



.8" LED ALARM CLOCK

12 hr. LED Alarm Clock uses 3½ digit .8" LED Display with AM/PM indicators and colons. Direct drive, PIN to PIN interface with **8199BA** I.C. Just add switches, AC Supply, Alarm. Display and I.C. only.

$7.95 or 2/$15.00

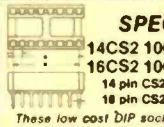
1

Price Breakthrough! **$17.50**

MA1003 CAR CLOCK

Bright Green Fluorescent Display Crystal Time Base Assembled, just add switches and 12 VDC.

SPECIAL



14CS2 100 for '14°°
16CS2 100 for '16°°
14 pin CS2 10 for '2°°
16 pin CS2 8 for '2°°

These low cost DIP sockets will accept both standard width plugs and chips.

For use with chips, the sockets offer a low profile height of only .125" above the board. These sockets are end stackable.

WRAP POST
for .042 dia. holes
(all boards on this page)
T-44 pkg. 100 ... $ 2.28
T-44 pkg. 1000 ..... $14.00
A-13 hand installing tool ..... $ 2.80

PRIORITY ONE ELECTRONICS ©

4911R West Rosecrans, Hawthorne, CA 90250

Terms: VISA, MC, BAC, check, Money Order, C.O.D., U.S. Funds Only. CA residents add 6% sales tax. Minimum order $10.00. Orders less than $75.00 include 10% shipping and handling; excess refunded. Just in case please include your phone no. "Sorry, no over the counter sales" Good thru October, 1978

Send for our latest brochure. phone orders welcome (213) 973-4876 OEM and Institutional inquiries invited.

24 PIN DIP PLUGS WITH COVERS

3 / $1.00
40 / $10.00

SALE S·100 BUS EDGE CONNECTORS SALE

PHONE CALL RECORDING ADAPTER

Record incoming and outgoing calls automatically with this all solid state unit connected to your telephone jack and tape recorder. Tape becomes a permanent record. Don't depend on your memory to recall important details of business and personal calls. Easily installed. No extra monthly phone chgs. FCC Approved

AMAZING ELECTRONIC MICRO MINI MIKE™

World's smallest, solid state, self contained with 1.3V Merc. Bat. furn. Picks up most sounds and transmits without wires up to 300 ft. thru FM Radio. Tuneable. Use as mike, ampl., alarm & alert system, baby sitter, hot line, etc. Mike $18.95*, Phone Call Adapter $24.50* (* plus $1.00 ea. for pstg. & hdlg.) Cal. res: add tax. Free data. Mail Order, B/A, M/C, cod's o.k. Qty. disc. avail. AMC SALES, Dept. 19, 9335 Lubec St., Box 928, Downey, CA 90241.

2-1/4 x 3/4 x 1/2"

SANKEN 50-watt power AMP 22.50 postpaid, 50-volt transformer for above 8.00 postpaid. **PRARIE SOUNDS,** P.O. Box 982, Champaign, IL 61820

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(No experience required) Each month you will receive nationally released albums to rate. THERE IS NO EXTRA CHARGE for the LP's you receive. You pay a small membership fee which covers all costs of the LP's. We pay postage. In return for your opinion, build your LP collection. "First come basis." For application write: EARS, DEPT. RX Box 10245, 5521 Center St., Milwaukee, WI 53210

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NEW, adjustable three-output, regulated power supply, plus 900 parts worth over $400.00 in complete cartrivision television electronics assembly. Documentation included. Perfect for microprocessor and all electronic applications. $16.95 plus $4.50 S&H. Master Charge, VISA. Free brochure. MADISON ELECTRONICS, 369, Madison, AL 35758. **Satisfaction guaranteed.**

AUDIO & ANALOG EXPERIMENTERS

- quality parts
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- ideas

FREE FLYER

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ASSOCIATES, INC. NEWTON, NH 03858

NAME brand test equipment. Up to 50% discount. Free catalog and price list. **SALEN ELECTRONICS,** P.O. Box 82, Skokie, IL 60076

TAPE head cleaner, 8 oz.—$2.30. Includes postage and handling. Write: **"CLEANER,"** Box 176, Whitewater, WI 53190. 800-558-9572 except WI

BUILD YOUR OWN TV CAMERA!
— Ideal for home & business —

THE ECONOMICAL ANSWER TO HOME MONITORING OF NURSERIES, ENTRANCES, DRIVEWAYS...BUSINESS and INDUSTRIAL SURVEILLANCE...ITV...AMATEUR TV PLUS HUNDREDS OF OTHER APPLICATIONS. MODEL XT-1A, SERIES D - KIT FORM $185; ASSEMBLED $275. SOLID-STATE. WORKS ON ANY TV SET. OPTIONAL SOUND KIT $28.95.

PHONE or WRITE for catalog. Dial 402-987-3771

BOX 453-RE **ATV Research** DAKOTA CITY, NE. 68731

SOLID-state brownout protector for central air-conditioning systems. Simple 3-wire connection to existing 24V control transformer. $14.95 ppus. **S & S Electronics,** Box 430260, Miami, FL 33143

Why is this the

LARGEST SELLING low cost COUNTER KIT?

This counter is such a great seller because people like you have found that, feature for feature, the CT-50 gives you more for your money. Advanced LSI and CMOS circuitry has; lowered power consumption, increased performance, and reduced cost. Complete push button operation makes using the CT-50 a snap, and automatic decimal point positioning gives you quick, reliable readings. Battery operation is also possible becuase the CT-50 runs equally as well on 12VDC as it does on 110VAC. For ultra-accuracy we offer the CB-1 color burst adapter, it locks the CT-50's internal crystal to the television networks color standard for .001 ppm accuracy! Why sacrifice performance by using another counter when you can get professional quality at the unheard of price of $89.95? Order yours today!

SPECIFICATIONS
Sensitivity: less than 10 mv.
Frequency range: 5 Hz to 60 MHz, typically 65 MHz
Gatetime: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 2 ppm, internal TCXO standard
Input: BNC, 1 megohm direct, 50 Ohm with prescale option
Power: 110 V ac 5 Watts or 12 V dc @ 300-400 ma
Size: Approx. 6" x 4" x 2", high quality aluminum case

CT 50,60 MHz Counter Kit $89.95
CT-50 wt 60 MHz Counter Wired & Tested $159.95
CT-600, 600 MHz prescaler option for CT-50, add $29.95

SELLING Rider manuals, single volumes, sets, older Sams' Photofacts, **Supreme. Beitman,** Box 46, Highland Park, IL 60035

BREATHE BETTER AIR WITH AMAZING
NEGATIVE ION GENERATOR
KITS AND ASSEMBLED UNITS

Scientists have long known that negative ions can be beneficial to man's health. These tiny but potent, atmospheric particles abound in nature. Now, through the magic of science, you can duplicate this delightful phenomenon in the privacy and convenience of your own home or office.

Room/Portable Units | Ion Testers | Accessories

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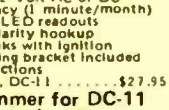

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±0.1 PPM TCXO

OPTO-8000.1

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

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

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

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

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Wire Kit 1 at $6.95 - 2 1/2¢/ft.	

* 30 Kynar stripped 1" on each end. Lengths are overall. Colors: Red,Blue,Green,Yellow,Black,Orange,White. Wire packaged in plastic bags. Add 25¢/length for tubes.

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3"	82	2.60	4.71/K	4.22/K
3"	86	2.80	5.12/K	4.55/K
4"	90	3.00	5.52/K	4.88/K
4"	94	3.21	5.93/K	5.21/K
5"	98	3.42	6.34/K	5.52/K
5"	1.02	3.65	6.75/K	5.86/K
6"	1.06	3.85	7.16/K	6.19/K
6"	1.15	4.05	7.57/K	6.52/K
7"	1.20	4.25	7.98/K	6.85/K
7"	1.25	4.45	8.39/K	7.18/K
8"	1.29	4.65	8.80/K	7.53/K
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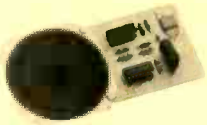

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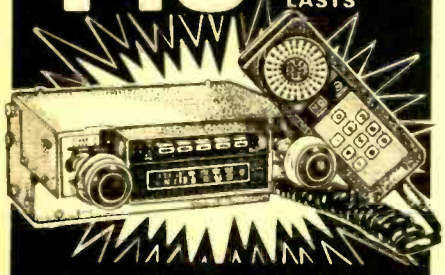

From J.I.L., a leader in car entertainment centers . . . a modular, compact, first quality 4-in-1 unit at a price you might pay for a radio only! Get stereo high-fidelity FM Radio, AM Radio, Cassette or 8-track, and CB all for on low price. Tens of thousands sold nationally. Order while supplies last.

☐ #853/102 In-Dash Combination 8-Track Stereo, AM/FM/Stereo Radio and 40-Channel Digital Touch-Tuning AM-CB. Features LO/DX switch. Stereo light, 8-track program lights, CB standby switch, LED channel readout. Plus many other features
-while supply lasts only.... **$149.00**

☐ #610/102 In Dash Combination Stereo Cassette Player, AM/FM/Stereo Radio and 40-Channel Digital Touch-Tuning AM-CB. Features cassette eject/FF button, CB selector, CB standby switch Plus many other features
-while supply lasts only.... **$159.00**

☐ #202-SSB Single Sideband 40-Channel CB featuring Digital Touch-Tuning AM-SSB CB for 120 effective channels with greater clarity and reach. All functions right on the mike. A top-notch unit. Choose SSB instead of standard 40-channel CB with #853 or #610 above.
Please add **$50.00**

ACCESSORIES

☐ AM/FM/CB Retractable Antenna
(mounts like reg. car antenna)
List $39.95 ..... NOW $29.95

☐ 5¼" Full-tone Coaxial Speakers
20, oz. magnets.
List 39.95 pr. ..... NOW $19.95

☐ 6"x 9" Full-tone Coaxial Speakers
10 oz. magnets each
List $69.95 pr..... NOW $29.95 pr.

☐ Field Strength/SWR Meter to test Ant.
List $29.95 ..... NOW $19.95

CLIP AD AND ATTACH TO LETTER
Pa. Res. Add 6% Sales Tax.

0300

LESLIE **PAUL** INC.
"DISCOUNT MAIL ORDER!"
70 James Way, Southampton, Pa. 18966
Phone Orders Call (215) 322-8599

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CITY _____ STATE _____ ZIP _____

BankAmericard/Visa, Master Charge-

Card # _____ Exp. Date _____

CIRCLE 26 ON FREE INFORMATION CARD

MULTI-TESTER

YX-360TR
TRANSISTOR TESTER
20K OHMS/VOLT

IT TESTS
TRANSISTORS AND LED's
AS WELL!!

$28.50

SPECIFICATIONS

DCV	0-0.1-0.5-2.5-10-50-250-1000 (20kΩ/V) ±3%, 25k (w/HV probe)
DCA	0-50μA-0.25-2.5-25mA-0-0.25A (100mV & 250mV) ±3%
ACV	0-10-50-250-1000 (8kΩ/V) ±4% Freq. 30Hz to 30kHz
Ω	x1-x10-x1k-x10k (max. 20M) Batt. 1.5V x 2 & 9V x 1
dB	−10 to +62
ICEO	0-150μA-0-15-150mA ±5%
hFE	0-1000 ±3% (w/connector)
	150x100x57 420gr

Surprising versatility at bargain prices! May be used as a transistor circuit analyzer measuring hFE with the optional connector. A 3 volt battery source gives extended capability in checking semiconductors and LEDs. Range placement on the selector dial gives fast operation and maximum safety from accidents mis-selections. Meter movement is protected with a diode and a varistor. Ohms scale has a 20 ohm center for accurately reading low ohm values. Popular school item.

- Measures hFE & ICEO (options)
- High versatility at low cost
- Ohms scale has 20 ohm center

ACCESSORIES AVAILABLE
SAN-HV14 Hi-Volt Probe, 25KV, 480 M OHM $7.50
SAN-FE2, hFE Semiconductor Connector $3.50

THE MOST POPULAR MM5314 CLOCK KIT

Features:
* 12/24 Hours Display
* 50/60 Hz Input
* 6 Digits Bright Orange Readouts

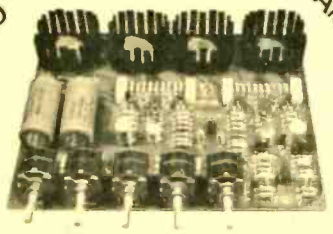
Kit includes plastic case, MM 5314 I.C. One set transistor drivers, P.C. Board, gas discharge displays, all other electronic parts and transformer. Catalog no. DC-8SP

SPECIAL PRICE
$16.95 PER KIT

9 STEPS LED LEVEL INDICATOR KIT

for most stereo amplifiers
This new project works as a pair of VU meter to indicate the output level of your amplifier from -20dB to +3dB. Kit includes all LED, transistors, electronic components, P.C. Board and instructions.
Easy to build and fun to see.
ONLY $9.90 EA.

60W + 60W STEREO AMPLIFIER



OCL pre amp. & power stereo amp. with bass, middle, treble 3-way tone control. Fully assembled and tested, ready to work. Total harmonic distortion less than 0.5% at full power. Output maximum is 60 watts per channel at 8Ω . Power supply is 24 - 36V AC or DC. Complete unit
only $37.50 ea.
Power transformer $7.50 ea.

RCA 2N3055

NPN power transistor.
100V 115 watt
15 amp
2 for $1.80

MERCURY SWITCH

The switch is a light bulb type SPST with a drop of mercury inside. Ideal for alarm control, or a motion device switch. Small size like a 6V light bulb. 60¢ ea.

COMPUTER GRADE CAPACITORS

All capacitors are Brand New U.S. made in standard size

5600MFD	60V	$2.20 EA.
8500MFD	35V	$2.75 EA.
9000MFD	50V	$3.25 EA.
4200MFD	150V	$2.50 EA.
3000MFD	15V	$1.50 EA.
11000MFD	35V	$3.20 EA.
14500MFD	40V	$3.40 EA.
20000MFD	55V	$3.50 EA.
23000MFD	20V	$3.00 EA.
58000MFD	20V	$3.20 EA.
100,000MFD	6V	$2.50 EA.

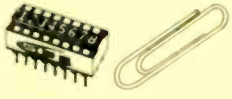
VHF MODULATOR

(Size of a Match Box)

This unit converts the video signal to RF signal. Ideal for computer terminal or TV games.
Video Input: 1V OC RF
output: 1.5MV
Preset at 61.25 MHz
(channel 3)
Frq. adjustable ± 3 MHz
Power Supply 5~8V DC 10MA
$4.50 EACH

NEW
MARK II
with both RF and audio signal output allows you to have sound!!
$8.50 EACH

DIP SWITCHES

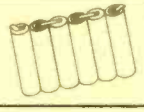


(On-Off Contacts)

4 positions	$1.50
5 positons	$1.60
6 positions	$1.70
7 positions	$1.70
8 positions	$1.80
10 positions	$2.00

PHOTO RESISTOR | C.D.S.

This U.S. made photo resistor is packed in a clear glass case with a dia. of ¼". Max. range 50K~0Ω.
80¢ ea.



AA SIZE NI-CD BATTERY
6 in a pack (1.2V X 6) 500 MA/HR
SPECIAL PRICE
$4.80 PER PACK

SUPER 15 WATT AUDIO AMP KIT

ONLY $23.50 each

Uses STK-015 Hybrid Power Amp

Kit Includes: STK-015 Hybrid IC, power supply with power transformer, front Amp with tone control, all electronic parts as well as PC Board. Less than 0.5% harmonic distortion at full power ½dB response from 20—100,000 Hz. This amplifier has QUASI—Complimentary class B output. Output max is watt (10 watt RMS) at 4Ω.

30MHZ FREQUENCY COUNTER KIT

Take advantage of this new state-of-the-art counter featuring the many benefits of custom LSI circuitry. This new technology approach to instrumentation yields enhanced performance, smaller physical size, drastically reduced power consumption (portable battery operation is now practical), dependability, easy assembly and revolutionary lower pricing!

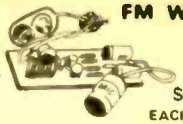
- 0.5" red LED 6 digits display
- Resolution: 1 Hz at 1 sec. 10 Hz at 1/10 sec.
- Sensitivity: 10 Mv RMS to 30 Hz
- Internal power supply: 5.2V at 1 amp regulated
- Input connector: BNC type
- Input power required: 117V AC 50/60 Hz
- Diode protected for over voltage input

Model 250-30A

Only ~~$59.50~~ **$53.50**

Includes all parts, PC Board and Transformer

FM WIRELESS MIC KIT



$6.95 EACH KIT

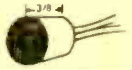
This new model FM wireless MIC kit uses 3 high freq. transistors, works in the FM range (88-108 MHz). It transmits the sound wave fidelity clearly over long distances (up to 250 ft.). Kit comes with all electronic parts, P.C. Board and mini microphone!

SOUND ACTIVATED SWITCH

All parts completed on a PC Board SCR will turn on relay, buzzer or trigger other circuit for 2—10 sec. (adjustable) Ideal for use as door alarm, sound controlled toys and many other projects Supply voltage 4.5V—9V D.C. $1.75 ea./2 for $3.00

Sub-Mini Size Condenser Microphone

$2.50 each
FET Transistor Built-in



FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED
Lights up 8—15 Watt Fluorescent Light Tubes
Ideal for camper, outdoor Auto or Boat

Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board, light tube not included!

ONLY $5.50 PER KIT

MANY SOUND DECISIONS!

$3.60 EACH

Solid state sound indicator operating voltage 6V DC 30μA. Small size approximately ¾" X 1⅛".

Model EB2116 (Continuous)
Model EB2126 (Slow Pulse)
Model EB2136 (Fast Pulse)

Continuous | Slow pulse | Fast pulse

POWER SUPPLY KIT

0-30V D.C. REGULATED

Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts.

0-30 POWER SUPPLY $10.50 each

Transformer for Power Supply, 2 AMP 24V x 2 $6.50
30V DC Panel Meter $4.20

12V DC MINI RELAY

P.C. Board Solder Type

2AMP Contact SPDT $1.30 EA
2AMP Contact DPDT $1.75 EA
5AMP Contact 4PDT $2.20 EA

12V D.C. AUTO DIGITAL CLOCK

Complete Unit
Not a Kit!

0.4" blue color 4 digits display. Turn off readouts when car is not running. X'tal controlled time base for time accuracy. Special designed case for easy mounting on top of your dashboard. Ideal for car, boat and campers.

ONLY ~~$28.50~~ ea. SALE! $24.50

HEAVY DUTY CLIP LEADS

10 pairs — 5 colors
Alligator clips on a 22" long lead. Ideal for any testing.

$1.85/pack

1Watt AUDIO AMP

All parts are pre assembled on a mini PC Board
Supply Voltage 6—9V D.C.
SPECIAL PRICE $1.95 ea.

"FISHER" 30 WATT STEREO AMP

(15W X 2)

Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not included). Power band with (KF 1% ± 3dB). Voltage gain 33dB. 20Hz — 20KHz.

Super Buy Only $22.50 each kit

ELECTRONIC SWITCH KIT

CONDENSER TYPE

Touch On Touch Off uses 7473 I.C. and 12V relay
$5.50 each

AUTO ALARM KIT

The Crimefighter Auto Alarm is an electronic, self-controlled auto protection system, normally mounted within the glove box of an automobile. Two minutes after turning off the ignition, the alarm automatically turns itself "on". When auto is re-entered, the horn will sound after a 10-45 second entry delay. The automobile owner, by inserting the ignition key, will activate the alarm. Once activated, the alarm will sound for two minutes before automatically turning off. The alarm then resets and is ready to again protect the vehicle from unwanted entry.

FEATURES: Simple installation: 5 wires. Automatically turns on when auto is parked. Adjustable entry time. Extended exit time to allow for unrushed exit from vehicle. Numerous applications include protection of boats, campers, trailers, motorcycles, trucks. Cannot be deactivated by "hot wiring" an auto. Cannot be turned off without ignition key. Negative ground only.

ONLY $14.00 PER KIT

GELYTE

Rechargeable Battery 6V 9AMP hour by Gould all batteries are new unused, solid with no liquid chemicals $9.50 EACH

we pay shipping

MINI-SIZED I.C. AM RADIO

Size smaller than a box of matches!
Receives all AM stations
Batteries and ear phone included

Only $8.50

5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Supply 6—18V DC
only $5.00 ea.

Sub Mini Size PANEL METER

500 UA
ONLY $1.20 ea

TIMER KIT

Time Controlled from 1-100sec.
Ideal to be used as timer delay unit for burglar alarm, photo service, and other purposes.
Max. loading 110V, 2 AMP.
Supply voltage 12-18V DC.

FT-20 ELECTRONIC IC TIMER $11.50 each

PANEL METER (D.C. Type)

$5.50 ea.

Size 60MM X 66MM
White Face Type

0-50 UA	0-30V
0-1MA	0-50V
0.5MA	0-100V
0-100MA	

MINI-MINI TOGGLE SWITCH

Half size of submini toggle switch rated 3 amp 125V AC contact

		1-9	10-99
MS 2432P	SPST	0.90	0.80
MS 244	SPDT	1.00	0.90
MS 245	DPDT	1.20	1.10

LARGE QUANTITY AVAILABLE FOR OEM

ELECTRONIC ALARM SIREN

COMPLETE UNIT
Ideal for use as an Alarm Unit or hookup to your car back up to make a reverse indicator.
Light Output up to 130dB
Voltage Supply 6—12V $7.50

AU—999

LED ALARM CLOCK

COMPLETE UNIT
NOT A KIT

- 0.5" RED LED READ OUT
- 24 HRS. ALARM SET
- 10 MINS. SNOOZE SET
- AM/PM ALARM INDICATORS
- SECOND DISPLAY SWITCH
- AUTOMATIC BRIGHTNESS CONTROL
- COMPACT AND HANDSOME PACKING
- 110V AC 60HZ INPUT

$17.50 EACH

TRANSFORMERS

ALL 117 VOLT INPUT

30V	4AMP	$7.50 EA.
36V CT	3AMP	$6.50 EA.
48V CT	3AMP	$6.50 EA.
24V CT	3AMP	$6.50 EA.
12 or 24V	2AMP	$3.90 EA.
24V CT	0.8AMP	$1.80 EA.
12V CT	0.8AMP	$1.80 EA.

SUBMINIATURES TOGGLE SWITCHES

SPDT	On-Off	$1.30 ea
DPDT	On-Off	$1.50 ea
3PDT	On-Off	$1.75 ea

Mini size Rocker Type
Also available at the same price

19 KEY HEXADECIMAL KEY PAD

- 1—0
- Homekey
- ABCDEF
- ←→Key

SPECIAL $10.50 ea.

AC POWER SUPPLY

Wall Type Transformer

12V AC	Output	200MA $2.75 EA.
16V CT AC	Output	100MA $2.10 EA.
6V DC	Output	120MA $1.90 EA.
12V DC	Output	100MA $1.90 EA.

MINI SIZE REED RELAY

Approx. 1" square
SPST Normal Open
Contact rated 1AMP
Coil 6—12V DC
All brand new by AMF
3 for $2.00

LINEAR SLIDE POT 500KΩ SINGLE

Metal Case 3" Long
2 FOR $1.20

2¼" ROUND SPEAKER

8Ω 0.25W
for most sound projects

SPECIAL 3 for $2.00

WIDE ANGLE PANEL METER

1¾" x ¾"
IMA Full Scale
(scale marks 0-100)
$1.50 each

PUSH-BUTTON SWITCH

N/Open Contact
Color: Red, White, Blue, Green, Black. 4/$1.00
N/Close also Available 50¢ ea.
LARGE QTY. AVAILABLE

DIGITAL ELECTRONIC LOCK KIT

$6.50 ea. CMOS I.C. IN CIRCUIT

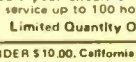
for auto ignition, entry door, burglar alarm, etc. 4 Digits Programmable to Any Combination

400A RELAY AND KEY PAD NOT INCLUDED

I.C. TEST CLIPS

Same as the E-Z clips With 20" Long Leads In Black and Red Colors
$2.75 per pair

HOUR INDICATOR



This unit is 1 5/8" long operating voltage 4V D.C. will tell you how many hours your circuit or machine has been in service up to 100 hours.

Limited Quantity ONLY $1.75 ea.

SOLID STATE ELECTRONIC BUZZER

Mini size 1" x ¾" x ¾"
Supply voltage 1.5V 12V
Ideal for Alarm or Tone Indicator
$1.50 each

BATTERY POWERED FLUORESCENT LANTERN

FEATURES

- Circuitry: designed for operation by high efficient, high power silicon transistor which enable illumination maintain in a standard level even the battery supply drops to a certain low voltage.
- 9" 6W cool/daylight miniature flourescent tube.
- 6 X 1.5V UM-1 (size D) dry cell battery.
- Easy sliding door for changing batteries.
- Stainless reflector with wide angle increasing lumination of the lantern.

$9.60 EACH
MODEL 888-R

MINIMUM ORDER $10.00. California residents add 6% sales tax and 10% shipping.
Out of state add 15% of total purchase for shipping charges, out of USA and Overseas add 25% of total purchase.
SEND CHECK OR MONEY ORDER TO:

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12603 CRENSHAW BOULEVARD • HAWTHORNE, CALIFORNIA 90250

For more information please call (213) 973-1921, (213) 679-5162
STORE HOURS 10-7 Monday - Saturday

master charge

your BANKAMERICARD welcome

SEND $1.00 FOR DETAILED CATALOG

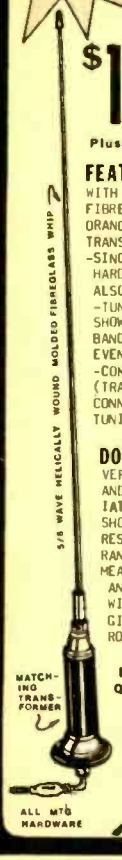
CIRCLE 10 ON FREE INFORMATION CARD

SURPLUS SPECTACULAR!

2 METER MOBILE ANTENNA

$12.95 Plus $1 Shipping

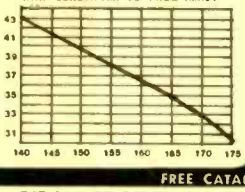
BRAND NEW FACTORY BOXED ANTENNAS MADE BY WELL KNOWN TOP LINE MFR. FOR POLICE AND GOVT. AGENCIES. ORIGINAL COST IN HUGE QUANTITIES WAS TWICE OUR LOW PRICE.



FEATURES: -HIGHEST QUALITY; DESIGNED FOR USE WITH STATE & COUNTY POLICE VEHICLES. MOLDED FIBREGLASS HELICALLY WOUND WHIP (FLOURESCENT ORANGE), HEAVILY PLATED PARTS, SEALED MATCHING TRANSFORMER.
-SINGLE HOLE MOUNT (1/2" DIA) WITH ALL MOUNTING HARDWARE INCLUDING TRIM RINGS AND RUBBER SEALS. ALSO WORKS WITH MOST "CLAMP TYPE" ADAPTERS.
-TUNES FROM 140-176 MHz -- WHIP CUTTING CHART SHOWS WHIP LENGTH VS FREQUENCY. CUT FOR 2M HAM BAND, FIRE & POLICE BANDS (FOR SCANNERS) OR EVEN USE IN THE MARINE BAND!
-COMPLETE WITH ALL PARTS - WHIP, LOADING COIL (TRANSFORMER), HARDWARE, COAX (RG58A/U), PL259 CONNECTOR, AND COMPLETE INSTALLATION AND TUNING INSTRUCTIONS.

DOES IT GET OUT? YOU BET !! 5/8 WAVE VERTICALS ARE MOST WIDELY USED IN COMMERCIAL AND 2 METER FM WORK BECAUSE OF THE LOW RADIATION ANGLE AND CONSIDERABLE GAIN OVER SHORTER VERTICAL WHIPS. BANDWIDTH IS GOOD, RESULTING IN LOWER SWR OVER A WIDER FREQUENCY RANGE. A LESSER DEPENDENCE ON A GROUND PLANE MEANS EASIER MOUNTING IN MANY CASES. (THESE ANTENNAS WERE USED ON POLICE MOTORCYCLES WITH EXCELLENT RESULTS -- GROUND PLANE ?) GIVE THEM A GOOD GROUND PLANE (LIKE A CAR ROOF) AND THEY'RE NEARLY UNBEATABLE !

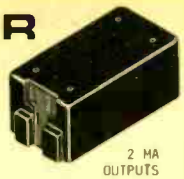
LIMITED QUANTITIES



FREE CATALOG

CIRCLE 65 ON FREE INFORMATION CARD

LASER POWER SUPPLIES



COMMERCIAL QUALITY SUPPLIES FEATURE 120 VAC INPUT, RECTIFIED AND FILTERED DC OUTPUT! THESE NEW UNITS ORIGINALLY COST THE MFR ABOUT $30 EACH IN BIG QUANTITIES. USE FOR LASERS, BUG ZAPPERS, HIGH VOLTAGE EXPERIMENTS OF ALL SORTS. SUPPLIES ARE POTTED IN PLASTIC WITH THE RECTIFIERS ACCESSABLE THROUGH A REMOVABLE PLATE.

2 MA OUTPUTS

12,500 Vdc 25 Watts L-1250
$79.95 Plus $2 Ship. (They are HEAVY!)

7,500 Vdc 15 Watts L-750
$69.95 Plus $1.40 shipping

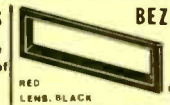
CRYSTALS

HC-6 case tune w/18pf FRESH STOCK!

D-3125

3.579 MHz $1.25
4.000 MHz $1.50
4.194 MHz $1.50

BEZELS



NEW, EASY MOUNT

RED LENS, BLACK FRAME. VIEWING AREA D.8" H x WIDTH GIVEN.

J-1200 2" Wide $1.79
J-1300 3" Wide $2.29
J-1400 4" Wide $2.98

"OUR FIFTH YEAR"

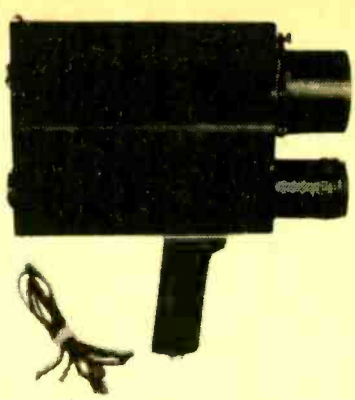
DIAMONDBACK ELECTRONICS COMPANY

PO BOX 194
SPRING VALLEY, IL 61362

•••FREE CATALOG•••

ALL MERCHANDISE 100% GUARANTEED
MINIMUM ORDER $5
ILL RESIDENTS ADD 5% SALES TAX
PLEASE INCLUDE SUFFICIENT POSTAGE
RATES QUOTED ARE CONTINENTAL US ONLY

PHONE ORDERS 815/664-5151



SEE IN THE DARK

IR viewer complete ready to operate. Guaranteed by the manufacturer. Portable, runs on lantern battery. New, see in total darkness. No shipments to Calif. Comes complete with built in IR source and adjustable focus lens. SPL-21 $199.00

CHARACTER GENERATOR CHIP
Memory is 512X5 produces 64 five by seven ASCH characters. New by National, w/specs $6.00

TOUCHTONE ENCODER CHIP
Compatible w/Bell system. Ideal for repeater work. W/specs $6.00

HAWKEYE RADAR SPEED TRAP alarm
Plugs into cigar lighter outlet $30

12 VOLT DC POWER SUPPLY 2½ amps.
Runs CB's, tape decks in house. New in metal cabinet. $14

customer pays all postage

MESHNA, PO BOX 62, E. Lynn Ma 01904

CIRCLE 48 ON FREE INFORMATION CARD

UNIVERSAL 4Kx8 MEMORY BOARD KIT $69.95

32-2102-1 fully buffered, 16 address lines, on board decoding for any 4 of 64 pages, standard 44 pin buss, may be used with F-8 & KIM

EXPANDABLE F8 CPU BOARD KIT $99.00

featuring Fairbug PSU 1K of static ram, RS 232 interface, documentation, 64 BYTE register

C/MOS (DIODE CLAMPED)

4001	.18	4019	.37	4049	.35	74C73	.65
4002	.18	4020	.90	4050	.35	74C74	.45
4006	.95	4021	.90	4053	1.10	74C83	1.15
4007	.18	4022	.90	4055	1.25	74C86	.40
4009	.37	4023	.18	4066	.70	74C93	.75
4010	.37	4024	.75	4071	.18	74C151	1.40
4011	.18	4025	.18	4076	.97	74C160	1.05
4012	.18	4027	.37	4520	.70	74C181	1.05
4013	.29	4028	.80	74C00	.22	74C174	1.05
4014	.75	4029	.95	74C02	.22	74C175	1.05
4015	.75	4030	.33	74C04	.24	74C193	1.20
4016	.29	4035	.97	74C08	.22	74C901	.48
4017	.90	4042	.65	74C10	.27	74C902	.48
4018	.90	4046	1.35	74C42	.85	74C914	1.70

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400	.09	.25	.50	1.40	6.50	9.50
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7404	.15	7450	.15	74157	.55
7405	.13	7472	.25	74161	.55
7406	.18	7473	.28	74163	.55
7407	.20	7474	.28	74164	.85
7408	.18	7475	.45	74166	.95
7409	.18	7476	.30	74170	1.68
7410	.13	7480	.31	74173	1.20
7411	.18	7483	.65	74174	.95
7412	.13	7485	.87	74175	.85
7413	.36	7486	.28	74176	.75
7414	.60	7489	1.25	74177	.75
7416	.22	7490	.42	74180	.65
7417	.25	7491	.58	74181	1.90
7420	.13	7492	.43	74190	1.00
7425	.25	7493	.43	74191	1.00
7426	.22	7494	.67	74192	.79
7427	.19	7495	.65	74193	.79
7430	.13	7496	.65	74194	.80
7432	.22	74107	.28	74195	.50
7437	.21	74122	.38	74196	.86
7438	.21	74123	.45	74279	.55
7440	.13	74125	.40	74367	.50
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74LS05	.21	74LS153	.59
74LS08	.21	74LS155	.67
74LS09	.21	74LS156	.62
74LS10	.20	74LS157	.59
74LS11	.20	74LS160	.79
74LS13	.60	74LS161	.79
74LS14	.80	74LS162	.79
74LS15	.21	74LS163	.79
74LS20	.21	74LS164	.80
74LS21	.21	74LS168	.80
74LS22	.21	74LS170	1.80
74LS26	.29	74LS173	.95
74LS27	.25	74LS174	.72
74LS28	.26	74LS175	.75
74LS30	.21	74LS181	3.00
74LS32	.25	74LS190	.88
74LS37	.28	74LS191	.88
74LS38	.28	74LS192	.88
74LS40	.21	74LS193	.88
74LS47	.80	74LS195	.50
74LS47	.73	74LS196	.75
74LS51	.25	74LS174	.75
74LS54	.25	74LS221	1.00
74LS73	.38	74LS257	.68
74LS74	.34	74LS258	.68
74LS75	.50	74LS290	.78
74LS78	.35	74LS279	.50
74LS85	.90	74LS290	.90
74LS86	.35	74LS293	.58
74LS90	.50	74LS365	.49
74LS92	.50	74LS366	.49
74LS93	.50	74LS367	.49
74LS109	.35	74LS368	.49
74LS112	.35	74LS375	.60
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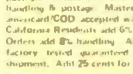

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INSTRUCTOR'S MANUAL — $3.00
Necessary for instruction of Bugbook I and II. Answers questions regarding experiments, suggestions for further reading, philosophy of authors approach to digital electronics. A must for self teaching individuals.

BUGBOOK V and VI — $19.00 per set
by David G. Larsen, Peter R. Rony, Jonathan A. Titus
Experiments in digital electronics, 8080A microcomputer programming and 8080A microcomputer interfacing. An integrated approach to self instructed basic digital electronics, breadboarding and 8080A interfacing programming. Bugbook VI integrates the digital concepts of Bugbook V into a treatment of 8080A microcomputer programming and interfacing. Detail & laboratory experiments included with each book.

OP AMP MANUAL by Howard M. Berlin W3HB — $9.00
An experiment guide to application of operational amplifiers. Over 25 experiments on all phases of Op Amps.

OBUG — $5.00
8080 interpretive debugger. A program for entering, debugging and storing assembly language programs.

CMOS-M — DESIGNERS PRIMER AND HANDBOOK New expanded version — $8.50
Starts at basic structure of CMOS devices through integration into MSI.

COMPLETE MANUAL FOR DIGITAL CLOCKS by John Weiss and John Brooks
Familiarizes technician or hobbyist with basic theories behind digital clocks. Includes trouble shooting guides, basic characteristics of clocks, soldering techniques, clock component data sheets and construction tips — $3.95

DISCRETE LEDS

.125" dia									.190" dia		
XC209	Red	5/$1							XC111	Red	5/$1
XC209	Green	4/$1							XC111	Green	4/$1
XC209	Yellow	4/$1				.200" dia			XC111	Yellow	4/$1
.200" dia			.185" dia						.085" dia		
						XC556	Red	5/$1	MV50	Red	6/$1
XC22	Red	5/$1	XC526	Red	5/$1	XC556	Red	100/$8	.170" dia		
XC22	Green	4/$1	XC526	Red	100/$8	XC556	Green	4/$1	MV10	Red	4/$1
XC22	Yellow	4/$1	XC526	Green	4/$1	XC556	Yellow	4/$1	INFRA RED LED		
SSL-22	RT	4/$1	XC526	Yellow	4/$1	XC556	Orange	4/$1			
			XC526	Clear	4/$1	XC556	Clear	7/$1	Flat		3/$1.00

DISPLAY LEDS

TYPE	POLARITY	HT	PRICE	TYPE	POLARITY	HT	PRICE
MAN 1	Common Anode-red	270	2.95	MAN 6680	Common Cathode-orange	560	99
MAN 2	5 x 7 Dot Matrix-red	300	4.95	MAN 6710	Common Anode-red-D.D.	560	99
MAN 3	Common Cathode-red	125	.25	MAN 6730	Common Anode-red ±1	560	99
MAN 4	Common Cathode-red	187	1.95	MAN 6740	Common Cathode-red-D.D.	560	99
MAN 52	Common Anode-green	300	1.25	MAN 6750	Common Cathode-red ±1	560	99
MAN 71	Common Anode-red	300	1.25	MAN 6760	Common Anode-red	560	99
MAN 72	Common Anode-red	300	99	MAN 6780	Common Cathode-red	560	99
MAN 74	Common Cathode-red	300	1.25	DL701	Common Anode-red ±1	300	99
MAN 81	Common Anode-yellow	300	99	DL702	Common Cathode-red	300	1.25
MAN 82	Common Anode-yellow	300	99	DL704	Common Cathode-red	300	99
MAN 84	Common Cathode-yellow	300	99	DL707	Common Anode-red	300	99
MAN 3620	Common Anode-orange	300	99	DL741	Common Anode-red	600	1.25
MAN 3630	Common Anode-orange ±1	300	99	DL746	Common Anode-red ±1	630	1.49
MAN 3640	Common Cathode-orange	300	99	DL747	Common Anode-red	600	1.49
MAN 4610	Common Anode-orange	300	99	DL749	Common Cathode-red ±1	630	1.49
MAN 4640	Common Cathode-orange	400	99	DL750	Common Cathode-red	600	1.49
MAN 4710	Common Anode-red ±1	400	99	DL338	Common Cathode-red	110	35
MAN 4730	Common Anode-red	400	99	FND70	Common Cathode	250	69
MAN 4740	Common Cathode-red	400	99	FND359	Common Anode	350	75
MAN 4810	Common Anode-yellow	400	99	FND503	Common Cathode (FND500)	500	99
MAN 6610	Common Anode-orange-D.D.	560	99	FND507	Common Anode (FND510)	500	99
MAN 6630	Common Anode-orange	560	99	5082-7300	4 x 7 Sgl. Digit-RHDP	600	19.95
MAN 6640	Common Cathode-orange-D.D.	560	99	5082-7302	4 x 7 Sgl. Digit-LHDP	600	19.95
MAN 6650	Common Cathode-orange ±1	560	99	5082-7304	Overrange character (±1)	600	15.00
MAN 6660	Common Anode-orange	560	99	5082-7340	4 x 7 Sgl. Digit-Hexadecimal	600	22.50

RCA LINEAR

CA3013	2.15	CA3082	2.00
CA2023	2.56	CA3083	1.60
CA3035	2.48	CA3086	.85
CA3039	1.35	CA3089	3.75
CA3046	1.30	CA3130	1.39
CA3059	3.25	CA3140	1.25
CA3060	3.25	CA3160	1.25
CA3080	.85	CA3401	.49
CA3081	2.00	CA3600	3.50

CALCULATOR CHIPS AND DRIVER

FCM3817	$5.00
MM5725	2.95
MM5736	1.95
MM5738	2.95
DM8864	2.00
DM8865	1.00
DM8887	75
DM8889	75
5030	7.95

CLOCK CHIPS

MM5309	$9.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
MM5841	9.95
7001	5.95

9374 7-segment LED driver common anode LEDs $ .99

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin LP	$.17	.16	.15	22 pin LP	$.37	.36	.35
14 pin LP	.20	.19	.18	24 pin LP	.38	.37	.36
16 pin LP	.22	.21	.20	28 pin LP	.45	.44	.43
18 pin LP	.29	.28	.27	36 pin LP	.60	.59	.58
20 pin LP	.34	.32	.30	40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100		1-24	25-49	50-100
14 pin ST	$.27	.25	.24	28 pin ST	$.99	.90	.81
16 pin ST	.30	.27	.25	36 pin ST	1.39	1.26	1.15
18 pin ST	.35	.32	.30	40 pin ST	1.59	1.45	1.30
24 pin ST	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin SG	$.30	.27	.24	24 pin SG	$.70	.63	.57
14 pin SG	.35	.32	.29	28 pin SG	1.10	1.00	.90
16 pin SG	.38	.35	.32	36 pin SG	1.75	1.40	1.26
18 pin SG	.52	.47	.43	40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin WW	$.40	.38	.35	22 pin WW	$.95	.85	.75
10 pin WW	.45	.41	.37	24 pin WW	1.05	.95	.85
14 pin WW	.39	.38	.37	28 pin WW	1.40	1.25	1.10
16 pin WW	.43	.42	.41	36 pin WW	1.59	1.45	1.30
18 pin WW	.75	.68	.62	40 pin WW	1.75	1.55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea	10 OHM, 27 OHM	12 OHM, 33 OHM	15 OHM, 39 OHM	18 OHM, 47 OHM	22 OHM, 56 OHM	1/4 WATT 5%	50 PCS
ASST. 2	5 ea	68 OHM, 180 OHM	82 OHM, 220 OHM	100 OHM, 270 OHM	120 OHM, 330 OHM	150 OHM, 390 OHM	1/4 WATT 5%	50 PCS
ASST. 3	5 ea.	470 OHM, 1.2K	560 OHM, 1.5K	680 OHM, 1.8K	820 OHM, 2.2K	1K, 2.7K	1/4 WATT 5%	50 PCS.
ASST. 4	5 ea.	3.3K, 8.2K	3.9K, 10K	4.7K, 12K	5.6K, 15K	6.8K, 18K	1/4 WATT 5%	50 PCS.
ASST. 5	5 ea.	22K, 56K	27K, 68K	33K, 82K	39K, 100K	47K, 120K	1/4 WATT 5%	50 PCS.
ASST. 6	5 ea.	150K, 390K	180K, 470K	220K, 560K	270K, 680K	330K, 820K	1/4 WATT 5%	50 PCS.
ASST. 7	5 ea.	1M, 2.7M	1.2M, 3.3M	1.5M, 3.9M	1.8M, 4.7M	2.2M, 5.6M	1/4 WATT 5%	50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) $9.95 ea.

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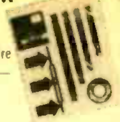


WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire

$12.95

WIRE WRAP TOOL WSU-30
WRAP • STRIP • UNWRAP-$6.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.95 ea.**
- Cuts wire to desired length
- Strips 1" of insulation Specify — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red — $1.98/spool

EXAR

XR2206KA $14.95 Function Generator Kit (includes chip, P.C. Board and instructions)

XR2206KB $19.95 Function Generator Kit (includes all components, P.C. Board and instructions)

XR-L555 $1.50
Micro-Power version of the popular 555 Timer and directly interchangeable. Dissipates 1/15th the power and operates down to 2.7 volts. Perfect for battery operation and CMOS circuits.

XR2242CP $1.50
Precision timing circuit for generating timing pulses in minutes, hours and days or up to 1 year by using two. Reduces cost of time delay circuits. Basic 555 Timer with built-in 8-bit Counter.

XR205	$8.40			XR2556	$3.20
XR210	4.40	XR1489	1.39	XR2567	2.99
XR215	4.40	XR1800	3.20	XR3403	1.25
XR320	1.55	XR2206	4.40	XR4136	1.25
XR555	39	XR2207	3.85	XR4151	2.85
XR556	99	XR2208	5.20	XR4194	1.45
XR567CP	99	XR2209	1.75	XR4202	3.60
XR567CT	1.25	XR2211	5.25	XR4212	2.05
XR1310P	1.30	XR2212	4.35	XR4558	75
XR1468CN	3.85	XR2240	3.45	XR4739	1.15
XR1488	1.39	XR2264	4.25	XR4741	1.47

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3.3	400m	4/1.00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5.1	400m	4/1.00	1N4006	800 PIV	1 AMP	10/1.00
1N752	5.6	400m	4/1.00	1N4007	1000 PIV	1 AMP	10/1.00
1N753	6.2	400m	4/1.00	1N3600	50	200m	6/1.00
1N754	6.8	400m	4/1.00	1N4148	75	10m	15/1.00
1N959	8.2	400m	4/1.00	1N4154	35	10m	12/1.00
1N965B	15	400m	4/1.00	1N4305	75	25m	20/1.00
1N5232	5.6	500m	28	1N4734	5.6	1w	28
1N5234	6.2	500m	28	1N4735	6.2	1w	28
1N5235	6.8	500m	28	1N4736	6.8	1w	28
1N5236	7.5	500m	28	1N4738	8.2	1w	28
1N456	25	40m	6/1.00	1N4742	12	1w	28
1N458	150	7m	6/1.00	1N4744	15	1w	28
1N485A	180	10m	5/1.00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1.00	1N1184	100 PIV	35 AMP	1.70
1N4002	100 PIV	1 AMP	12/1.00	1N1185	150 PIV	35 AMP	1.70
1N4003	200 PIV	1 AMP	12/1.00	1N1186	200 PIV	35 AMP	1.80
1N4004	400 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR(2N1849)	$1.95
C38M	35A @ 600V	SCR	1.95
2N2328	1.6A @ 300V	SCR	50
MDA 980-1	12A @ 50V	FW BRIDGE REC	1.95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1.95

TRANSISTORS

C106B1	50			2N3904	4/1.00
MPSA05	30	2N3055	89	2N3905	4/1.00
MPSA06	5/1.00	MJE3055	1.00	2N3906	4/1.00
TIS97	6/1.00	2N3392	5/1.00	2N4013	3/1.00
TIS98	6/1.00	2N3398	5/1.00	2N4123	6/1.00
TIS133	5/1.00	PN3567	3/1.00	PN4249	4/1.00
TIS135	5/1.00	PN3568	4/1.00	PN4250	4/1.00
40409	1.75	PN3569	4/1.00	2N4400	4/1.00
40410	1.75	MPS3638A	5/1.00	2N4401	4/1.00
40673	1.75	MPS3702	5/1.00	2N4402	4/1.00
2N918	4/1.00	2N3703	5/1.00	2N4403	4/1.00
2N2219A	3/1.00	MPS3704	5/1.00	2N4409	5/1.00
2N2221A	4/1.00	2N3705	5/1.00	2N5086	4/1.00
2N2222A	5/1.00	MPS3705	5/1.00	2N5087	4/1.00
2N2369	5/1.00	2N3706	5/1.00	2N5088	4/1.00
2N2369A	4/1.00	MPS3706	5/1.00	2N5089	4/1.00
MPS2369	5/1.00	2N3707	5/1.00	2N5129	5/1.00
2N2484	4/1.00	2N3711	5/1.00	PN5134	5/1.00
2N2906	4/1.00	2N3724A	65	PN5138	5/1.00
2N2907	5/1.00	2N3725A	1.00	2N5139	5/1.00
2N2925	5/1.00	2N3772	2.25	2N5210	5/1.00
MJE2955	1.25	2N3823	1.00	2N5449	3/1.00
2N3053	2/1.00	2N3903	4/1.00	2N5951	3/1.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-99	100-		1-9	10-99	100-
10 pf	.05	.04	.03	.001µF	.05	.04	.035
22 pf	.05	.04	.03	.0047µF	.05	.04	.035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	.05	.04	.03	.022µF	.06	.05	.04
220 pf	.05	.04	.03	.047µF	.06	.05	.04
470 pf	.05	.04	.035	.1µF	.12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.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

.1/35V	.28	.23	.17	1.5/35V	.30	.26	.21
.15/35V	.28	.23	.17	2.2/25V	.31	.27	.22
.22/35V	.28	.23	.17	3.3/25V	.31	.27	.22
.33/35V	.28	.23	.17	4.7/25V	.32	.28	.23
.47/35V	.28	.23	.17	6.8/25V	.36	.31	.25
.68/35V	.28	.23	.17	10/25V	.40	.35	.29
1.0/35V	.28	.23	.17	15/25V	.63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.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 71 ON FREE INFORMATION CARD

ELPAC POWER SUPPLIES

Completely Assembled

SPECIFICATIONS:
105-125/210-250 Vac, 47-440 Hz Input:

Line Regulation	±0.1%
Load Regulation	±0.1%no-load to rated-load
Output Ripple and Noise	±0.1%p-p,dc to 10 MHz
Input/Output Isolation	100 megohm dc, 900 Vac
Short Circuit Current	35% rated current

PART NO.	RATINGS WATTS	VOLTS	AMPS	PRICE
SOLV15-5*	15	5	3	$36.95
SOLV15-12*	15	12	1.5	36.95
SOLV30-5	30	5	6	59.95
SOLV30-12	30	12	3	59.95
OVP1	over voltage protection for SOLV30-5,-12			9.95

*SOLV15-5, 12 includes OVP installed

SUP 'R' MOD II

UHF Channel 33 TV Interface Unit Kit

- Wide Band B/W or Color System
- Converts TV to Video Display for home computers, CCTV camera, Apple II, works with Cromeco Dazzler, SDL-20, IRS-80, Challenger, etc.
- MOD II is pretuned to Channel 33 (UHF).
- Includes coaxial cable and antenna transformer.

MOD II $29.95 Kit

CRYSTALS

THESE FREQUENCIES ONLY

PART NO.	FREQUENCY	CASE	PRICE
CY1A	1.000MHz	HC33	5.95
CY1.84	1.8432MHz	HC33	5.95
CY2A	2.000MHz	HC33	5.95
CY2.01	2.010MHz	HC33	1.95
CY2.50	2.500MHz	HC33	4.95
CY3.27	3.2768MHz	HC33	4.95
CY3.57	3.579545MHz	HC33	4.95
CY3A	4.000MHz	HC18	4.95
CY4.91	4.916MHz	HC18	4.95
CY7A	5.000MHz	HC18	4.95
CY5.18	5.185MHz	HC18	4.95
CY6.14	6.144MHz	HC18	4.95
CY6.40	6.400MHz	HC18	4.95
CY6.55	6.5536MHz	HC18	4.95
CY12A	10.000MHz	HC18	4.95
CY14A	14.31818MHz	HC18	4.95
CY19A	18.000MHz	HC18	4.95
CY18.43	18.432MHz	HC18	4.95
CY22A	20.000MHz	HC18	4.95
CY30A	32.000MHz	HC18	4.95

AUTO-TEL KITS

As Featured in August - Popular Electronics

An Electronic Warning Device For Temperature and Oil Failure

Size: 2½" x 2½" x ⅞"

AUTOTEL — An audible alarm kit indicating potential engine damage. An audible signal (70 db pulsing) immediately forewarns a malfunction or failure. There is no sound during normal operation. Features CMOS circuitry. Complete kit with all components, hardware.

$4.95/ea

1/16 VECTOR BOARD

	0.1 Hole Spacing Part No	P-Pattern L	W	Price 1-9	10 up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY	64P44 062WE	4.50	6.50	2.07	1.86
GLASS	84P44 062WE	4.50	8.50	2.56	2.31
	169P44 062WE	4.50	17.00	5.04	4.53
	169P64 062WE	6.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062WEC1	4.50	17.00	6.80	6.12

CONNECTORS

25 Pin-D Subminiature

DB25P(as pictured)	PLUG	$3.25
DB25S	SOCKET	4.95
DB51226-1	Cover for DB25 P or S	1.75

MOLEX CONNECTOR PINS

M-530-1 $1.95/100 pins (minimum order) $16.00/1000 pins

Pre-packaged in strips

INSTRUMENT/ CLOCK CASE

Injection molded unit. Complete with red bezel. 4⅜" x 4" x 1-9/16".

$3.49

MICROPROCESSOR COMPONENTS

P8085	CPU	$29.95	CDP 1802	CPU	$19.95
8080A	CPU	10.95	Z80	CPU	24.95
8212	8-Bit Input/Output	4.95	2650	MPU	26.50
8214	Priority Interrupt Control	7.95	MC6800	MPU	19.95
8216	Bi-Directional Bus Driver	4.95	MC6810API	128 x 8 Static Ram	5.95
8224	Clock Generator/Driver	5.95	MC6820	Periph. Interface Adapter	7.95
8228	System Controller/Bus Driver	5.95	MC6821	Periph. Interface Adapter	11.50
8251	Prog. Comm. Interface	9.95	MC6830L8	1024 x 8 Bit ROM	14.95
8255	Prog. Periph. Interface	10.95	MC6850	Asychronous Comm. Adapter	14.95

RAM'S

1101	256 x 1	Static	$ 1.49	1702A	2048 x 1	Famous $ 5.95
1103	1024 x 1	Dynamic	.99	5203	2048 x 1	Famous 14.95
2101	256 x 4	Static	5.95	82S23	32 x 8	Open C 5.00
2102	1024 x 1	Static	1.75	82S115	4096 x 1	Bipolar 19.95
2107-5280	4096 x 1	Dynamic	4.95	82S123	32 x 8	Tristate 5.00
2111	256 x 4	Static	6.95	74S287	1024 x 1	Static 7.95
2112	256 x 4	Static	5.95	TMS2532	32K	EPROM 99.95
2114	4K x 1	Static 450ns	9.95	2708	8K	EPROM 10.95
2114L	4K x 1	Static 450ns Low Power	10.95	2716 T.I.	16K	EPROM 29.95
2114-3	1K x 4	Static 300ns	10.95	2716 Intel (2516 T.I.)	16K	EPROM 59.95
2114L-3	1K x 4	Static 300ns Low Power	11.95	6301-1	1024 x 1	Tri-State Bipolar 3.49
7489	16 x 4	Static	1.75	6330-1	256 x 1	Open C Bipolar 2.95
8101	256 x 4	Static	5.95			
8111	256 x 4	Static	6.95			
8599	16 x 4	Static	3.49			
21L02	1024 x 1	Static	1.95			
74200	256 x 1	Static	6.95			
93471	256 x 1	Static	2.95			
MM5262	2K x 1	Dynamic	3.75			
MK4027 (UPD414)	4K	DYNAMIC 16 PIN	5.95			
MK4116 (UPD416)	16K	DYNAMIC 16 PIN	19.95			
TMS4044-45NL	4K	STATIC	14.95			

PROMS

1702A	2048 x 1	Famous $ 5.95
5203	2048 x 1	Famous 14.95
82S23	32 x 8	Open C 5.00
82S115	4096 x 1	Bipolar 19.95
82S123	32 x 8	Tristate 5.00
74S287	1024 x 1	Static 7.95
TMS2532	32K	EPROM 99.95
2708	8K	EPROM 10.95
2716 T.I.	16K	EPROM 29.95
2716 Intel (2516 T.I.)	16K	EPROM 59.95
6301-1	1024 x 1	Tri-State Bipolar 3.49
6330-1	256 x 1	Open C Bipolar 2.95

ROM'S

2513(2140)	Character Generator (upper case)	$ 9.95
2513(3021)	Character Generator (lower case)	9.95
2516	Character Generator	10.95
MM5230N	2048 Bit Read Only Memory	1.95

USER MANUALS

1802M	CDP1802 Manual	$ 7.50
Z80M	Z80 Manual	7.50
2650M	2650 Manual	5.00

SHIFT REGISTERS

MM5013N	1024 BitAccumulator Dynamic	2.95
MM5016H	500/512 Bit Dynamic	.89
MM5017N	Dual 500/512 Bit Dynamic	2.95
2504T	1024 Dynamic	3.95
2518	Hex 32 Bit Static	4.95
2519	Hex 40 Bit Static	4.00
2522	Dual 132 Bit Static	2.95
2524	512 Dynamic	.99
2525	1024 Dynamic	2.95
2527	Dual 256 Bit Static	2.95
2528	Dual 250 Static	4.00
2529	Dual 240 Bit Static	4.00
2532	Quad 80 Bit Static	2.95
2533	1024 Static	2.95
3341	Fifo	6.95
74LS670	4 x 4 Register	1.95

UART'S

AY-5-1013	30K BAUD	$ 5.95

SPECIAL REQUESTED ITEMS

TELEPHONE KEYBOARD CHIPS

AY-5-9100	$14.95
AY-5-9200	14.95
AY-5-9500	4.95
AY-5-2376	14.95
HD0165	7.95
74C922	9.95

ICM CHIPS

ICM7045	$24.95
ICM7205	19.95
ICM7207	7.50
ICM7208	19.95
ICM7209	6.95

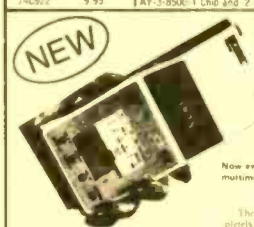
TV GAME CHIP SET
AY-3-8500-1 Chip and 2.010 MHz Crystal $7.95

NMOS READ ONLY MEMORIES

MCM6571	$13.50
MCM6571	13.50
MCM6575	13.50

MISCELLANEOUS

11C90	$19.95
MC3061P	11.95
MC1408L7	4.95
MC1408L8	5.75
LD110/111	$25.00/set
MC4016(74416)	7.50
4N33	3.95
MK4024O	$17.50
DS0026CH	3.75
TIL308	10.20
95H90	11.95



NEW

The Sinclair PDM35. A personal digital multimeter for only $59.95

Now everyone can afford to own a digital multimeter.

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

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

The Sinclair PDM35 is supplied completely assembled with test leads and probe, protective wallet and Operator's Manual.

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

Technical specification

DC Volts (4 ranges)
Range 1mV to 1000 V
Accuracy of reading 1.0% ± 1 count
Note 10 MΩ input impedance

AC Volts (40 Hz-5 kHz)
Range 1 V to 500 V
Accuracy of reading 1.0% ± 2 counts

DC Current (4 ranges)
Range 1 mA to 200 mA
Accuracy of reading 1.0% ± 1 count.
Note. Max. resolution 0.1 mA

Resistance (3 ranges)
Range 1Ω to 20 MΩ
Accuracy of reading 1.5% ± 1 count
Also provides 5 function test ranges

Dimensions 6 in x 3 in x 1½ in

Weight 6½ oz

Power supply 9 V batters or Sinclair AC adapter (Battery not incl.)

Sockets: Standard 4 mm for resilient plugs

Options: AC adapter for 117 V 60 Hz power. Deluxe padded carrying wallet

PART NO	DESCRIPTION	PRICE
PDM35	Digital Multimeter (Completely Assembled)	$59.95
PDM-AC	117volt AC Adapter	6.95
PDM-DP	Deluxe padded carrying case	6.95

B&K PRECISION

3½-Digit Portable DMM

- Overload Protected
- .3" high LED Display
- Battery or AC operation
- Auto Zeroing
- 1mv 1Va 0.1 ohm resolution
- Overange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC voltage 0-1000V; AC voltage 0-1000V; Freq. Response 50-400 HZ; DC/AC Current 0-100mA; Resistance 0-10 meg ohm; Size 6.4 x 4.4 x 2

Accessories:

AC Adapter BC-28	$9.00
Rechargeable Batteries BP-26	20.00
Carrying Case LC-28	7.50

Model 2800 $99.95

Comes with test leads, operating manual and spare fuse

CSC

100 MHz 8-Digit Counter

- 20 Hz-100 MHz Range
- .6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.38" x 5.63"
- Four power sources, i.e. batteries, 110 or 220V with charger 12V with auto lighter adapter and external 7.2-10V power supply

MAX-100 $134.95

ACCESSORIES FOR MAX 100:

Mobile Charger Eliminator use power from car battery	Model 100 — CLA $3.95
Charger/Eliminator use 110 V AC	Model 100 — CAI $8.95

63-Key Unencoded KEYBOARDS Hexadecimal Key Pad Unencoded

This is a 63-key, terminal keyboard newly manufactured by a large computer manufacturer. It is unencoded with SPST keys, unattached to any kind of PC board. A very solid molded plastic 13 x 4" base suits most application. IN STOCK **$29.95/each**

19-key pad includes 1-10 keys, ABCDEF and 2 optional keys and a shift key. **$10.95/each**

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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 for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift-Keying, full-duplex (half-duplex selectable)
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character).
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark
Transmit Channel Frequencies	Switch selectable. Low (normal) — 1070 space, 1270 mark. High — 025 space, 2225 mark
Receive Sensitivity	-46 dbm accoustically coupled.
Transmit Level	-15 dbm nominal. Adjustable from -6 dbm to -20 dbm.
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase, 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align

The Original the 3rd Hand

$9.95 each

- Leaves two hands free for working
- Clamps on edge of bench, table or work bench
- Position board on angle or flat position for soldering or clipping
- Sturdy, aluminum construction for hobbyist, manufacturer or school rooms

DIGITAL STOPWATCH

- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One (times Single Event — Split & Taylor)
- Size 4.5" x 2.15" x .90" (4½ ounces)
- Uses 3 Penlite Cells

Kit — $39.95
Assembled — $49.95
Heavy Duty Carry Case $5.95

Stop Watch Chip Only (7205) $19.95

iMK 3½ DIGIT DPM KIT

- New Bipolar Unit
- Auto Zeroing
- .5" LED
- Auto Polarity
- Low Power
- Single IC Unit

Model KB500 DPM Kit $49.00
Model KB503 5V Power Kit $17.50

JE700 CLOCK

12 or 24 Hour

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

115 VAC *KIT ONLY* **$16.95**

JE803 PROBE

The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols (H), (L), (O), (PULSE), (P). The Probe can detect high frequency pulses to 45 MHz. It can be used at MOS levels or critical damage will result.

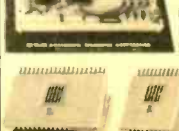
$9.95 Per Kit
printed circuit board

T²L 5V 1A Supply

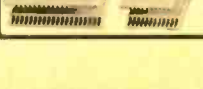
This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts. We try to make things easy for you by providing everything you need in one package, including the hardware for only **JE225 $9.95 Per Kit**

CSC PROTO BOARDS

PROTO BOARD 6
$15.95
(6" long X 4" wide)



PB100 - 4.5" x 6"	$ 19.95
PB101 - 5.8" x 4.5"	22.95
PB102 - 7" x 4.5"	26.95
PB103 - 9" x 6"	44.95
PB104 - 9.5" x 8"	54.95
PB203 - 9.75 x 6½ x 2¾	75.00
PB203A - 9.75 x 6½ x 2¾ (includes power supply)	124.95



PROTO CLIPS

14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

OCTOBER 1978

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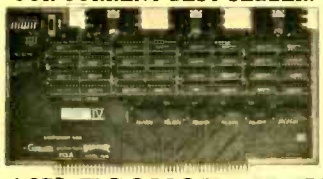

16K ECONORAM IV™

$279 unkit Assembled $314, CSC $414.

Current under 2000 mA; manual write protect for 4K blocks; use with or without phantom line. Excellent where you need a big chunk of cost-effective memory.

OUR TOP OF THE LINE:

24K ECONORAM VII™

$445 unkit Assembled $485, CSC $605.

A full feature dense memory with current under 2000 mA. Configuration as two 4K and two 8K blocks, with independent write protect for each block; use with or without phantom lines; and provision for two unused qualifiers.

TRS-80 CONVERSION KIT $190 (3/$540)

Upgrade your 4K TRS-80 mainframe with our Conversion Kit; chips are also compatible with Memory Expansion Module. Includes eight uPD16 16K RAMs, DIP shunts, and instructions for mainframe conversion. (Many dealers additionally report using these chips to expand memory in APPLEs). **We back up these parts with a 1 year warranty.**

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Needs only 12V DC and 3 time-setting switches for operation in boat, truck, van, car, or home. 4 digit, 0.3" green flourescent display with blinking colon. When wired in car, display turns off when ignition is off. Accurate to ± ½ second a day thanks to built-in crystal timebase.

Finally . . . here is a clock that is simple to build, good looking, and at our price, inexpensive.

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#2NRF1 2GHz power transistor. Pd max 3.5W, Pout minimum 1.0W, Pin 310 mW, efficiency 30%. Similar to RCA 2N5470. $4.95

#2NRF2 2 GHz power transistor, Pd max 8.7W, Pout min 2.5W, Pin 300 mW, efficiency 33%. Similar to RCA TA8407. $5.95

#2NRF3 2 GHz power transistor. Pd max 21W, Pout min 5.5W, Pin 1.25W, efficiency 33%. Similar to RCA 2N6269. $6.95

#2NRF4 2 GHz power transistor. Pd max 29W, Pout 7.5W, Pin 1.5W, efficiency 33%. Factory selected prime 2N6269. $7.95

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2SA880	.75
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2SA915	.77
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2SC356	.95
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2SC1548	.79
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2SC1622	.49
2SC1630	3.60
2SC1681	.39
2SC1682	.39
2SC1761	1.58
2SC1762	4.85
2SC1775	.54
2SC1778	.45
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2SC1811	1.29
2SC1844	.54
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LA1366	3.60
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LA4400	3.10
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PLL02A	8.40
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UPC1152H	3.25
UPC1156H	2.80
UPD857C	9.99
UPD858C	7.20

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2SA473	.65
2SA484	2.25
2SA496	.89
2SA497	1.39
2SA564A	.39
2SA634	.65
2SA636	1.25
2SA643	.55
2SA678	.55
2SA682	1.35
2SA683	.45
2SA684	.45
2SA699A	.80
2SA706	1.25
2SA733	.35
2SB22	.45
2SB54	.35

TRANSISTORS	
2SB175	.39
2SB324	.55
2SB337	1.35
2SB370	.62
2SB405	.45
2SB407	1.20
2SB435	1.25
2SB463	1.40
2SB474	.85
2SB492	.85
2SC372	.35
2SC373	.35
2SC380	.35
2SC387A	.45
2SC394	.39
2SC458	.45
2SC460	.45
2SC481	1.45
2SC482	1.35
2SC495	.79
2SC509	.45
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2SC535	.45
2SC627	1.35
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2SC778	3.35
2SC781	2.50
2SC784	.45
2SC789	.85
2SC793	2.45
2SC799	2.65
2SC828	.35
2SC839	.43
2SC867A	3.95
2SC930	.35
2SC945	.35
2SC1014	.83
2SC1018	.85

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2SC1034	5.45
2SC1061	1.00
2SC1079	3.95
2SC1096	.75
2SC1166	.40
2SC1172	4.80
2SC1173	.70
2SC1226A	.70
2SC1237	2.15
2SC1239	3.15
2SC1306	2.95
2SC1307	3.85
2SC1383	.45
2SC1384	.55
2SC1675	.40
2SC1678	1.90
2SC1728	1.00
2SC1760	1.05
2SC1909	2.75
2SC1957	.95
2SC1973	.55
2SC2028	.74
2SC2029	3.35
2SC2091	2.40
2SC2092	3.10
2SC2098	3.40
2SD72	.78
2SD92	1.75
2SD180	2.35
2SD218	3.45
2SD234	.80
2SD235	.80
2SD261	.49
2SD313	.90
2SD315	1.05
2SD325	.85
2SD330	.89
2SK19	.68
2SK33	.85
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3SK22	1.80
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Request 20 No.032MS037 (20 oz.) One Gift per order, Please!

12.95 EACH!

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QC-04 CD-4 FOUR CHANNEL QUAD RECORD DEMODULATOR!

$9.95 ea., lots of 3
$8.95 ea., lots of 100!

SENSATIONAL VALUE! Brand new Factory Surplus, with minor parts missing. A goldmine of parts! & semiconductors! 1000 purchased. Schematic included. (5 lb.) 032HP099.

3—TRANSISTOR AUDIO AMPLIFIER!

99¢

FACTORY SURPLUS!

WE BOUGHT 'EM ALL!

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BRAND NEW FACTORY SURPLUS - 12,000 IN STOCK! With schematic. Crystal cartridge input, 8 ohm output. 10,000 ohm volume control. Operates on 6 vdc. (3 oz.) 032PK032.

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Your own electronic percussion orchestra—

PANASONIC "MINI SIDEMAN"

REDUCED!

39.95

Amazing electronic synthesizer produces realistic cymbal, snare and bass drum sounds. Creates 2-beat, 4-beat, jazz, waltz and rock tempos manually or automatically. Plugs in to any stereo, recorder, P.A. or music amp. Operates on 9 volt battery (not included). Limited quantity - order early! (2 lb.) 032HP028

Worth it for the Speakers Alone!

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PRICE BREAK!

12.95

Reg. $19.95

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A Sensational ETCO purchase! Designed to accept and power AR car stereo models SPC-5002 and SPE-5004, but can be adapted to just about any car stereo or radio. (could power CB sets and scanners, too! 2 speakers included. Exactly as pictured, less car stereo unit. AR No. HCS-5103. Walnut woodgrain finish. Built in 110 vac power supply. Pilot light, on-off switch. Stereo headphone jack. Original factory sealed cartons. An excellent dealer item! (9 lb.) 032HP725. Speakers: 12"H x 8"W x 7½"D.

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032SP004 4", 3.2 ohm replacement spkrs.(8 oz.) . . . . . 59c ea., 10/$4.95, 100/$42.88

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EVEREADY TRADE MARK *FALL SPECIAL!* ALKALINE PENCELL (SIZE "AA") BUYOUT!

MALLORY

SPECIAL PURCHASE

39¢

Reg. 59c

37c ea./10 lots
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Sensational ETCO Purchase - 14,000 in Stock! Mallory Duracells and Eveready Alkalines! Every cell fully guaranteed. Selling below nationally advertised prices! (2 oz.) 032BA220.

12 VOLT 2 AMP **POWER SUPPLY**

FALL SPECIAL!

7.89

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Sensational Purchase of European inventory! Easily capable of 3-4 amp. surges! Excellent for CB, car stereo, and general hobby applications. Make an excellent battery charger! Incredible value! Dealers: Stock up NOW! (2lb.) 032HP233.

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TELEPHONE PULSE-OUT DIALER WITH LAST-NUMBER MEMORY!

49.95

$44.95 ea., 3 lots.
$39.95 ea., 10 lots.

Allows "touch-button" operation on dial exchanges! Convert dial phones or build "touch" phones with this state of the art module. Touch single button for last number recall. FREE data sheet (request 032BJ043). Complete with installation instructions. (12 oz.) 032PH006.

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2.95

FALL SPECIAL!

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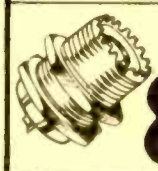
GM No. 4L2-0015-01-UCC2181. Original Cadillac solid state headlite turnoff timers. Brand new, with schematic and sheet showing timer, burglar alarm and automotive applications. Times from 1 second to 3 minutes. (1 lb.) 032HM162.



POPULAR SINGLE-HOLE MOUNT SO-239 SOCKET

89¢

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79c ea., 10 lot.
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SAVE!

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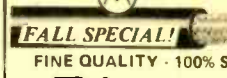

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RG58/U COAXIAL CABLE!

FINE QUALITY - 100% SHIELDED! 032WR002 (3 lb./100')

7¢/FT.

Reg. 9c/ft.

$5.49/100 ft.
$49.95/1000 ft.

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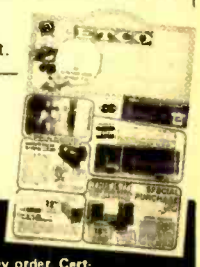

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WE HAVE ONE THOUSAND OF THESE HIGH QUALITY ROCKER TYPE AMP TEN POLE SWITCHES.. SEND AN ORDER FOR $15 OR MORE- MENTION THIS AD AND YOU GET FREE SHIPPING AND ONE AMP SWITCH.. (prepaid and U.S. orders only).....

BISTABLE RELAY

SPDT 6VDC 200 OHM COILS
1 AMP 20 WATT DC CONTACTS
LONG LIFE (1 X 10^9) OPER.
HIGH SPEED (500 HZ)
HERMETICALLY SEALED
3/8X3/8X3/4"

$2.95 ea.

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EPOXY BRIDGE RECTIFIERS
10 AMP 50V VJ048
.90 ea. 10 for $7.50 100-$65

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14 PIN GOLD PLATED WIRE WRAP SOCKETS THREE LEVEL
35¢ each
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CD4025 CMOS gate	.19
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S270 functional sub for 7400 quad 2 in NAND gate	.10
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2N4304 N channel FET HEP 802	.25
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FOR TRIACS and SCR's

PULSE TRANSFORMER 1/1 toroid
DIAC (trigger diode)
25¢ 10 for $2 specify which one to ship !

RCA 40374

250V - 2A NPN T066
POWER TRANSISTOR MOUNTED ON A FACTORY ASSEMBLED HEAT SINK - 5.8 WATTS @ AMBIENT OF 25C
$.75 ea. 10 for $6

ultra sensitive relay

Single pole normally open dry reed relay. Unbelievable sensitivity, 1800 ohm coil with 9 volt pull-in (that's less than 3 ma.) A TTL gate will drive many of these. A CMOS buffer will directly actuate this nifty relay.... MFR. unknown, but I was told they came from IBM. 600 available

$2.95 ea.

ELEC-TROL REED RELAY

12 vdc
440 Ω coil
4 dpst n.o.
1.1" x 3

PICTURE IS APPROXIMATION, RELAY HAS FOUR PINS ON ONE END AND TWO ON OTHER, PINS ARE SPACED .1" X 1". 1/2A CONTACTS.

79¢ ea. 10 - $6

TRANSISTOR BONANZA

$6 per 100 - $50 per 1000

PRIME TO-92 PLASTIC TRANSISTORS FROM A MAJOR SEMI HOUSE. THESE ARE FIRST GRADE DEVICES WITH CUT AND FORMED LEADS AND MARKED WITH A HOUSE NUMBER. THESE ARE NOT BARREL REJECTS.... PNP AND NPN AVAILABLE WE WILL SHIP 50/50 OR ANY MIX WITH 50 PIECE PER TYPE MINIMUM.....

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$1.60 ea.

FANTASTIC OPTO ISOLATOR

FAIRCHILD FCD820
89¢ ea. ten $7.95

DIP TRIMMER

12 TURN 1/4" SQ. 5K or 200K only
mfg. DALE
$.50 TEN FOR $4

1/8 WATT RESISTORS

10 ea.-390, 1.8k, 3.9k, 6.8k, 11k, 43k, 68k, 240k - 5 percent tol.
80 FOR $4

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$15 minimum order

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- U.S. FUNDS ONLY!

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ADD 25c FOR SPEC. SHEETS

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LM100	2-37v ADJUSTABLE VOLTAGE REGULATOR	$4.95
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LM733	DIFFERENTIAL VIDEO AMPLIFIER	$1.95
LM1414	DUAL DIFFERENTIAL VOLTAGE COMPARATOR	$2.95
LM1496	BALANCED MODULATOR/DEMODULATOR	$1.95
LM1830	FLUID DETECTOR (PRESENCE, ABSENCE, LEVEL)	$1.98
LM2907	FREQUENCY TO VOLTAGE CONVERTER	$1.95
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MM57100	COLOR TV 3 GAME CHIP	$7.95
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PRICES & AVAILABILITY SUBJECT TO CHANGE WITHOUT NOTICE

DC-DC UP CONVERTER SWITCHING REGULATOR I.C.

BUILD YOUR OWN MICRO MINIATURE CONVERTER

$1.49 WITH DATA

MINI DIP PKG.

HEWLETT — PACKARD

HI-INTENSITY MICRO LEDS
SIDE STACKABLE AXIAL LEAD

RED	CLEAR	YELLOW
6/99c	5/99c	4/99c

CARBIDE DRILL BITS for P.C. BOARD WORK

SIZES FROM NO. 55 TO NO 70

OUR MIX 5/$7.49 10/$12.49

SUBMINIATURE CRYSTAL FILTER

455 KHZ
WITH DATA
$2.95

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2 x 2 cm
130 ma
$1.59 ea.
10/$9.90

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LOW PROFILE SOLDERTAIL

	GOLD INLAID	TIN
8 PIN	10/$1.59	10/$1.35
14 PIN	10/$1.89	10/$1.49
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24 PIN	5/$1.09	5/$0.89
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4000	.15	74C08	.65	7427	.35	74161	1.00	8973	2.95	8334	4.00
4001	.20	74C10	.25	7430	.15	74163	1.30	8974	2.95	8553	6.50
4002	.20	74C14	1.75	7432	.30	74164	1.45	8976	2.95	8556	3.25
4007	.20	74C20	.26	7437	.44	74165	1.35	75107	3.25	8599	3.25
4010	.36	74C30	.26	7440	.18	74166	1.20	75450	1.00		
4011	.20	74C32	.30	7442	1.00	74173	1.70	75451	.80		
4012	.20	74C42	1.40	7445	.70	74175	1.05	75452	.80		
4013	.35	74C48	2.75	7446	.70	74177	.90	75453	.80		
4014	.80	74C73	1.25	7448	.70	74182	.95	75491	1.25		
4015	.80	74C74	.75	7450	.25	74191	1.20	75492	1.40		
4016	.35	74C86	1.00	7451	.25	74192	1.45	75494	1.50		
4017	.92	74C90	1.10	7453	.25	74193	1.35				
4018	.92	74C93	1.25	7454	.35	74195	1.00				
4019	.20	74C151	2.75	7460	.22	74196	1.10				
4020	1.00	74C154	3.00	7472	.40	74197	1.10				
4022	.83	74C157	2.10	7473	.40	74199	2.25				
4023	.21	74C160	1.40	7474	.40	74367	.90				
4024	.75	74C162	1.70	7475	.55						
4025	.20	74C164	1.75	7476	.45						
4027	.34	74C165	1.75	7483	1.05						
4028	.79	74C174	1.50	7485	1.10						
4029	1.00	74C902	.85	7486	.43						
4030	.20	74C904	.85	7489	2.00						
4035	.95	74C905	3.00	7492	.75						
4040	1.00	74C914	1.95	7493	.65						
4041	1.00			7495	.78						
4042	.70			7496	.85						
4044	.60			74121	.35						
4049	.35			74122	.49						
4051	1.10			74123	.65						
4066	.70			74125	.65						
4068	.40			74132	1.25						
4069	.40			74141	1.15						
4075	.20			74145	1.10						
4082	.23			74148	1.20						
74C00	.25			74150	.90						
74C02	.45			74153	1.10						
74C04	.32			74154	1.25						
				74155	.75						
				74157	1.00						

TTL

7400	.16	74121	.35	74161	1.00	8973	2.95	8334	4.00		
7401	.17	74122	.49	74163	1.30	8974	2.95	8553	6.50		
7403	.17	74123	.65	74164	1.45	8976	2.95	8556	3.25		
7404	.19	74125	.65	74165	1.35	75107	3.25	8599	3.25		
7406	.40	74132	1.25	74166	1.20	75450	1.00				
7407	.40	74141	1.15	74173	1.70	75451	.80				
7409	.25	74145	1.10	74175	1.05	75452	.80				
7410	.18	74148	1.20	74177	.90	75453	.80				
7413	.78	74150	.90	74182	.95	75491	1.25				
7414	.68	74153	1.10	74191	1.20	75492	1.40				
7417	.38	74154	1.25	74192	1.45	75494	1.50				
7420	.18	74155	.75	74193	1.35						
7421	.35	74157	1.00	74195	1.00						
				74196	1.10						
				74197	1.10						
				74199	2.25						
				74367	.90						

Interface

0025	3.50										
0026	1.75										
8640	1.25										
8641	2.75										
8806	3.00										
8819	1.25										
8820	5.00										
8830	4.90										
8833	2.45										
8835	2.45										
8836	1.25										
8837	2.45										
8838	2.45										
8859	1.50										
8865	1.50										
8866	1.50										
8867	1.85										
8869	1.75										
8879	2.25										
8880	2.75										
8884	2.45										

Peripheral

8212	3.50										
8214	8.50										
8216	3.75										
8224	4.75										
8228	9.90										
8251	11.50										
8255	10.50										
2513	9.50										
2516	9.50										
1013	6.50										

8000 TTL

8T20	3.25										
8T97	1.75										
8092	.95										
8094	.60										
8095	.80										
8096	.90										
8098	.90										
8121	2.25										
8136	3.25										
8220	3.25										
8231	2.25										
8242	1.75										
8250	1.75										
8260	2.25										
8281	1.00										

LINEAR

301N	.35										
307N	.35										
308H	1.00										
309K	1.25										
309N	1.00										
318H	1.50										
320H-5	.88										
320T-5	1.25										
320T-12	1.25										
324N	1.75										
340T-5	1.25										
340T-12	1.25										
340T-15	1.25										
340T-24	1.25										
387N	1.25										
388N	1.15										
555N	.35										
556N	.85										
558N	2.80										
561N	5.00										
566N	1.70										
567N	1.65										
709N	.30										
741H	.25										
3035	2.40										
3401	1.25										

74LSxx *

74LS00 through 74LS670	.25 3.95										

* For more 74LSxx, refer to our ad in the June issue of this magazine.

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OEM EDUCATORS AND SCHOOLS

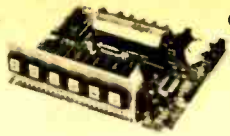
For a low quote, send a list of your needs and, if possible, desired prices. No quantity is too small.

Minimum order $5.00 US currency. Check or money order only. Add 5% to cover shipping and handling charges. Calif. residents add 6% sales tax. Santa Clara County residents add 6.5% sales tax.

CIRCLE 73 ON FREE INFORMATION CARD

30 MHZ LOW COST FREQUENCY COUNTER KIT

Features:
- Frequency Range—100Hz to 30MHz min., resolution 100 Hz
- All TTL Circuitry—No tears in the eyes when replacing ICs
- FET Input Stage—Offers high input impedance
- High Sensitivity—15mV typical
- Xytal Time Base—0.001% 10MHz for better accuracy
- On Board Regulator—No external power supply needed
- All ICs Socketed—Easy to service
- Easy to Operate—No switches to flip
- Tin Plated & Screened Board—For easy assembly



COMPARE and SAVE!

$54.95

KIT # T-250-30A

KIT INCLUDES: Detailed Instructions (22 pages). All parts including transformer (case not available).

OUR BEST SELLER
5V 10A POWER SUPPLY KIT

Includes: Extra large heat sink, power transistor, ICP regulator, P.C. board with OVP.

Kit. No. T-500 $14.95

With optional rectifiers and filtering cap $17.95

2-20V ADJ. POWER SUPPLY

KIT INCLUDES: Transformer, PC Board, Large heat sink, Large filtering capacitor and all the parts with detailed instruction. KIT # T-450 **$12.95**

Car Battery Eliminator

KIT INCLUDES: Transformer, PC Board, Large heat sink, Large filtering capacitor

KIT#700 $16.95

Plastic Molded Instrument Case

H—2 7/16" 3 11/16" W—8½" D—9¼"

Adjustable heights to accommodate most needs. Available in tan & gray.

Model #CH-200 $19.50

Instrument Case for Kit

H—2½" W—6 1/16" D—6¼"

Ideal for many smaller projects. Similar to CH-200 less handle.

CM-6-225 $9.40

6-DIGIT AUTO CLOCK KIT WITH ALARM

Features:
- A. Fairchild 0.5" FND 500 Series Display
- B. Display Board may be remote
- C. Xtal time base
- D. P.C. Boards, speaker, IC's and all parts.
- E. Detailed Instructions

$19.95

KIT # T-1300

0.8" 4 Digit Jumbo Display Alarm Clock Kit

Features:
- A. Fairchild 0.8" FSC8000 Display Array
- B. Fairchild Super Chip — F-3817PC
- C. P.C. Board, Transformer, Speaker and all parts included (less case)
- D. Detailed Instructions

$19.50

I.C. SOCKETS

	LO-pro 5 pcs	LO-pro 10 pcs	LO-pro 100 pcs	Wire Wrap 5 pcs.	Wire Wrap 10 pcs.	Wire Wrap 100 pcs.
8-pin	0.80	1.50	12.00	1.90	3.50	32.00
14-pin	0.95	1.75	15.00	2.10	3.90	36.00
16-pin	1.05	2.00	17.00	2.50	4.20	39.00
18-pin	1.40	2.50	23.00	3.20	6.00	55.00
20-pin	1.60	3.10	28.00	3.50	6.50	60.00
22-pin	1.80	3.40	32.00	3.75	7.00	65.00
24-pin	1.85	3.50	33.00	4.25	8.00	75.00
28-pin	2.20	4.20	39.00	4.75	9.00	85.00
40-pin	3.50	6.20	59.00	6.50	12.00	100.00

HAMMOND BREADBOARD KIT

BIMBOARD 1 $9.95 ea.

Accepts DIP packages without adaptors or damaging component leads.

Contacts are double sided, nickel silver, current carrying capacity of 1 Amp with less than 10 milliohms contact resistance.

Total of 550 sockets identified by a letter and number matrix for recording experiments

Buss strip section runs up each side of board.

Component bracket (included with each board) will fit on any of the four edges or down the center.

BIMBOARD 2 $23.95

2 Bimboards and 2 component brackets

1 Aluminum base with 4 insulated Terminals

BIMBOARD 3 $34.95

3 Bimboards and 3 component brackets

1 Aluminum base with 4 insulated terminals

BIMBOARD 4 $43.

4 Bimboards and 4 component brackets

1 Aluminum base with 4 insulated terminals.

FULLY ENCODED 74-key keyboard manufactured by Micro Switch for Honeywell (Limited Qty.) $50.00 ea.

PRECUT WIRE WRAP WIRE

30 Kynar in red, orange, blue, yellow, green, black, white. Pre-stripped both end.

	100	500	1000	5000
2½ in.	.78	2.40	4.30/K	3.89/K
3 in.	.82	2.60	4.71/K	4.22/K
3½ in.	.86	2.80	5.12/K	4.55/K
4 in.	.90	3.00	5.52/K	4.88/K
4½ in.	.94	3.21	5.93/K	5.21/K
5 in.	.98	3.42	6.34/K	5.52/K
5½ in.	1.02	3.65	6.75/K	5.86/K
6 in.	1.06	3.85	7.16/K	6.19/K
6½ in.	1.15	4.05	7.57/K	6.52/K
7 in.	1.20	4.25	7.98/K	6.85/K
7½ in.	1.25	4.45	8.39/K	7.18/K
8 in.	1.29	4.65	8.80/K	7.53/K
8½ in.	1.32	4.85	9.21/K	7.84/K
9 in.	1.36	5.05	9.62/K	8.17/K
9½ in.	1.40	5.25	10.03/K	8.50/K
10 in.	1.45	5.51	10.44/K	8.83/K
Addl. in	.10	.41	.82/K	66/K

Z-80 CPU BOARD/KIT

On board 2708 EPROM addressable to any 4K boundary above 32K. Power-on-jump to any 4K boundary above 32K, or the on board 2708. On board run-stop flip-flop and optional generation of Memory Write allow front panel-less operation.

BARE BOARD $34.00

$130.00 (2MHz) $145.00 (4MHz)

ASSEMBLED & TESTED ADD $50.00

8080 A CPU BOARD/KIT

With 8 level vector interrupt, CPU chip 8080 clock chip: 8224; crystal Freq.: 18MHz; vector interrupt chip: 8214.

BARE BOARD $28.50 KIT $95.00

Assembled and Tested $145.00

REAL TIME CLOCK FOR S-100 BUSS

On board 1MHz Crystal Oscillator, two independent interrupts. 16 bit counter in 10 s steps; and decade steps from 100 s to 10 sec.

KIT $120

Assembled & Tested $179.95

BARE BOARD $24.00

8K STATIC RAM

	450ns	350ns	250ns
8K Kit	$129.95	$139.95	$169.95

ASSEMBLED/TESTED ADD $25.00 Bareboard $25.00

16K STATIC RAM KIT $375

BOARD $24.00 ASSEMBLE/TEST $425.00

32K STATIC RAM

BARE BOARD $35.00

KIT	ASSEMBLE/TESTED
250ns $795.00	$875.00
450ns $625.00	$775.00

2708/2716 EPROM KIT $59.95

Special Kit With 8ea

2708's $129.95

Bare Board $30.00

ULTRAVIOLET EPROM ERASER

Erase up to 48 ICs each time

$49.50

FREQUENCY COUNTER LSI CHIPS

1CM7207	$ 8.75
1CM7207	$16.95
6.5536 MHz X'ytal	$ 4.25

SAVE MORE BUY THEM ALL FOR $28.00

STOP WATCH CHIP

1CM7205	$18.50
3.2768 MHz X'ytal	$ 4.75
Trimmer Cap.	$ 0.50
ALL FOR JUST	$21.50

TRIACS

TIC 206A	3A	100V		.80
TIC 206B	3A	200V		.90
TIC 206D	3A	400V		1.00
TIC 216A	6A	100V		.99
TIC 216B	6A	200V		1.05
TIC 216D	6A	400V		1.25
TIC 236B	12A	200V		1.40
TIC 236D	12A	400V		1.70
TIC 253B	20A	400V		2.50
TIC 253D	20A	400V		2.95
TIC 263E	20A	600V		3.55
TIC 263B	25A	200V		3.10
TIC 263D	25A	400V		3.70
TIC 263E	25A	600V		4.25

SCR's

2N5062	0.8A	100V	.30
2N5064	0.8A	200V	.40
TIC 106B	5A	200V	.45
TIC 106D	5A	400V	.55
TIC 116A	8A	100V	1.00
TIC 116B	8A	200V	1.20
TIC 116D	8A	400V	1.50
TIC 116E	8A	500V	1.80
TIC 116M	8A	600V	2.10
TIC 126A	12A	100V	1.35
TIC 126B	12A	200V	1.50
TIC 126D	12A	400V	1.90
TIC 126E	12A	500V	2.25
TIC 126M	12A	600V	2.55

TRANSISTORS

NPN Gen. Pur. 30V	10/$1.00
PNP Gen. Pur. 30V	10/$1.10
2N5458 Gen. Pur. FET	10/$4.00
2N5245 R.F. FET	10/$5.00
2N2222 Switching	10/$1.75
2N3055 150W Power	10/$6.00

POWER TRANSISTORS

MATCHED PAIR

MOTOROLA MJE2955 PNP

MJE3055 NPN

10 AMP 60 VOLT 90 WATTS

$2.25 PER PAIR

MINIATURE SLIDE SWITCH

DPDT 20 each

10 for $1.75

100 for $15.00

MINIATURE TOGGLE SWITCH

SPDT $1.30 ea.

DPDT $1.50 ea.

PUSH BUTTON SWITCH

White, green and yellow 30¢ ea.

4/$1.00

0.2" L.E.D. Lamps

Red	15¢	100/10.00
Green	20¢	100/15.00
Yellow	20¢	100/15.00
Amber	20¢	100/15.00

L.E.D. Displays

END 503	C.C. 0.5"	75¢
END 510	C.A. 0.5"	75¢
1720R	C.A. 1"	4.75
1723R	C.C. 1"	4.75

JUMBO LED READOUT ARRAY

- 1.00 Inch High Characters
- Common Cathode Connections
- 3½ Digits with Colons
- Independent Segments

LT1012 $7.50

SOLDER

Quick solder remover

1/32" 5 ft.

1/16" 5

1/8" 5 1.40 ea.

1/4" 2½

TANTALUM CAP AXIAL LEADS

1	10V	15¢
1	35V	20¢
3.3	35V	25¢
10	50V	30¢
22	35V	30¢

DIP PLUGS

	5 pcs	10 pcs	100 pcs
14-pin	3.25	6.00	55.00
16-pin	3.50	6.50	60.00
40-pin	9.50	18.00	150.00

DIP TANTALUM

10u 20V	35¢
22u 15V	50¢
33u 15V	65¢
68u 10V	80¢
100u 10V	99¢

AUDIBLE TRANSDUCERS

Manufactured by GULTON INDUSTRIES for producing audible sound. With a very simple one X'istor cct. Ideal for smoke detector & morse code practicer $1.75 ea. 10/$14.00

TIME BASE MINI KIT

Includes MM5369 I.C. 3.5795 MHz X'ytal Trimmer Cap.

$3.45

Wire Wrap Wire Special Purchase

500 ft. roll @ 5.00

White only

WIRE-WRAP TOOLS

Hobby Wrap - 30

Hobby Wrap - BW-630 Battery Op. (less batt.)

$30.95

ERIE MINI CERAMIC TRIMMER CAP.

10 - 40 p/F 10/$4.50

SWITCHING DIODES IN4148

10 for 0.50

50 for 2.00

100 for 3.50

SPECIAL OF THE MONTH

AN214-4.5W Power IC with spec.	$2.95 ea.
MH0026-5MHz Clock Driver	$1.95 ea.
14-pin Lo pro IC Socket	100/$16.00
16-pin Lo pro IC Socket	100/$17.00
P.C. Mount X'former, 24V .45A	$1.95 ea
1,000 uF 50V cap. Axial Lead	$1.00 ea
C-60 Digital Cassette Tape	$1.50 ea

MINIATURE CONSOLES

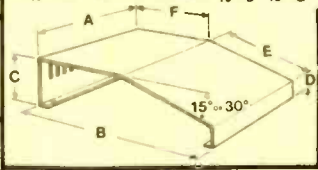
15° SLOPING PANELS

A	B	C	D	E	F	CASES (bottoms)				PANELS (tops)			
4.0	5.5	2.0	1.1	3.3	2.2	1 - B	1 - G	1 - L	5.50	1 - W	1 - S	1 - K	5.50
6.5	5.5	2.0	1.1	3.3	2.2	2 - B	2 - G	2 - L	6.10	2 - W	2 - S	2 - K	6.10
6.5	8.5	2.0	1.1	3.3	5.2	3 - B	3 - G	3 - L	6.70	3 - W	3 - S	3 - K	6.70
6.5	8.3	3.0	1.3	6.3	2.2	4 - B	4 - G	4 - L	7.30	4 - W	4 - S	4 - K	7.30
10.0	8.3	3.0	1.3	6.3	2.2	5 - B	5 - G	5 - L	7.80	5 - W	5 - S	5 - K	7.80
10.0	11.3	3.0	1.3	6.3	5.2	6 - B	6 - G	6 - L	8.40	6 - W	6 - S	6 - K	8.40
14.0	8.3	3.0	1.3	6.3	2.2	7 - B	7 - G	7 - L	8.80	7 - W	7 - S	7 - K	8.80
14.0	11.3	3.0	1.3	6.3	5.2	8 - B	8 - G	8 - L	9.70	8 - W	8 - S	8 - K	9.70

30° SLOPING PANELS

B=Blue, G=Green, L=Gold, W=White, S=Sand, K=Black

4.0	5.5	3.0	1.1	3.7	2.2	9 - B	9 - G	9 - L	5.50	9 - W	9 - S	9 - K	5.50
6.5	5.5	3.0	1.1	3.7	2.2	10 - B	10 - G	10 - L	6.10	10 - W	10 - S	10 - K	6.10
6.5	7.2	4.0	1.1	5.7	2.2	11 - B	11 - G	11 - L	6.70	11 - W	11 - S	11 - K	6.70
10.0	5.5	3.0	1.1	3.7	2.2	12 - B	12 - G	12 - L	7.30	12 - W	12 - S	12 - K	7.30
10.0	7.2	4.0	1.1	5.7	2.2	13 - B	13 - G	13 - L	7.80	13 - W	13 - S	13 - K	7.80
10.0	10.2	4.0	1.1	5.7	5.2	14 - B	14 - G	14 - L	8.40	14 - W	14 - S	14 - K	8.40
14.0	7.2	4.0	1.1	5.7	2.2	15 - B	15 - G	15 - L	8.80	15 - W	15 - S	15 - K	8.80
14.0	10.2	4.0	1.1	5.7	5.2	16 - B	16 - G	16 - L	9.70	16 - W	16 - S	16 - K	9.70



CRYSTALS ± =0.002%

Frequency MHz

1.000	2.4576	4.0000	6.144	10.000	32.0000
1.8432	2.667	4.1943	6.400	14.318	36.0000
@5.25	3.000	4.9152	6.5536	14.391	48.0000
	3.200	5.0000	8.0000	18.000	
	3.2768	5.0688		18.4320	
2.000	3.5795	5.1850	@4.25	20.0000	@3.50
2.0100		5.7143		22.1184	
2.097152	@4.75	6.0000		27.0000	

KEPCO Ferroresonant power supply.

Input 110V 3A Factory Price $206

Output 24V 8A Our Price $80

LAMBDA Precision Power Supply

Model LXS-EE-5-DV

5V 45A Factory Price $600

Our Price $100

Please add $5.00 extra postage to these items.

THE KIM-1 MICROCOMPUTER SYSTEM

- 6502 - 8 bit MPU with powerful instruction set, 13 addressing modes, multiple interrupts, full 65K byte address range.
- 2 MCS 6530 chips each with 1024 bytes of ROM, 64K bytes of RAM, 15 I/O pins, and an interval timer.
- The KIM-1 monitor and operating programs are stored permanently in the 1048 ROM bytes provided.
- Comes with keyboard and alpha-numeric display.
- TTY and cassette interface.
- Completely assembled and tested and documented.
- Including KIM-1 user manuel, 6500 programming manual, and 6500 hardware manual.

ALL THESE FOR JUST $235.00

KIM SUPPORT

6102	8.00
6502	11.95
6520	10.00
6522	9.25
6530	15.95
6530-002	15.95
6530-003	15.95
6530-004	15.95
6530-005	15.95

VHF Modulator

For TV Game or Computer

Modulates Video Input to a RF output (ch. 3)

Supply voltage 5V

$4.50 ea.

3815 5-DECADE COUNTER

The 3815 is a 5-Decade Counter which includes a memory with static latches for each counter digit and an output multiplexer. The 3815 is designed to drive a multiplexed display which has a Binary Coded Decimal output and five decoded outputs to strobe the display.

With Specification $5.00 ea.

TRINCO

2795-L West Lincoln Ave.
Anaheim, CA 92801
(714) 821-0234

Minimum order $5.00. Please add $2.00 postage and handling for out of States, $1.00 Inside California plus Tax. C.O.D. orders welcome (Min. Order $20.00)

Store Hours 10 - 7, Mon. - Sat.

VISA MASTERCHARGE

MICROCOMPUTER COMPONENTS

MICROPROCESSORS

F8	16.95
2B0	22.95
2B0A	28.00
CDP1802CD	19.95
2650	24.95
AM2901	22.95
6502	11.95
6800	18.95
6802	75.00
8008-1	5.95
8035	22.00
8080A	18.95
8085	27.00
TMS9900NL	75.00

8080A SUPPORT

8216P	4.95
8881OP	6.00
8870P	7.50
8821P	7.50
8879P	11.25
8834P	16.95
8852P	9.75
8852P	11.75
8860P	10.00
8862P	14.50
8871P	29.00
8875P	8.75
8880P	2.50

STATIC RAMS

2102	1.50
21L02	1.50
21L02 (350)	1.60
21L02 (250)	1.75
4100	10.75
1101A	1.00
2101-1	2.95
2102	1.25
2111-1	3.95
2112-1	2.95
2114-3	11.00
2125A	11.10
2147	37.50
3101	2.50
3106	3.95
3107	3.95
TMS 4044	9.95
4200A	12.95
TMS 4045	11.00
5101	8.30
74C89	3.25
7489	2.25
745201	4.50
P8101	4.20
P8155	17.00
P8156	21.00
8908	1.82
9102BPC	1.65

CHARACTER GENERATORS

2513	6.75
2513 5v upper	9.75
2513 5v lower	10.95
2515	10.95

8080A SUPPORT DEVICES

8212	3.50
8214	9.00
8216	3.75
8224	3.50
8224-4	9.95
8226	3.95
8228	7.95
8238	7.50
8251	9.95
8253	21.95
8255	21.95
8257	21.95
8259	21.95
8275	75.00
8279	20.00

PROM'S

1702A	4.00
2704	15.00
2708	12.00
2716	30.00
2716 mil	38.00
2758	25.60
D3601	4.50
D3604	13.00
52304Q	5.00
52304Q	7.50
6834	17.50
6834-1	14.95
82S230	4.00
82S129B	4.25
8279H	3.50

DYNAMIC RAMS

4116D/4116	32.00
1103	1.00
2104	4.00
2107B	4.25
2107B-4	3.95
TMS4050	4.50
TMS4060	4.50
TMS4070-2	32.00
4096	4.00
4116/416D	32.00

Z80 SUPPORT DEVICES

3881	12.95
3882	12.95

USART'S

AY5-1013A	5.25
AY5-1014A	8.75
TR1602B	5.25
TMS6011	5.95
MM5402	10.50
MM5403	10.80

KEYBOARD CHIPS

AY5-2376	13.75
AY5-3600	13.75

P.C. MOUNT PUSH BUTTON SWITCHES

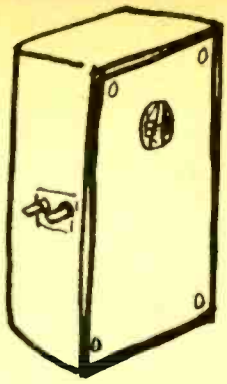
45¢ ea.

10/$4.00

OCTOBER 1978

CIRCLE 31 ON FREE INFORMATION CARD

MOTION DETECTOR



When there is a new development in the field of electronics, it takes some time before that development is available to hobbyists and experimenters, especially at surplus prices. We have reversed the process, and announce a DELTA EXCLUSIVE, the DELTA MOTION DETECTOR. This device detects motion or movement at a minimun distance of eight feet, in a cone with a two foot diameter. The secret is in the custom, ultra complex LSI chip. The device is completely self contained in a case 6"x3 1/8"x2¼" and operates from 4 "Ni-Cad" batteries. Nothing else is needed for the device to perform its basic function, motion detection.

When motion is detected, a "whoop" alarm is sounded. The kit is designed so that either an audible or silent remote alarm is available at the turn of a switch. The silent alarm activates a relay, whose contacts are brought out thru a plug, and will activate ANY device, such as a siren, horn, bell, telephone dialer, tape recorder etc. The silent alarm is adjustable timer controlled, and witholds the alarm for a programmed number of seconds, so that you may deactivate the alarm when you trigger it yourself.

The motion detector works on a change of light. A change of ±5% in light level triggers the detector. Works within a range of 0.1 candlepower (almost dark) to 100 candlepower(quite bright), a ratio of 1000 to 1. NO external light source is needed.

There will be several articles describing the DELTA MOTION DETECTOR. Look for one either in the Nov. 1978 or Jan. 1979 issue of POPULAR MECHANICS.

Stk.No.5611R	Complete Motion Detector Kit	$24.50
Stk.No.1072R	Motion Detector Chip Only	$8.95
Stk.No.5611RB	set of 2 PC boards	$6.50
Stk.No.5288R	Set of 4 Ni-Cad Batteries (When available)	$4.50

DELTA ELECTRONICS

7 Oakland St.
Amesbury, Mass. 01913
617-388-4705

ATLANTA, GA.

DELTA MOTION DETECTOR
HEADQUARTERS IN ATLANTA
DELTA ELECTRONIC HOBBIES
5151 Buford Hwy.
Doraville, (Atlanta) Ga.

Include sufficient postage. Excess will be refunded. Send for new Catalog 19, 120 pages of electronic bargains.

BANKAMERICARD · Master Charge

CIRCLE 47 ON FREE INFORMATION CARD

B&K PRECISION Transistor Testers

MODEL 520B

Industrial Transistor Tester

- Now with HI-LO Drive
- Works in-Circuit when others won't
- Identifies all three transistor leads
- Random lead connection
- Audibly and visually indicates GOOD transistor
- Automatic NPN/PNP determination
- Positive Si/Ge identification
- Tests diodes, SCR's, FET's, and Darlingtons
- CSA approved version available

MODEL 510

Portable Transistor Tester

- Fast GO/NO-GO in-circuit transistor testing
- Fast and thorough GOOD/BAD out-of-circuit testing
- Tests FET's and SCR's in-circuit or out-of-circuit
- Connect any test clip to any component lead
- Gives positive emitter-base-collector identification in LO drive—positive base identification in HI drive
- Light-Emitting Diodes indicate NPN OK or PNP OK
- Pocket-size—Over 100 hours of testing from single set of "AA" cells
- Digital stability—no adjustments; nothing to go out of calibration
- Includes carrying case and leads

MODEL 501A

Semiconductor Curve Tracer

- Display characteristic curves for all semiconductor devices on your scope
- Measure breakdown voltage non-destructively
- Identify unknown devices
- Complete with FP-5 probe

MODEL 530

Lab-Quality Semiconductor Tester...

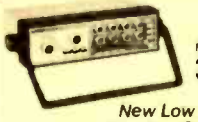
- Measure fr of bipolar transistors up to 1500 MHz
- Nondestructive testing of transistor and diode breakdown voltages
- Measures transistor beta or FET g_m
- Measures all transistor breakdown and leakage parameters
- Fast testing of transistors, FET's, and SCR's—in or out-of-circuit
- Base diagrams are not required
- No biasing information required
- Identifies all leads of transistors and SCR's
- Automatic identification of PNP/NPN types and N- or P-channel FET's

New from B&K... and we have them at discount prices!

MODEL 820

New Portable Digital Capacitance Meter

- Measures capacitance from 0.1pF to 1 Farad
- Resolves to 0.1pF
- 10 ranges for accuracy and resolution
- 4 digit easy-to-read LED display
- 0.5% accuracy
- Special lead insertion jacks or banana jacks
- Fuse protected
- Uses either rechargeable or disposable batteries
- Overrange indication



MODEL 3010

New Low Distortion Function Generator

- Generates sine, square and triangle waveforms
- Variable amplitude and fixed TTL square-wave outputs
- 0.1 Hz to 1MHz in six ranges
- Push button range and function selection
- Typical sine wave distortion under 0.5% from 0.1 Hz to 100 kHz
- Variable DC offset for engineering applications
- VCO external input for sweep-frequency tests

MODEL 3020

New Sweep/Function Generator

- Four instruments in one package—sweep generator, function generator, pulse generator, tone-burst generator
- Covers 0.02Hz-2MHz
- 1000:1 tuning range
- Low-distortion high-accuracy outputs
- Three-step attenuator plus vernier control
- Internal linear and log sweeps
- Tone-burst output is front-panel or externally programmable

Model 1650

New Multiple-Output Lab Power Supply

- Functions as three separate power supplies
- 5VDC, 5A fixed output
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- Fully automatic, current-limited overload protection
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74H03	.16	74H40	.16	74H65	.16	74H106	.45
74H04	.17	74H50	.16	74H71	.35	74H108	.49
74H05	.17	74H51	.17	74H72	.31	74H113	.24
74H08	.22	74H52	.17	74H73	.49	74H114	.24
74H10	.16	74H53	.17	74H74	.24	74H183	2.25
74H11	.22	74H54	.18	74H76	.55		
74H12	.16	74H55	.18	74H78	.55		
74H15	.17	74H60	.18	74H87	2.75		

Part No.	Price
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74S15	.19
74S20	.19
74S22	.19
74S40	.19
74S64	.19
74S74	.39
74S112	.45
74S151	.60

Part No.	Price	Part No.	Price	Part No.	Price	Part No.	Price
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74LS14	.68	74LS109	.32	74LS165	1.25	74LS258	.85
74LS15	.17	74LS112	.32	74LS170	1.25	74LS280	1.70
74LS28	.19	74LS123	.79	74LS174	.69	74LS283	.85
74LS37	.23	74LS132	.79	74LS175	.69	74LS290	.85
74LS38	.23	74LS138	.64	74LS191	.90	74LS324	1.25
74LS40	.19	74LS139	.64	74LS192	.95	74LS365	.55
74LS47	.89	74LS151	.59	74LS195	.66	74LS366	.55
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11000	74194	.34
47000	74195	.29
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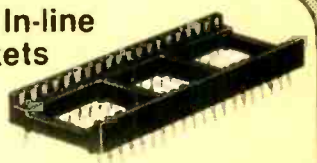

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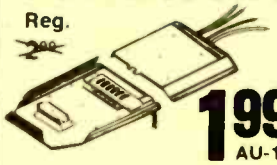

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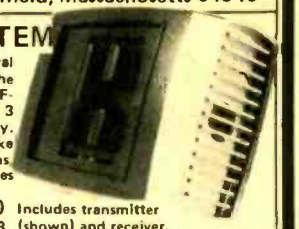

This handy control was part of an Admiral remote control package for color TV. The original functions were: On-Off, Volume, VHF-UHF, and channel select. Receiver contains 3 relays and one-four position stepping relay. Also a complete 4 page data pkg. Use it to make all kinds of remote operating toys, alarms, detectors, appliances, etc. Transmitter requires AA cell (not included). Qty Ltd.

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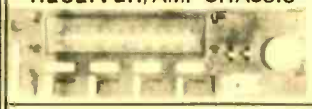

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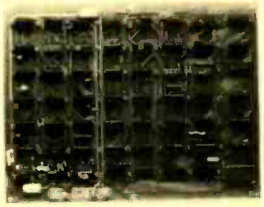

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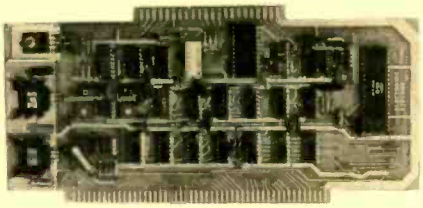

Part no. 112
• Tape Interface Direct Memory Access • Record and play programs without bootstrap loader (no prom) has FSK encoder/decoder for direct connections to low cost recorder at 1200 baud rate, and direct connections for inputs and outputs to a digital recorder at any baud rate. • S-100 bus compatible • Board only $35.00; with parts $110.00

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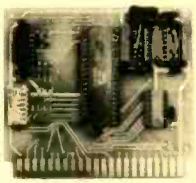

Part no. 101
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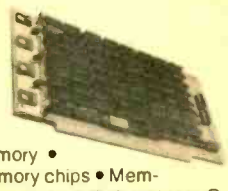

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74LS04	.20	74LS85	.71	74LS162	.63	74LS258	.66
74LS05	.20	74LS86	.30	74LS163	.63	74LS259	.83
74LS08	.18	74LS90	.42	74LS165	.86	74LS260	.18
74LS09	.18	74LS92	.43	74LS168	.84	74LS266	.29
74LS10	.18	74LS93	.43	74LS169	.84	74LS279	.31
74LS11	.18	74LS95	.74	74LS170	1.27	74LS283	.71
74LS13	.31	74LS109	.26	74LS173	.51	74LS290	.56
74LS14	.48	74LS112	.26	74LS174	.51	74LS293	.63
74LS15	.18	74LS113	.26	74LS175	.51	74LS295	.89
74LS20	.18	74LS114	.26	74LS181	2.17	74LS298	.89
74LS21	.18	74LS122	.33	74LS190	.96	74LS365	.36
74LS22	.18	74LS123	.63	74LS191	.81	74LS366	.36
74LS26	.21	74LS125	.36	74LS192	.64	74LS367	.36
74LS27	.18	74LS126	.36	74LS193	.64	74LS368	.36
74LS28	.20	74LS132	.59	74LS194	.66	74LS378	.69
74LS30	.18	74LS133	.18	74LS195	.64	74LS390	.96
74LS32	.18	74LS136	.28	74LS196	.76	74LS393	.96
74LS33	.21	74LS138	.51	74LS197	.76	74LS395	.96
74LS37	.21	74LS139	.59	74LS240	1.39	74LS490	1.78
74LS38	.21	74LS151	.44	74LS241	1.39	74LS670	1.89
74LS40	.20	74LS153	.44	74LS242	1.32		
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7400	.10	7441	.75	7491	.64	74163	.75
7401	.15	7442	.35	7492	.39	74164	.65
7402	.14	7443	.45	7493	.39	74165	.75
7403	.12	7444	.60	7494	.59	74166	.95
7404	.14	7445	.50	7495	.59	74170	1.50
7405	.17	7446	.55	7496	.49	74173	1.25
7406	.15	7447	.55	74100	.89	74174	1.05
7407	.15	7448	.60	74105	.38	74175	.65
7408	.18	7450	.15	74107	.25	74176	.70
7409	.15	7451	.15	74121	.29	74177	.70
7410	.10	7453	.13	74123	.32	74180	.40
7411	.19	7454	.10	74125	.45	74181	1.95
7413	.30	7460	.10	74126	.40	74182	.70
7414	.55	7464	.20	74132	.60	74185	1.85
7415	.22	7465	.20	74141	.70	74190	.95
7416	.14	7470	.27	74145	.70	74191	.85
7417	.20	7472	.30	74150	.89	74192	.50
7420	.14	7473	.29	74151	.50	74193	.50
7423	.28	7474	.18	74153	.50	74194	.85
7425	.32	7475	.42	74154	.95	74195	.50
7426	.15	7476	.29	74155	.55	74196	.80
7427	.20	7480	.17	74156	.40	74197	.75
7430	.17	7483	.58	74157	.45	74198	1.40
7432	.15	7485	.75	74158	.55	74199	1.25
7437	.15	7486	.27	74160	.65	74S200	3.25
7438	.15	7489	1.25	74161	.60	74279	.65
7440	.13	7490	.35	74162	.95		

LINEAR CIRCUITS

All guaranteed functional
Some items overmarked house numbers
Buy $10.00 -any mix- deduct 10%
Buy $15.00 -any mix- dedict 15%

LM300H	.49	LM340T (78XX)		LM566CN	1.19
LM301CN	.20	5,6,8,12,		LM567CN	1.19
LM302H	.45	15,18,24	1.19	LM567H	1.49
LM304H	.80	LM370	.65	LM703H	.59
LM305H	.45	LM372N	2.93	LM703CN	.39
LM307CN	.20	LM376CN	.25	LM709N	.25
LM307H	.30	LM377N	.95	LM709H	.29
LM308H	.39	LM380N	.79	LM710N	.59
LM309H	1.05	LM380-8CN	.59	LM711N	.35
LM309K	1.05	LM381N	1.75	LM723H	.55
LM310CN	1.07	LM382N	1.75	LM723N	.52
LM311CN	.40	LM385K	.25	LM733H	.59
LM311H	.50	LM386CN	.49	LM739N	.65
LM319N	1.13	LM387CN	.49	LM741CN(8)	.25
LM320K		NE531V	1.90	LM741CN(14)	.32
5,5.2,12,		NE540L	1.90	LM741CH	.35
15	1.29	NE546A	1.09	LM747H	.79
LM320T (79XX)		NE550A	.75	LM747N	.65
5,12,15	1.19	LM555CN	.39	LM748CN	.25
LM322N	.69	NE556A	.85	LM1310N	2.25
LM324N	.95	LM560N	2.95	LM1414N	.60
LM339N	.69	LM561N	2.95	LM1456CN	1.29
LM340K		LM565N	.59	LM1458CN	.55
5,6,8,12,		LM565H	1.39	LM1496N	.89
15,18,24	1.29	LM566H	1.39	LM1800N	1.75

ULN2208	.89
ULN2209	.89
CA3046	1.19
CA3081N	1.49
CA3081H	1.97
CA3082	1.45
LM3900N	.35
LM7524	.79
LM7525	.79
LM7535	.45
8038B	4.59
75450AN	.35
75451CN	.25
75452CN	.25
75453CN(351)	.25
75454CN	.35
75491N	.65
75492N	.75
XR320	1.19
XR2207	1.49
XR2567	1.49
XR4136	1.49
XR4202	.69
XR4212	.69
XR4739	.69

IC SOCKETS

Low Profile Solder Tail				Wire Wrap	
8 pin	$.16	24 pin	$.36	8 pin	.45
14 pin	.19	28 pin	.44	14 pin	.49
16 pin	.21	40 pin	.61	16 pin	.55
18 pin	.28				

CAPACITOR ASSORTMENT - All ±10%

(10pf-820pf ceramic) (.001uf-.47uf polyester)

10pf/50V	68pf/50V	220pf/50V	.001uf/100V	.022uf/100V
22pf/50V	82pf/50V	270pf/50V	.0022uf/100V	.047uf/100V
33pf/50V	100pf/50V	470pf/50V	.0033uf/100V	.1uf/100V
47pf/50V	150pf/50V	600pf/50V	.0047uf/100V	.2uf/100V
56pf/50V	180pf/50V	820pf/50V	.01uf/100V	.47uf/100V
			.015uf/100V	

5 ea of above capacitors.....$13.95
Supplied in steel cabinet with clear styrene drawers.....$23.95
Cabinet shipping chrg (US & Canada) $2.00

TANTALUM CAPACITORS

±20% solid dipped

	1-10	11-		1-10	11-
.22u/35V	.25	.20	10u/16V	.35	.30
.33u/35V	.25	.20	10u/20V	.38	.33
1u/35V	.25	.20	15u/6.3V	.38	.33
2.2u/20V	.28	.23	15u/20V	.45	.40
2.2u/35V	.30	.25	22u/16V	.45	.40
3.3u/35V	.35	.30	33u/10V	.55	.50
4.7u/16V	.30	.25	47u/6V	.55	.50
6.8u/6V	.30	.25	47u20V	.65	.55
6.8u/16V	.30	.25	56u/6V	.75	.65
6.8u/50V	.35	.30	100u/20V	1.45	

cylindrical (axial)

	1-10	11-
.68u/15V	.20	.15
15u/25V	.40	.35

CERAMIC DISC CAPACITORS - 50V

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

1pf-.050u .1uf

1-10 per value	$.10	$.15
11-100	.05	.10
100-	.04	.08

CAPACITOR KIT - ceramic disc

50V, 24 values, 10 capacitors each

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

capacitors only...$11.95

SUMMER CIRCUITS

ELEKTOR 78
Double issue containing more than 100 circuits - such as high-perf. disc pre-amp, Audio control ampl., LED level indicator, Car ammeter, Bike speedometer, A/D Converter and many more.
with order $3.00
mag only 4.25

LED DISPLAYS

DL10A	.27" Red CA LHD	.79
MAN66	.60" Red CA LHD	1.19
OL338	2 Dig .17" Red CC	.29
OL338	3 Dig .17" Red CC	.49
N5N33	3 Dig .17" Red CC	.39
MAN72	.30" Red CA LHD	.59
MAN74	.30" Red CC RHD	.59
N5N74R	.30" Red CC RHD	.59
MAN82	.30" Yellow CA LHD	.69
OL702	.30" Red CC LHD	.69
HP7651	.5" Red CA RHD	.79
HP7653	.5" Red CC RHD	.79
HP3400	.8" Red CA LHD	1.25
HP3405	.8" Red CC LHD	1.25
MAN3620	.30" Orange CA LHD	.79
MAN3630	.30" ±1 Orange CA RHD	.49
MAN4610	.40" Orange CC RHD	.59
HP5082	5 dig .11"mag. Red CC RHD	.49
HP5082	4 dig .11"mag. Red CC RHD	.39
HP5082	5 dig .11"mag. Red CC CD	.49

REO LED - jumbo 12/$1.00
CLEAR LED - jumbo 15/$1.00

MM5316	Clock Chip	.95
MM5370	Clock Chip	3.95
MM5375AA	Clock Chip	2.95
MM5261	1K RAM	.55
MM5262	1K RAM	.95
F93410	256 bit RAM	.95
2513(caps)	Char. Gen.	3.95
2513(L.C.)	Char. Gen.	3.95
MM1101	256 bit RAM	.65
MM1103	1K RAM	.75
2510	Dual 50 bit Shift Reg.	.95
2511	Qual 100 bit Shift Reg.	.95
2518	Hex 32 bit Shift Reg.	1.25
2522	Qual 132 bit Shift Reg.	.95
MM5016	500/512 bit Shift Reg.	.95
SL-5-4025	Quad 25 bit Shift Reg.	.59

Silicon SW diode assorted 400 mw	$.05ea
1N4148 (1N914) Silicon diode 400 mw	.10
1N3064 Silicon SW diode 400 mw	.10
1N4006 Silicon rect. diode 600V 400mw	.10
Zener diode 400 mw - 2.4V, 3.6V, 5.1V, 6.5V, 6.8V, 10V, 12V, 14.5, 15V, 120V	.15
Germanium diode 400 mw	.08

2N1132	PNP Gen Purp. Ampl TO-5	$ .69
2N2218A	NPN Low Power Trans TO-5	.69
2N2222A	NPN Low Power Trans TO-18	.29
2N2223	NPN Low Power Trans. TO-5	.69
2N2369	NPN Low Power Trans TO-5	.29
2N2904	PNP Low Power Trans TO-5	.49
2N2905A	PNP Low Power Trans TO-5	.76
2N3227	NPN Low Power Trans TO-18	.69
2N3904	NPN Low Power Trans TO-92	.17
2N3906	PNP Low Power Trans TO-92	.17
SCA 13572	NPN Pwr Trans - 200V TO-5	1.75

ELECTRONIC BUZZER

Miniature, Solid State
6V 15ma (4-9V oper.) $1.29 ea.
12V 15ma (8-20V oper.) $1.29 ea.

CLOCK KIT - Mark I

6 digit clock kit with one PC board. Accommodates MM5314 clock chip and 6 FND 359 displays contains all components except transformer. Includes 3 switches. Board has terminals for remote displays. $10.95

TANTALUM CAPACITOR KIT

solid dipped, 12 values, 5 each

.1uf/35V	2.2/35	10/25	33/10
.33/35	4.7/16	15/20	47/25
1/35	6.8/16	22/16	56/6

capacitors only.....$14.95

PLASTIC CASES

VERO - dark and light gray
nominal O.D.

2514F	2"x4"x1"	$4.34
2516G	2"x4"x1.6"	4.90
2518H	2.6"x 4.7"x1.6"	5.48
2520J	3.2"x6"x2"	6.24
2522K	4.3"x7.4"x2.4"	8.28
2755G	2.6"x4.7"x2.6"	6.74
2760D	4.3"x7.4"x2.4" (w/ handle/stand)	10.78
2525F	2.8"x5.4"x2.4" (ventilated)	5.40

HAMMOND - blue

1591C	2.6"x4.8"x1.6"	2.65

BEZELS - with red filters

140-2	cut-out 1.125" x 2.375" max .062" panel thickness	$1.75
140-4	cut-out 1.160" x 4.375" max .125" panel thickness	$2.75

POWER SUPPLY

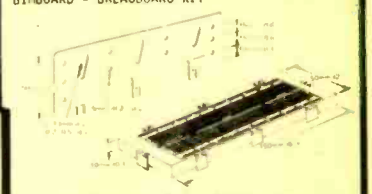
5 VOLT, 3 AMP - parts package

Includes following components:

115/9V Transformer	2 - 3300uf/25V Caps.
PC Board	Diode
Rectifier	Terminal Block
Power Transistor	Heat sink
5V Regulator	Power cord

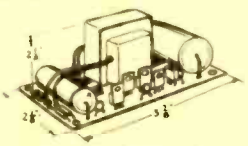
Supplied with layout and schematic..$22.95
Shipping (US & Canada).....$3.00

BIMBOARD - BREADBOARD KIT



Solderless breadboard section has 94 breadboard strips of 5 sockets each. 2 bus strips of 40 sockets each. Component bracket for switches lamps etc., accepts leads .01" to .035" diameter. $11.95 ea.

REGULATED POWER SUPPLY



Plus & minus 5V, 12V and 15V. Uses 3 LM340T and 3 LM320T regulators, 115V/29V CT transformer plus PC board capacitors & diodes. All parts, schematic, instructions PS-29.....$12.95 + $1.00 Shppng.

TRIMPOT - Single Turn

Mepco - Cermet 8014
.5w, + 100 PPM/°C + 20%
500 ohm, 2K, 10K, 20K, 50K, 100K, 500K, 1M.

1-9	10-99	100-999	1000-
$.75ea	.69	.63	.57

TRIMPOT - 25 turn

Bourns - Cermet 3299W
PC Mount, vert. adj.
2K, 10K, 20K

1-9	10-999	100-
$1.65	1.50	1.35

METAL FILM RESISTORS

Rohm QUALITY RELIABILITY

± 1%, 1/4w, ± 50 PPM/OC
Standard Decade Values 10.5 - 464K

Qty.	Ea.	Min 10/value	Min 100/value
1-99	$.20	$.15	
100-999	.20	.10	$9.00/100
1000-			8.00/100

Carbon Film Fesistors ± 5% 1/4w, 1/2w

Qty.	Ea.	Min 10/value	Min 100/value
1-99	$.10	$.05	
100-999	.10	.04	$3.00/100
1000-			2.50/100

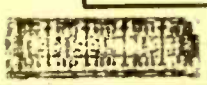
Carbon Film + 5% 1/4 w or 1/2 w
15 ea. of 12 values:
100, 220, 470, 1K, 1.5K, 3.3K
4.7K 6.8K, 10K, 33K, 100K, 1M.
$5.45

Carbon Film + 5% 1/4w or 1/2w
Usage Evaluated Assortment
5 to 20 ea of 44 values.
$12.95
Supplied in 15 Drawer 60 Comp. Cabinet. $22.95 + $2.00 Sh.

PRECISION RESISTOR PACKAGE

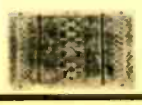
Metal Film ± 1% 1/4 watt
Starter Kit - 2ea. 60 values
120 Resistors 10.5 ohm- 464K
$14.95
Supplied in 15 Drawer 60 Comp. Cabinet - $26.50 + $2.00 Sh.

I C BREADBOARD



Silver plated copper circuits holds 5 - 16 pin DIP IC's and interconnection holes. $1.00

UNIVERSAL BREADBOARD



Silver placed copper circuits fits any IC and related components. 2 triple rows of 27 holes for DIP. 3-3/16"x5-1/16" $1.00

VECTOR BOARD - Phenolic

169P44-062 (.1"spacing .42" dia.)
4-1/4" x 4-1/2" x .0625"...$1.15 ea.

COMPLETE SATISFACTION GUARANTEED. SHIPMENT TO US AND CANADA PREPAID UNLESS INDICATED OTHERWISE. OTHER COUNTRIES ADD 10% - EXCESS REFUNDED. ORDERS SHIPPED IN 3 WORKING DAYS FROM RECEIPT. MINIMUM ORDER $10.00 CALIFORNIA RESIDENTS ADD SALES TAX. MINIMUM COD OR CHARGE ORDER $15.00

INTERNATIONAL ELECTRONICS UNLIMITED
VILLAGE SQUARE, P.O. BOX 449, CARMEL VALLEY, CA 93924 USA
TELEPHONE 408 659-3171

CIRCLE 16 ON FREE INFORMATION CARD

ADVERTISING INDEX

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

IF YOU'RE WAITING FOR SOLDERLESS BREADBOARDS TO BE FASTER, EASIER, MORE VERSATILE AND LOWER-PRICED...

Incredibly inexpensive. EXPERIMENTOR solderless sockets begin at $5.50* ($4.00* for the 40 tie-point quad bus strip). A spool of solder costs more.

Mix and match. Use large and small chips in the same circuit without problems. There are two sizes of EXPERIMENTOR sockets with 0.3" and 0.6" centers.

Full fan-out. A CSC exclusive. The only solderless breadboard sockets with full fan-out capabilities for **micro-processors** and other larger (0.6") DIP's.

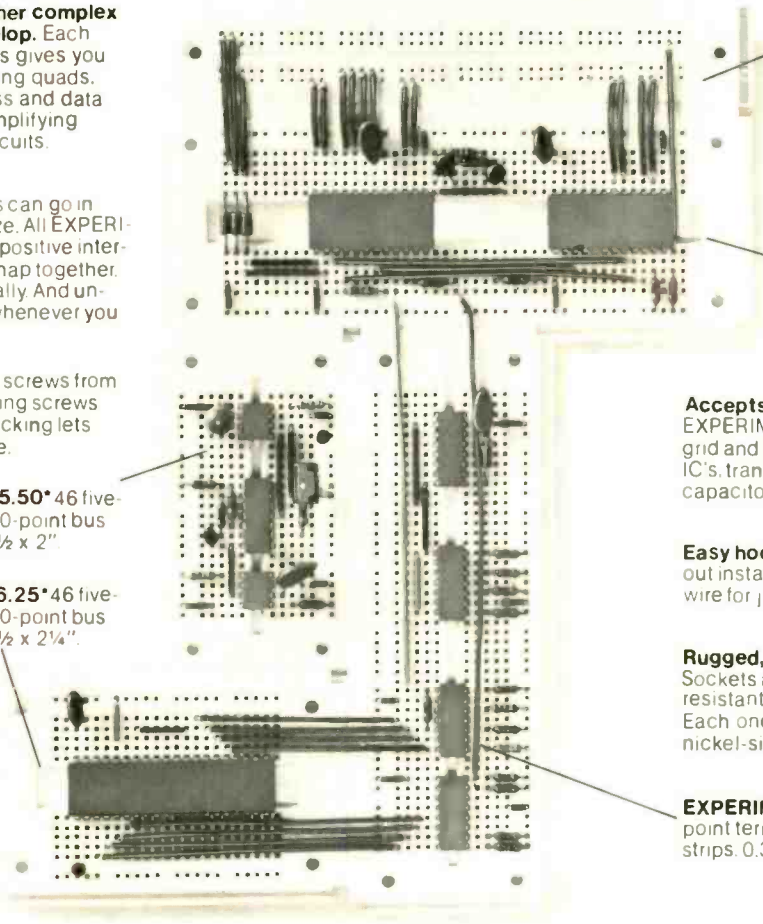
Microprocessors and other complex circuits are easy to develop. Each EXPERIMENTOR quad bus gives you four bus lines. By combining quads, 8-, 12- and 16-line address and data buses can be created, simplifying complex data/address circuits.

Infinitely flexible. Circuits can go in any direction, up to any size. All EXPERIMENTOR sockets feature positive interlocking connectors that snap together. Horizontally and/or vertically. And unsnap to change a circuit whenever you wish.

Easy Mounting. Use 4-40 screws from the front or 6-32 self-tapping screws from the rear. Insulated backing lets you mount on any surface.

EXPERIMENTOR 350. $5.50* 46 five-point terminals plus two 20-point bus strips. 0.3" centers; ⅜ x 3½ x 2".

EXPERIMENTOR 650. $6.25* 46 five-point terminals plus two 20-point bus strips. 0.6" centers; ⅜ x 3½ x 2¼".



EXPERIMENTOR QUAD BUS STRIP. $4.00* Four 40-point bus strips. ⅜ x 6 x ¾".

Designated tie-points. Simplify translation from breadboard to PC-boards or wiring tables.

EXPERIMENTOR 600. $10.95* 94 five-point terminals plus two 40-point bus strips. 0.6" centers; ⅜ x 6 x 2¼".

Accepts all standard components. EXPERIMENTOR sockets conform to an 0.1" grid and are DIP compatible. Also accept IC's, transistors, diodes, LED's, resistors, capacitors, transformers, pots, etc.

Easy hookup. Components push in and pull out instantly. Use #22-30 solid AWG wire for jumpers.

Rugged, dependable construction. Sockets are constructed from abrasion resistant materials and withstand 100°C. Each one features non-corrosive nickel-silver contacts.

EXPERIMENTOR 300. $9.95* 94 five-point terminals plus two 40-point bus strips. 0.3" centers; ⅜ x 6 x 2".

WHAT ARE YOU WAITING FOR?

Discover today how solderless breadboarding can save time and money on every circuit you build. Get acquainted with EXPERIMENTOR™ sockets† and how they simplify circuit design, assembly and testing. Eliminate the hassles and component damage of soldering. No special hardware or jumper cables required, either. And the price is so low, it's hard to believe.

"Order today. Call 203-624-3103 (East Coast) or 415-421-8872 (West Coast): 9 a.m.-5 p.m. local time. Major credit cards accepted. Or see your CSC dealer. Prices slightly higher outside USA."

CONTINENTAL SPECIALTIES CORPORATION

70 Fulton Terrace, Box 1942, New Haven, CT 06509. 203-624-3103 TWX 710-465-1227
WEST COAST: 351 California St., San Francisco, CA 94104, 415-421-8872 TWX 910-372-7992
GREAT BRITAIN: CSC UK LTD., Spur Road, North Feltham Trading Estate, Feltham, Middlesex, England, 01-890-0782 Int'l Telex: 851-881-3669
CANADA: Len Finkler Ltd., Ontario

†U.S. Patent No. D235,554

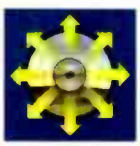
*Manufacturer's recommended resale

CIRCLE 5 ON FREE INFORMATION CARD

New, K40 Magnamount: Grips like a grapple, actually improves transmission.

We double guarantee it.*

Exclusive Octopole Construction.



That's eight magnets set in eight different directions to give you a magnetic seal so complete and powerful, your antenna would stay up there if you could squeeze between two semis passing each other at 180 miles an hour. That's magnetic octopower.

* GUARANTEE I

Placed on the roof of a vehicle; properly tuned, the K40 Magnamount is guaranteed to transmit a further distance than a standard K40 without the Magnamount or you will receive a prompt and full refund from your K40 dealer who installed and tuned the Magnamount K40 for you.

* GUARANTEE II

Materials and workmanship are guaranteed for a full 12 months. Any part that fails to perform satisfactorily will be replaced absolutely free.

Exclusive K40 Flux Harmonics for Greater Transmission.

The magnetic radiation pattern was designed to match the K40 antenna radiation for greater distance than the standard K40. See our guarantee.

The facts: Physics and Physical.

1. Magnamount is a bigger, stronger magnet—in fact it's 8 bigger, stronger, magnets.
2. It doesn't just hold the K40 antenna, it helps it transmit further.
3. Remember the law of reciprocity. The antenna that transmits better, receives better.
4. It provides a flatter, lower SWR because the Magnamount is capacitance grounded.
5. It puts your 5/8 wave K40 antenna securely in place in the most advantageous place to work against a ground plane—high and free from obstruction. That's square in the middle, right up on top.

$15.95 buys it.

(SUGGESTED RETAIL)

K40 Magnamount.

American Antenna 1945 South Street Elgin, Illinois 60120

This professional CB equipment available only through Registered K40 Dealers!

CIRCLE 3 ON FREE INFORMATION CARD