CB REPORT – BASE-STATION ANTENNAS

75¢ ■ JULY 1976

Radio-Electronics

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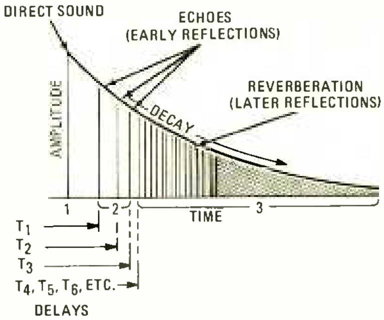
JULY 1976 Vol. 47 No. 7

ON THE COVER

Mindpower: Alpha is no ordinary brainwave monitor. It displays the presence of alpha waves on a TV screen in either of two possible modes. Use it to train yourself to relax. To get started on this project turn to page 36.



A NEW DIGITAL REVERB unit that can turn your home into a concert hall. For a complete description, turn to page 43.

WHAT! NO CLOCKS

Last month we reported that this issue would feature two construction projects—a countdown timer and a digital clock. We are sorry to report that both these projects experienced difficulty and we had to delay publication. The countdown timer will run in the August, 1976, issue and the digital clock will run in a near future issue.

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looking ahead

New CB licenses

The FCC is now issuing temporary CB licenses to all transmitter purchasers, enabling them to go on the air immediately—and legally—right after the purchase. The temporary permit is supplied by the dealer at the time of purchase, and is good for 60 days from the date a permanent-license application is mailed to the FCC. The applicant derives his own temporary call sign, consisting of the letter K followed by the initials of his first and last names and his ZIP code.

By mid-April, the FCC was receiving an average of 500,000 CB license applications a month. The backlog of unopened mail at its Gettysburg, PA, license-processing center was about 2½ weeks and it was taking seven weeks from the time the application was mailed to Gettysburg to receipt of a permanent license.

30-inch color tube

The largest picture tube ever produced in quantity is the new giant Sony Trinitron direct-view color tube that measures 30-inches diagonally. The measurements of the picture are 21.1 × 27.2 inches or approximately 575 square-inches in area, 82.5% larger than the 25-inch color tube (315 square-inches). The tube will be offered in Japan this fall in a television console at about $5,000 and in a monitor at approximately $3,300. Both units are designed for use with Sony's U-Matic and Betamax videocassette recorders. The tube may be offered in U.S.-market TV receivers later.

Old-timers will recall another 30-inch television set that hit the market a long time ago. This was the DuMont Royal Sovereign, introduced in 1951, sporting a giant 30-inch round black-and-white tube with a picture measuring around 550 square inches. Between 500 and 1,000 of these sets were sold before they were obsoleted by the 27-inch rectangular tube that briefly reigned as the largest "industry-standard" black-and-white picture tube.

VIR TV

A line of television receivers whose chroma and tint are adjusted by the TV station has been introduced by General Electric. The sets have a special circuit that makes automatic adjustments based on the standard color burst and chrominance elements of the vertical interval reference (VIR) signal which is rapidly becoming a standard feature of broadcast transmission.

The VIR signal has been approved by the FCC for insertion in line 19 of the blanking period between television frames. The signal contains references for luminance amplitude, black-level amplitude and sync amplitude as well as chrominance amplitude and color-burst amplitude and phase. At any point of origination—from videotape recorder to transmitter—the color, brightness and contrast of the picture may be maintained at the proper level by restoring the reference signal to its exact specifications.

All three commercial TV networks as well as the Public Broadcasting System are now inserting the VIR signal in their pictures, as are many videotape production houses and independent stations. It is estimated that perhaps 50% of all television stations now use the VIR signal for picture adjustment, and it's hoped that eventually all stations will make use of it. Adjustment at the station is usually manual, although automatic adjustment equipment is available from Tektronix.

The new G-E sets automatically track the color portions of the reference signal by means of a 5-in. × 5-in. circuit-board containing five specially developed IC's. A pilot light indicates when the VIR signal is present. The automatic correction may be overridden by a defeat switch. The special VIR feature is included in one 19-inch set designed to sell for about $550 and four 25-inch consoles in the $775-to-$800 price range. The automatic circuitry adds an estimated $30 to $50 to the retail price. Although the VIR signal could also be used to automatically adjust the contrast-brightness ratio, G-E has decided that these settings should be left to the viewer's own preference.

Another new feature in G-E's 1977 line is the first 25-inch color-picture tube with in-line gun. The new tube has a standard dot-type mask (as opposed to the slot masks in most in-line tubes) with a new electron gun designed to provide a finer spot size, overcoming the major problem of in-line guns in large-size picture tubes.

CB expansion

The eagerly awaited expansion of the 27-MHz Class-D Citizens band has been postponed again, as reported here last month. The FCC says it could come by January 1—although some veteran FCC-watchers caution against expecting anything before next April. The hold-up in expansion is an investigation of interference problems—particularly intermodulation (IM). The FCC stressed that expansion in the current 27-MHz band is only an interim step to relieve the immediate problem of congestion, and that it is studying "long-term needs of the general public for personal radio communications." It's generally believed that the ultimate home for personal radio will be further upstairs in the spectrum, possibly around 600 MHz.

The Commission indicated that the present 23 channels on 27 MHz would be expanded to about 58 conventional AM channels—or possibly 99, 105 or 115 through various combinations of amplitude modulated and single sideband channels.

Videodisc postponed

Once again the videodisc is sliding over the horizon into the further future. The plans of both RCA and Philips (Magnavox) to begin marketing in 1976 apparently have been shelved for at least a year. Although both companies have produced a number of players and are convinced that this can easily be translated to mass production and are setting up disc production facilities, they are going slow on plans for market introduction—presumably waiting more for a better economic climate than for any technical breakthrough.

RCA has an in-home test project well under way in Indianapolis, and Magnavox is believed to be starting a similar program in Fort Wayne. The tests, which involve the placement of players in consumer homes, are designed to determine reliability, ease of operation and consumer reaction to the new video medium.

We recently visited RCA's videodisc mastering and duplication facilities in Indianapolis, and there is no doubt this company has a serious commitment to the new product. Specialized equipment there has the capability of producing nearly 6,000,000 two-sided 12-inch discs (playing time is one hour) per year on a two-shift basis. Mastering has already started on the first of 250 or so initial video programs. RCA President Anthony Conrad estimates that marketing of player and discs will start on a regional basis some time between mid and late 1977.

Philips and its subsidiary Magnavox are quieter about their plans, but they seem to be headed for a 1977 introduction date as well. MCA Disco-Vision is now in the process of mastering the forerunners of an anticipated 1,000 initial programs on 30-minute optical discs for the Philips player.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

new & timely

Two Bell scientists honored for semiconductor research

William G. Pfann and Henry C. Theurer have been named by the American Physical Society as the winners of the Society's International Prize for New Materials. The prize is awarded for outstanding achievement in research and carries a $2,500 award for each recipient. The two Bell scientists were cited "for their outstanding work on the development of methods for purifying semiconductors and growing epitaxial crystals from the vapor phase. This effort has been of vital importance in the growth of semiconductor technology."

Mr. Pfann invented the zone refining method (**Radio-Electronics,** December 1972, page 36) to make the ultra-pure germanium that made the first transistors possible. Mr. Theurer invented the floating zone refinishing method that improved ordinary zone refining and eliminated the need for a crucible. It was used to make ultra-pure silicon, the basic material for field-effect transistors and for most of the transistors used today. Theurer also invented a process for preparing ultra-pure silicon tetrachloride, which Bell Labs used to make the first successful epitaxial crystals for transistors. These developments were all quickly adopted by the semiconductor industry and since then have been extended to other fields.

Vertical interval test signal for automatic color correction

With the anchoring of VIRS (*V*ertical *I*nterval (Color) *R*eference *S*ignal) on line 19 by the FCC, a completely automatic color television receiver becomes possible. Although some manufacturers insist they can regulate chroma, color sync and luminance signals in their receivers without recourse to outside signals, others are enthusiastic about the proposed new approach.

Bill Quinn, manager at General Electric, Portsmouth, VA, says "Broadcasting VIRS offers an excellent tool for the receiver manufacturers, networks and local broadcast stations to ensure that the customer receives and maintains a picture of the quality seen by the studio camera."

According to Quinn, to make VIRS work in TV receivers, the circuitry must locate and identify line 19; gate out the black-reference and white-reference levels, chroma and burst; correlate the amplitude of the 3.58-MHz chroma in the luminance part of the signal with the luminance reference to insure the proper relationship between luminance and chroma; establish the black level for the picture-tube cutoff; and correct differentially the phase errors between the chrominance reference and the corresponding frequency in the receiver-regenerated subcarrier.

One drawback is that the FCC has not yet made it mandatory to broadcast the VIRS, though manufacturers tend to believe it will become a federal regulation.

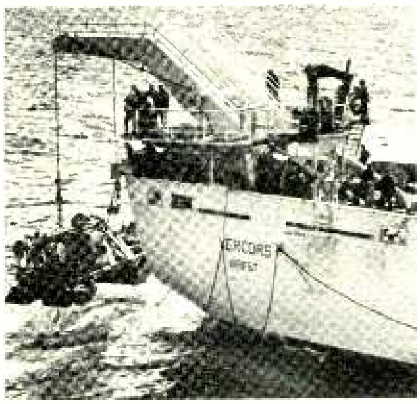
Footstep detector patented

Two Honeywell engineers have invented a seismic human footstep detector to be used in intruder alarms. Vibration and sound detectors have been used in intrusion alarms in the past, but have had the weakness that they would respond to many other signals than human footsteps.

According to Patent 3,992,663, issued to Roger A. Lubke and Charles P. Varecka and assigned to Honeywell, Inc., the human footstep does not normally exceed 250 milliseconds in duration and successive footsteps occur within a period of less than 1.6 seconds. With this basic data, the device is able to determine whether the vibrations—picked up by a geophone—are human footsteps or not. If they fit the specifications, an alram is sounded.

Newest transatlantic cable carries 4,000 conversations

Second step in the laying of the world's largest capacity transatlantic cable began early last spring when the Bell System's cable ship *Long Lines* began to lay the deep-sea portion of the cable. The work began last August when the French



UNDERWATER SEA PLOW is suspended from the stern of the French cable ship *Vercors,* that has plowed under—in a trench about two feet deep—the parts of the transatlantic cable that lie in shallow water on the continental shelves off the U.S.A. and France.

cable ship *Vercors* plowed under the shallow-water portions, burying 111 nautical miles of cable between the Rhode Island shore and the edge of the continental shelf. It then laid a similar section off the French coast. The cable was buried about two feet deep with the special plow, designed by Bell Laboratories, that forms part of the equipment of the *Vercors.* This prevents damage from fishing vessels or anchoring ships.

The entire cable system, called TAT-6, will extend 3,379 nautical miles (3,891 land miles) from Green Hill, Rhode Island, to the French coastal town of St. Hilaire. It will be able to carry 4,000 telephone conversations simultaneously—more than twice the capacity of any transatlantic cable now in service—and will also carry data, telex and other forms of communications.

Repeaters, each weighing more than 600 pounds, spaced every 5.1 nautical miles (roughly every 6 miles) along the cable will amplify the signals so that they will arrive at their destination with approximately the same strength they started with.

The system was developed as a joint engineering project by groups from the British Post Office, the French Ministry for Posts and Telecommunications and AT&T.

Cable-TV companies in struggle against pirate program tappers

Hundreds of thousands of homes in the United States are connected illegally to local cable-TV distribution systems, says the president of a national cable-TV company. These free riders are enjoying their programs at the expense of the viewers who do pay, and endangering the very existence of some of the companies by denying them revenues they would receive if the free-riders paid for the services they are receiving.

The recent expansion of Pay-TV has aggravated the situation by increasing the incentive to rob the cable. The companies costs have also increased by the fees they have to pay to transmit the programs, and these costs must be paid back in customer rental fees if the companies are to survive.

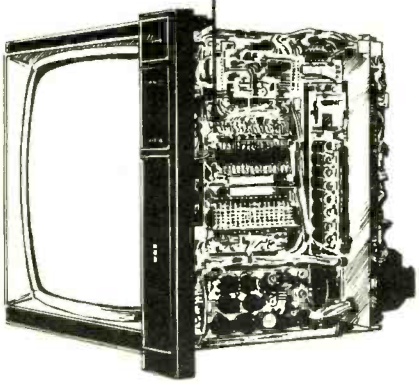
Some cable companies use special security forces to track down illegal connections. In Manhattan, for example, Teleprompter Corp. employs a force of 30 persons to trap thieves who tap into apartment building connection boxes. The security system is paying for itself —Teleprompter reports that 25 percent of the persons disconnected decide to pay for the service.

On another front, prosecutions are being initiated against concerns that sell the converters that change the shortwave transmissions from the cable companies to an unused local VHF channel. State

(continued on page 12)

Three different schools give you this 25" DIAGONAL hobby-kit Color TV...

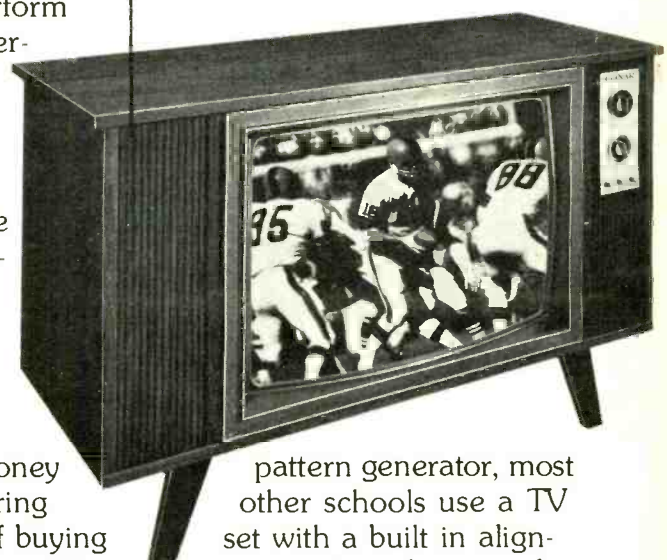
Only NRI gives you this 25" DIAGONAL designed-for-learning Color TV...



No other home training school gives you both an exclusive solid state color TV and an SQ® Quadraphonic Receiver complete with four speakers . . . all in one course. You get both for hundreds of dollars less than the combined tuition cost of TV and Audio courses at another school. And only NRI's Master Course in Color TV/Audio servicing lets you train on equipment specifically designed for training with exclusive "power-on" features.

NRI doesn't give you hobby kits or commercial sub-assemblies. We invested the time and money to design equipment with learning in mind.

It's the only way you can (1) get the feel of typical commercial circuitry, (2) learn bench techniques while building complete units from the "ground" up, (3) perform over 35 "in-set" experiments during construction, and (4) end up with a 25" diagonal solid-state color TV with console cabinet *and* a 4-channel quadraphonic Audio Center.



NRI passes the savings on to you

NRI can save you money because our engineering eliminates the cost of buying from an outside source. We pay no salesman's commission. Students are enrolled by mail only. The savings are passed on to you in the form of low tuition fees, extras like the TV's console cabinet and the four speaker Quadraphonic System; a 5" triggered sweep oscilloscope, CMOS digital frequency counter, and an integrated circuit color TV pattern generator. Where NRI supplies a professional color pattern generator, most other schools use a TV set with a built in alignment generator of no use for servicing other sets. Only NRI designs, engineers, and supplies training kits specifically for learning and professional use. You can pay hundreds of dollars more for a similar course and not get a nickel's worth more in training and equipment.

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new & timely

(continued from page 6)

laws are also coming into play against cable pirates. More than a dozen states have passed theft-of-service laws—some of which provide jail sentences as well as fines. In Wilmington, DE, several members of the local police force were found enjoying cable-TV without pay. A number of converters stolen from the local cable company had been recovered by one of the officers, who turned in a number and gave the rest to his friends. He was indicted on 10 criminal charges.

Most severe sentence reported so far was a 45-day jail sentence imposed on an Ilion, NY, man who connected his girlfriend's TV set to the local cable.

In spite of the partial successes against the pirates, there are still a number of difficulties including the uncertainty of the legality of making and selling converters that can be used for illegal purposes only, and the fact that perfectly legal equipment can in some cases be used to receive such signals. The struggle is crucial according to the cable companies, and on its success may depend the future expansion of cable TV—particularly pay-TV, the viewers of which tripled in number last year from 160,000 to more than a million.

Maritime satellite provides instant ship-shore radio ties

MARISAT, the world's first commercial telecommunications satellite was launched into synchronous orbit over the equator at 15 degrees West longitude. Its

MARISAT, being checked out at the Hughes Aircraft Co. plant in California, where it was built for Comsat General Corp. A Hughes technician is using a theodolite to check out its vertical and horizontal alignment.

twin was launched into orbit over the Pacific at 176 degrees East longitude. The satellites will provide "a new clear voice for ships." Ship captains have in the past waited as long as 8 to 20 hours for messages by ordinary shortwave radio, troubled as it is by severe fading, interference, atmospherics and propagation difficulties.

The new satellite technique assures instant communication by voice, telex, facsimile and data communications, both for the international merchant marine and the U.S. Navy. Three channels are provided, one in the UHF range for the Navy and two in the gigahertz region—L-band for merchant vessels and C-band between shore stations and the satellite.

Lighter weight, lower costs in new Zenith picture tube

Zenith has demonstrated to TV manufacturers a new 19-inch color tube expected to reduce cost as well as weight. The tube has a unique slot-type shadow-mask assembly two pounds lighter than previous masks. It is made by multi-stage mask forming dies to achieve a self-supporting mask that eliminates the conventional mask frame and can be inserted with automatic equipment.

Another weight-reducing concept is a "skirtless" faceplate panel that eliminates the heavy molded glass flanges of current tubes. The new faceplate panel, with an unground seal edge, can be joined easily with a newly designed funnel shaped for maximum strength.

The new tube has a deflection angle of 100 degrees, a small neck in-line high resolution gun and a smaller spot. It is 2.5 inches shorter than older 19-inch Zenith picture tubes.

Two CB stations silenced

Val G. Hodges of York, PA, was fined $200 and received a suspended 60-day sentence, and James R. Laden of Anchorage, AK, lost his license for violation of FCC regulations.

Hodges was operating a mobile without a license. He was tracked down by direction-finding equipment, which made the final positive identification of his operation from a vehicle in violation of a previous cease and desist order. Six pieces of radio transmitting equipment, including two illegal linear amplifiers, were seized.

Laden (KHO-4585) was found guilty of transmitting communications to another station on a frequency reserved for intrastation communication, for failing to identify his station, and of refusing to permit an inspection of his station by FCC personnel. His conduct, the judge stated, was further aggravated by "misrepresentation" and lack of the truthfulness and candor required to qualify to be or remain an FCC licensee. **R-E**

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letters

ASCII TO BAUDOT

I would like to call attention to two important corrections that were omitted from the "ASCII To Baudot" article (*R-E*, March 1976).

First: In Table I, word 31, Bell should be removed and replace with a Null, and no bits should be shown programmed. The code as shown is the same as letter "S".

Second: On the schematic diagram (Fig. 1), pin 3 of IC2-a should be shown connected to *pin 15* (not 11) of IC7. We must detect a change in bit 6 instead of bit 7 or else a CR or LF will shift us to LETTERS with no way to output FIGURES.

Printed-circuit boards from Southwest Technical Products are correct. It should also be pointed out that the kit of all parts *includes* the PC board.

ROGER L. SMITH

TI CALCULATORS

Many of your readers probably have the SR-52 or SR-51 calculators which are manufactured by Texas Instruments, Inc. Both of these calculators have fully addressable memories which are accessible from the keyboard that are not mentioned in the respective owner's manuals.

For the SR-51, memories 1, 2, 3, 4, 5, 6, 7, 8, and 9 are available. Care should be exercised in using memories 4-9 since they are used during various calculations, chiefly for linear regression.

On the SR-52, memories 60-69 are the operational registers and are directly accessible from the keyboard. With care, some of these registers can be used for data storage—depending on the number of pending operations required. Registers 70-79 are used for program storage. Each of the registers 70-97 corresponds to 8 programming steps, i.e. register 70 corresponds to program steps 000-007. If all programming steps are not required, registers 70-97 are available for data storage.

Care must be exercised in using registers 70-97 for data storage since these registers can be written over when loading a program from magnetic cards. Registers 98 and 99 are also available on the SR-52. These registers are not destroyed by loading magnetic cards, internal operations, etc. Registers 60-69 are cleared by pressing the CLR key. Registers 70-99 can be cleared by storing 0 in them or overwriting them with new data.

Access to the memories on the SR-51 is provided by following STO or RCL by the numbers 1-9. Memories on the SR-52 are accessed by STO or RCL followed by the appropriate two digit number. It should be noted that register arithmetic can be done in any of the registers mentioned for the SR-52.

It should be re-emphasized that extreme care must be taken to avoid losing data stored in these memory registers. With proper precautions the capabilities of both of these calculators is greatly enhanced.

I read your magazine every month and find it very interesting. Keep up the good work.

THOMAS S. COX
Greenville, SC

MICROCOMPUTER/TV INTERFACE

I can't understand it!! There are so many computer hobbyists without any I/O. And yet we can find no circuit that will take our 8 bit output and put it on our TV screen.

There are many TV typewriters, TV games and TV graphics (most in the range of $160-$300). Where is the circuit (inexpensive) that will accept 8-bits of x, y, brightness (whatever the TV will need) and convert it to video for my portable TV?

My 6800 is waiting as are many others!! This circuit would be more versatile than a dedicated TV typewriter or game.

Let the computer owner build it to fit into his system to accommodate his needs. Let him decide on where the memory shall reside.

There is a need!!!!! See what you can do!!!!

PAUL HYDE JR.
Milwaukee, WI

We agree. There is a definite need for an inexpensive project of this kind. If any of our readers have any ideas, circuits, etc., please forward them. We are interested.—Editor

LOW-FREQUENCY METER

Ever since the calculator on a chip came out a few years ago, I've been waiting for someone to come out with a kit for a high-accuracy low-frequency meter. Using a crystal-controlled timebase, it would count the number of crystal oscillations between input pulses. The calculator chip would then divide this number into an appropriate constant to obtain the display output. For example, with a 1-MHz timebase and a 60-Hz input, the counter would count to 16,666. This could be entered into the calculator as 16.666 ms. Then dividing 16.666 into 1,000 (the constant for hertz output), the meter (digital display of course) would display 60.00. With a .01% crystal, this reading is approximately ± .01 Hz. To obtain RPM, the constant would be 60,000 and the display would read 3600 RPM.

The uses for low-frequency meters are quite extensive: tachometers, tuning mu-

(continued on page 16)

In receiving tubes, the only full line is now our line.

Sylvania makes the broadest line of receiving tubes in the world—from Nuvistor to power tubes.

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GTE SYLVANIA

GTE Sylvania, Electronic Components Group, 100 First Ave., Waltham, MA. 02154

Circle 5 on reader service card

(continued from page 14)

sical instruments, measuring a heart beat or even setting a mechanical timepiece by measuring the time between ticks. In the case of heart beat or ticks of a clock, the meter might be arranged to take an average over four or five or more input pulses. The meter would still be faster and more accurate than meters that use long pulse counting periods or pulse insertion methods.

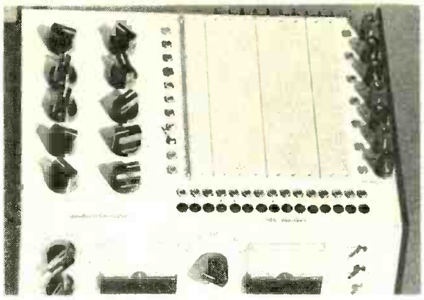
Now the processor on a chip is available at quite reasonable prices, and it seems this device would make simpler the implementation of the meter.

If such a kit already exists, I would appreciate knowing about it. If not, it might be a good idea for a construction project for your magazine.
DOUGLAS GORGEN
Apt. 202-A
548 W. Johnson St.
Madison, WI 53703

IC BREADBOARD

Enclosed you will find a photograph of my finished IC Breadboard Prototyping system (**R-E,** February 1975 issue). After 5 months of construction and wiring and all, I finally finished it. I changed several things from the suggested layout but I tried to stick with the general format of your article.

Some innovations I put in were: a built-in 3" speaker on the bottom of the cabinet and a pair of terminals (banana



jacks) on rear panel for a scope—these jacks are interconnected to pin jacks to left of breadboarding socket through a rotary switch to make testing circuit conditions much easier. I added an external position to the voltmeter in the meter section and I included an AM/FM modulation type generator using two XR205's enabling me to have 2 separate signals if I choose. There are +5 and +12 volt pin outs too.

I priced the nearest thing to what I had constructed and it cost well over $1400 and it fell way short of the capabilities of my system. I think this system is worth close to $2000 and it only cost me about $180. That's a bargain. Keep up the fine projects.
DONALD MAHARAS
Everett, WA

CALCULATOR/STOPWATCH

Regarding the article on Build a Calculator/Stopwatch (**R-E,** November, 1975 and February, 1976.) I had a National Semiconductor model 600 calculator which had the right components to attempt the conversion, so I decided to attempt it.

The parts were procured for the added circuit and put together. When wiring the circuit I found that the driver IC was wired entirely different than the one shown in the article. After figuring out the correct combination of which driver went to which digit (new pin numbers are shown in circles on diagram), I wired in the Stopwatch unit and it worked fine. I adjusted it to within .03 seconds in 2 minutes.

Fine, but when I went to use the calculator I found that when entering 8 from the keyboard, a zero was automatically displayed and also stored in the register. This caused some head scratching since all other functions of the calculator performed normally. Through some consultation with local engineers, it was decided to try breaking the foil from pin 1 of the 5736 IC to the keyboard and connect the keyboard side to pin 14 of the driver IC. After accomplishing this, the calculator worked properly (including the 8) and the stopwatch ran fine.

Maybe other readers have run into this same problem and have wondered what to do. Also, since I could not find a source for the MC14571, I used a N4081 which seems to be an exact replacement. (MC14571 was a Motorola developmental type number. The production type number is MC14081. The RCA equivalent is CD4081.—Editor)

I enjoy your magazine very much—keep up the good work.
BILL WAINES

Regulation of cable-TV rates now being checked by FCC

The Federal Communications Commission has ordered an inquiry into the process by which cable-TV subscription rates are regulated. At present, most of these rates are set by the municipalities in which the cable systems are located.

The FCC reported that the inquiry does not indicate any immediate intended change in the present system of largely local regulation. One of the reasons suggested for the investigation was concern by some cable companies over what they considered "unreasonable delays" in considering requests for rate increases.

Circularly polarized antennas improve TV pictures

Results of an extensive FCC-authorized test of circularly polarized TV antennas were reported to the recent NAB convention in Chicago by Peter K. Onnigian of Jampro Antenna Co.

The test results, Mr. Onnigian reported, indicate that TV pictures on home receivers are "significantly improved" when the signal is transmitted with a circularly polarized antenna. Ghosts are eliminated while snow and signal fading are reduced.

The tests were carried out at TV Station KLOC (UHF) in Modesto, California. Test results have been submitted to the FCC for analysis. Jampro has had long experience in designing and manufacturing circularly polarized FM broadcast antennas. R-E

We'd like to compare our

But there's no

(Simulated TV Reception)

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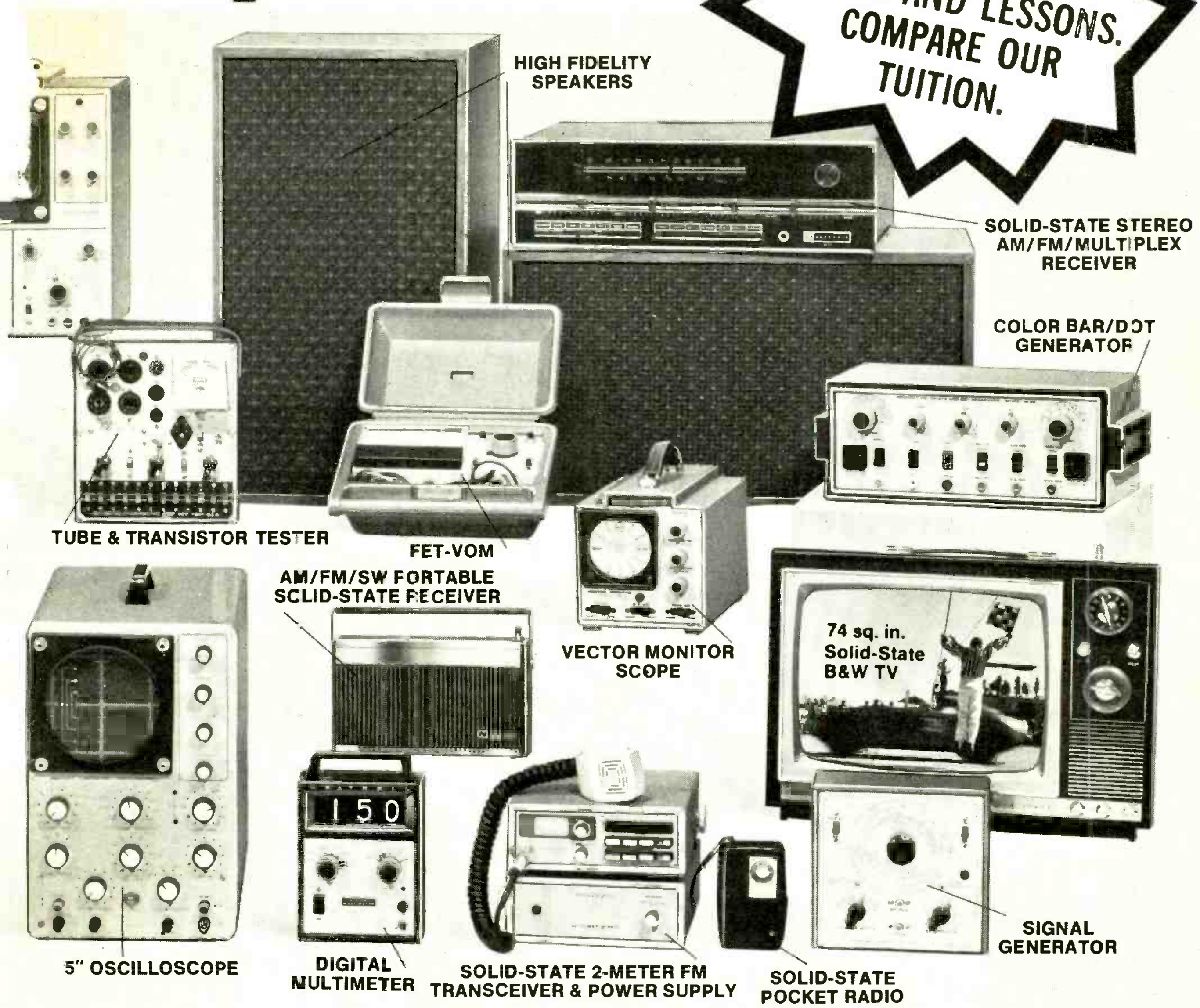
comparison.



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KOMPUTER KORNER

DAVID LARSEN, PETER RONY, and JOHN TITUS*

THIS MONTH WE WILL DISCUSS THE 8080 microprocessor. Will cover the 8080's hardware architecture and in a future column we will discuss its instruction set and programming characteristics. This should provide us with enough information to begin discussing various programming techniques illustrated with examples using the 8080.

Background

The 8080 microprocessor was introduced by Intel Corporation in late 1973. It is a direct descendant of the Intel 8008 and it was developed to provide additional features and corrections to limitations imposed on the 8008 by process and packaging constraints. The 8080 is an 8-bit parallel microcomputer central processing unit, fabricated on a single integrated circuit using an n-channel MOS process. It has a basic machine cycle time of 500 ns, with instruction execution times ranging from 4 to 18 machine cycles (2 μs to 9 μs). The 8080 requires an external two-phase clock and power supplies of +5, +12, and −12, all referenced to ground.

The 8080 must be supported by various peripheral circuits if it is to be made into a useful system. This interface is accomplished using an 8-bit data bus, a 16-bit address bus, and ten timing and control signals (six outputs and four inputs). The bus structure and control signals allow the 8080 to be interfaced to a wide variety of memory and I/O devices. All outputs and inputs (except for the clocks) are capable of directly interfacing one TTL load. In addition, the address and data busses are both three-state. This provides for bi-directional data transfers using the normal high or low states. The third is a high impedance "floating" state that permits multiple devices to be wired in parallel to the bus.

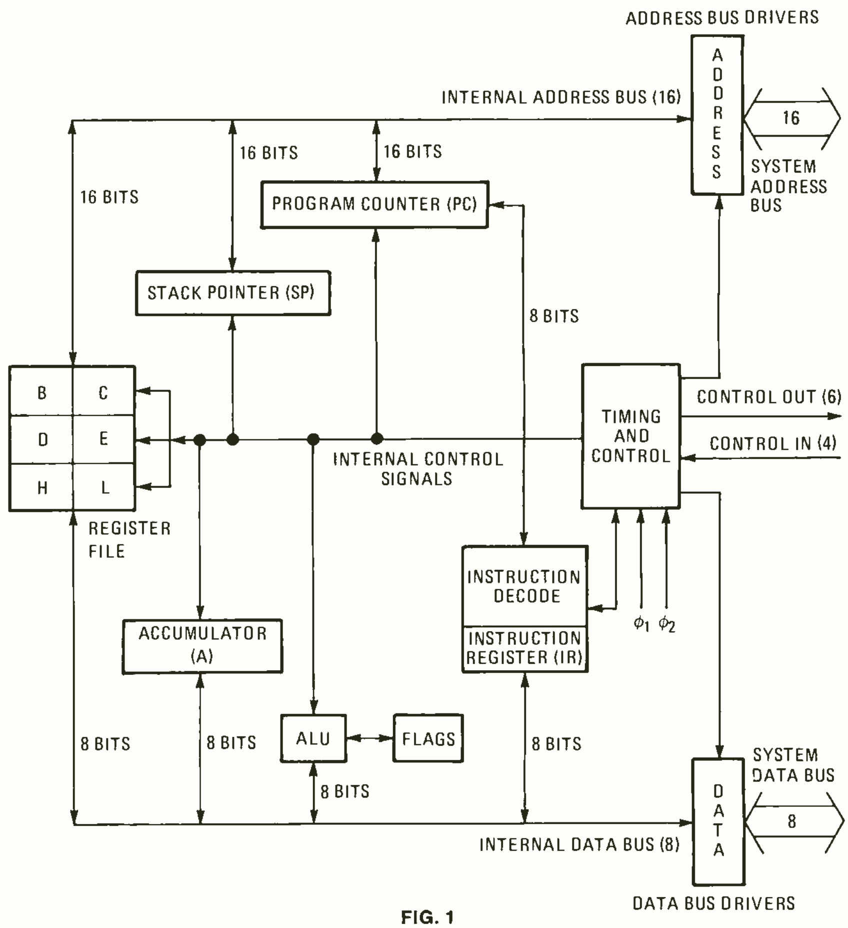

FIG. 1

Architecture

A block diagram of the 8080's basic architecture is shown in Fig. 1. With the

(continued on page 24)

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(continued from page 22)

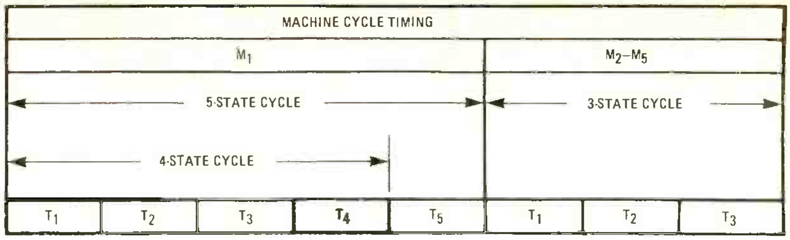
exception of its internal register file and separate address and data buses, the architecture is fairly conventional. From a user standpoint, the areas that are of most interest to us are the registers, memory addressing modes, instruction set and basic timing and control sequences. These are the features that have the most effect on how we will be able to use the processor in practical systems.

Registers

The 8080 provides an interesting internal register structure. The user accessible registers are organized into three 16-bit general-purpose registers (BC, DE, and HL), a 16-bit stack pointer (SP), a 16-bit program counter (PC), and an eight-bit accumulator. There are also five processor flags that are treated together as a register by certain instructions.

The three 16-bit general-purpose registers are designed so that they can also be used as six independent 8-bit registers for a number of operations. The internal organization of the 8080 makes this feature significant. The 8080 uses an 8-bit word (byte) as its basic memory data elements. However, it addresses memory with a 16-bit memory address. To do this, the 8080 is effectively divided internally into an eight-bit "data side" and a 16-bit "address side". Now, one of the most important measure of any computer's flexibility is

(continued on page 87)



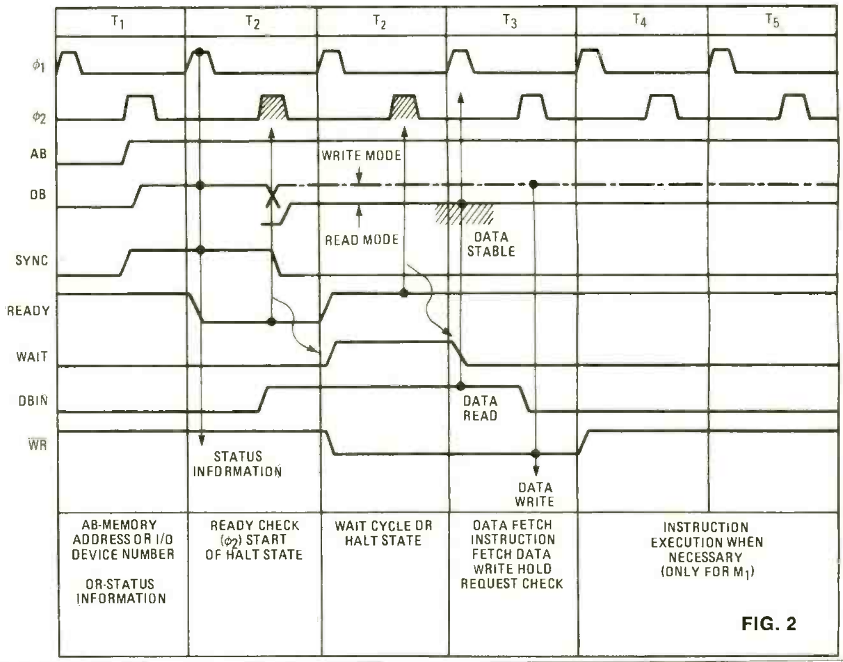


FIG. 2

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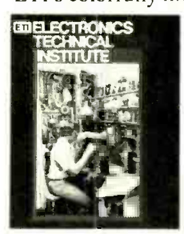

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Circle 8 on reader service card

State of SOLID STATE

A novel battery-monitor circuit from Intersil plus new releases from RCA and Motorola

KARL SAVON
SEMICONDUCTOR EDITOR

EVERY ONCE IN A WHILE I SEE A CIRCUIT so free of nuances that its simplicity is a joy to behold. Intersil's ICM7201 is nothing much more than a Schmitt trigger that is adaptable to the majority of rechargeable battery powered equipment. It is a four-terminal circuit mounted in a TO-72 can.

The circuit in Fig. 1 will sense the

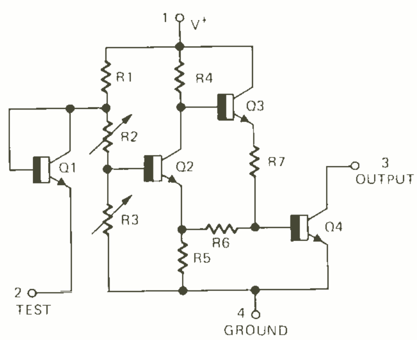


FIG. 1—INTERSIL BATTERY MONITOR.

charge-level of a 3-cell series-connected nickel-cadmium battery pack. The battery voltage is applied directly across pins 1 and 4. When the battery voltage falls below a preset threshold, pin 3 is switched to ground by turn-on of Q4. Design center trigger points of the circuit are 2.9 and 3.1 volts. The 0.2-volt hysteresis between the two voltages is the noise margin that prevents the output indicator from flashing intermittently, or being only partially energized as the voltage reaches one of the trigger points. The collector of Q4 can be connected to trigger an audible alarm with extra parts, but the simplest hookup is to an LED that will light at the lowered voltage as the batteries become depleted.

The fully charged voltage of a single cell Ni-Cad is 1.3 adding up to 3.9 volts for the three. When the rated ampere-hour capacity has been drained from the cell its voltage drops to 1.1 volts at the 10-hour discharge rate. A voltage of 2.9 for three cells, or .967 volt for one, is the cutoff voltage at some higher discharge rate. There is no easy way to determine the ampere-hour capacity between the fully-charged and cutoff points. The voltage discharge characteristic is nearly flat until it nears full discharge.

Connecting the batteries to the 7201 first turns on transistors Q3 and Q4 as pin 1 quickly rises and passes through $2V_{be}$ (about 1.2 volts). The conduction path is through R4, the base-to-emitter of Q3, R7, and the base-to-emitter of Q4. Q2 is still off and does not divert any current. Above this point the emitter of Q2 sees the 0.6-volt Q4 junction through R6 and ground through R5. Voltage divider R1, R2, R3, drops V+ by a ratio less than one: $A = R3/(R1 + R2 + R3)$. When A times V+ minus the V_{be} of Q2 exceeds BV_{be} where $B = R5/(R5 + R6)$, Q2 turns on. This is set up to be the 3.1-volt point, which is still below the voltage of a partially charged 3-cell battery pack. Q2 now conducts current and its collector begins to fall below V+, reducing the current in Q3. Q3 had been supplying a portion of the current in R5. As it turns off, Q2 must pick up the extra current, further dropping its collector voltage. The action continues in regenerative fashion until Q3 is turned off. Q4 goes off at the same time and the circuit is in the "charged battery" state. Q2 and Q3 are the conventional Schmitt trigger circuit. Both devices are in a non-inverting DC loop. Q2 operates as a grounded-base DC amplifier and Q3 as an emitter follower. The loss of the contributing emitter current of Q3 accounts for the circuit hysteresis or voltage lag before the circuit will switch back when the battery voltage drops 0.2 volt.

What has happened is that the emitter of Q2 previously saw a voltage higher than ground, BV_{be}, through the Thevenin equivalent parallel resistance of R5 and R6. Now with Q2 on and Q3 off, the emitter of Q2 sees a lower voltage, namely ground, through R5 alone. AV+, the base voltage of Q2, must now drop below one V_{be} before Q2 starts turning off and the loop becomes regenerative in the reversed sense.

Putting it into numbers, at 3.1 volts: $V_{high}A - V_{be} = V_{be}B$ or $B = 4.17$ A.

(continued on page 28)

STATE OF SOLID STATE

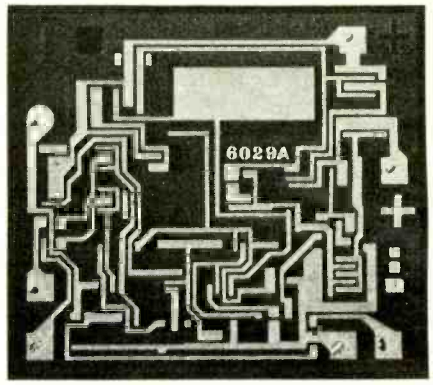
(continued from page 26)

From the 2.9 volt point: $A \times 2.9 = 0.6$, $A = 0.207$ and $B = 4.17 \times 0.207 = 0.862$, giving a feel for what these resistor ratios have to be. A more complete analysis would include the effects of base currents and the exact points at which the loop gain is high enough to be regenerative. Pin 2 is a test point that is pulled down through diode-connected Q1 to simulate a reduced battery voltage on the Q2 base divider. If the sensing circuit is working properly it will switch and turn on Q4, activating the low-battery alarm.

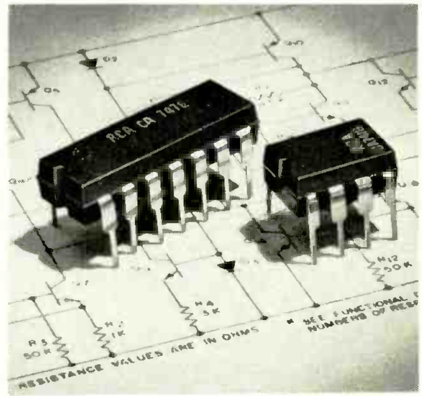
RCA's gold chip

RCA has announced a tri-metal process, similar to Bell Telephone Labs beam-lead construction. Changes have been made so the RCA method is simpler and more cost-effective for plastic DIP's. Significantly, the chip protection takes place on the silicon wafer before the pellets are encapsulated.

Tri-metal is short for Silicon Nitride Passivated Trimetal. Conventional integrated circuits use a layer of aluminum, evaporated on the chip surface, to interconnect all the devices, thereby wiring the circuit. Moisture may leak in where the leads penetrate the plastic package or it can seep through the plastic material itself. Insulating layers of aluminum oxides and hydroxides form, creating open circuits, which cause malfunction. There are other failure mechanisms besides this electrolytic corrosion. "Purple plague" is a compound that forms at high temperatures between the dissimilar gold bond wire and aluminum metallization. The junction becomes brittle and may eventually break open. Electromigration is the physical movement of metal at high temperature and current densities above $10A/cm^2$. The surface of an IC is a series of hills and valleys over which the aluminum is evaporated. Poor step coverage is a common problem that will produce cracks where the metal is thin, high contact resistance, and high current density areas.



PHOTOMICROGRAPH OF CA741CG CHIP shows gold metallization in all light areas of photo, instead of the older-process aluminum.



TWO NEW IC'S, CA741CG AND CA741G.

Figure 2 shows the IC surface after fabrication by the Gold Chip process. Up to the final silicon nitride and metallization steps, circuit production is the same as the aluminum-metallization process. The similar procedure makes cost differences minimal and the circuits will be sold at the same price as the standard versions.

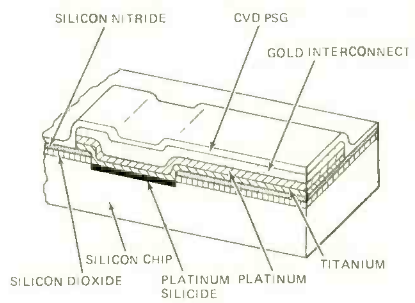


FIG. 2—RCA'S LAYER-BUILT CHIP.

After completing device diffusions ending with an SiO_2 layer, a silicon nitride layer hermetically seals all device junc-

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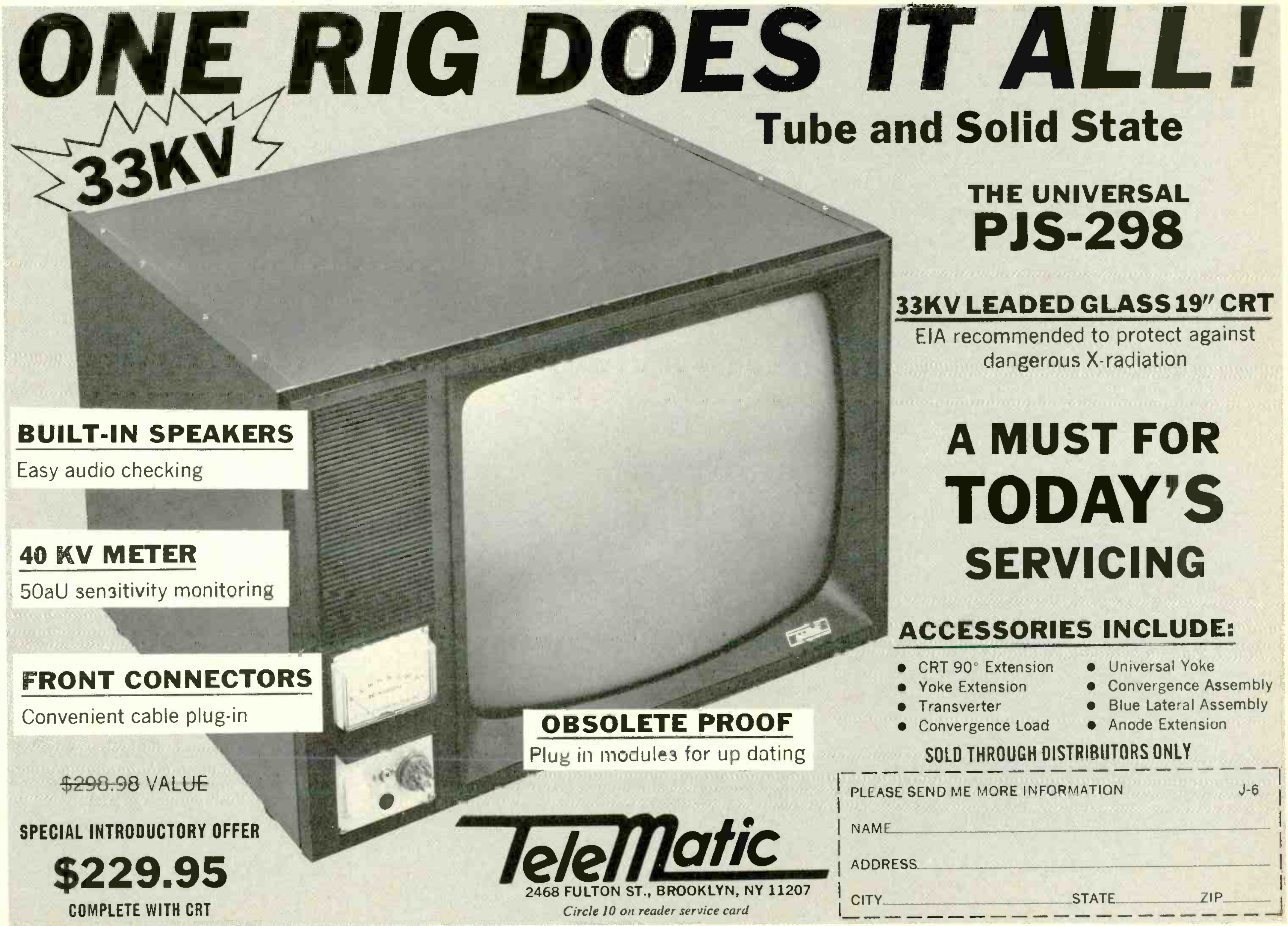
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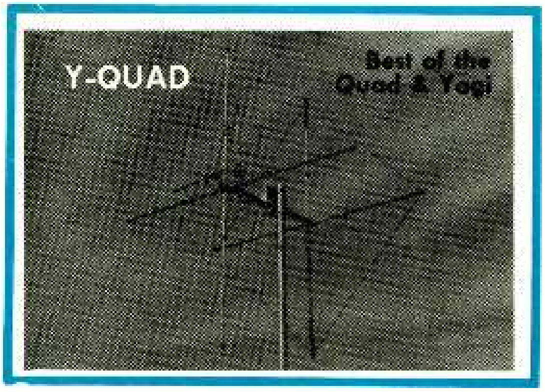


• WINNING COMBINATION •

The Y Quad combines the best of the Quad & Yagi designs giving one of the best performing switchable polarity lightweight antennas on the market. Uses a Quad Reflector and Yagi driven element.

• ANGLE OF RADIATION •

The Quad Reflector assures low angle of radiation even at low heights for real long distance performance.

• FRONT TO BACK •

The Quad Reflector gives an excellent front to back ratio of 25-30 dB along with a forward gain of 10.5 dB.

• DUAL POLARITY •

This feature gives considerable improvement in the following types of communications:

A. Maximum transmission to either base or mobile stations.
   1. Mobile antennas are invariably vertically polarized antennas. Switching to the vertical mode of the Y Quad allows effective communications with these mobiles.
   2. Base to base transmissions are mos effective using horizontal polarization.

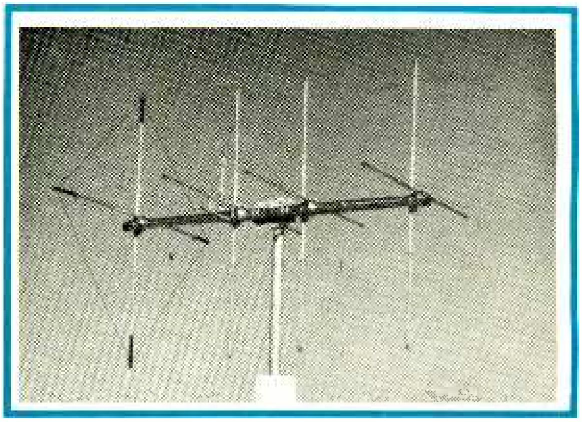
B. Line of sight transmission
   1. By shifting polarity, you shift the signal 90° thereby reducing the received signal in the opposite polarity by as much as 20 dB. Good gain with other station is still maintained if polarity is matched with yours.
   2. Good front to back and front to side rejection of unwanted signals in both polarities.

• SPECIFICATIONS •

- Gain 10.5 dB
- Front to back ratio 25/30 dB
- Boom length, 6 ft.
- Weight, 12 lbs.
- Horizontal or vertical polarity
- JMP 50 Ω Gamma Match
- Power capability, 2,000 watts
- Can be turned with small TV rotor
- Fiberglass Spreaders

Wilson Electronics Corp.

SHOOTING STAR



The 8 Element Shooting Star was developed to fill the need for a top performing, high quality, dual polarity antenna at a reasonable price. Its design is the same as antennas used to bounce signals off the moon using ½ wave dipoles and quad reflector

The design uses a scientifically matched boom of 16' and precision spacing to give the very best gain and front to back combination possible. A quad type reflector is used to increase gain and improve front to back ratio Gamma matches are used to obtain the best impedance match, eliminating coils which burn out, allowing a 2 KW power handling capability.

The mechanical construction is superior to other antennas, as we use extruded aluminum boom to element clamps which do not require drilling holes in the elements. All aluminum tubing is heavy wall aircraft type. Uses same construction as the famous Laser beams

With dual polarity you can switch to vertical and work the mobiles or local stations and when things get rough, switch to horizontal and eliminate interferance as much as 25 dB.

- Gain · 14.5 dB
- SWR · 1.3 to 1
- Impedance · 50-52 Ohms
- Power Handling Capabilities 2,000 watts
- Front to Back Ratio · 38 dB
- Vertical · Horizontal Separation · 25 dB
- Weight · 29 lbs.
- Boom · 2"
- Recommended Rotor · CD44 or Ham II
- Fiberglass Spreaders

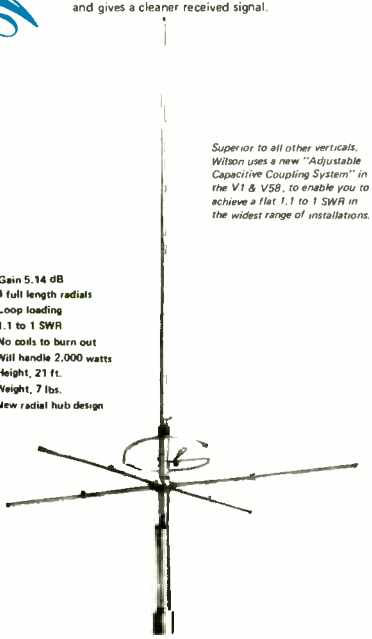
Wilson

ALPHA V58

5/8 Wave Ground Plane

The Alpha V58 is a full 5/8 wave ground plane with four full size radials, using a loop for loading which eliminates the need for a coil that could easily burn out. The use of DC ground reduces the static noise and gives a cleaner received signal.

Superior to all other verticals, Wilson uses a new "Adjustable Capacitive Coupling System" in the V1 & V58, to enable you to achieve a flat 1.1 to 1 SWR in the widest range of installations.



- Gain 5.14 dB
- 4 full length radials
- Loop loading
- 1.1 to 1 SWR
- No coils to burn out
- Will handle 2,000 watts
- Height, 21 ft.
- Weight, 7 lbs.
- New radial hub design

V1

5/8 Wave Ground Plane Without Radials

Our V1 is a 5/8 wave vertical ground plane without radials

It's the perfect antenna campers and mobilers like to have for portable operation. It is quick & easy to set up or take down. Be on the air in less than 5 minutes after arriving at your camping spot.

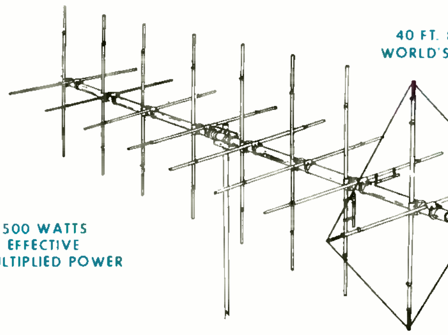
- Gain 3 dB
- No radials
- Loop loading
- 1.1 to 1 SWR
- No coils to burn out
- Will handle 2,000 watts
- Height, 21 ft.
- Weight, 5 lbs.

Ideal for campers or portable operation

WILSON ELECTRONICS' SUPER LASER 500

THE MOST POWERFUL AND DIRECTIVE CB ANTENNA IN THE WORLD

40 FT. BOOM – WORLD'S LONGEST



500 WATTS EFFECTIVE MULTIPLIED POWER

The Super Laser's tremendous Gain and Directivity, with the great rejection of unwanted signal, will enable you to hear and talk to stations that before were just noise in the pile of hetrodynes Your normal CB rig will develop an effective power of 500 watts, and the received signals will pop in loud and clear.

Now When You Hit That Mike, Others Will Listen
They'll Have To — You Offer No Choice!

You've seen advertisements telling of the Cadillac of antennas Well, here's the Rolls Royce of CB Antennas

1 World's longest boom — 40 ft
2 World's most powerful — 500 W of Effective Multiplied power
3 World's most directive — unbelievable
4 World's best F/B Ratio & Side Rejection – fantastic 50 dB.
5. World's most rugged construction — special aircraft aluminum

And the list continues on

Ask one of the staff at Wilson Electronics what he thinks of the Super Laser, and his answer will be "FANTASTIC"! That pretty well describes this antenna.

The unique method of gain and directivity of The Super Laser will take a normal transmitter (even though it will handle 2 KW) and produce an Effective 500 Watts of Multiplied Power

The Super Laser has adjustable Gamma Matches to obtain the lowest SWR for Horizontal or Vertical Polarization. The boom, 40 ft of 3" OD, with 5/8" elements of quality heavy wall aircraft aluminum, produce an assembled antenna weighing 70 lbs with a wind survival of over 90 mph

With this kind of strength and durability we recommend using the following with The Super Laser

Mast — 2" OD
Tower — Rohn 25G, Consolidated HD 18 or Equivalent
Rotor — Rotor Brake or Prop Pitch

ELECTRICAL

Gain	18 dB
F/B Ratio	up to 50 dB
Side Rej	up to 50 dB
SWR	1.3 to 1 or less
Polarity	Horizontal or Vertical
Power	2 KW

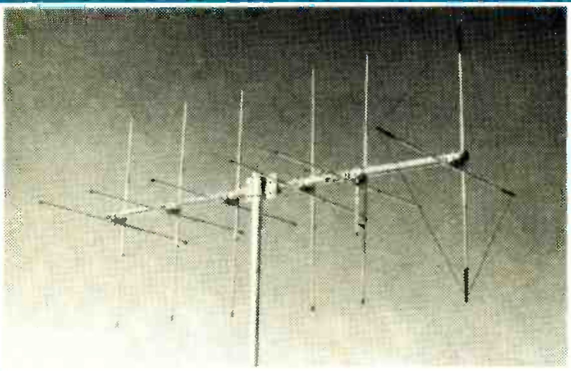
MECHANICAL

Boom	40 ft. 3" OD aluminum
Elements	5/8 inch aircraft quality aluminum
Weight assembled	70 lbs

Quad Reflector for improved Gain & F/B
New Fiberglass Spreaders

Wilson Electronics Corp.

NEW LONG BOOM 12 ELEMENT LASER BEAM



31 FT. BOOM — 400 WATTS EFFECTIVE POWER

The new 12 Element Laser has been expanded to achieve the maximum forward gain and front to back ratio covering a wide range of installations. This is achieved by the unique use of a Quad Reflector and Yagi Parasitic elements. There are six elements horizontal and six elements vertical, scientifically spaced, on a new 31 ft. boom. The 12 Element Laser has been tested and proven. It is second only to the Super Laser 500. The same top quality aircraft aluminum that has made Wilson Electronics famous, is used in the new 12 Element Laser.

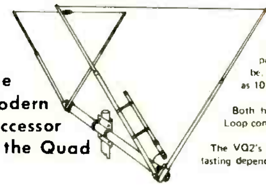
MECHANICAL SPECIFICATIONS

- Boom Length 31 ft
- Longest Element 17.5 ft
- Elements Aircraft type aluminum
- Element Mounts Aluminum extrusions
- Quad Reflector Wire 14 GA. Copper Stranded
- Boom 2" OD
- Weight 45 lbs
- Fiberglass spreaders
- Recommended Rotor Ham II

ELECTRICAL SPECIFICATIONS

- Gain 17 dB
- Front to back ratio up to 40 dB
- Side Rejection up to 45 dB
- Horizontal or Vertical Polarization
- Power Cabability 2,000 watts
- Adjustable Gamma Matches for Horizontal & Vertical
- SWR 1.3 to 1 or less
- 400 Watts effective multiplied power

Wilson V QUAD BEAM VQ2



The Modern Successor to the Quad

Now the Wilson VQ2 Quad offers CB'ers the advantages of both horizontal and vertical polarization with only one coax feed line. The new V configuration gives outstanding gain and pinpoint rejection. Experienced CB'ers know how annoying fading due to polarization loss can be. With the dual polarity of the VQ2 Quad signal fading is reduced as much as 10 dB.

Both horizontal and vertical polarization is achieved through unique V Quad Loop configuration.

The VQ2's rugged mechanical structure of top grade aluminum tubing assures long lasting dependable service. Handles up to 2,000 watts with maximum power transfer.

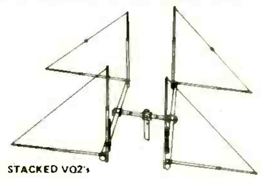
MECHANICAL SPECIFICATIONS

- Boom length, 6 ft.
- Element length, 12 ft.
- Accepts up to 1-5/8 in. mast
- Wind survival, 100 mph.
- Net weight, 7.5 pounds

ELECTRICAL SPECIFICATIONS

- Gain, 10.5 dB
- F/B Ratio, 25 dB
- Side Rejection, 40 dB
- SWR, 1.3:1 or less
- Polarization Vert. and Horiz.
- Impedance, 50 ohms.

Stacking Kit includes Boom, Hardware and Coax Network.



STACKED VQ2's

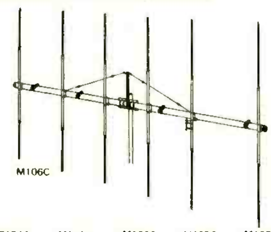
Wilson "MAXIMUM" ANTENNAS

The new "Maximum" antennas are tunable from 26.5 to 30 MHz in either the horizontal or vertical position. This is possible by adjusting the element lengths to the specific frequency between 26.5 and 30 MHz.

The mechanical construction is superior to other antennas as we use extruded aluminum boom to element clamps which do not require drilling holes in the elements. All aluminum tubing is heavy wall aircraft type.

All Wilson CB Beams have the following common features:

- Taper Swaged Tubing
- Full Compression Clamps
- No Holes Drilled in Elements
- 2" or 3" Aluminum Booms
- Adjustable Gamma Match 52 Ω
- Quality Aluminum
- Handle 2kw
- Heavy Extruded Element to Boom Mounts



M106C

MECHANICAL	M108C	M106C	M105C	M103C
Boom Length	40'	31'	26'	11'8"
Boom OD	3"	2"	2"	1⅝"
No. of Elements	8	6	5	3
Longest Element	19'	19'	19'	19'
Turn Radius	24'	17'	15'	10'
Surface Area	4 sq. ft.	3 sq. ft.	2.5 sq. ft.	1.5 sq. ft.
Wind Survival	100 mph	100 mph	100 mph	100 mph
Weight	60 lbs.	35 lbs.	24 lbs.	12 lbs.
Rotor	H.D.	H.D.	Med.	T.V.
Stacking Kit	N/A	MBSK	MBSK	VQ2SK

ELECTRICAL	M108C	M106C	M105C	M103C
Tuning (MHz)	26.5-30	26.5-30	26.5-30	26.5-30
Gain (dB)	18	17	15.5	11
Front-To Back (dB)	50	31	31	25
SWR	1.5:1 or less	1.5:1 or less	1.5:1 or less	1.5:1 or less
Power Capabilities	2,000 watts	2,000 watts	2,000 watts	2,000 watts

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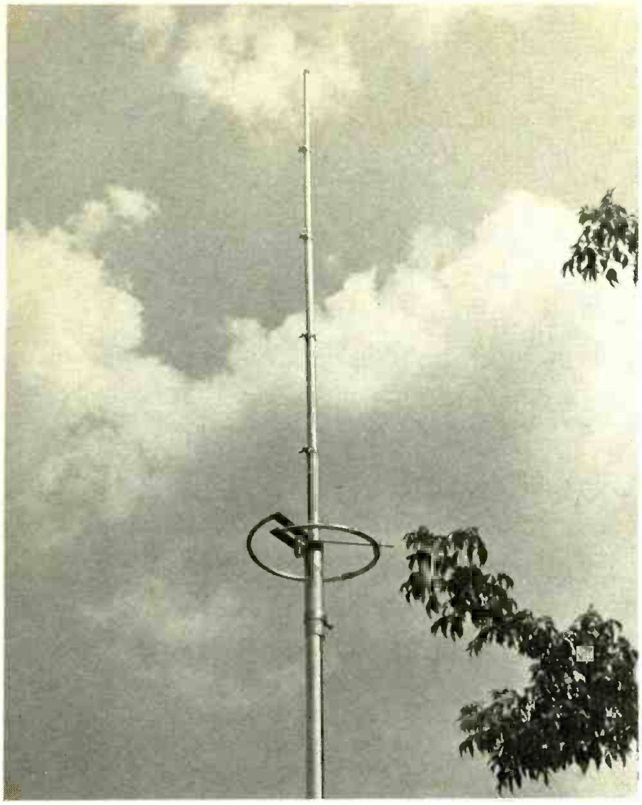
Circle 11 on reader service card



Selecting Station

Selecting the best possible
is a difficult choice.
and specifications that

GETTING MAXIMUM RANGE FROM CB EQUIPment is a never-ending quest for many operators. With maximum legal power output limited to 4 watts, the only way a CB'er can be assured of maximum communications range is to use the most efficient base antenna installation he can afford.

This means selecting the antenna that is best for typical operating conditions and then installing it within the limits set by the FCC. The factors to be considered are antenna polarization, vertical radiation angle, directivity and gain.

Perhaps one of the first things that anyone should consider in connection with 2-way communications antennas is based on the principal of *reciprocity*. In effect, this states that polarization, gain, directivity, radiation angle and all other characteristics are the same whether the antenna is transmitting or receiving.

Polarization

When power is fed to a transmitting antenna, it radiates *magnetic* and *electric* fields that are at right angles to each other. The electric (or electrostatic) field components are always—at least as far as CB antennas are concerned—in the same plane as the radiator. Thus, a vertical antenna such as a mobile whip or vertically oriented Yagi will radiate a vertically polarized signal. Similarly, an antenna with elements parallel to the earth radiates a horizontally polarized signal. (As an example, TV and FM antennas in the U.S. are horizontally polarized. However, recent announcements indicate that the U.S. TV standard may be changed to circular polarization to minimize aircraft-flutter, ignition interference and other problems.)

For the most reliable contacts between two CB stations using ground-wave communications—as intended by the FCC—both should use antennas with the same polarization. An antenna with one type of polarization will still pick up signals of the opposite polarization but with much lower efficiency. Usually, cross-polarization results in a signal loss of around 20 dB—3 to 4 "S" units on your receiver. Generally, base antennas are vertically polarized to provide the best communications to and from mobile units that use vertical whips.

Vertical radiators

The basic vertically polarized CB antenna is the quarter-wavelength ground-plane type. It consists of a one-quarter wavelength radiator cut from aluminum or copper tubing (one-quarter wavelength is approximately 108 inches at 27 MHz) and a ground plane composed of three or four quarter-wavelength radials mounted horizontally at the base of the radiator. The radiator and ground plane are insulated from each other and used as the connecting points for the coaxial feed line as shown in Fig. 1.

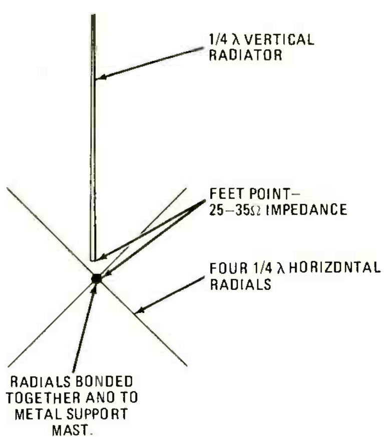


FIG. 1—DIAGRAM OF A TYPICAL GROUND-PLANE. Some have three radials.

The feed-point impedance is generally between 25 and 35 ohms. Most CB transceivers are designed to match 50—52-ohm antenna systems so some means must be

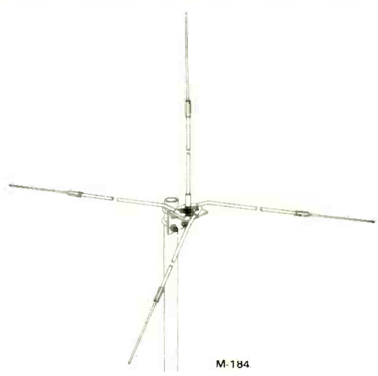


FIG. 2—DROOPING RADIALS raise antenna feed-point impedance to 50 ohms to match the coaxial transmission line.

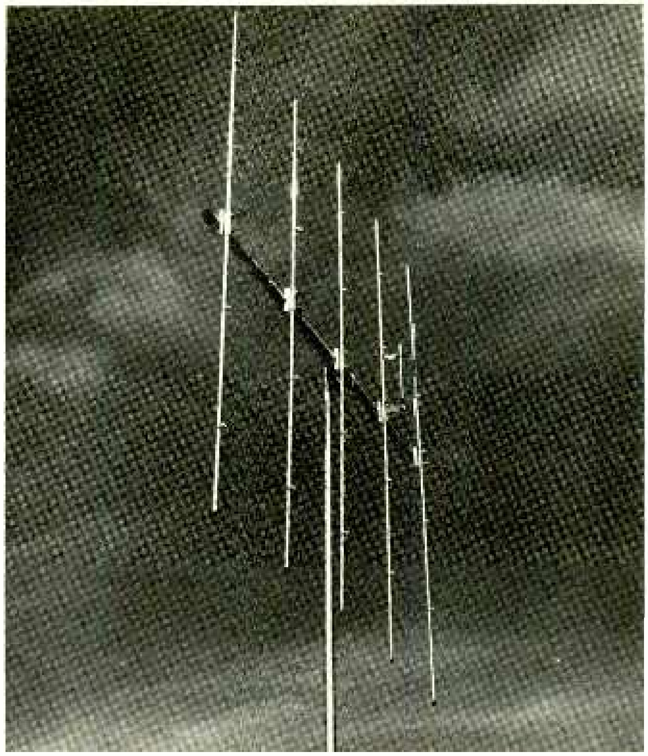
provided to raise the feed-point impedance to about 50 ohms to match the coax transmission line. One method is to tilt the radials downward at about 35 degrees as in the Antenna Specialists model M-184 (Fig. 2). Another method of providing a match between the antenna and 50-ohm line is to use a *beta match* as in the Hy-Gain GP-54 and the Breaker model 11-101 (Fig. 3).

The vertical radiator has an omni-directional horizontal pattern. That is, it radiates, or receives signals, equally in all directions. In free-space—where proximity to earth does not affect feed-point impedance—the pattern resembles a doughnut as in Fig. 4. In practical applications, a quarter cross-section of a ground-plane radiation pattern is shown in Fig. 5-a. The

CB Base Antennas

antenna to fit your needs
Here's a rundown of the factors
should be considered

ROBERT F. SCOTT
TECHNICAL EDITOR, KXK-8533



concentric half-circles represent signal strength at various angles to the horizon and distances from the antenna.

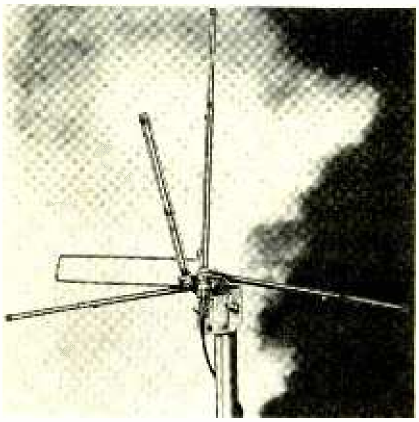


FIG. 3—THE BETA MATCH—it looks like the slide portion of a trombone—is one method of matching a ground-plane antenna to 50-ohm coax when the radials are horizontal.

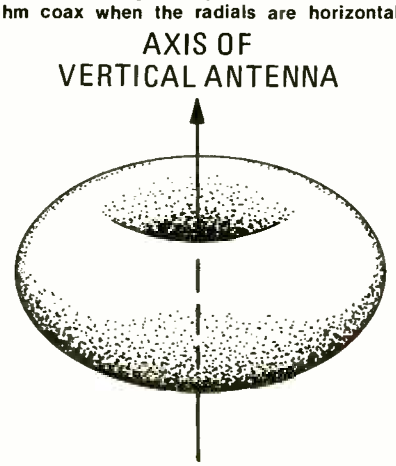


FIG. 4—FREE-SPACE HORIZONTAL PATTERN of a vertical quarter-wave length antenna such as a ground-plane type.

The quarter-wavelength ground-plane antenna is generally inexpensive and has a relatively high angle of radiation—an appreciable amount of power is radiated at an angle of about 50 degrees above the horizon. It is the standard or basis for comparing the performance of all other vertically polarized antennas. Its gain is *unity* or 0 dB.

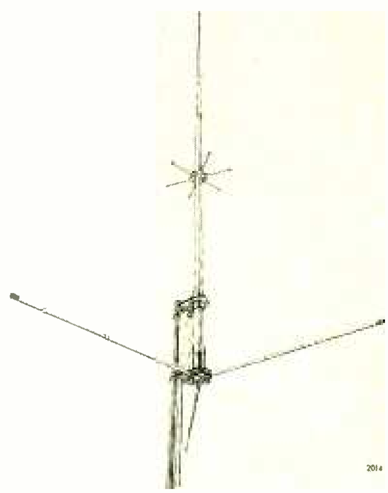
Gain vertical antennas

An antenna is not an amplifier so it cannot radiate more power than is fed to it by the transmitter. Thus, a CB antenna cannot legally radiate more than 4 watts. However, a gain-type antenna can provide nearly 4 dB gain (2.5 times the power) over a quarter-wave type by concentrating the radiated energy at a lower and more useful angle. This is accomplished by lengthening the radiator. Figures 5-b and 5-c compare the vertical radiation patterns of half-wave and five-eighths wavelength radiators to the quarter-wave ground-plane. Figure 6 shows these patterns superimposed on a representation of the earth's surface to show the effective gain and coverage of each type.

The five-eighths wavelength antenna provides the greatest gain. As length is increased beyond five-eighths wavelength, the energy in the low-angle lobe drops drastically and much of the power is radiated at around 80 degrees.

The basic half-wave vertical has a gain of approximately 1.8 dB over a ground-plane. It does not require radials in most installations but some designs use short radials as a part of the impedance-matching system and to decouple the coax shield from the field of the antenna. (Coax shielding that absorbs energy from the antenna is a common cause of TVI and RF feedback in the CB shack.)

Figure 7 shows two common methods of connecting the low-impedance coax feedline to a half-wave base-fed radiator. Fig. 7-a shows the coax tapped onto the 50-ohm point on a 27-MHz tuned coil at the base of the radiator. Fig. 7-b shows the version of the resonant circuit used by Cush-Craft. The parallel-resonant circuit is horizontal like a ground plane. The single-turn coil is tapped at the 50-ohm point to match the transmission line.



FIVE-EIGHTHS WAVELENGTH colinear-type vertical from Hustler. The model 27-T has short stub radials that help lower the vertical radiation angle.

Figure 8 shows the basic construction of the Cush-Craft gamma loop matching network used in the new CX-1000 antenna. The variable capacitor consists of a piece of dielectric sleeving between two telescoping sections of vertical tubing.

The five-eighths wavelength vertical provides a gain of nearly 4 dB over a ground plane and also eliminates the need for radials. Some manufacturers vary the basic configuration by using short stubby radials at about half-way up the radiator (as in the Hustler *Trumpet* model *27-T*, see photo) and/or small loops or radials at the tip to further lower the radiation angle and thus provide greater gain. The Hy-Gain *CLR* series of five-eighths wavelength verticals has a matching coil and three one-quarter wavelength radials at the base and a "top hat" consisting of three short radials to lower the radiation angle and provide a gain of approximately 3.4 dB. Another approach to the design is Mosley's *Devant Special* with its gamma match and "top hat" radials. The tapped matching coil and the gamma impedance-matching section permit the whole antenna to operate at DC ground potential, thus providing lightning protection and a reduction in atmospheric and precipitation static.

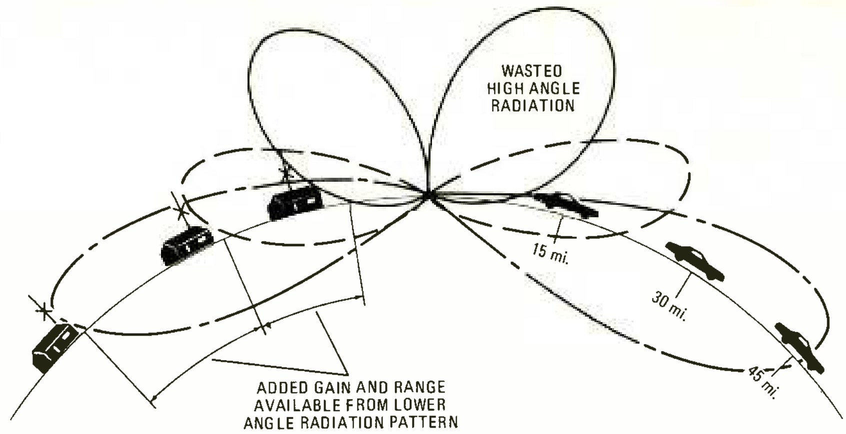


FIG. 6—RADIATION PATTERNS of antennas in Fig. 5 superimposed on representation of earth's surface to show how quarter-wave ground-plane wastes energy in high-angle radiation while longer verticals have increased communications range through their lower angles of radiation.

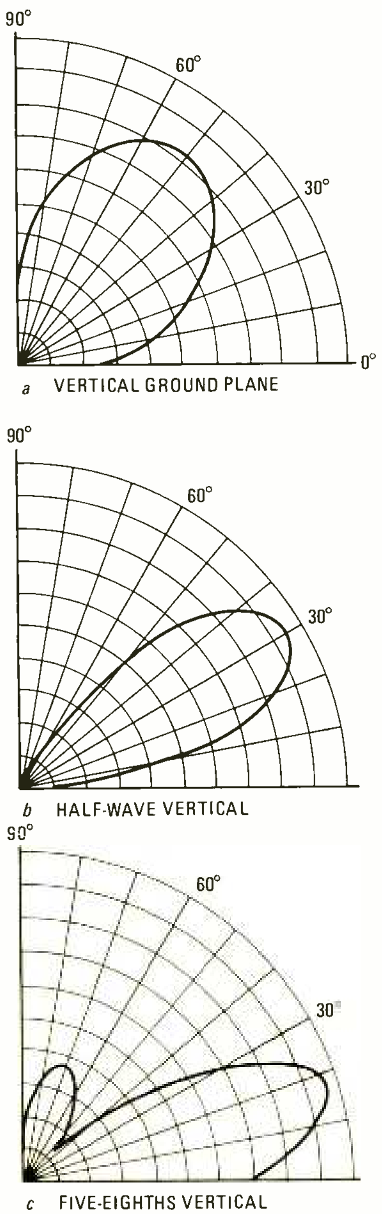


FIG. 5—VERTICAL RADIATION PATTERNS from three popular types of CB antennas. The five-eighths wavelength vertical (c) provides highest gain through its lower angle of radiation.

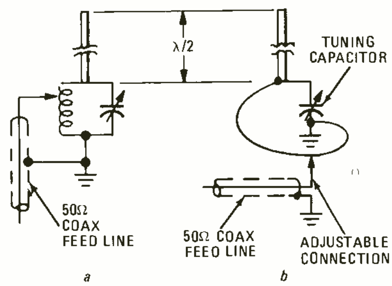


FIG. 7—TWO COMMON METHODS OF FEEDING HALF-WAVE VERTICALS. The method at (a) uses a tapped coil in a resonant circuit at the antenna base. The second method (b) uses a tuned circuit with a single-turn helical coil mounted horizontally.

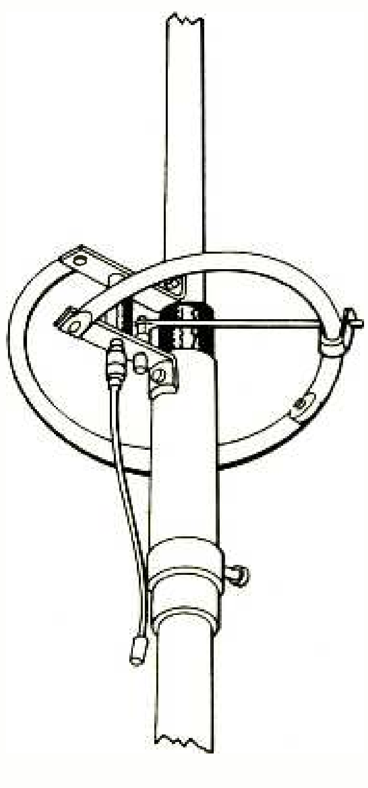
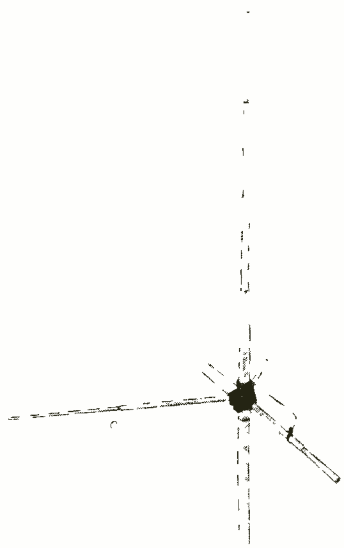


FIG. 8—BASIC CONSTRUCTION of the Gamma-loop matching system used in Cush-Craft verticals such as the new CX-1000.



GAMMA MATCH in the Mosley Devant series of base-station antennas. The Devant Special has "top-hat" radials for low angle of radiation.

Rotatable vertical beams

The most common uni-directional beam antennas consist of three to five vertical elements in a Yagi configuration so it looks like a "real wild" TV antenna standing on end. In these beam or directive antennas, gain is realized by the ability to concentrate all the energy in a narrow signal beam that can be directed to a specific area or point. This type of antenna consists of a half-wave *radiator* or *driven element*, a slightly longer *reflector* and one or more shorter elements called *directors*. The directors point in the direction of maximum radiation. The beam antenna must be rotated when 360° coverage is desired. Two identical Yagis can be mounted on a cross boom to provide a very narrow horizontal beam with a gain of 3 dB over a single Yagi of the same type.

Beam antennas can provide nearly 13 dB of gain, depending on the number of elements and their configuration. Figure 9 shows how stacking two simple Yagis horizontally can sharpen the horizontal radiation pattern and increase gain by 3 dB.

Figure 9-a is the pattern of a single vertical Yagi and Fig. 9-b shows the response of two identical Yagis stacked horizontally as in Hy-Gain's *Super Duo Beam SDB-6*. This antenna has a gain of 12.7 dB (18.6 power multiplication factor), providing an effective radiated power of 74.4 watts from a 4-watt CB transceiver. Front-to-back ratio is 23 dB. A similar model, Cush-Craft's CB-2KD, is shown in Fig. 10.

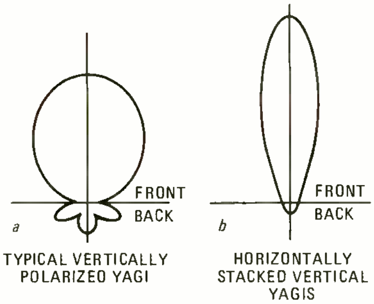


FIG. 9—STACKING ANTENNAS HORIZONTALLY (side-by-side) provides a 3-dB gain due to narrowing of the horizontal pattern.

Most CB antenna manufacturers such as Hy-Gain, New-Tronics (Hustler) and Mosley supply stacking kits so you can add a second Yagi to your array if you need a narrower beam or an additional 3 dB gain.

We mentioned earlier that cross-polarization between transmitting and receiving antennas results in about 20 dB attenuation in the received signal. Thus, in point-to-point applications where beam antennas can be used to an advantage, you might consider using horizontally polarized Yagis to reduce interference from CB stations in the beam's path that are using vertical polarization. Thus, horizontal polarization can be used to advantage between base stations but will prove to be a disadvantage when either base needs to contact a mobile unit.

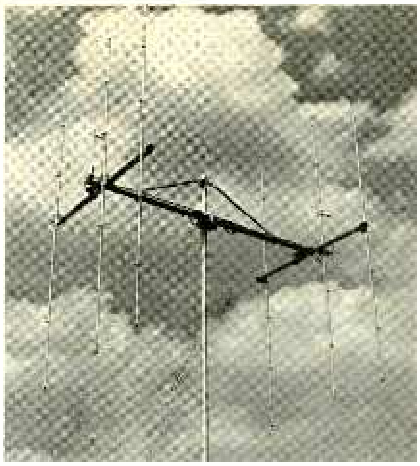


FIG. 10—SIX-ELEMENT ARRAY from Cush-Craft is made by mounting two 3-element Yagi's side-by-side on a cross boom.

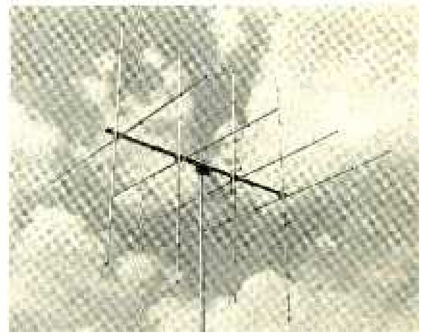
For this reason, several manufacturers have developed dual-polarity CB antennas consisting of two Yagis on the same boom. The elements of one are horizontal; the other's are vertical. Typical antennas of this type are the Avanti *Moonraker*, Cush-Craft *Superfire* (see photo) and Mosley's *Saser*. The Hy-Gain approach to dual polarization is the two-element model *Eliminator II* quad. Antenna polarization is selectable through switching from the operating position.

Another advantage of selectable polarization is the ability to avoid interference from distant CB stations whose signals arrive at your antenna after being bounced between the ionosphere and earth. These "long-hop" or "skip" signals often undergo polarity reversals as they are reflected off the earth or ionosphere. Thus, when "skip" comes in, you can polarize your antenna system for minimum interference.

Large rotatable beam antennas like those just discussed have several disadvantages. Among them are high installation cost—you need a tower and heavy-duty rotator, TV-grade components won't do—and you need a *large* cleared area to accommodate the beam's turning radius with sufficient clearance from trees, power lines and your neighbor's property.

Fixed steerable arrays

This type of beam antenna—called a phased-array—has the advantages of a rotary beam while eliminating the need for a sturdy tower and rotator. It consists of vertical radiators spaced either one-quarter or one-half wavelength apart and fed through phasing harnesses to provide the desired directivity pattern. For example, two ground-plane antennas one-half wavelength apart and fed through equal-length transmission lines will radiate two narrow beams at right angles to the plane of the antennas as in Fig. 11-a. When the antennas are excited (fed) in-phase, radiation is *broadside* to the plane of the antennas with a gain of about 3.85 dB over a single ground-plane. Half-power beam width is about 60°.



DUAL POLARIZATION results when two Yagis are mounted at right angles on a common boom. This Cush-Craft Superfire has a quad-type reflector for a superior front-to-back ratio.

If the phasing harness adds one half-

(continued on page 75)

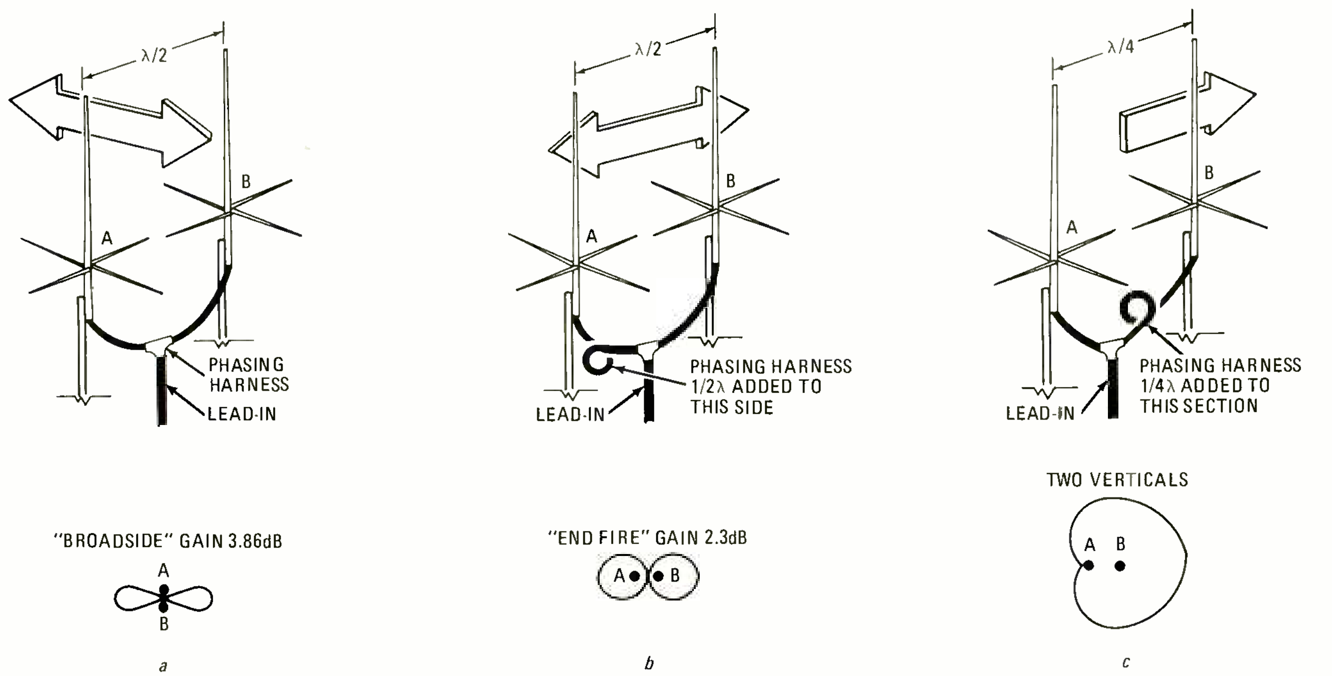


FIG. 11—TWO FIXED GROUND-PLANE ANTENNAS can be used as a bi-directional or cardiod-type omnidirectional beams. Directivity is determined by the phase of the signals fed to the two radiators. Typical radiation patterns are shown.

MIND POWER: ALPHA

Build this biofeedback device that displays the presence of alpha waves on a TV screen. You can use it to learn how to control your alpha waves and gain from the benefit of the relaxation that comes with it

DEVISED BY SCIENTISTS, RATHER THAN YOGIS, ALPHA-WAVE biofeedback is a technique of *mental training*, through which the brain and the body are made to link-up more closely, so that the physiologic sources of stress come under the control of the mind.

If that seems a bit too much to grasp on the first pass, consider this: Since birth, your mind has gradually "learned" to control many of your body's important functions. Most have come naturally, like learning to stand erect, to walk, to throw a ball, ride a bicycle, to speak, to type, and countless others. Yet, there are several functions in which the body apparently acts *independently* of the mind. The heartbeat, respiration, digestion and certain glandular functions are representative of these *autonomous functions*. So, too, are the reactions of small muscle masses surrounding the tiny blood vessels of the body. When these tense under stress, blood pressure goes up.

What has this to do with alpha wave biofeedback? Well, research over the past two decades has suggested that if we can get the brain to downshift from its usual *high-gear state*, to the "idling" state, in which a recording of brain wave activity shows a predominance of *alpha waves*, a host of beneficial physiologic changes take place. A feeling of well-being and general comfort spreads throughout the body as muscles slacken, heart-rate and respiration slow down, body temperature eases and the body enters into a longed-for state of relaxation. The body is essentially responding to a *mental state* of relaxation. Obviously, therefore, a feedback link *does* exist between the brain and "involuntary" body functions. To strengthen that link, an outside training instrument is needed. Using it, the mind can be made aware of its success in achieving the alpha state, and, the accompanying beneficial physiologic responses serve as a "reward" to the mind, thus inspiring the continuation of the alpha state.

Such an instrument is *Mindpower: Alpha*. It is a *true* alpha-wave biofeedback instrument that incorporates an electroencephalographic "front-end," designed to amplify and selectively process the tiny potential indicative of the brain's "idling" state, as picked up by headband electrodes. It also includes the circuitry for converting these potentials into signals, that exert control over *both auditory* and *visual* stimulus devices. In the auditory sense, *Mindpower: Alpha* provides an audible tone indication when the user's mind is generating alpha waves. However, *Mindpower: Alpha* also includes the circuitry to convert alpha waves into *signals that control a video display on a television screen!*

Why? Well, if it is possible to train the mind to generate the waves of relaxation in quiet meditation, with eyes closed, does it not make sense that the mind can be trained to the extent that the waves of relaxation can be generated with *eyes open*? After all, the things that cause *stress* and *anxiety* to arise in our minds are largely *visual* in nature. We *see* emotion-charged situations that cause our bodies to tense-up. We *read* words that produce anxiety. We respond to television news programs, in which the visual input sometimes elicits responses from us which can only be classed as preparation for *fight* or *flight*.

NOTE

Mindpower: Alpha is an intriguing device for entertainment and experimentation in video biofeedback. It is not a therapeutic instrument, neither is it suggested as a cure for individuals suffering from psychological or physiological disorders.

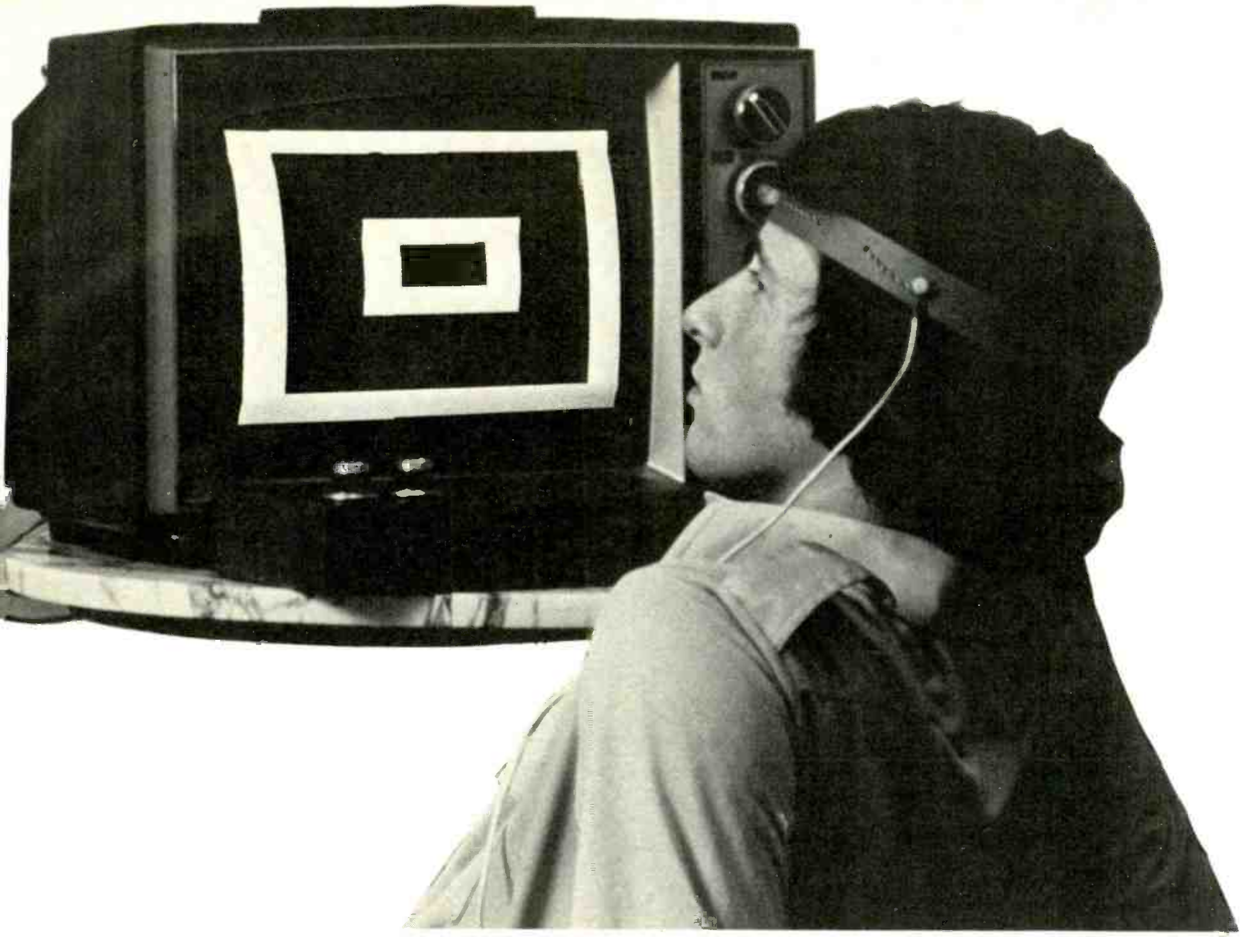
And so, it is only natural that the brain should "communicate" with and train itself, through our powerful visual sensors: the eyes. But, to do so, an external instrument is needed to "close the loop." That instrument is the combination of *Mindpower: Alpha* and your television set.

The Mindpower: Alpha biofeedback loop

The brain is totally dependent upon its sensors for information. The eyes, ears, nose, mouth, skin, and the proprioceptors within the body's muscles supply the basic data inputs through which the brain is informed, educated, and on which it bases its executive functions. But, our sensors are mostly directed to the external world, rather than to our internal environment. We have no built-in means to see or hear what is happening within our bodies. Without a mirror, we cannot even look into our own eyes!

Yes, once information about what is going on inside the body or mind can be brought outside ourselves, where our sensors can detect it, a main-line path is opened to the information-hungry brain. With that link established, the executive power of the mind can begin to go to work on itself.

Mindpower: Alpha is designed to detect and amplify the tiny bioelectric signals produced by your brain's activity. From the full spectrum of the brain waves, it filters-out everything but the alpha waves (slow 8 to 13-Hz variations) and converts these into signals that control an audio "beeper" *and* a video display created by a symbol generator. (The symbol is a white rectangle on a black field.) The beeper sounds each time a significant amount of alpha appears in your brain-wave spectrum, thus feeding back to your brain via the ears.



Part of the price we pay for the comfort and convenience of living in an advanced, industrialized society is the acceptance of a high degree of *anxiety* and *stress*. Sociologists, psychiatrists, and medical investigators agree that the forces of our complex, technologic, and ever-changing society hammer away incessantly on the individual. Shock waves of change and new crisis wash over us so rapidly that, scarcely have we prepared ourselves to deal with a problem, when suddenly, it mutates or disappears, leaving us confronted by a new threat. In rapid succession, we find ourselves buffeted by an Energy Crisis, Inflation, Recession, Shortages, Lay-offs, Corruption in High Government, and the countless smaller forces in our daily lives which keep us constantly "on-edge" and defensively anxious.

This anxiety and the stress of being always ready to ward off the blow of some new crises can have fearfully great effects upon our health *and* our ability to lead a "normal" life. Extreme, prolonged stress is believed to be linked to high blood pressure, increased incidence of heart attacks and strokes, and serious deterioration of important organs of the body. What's more, constant stress and anxiety exert a debilitating effect on the *mind* as well as the body. That "always tired" feeling—the inability to hold a problem in focus and think through a solution—both may have the same malevolent origin: *constant stress!*

Small wonder that Transcendental Meditation (TM) has found so many new converts in our overwrought society. Combining the mysticism of the East with varied exercises in meditation, TM seems to have proven helpful to many people in the relief of stress. Unfortunately, the technique is long in learning for many people and requires a daily regimen of meditation which some busy people find as hard to swallow as their dentist's demand for thrice-daily brushing!

However, there is another approach to stress—relief, relaxation, and the rejection of anxiety. This article will show you how to build an Alpha-Wave trainer to help you learn how to control these stresses with your own MINDPOWER.

Meanwhile, the alpha has a *direct visual impact* on the video display. In Mode 1, where the rectangle is normally stationary, when alpha occurs, the rectangle shrinks. Steady alpha will reduce it to a small dot at the screen center. When alpha stops, the rectangle grows again, until it fills the screen, or until reappearance of alpha reverses the process.

In Mode 2, the rectangle is always moving, originating as a dot at the screen center and automatically growing outward until it passes beyond the extreme edges of the screen, only to reappear at the screen center and start travelling outward again. In this mode, the occurrence of alpha slows or stops the rectangle's inexorable travel. Prolonged alpha will even back it down to a dot and hold it there!

The implications of this instrument are apparent. By feeding back success at alpha generation to the brain which is producing it, more and stronger alpha should be produced. With time and practice, it should be possible to extend the periods of alpha and, it may ultimately be possible for the user to generate the waves of relaxation *at will*! In effect, here is the prospect for developing a new retaliatory response to everyday stress, and to increasing the power of the mind to overcome anxiety.

Understanding your brain waves

More properly called the EEG (electroencephalogram), brain waves are neither incomprehensibly medical nor mystical. However, to properly understand the workings of *Mindpower: Alpha*, you must have a fair grasp of these simple facts.

The adult human brain contains some 12 billion neurons —specialized nerve cells that are densely packed to form an organ that weighs scarcely more than three pounds and fits easily into the limited space within the human skull. All of the brain's neurons exhibit *bioelectrical* activity: the production of small varying potentials associated with their functioning. Such a dense population of active neurons might be compared to a crowd of noisy spectators in a football stadium, and the shouts of individual spectators likened to the changing potentials of individual neurons. Just as it would be hard to single-out a conversation within the noisy environment of the crowd, it is also practically impossible to single-out the electrical activity of just a few neurons in their "noisy" environment.

But just as the overall noise of the crowd is audible outside the stadium, so also are the gross changes of the bioelectric potentials detectable outside the brain, on the surface of the forehead and scalp. And, just as you, standing outside, might easily detect rhythmic chants of the crowd in the stadium without knowing specifically what is being said, so also can we detect rhythmic variations in the gross bioelectric activity of large neural masses of the brain by strategically placing electrodes on the forehead and scalp.

Early in this century, medical researchers discovered that the brain generates a broad spectrum of rhythmically varying electrical waves. Though very low in amplitude (on the order of 10 microvolts in averaging amplitude), these potentials are detectable at the skin surface of the forehead and scalp. At first, the waves appeared to be completely random—rather like the noise of the football stadium crowd. But, through patient research, investigators were able to separate the dominant bands of brain-wave rhythms into these four:

delta (δ): 1– 3 Hz
theta (Θ): 4– 7 Hz
alpha (α): 8–13 Hz
beta (β): 13–30 Hz

Further research has shown that psychological and pyhsiological states affect the frequency content of the brain waves. Thus, when we are in deep sleep, the brain generates delta waves. Day-dreaming and problem solving brings up the theta waves. Fear, anger and intense concentration increase the beta waves. But a state of relaxation and tranquility bring up the alpha waves. A graphic recording of the brain waves produces a chart that is called an electroencephalogram. (EEG, for short).

The waves are recorded by placing electrodes on the forehead and scalp, and by measuring the instantaneous *potential difference* between selected pairs of electrodes. Thus, for example, the potential detected at the right frontal lobe of the brain may be differentially measured with respect to the potential present at the rear of the skull, opposite the left occipital lobe of the brain. The two electrodes, connected to a carefully designed high-gain differential amplifier that rejects common-mode voltages (60-Hz pickup, im-

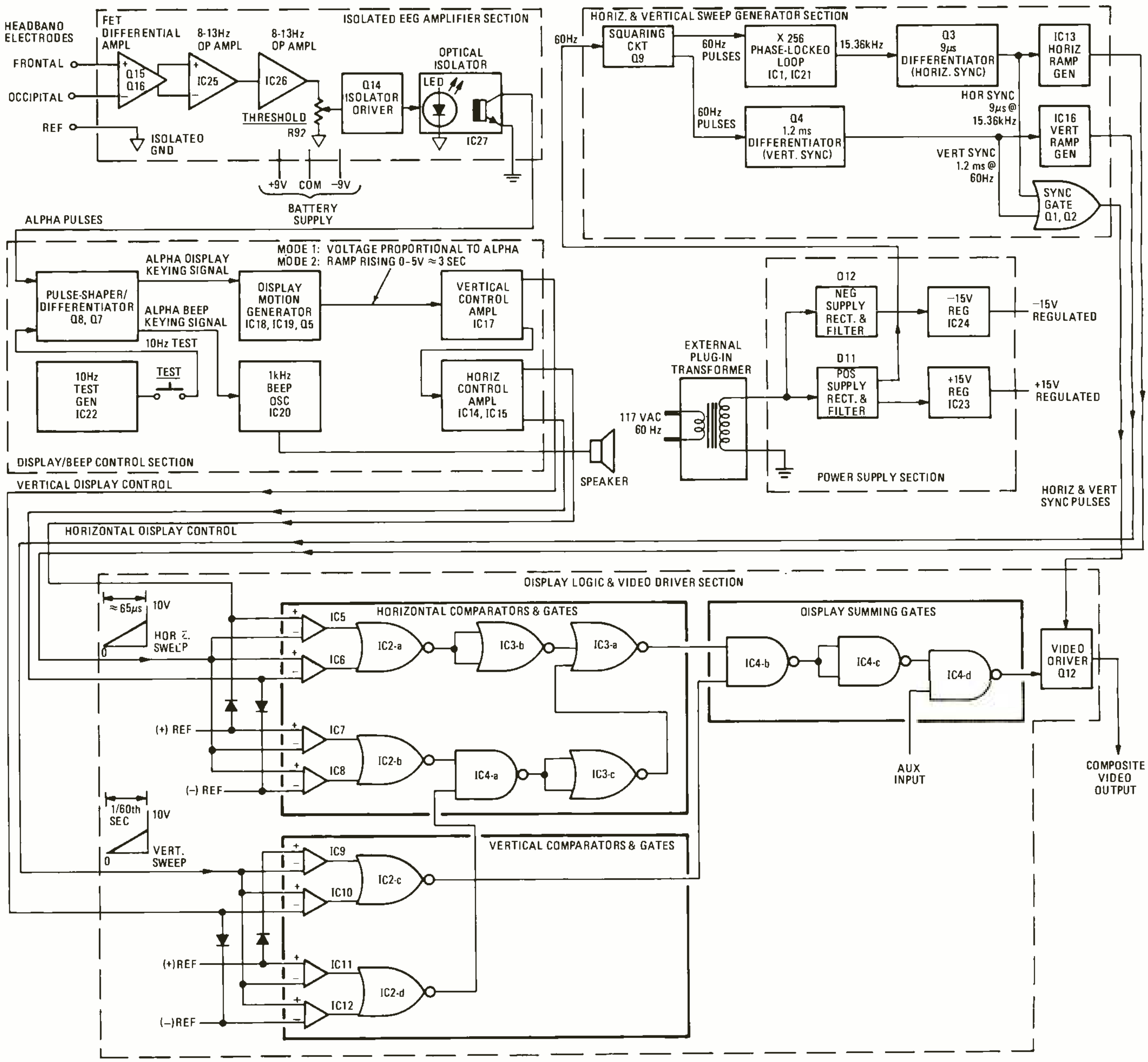


FIG. 1—MINDPOWER: ALPHA, block diagram. The device displays a pattern on a TV screen in accordance with the amount of alpha waves detected.

PARTS LIST

All resistors ¼-watt 10% unless noted
R1, R2, R14, R16, R20, R28, R32, R45, R46, R64—10,000 ohms
R3, R4, R41, R42, R47, R68, R72, R73—10,000 ohms, 5%
R5, R31—2700 ohms
R6—27,000 ohms
R7, R8, R48—30,000 ohms, 5%
R9, R10, R12, R13—3 megohms, 5%
R11—3900 ohms
R15, R53, R63, R65, R74, R75, R77, R78, R79, R80, R88—4700 ohms
R17—820,000 ohms
R18—22 ohms
R19, R36, R52—56,000 ohms
R21, R39, R44, R59, R76, R91—15,000 ohms
R22, R34, R51—100,000 ohms
R23, R25, R26, R33, R81, R82, R83, R84, R86—22,000 ohms
R24—47,000 ohms
R27—3300 ohms
R29—10 megohms
R30—1.5 megohms
R35—750,000 ohms
R37—20,000 ohms, 5%
R38—4700 ohms, 5%
R40, R89—1000 ohms
R43—15,000 ohms, 5%
R49—120,000 ohms
R50—39,000 ohms
R54, R57, R58, R60, R61—5600 ohms
R55, R62—33,000 ohms
R56—220,000 ohms, 5%
R66, R71—13,000 ohms, 5%
R67—220,000 ohms
R69—12,000 ohms, 5%
R70—7500 ohms, 5%
R85—12,000 ohms
R87—240 ohms
R90—200 ohms
R92—10,000 ohms, linear potentiometer

All capacitors 25V or more unless noted
C1, C2—0.47 μF, 100 V, 10%
C3, C4, C5, C6—.0033 μF, disc, 10%
C7, C8, C20—5 μF, electrolytic
C9, C15, C29, C30—10 μF, 25V, electrolytic
C10, C12, C14, C19—1 μF, 100V, 20%
C11, C23—0.1 μF, 100V, 10%
C13, C26, C27—0.01 μF, disc
C16—(see text)
C17, C18—2000 μF, 50V, electrolytic
C21—.0082 μF, disc, 10%
C22—.033 μF, 100V, 10%
C24—.0015 μF, disc, 10%
C25—.0068 μF, disc, 10%
C28—150 pF, disc
C29, C30—10 μF, 25V, electrolytic
*C31, C32—10 μF, 25V, electrolytic
*If required (see text)

Transistors*
Q1, Q2, Q3, Q4, Q5, Q7, Q8, Q9, Q10, Q11, Q12, Q13—2N4401
Q6—2N4403
Q14—2N5524
Q15—SE4021

Diodes*
D1 through D19—1N3064
D20—1N5240, 10V, 10% Zener

Integrated Circuits*
IC1—CD4046AE (CMOS)
IC2, IC3—CD4001AE (CMOS)
IC4—CD4011AE (CMOS)
IC5, IC6, IC7, IC8, IC9, IC10, IC11, IC12—LM311N (voltage comparator)
IC13—LM318N (op amp)
IC14, IC15, IC16, IC17, IC18, IC19, IC25, IC26—LM307N (op amp)
IC20, IC22—NE555 (programable timer)
IC21—CD4040AE (CMOS)
IC23—MC7815 (+15V regulator)
IC24—MC7915 (−15V regulator)
IC27—MCT-2 photocoupler

Miscellaneous
Printed circuit board (2 sided, plated through holes)
Plastic case
Miniature speaker, 8-ohms
Headband assembly
Battery clips
Battery connectors
BATT1, BATT2—9-volt alkaline batteries
Transformer
S1—3-pole, double throw slide
S2—N.O. single pole pushbutton (or slide)
S3—dpst slide
S4—spst slide
IC sockets
Misc hardware

***Do not substitute**

The following items are available from National Mentor Corp., Box 53, Wykagyl Station, New Rochelle, NY 10804

Circuit board. 2-sided, plated through holes. Order part number NM-P108: $34.50

Transformer. Order part number NM-T6: $17.50

Headband. Order part number NM-HA39: $9.50

Case, punched and drilled. Order part number NM-C56: $14.75

Set of all semiconductors including 27 IC's and 35 transistors and diodes. Order part number NM—Semis 1: $99.50

Complete set of all parts needed to build Brainwave: Alpha: $265.00.

All prices include postage and insurance in the continental United States.

pinging noise voltages, etc.) produce a signal that shows the predominant make-up of the brain waves across the greatest mass of the brain, traversing the frontal, temporal, parietal, and occipital lobes. In effect, such a signal describes the principal state of the brain's major, distinguishable lobes, thus providing a useful index of brain-wide mental state.

How it works

A simplified functional block diagram of *Mindpower: Alpha* is shown in Figure 1. There are five principal sections, enclosed by dashed lines. These are: the horizontal and vertical sweep generators, the display logic and video driver, the isolated EEG amplifier, the display beep control section, and the power supply.

Because *Mindpower: Alpha* creates a video display that is then acted upon by control signals developed from an alpha wave input, the most logical starting point is the horizontal and vertical sweep generators section.

To establish a field for producing a display on a TV screen, it is necessary to sweep the CRT electron beam both horizontally and vertically on the screen face. The horizontal sweep must produce 256 left-to-right lines (one-half frame), moving vertically from top to bottom of the screen within 1/60th of a second. Each line must be written within 65 microseconds. The flyback time between lines must thus be less than nine microseconds. To develop this basic field, the horizontal and vertical sweep generators receive a 60-Hz AC input signal from the AC power supply. This signal is squared by transistor Q9. This stage provides 60-Hz pulse outputs to the two sweep generators. Horizontal sweep is obtained with a X 256 phase-locked loop (IC1, IC21), that multiplies the input to an output of 15.36 KHz. This output is differentiated by Q3, and is applied to the horizontal ramp generator, IC13. This stage produces a ramp voltage rising from 0 to 10 volts in 65 microseconds. Its output is applied to the horizontal comparators and gates of the display logic and video driver section.

Since the vertical sweep rate is synonymous with the line frequency, the pulse output of Q9 is simply differentiated to produce pulses which control the vertical ramp generator, IC16. The output of this stage is a ramp voltage rising from 0 to 10 volts in 1/60th of a second (16.7 milliseconds), and is applied to the vertical comparators and gates of the display logic and video driver section. Sync pulses to determine field timing are provided by sync driver Q1, Q2 to video driver Q12.

The two ramp voltages provided from these earlier stages are used to produce a rectangular display by comparing their instantaneous voltage levels against reference voltage levels in horizontal comparators IC5 through IC8 and vertical comparators IC9 through IC12. These develop beam control signals which determine the point on each line where the CRT electron beam will be turned-on and shut-off. However, since it is desired to produce a rectangle display rather than a cross-hatch, we must use logic to eliminate those line segments which lie *outside* the rectangle's confines. This function is performed by gates IC2, 3, and 4. The result is a white rectangle on a dark field, sized (in Mode 1) to fill about 75% of the screen's usable area. This video signal is applied to the television set by video driver Q12.

Having established the basic display, all we now need is a way to vary the *size* of the display. This is done by the display/beep control section. Vertical control amplifier IC17

(continued on page 91)

mits WORLD ALTAIR COMPUTER CONVENTION

THE FIRST WORLD ALTAIR COMPUTER CONVENTION WAS HELD March 26-28 at the Airport Marina Hotel in Albuquerque, NM. Successful? Was it ever! Over 700 participants from 46 states and 7 foreign countries gathered to talk computers, exchange information, ask questions, participate in seminars, match their system against other systems in a demonstration contest and see many different systems in operation.

MITS sponsored the convention and they plan to make it an annual event. Seminars were presented by MITS' engineers and software developers.

Saturday night's event was a discussion led by a group of guest speakers. The theme of the discussion was the future of computers in general and its effect upon hobbyists in particular. The group of speakers included Ted Nelson (author of *Computer Lib*), David Ahl (*Creative Computing*), Carl Helmers (*Byte Magazine*), Larry Steckler (**Radio-Electronics**) and Les Solomon (*Popular Electronics*) among others.

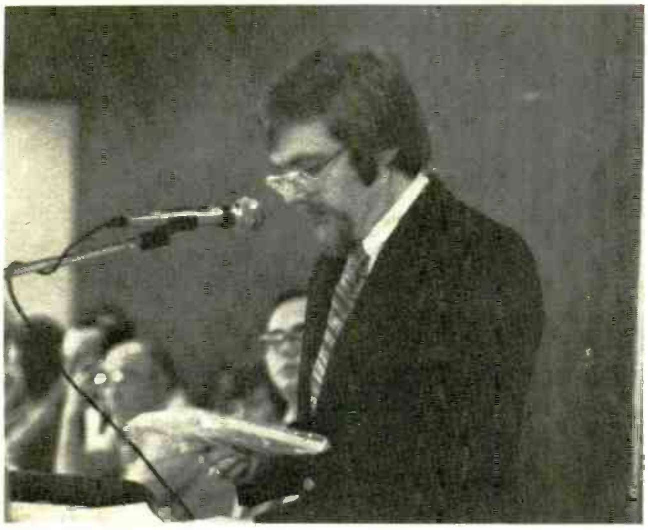
The highlight of the convention was the awards banquet held Sunday where the winners of the demonstration contest were announced. The grand prize, a complete Altair floppy-disc system, was awarded to Don Alexander of Columbus,

GUEST SPEAKERS at Awards Banquet are, from left to right, Lou Fields (Vice President of Southern California Computer Society), Manfred and Virginia Peschke (publishers of Byte), David Ahl (publisher of Creative Computing) and Larry Steckler (Editor of Radio-Electronics).

BILL GATES, one of the writers of Altair Basic, presents a general software seminar.

SEMINARS were interesting and well attended, as can be seen from the above photograph.

CARL HELMERS of Byte receives trophy from Lou Fields, Vice President of Southern California Computer Society, in recognition of Byte's contribution to the home computer field.



PAUL ALLEN, director of software at MITS, announces the winners of the software contest at the Awards Banquet.

OH, for his computer-controlled amateur radio station. The system consisted of an Altair 8800 with 8K of memory, an ASCII keyboard, a video display, Baudot Teletype and stan-

DON ALEXANDER receives Grand Prize, a complete Altair floppy-disc system, for his amateur radio station.

GRAND PRIZE WINNER Don Alexander demonstrating his computer-controlled amateur radio station.

dard transmitter and receiver. The system was designed to transmit and receive messages in a radio Teletype contest. The Altair was used for ASCII to BAUDOT translation, cross-checking calls for duplication, transmitting the time and message number of a transmission and generating a hard-copy printout of all exchanges. Mr. Alexander developed his own software and wrote the assembler and editor in addition to building the hardware.

The competition resulted in a tie for second place. Randy Miller of Tempe, AZ, with a computer chess demonstration and Wirt and Valerie Atmar of Las Cruces, NM, with a speech synthesizer, were the second place winners. Both winners received an Altair 8800B.

Third place was awarded to Danny Kleinman, Steve Grumette and Mike Gilbert of Los Angeles, CA, for their

NORMAN TILBURY AND BARBRA SOLOMON demonstrating Daylight Savings Company system.

backgammon game. The software was written in Altair Basic and displayed by a Cromemco TV Dazzler. An Altair 16K static-memory card was the prize.

The winners of the MITS' yearly software contest were also announced at the banquet. James Gerow of Houston, TX, took first place for the Best Program and Lee M. Eastburn of Langdon, MD, won the top prize in the subroutine category.

WINNERS OF THE DEMONSTRATION CONTEST are, from left to right, Randy Miller (second place), Danny Kleinman, Steve Grumette and Mike Gilbert (third place).

This was the first computer convention of its kind and you had to be there to experience the enthusiasm. Computer hobbyists brought just about everything with them to the convention—from Teletypes to floppy discs. Have you ever walked through the halls of a hotel in the early hours of the morning and heard Teletypes clanking away? The era of the home computer system is definitely upon us and we would like to add our support to MITS and hope their plans for an annual convention develops into a reality in time for next year's convention. BRAVO MITS! **R-E**

State of SOLID STATE

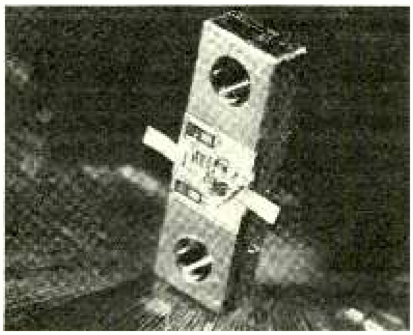
A new semiconductor transistor-like device from G-E that operates beyond 3 GHz, new memory devices and power Schottky diodes are featured this month

KARL SAVON
SEMICONDUCTOR EDITOR

GENERAL ELECTRIC HAS A NEW SOLID-STATE device designed for operation beyond the present 3-gigahertz limitation of present transistors. Seven times higher frequency range will be possible with the new triode. The CATT (Controlled Avalanche Transit Time) triode combines transistor and IMPATT diode features.

Radar and communications equipment design should be simplified by the G-E development. The CATT could play an important role in increasing activity in the less crowded upper portion of the radio spectrum.

Just like conventional transistors, the low power input signal feeds the emitter-base junction, injecting carriers into the base region. The base-collector depletion region has an IMPATT diode profile with the avalanche zone close to the base.



G-E's TRANSISTOR-LIKE CATT TRIODE, shown mounted for operation in a microstrip circuit, can operate at as much as seven times the frequency of conventional transistors.

Computer simulation was used in the development of the triode. So far devices have been operated between 2 and 3 gHz with 12 watts output, 13 dB gain, and 30% collector efficiency.

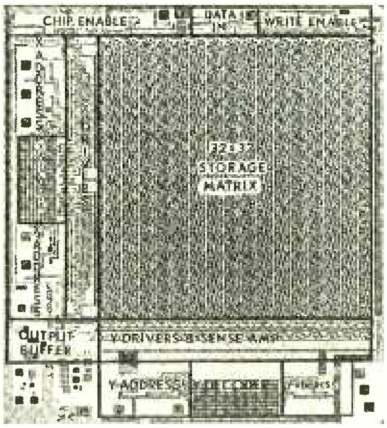
General Electric Company, Research and Development Center, P.O. Box 8, Schenectady, NY 12301.

Memories

TI and Signetics have introduced new memory products.

Texas Instruments has the TMS4033, 4044, and 4045 types organized as 1024 1-bit words. Their access times are 450, 650, and 1000 nanoseconds. N-channel silicon gate technology is used and they are fully compatable with the 74 TTL series. The price of the TMS4035NL is $13.36 in 100 quantities.

Signetics' 82S10 open collector and 82S11 tri-state output is a 1024 x 1 bipolar RAM. It is the fastest 1024 bit bipolar random-access-memory on the market



SIGNETICS 82S10 bipolar random-access memory.

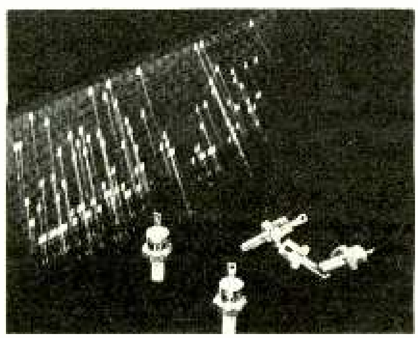
with a 30-ns typical access time. Schottky processing and dual-layer metalization is used. It surpasses other high speed 1024 bit RAM's, whether ECL or quasi-static N-channel, as well as standard 256-bit TTL RAM's. Performance is at the same level as 256-bit ECL RAM's and specially selected TTL RAM's. Typical input currents are 10 microamps giving a reduction in fan-in. This specification lets a single TTL gate drive many paralleled address and control inputs, well beyond the normal fanout of 10. The 82S10 and 82S11 can be used in high-speed main frame, cache memory, buffer storage and write-able control storage applications.

TRW power Schottky diodes

All the energy converted from the AC power line to DC voltages passes through the power-supply rectifier diodes. Power dissipation in the diodes is often substantial. A 1-volt forward diode drop at 10 amps is 10 watts of unproductive dissipation. Efficiency is poorer at the lower power-supply voltages because a larger proportion of the voltage appears across the diodes. Many logic, computer, and industrial systems use 5 volt supplies at large currents.

Schottky diodes have forward drops that are less than half the comparable normal silicon junction drops, and wasted power drops in the same proportion. Not only does power supply efficiency leap upward, but the entire cost picture improves. The devices shrink in size because of the reduction in thermal resistance requirements. System cooling and heat exchange needs are less demanding.

TRW has added the new SD-41 30-amp device to their already existing SD-51 60-amp device. Early Schottky rectifiers had problems at high temperatures and high reverse-voltages. But the SD-41 has a maximum forward voltage drop of only 0.55 volt at 30-amps and an unprecedented 125°C case temperature. The SD-41 is rated at a maximum reverse-current of 100-mA at 125°C and 35 volts. Non-repetitive 500-amp peak forward-current surges cause it no harm. Reverse recovery-time is under 10 nanoseconds.



TRW POWER SEMICONDUCTORS' 30-amp Schottky diode.

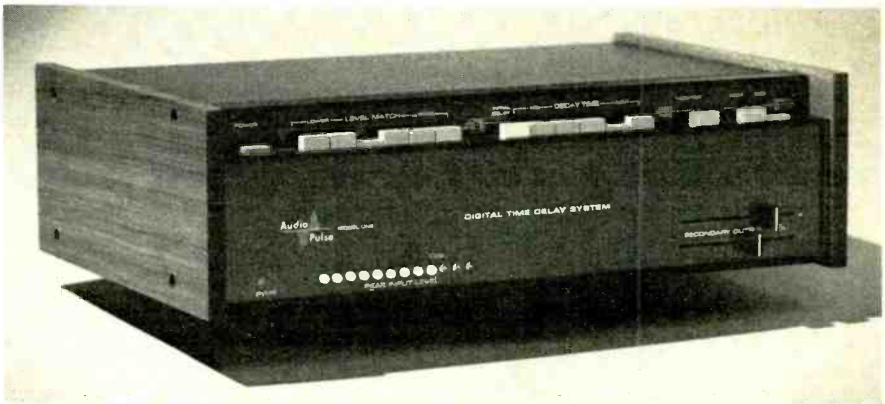
Schottky's have metal-to-silicon junctions instead of conventional PN junctions. TRW credits much of the superior performance of their power Schottky line to a new structure that uses a proprietary metalization technique for the interface in the silicon-to-metal junction.

TRW's SD-41 comes in a JEDEC DO-4 case and is priced at $5 each in production quantities. **R-E**

DIGITAL REVERB FOR TODAY'S HI-FI SYSTEMS

A new digital time-delay system that brings the spaciousness associated with a concert hall into the living home

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR



AUDIO PULSE MODEL ONE time-delay system eliminates the disadvantages inherent in mechanical delay lines.

EVEN AN UNTRAINED LISTENER CAN easily distinguish the differences between music in a spacious concert hall and the same music reproduced over an audio system in a home listening environment. The concert hall has richness and depth because of the blending of the direct sounds coming from the performers on stage with indirect sounds reflected in a variety of complex patterns from the sides and rear of the hall. These reflected sounds arrive fractions of a second later than the direct sounds and, though they may not be perceived as separate sounds by our ears, are responsible for the listener's ability to perceive—even with eyes closed—that the musical event is taking place in a spacious environment.

Earliest recording experiments with 4-channel sound attempted to recreate this feeling of spaciousness or ambience by using the added pair of back channels to record and reproduce random reflections picked up at some point far removed from the sound itself. Less dramatic, perhaps, than later "surround sound" quadriphonic recordings (in which primary musical information reaches the listener from every direction), the "ambience" approach to 4-channel sound soon gave way to more "gimmicky" musical effects. At a recent electronic industry exhibition in Chicago, we were introduced to a newly developed digital time delay system which, to our ears, seemed more able to recreate the spaciousness of a concert hall than any quadriphonic approach we had heard before. Designated the *Model One Digital Time-Delay System* by its makers, Audio Pulse (a division of Hybrid Systems, Inc.), this unusual device synthesizes the live listening experience by adding multiple continuous time delays to the original content of a stereo recording or broadcast. The delayed reverberant signal is fed to a separate stereo amplifier and heard over a second set of speakers to the sides or rear of the listener's usual seating area. The number, length and combination of time delays can be varied, so that the blend of direct and indirect sound in a listening room can be varied to suit different kinds of music and listening requirements. Fig. 1 shows how the time-delay unit would be hooked into an ordinary stereo component system. Superficially the setup resembles the familiar 4-channel array, but that's where the similarity ends.

Digital design comes to audio

Nor is Audio-Pulse's time delay system a new-fangled version of the old mechanical "reverb" units which employed springs as transducers and were moderately popular in the earlier days of high-fidelity and stereo. Such spring devices were noted for adding a "twangy" coloration to delayed or reverberant signals produced by them, and, in any event, delay effects were at best random, incapable of being varied, and certainly unrelated to what takes place in a large concert hall.

The Audio-Pulse unit can be thought of as a miniature computer containing an electronic model of acoustic space. Using various components to be described, the system converts input audio signals to digital pulses with an analog-to-digital (A/D) converter. Once in digital form, signals can be delayed by selected amounts of time, added or mixed together at selectable amplitudes and finally reconverted by a digital-to-analog (D/A) converter and reinserted into the audio reproduction chain through the extra pair of amplifier and speaker channels.

The idea of electronic digital time delay for audio is not, in and of itself, new. Such devices as the *Cooper Time Cube* have been in use in professional recording studios for some time. Their drawback, from the home user's point of view, has been their cost, which can mount up to several thousands of dollars because of the complexity of the circuits involved. While the Audio Pulse unit employs the equivalent of 150,000 transistors (most of which are reduced to integrated circuitry), its advanced encoding process and decoding process has made possible the introduc-

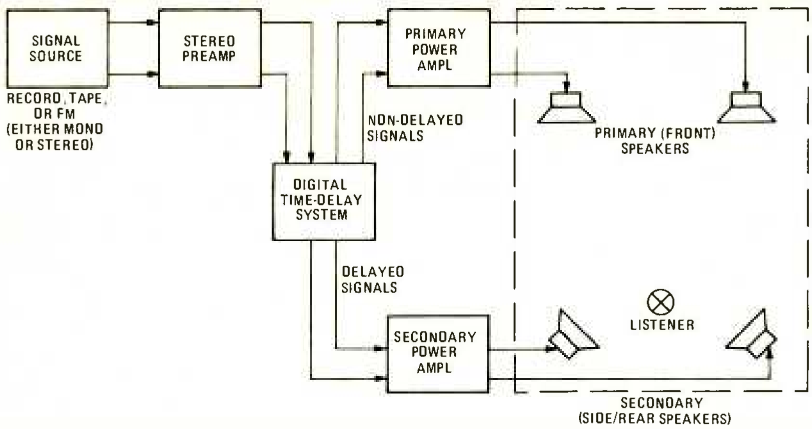


FIG. 1—THE DIGITAL TIME DELAY is inserted in the rear-speaker circuit of a four-speaker system, after the stereo preamp.

tion of this device at a cost of under $600.00.

This time delay system is a unity-gain device. It contains level-matching input and output circuitry to enable the line-level audio signals to be matched to the dynamic range of the digital encoders for optimum signal-to-noise ratio. Selecting the optimum gain is simplified by a sensitive, frequency-controlled, front panel 3-color, 12-LED display which continuously shows the peak signal levels at the encoder inputs.

Circuit description

A simplified block diagram (Fig. 2) will aid in understanding the operation of the digital time delay system. In each channel, the incoming audio signal is fed to a buffer stage and then to an active filter, which attenuates frequencies above 8 kHz. This deliberate roll-off is introduced because it has been found that in actual concert halls the reverberant-field energy rolls off rapidly at high frequencies. The filtered audio signal then goes on to a pre-emphasis/compression circuit used as a noise reduction encoder, somewhat analogous to Dolby (but with different characteristics specifically matched to the behavior of the encode-decode system which follows.)

The audio signal in each channel is converted to digital pulses by an analog-to-digital (A/D) converter. This particular A/D circuit is a new one employing *Delta Modulation With Memory*, which will be explained in detail shortly, and which was developed expressly for this instrument. The A/D encoding takes place at regular intervals defined by the "clock". In the LONG position of the front panel INITIAL DELAY switch, encoding occurs at a rate of 250,000 pulses per second. In the SHORT position of the switch, the encoding interval is about 2.5 microseconds, yielding 400,000 pulses per second.

At either rate, the two channels of pulses are fed into two serial memories consisting of a total of thirty-seven 1,000-bit shift registers. In either channel, as each clock pulse occurs, a data pulse from the encoder enters the first shift register and all the data pulses in the memory are shifted by one bit. Pulses emerge from the opposite end of the shift register bank after a time delay that is simply the clock interval multiplied by the number of shift register bits. In addition to this full delay, a briefer partially delayed signal is obtained by tapping the shift register memory at about one-third its length.

The fully and partially delayed pulse trains then go to the digital-to-analog (D/A) converters to be decoded back into audio waveforms. The decoders also operate on the Delta Modulation with Memory principle and complement the A/D converters precisely.

Fully and partially delayed audio signals are fed to a variable mixer. Here, relative proportions of partial and full delays are controlled by a bank of selectable DELAY TIME switches on the front panel. Increasing the proportion of the fully-delayed signals lengthens the reverberant decay time and *vice versa*.

A dynamic expansion/de-emphasis circuit restores the signal to its original dynamic range and frequency spectrum balance while reducing noise and distortion introduced by the digital encoding and decoding process. An active filter, similar to the one used at the input, smoothes out the signal and reduces residual noise beyond 8 kHz while limiting reverberated signals to that bandwidth. The delayed output from each channel is fed back and mixed into the input of the opposite channel, where it is further delayed and then fed back to the input of its original channel, and so on. In addition to these cross-channel recycling loops there are also recycling loops within each channel (not shown in Fig. 2). As each delayed signal is recycled it is mixed into the input at a reduced level, corresponding to the attenuation of a sound wave as it is reflected from the walls of a concert hall. As a result, the composite output signal following an input transient contains dozens of delayed signals, decaying exponentially in amplitude, very much like the actual reverberant decay of sound that takes place in a real concert hall, as illustrated in Fig. 3.

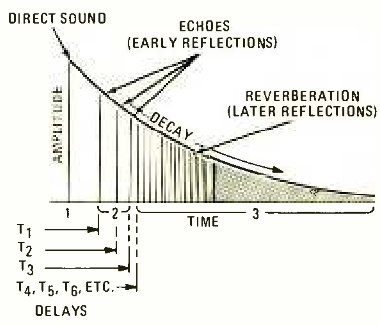


FIG. 3—THE DELAY APPROXIMATES the reverberation in an actual concert hall, as represented in this drawing.

In a real concert hall or any other large acoustic space, reverberant-field energy arriving at a listener's two ears is largely incoherent and random-phase in character, with little or no left-right symmetry. So, the Model One contains active signal processing output circuits following the digital time delay circuitry. These include a phase-shifting

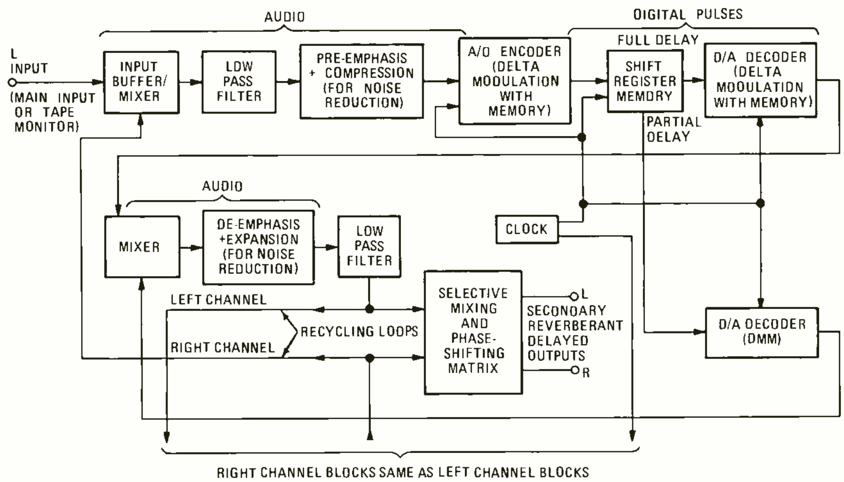


FIG. 2—HOW THE SYSTEM WORKS—a simplified block diagram of the operation.

network whose purpose is to insure that the delayed signals will have the spacious, non-localizable character of actual reverberant-field energy in an acoustic space. At the same time, these extra circuits solidify the bass energy in the sound field by minimizing low-frequency cancellations due to the standing waves in listening rooms of typical size.

Delta modulation with memory

As mentioned earlier, the most important element in this time delay audio system is a new form of analog-to-digital converter which Audio Pulse calls "Delta Modulation With Memory" (DMM). Unlike conventional pulse code modulation (PCM) encoders, which digitally encode the amplitude of audio waveforms, the DMM encoder is a waveform slope detector, which digitally encodes the moment-to-moment *changes* in the audio signals applied to it. To understand its operation, refer to Fig. 4, which is a detail of the more generalized central blocks of Fig. 1 (A/D encoder, shift register memory and D/A encoder).

The core of the digital DMM encoder is a comparator IC. The comparator is essentially a high gain open-loop operational amplifier in disguise. It has two inputs ("sig" and "ref") and one output. This comparator is a binary, or digital device in that it is capable of only two output levels of

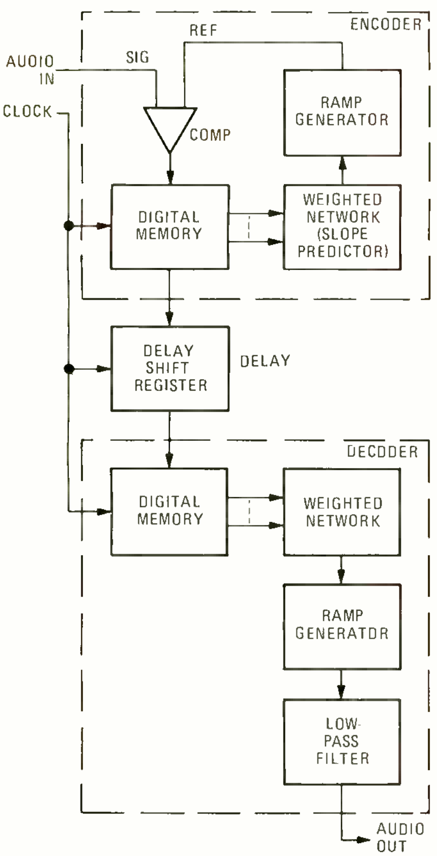


FIG. 4—DIGITAL MODULATION WITH MEMORY circuit is an expansion of the encoder, delay and decoder blocks shown in Fig. 1.

voltage. If the audio signal voltage is greater than the reference voltage, output of the comparator is equal to the power supply voltage (corresponding to a "1" logic state). When audio signal level is less than reference voltage level, comparator output instantly flips to 0 volts (corresponding to a "0" logic state).

In the DMM circuit developed by Audio Pulse, the reference voltage supplied to the comparator is not a fixed level; rather, it is a rising or falling voltage ramp. The ramp generator is part of a feedback loop that varies the comparator reference voltage in an attempt to track the incoming audio signal voltage. Thus, the comparator's binary output is essentially an error signal continuously indicating whether the ramp generator's voltage is above or below the audio waveform voltage. Generation of the reference voltage is the key to the DMM encoder's operation.

At regular intervals of a few microseconds (as determined by the clock signal), the comparator's "up" or "down" output state is transferred into a short-term digital memory. This memory contains several storage cells (the exact number remains a proprietary secret with Audio Pulse, for the moment) which retain logic "1" 's and "0" 's generated during an equal number of previous clock intervals. The contents of the memory comprise an n-bit digital code ("n" being the number of cells) which describes recent history of the audio signal waveform. At each clock interval this group of logic pulses is fed to a weighting network whose output controls the ramp generator. The ramp generator produces a rising or falling voltage ramp whose polarity and slope are selected in accordance with the control signal produced by the weighting network.

The weighting network uses the pattern from the digital memory to predict what the audio waveform slope will be during the forthcoming clock interval, and it causes the ramp generator to produce a voltage ramp whose slope approximately leads the predicted audio waveform slope. The comparator then generates an "up" or "down" binary output, depending upon whether ramp voltage rises above or falls below audio waveform voltage during the next clock interval.

The serial pulse train that results is then time-delayed by sequential shift through the shift registers. The output pulse train from the delay shift register is identical in every way to the pulse train generated by the encoder section except for its time delay.

When the delayed pulse train reaches the decoder, it is fed into a multiple-bit digital memory which is identical to that used in the encoder section. In each clock interval, pulses in the DMM decoder memory comprise an n-bit digital code identical to that previously found in the encoder. The pulse group is fed to a weighting network (also identical to that in the encoder) whose output controls another ramp generator. The delayed pulse train causes the decoder's ramp generator to reconstruct audio waveforms, segment by segment. The low-pass filter removes the sharp corners of the reconstructed waveform, resulting in a smooth and undistorted delayed replica of the original audio signal.

While delta modulators have been available for several years and, unlike PCM encoders, cannot be overloaded by low-frequency or mid-frequency signals (unless they exceed the encoder's power supply voltage), the simpler form of basic delta modulator was subject to severe slew-rate limitations and had a constricted high-frequency dynamic range. The development which made the Audio Pulse Model One practical was the new form of delta modulator with short-term memory which has just been described. The encoder's slew-rate is effectively quadrupled in this approach, providing ample dynamic range for high-frequency transients.

What is most exciting about this new device is that, in our opinion, it provides a level of sonic realism that serious audiophiles have sought for a long time (and have not been able to find in any available quadriphonic system, as presently offered). While it does call for a second stereo amplifier and pair of speakers, the performance requirements for those extra pieces of equipment do not seem to be as critical as they are for quadriphonic reproduction. Since bandwidth of the reverberant sound signals is deliberately restricted to reproduce the narrower bandwidth of reflected sound, the second pair of speakers not be be ultra-wide range. And since the device requires no special program material (it even does some remarkable "space expanding" when reproducing older, monophonic program sources), it won't become obsolete or incompatible.

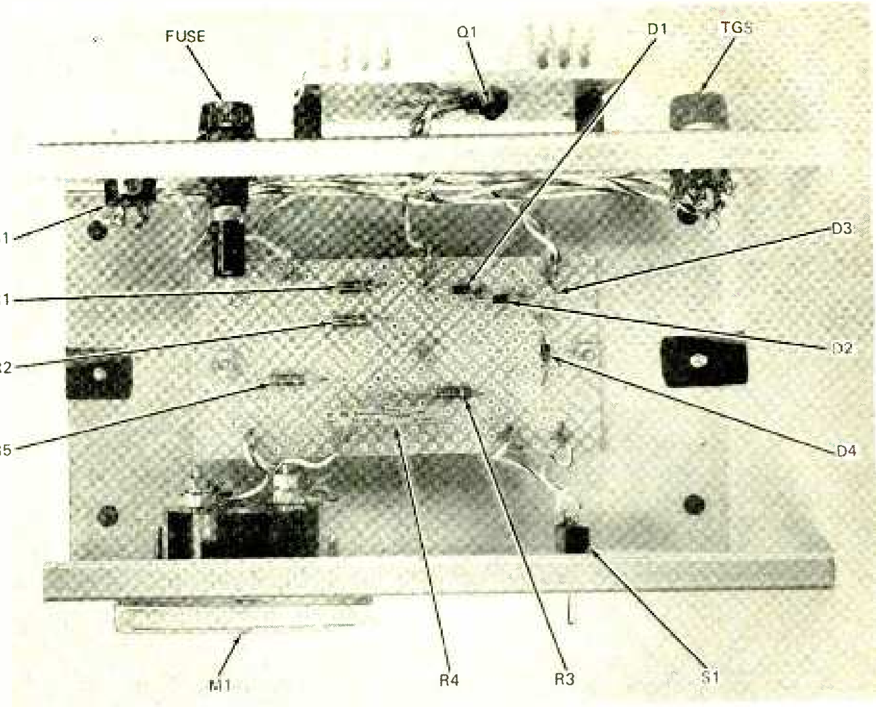
Evaluative listening test

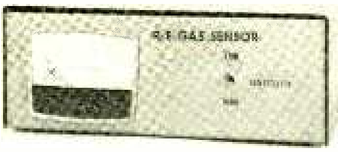
We first heard the Audio Pulse Model One in a listening room which was, if anything, smaller than most people's living rooms. Speakers driven by the Model One and its second stereo amplifier were mounted fairly high on the side walls of the room parallel to our front-to-back listening point. The most amazing thing about what we heard is the fact that one is not conscious of the presence of those

(continued on page 108)

Build A Gas Sensor

This simple device measures the concentration of various noxious gases





THE GAS SENSOR gives a direct readout of the relative concentrations of noxious gas.

CASS R. LEWART

THE GAS SENSING INSTRUMENT DEscribed in this article can detect and measure low concentrations of various noxious gases in your car or boat and can possibly give you a warning before it is too late. The instrument is based on an inexpensive semiconductor device called the Taguchi Gas Sensor (TGS).

Sensor operation

The TGS sensor changes its resistance as a function of minute quantities of a deoxidizing gas that is present. Typical gases detected by this device are carbon monoxide, gasoline or alcohol vapors, propane, methane and hydrogen. The TGS sensor consists of a combination of n-type metal oxides, such as tin, zinc and ferric oxides, that decrease their electrical resistance with an increasing concentration of a deoxidizing gas.

The sensor has an amazing range of sensitivity to gas concentration. Depending on external circuitry, it can detect concentrations of a few parts-per-million, but it can also be used to measure high gas concentrations encountered in the exhaust of an automobile. Due to this wide sensitivity range, the instrument can be used to check the inside of a boat, car or trailer for escaping gasoline vapors, carbon monoxide or exhaust fumes. It can also be used for automobile tune-ups. Because of the wide variety of gases to which the TGS sensor responds, the readings of the instrument can only be interpreted in a qualitative, comparative way.

If you observe the meter needle jumping as the TGS sensor approaches a pipe joint, you will know that gas is escaping. If the inside of your car, boat or trailer gives a higher meter reading than the fresh air, you will know that a problem exists. However, there is no way to translate the meter readings directly into gas concentration because the sensitivity of the TGS sensor is different for various gases.

Circuit description

The circuit consists of a regulated voltage supply for the TGS sensor and of a resistance-indicating meter that has its own regulated voltage supply. A higher than normal concentration of a noxious gas lowers the TGS resistance between pins 1, 2 and 3, 4 and causes the meter reading to increase.

The TGS sensor requires approximately 1 volt at 0.4 ampere to operate. This voltage is derived from a 12-volt automobile or boat battery by the voltage regulator consisting of the transistor Q1 and three diodes as shown in Fig. 1. The voltage drop across diodes D1, D2 and D3 (approximately 1.7 volts) minus the voltage drop across the base-emitter junction of Q1 (0.7 volts) provides the required regulated voltage of 1 volt for the TGS sensor. Then Zener diode D4 supplies a constant voltage for the resistance-indicating meter circuit making it independent of battery fluctuations. The initial adjustment consists of connecting points A and B with a jumper wire and rotating R4 to read full scale on the meter. Switch S1 shunts resistor R5 across the metering circuit, thus giving a LOW and HIGH sensitivity range of gas concentration. A 0.75-ampere fuse is recommended to protect the circuit.

The normal reading on the meter after the initial warm-up of 5–10 minutes is 0.3–0.6 mA on the HIGH sensitivity setting and 0.1–0.3 mA on the LOW setting. You can test the circuit by putting a drop of gasoline on your finger, bringing it close to the TGS sensor and watching the meter needle deflect. The meter should then register close to its maximum reading. After the sensor detects a high gas concentration, it takes several minutes after the gas removal until the reading goes back to normal.

Construction

Wiring of the circuit is not critical, however, we would recommend the parts layout shown. Mount the meter in a metal cabinet. Depending on the intended use you can mount the TGS sensor on the cabinet or in a separate housing connected with a 3-wire extension cord to the main circuit. The TGS sensor will fit into a 7-pin miniature

PARTS LIST

All resistors are ½-watt, 10%, unless noted.

R1—1000 ohms
R2—150 ohms
R3—6800 ohms
R4—5000-ohm potentiometer
R5—680 ohms

D1, D2—1N914 diode (HEP154, HEPR0050, or equal)
D3—1N34 diode (HEP134, HEPR9134, or equal)
D4—9-volt, 1-watt Zener (HEP104, HEPZ0412, or equal)

Q1—2N5190 transistor (HEP701, HEPS5000, or equal)

S1—SPST switch
J1—Male 2-conductor connector
M1—1-mA meter (Calectro D1-912 or equal)

TGS—TGS gas sensor, order from Southwest Technical Products, Dept. RE, 219 West Rhapsody, San Antonio, TX 78216. $6.25 postpaid.
Metal cabinet—8 × 4 × 6" (Lafayette Radio Electronics, catalog no. 12-R-03074V, or equal)
Misc.—Heat sink (Radio Shack no. 276-1361 or equal), 7-pin tube socket, Vector board, fuse, hardware.

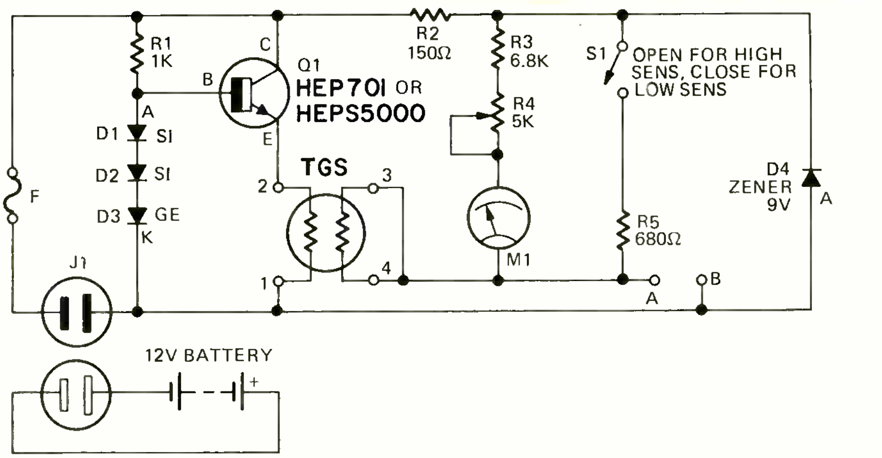


FIG. 1—GAS SENSOR is built around sensing element that changes resistance in accordance with gas concentration.

tube socket with only 4 pins being used. The input pins 1 and 2 and output pins 3 and 4 of the sensor are interchangeable.

The power transistor Q1 dissipates approximately 4 watts and should be mounted on a heat sink outside the cabinet. Use fiber spacers to mount the heat sink to the cabinet. Check diodes D1, D2 and D3 before connecting the unit to the cigarette lighter in your car. An open or reversed diode may destroy the sensor. **R-E**

Public Broadcasting Service wants captioned video

A petition recently filed with the FCC by Public Broadcasting Service asks that video scanline 21 be permitted to carry captions so that deaf viewers may read the titles and some of the information content of the program they are watching. This, it is estimated, would help 13.7 million hard-of-hearing television viewers. Station WETA, channel 36, near Washington, DC, has been given permission to test the system.

Home decoders for these captions are expected to cost less than $100, and since they have been developed under federal funding, their designs will be available to all manufacturers.

An important by-product of the proposal is a special "ghost excisor" that cancels secondary bounce reflections. Engineers suspect that this excisor could be developed to the point that all video ghosts could be curtailed or eliminated.

Public Broadcasting Service would use satellite relays

The FCC has been asked to approve a plan for linking the Public Broadcasting System (PBS) stations by satellite instead of by leased land-lines as at present. Economy (savings of $1 million per year), better reception and more flexibility in programming are cited as advantages of the proposed system. The plan, approved by the annual conference of PBS members held in Los Angeles last February, would provide three two-way channels. Under the present system, programs are sent out over a single line for live broadcast or taping for later use by the receiving station. The three-channel system would have far more flexibility and capacity (comparable to that of a three lane, two-way highway as opposed to a one-lane, one-way road).

With three channels, PBS could send out two programs at the same time giving its stations a chance to select. Programs could also be originated from various points and individual stations would even be able to exchange programs. While all these types of transmission are technically possible with leased lines, the excessive costs make them practically unattainable.

Quality would be better since signals can deteriorate when sent long distances in 30-mile jumps by microwave, and reception would be more uniform—each station would receive practically the same signal.

Western Union is prepared to offer three two-way channels on its Westar satellite, and Collins Radio has bid for the construction of earth stations at about $100,000 each.

X-ray tomography patent to Maryland doctor

Patent 3,922,582 has been issued to Dr. Robert S. Ledley, of Georgetown University Medical School, for an X-ray machine that scans any organ, or the whole body, and immediately displays a cross-section of the area scanned.

Tomography, a technique that has attracted the attention of several scientific journals recently, is performed by what one reviewer called the "barbecue" method. However, instead of rotating the body being scanned, the X-ray tube is rotated around the body. On the opposite side, a group of X-ray detectors—with sensitivity far surpassing that of any X-ray film—is rotated. The area of interest is in the center of the plane of rotation. Scanning signals are fed continuously into a computer that generates—as soon as the scanning is complete—a cross-section picture of the scanned area on a color television receiver.

The cross-section picture (tomograph) shows the exact location of any object in the plane being scanned. Thus a brain tumor or other object can be located for surgery. Much lower-voltage (softer) X-rays can be used with this technique, reducing the amount of radiation the patient receives. Resolution down to one millimeter is possible (this is *good* in X-ray photography!). This makes it possible to see such details as a clogged coronary artery that would be difficult or impossible to see in an ordinary X-ray photograph.

Cost is also high—about 20 times that of an ordinary X-ray machine. In spite of that, about four dozen of the machines are already in use.

Smokey ticketed by FCC

The FCC hands out hundreds of fines each week—to amateurs and CB'ers. The difference is that this particular fine goes to a police station in Marlton, New Jersey. Their police radio station, call sign KFR-661, was in "repeated violation of Section 1.89 of the rules by failing to reply to official communications." The fine was set at fifty dollars. **R-E**

build an 8080 microcomputer

The first two parts of this article (May and June, 1976) described the Dyna-Micro and presented the construction details.

This third and concluding part of the article discusses the 8080A and describes how the Dyna-Micro works.

The 8080A microprocessor

The 8080A microprocessor is an eight-bit parallel central processing unit (CPU). Unlike the earlier 8008 and 8008-1, the 8080A is a more powerful, easy to use device. The 8008 was an 18-pin device and many things were multiplexed on the same bus. The 8080A is a 40 pin package that offers many advantages over the earlier devices:

- A simplified bus that has separate address (16 bits) and data (8 bits) buses.
- Three state and TTL compatible buses.
- Simplified control.
- Improved interrupt and stack.
- More instructions.

While the power and clock requirements for the 8080A are more complex than for the 8008, they are easily met.

How the Dyna-Micro works

The Dyna-Micro uses the same basic computer functions found in most other computers, large or small. These are:

- Central processing unit (CPU)
- Memory (R/W and PROM)
- Control Logic
- Input/Output Control
- Clock and power supplies

The 8080A has 24 output-lines, 16 of which are used for address information and eight of which are a bi-directional data bus taking data to and from the CPU. The data flow on the data bus is controlled by the DBIN (Data Bus IN) signal from the 8080A chip on pin 17. Two bus buffers, Intel type 8216, are used to boost or buffer the data bus outputs and to protect the 8080A's inputs. The DBIN signal switches the 8216 IC's for either input or output of data on the bus.

The system's operation is controlled by signals from the 8080A at various times as synchronized by the clock frequency. An Intel 8224 clock chip with a 6.75-MHz crystal is used to provide the 750-kHz MOS clock levels to the 8080A. These clocks are slightly out of phase and do not overlap. While the 8080A chip can operate at frequencies up to 2 MHz, the Dyna-Micro's clock has been set to 750 kHz so that it will work with the relatively slow 1702A type PROM's. You can increase the speed of the Dyna-Micro by using a higher-frequency crystal. The 8224 chip divides the crystal's frequency by nine, so an 18 MHz crystal will give the 2 MHz output needed for the highest operating speed.

The clock chip also synchronizes the READY input with the clock so that system can slow down for slow memories and I/O devices. The RESET input from the R key is also input to the 8224 IC where it, too, is synchronized to the clock and output to reset the 8080A.*

The 8080A's data bus will also contain some STATUS information that is used by the control logic section to synchronize its control operations. The STATUS information is output and is available when the SYNC signal is output from the 8080A. The 8224 clock IC gates the SYNC pulse from the 8080A with the main system clock to provide a very short STSTB (Status Strobe) signal that 'catches' the status information in the SN74174 latch. The status information indicates data output, data input, halt condition, memory read, memory write and a special condition that signals the start of the next instruction, M1. Four of these status signals are gated with other system signals to provide the $\overline{\text{IN}}$, $\overline{\text{OUT}}$, $\overline{\text{MW}}$ and $\overline{\text{MR}}$ signals used throughout the Dyna-Micro. These signals are used as indicated below:

- $\overline{\text{IN}}$ and $\overline{\text{OUT}}$—used to synchronize data flow to ($\overline{\text{IN}}$) and from ($\overline{\text{OUT}}$) the 8080A CPU. They are used with external devices for data transfer.
- $\overline{\text{MR}}$ and $\overline{\text{MW}}$—used to indicate to the memory that the computer is executing a Memory Read or a Memory Write.
- $\overline{\text{INTA}}$—indicates that the computer has acknowledged an interrupt.
- HALT and ML—latched and provided for the user. These are not used in the Dyna-Micro, but are described in the experiment modules and are available for your use.

When the 8080A addresses memory, one and only one address must be specified on the 16-bit address lines. Since the 1702A and the 8111-2 memories only have eight lines to address their 256 locations, the remaining eight lines must be used to select one and only one of the memory blocks. We can select from two blocks of PROM, two blocks of R/W or possibly no blocks on the Dyna-Micro if we have expanded the memory off the PC board.

Address lines A0 through A7 are applied directly to the memory IC's on the Dyna-Micro card. Address lines A10 through A15 are gated in a six input NOR gate IC13. When this gate's output is a logic 1, it indicates that we are selecting one memory location within the first 1024 locations. Address lines A10—A15 are equal to logic 0. This would be one of the locations in either R/W or PROM, since these are located within the first 1024 locations. If the NOR gate produces a logic 0, at least one of the address inputs (A10-A15) must be at a logic 1, indicating that we are now addressing memory outside the blocks on the Dyna-Micro. Address bits A8 and A9 and the memory read signal ($\overline{\text{MR}}$) are gated together in an SN74LS155 decoder to select the proper block of the four possible on the Dyna-Micro card. The 8111-2 memories input the memory read and memory write signals to control the flow of data from and to the CPU. The 1702A PROM has only a chip-select input, so the memory read synchronizing signal is used in the SN74LS155 to gate data from the 1702A onto the bus at the correct time. Table V shows the memory selection.

TABLE V—MEMORY SELECTION

NOR Output	A9	A8	$\overline{\text{MR}}$	Memory
0	X	X	X	NONE
1	0	0	0	PROM 0
1	0	1	0	PROM 1
1	0	0	1	NONE
1	0	1	1	NONE
1	1	0	X	R/W 2*
1	1	1	X	R/W 3*

*$\overline{\text{MR}}$ and $\overline{\text{MW}}$ applied independently to the 8111-2 chips.

X = Don't care condition, logic 0 or logic 1.

Data flows to and from the memory on the bidirectional data bus and the 16-bit address bus specifies each location. This address bus is also used to help control the flow of data to and from external devices. The eight least-significant or LO address bits can specify one of 256 possible peripheral devices. The address bits are decoded in

(continued on page 85)

*For more information about these signals and IC's, see the *8080 Microcomputer System User's Manual*, Sept. 1975 from Intel Corp., 3065G Bowers Ave., Santa Clara, CA 95051.

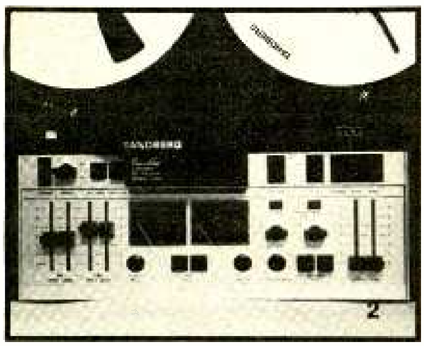
Radio-Electronics Tests Tandberg 10XD

1

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

TANDBERG STATES QUITE SIMPLY THAT their new model 10XD is the best tape deck they have ever produced. That's quite a statement for a highly respected company that has been designing and manufacturing tape recorders and tape decks almost as long as that type of product has been available for home and professional studio use. By the time we were finished with our tests and evaluations we were ready to agree and to go even a bit further. The Tandberg 10XD may well be among the few best tape decks ever produced by any home tape deck manufacturer!

It is a credit to the industrial designers of this flexible unit that its front panel seems to be remarkably simple in layout and ideally organized as to its control functions. The complete unit is shown in Fig. 1 while a closeup of the lower control-



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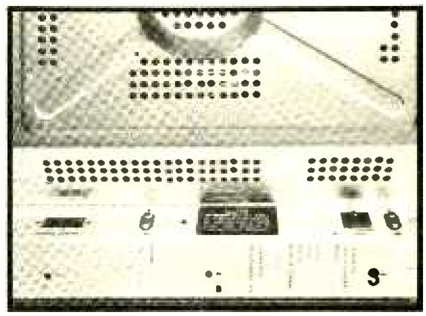
section is shown in Fig. 2. We'll deal with the transport, tape paths and tape guidance system presently. For the moment, let's examine those tastefully designed controls. A rocker switch below the left tape reel turns-on power, indicated by a green lamp just above it. Next is a SPEED selector knob for the three available speeds, followed by a reel-size selector button and an EDIT/CUE button. When this button is depressed, the user can hear sounds recorded on the tape even when the transport is in either of its fast wind modes or when tape is moved by hand for precise editing. Below the right take-up reel is a 4-digit tape counter.

Transport mode selection buttons are located beneath the digit counter and there are no restrictions on the sequence of buttons depressed. The RECORD button also sets tape in motion, thereby acting in lieu of a pause control which this machine does not possess as such. Since recording can only take place if one or both of the RECORD SELECT buttons (elsewhere on the panel) is activated, a measure of safety (against inadvertant recording or erasure) is also provided. Tiny lights beneath each of the transport keys become illuminated indicating the mode of transport motion that is in progress, while the RECORD key is totally illuminated in red whenever it is depressed.

The lower section of the front panel contains a pair of record level meters that also read during playback. The meters are peak-reading and are inserted in the circuit chain beyond the record equalization circuits. Furthermore, a 0-dB reading on these meters corresponds to a +6 VU record level in terms of NAB standards, so that in reality the machine has a good deal more headroom than one might at first suppose. To the left of the meters are individual slide controls for each channel's microphone and line inputs. Microphone input jacks (that are balanced and have a self-adjusting sensitivity feature that is dependent upon the impedance of the microphone used) and the record select buttons are located below the two meters. The lower right section of the panel contains HEADPHONE jack, SOURCE/TAPE switches, OUTPUT LEVEL slide controls, a three position SOUND-ON-SOUND switch and a DOLBY selector switch with positions for NORMAL Dolby encoding or decoding, FILTER, and DOLBY FM (used for recording a Dolbyized FM program). Lights located above the two last switches turn on when either sound-on-sound or Dolby operation is selected.

A photo of the rear panel is shown in Fig. 3. It contains the usual LINE IN and



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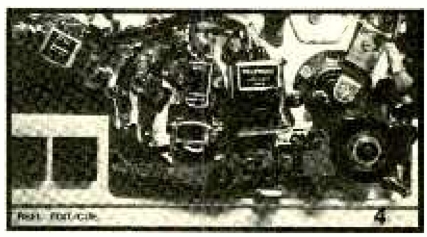
LINE OUT jacks, a DIN connector (that Tandberg prefers to label RADIO), and a REMOTE CONTROL socket for connection of an available accessory that permits complete remote operation of the transport system in any mode.

Internal features

While the visible features and controls of the Tandberg 10XD are certainly impressive enough, a real appreciation of the engineering that went into this unit can only be gained by exploring the not-so-obvious built-in features. Covering them all is beyond the scope of this report, but a few of the more important ones will be touched upon briefly. Consider, for example, the photo in Fig. 4. It is a closeup



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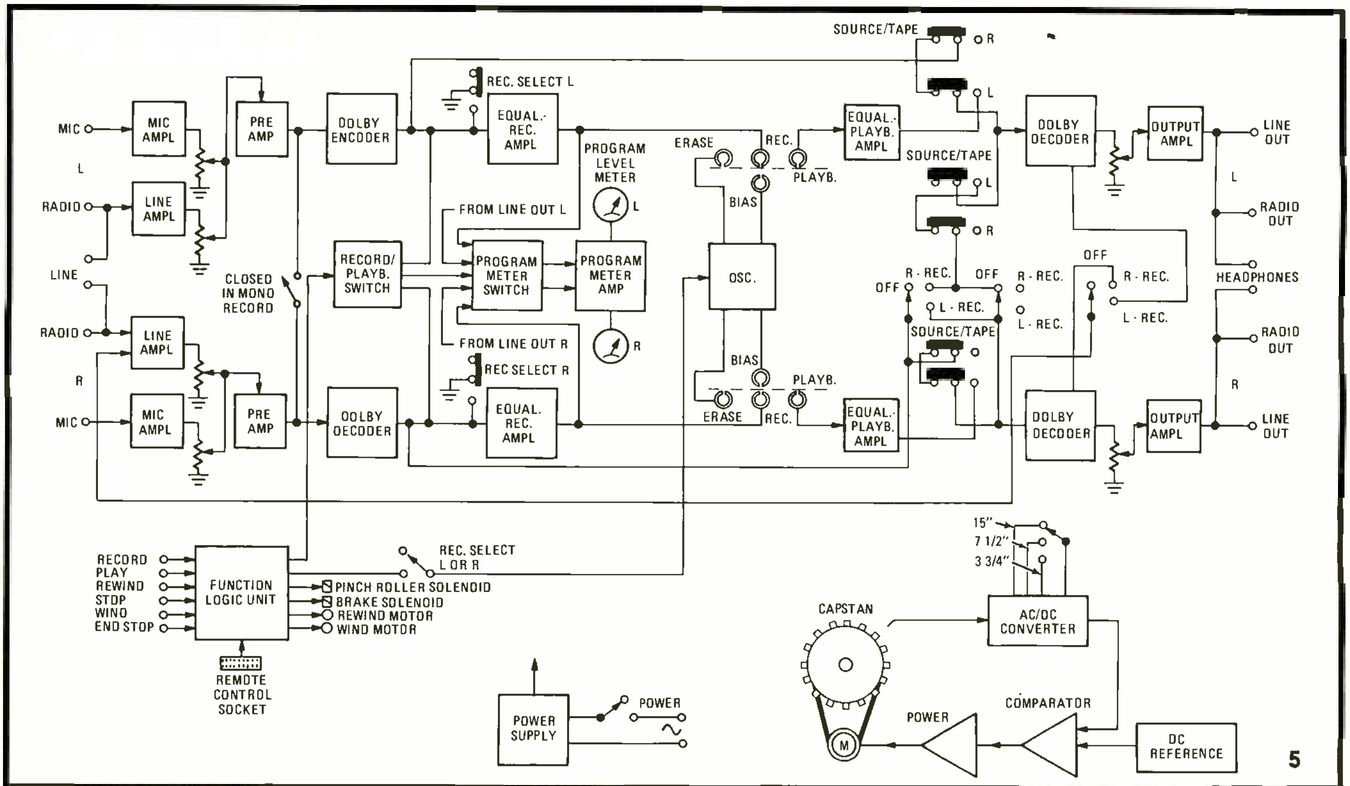
view of the head area with tape-head covers removed. What is unusual is the pair of heads that traverse the tape path from either side. These are the record and bias head, positioned on opposite sides of the tape. The technique is called cross-field recording and with it, Tandberg maintains that the tape can accept much stronger signals then with conventional techniques in which bias and recording signals are applied via a single recording head.

A simplified block diagram of the 10XD is shown in Fig. 5. The operation of the tape transport is controlled elec-

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Tape Speeds: 15, 7½, 3¾ IPS. **Speed Tolerance:** ±0.3%. **Wow-And-Flutter** (WRMS): (15 IPS) 0.04%; (7½ IPS) 0.06%; (3¾ IPS) 0.11%. **Frequency Response** (±2.0 dB): (15 IPS) 30-25000 Hz; (7½ IPS) 30-22000 Hz; (3¾ IPS) 40-18000 Hz. **S/N:** (unweighted) 56 dB; (unweighted, with Dolby) 60 dB. **Crosstalk Attenuation:** (mono) 60 dB; (stereo) 50 dB. **Harmonic Distortion:** (0 dB Record Level) 2.0%. **Mic Input Sensitivity:** Automatically adjusted for mic impedance; balanced mic inputs. From 1 mV to 130 mV. **Line Input Sensitivity:** Automatically adjusted from 100 mV to 5 V. **Line Output Level:** 1.5 V at 150-ohms load. **Dimensions:** 17¾" (45.1 cm) high by 17⅛" (43.5 cm) wide by 7¼" (18.4 cm) deep. **Weight:** 36 lbs. (16.3 Kg). **Suggested Retail Price:** $1299.00.



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tronically. Of the three motors used in this model, the two reel-motors are connected directly to the reel hubs while the third motor drives the tape capstan. The capstan motor is a servo-controlled brushless DC motor.

The 10XD is equipped with photoelectric stop. The tape passes between a lamp and a photo transistor. At the end of the tape (or if a transparent leader passes through the tape path) the tape drive stops automatically and the pinch roller is retracted from the tape. The operation of the transport logic control is such that regardless of the order that the mode buttons are depressed, the electronic control and tape tension-adjusting system ensures that tape travel is always correct and the tape is never stretched or in any way damaged. Controlled braking is also accomplished electronically. A light-emitting diode and a photo-transistor sense whether the right reel-motor is rotating or not and sends the information to the logic control. At the instant when that reel motor stops, the logic control dictates that information and permits the tape recorder to go into playback with practically no delay.

In the 10XD, power from the capstan motor is transferred by a belt to the flywheel. This keeps the capstan motor far away from the tape heads to avoid interference pickup and provides a simple and stable power transfer system.

Additional features of the 10XD include automatic adjustment of the tape tension as the tape is transferred from one reel to another. What Tandberg calls "flying start" electronic editing permits the user to go directly from the play mode to the record mode while the tape is running, thereby permitting precision editing or recording revisions. As far as we know, the 10XD is probably the only high-speed (15 IPS) machine that has as flexible a Dolby system. For example, the 10XD

TABLE I
RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Tandberg** — Model: **10XD**

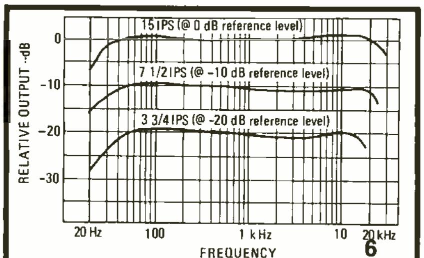
OPEN-REEL TAPE DECK MEASUREMENTS

	R-E Measurements	R-E Evaluation
FREQUENCY RESPONSE MEASUREMENTS		
STANDARD TAPE		
Frequency response @ 15 IPS (Hz-kHz ± — dB)	29-27, 2-dB	**Excellent**
Frequency response @ 7½ IPS (Hz-kHz ± — dB)	32-22.5, 2-dB	**Excellent**
Frequency response @ 3¾ IPS (Hz-kHz ± dB)	35-18, 2-dB	**Superb**
CrO_2 TAPE		
Frequency response @ 15 IPS (Hz-kHz ± — dB)	N/A	
Frequency response @ 7½ IPS (Hz-kHz ± — dB)	N/A	
Frequency response @ 3¾ IPS (Hz-kHz ± dB)	N/A	
DISTORTION MEASUREMENTS (RECORD/PLAY)		
Harmonic distortion @ −10 VU (highest speed) (%)	0.9%	**Excellent**
Harmonic distortion @ −3 VU (highest speed) (%)	0.7%	**Excellent**
Harmonic distortion @ 0 VU (highest speed) (%)	0.5%	**Superb**
Harmonic distortion @ +3 VU (highest speed) (%)	0.7%	**Excellent**
Recording level for 3% THD (dB VU/dB meter)	+8/+2	**Very good**
SIGNAL-TO-NOISE RATIO MEASUREMENTS		
Best S/N ratio, standard tape (dB)	61 dB weighted	**Very good**
Best S/N ratio, CrO_2 tape (dB)	N/A	
MECHANICAL PERFORMANCE MEASUREMENTS		
Wow-and-flutter @ 15 IPS (% WRMS)	0.017	**Superb**
Wow-and-flutter @ 7½ IPS (% WRMS)	0.025	**Superb**
Wow-and-flutter @ 3¾ IPS (% WRMS)	0.07	**Superb**
Rewind time, 1800′ tape (seconds)	90 sec.	**Average**
COMPONENT MATCHING CHARACTERISTICS		
Microphone input sensitivity (mV)	0.5mV/600 ohm (see text)	
Line input sensitivity (mV)	180	
Line output level (mV)	1800	
Phone output level (mV or mW)	5 mW/8 ohm (see text)	
Bias frequency (kHz)	Approx. 125	
TRANSPORT MECHANISM EVALUATION		
Action of transport controls		**Excellent**
Tape guidance system		**Excellent**
Absence of mechanical noise		**Very good**
Tape head accessibility		**Good**
Construction and internal layout		**Excellent**
Evaluation of extra features, if any		**Excellent**
OVERALL TAPE DECK PERFORMANCE RATING		**Superb**

can be used with any tuner or receiver equipped with 25 microsecond de-emphasis to decode FM Dolby broadcasts even if you do not wish to record them.

Laboratory measurements

Some of the most important performance measurements taken for the 10XD in our laboratory are listed in Table I and these may be compared with published claims of the manufacturer. Note that we have used a 2.0 dB roll-off point in specifying frequency response simply because that is what Tandberg did. Were we to specify the 3 dB roll-off points (as most other tape deck manufacturers do), high-end response would extend even further than the impressive figures shown. Figure 6 is a plot of frequency response taken at



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the three transport-speeds. Maxell UD tape was used in all of these measurements. It should also be noted that 0 dB on the Tandberg's own meters really corresponds to +6 VU based upon NAB standards. This demonstrates the outstanding characteristics of the cross-field recording technique insofar as recording level capabilities without tape saturation are concerned.

As for wow-and-flutter, the readings shown are the lowest we have ever observed for a consumer-intended tape deck. Distortion at all levels observed was far below that conservatively listed by Tandberg, rising to 3% at +8 VU (+2 VU on Tandberg's meters).

A word of clarification is needed with regard to the single signal-to-noise measurement of 61 dB (weighted) that we show for this unit. First, the measurement was made without Dolby. With Dolby, the S/N would increase to around 66 or 67 dB as a single meter reading. If one were to use IEC A weighting in making the S/N measurement, the reading would be further increased to around 65 dB without Dolby and more than 72 dB with Dolby! Tandberg gives all these S/N numbers in their data sheet and our observations came out a bit better than the numbers they quote in every instance using our tape sample (Maxell UD).

TABLE II

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Tandberg** Model: **10XD**

OVERALL PRODUCT ANALYSIS

Retail price	**$1299.00**
Price category	**High**
Price/performance ratio	**Excellent**
Styling and appearance	**Superb**
Sound quality	**Excellent**
Mechanical performance	**Superb**

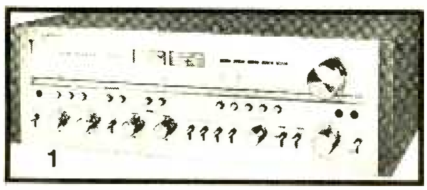
Comments: It is difficult to come up with the proper superlatives with which to summarize this report. The Tandberg 10XD is certainly that company's best effort to date. We have never measured a machine with lower wow-and-flutter, or lower distortion at high recording levels. As we recall, Tandberg was the first company to prove to the world that high-fidelity recording results could be obtained even at low 3¾ IPS speeds and it is altogether fitting that they should have included that non-professional speed in this thoroughly professional deck. No doubt Tandberg's cross-field biasing technique has much to do with the amazing frequency response achieved at that slow speed, but the transport mechanism together with its governing electronic and logic control is as much a masterpiece of design as are the purely electronic elements that govern recording quality. The Dolby noise reduction system incorporated in this machine almost seems unnecessary—especially when the machine is used at its highest 15 IPS speed, but of course it provides the usual improvement in signal-to-noise and if users intend to make dubbings or re-recordings from master tapes originally recorded on the 10XD, those extra dB's of signal-to-noise capability really make a difference as each successive dubbing adds its own noise contribution. The Tandberg 10XD is adjusted to be used with low-noise, high-output tape and, since there are no selectable bias or EQ positions (other than those that are automatically adjusted as speeds are changed), a user would be well advised to use only that type of tape if best results are desired. Action of the logic-controlled transport is just about as perfect as anyone would desire and we have not seen a faster "start up" on any consumer machine. Pauses between fast and play modes are just long enough to prevent tape damage, but not so long as to negate the advantages of this fully-automated fool-proof automated transport system. All in all, we shall be most reluctant to part with this magnificent example of open-reel tape deck technology.

Using the Tandberg 10XD

In its advertising literature, Tandberg suggests that the quality of the recorder can best be judged subjectively by switching from "source" to "tape" while making a recording. (This can be done without interrupting the tape recording process) and that is just one of the things we tried while using the machine for more than a week. The point of this test is to try to determine any difference between the source material (which should be of highest fidelity to begin with) and the recorded version of it. Suffice it to say, we could tell no difference at even the slowest speed of 3¾ IPS!

Tandberg has a winner here—and the serious recordist has a new machine to consider—one that sells for but a fraction of the total cost of those studio or professional tape recorders that it comes close to equalling. **R-E**

Pioneer Model SX-1250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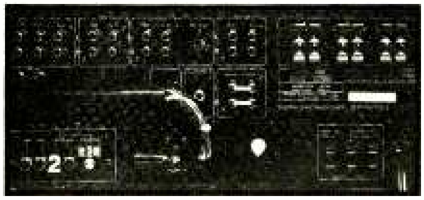
PIONEER BILLS THEIR NEWEST TOP-OF-THE line receiver as the most powerful in the world—and that it certainly is. But it is also a superior piece of equipment from several other viewpoints, and one that will appeal to the audio enthusiast who requires high power but hasn't the room or the funds to purchase a two-piece or even a three-piece high-fidelity configuration.

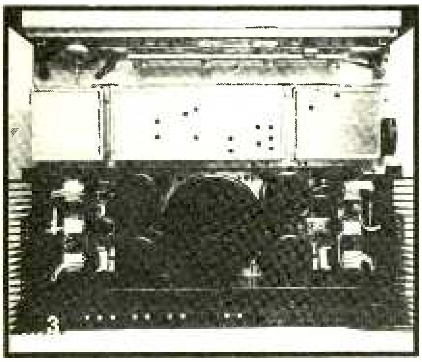
The front panel of the SX-1250 (shown in Fig. 1) is styled very much like that of Pioneer's separate tuners (and the front panels of many other new products made in Japan), in that it has abandoned the black-out dial approach that had become almost standard for most receivers in the last decade. Now, the linearly calibrated FM dial and AM dial scales are highly visible even when the unit is turned off. Both tuning and signal-strength meters are centrally positioned above the dial scales and these meters are flanked with a series of colored rectangles containing legends that illuminate to denote the speaker system (or systems) in use, program source selected and reception of a stereo FM signal. The dial pointer itself is smoothly guided along the bottom edge of the sloped (for easy viewing) dial scales by means of a massive flywheel-tuning knob arrangement that is about the smoothest we have ever twirled.

A series of pushbuttons just below the dial area select one or two out of three possible pairs of speaker systems, actuate low- and high-cut filters, turn FM muting on and off, permit audible observations of multipath interference and select the various program inputs. The usual phone jack (at the left) and a pair of left- and right-channel microphone input jacks are also in line with these buttons.

The lower section of the panel contains six rotary-controls and nine toggle-switches. Pioneer's novel twin-bass and twin-treble control arrangement has been carried over from earlier receivers and affords a degree of tone control not possible with simple, single bass and treble control arrangements. The toggle switch between these pairs of controls defeats the tone control action entirely when desired. Other rotary controls are the usual BALANCE control and a step-type master VOLUME control calibrated in dB down to −70. Two TAPE MONITOR switches are augmented by a TAPE DUPLICATE switch (enabling tape dubbing from either tape deck connected to the other) and a fourth toggle switch labelled ADAPTOR that is in reality a third circuit interruption point suitable for connection of a four-channel adaptor or even a third tape deck or other accessory. LOUDNESS, stereo/mono MODE and audio MUTING switches plus a main POWER on/off switch complete this most carefully thought out from panel layout.

The rear panel, shown in Fig. 2, has three sets of spring-loaded SPEAKER terminals for connection of as many speaker pairs (only two of which may be heard at any one time), the usual PHONO inputs (two phono pairs of jacks), high-level AUX inputs, TAPE and ADAPTOR inputs and outputs and a pair of jumpers that interconnect the preamplifier output and amplifier input circuits. Antenna connection facilities include 300-ohm and 75-ohm coaxial for FM, plus external AM and ground terminals. A pivotable AM ferrite-bar antenna is included, as are three convenience AC outlets (one switched) and an FM detector output jack for possible use with future FM 4-channel adaptors.





There is also a slide switch that selects 75-μs or 25-μs FM deemphasis (the latter required for Dolby FM listening if you have an accessory Dolby decoder). A DIN socket parallels the TAPE 2 input and output jacks.

MANUFACTURER'S PUBLISHED SPECIFICATIONS

FM TUNER SECTION:
Usable Sensitivity: 8.7 dBf (1.5 μV) mono; 14.5 dBf (2.9 μV) stereo. **50-dB Quieting Sensitivity:** 11.5 dBf (2.05 μV) mono; 36 dBf (34.5 μV) stereo. **S/N Ratio:** (mono): 80 dB; (stereo): 74 dB. **THD:** (1 kHz): 0.1% mono; 0.20% stereo; (100 Hz): 0.1% mono; 0.25% stereo; (6 kHz): 0.3% mono; 0.3% stereo. **Capture Ratio:** 1.0 dB. **Selectivity:** 83 dB. **Spurious and Image Rejection:** 110 dB. **IF Rejection:** 120 dB. **AM Suppression:** 60 dB. **Muting Threshold:** 13 dBf (2.45 μV). **Stereo Separation:** (1 kHz): 50 dB; (30 Hz to 15 kHz) 35 dB. **Sub-carrier and SCA Rejection:** 74 dB.

AM TUNER SECTION:
IHF Sensitivity: 15 μV external antenna; 300 μV/m internal antenna. **Selectivity:** 40 dB. **S/N Ratio:** 55 dB. **Image Rejection:** 65 dB. **IF Rejection:** 85 dB.

AMPLIFIER AND PREAMPLIFIER SECTION:
Power Output: 160 watts per channel minimum continuous power into 8 ohms, 20 Hz to 20 kHz at no more than 0.1% total harmonic distortion; 200 watts into 4 ohms, same conditions. **IM Distortion:** 0.1%. **Damping Factor:** 30. **Input Sensitivities:** phono 1 & 2: 2.5 mV; mic: 6.5 mV; Tape and Aux: 150 mV. **Phono Overload:** 500 mV. **Frequency Response:** (phono): RIAA ±0.2 dB; (high level inputs): 10 Hz to 50,000 Hz, +0, −1 dB. **Tone Control Range:** (main bass): ±10 dB @ 100 Hz; (sub-bass): ±5 dB @ 50 Hz. (main treble): ±10 dB @ 10 kHz; (sub-treble): ±5 dB @ 20 kHz. **Filters:** (low): 30 Hz; (high): 8 kHz (both 12 dB/octave). **S/N:** (phono): 75 dB weighted. (high level): 90 dB weighted.

GENERAL SPECIFICATIONS:
Power Consumption: 1200 watts. **Dimensions:** 21⅞" W × 7⅜" H × 18¾" D. **Weight:** 64¼ lbs. **Suggested Price:** $900.00.

TABLE I

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **U.S. Pioneer Electronics** Model: **SX-1250**

OVERALL PRODUCT ANALYSIS

Retail price	**$900.00**
Price category	**High**
Price/performance ratio	**Very Good**
Styling and appearance	**Excellent**
Sound quality	**Excellent**
Mechanical performance	**Excellent**

Comments: The enormous power output capability of the Pioneer SX-1250 places it in a class by itself as far as integrated receivers are concerned. But the Pioneer SX-1250, in our view, was not designed or conceived simply to produce "brute force" power. Its FM tuner section proved, in many respects, to be equal to or even better than the best separate tuner made by Pioneer. We are firm believers in the importance of high phono-overload capability, and the 500+ millivolt input capability of the preamplifier section of this receiver, coupled with its extremely accurate RIAA equalization make its preamp performance as good as many preamp sections we have measured on separate control units or integrated amplifiers. All of which raises the question, once more, as to whether there is a meaningful reason these days to opt for "separates." As far as we know, this is also the first high-powered receiver that uses two independent power supply transformer windings for the high-voltage output stages, an innovation that we have seen and admired in separate power amplifiers. Low-frequency reproduction superiority was clearly discernible and, we think, attributable at least in part to this feature.

We are indeed sorry that the people at Pioneer have misinterpreted the newly approved Tuner Measurement Standards (with respect to the relationship between dBf power numbers and previously used microvolts) both in their instruction manual and in their advertising literature and hope that future printings will correct these errors. We question, too, Pioneer's "need" to quote usable sensitivity at 1.5 microvolts (8.7 dBf) since, in production, it will be difficult if not impossible for them to maintain that ultra low figure consistently. All of which does not detract from the fact that this is a receiver having a most sensitive tuner section, an excellent and flexible preamplifier section, and a power amp section that should have no difficulty in driving even the lowest efficiency speakers around too high, clean sound levels.

Construction and circuit description

A view of the SX-1250 chassis with cabinet cover removed is shown in Fig. 3. Visible is a massive toroidal-core power transformer with separate windings for powering the left and right channels and flanking this transformer are dual pairs of 22,000-μF filter capacitors for each voltage polarity of each separate channel. Not visible, because of extensive use of shield covers, are the circuitry of the FM and AM sections of the receiver. Five-gang tuning is used in the FM front-end while three gangs are employed in the AM section. Dual gate MOSFET's are used for two RF amplifiers and mixer and the local oscillator is equipped with a buffer stage to increase oscillator stability. Four phase-

(Continued on page 00)

microphones in pro sound systems

Microphones are an important part of the professional sound system. Here's the ins and outs of selecting the right one

JOE BLACK*

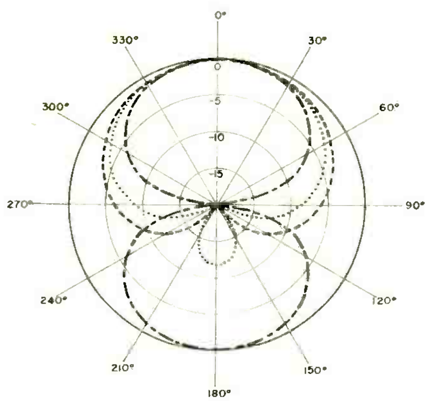
IT IS VITAL TO EVERY SOUND SYSTEM that the proper microphone be used. For no matter how good the amplifier, no matter how well laid out the speakers, no matter how beautiful the auditorium or restaurant or meeting room or nightclub, the wrong microphone will destroy all the previous planning.

Yet, selecting a microphone can be easy if it is approached in a logical, step-by-step fashion. The procedure is simple and breaks down into four basic areas: (1) pick-up patterns (2) frequency response (3) the type of microphone and (4), last but not least, price.

Pick-up patterns

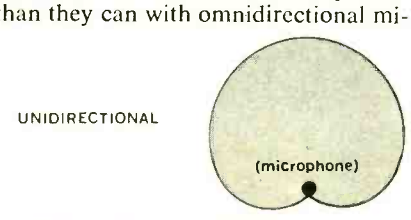
There are three basic types of microphone sensitivity patterns. Unidirectional, omnidirectional, bidirectional. The unidirectional picks up sound mainly from the front and at the same time suppresses sound and noise coming from the back. The most generally useful unidirectional pick-up pattern is the cardiod, meaning heart-shaped. This pattern successfully suppresses rear sounds by at least seventy percent, while picking up sound from the front over a broad area. Sounds 120° to 180° off-axis are almost entirely suppressed, but you must be sure to check the pattern of the particular microphone you plan to use to determine the exact cut-off angle. A typical pattern of a unidirectional cardiod microphone is shown in Figure 1.

*We wish to thank Shure Brothers Inc., Evanston, IL for providing the materials used to develop this article.



POLAR RESPONSE
DIRECTIVITY COMPARISON

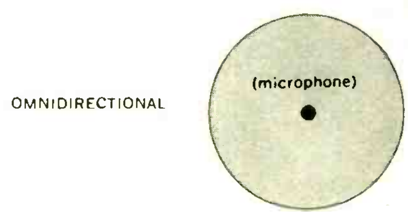
The cardiod microphone is most commonly used to solve feedback problems. Because of its reception pattern (the rear of the microphone rejecting sound) it can be easily positioned so that sound projecting from the speakers of the system cannot re-enter the microphone and produce feedback. As a result, performers can work much further away from unidirectional microphones than they can with omnidirectional microphones, because amplifier gain can be set to a higher level without encountering feedback.



UNIDIRECTIONAL CARDOID microphone has a typical pick-up pattern as shown.

The use of the unidirectional microphone also reduces the affects of audience noises; coughing, shuffling feet, etc. Because of the wide reception area, it is also convenient to use for a fixed installation in front of an individual performer or even a small group. To cover a large group, multiple unidirectional microphones are necessary.

Omnidirectional microphones pick up sounds from all directions and with almost equal sensitivity. A typical omnidirectional pattern is shown in Figure 2. For all practical affects these microphones are non-directional. They can be hand held, stand mounted or worn around the performer's neck. These are perhaps the most commonly used microphones, and probably account for the largest number of microphones in use.

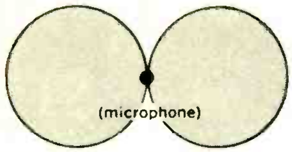


OMNIDIRECTIONAL MICROPHONE has a typical pick-up pattern as shown.

Omnidirectional microphones are great in applications where feedback or audience noise is no great problem. Since these microphones are extremely versatile, and many of them are thin, long, probe type units, they are perfect for walk-around and interview situations.

The bidirectional microphone (its pattern is shown in Figure 3 picks up sound from both front and back, but

BIDIRECTIONAL



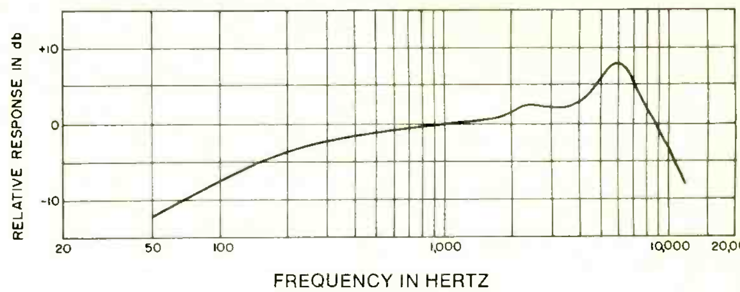
BIDIRECTIONAL MICROPHONE has a typical pick-up pattern as shown.

suppresses the reception of audio signals from the side, the top and the bottom. This category of microphones is perfect when two performers or groups are positioned on opposite sides of the same microphone. It permits that same freedom of movement that you get when you use undirectional microphones, yet helps solve feedback problems caused by rooms that have hard, reflective ceilings, or in set-ups where the loudspeakers are mounted directly over or to one side of the microphone.

Frequency response

Once you have decided on the kind of pick-up pattern your application demands, it's time to decide on the frequency response required. Because the fidelity of reproduction is not always the prime requirement. The frequency response of a microphone should be tailored to the application. For example: if you are going to do recording, broadcasting, or need a PA system that can handle quality music, you've got to look for a wide-range frequency response, and here your microphone must deliver a minimum of 50 to 15000 Hz. And the response has got to be both flat and smooth over that range. The best types of microphones for such an application are ribbon and dynamic types. On the other hand, if all we need is a quality public address system for voice and music, but total frequency response is not needed, we can get by with a microphone that only covers 70 to 10,000 Hz. It, like the wide range microphone, should have a flat response. It could be slightly rising, but definitely must have no prominent peaks. There are three types of microphones that can be used in this type of application. They are: ribbon, dynamic, and some of the better crystal or ceramic units.

If all we are concerned with is indoor paging systems and public address systems for voice only, a frequency response from 200 to 5000 Hz is more than enough. Again, it is desirable to have a response curve that is slightly rising and it must have no prominent peaks. For this kind of application, again, we can use ribbon, dynamic, and some the better crystal or ceramic microphones, but we can also use some controlled-magnetic mikes.



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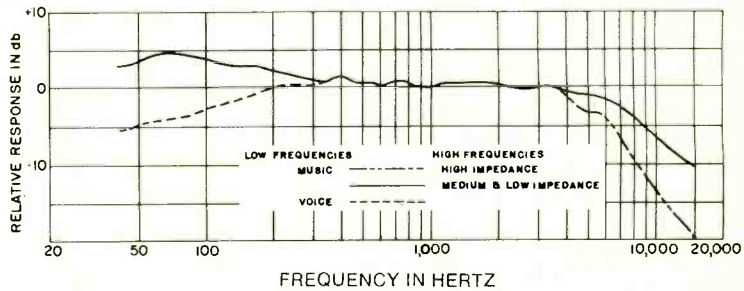

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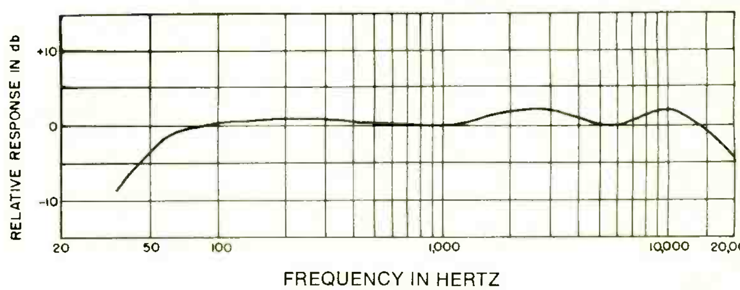

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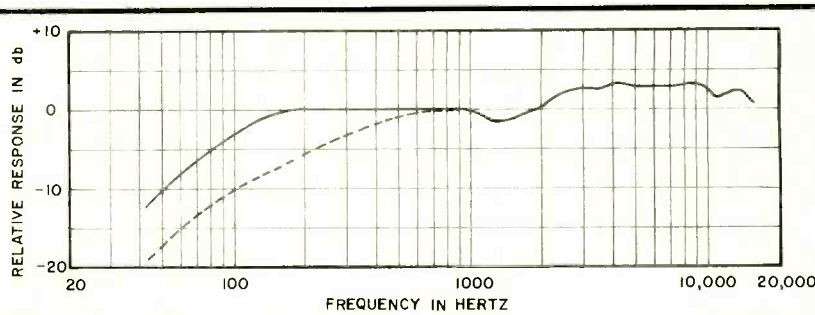

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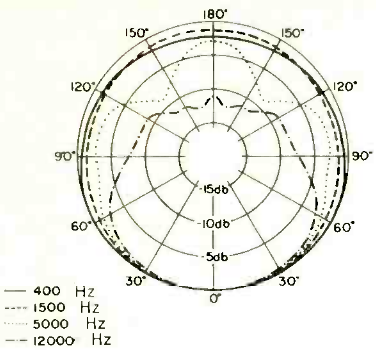
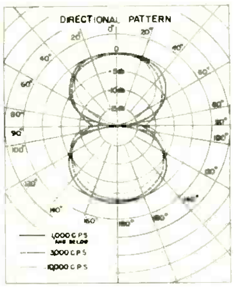
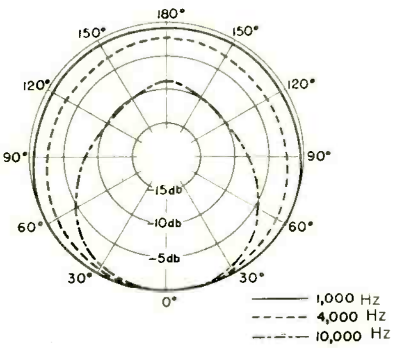
FREQUENCY RESPONSE AND PICK-UP PATTERNS for three different microphone-types. (A) Dynamic Lavelier. (B) Bidirectional Ribbon. (C) Omnidirectional Dynamic. (D) Unidirectional Dynamic.

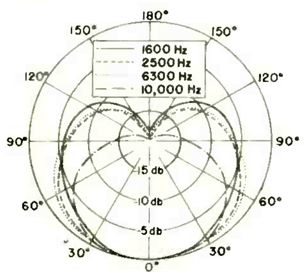
The final application area is for outdoor paging systems or systems that are installed in noisy locations, such as in a factory or warehouse. These systems are normally used only for voice, and the requirement here is maximum intelligibility of what is being said. Ideally, the response requirements should be limited, and the range of 300 to 3500 Hz is ideal. The response curve should be rising and should show a peak in the 2000 to 3500-Hz region. This peak is not mandatory, as in some situations it is not necessary, but it is helpful in improving intelligibility under the circumstances outlined. These microphones are available in controlled magnetic, dynamic, carbon, and some ceramic units.

In general, the more extended the frequency response of the microphone,









the more faithful the reproduction. Therefore, the more important reproduction quality is, the better and wider and flatter the frequency response you should look for.

A true high-fidelity microphone will deliver a response that is very smooth. When you look at its response curve, you should see no obvious abrupt peaks or valleys of output at any frequency. A mike that does this results in a smooth frequency curve and good hi-fidelity type quality reproduction.

A flat frequency response curve, as we all know, is one that shows no change in the output signal over the frequency range. This means that that microphone responds equally well at any frequency, and as we so well know, this is an absolute must for hi-fidelity reproduction.

While we know that microphones that have the widest frequency range, coupled with the smoothest and flattest frequency response curves, will give the best fidelity, they are not necessarily best for every application.

For example, we often deliberately use a microphone that has a shaped response plus peaks in some area of the frequency curve so that we can add presence and improve intelligibility in systems used for paging and communications use.

Types of microphones

We will not attempt to present here a course on microphones, but instead will briefly summarize the five major types of microphones used in pro sound systems. These are ceramic, ribbon, controlled magnetic, dynamic, and crystal types.

Ceramic microphones are quite similar to crystal microphones in design. The difference is that the ceramic microphone uses a man-made ceramic element. These microphones are economical, and are better than crystal types for outdoor use since they are not affected by high temperature extremes and humidity changes. These mikes have a high output-impedence too. Overall, whenever price becomes an important factor, ceramic microphones should be used. They are available in both omnidirectional and unidirectional units. All tend to be economical and rugged.

The ribbon microphone offers the great advantage of virtually uniform frequency response. It is definitely among the very best microphones available. It is extremely rugged for normal use indoors, offers adjustable impedence and is great for use wherever the quality of frequency response is the first consideration, such as in broadcasting, professional recording or PA systems intended to carry good music. They can be found in both unidirectional and bidirectional versions. They are excellent for music, but are not recommended for outdoor use, however, they can be used outdoors if protected against wind and environmental conditions.

The controlled-magnetic microphone uses a balanced armature, and as a result, is rugged, stable and delivers high signal-output. This type of microphone was originally developed for the military to combine the advantages of carbon and dynamic microphones with none of the disadvantages. It has the ability to directly supply any needed impedence without using a transformer, and controlled magnetic microphones tend to be modestly priced and deliver dependable performance over a long life time.

These microphones can be used indoors or outdoors; in fact, wherever rugged performance must be coupled with a reasonable price and frequency response. They are ideal for paging, language labs, portable PA systems, and are normally available only in omnidirectional types.

The dynamic or moving-coil microphone is available in a wide range of types, styles, and prices. The better dynamic units are among the very best microphones for frequency response, flat response up to 20,000 Hz is not unusual.

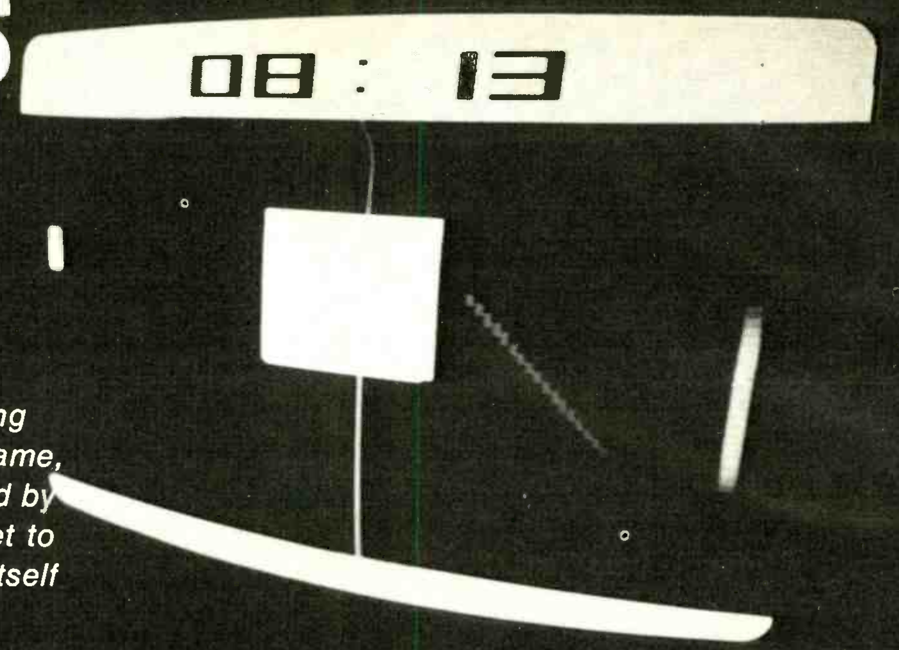
These dependable units should be used where unusual performance coupled with ruggedness and reliability are required. These encompass broadcasting and better-quality public address systems. The dynamic microphone tends to be superior in frequency response to ceramic, crystal, carbon, and controlled magnetic units are available in both directional and omnidirectional versions.

The crystal microphone offers good quality at a low price. Response is normally somewhat limited, usually to somewhere around 10,000 Hz at the top. Sealed crystals used in some microphones makes it possible to use the crystal microphone in applications where high humidity could otherwise cause a problem. However, high temperature, such as indirect sunlight, over a prolonged period will normally require the use of another type of microphone. Crystal microphones provide high impedence and are primarily used where price is a limiting factor.

Price is always a consideration

Microphones vary from the very inexpensive to the very expensive, but compared to the total cost of a sound system, the microphone is often the lowest priced single item in the system. Despite this, the function of the microphone is critical. Actually, no sound system can be any better than the microphone that does the original conversion from sound into electrical impulses. If you want to make comparisons, the unidirectional cardoid microphones tend to be the most expensive, however, there are first rate omnidirectional and bidirectional microphones that can cost just as much as the unidirectionals. If economy is the major factor, you've got to look at crystal, ceramic or controlled magnetic units. Where quality is the most important factor, a ribbon or dynamic microphone becomes a must. **R-E**

Build This Great TV Game



Part II. With on-screen digital scoring and a unique alternate "bumper" game, this ping-pong game can be played by two or four people, or it can be set to play a perfect game against you or itself

THE FIRST PART OF THIS ARTICLE (JUNE, 1976) presented the schematic and began the discussion of how the circuit works.

This second part of the article concludes the discussion of the main circuit board and presents the foil patterns.

Generating the ball

In a manner somewhat similar to that used to produce the paddles, we generate the ball. Two comparators are used to determine the vertical and horizontal coordinates of the ball. The actual position of the ball is set by the voltages appearing on the collectors of transistors Q3 and Q4.

Q3 determines the vertical position and Q4 the horizontal position. When the horizontal ramp voltage reaches the voltage of Q3, pin 14 of IC6-d goes low, producing a negative pulse at pin 11 of IC5-d. These two pulses are AND'ed by IC5-d to produce a positive pulse at the output pin 13 of IC5-d. This signal is the ball signal that is displayed on the screen via IC13.

Since the ball is always in motion, it is apparent that the voltages on Q3 and Q4 are constantly changing. The direction (positive or negative) of that change is determined by the state of two flip-flops, IC9-a and IC10-a. The signal at pin 5 of IC9-a determines the balls vertical direction. The signal at pin 9 of IC10-a determines its horizontal direction. The rate of change (hall speed) is determined by the rate at which the two capacitors C5 (vertical) and C14 (horizontal) are charging or discharging.

Let us assume for the purpose of this description that the hall on the screen is moving diagonally from the upper left to the lower right corner. When this is happening, the voltage on the collectors of Q3 and Q4 are both increasing in the positive direction and flip-flops IC9-a and IC10-a are both in the set state.

Now the ball reaches the bottom boundary, and must rebound back into the playing field. The ball is made to rebound simply by changing its vertical direction; since IC9-a controls ball vertical direction, all that is required is to reset IC9-a. This resetting is done by the signal from pin 8 of IC7-c. The inputs of this gate are the signals from pin 9 of IC7-c and pin 10 of IC7-c. The ball signal is on pin 9 of IC7-c and the bottom boundaries on pin 10 of IC7-c.

If the ball and bottom boundary both occur at the same time (the ball has reached the boundary), both of these inputs will be high, causing their ANDed output to go low. This output signal goes to the direct clear input of IC9-a causing the flip-flop to reset, which in turn reverses the direction of the charge on C5 and Q3, thereby reversing the vertical direction of the ball.

The top boundary rebound functions in a similar manner. The ball is ANDed with the top boundary signal at pin 3 of IC7-b. When a coincidence occurs at the top boundary, IC9-a is set, causing the ball to reverse direction downwards. (Diode D2 connected to pin 14 of IC4-d and pin 1 of IC7-b is part of the video circuit and allows the score to be displayed in the top boundary area and has no function in the rebound circuit.

Horizontal direction of the hall is controlled by IC10-a and Q4/C14 in a similar manner. Horizontal direction is reversed only in an instance where the ball strikes a paddle (or the bumper). Horizontal direction is reversed by resetting IC10-a. This is controlled by the output at pin 6 of IC7-a and pin 6 of IC8-a, which are ANDed outputs of the ball and right paddle and left paddle, respectively.

They are used to direct set or direct clear IC10-a in the same manner as IC9-a is controlled for vertical direction. Additionally, the output from pin 8 of IC8-b is the ORed signal from either paddle which indicates a paddle hit. The signal is used for the audio as well as in the ball angle randomizer circuit.

When the ball is hit

When the ball rebounds from a paddle, several other things take place. The ball may or may not change speed or angle. Whether or not it does is determined in the ball-hit randomizer circuit. This circuit is a pseudo-random pattern generator that gives ten different combinations to determine the ball's speed and angle. The ten combinations are provided by IC20, a counter, that is clocked at the horizontal sync rate (15, 750 Hz). Thus, the four outputs (A, B, C, D) are changing at rates of 7875, 3937, 1968 and 984 times per second.

When a paddle-hit occurs, the four sections of IC21 are enabled by the paddle-hit signal, and at that instant the pattern contained in IC20 is applied to the clock inputs of four flip-flops [IC9 (a and b) and IC22 (a and b)].

If the respective output of the pattern happens to be low at the time of the hit, the corresponding flip-flops will toggle. As a result pin 5 of IC9-a, which controls vertical direction, may reverse if the signal at pin 12 of IC20 happened to be low at the time of the hit, and so on for pin 5 of IC22-a and pin 9 of IC22-b.

The signal from pin 5 of IC22-a controls vertical speed. The signal from pin 9 of IC22-b is used to allow a nearly horizontal shot. When set, it causes the signal at pin 11 of IC8-d to continuously toggle IC9 at a 7875 Hz rate. Thus the ball will travel nearly horizontally because the signal at pin 5 of IC9-a will be rapidly setting and resetting during the ball's travel across the screen, preventing capacitor C14 from either charging or discharging and the ball from changing its vertical direction.

PARTS LIST

All resistors ¼-watt 5% unless noted
R1, R2, R9, R57, R77, R78, R80, R81, R82, R83—5000 ohms, trimpot
R3, R45—2000 ohms
R4, R7, R10, R12, R16, R19, R21, R24, R25, R28, R30, R52, R64, R70, R74—1000 ohms
R5, R6, R13, R20, R22, R23, R27, R32, R42, R54, R58—10,000 ohms
R8, R17—15,000 ohms
R11, R26, R60—47,000 ohms
R14, R15, R18, R29, R31, R39, R40, R41, R48, R53, R56, R71—5100 ohms,
R33—3.3 megohms
R34, R65, R66, R68, R69, R76—470,000 ohms
R35, R38—1000 ohms, trimpot
R36, R37, R47, R61, R73—510 ohms
R43—20,000 ohms nominal (V sync)
R44—30,000 ohms nominal (H sync)
R46—15 ohms
R49, R59, R62—100,000 ohms
R50, R51—75,000 ohms (or 68,000 or 82,000 ohms)
R55, R72—200 ohms
R63—50,000 ohms, trimpot (or 100,000 ohms, trimpot)
R67—Not used
R75—1200 ohms
R79—1000 ohms, optional, see text
R84, R85, R86, R87, R88—5000 ohms, potentiometer linear taper (or any value between 5000 and 25,000 ohms)

All capacitors 15 volts or more
C1—2000 pF, temp stab polystrene
C2—1.0 or 1.2 μF, temp stab tantalum
C3—0.2 μF, dipped tantalum
C4—not used
C5, C14, C33, C42—10 μF, axial
C6, C32—1000 μF, radial
C7—.001 μF
C8, C18—0.1 μF, dipped tantalum
C9, C35, C36—270 pF
C10, C12, C44, C47, C48—1 μF, axial
C11, C13, C19—500 pF or 470 pF
C15, C16—0.47 μF, dipped tantalum
C17—1 μF, dipped tantalum
C20, C22, C23, C24, C38, C39—.01 μF
C21, C26, C27, C28, C29, C30, C31—.05 μF
C25—not used
C34, C37—100 pF
C40, C41, C46—.005 μF
C43—2.2 μF, dipped tantalum
C45—100 μF, radial
C49—6.8 μF, tantalum
C50—not used

Diodes
D1 to D8—1N4148 (or any signal diode)
D9 to D12—not used
D13 to D23—1N4148 (or any signal diode)
D24, D25—1N4148 (optional for low-resistance joystick)

Transistors
Q1 to Q6—2N2222

Integrated Circuits
IC1, IC11, IC26—555
IC2—7404
IC3, IC7, IC8, IC14, IC15, IC18, IC19—7400
IC4, IC6—339
IC5—7402
IC9, IC22—74C74
IC10, IC17—7474
IC12—4066
IC13—7423
IC16—7420
IC20—74C90
IC21—74C00
IC23, IC24—74C04
IC25—74C10
IC27—LM309 (5v, 1A regulator)

Switches
S1—spst toggle
S2, S3—spdt toggle
S4—spst N.O. momentary push button
SPKR—4 to 8 ohms, 2¼ inch diameter

The following items are available from Visulex, P.O. Box 4204, Mountain View, CA 94040. Also available from Technology Trends, P.O. Box 732, Manhasset, NY 11030

Main circuit board, with pre-aligned horizontal and vertical sync oscillators soldered in place. Includes circuitry (but not components) for ball, paddle and boundary display, sound effects, computer-control module, paddle size selector, ball speed/angle randomizer, game action electronics for bumper and power filters. Order Kit MB-3: $29.50

Component kit for main board. Contains all additional ICs, IC sockets, transistors, resistors, diodes, trimpots and 5V regulator Order kit MBK-3: $48.50

Assembled and tested main board. Order MBA-3: $105.00

On screen scoring circuit board, including LSI character display generator IC. Order kit SB-3: $18.75

Component kit for scoring board contains all additional ICs, IC sockets, resistors, capacitors, diodes and trimpots. Order kit SBK-3: $20.50

Assembled and tested scoring board. Order SBA-3: $55.00

Accessory kit contains parts for external game control. Includes paddle potentiometers for horizontal and vertical motion, 6-wire cables for remote use of paddle motion potentiometers, paddle size potentiometer, switches for computer control and game selection, score reset push button, speaker and hook-up wire, knobs. Order kit AK-3; $25.75

Power supply, 12 volts DC. Powers the entire game including scoring module. Order kit PS-3; $8.70

Cases. Including main cabinet plus remote player control boxes. Order kit CC-3: $22.50

The Everything Package. Supplies everything needed. Includes CP-3, MB-3, MBK-3, SB-3 SBK-3 AK-3, PS-3 and CC-3. Order EP-3: $162.50

Ball speed

Should the ball encounter either the top or bottom boundary in this mode, the signal at pin 9 of IC22-b will be cleared through diodes D17 or D18 and the ball will rebound off the boundary. The two diodes, D15 and D16 that connect to pin 3 of IC21-a and pin 11 of IC8-d are simply an OR gate to allow either gate to clock pin 3 of IC9-a.

Ball speed is controlled in both the vertical and horizontal directions. As was previously mentioned, the signal from pin 9 of IC9-b controls the horizontal speed while the signal at pin 5 of IC22-a controls the vertical speed. The element that determines the speed is IC12, a bilateral switch.

You will recall from the previous discussion that ball speed is a function of the charge rates of capacitors C5 and C14. These rates are determined by resistors R11 and R50. The values of these components were selected to produce the slower ball speeds. When the faster ball speed has been selected, an additional resistance R49 (or R51) is switched across the appropriate resistor by IC12, under the control of the signal from pin 9 of IC9 or pin 5 of IC22. This additional resistance effectively lowers the value of R11 (or R50) thereby increasing the ball's speed.

The computer-controlled paddles, a special feature of this machine and not to our knowledge seen elsewhere operates via IC12 too. By means of the external SPDT switches, the vertical paddle position voltage on pin 4 of IC4 and pin 6 of IC4 can be determined by either the player potentiometer or the computer control circuitry.

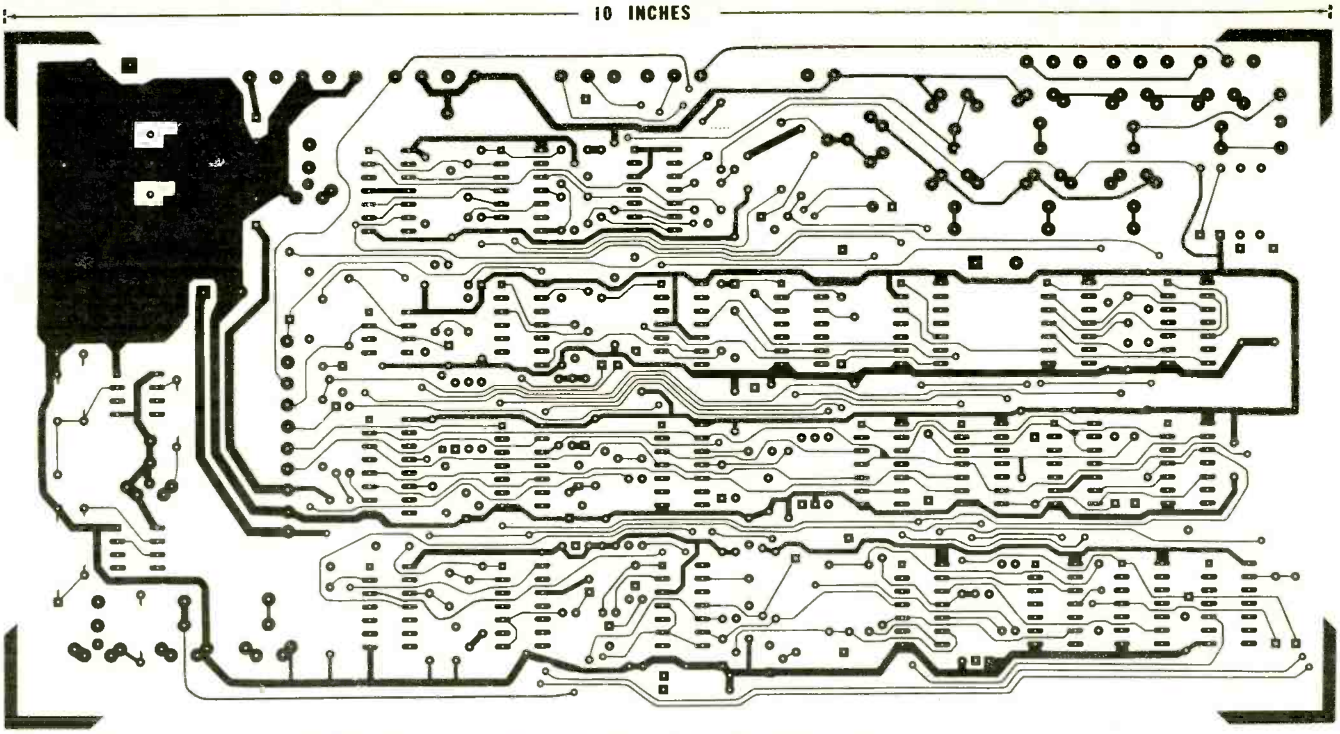
Recall the previous discussion of how the vertical position of the ball is determined by the voltage appearing on the collector of Q3. If this same voltage were applied to the paddle vertical position input, then the paddle should have the same vertical position as the ball. This is exactly the case. Instead of the player potentiometer determining the vertical position of the paddle, then, a paddle is slaved to the ball. Thus, the paddle tracks the ball motion and always has the same vertical position as the ball.

Since there are two paddles, it is necessary to select which one is to be slaved to the ball. This selection is done via the remaining two sections of IC12 and is controlled by IC10. When the ball is travelling toward the left side, the left hand paddle is slaved to the ball. When IC10 caused the ball to reverse direction, the other paddle becomes selected at that time.

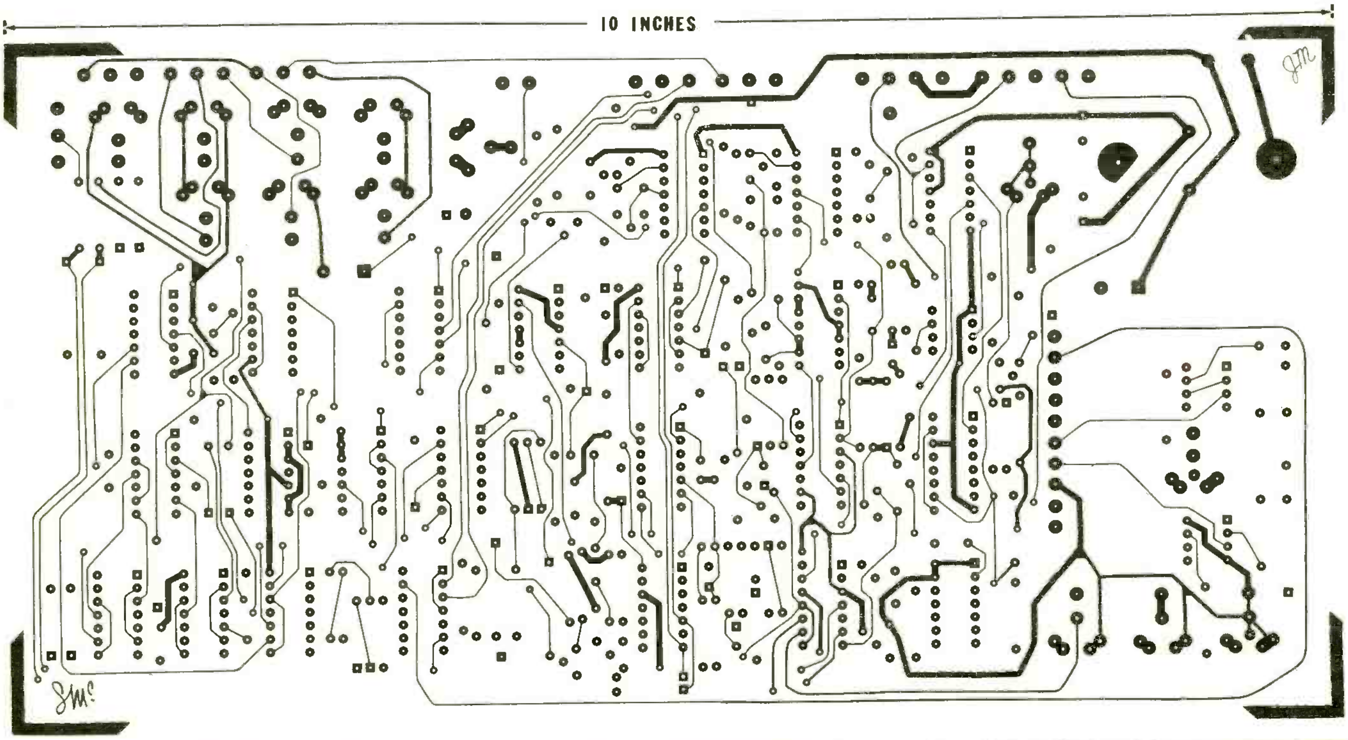
Registering a point

A miss is detected by two end boundaries which are generated by IC15 and IC16, although not displayed on the screen. The left-hand boundary is generated by stretching the width of the horizontal sync pulse to about 8 microseconds through pins 11 and 8 of IC15; and then by AND'ing with the ball signal from pin 13 of IC5, the left-hand signal from pin 9 of IC10, and the inverted ball horizontal position signal from Q4 (also pin 11 of IC6) via pin 3 of IC15.

Coincidence of all four input signals on IC16 (ball presence, ball on left, ball going left, very near edge of screen) constitutes



MAIN CIRCUIT BOARD FOIL PATTERN shown from component side of double-sided board.



MAIN CIRCUIT BOARD FOIL PATTERN shown from bottom side of double-sided board.

a miss. The output pin 8 of IC16 goes low, through IC15 which is used as an OR gate and sets pin 5 of IC17, which indicates a miss. Similarly, a right hand miss is detected by pin 6 of IC16, which detects ball off the screen to the right at the beginning of the next scan line.

With pin 5 of IC17 set, pin 5 is high, which allows capacitor C17 to start charging. When C17 reaches the required level, IC11, the re-serve timer generates a re-serve signal. The signal resets pin 5 of IC17 and also clocks pin 9 of IC10 causing the ball to reverse direction horizontally.

In addition, with the occurrence of a miss signal pin 5 of IC9 is cleared from pin 6 of IC17, which causes the ball to return to the top of the screen. You will note that the ball always re-serves from either the upper right or upper left corner.

In the August issue we will present the description of the second game "Bumper" and the remaining construction information, which will include the parts location diagram. This article has required more space than we originally expected, but we want to present all the information we have. **R-E**

"Rampart, this is three. I have a mahogany patient, about four years old, picture weak, stand by for vital signs."

Step-by-step TV Troubleshooters Guide

DC power supplies—how they work and how to troubleshoot and repair them

JACK DARR
SERVICE EDITOR

WHAT! DO A WHOLE TROUBLE-SHOOTING article on the DC power supply? Yes, SIR! This is a vital part of all electronics equipment. It is also the first thing that should be checked in any halfway logical approach to troubleshooting. If you have no DC power supply, none of the other stages can work at all. Besides, the DC power supply gives us a large percentage of the service jobs we run into.

Most of the circuits used are simple, and "stock". But a large part of the mail we get shows that this circuitry isn't all that clear to too many of us. In addition to the regular problems, it can give us some real headaches, with the cause too often unsuspected. Let's look over these circuits.

How do they work?

The stock AC-to-DC power supply *is* very simple. We feed an AC voltage to rectifier, which converts it to pulsating DC. The pulsations (ripple) are filtered out and we wind up with a nice smooth DC voltage. The DC voltage output is determined by the AC input voltage.

The simplest circuit is the half-wave rectifier of Fig. 1. The AC line voltage is fed directly to the rectifier diode. We come out with a series of pulses at 60 Hz; the polarity of these pulses is determined by the polarity of the diode. In tube sets, polarity is always positive; in transistor sets it can be either + or −.

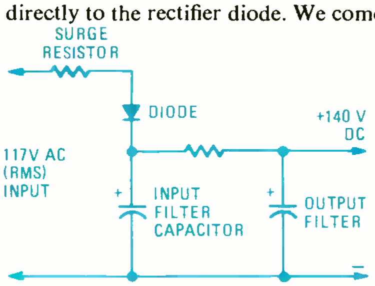


FIG. 1—HALF-WAVE rectified DC supply.

Let's pause for a moment here and go over something that puzzles a lot of novices. Our AC input voltage here is 117 volts AC RMS. The DC output voltage is +140 volts. Are we getting something for nothing? No! the *apparent* gain of voltage is simply due to the way we *read* these voltages! Our AC voltmeter is calibrated in RMS, which is roughly 70% of the *peak* voltage. When the AC is rectified, we come out with a series of pulses, but these go to the peak value of the AC. Fig. 2 shows this relationship. These pulses are fed into the input filter capacitor and charge it up to peak voltage, and we could see a DC output voltage of about 160 volts, if there were no load at all on it. When we load the power supply, we are actually drawing out the charge that we put into the input filter capacitor. So, the voltage goes down somewhat. This capacitor is sometimes called a "reservoir" capacitor, for it acts like one.

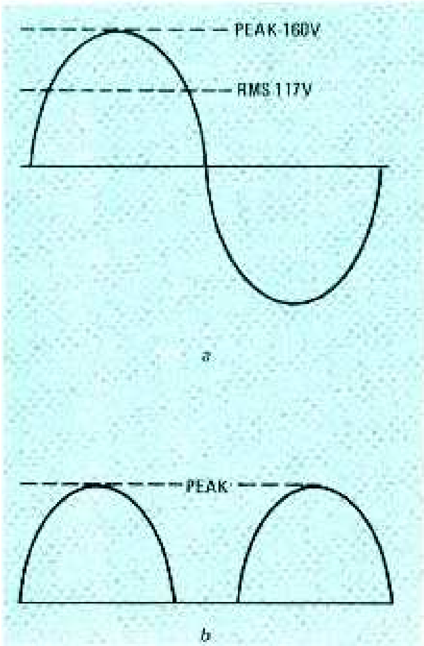


FIG. 2—IN- AND OUTPUT VOLTAGES. At *a*, 160-volt peak, 117-volt RMS ingoing AC voltage; at *b*, positive-going half cycles with 160 volts peak coming out of rectifier.

The next most common type of supply is the full-wave rectifier. Fig. 3 shows a typical circuit. This type is generally used with a power transformer, with a center-tap in the high-voltage winding. The cathodes of the diodes are tied together for the + DC voltage, and the center-tap of the transformer secondary is the minus terminal, usually grounded. (If you put a resistor in series with this CT lead, you can develop a negative voltage across it. Lots of older sets used this circuit.)

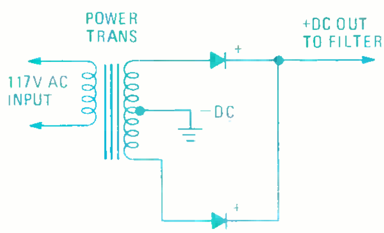


FIG. 3—THE FULL-WAVE RECTIFIER. Diode cathodes are plus, the center tap of the secondary winding is the minus terminal.

The voltage output here has the same ratio as the first circuit. The DC voltage output is higher than the AC RMS input. Just as before, we can get a negative voltage by reversing the diodes (and the filter capacitors!) In tube type TV sets, the DC voltage will run from about 300 to 400 volts, always positive to ground. In solid-state TV sets, you may see voltages or either or both polarities. Voltages will be lower.

The "bridge" rectifier

If we use four diodes hooked up as a "full-wave bridge" (Fig. 4) we can save some money. The secondary doesn't need to be center-tapped, and it doesn't have to be twice the DC voltage. It can be the same (well, approximately). For a +300-volt DC output, a full-wave rectifier transformer would have to be 270-0-270 volts AC, or "270 volts each side of center tap". Using a full-wave bridge rectifier, we need only a 270-volt winding. The common-cathode connection of the bridge is the + terminal and the common-anode connection the −. We can get DC voltage of any polarity we need by grounding the appropriate terminal of the bridge.

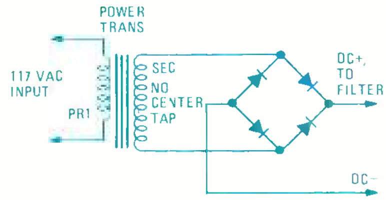


FIG. 4—THE FULL-WAVE BRIDGE uses a smaller transformer, but needs four diodes.

Voltage doublers

A popular circuit for line-operated DC power supplies is the half-wave voltage doubler of Fig. 5. A polarized electrolytic capacitor is connected directly to the AC line input. (This confuses people, but wait. This capacitor does *not* have ac on it.) Two diodes are used; they are called the series diode and the shunt diode. A filter capacitor is connected across the output.

Here's how it works: During the first negative-going half-cycle of the AC input voltage, input capacitor C1 charges up to the peak voltage, because diode D2 is conducting. During the positive-going half-cycle, D2 is cut off, but D1 (series diode) is conducting. So, the charge on the capacitor C1 is fed through D1, in addition to the charge developed by the positive-going half-cycle. This action charges C2 (filter capacitor) to *double* the applied AC line voltage. C3 then discharges into the load,

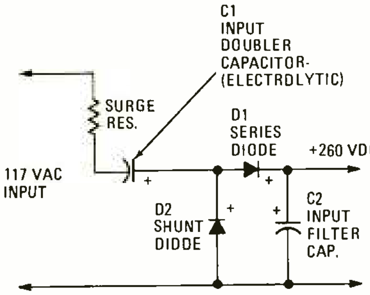


FIG. 5—VOLTAGE DOUBLER CIRCUIT. This half-wave doubler is common in line-powered TV sets and many low-priced radios.

to give us a DC output voltage of about 260. Because of the presence and hookup of the diodes, C1 never actually has AC applied to it, though it does look like it! For reference, remember how a diode conducts: Fig. 6.

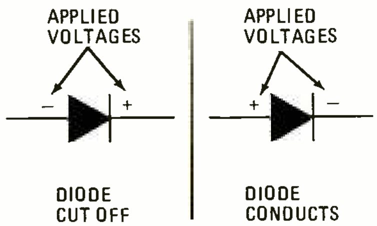


FIG. 6—WHEN CATHODE IS POSITIVE, diode is cut off; when negative, it conducts.

The full-wave voltage doubler

Another form of this circuit is shown in Fig. 7. It is called a full-wave voltage doubler. You'll find this circuit in sets with power transformers, because the AC input must be isolated. The basic action is the

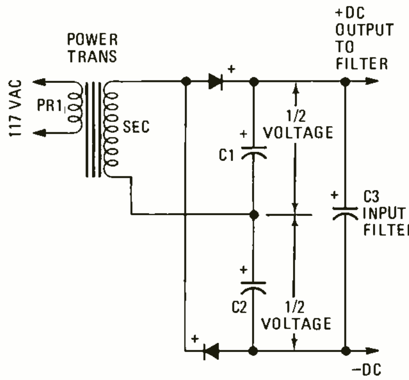


FIG. 7—FULL-WAVE DOUBLER requires a power transformer, two doubler capacitors.

same as in the half-wave type. The only difference is that each diode charges one of the doubler capacitors while it is conducting; one on each half-cycle, so that we use them both. In effect, the doubler capacitors are charged in parallel, then discharged in series. So, we get double the input voltage again.

The "identifier" for this circuit is the low side of the ac line. Note that it goes to the junction of the two doubler capacitors and nowhere else! C3 is the filter capacitor.

Table I is a fault-chart giving the typical reactions to various faults in each of the rectifier circuits. Each one has its own peculiarities. These are valuable clues to the actual part causing the trouble.

The filter circuit

The "DC output" of each of these rectifier circuits still consists of *pulses* of current or voltage. This has too much ripple in it; we've got to get rid of it before we can use the DC. So, we "filter" it out. The stock filter circuit is called a "pi-filter"

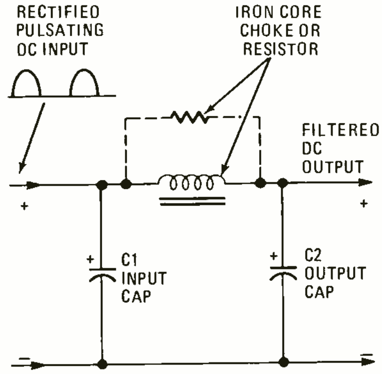


FIG. 8—THE PI-SECTION FILTER is used by the majority of power supplies.

from its resemblance to the Greek letter. Fig. 8 shows it. C1 is the input-filter capacitor, and C2 the output-filter capacitor. This circuit is still used in many TV sets.

In others, we use what is known as "brute force" filtering—we use capacitors so big that they simply swamp out the ripple. A resistor often replaces the filter choke. All of these reduce ripple in two ways: We treat the rectifier output as *two* voltages; one, the DC voltage we want, the other, a small AC voltage riding on top of the DC. The filter choke opposes the AC by inductive action. The filter capacitors provide a very low-impedance path to ground *for AC only*. So, the ripple flows through the filter capacitors to ground. These capacitors are so big they give the DC power supply lines a "zero impedance to ground." REMEMBER THAT! For the purists, this impedance isn't actually zero. It's something like 0.0000001 ohm or so in a well-designed filter.

Power supply protection

Most power supplies are protected against short circuits. (All of them should be.) Fuses and circuit-breakers will be found in both primary and secondary circuits. There are two types of fuses; the "fast blow", with a simple link, and the slow-blow. The last has a tiny heating element in series; it can withstand short current surges without opening up. Both fuses and circuit-breakers must always be replaced with exactly the same kind originally used. One common mistake is to put in a larger fuse. This can allow serious damage to happen to the set, unless the circuit trouble that blew the original fuse is cleared!

Testing and test equipment

The DC power supply can be tested with only a few pieces of test equipment. A good AC/DC voltmeter is essential. A DC milliammeter can be very helpful. For some tests, a wattmeter is a time-saver, for reading the input power. Finally, the scope. We'll go into the uses of each in a minute.

Power supply testing can be very simple; just turn the set on and read the DC voltage under normal load. If it is up to the value shown on the schematic, fine. This is also a pretty good indicator of conditions in the whole set. If the DC voltage is normal, most of the thing is OK. If it's below normal, you may have an overload somewhere. It its above normal, you have an *open* circuit somewhere.

There are only two types of faults in DC power supplies. One is "weak supply"; the thing won't supply enough current for normal operation, so down goes the DC voltage. The other one is overload; some stage or part is drawing for too much current. This too pulls the DC voltage down. However, in the last one, something will usually get hot.

There is one easy way to tell which of these faults you have. Read the input *wattage* with a wattmeter. For example: the set has a normal input of 150 watts. You can get this figure from the service data, or by looking at the rating-plate on the chassis. You have low DC voltage. Plug the television receiver into the wattmeter and turn it on.

A reading of say about 75 watts means that you have something weak, or open. A reading of 250 watts means that something is leaky; about 400 watts means that you've got a big fat short somewhere! This should be the first step in the actual diagnosis. More on this useful instrument later.

TABLE I—FAULT CHART

Circuit	DC Voltage Low	No DC Voltage
Half-Wave	Open input filter capacitor	Open diode, open surge resistor, shorted input capacitor
Full-Wave	Open input filter capacitor	Open diodes, or shorted input filter
Full-Wave Bridge	Open input filter capacitor (NOTE: one diode in bridge open will not reduce DC voltage by very much, but will increase *ripple*)	Shorted filter capacitor
Half-Wave Doubler	Open input filter capacitor	Open input doubler capacitor, diode or surge resistor
Full-Wave Doubler	Open input filter, one diode open; one doubler capacitor open	Shorted filter capacitor

Weak supply problems

Let's take the easy one first, the weak supply. In half-wave and full-wave circuits, a low-emission rectifier tube or selenium rectifier can cause it. For a quick check, just shunt a silicon diode across the original rectifier. If the DC voltage comes up, replace the old one. The same symptom can be caused by a low-capacitance or open input-filter capacitor. Since it acts as a reservoir to hold the charge, the DC voltage drops when it loses capacitance. Here again, just shunt another capacitor across the suspected one. If the DC voltage comes up, that was it.

In both half-wave and full-wave voltage doublers, low or open capacitors will reduce the DC voltage. In the half-wave circuit, the input doubler (not the filter, the doubler capacitor) can reduce the *DC* output to almost nothing if it opens. Clue: there will be very little *AC* voltage on the rectifier side of this capacitor. In the full-wave doublers, if either one of the doubler capacitors opens, down goes the voltage. Clue: half normal output DC voltage across one of the capacitors, very little across the other. It is a good idea to replace both of them. They must be matched.

NOTE: do *not* bridge large electrolytic capacitors across others in transistor power supplies, with power on. This causes a large transient, and can damage transistors. Turn the power off first.

In a full-wave bridge rectifier circuit, an open input-filter capacitor will drop the voltage; same reason. If one of the diodes in the bridge should open, the DC voltage will not drop by very much, but the ripple will go up quite a lot.

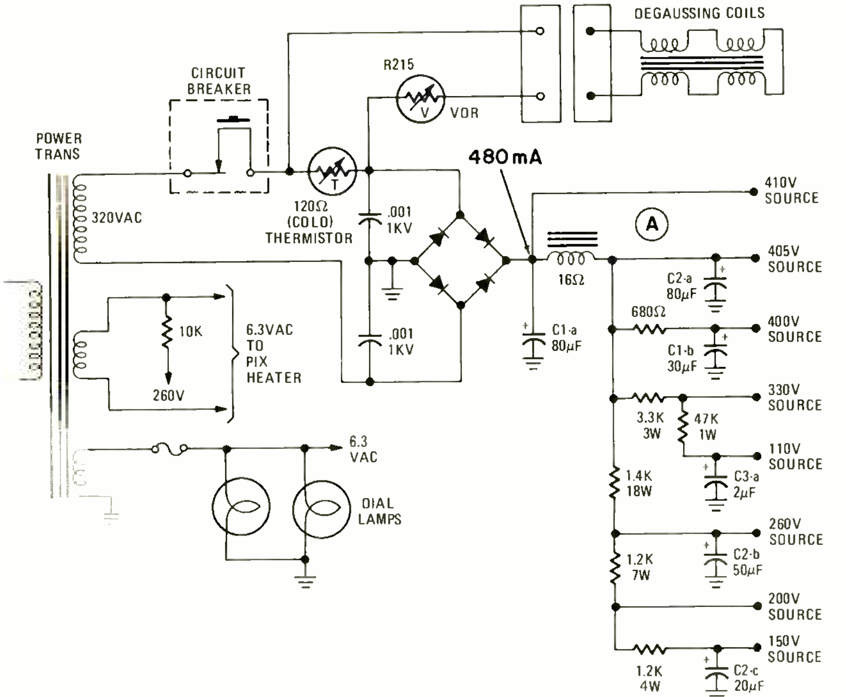
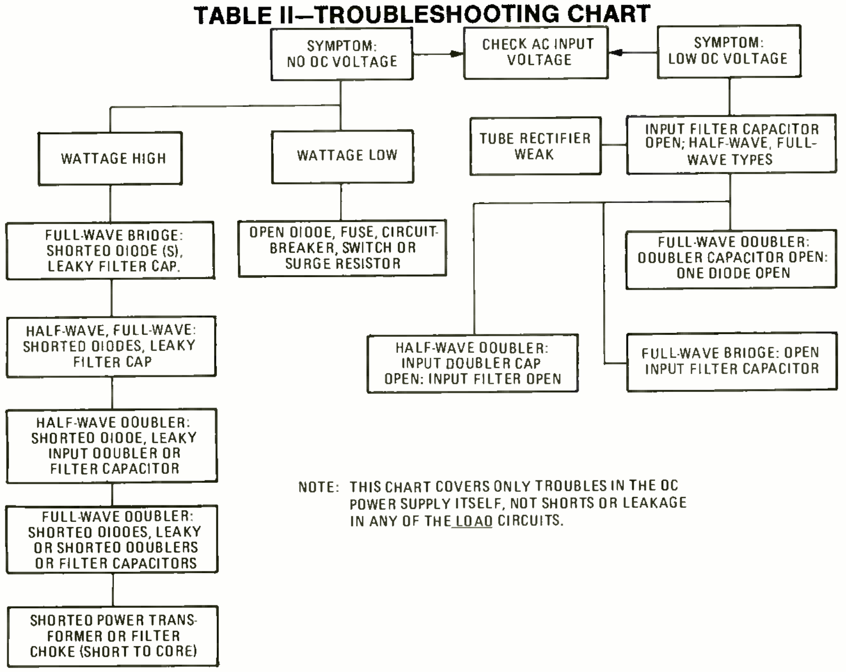


FIG. 9—COMPLETE DC POWER SUPPLY.

TABLE II—TROUBLESHOOTING CHART



Overloads and shorts

An overload is just that. Something is trying to draw far too much current from the DC power supply. Typical symptoms are low DC voltage and something getting very hot (like the power transformer). The input power reading will be well above normal, and fuses or circuit breakers will open up.

This can be caused by a shorted part in the DC power supply itself. Silicon diodes should be checked; you can do that with an ohmmeter. All good silicon diodes should show a high resistance one way and a much lower one with the ohmmeter prods reversed. A shorted one will usually read almost zero both ways.

Electrolytic filter capacitors can short. These too can be checked with the ohmmeter. Hint: electrolytic capacitors will show a low resistance if the ohmmeter polarity is reversed; always reverse the ohmmeter prods. In a full-wave bridge rectifier circuit, you will probably get a low ohms reading both ways! One of the diodes will always be forward biased and conducting. For a definite check, lift the DC output lead of the bridge, and repeat the resistance check.

Electrolytic capacitors can develop high leakage, causing an overload. The clue to this is a "hot can" in the can-types, Normally, electrolytics should not be warm, unless there is a hot tube nearby. If the can is hot, leakage is too high.

Breaker tripping

Circuit-breaker tripping is often the sign of an overload. Note that I didn't say "always." The breaker may be tripping on too little current. To check, let it trip; then clip a *duplicate* breaker across its terminals, and turn the set on again. If this one trips, then you do have an overload. There are several other tests, as usual. You can connect an AC ammeter across the terminals of the breaker and read the actual AC current being drawn.

Power transformer shorted?

In quite a few cases, we have trouble finding out whether the short is in the load circuits or in the power transformer itself. It's not too hard to tell. One good check is to disconnect all loads from the secondaries, plug it in and let it sit for about 15 minutes. If it isn't shorted, the case will still be at room temperature. If there is an internal short, the case will be pretty hot. The wattmeter can be used here; a good transformer, with no load, will show a very small reading, about 5 watts or less, with a wattmeter in its primary. This is the "iron loss" of the transformer. **Note:** the wattmeter used for this test must be the "true wattmeter" or dynamometer type with a current coil and voltage coil. You can identify one by the fact that the meter has *four* terminals.

You can make an "emergency wattmeter" by connecting a 1-ohm resistor in series with the AC circuit, and then hooking an AC voltmeter across the

(continued on page 108)

R-E's Service Clinic

CB in hi-fi and TV

How to cure CB interference

JACK DARR
SERVICE EDITOR

WITH THE RECENT INCREASE OF CB radios, we're beginning to get the kind of complaints that we got on ham transmitters. These complaints are in regards to interference with other services—radio, TV, stereo, hi-fi and musical instrument amplifiers, as well as PA systems.

The problems in TV are beats and lines on the screen and garbled voice signals in the sound. In audio amplifier systems, it's different. The interference is usually loud and clear. Speaking of loud, one reader says that it almost broke windows in his home—he had a 500-watt amplifier!

The cause is usually unmistakable. When your stereo suddenly booms out "Big Bad Bertha to Poopdeck Pete. Is Smokey in sight?", there isn't much doubt! However, before I get run over by a 16-wheeler, let me say this in self-defense. Hardly *any legally operated* CB radio will cause this severe interference. Not in a properly designed radio, stereo, TV or PA system.

Causes

People say, "But this is an RF signal. How can it get into my audio amplifier?" Easy. The input of a modern audio amplifier is pretty sensitive. When there is a strong RF signal at the input, it can be demodulated by the first preamplifier stage. After this, it's audio and goes sailing right on through. Transistor stages are especially prone to this. Any of the junctions can act as a diode detector. A tube stage will do the same thing in a slightly different way.

In fact, this is a well-known servicing trick. I have used it for many years in testing audio amplifiers, particularly PA systems. I just connect a TV antenna to the input (see Fig. 1). Any antenna with continuity will do, an open-end type like a simple dipole will make it hum very badly. If the amplifier is working, it will sit there and "radio" all day. This works in any place with a fairly strong local radio station.

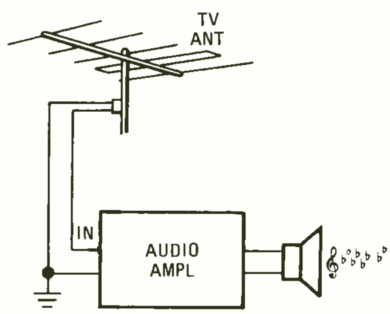


FIG 1

That's what happens in audio amplifiers, we'll get to the TV later. Now, how can we stop this? The cure is fairly simple; just kill the RF signal at the input of the amplifier. All we need to do is add a simple filter to eliminate the RF. This should have no effect on the audio signals. The simplest way of doing this is to connect a small bypass capacitor, say 250 pF, from the base of the first preamp stage to ground. This will look like a dead short to the RF and a very high resistance to the audio signals. The 250-pF capacitor has 650,000-ohms reactance at only 1.0 kHz, but only 200 ohms at 27 MHz. Be sure to use the shortest possible leads and connect it directly from the base of the transistor to ground, as shown in Fig. 2.

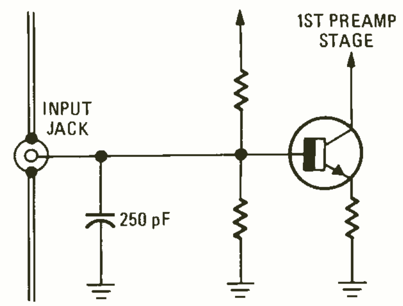


FIG 2

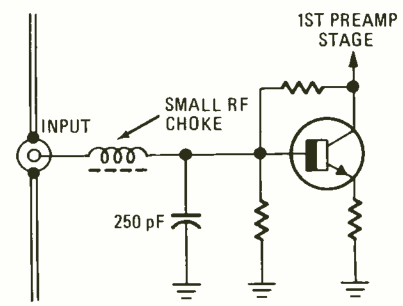


FIG 3

If this helps but doesn't cure the problem, add a small RF choke in series with the lead from the audio input to the base of the transistor. Figure 3 shows the addition of the RF choke. Here we're taking advantage of the opposite characteristics of a coil to a capacitor. A 1.0 millihenry choke has only 31.4-ohms reactance at 5,000 Hz, but almost 200,000 ohms at 27 MHz. If you still need more attenuation, you can convert this into the familiar pi-type filter by adding another capacitor to ground at the input jack (see Fig. 4.)

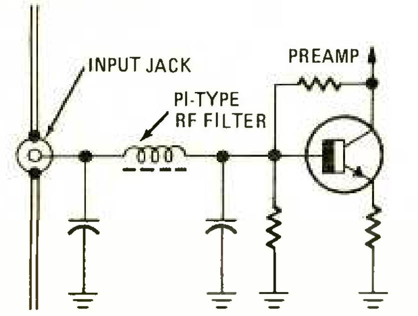


FIG 4

If you want to do a little extra work, you might even try tuning this filter to 27 MHz! Or, rig up a parallel-resonant circuit and put this in series with the input lead. Ordinarily, this isn't needed.

Shielding

Oddly enough, this kind of interference will be found even though all leads are shielded. I don't really understand this, but it happens. The RF signal may be coming into the chassis on the AC lines. This could be cured by the same basic method. Bypass the AC line to chassis right at the point where it enters. It might be that the shielding braid on audio cables, though adequate for audio, isn't "tight" enough for RF. In difficult cases, you might try adding a "bottom plate" to the amplifier chassis. A piece of aluminum foil held by the mounting bolts will do nicely.

CB in the TV

Now we come to a more difficult type of CB interference–in TV sets. The typical symptom will be beats in the picture, sometimes these will be in the form of a typical 120-Hz hum-bar. There will be two bands of wiggles across the picture, sometimes affecting the color, sync, etc. In most cases, you'll be able to hear garbled voice signals along with the TV sound.

Here we have several possibilities. One, the 27-MHz RF signal may be getting into the tuner. The signal can beat with the TV station signal or the local oscillator, or simply develop its own harmonic beats in the mixer. TV RF stages are not noted for sharp selectivity. If they were, they wouldn't work. If there is a 2nd harmonic developed in the mixer, it would produce some dandy beats, sidebands, etc., right in the middle of the TV's bandpass!

A less common but possible place for RF pickup might be in the IF input. The 2nd harmonic would be developed in the 1st IF stage. This is one place where we might get better results by shielding. The coupling from the tuner to chassis is through an RF coaxial cable. If the IF stage is properly shielded, as is customary, pickup in this area should be very rare.

In the large combination sets with TV and a stereo amplifier, we could get pickup directly on the audio system input. If this happens, the cures mentioned can be used.

Tuned traps

In cases where you're almost certain that the problem is caused by RF pickup on the lead-in, you should be able to minimize it with tuned traps. A high-pass filter can be connected between the lead-in and TV input terminals. If this is efficient enough, it should be able to reduce all RF signals below about 40 MHz. You can get these already made, but get a good one. I have tried some of the cheaper ones. I couldn't even tell they were in there!

The FCC

In most cases, complaining to the FCC won't do a great deal of good. At least not immediately. The FCC is overloaded right now. You should exhaust all local alternatives first. For one reason, (I repeat) it is possible for a perfectly legal CB transmitter to cause some interference to a radio, TV or audio amplifier that isn't properly designed to reduce RF pickup at its input. The better amplifiers do have this protection built-in. For consumers, the first step should be to check with your radio-TV technician. He can probably help the situation with some of the things mentioned.

A good CB transmitter doesn't radiate enough 2nd harmonic signal to give any trouble. FCC type-acceptance specifications require that the 2nd harmonic emission be held to a very low level—60 dB down or more. It *is* possible for 2nd harmonics to be bothersome, but in most cases these are generated inside your own set!

Another good way to get help is to contact the head of the local CB or amateur radio club. These groups are interested in clean interference-free operation and reception.

Listen carefully to any interfering transmissions. Make notes of any handles used, or even a call-sign. See if you can get any idea of the location of the station. When you get some information, ask the CB'ers to check it out. When you have something to go on, *then* write or call the nearest FCC Field Office, giving dates, places, type of interference and so on.

Speaking to the electronics technicians, check up on cases of CB interference in your area. Eliminating this is often quite simple and can provide a good source of extra business. Follow the suggestions given and you may be able to help clear up the problem. Technicians, listeners and CB clubs working together can help clean up this particular kind of noise pollution. **R-E**

reader questions

INSTRUMENTATION PROBLEM

I'm having difficulty in trying to fix a black-and-white Zenith. After tube changes, the raster came back. Now I have some very unusual readings! The grid of the horizontal-output tube ought to be −39 volts, and I read a +100 volts. The horizontal oscillator grid ought to be −70 volts, and I get +125 volts. Others are also off. The only voltages I get that are normal are the boost at +680 volts and B+ of 260 volts. I've changed some capacitors and resistors, but I still can't get any change in these readings. What else can I try?—G.S., Baton Rouge, LA.

We have a couple of contradictory statements here! If you *do* have a raster, a picture, and a boost voltage of +680 volts (normal), this set is *work-*

ing! It couldn't possibly work with the grid voltages you read. So, I think the first thing to try would be another *voltmeter*. For a crystal-ball guess, your voltmeter is giving you incorrect readings because of the presence of high pulse voltages. I've had this happen to me. You need a bypass capacitor across something to prevent this.

AUDIO POWER MODULES

I've just gotten hold of some RCA HC2500 100-watt power amplifier modules. What would be the best way to get a 200-watt power output from these? Could I use one of these as a booster for another?—D.K., Commack, NY.

You can't increase the power output of these above the rating. However, you could easily get a 200-watt total output by using two modules, each driving its own speaker system, and feeding the inputs in parallel. The power supply would have to be beefed up to handle the extra current drain, of course.

ODDBALL SYMPTOMS

This set came in with no high voltage. I found a short between the horizontal and vertical windings of the deflection yoke. Replacing this, I put my DC milliammeter in the cathode circuit of the horizontal output tube. Now I get some very odd reactions! There's a chirping in the flyback and it loses horizontal sync, then there is a frying in the flyback. Current through the output stage decreases and the high-voltage goes down.

I checked several things, including the filter capacitor—no help. I accidentally grabbed the leads to the meter and the high-voltage came back! I found that I could twist these and it came back to almost normal. Taking the meter out, it works fine. What's going on here?—R.O., Daly City, CA.

You're getting some kind of screwball feedback due to pulse voltage across your milliammeter! When you grabbed the leads, you added some shunt capacitance. Add a 0.5 μF capacitor right across the meter and you won't have this trouble any more.

RCA TRANSISTOR NUMBERS

I'm not having any luck crossing the IF transistors from an RCA CTC-38 against the substitution guides! Especially the 3536, AGC; 3535, 1st IF, and 3576 3d video IF. Any ideas?—G.R., Clymer, PA.

Try using the stock numbers. In the RCA SPG-202R *Transistor Manual*, the ones you're looking for are on page 110. AGC transistor, 124573 = SK-3122. The 1st and 2d IF, 124757 = SK-3117. The 3d IF 124754 = SK-3132. The secret is to keep looking until you have found all of the numbers that *start* with "124." **R-E**

HI-FI TEST REPORTS

continued from page 52

linear ceramic filters, two IC's and an LSI circuit are employed in the FM-IF section.

The multiplex decoder section uses the now-popular phase-locked-loop IC circuit plus low-pass output filtering for extra subcarrier suppression. FM muting employs a reed relay for positive action at the threshold signal level. The AM circuit uses an IC to replace most discrete components.The phono equalizer-preamp section uses a three-stage direct-coupled circuit powered by relatively high (±49 volts) supply voltages for high overload characteristics. A dual-polarity supply is used to power the tone control stages, too.

A two-stage class-A differential amplifier is used as the input stage of the power amplifier section that is entirely DC-coupled and the output section (drivers and outputs) consists of a three-stage Darlington direct-coupled circuit with power transistors arranged in a parallel push-pull circuit. The electronic protection circuitry of the SX-1250 uses a power relay which also delays turn on until the supply voltage has been stabilized. A block diagram of the entire receiver (one amplifying-channel only) is shown in Fig. 4, while Fig. 5 shows the variety of auxiliary equipment that may be connected to the unit.

FM performance measurements

A summary of FM performance measurements measured in our lab is listed in Table II. We feel that Pioneer "pushed" sensitivity specs just a bit too far in their published literature. While a given number of receivers may well meet the 1.5 μV (8.7 dBf) usable sensitivity figure claimed, that is so difficult to maintain consistently in production that the company would have been well advised to settle for a 1.7 μV (10 dBf) claim—which is what we measured for our sample—rather than risk failing to meet what is at best an unimportant spec.

We have also advised Pioneer that their interpretation of the new dBf notations in their literature is *not* correct. In our list of Manufacturer's Published Specs shown

TABLE II

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **U.S. Pioneer Electronics** Model: **SX-1250**

FM PERFORMANCE MEASUREMENTS

SENSITIVITY, NOISE AND FREEDOM FROM INTERFERENCE	R-E Measurement	R-E Evaluation
IHF sensitivity, mono: (μV) (dBf)	1.7 (10.0)	Excellent
Sensitivity, stereo (μV) (dBf)	3.0 (14.9)	Very good
50 db quieting signal, mono (μV) (dBf)	2.4 (13.0)	Very good
50 db quieting signal, stereo (μV) (dBf)	50.0 (39.3)	Poor
Maximum S/N ratio, mono (dB)	81	Superb
Maximum S/N ratio, stereo (dB)	73	Excellent
Capture ratio (dB)	1.0 dB	Excellent
AM suppression (dB)	58 dB	Very good
Image rejection (dB)	Greater than 100	Excellent
IF rejection (dB)	Greater than 100	Excellent
Spurious rejection (dB)	Greater than 100	Excellent
Alternate channel selectivity (dB)	81 dB	Very good
FIDELITY AND DISTORTION MEASUREMENTS		
Frequency response, 50 Hz to 15 kHz (±dB)	+0, −1.0	Very good
Harmonic distortion, 1 kHz, mono (%)	0.14	Very good
Harmonic distortion, 1 kHz, stereo (%)	0.20	Very good
Harmonic distortion, 100 Hz, mono (%)	0.12	Excellent
Harmonic distortion, 100 Hz, stereo (%)	0.20	Excellent
Harmonic distortion, 6 kHz, mono (%)	0.14	Excellent
Harmonic distortion, 6 kHz, stereo (%)	0.24	Superb
Distortion at 50 dB quieting, mono (%)	0.6	Very good
Distortion at 50 dB quieting, stereo (%)	0.25	Very good
STEREO PERFORMANCE MEASUREMENTS		
Stereo threshold (μV) (dBf)	4.0 (17.4)	Very good
Separation, 1 kHz (dB)	48	Excellent
Separation, 100 Hz (dB)	42	Excellent
Separation, 10 kHz (dB)	36	Superb
MISCELLANEOUS MEASUREMENTS		
Muting threshold (μV) (dBf)	2.0 (11.4)	Excellent
Dial calibration accuracy (±kHz @ MHz)	−300 kHz	Fair
EVALUATION OF CONTROLS, DESIGN, CONSTRUCTION		
Control layout		Excellent
Ease of tuning		Superb
Accuracy of meters or other tuning aids		Very good
Usefulness of other controls		Excellent
Construction and internal layout		Excellent
Ease of servicing		Good
Evaluation of extra features, if any		Very good
OVERALL FM PERFORMANCE RATING		Excellent

separately, we have *correctly* specified the **dBf** versus microvolt readings. Pioneer, for example, interpreted 8.9 dBf *correctly* but paranthetically called that reading equivalent to 3.0 μV across a 300 ohm input impedance when, in fact, it corresponds to 1.5 μV across that impedance. All other microvolt readings (listed alongside the dBf figures in Pioneer's literature) are equally in error by two-to-one, or 6 dB. We give Pioneer an "A" for effort in hastening to try to conform to the newly accepted measurements and notations but suggest that they re-read the standards very carefully. If you happen to pick up a spec sheet for any new 1976 Pioneer receiver or tuner, simply divide the "μV" notations that you will find listed near the dBf notations by two to get the right microvolt equivalent!

Nearly all of the measured results regarding FM performance were either very good or excellent, with the exception of 50 dB quieting in stereo which, on our sample, required a signal input of 39.3 dBf (50.0 μV/300 ohms). The various rejection ratios (image, IF and spurious) were, in fact, so superior that we could not measure them accurately with our lab equipment that had a 100-dB limit. Distortion readings in both mono and stereo were very good to excellent and we were particularly impressed with the low THD reading (0.24%) at the high-frequency test point in stereo where THD usually tends to get out of hand because of beat frequencies. Separation was also excellent both at mid frequencies and at the audio frequency extremes. Dial calibration was off by a consistent 300 kHz across the dial which simply means that the dial pointer needed to be shifted slightly (and is not indicative of mis-alignment of the RF section).

Amplifier and preamplifier measurements

The power amplifier was subjected to the usual one hour preconditioning tests with no resulting heat problems or thermal cutout. The SX-1250 is one of very few receivers that boast a 4-ohm power rating these days, since at 4-ohms considerably more current is delivered by the output circuits than is true under 8-ohm loads and not many receivers can pass the stringent FTC burn-in requirements when so loaded. Maximum power-output ratings were exceeded moderately under 8-ohm conditions before reaching the low 0.1% rated THD figure, and by a wider margin under 4-ohm load conditions. These and other results are listed in Table III. The IM distortion at rated power was almost as low as the THD, measuring only 0.095%. At the one-watt level, where many amplifiers tend to show higher or rising distortion, both THD and IM were still low.

Hum and noise for both phono and high-level inputs was very low, as would be expected from a receiver of this quality. But even more surprising was the incredible overload capability of both phono inputs which measured 540 milli-

continued on page 82


The United States of America
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Circle 21 on reader service card

new products

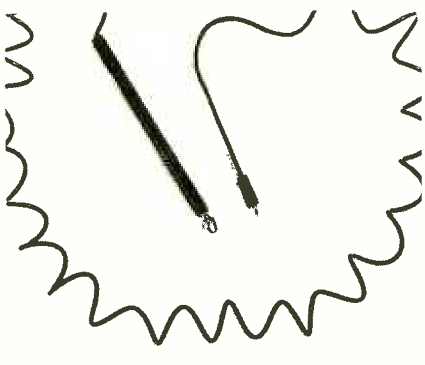
More information on new products is available from the manufacturers of items identified by a Reader Service number. Use the Reader Service Card inside the back cover.

ELECTRONICS TOOL SET. The *model 250K* is a 12-piece starter tool set for electronic technicians and kit builders in a compact plastic carry case with storage tray. Included are the Weller® UL listed 25-watt iron with two 750°F. tips, soldering aid tool and 10 oz.

of resin core solder. From Xcelite®, 4" long-nose pliers, diagonal cutters and wire strippers, all with Poly-Cushion grips, a ¼" nutdriver, and both slotted and Phillips head screwdrivers with chrome vanadium steel blades and plastic handles.—**Weller-Xcelite Electronics Div.**, The Cooper Group, Apex, NC 27502.

Circle 31 on reader service card

MINIATURE NEEDLE-TIP TEST PROBE with a miniature banana plug 48 inches long. *Model 4071-48* includes a sharp, replaceable needle tip that easily pierces varnish or plat-

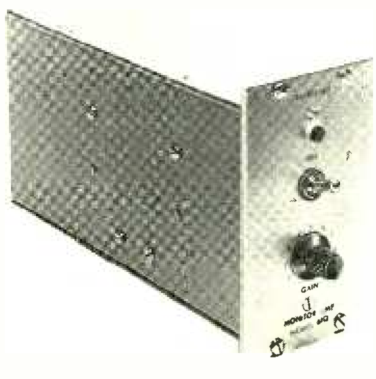


ing to give a good electrical reading. Tough thermoplastic is molded directly onto the probe tip and wire lead, providing a strong, reliable integral unit.

The pin tip plug is .080 inches in diameter, made of gold-plated brass. The stack-up is of beryllium copper spring, gold-plated, and accepts .080 inches diameter pin. Operating temperatures are from −25°C to +105°C. $2.50.—**ITT Pomona Electronics,** 1500 E. 9th St., Pomona, CA 91766.

Circle 32 on reader service card

25-WATT POWER AMPLIFIER, *model F62500,* is a compact monitor power amplifier for recording and broadcast studios and for commercial-sound and sound-reinforcement applications. It fills the need for an amplifier with higher power output than the company's 10-watt *model 610* (shown), but with lower power than the company's 70-watt *model 870* monitor amplifier. One important application of the new amplifier is for use by disc jockeys who want more headset sound than can be provided by lower-power units while monitoring a record.

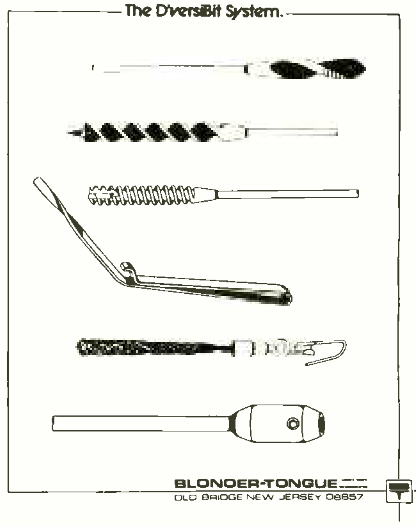


The unit is completely self-contained with a built-in 110 to 120 volt AC, 50 to 60 Hz power supply. Operating from a standard 600-ohm audio line, the amplifier readily drives an 8- or 16-ohm monitor loudspeaker. The *model F62500* is housed in a compact chassis with brushed-aluminum front panel. Up to five of these amplifiers can be mounted in the company's 662 PM 5¼ by 19 in. rack-mounting frame.

Some important specifications of the amplifier are: power output (8-ohm load), 25 watts continuous; power output (16-ohm load), 15 watts continuous; harmonic distortion at full power, 0.4 percent; frequency response, ±1 dB from 20 to 20,000 Hz, hum and noise, 85 dB below rated output; and input voltage for full output, 0.4 volt.—**Robins Industries,** 75 Austin Blvd., Commack, NY 11725 .

Circle 33 on reader service card

TOOLS FOR CABLE INSTALLATION. The *D'versaBit* combines a long flexible spring-steel shaft with high-quality drill bits in a tool system that reduces the time required for in-wall cable installations. The tools can be used for rapid installation of coaxial and electrical cable within all type of building walls. A standard quarter-inch drill is used to drive the tools.

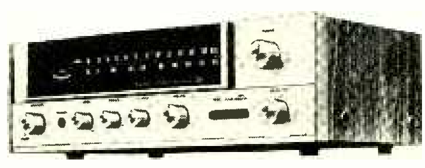


The various items making up the system include: a ½-inch auger bit with a 54-in. flexible shaft for easy starting and a clean entrance hole; a ½-inch carbide-tipped masonry bit with a 54-in. flexible shaft for drilling cement blocks and plaster; and a ½-inch combination bit with a 54-in. flexible shaft for greater durability and general-purpose use. Also available is a special alignment tool to guide and hold steady the *D'versaBit* flexible shafts; a line-recovery pulling-grip attachment for drawing RG-59 and RG-6 coax cable through the drilled holes; and a 54-in. extension attachment.

Installers of burglar and fire alarms, TV cables, telephone lines and electrical power lines will find the new tool system indispensible for quick and easy installations.—**Blonder-Tongue Labs,** 1 Jake Brown Rd., Old Bridge, NJ 08857.

Circle 34 on reader service card

AM/FM STEREO RECEIVER, *model 331.* Tuner section uses circuit-board module construction, has frequency-linear variable



capacitor, a low-noise MOSFET to improve sensitivity, and heavy sintered alloy flywheel for smooth tuning. There is also a sensitive tuning meter and a blackout dial face. Two ceramic filters and IC's deliver first rate performance. The *model 331* is rated at 12 watts-per-channel, minimum RMS power with both channels driven into 8 ohm speakers over a bandwidth of 40 Hz to 20,000 Hz with no more than 1.0% THD. Power bandwidth is 40 Hz to 20,000 Hz at or below rated minimum RMS power output and total harmonic distortion. Frequency response at 1-watt output is 25 Hz to 30,000 Hz, +2 dB, −3 dB. IHF sensitivity is 2.5 microvolts, signal-to-noise ratio is better than 65 dB, selectivity is better than 60 dB, capture ratio less than 1.5 dB. $200.00—**Sansui Electronics Corp.**, 55-11 Queens Blvd., Woodside, NY 11377.

Circle 35 on reader service card

ALL-WEATHER OUTDOOR SPEAKER, the *Kriket KC-45* is built for external mounting

on boats, sports vehicles, tractors, or any mobile application. Designed to look good

Circle 22 on reader service card

Circle 23 on reader service card

and keep operating during all weather conditions, the *Kriket KC-45* is carefully crafted with an impact-resistant, Duralex cover for rugged dependability.

Kriket KC-45 outdoor speaker specifications: power handling, 5 watts, 9 watts program, 13 watts peak. Frequency response: 150 Hz—10,000 Hz. Impedance: 8 ohms. Shipping weight: 2 lb. 6 oz.—**Acoustic Fiber Sound Systems, Inc.,** P.O. Box 18228, Indianapolis, IN 46218.

Circle 36 on reader service card

TURNTABLE. The *FONS CQ-30* transcription is a precision engineered device for those who demand top performance and reliability.

It comes standard without a pickup arm. High-performance arms, available from a number of manufacturers, can be used with the *FONS*. Pre-cut mounting boards are available for the turntable. For the purchaser who likes to "do it himself", the blank board that is standard on the CQ-30 may be custom drilled. For those who prefer a turntable with an arm already installed, the *FONS* also comes equipped with a factory-installed SME arm.

Among the outstanding features of the *FONS* is the individually and continuously variable three-speed (33⅓, 45, 78 rpm) speed control allowing total speed variation from 29 to 100 rpm. Aside from accurately playing records, the wide range of speed allows the user the ability to play records at varying speeds for "in home" recording effects or for listening to older off speed records.

The drive system consists of a DC servo control motor with tachometer generator coupled to a high mass, anodized aluminum platter by means of a precision belt. This, along with the full electronic speed control insures an accurate speed regardless of power supply fluctuations.

Another benefit of the high torque motor/drive system is a platter run up time of .66 of a revolution (1.7 seconds) to 33⅓ rpm.

The "instant speed" features make the turntable ideal for recording studio use, and production wherein tight cueing of records is desirable. Rumble is typically −79dB and wow and flutter is better than ±.04%.

The base incorporates the *FONS* anti-feedback phase cancellation suspension system. The unit comes with a walnut base and hinged, smoked plexiglass dust cover. Approximately $300.00. The turntable is manufactured in Scotland by Fergus-Fons and distributed by—**Audio Dimensions,** 4 Riverstone Drive, Weston Ontario M9P 2R6 Canada.

Circle 37 on reader service card

CAR FM SIGNAL BOOSTER, the *Stereo One*, is designed to help eliminate signal fade and flutter associated with weak-signal FM reception. The *Stereo One* can be used with any auto AM/FM radio without adverse affect on normal AM/FM operation. The circuit more than triples the received signal in the "on" mode to provide clear, crisp FM reception in fringe signal areas. The booster does not overload in strong-signal metropolitan areas.

The *Stereo One* is a 2-piece unit consisting of the amplifier that mounts close to the auto radio and the ON-OFF control switch that self-mounts on the dash in any convenient location. The control switch includes an LED "on" indicator.—**The Finney Co.,** 34 W. Interstate St., Bedford, OH 44146. **R-E**

Circle 38 on reader service card

CB ANTENNAS

(continued from page 35)

wavelength to the feed line to one of the verticals, the array provides an *end-fire* bi-directional pattern along the plane of the antennas as in Fig. 11-b. End-fire gain is 2.3 dB and beamwidth is about 80°. Note that broadside operation provides more gain while end-fire operation provides wider lobes.

When two identical vertical antennas are spaced one-quarter wavelength apart and fed 90° out-of-phase (by adding one-quarter wavelength to the feed line to one antenna) the radiation pattern is unidirectional in the shape of a cardioid with 120° beamwidth, 30 dB attenuation to the rear and 20 dB attenuation to the sides. Radiation is in the direction of the out-of-phase antenna (Fig. 11-c).

When three identical ground-plane verticals are spaced one-quarter wavelength apart and excited directly, 90° out-of-phase, the cardioid radiation pattern has a half-power beamwidth of 60°. This pattern can be switched in either direction. Inserting a one-quarter wavelength section in the feed line to one vertical causes the array to "fire" in the direction of that particular element. By using three radiators one-quarter wavelength (9 feet) apart in the form of a triangle, it is possible to steer the 60° cardioid pattern around the horizon in six steps while providing 4.5 dB over a single vertical radiator.

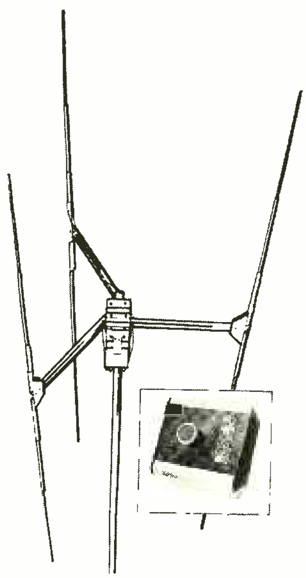


FIG. 12—THIS THREE-ELEMENT PHASED ARRAY—Antenna Specialists' Super Scanner MS119—provides 360° directivity by selecting one vertical dipole as the radiator and using the other two as reflectors.

The switching system—usually controlled from the operating desk—selects the two radiators to be directly excited and the other that is to be fed with a 90° phase shift. This permits the beam to be switched to any one of six positions. A letter to the engineering department of most antenna makers will bring application notes and engineering reports that will make it easy for you to design your own steerable vertical array.

Electrically steerable antenna systems based on the phased array are the *Super Scanner* model MS119 by Antenna Specialists and the Turner *Ultra Kicker*. The *Super Scanner* (Fig. 12) consists of three elements mounted 120° apart on a bracket that mounts on a mast. Predetermined lengths of coaxial cable connect each element to a set of switching relays. The relays switch the cables so one element becomes the radiator while the other two are electrically lengthened to act as reflectors. All points of the compass can be covered by switching the 120° cardioid through three positions. The control switch has a OMNI/MONITOR position that provides an omnidirectional pattern for use when on stand-by or monitoring. When a call comes in, the operator turns the selector switch for the strongest signal.

Selecting your base antenna

Carefully consider your requirements before you select an antenna for your base. (If you have received your license and are anxious to get on the air, then obtain an inexpensive ground plane while you analyze your needs. A coffee break or jamboree is a good place to get an inexpensive antenna. Be wary if offered a phased-array beam at a bargain price. The relay switching box is generally jammed with coax coils that make up the half-wave or quarter-wave phasing sections. Many a CB'er and a few hams have been known to lop off the "extra" coax for use in a mobile installation or other application. If any of the phasing lines are shortened or removed, the system won't work right and you'll have to purchase new phasing networks—if you are smart enough to figure out why the antenna array won't work.)

Factors to be considered are desired range, terrain, elevation above mean ground level, weather conditions (if your winters are severe with heavy icing, you'll need a rugged system) and cost. A simple ground-plane will do for local contacts in fairly open terrain and residential areas. A half-wave antenna provides a little more range and is relatively free from precipitation static and man-made interference.

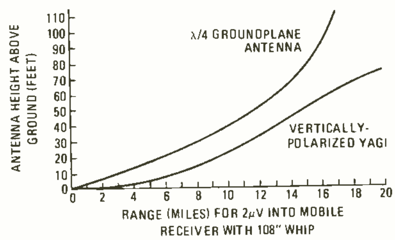
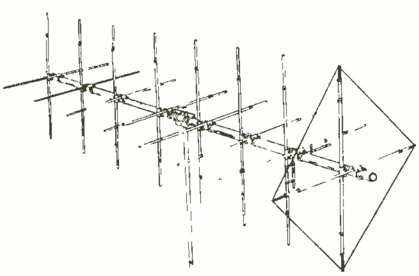


FIG. 13—HOW HEIGHT AND ANTENNA-TYPE affect the communications range. The curves are based on developing a 2-μV signal in a 108-inch mobile whip.

Use a beam if you need extended range or the ability to "punch" a signal into normally "dead spots" where signals are attenuated by terrain or tall buildings. Figure 13 (prepared from material developed by International Crystals Corp.) interference on their TV or radio. You may be innocent but you'll have a heck of a time proving it to him. Many neighbors antenna height above mean terrain level and the horizontal scale shows how far away each antenna will put a 2-μV signal into a 108-inch mobile whip.

Remember, if you use a beam and intend to do a lot of monitoring, you may miss an incoming call if the antenna is not aimed in the right direction. Too, before considering one of the really big rotary beams, give a thought to your neighbors. Many, seeing your big antenna, will immediately blame you for all the interference on their TV or radio. You may be innocent but you'll have a heck of a time proving it to him. Many neighbors will suspect anything unusual sprouting from your roof but won't give a second thought to a couple of verticals in your back yard. Don't ask for trouble.

NO RADIALS ARE USED on this Hy-Gain 488 antenna. It consists of a 70.5-inch fiberglass mast topped by a 52-inch stainless steel whip. Ratchet-type base permits mounting on flat or sloping surface.



WILSON ELECTRONICS' SUPER LASER 500 is a 16-element dual-polarized array on a 40-foot boom. It features 18-db gain.

If you need more information on antennas, there are lots of good books in your local library and on the shelves of a good book store. A glance through them will enable you to select one on your level. For a good, easy-to-understand treatment on antennas, take a look at *The ARRL Antenna Book* published by The American Radio Relay League. Another one of interest is *The Truth About CB Antennas* by Orr and Cowan.

Another good way to separate truth from scuttle-butt is to arrange for your CB club to have a speaker from the engineering staff of one of the leading antenna makers. Some distributors have knowledgeable field agents that will be happy to speak on antennas at your next club meeting. Beware of a lot that you'll hear about antennas over the air. The best antenna in the world won't be satisfactory if it is not properly installed or if the owner expects too much from it. **R-E**

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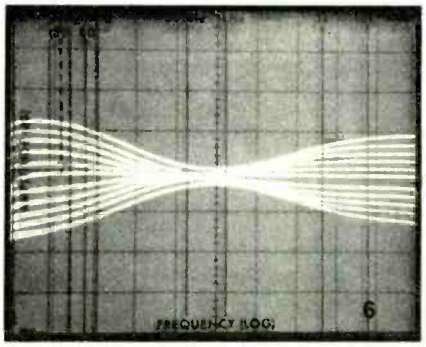
HI-FI TEST REPORTS
continued from page 67

volts, the highest we have ever recorded for an all-in-one receiver we tested.

The complete range of tone control action, in discrete 2 dB increments, is shown in Figs. 6 and 7. There are several nice things worth mentioning about the tone control system. For one thing, the rotary controls have distinct "stops" so that any of the curves shown in Figs. 6 and 7 (or combinations of both) can be reliably duplicated exactly. In addition, the sub-bass and sub-treble controls permit adjustment of the frequency extremes without affecting mid-range tones. Single or combined use of main and/or sub controls affords an unusually great choice of pre-

continued on page 84



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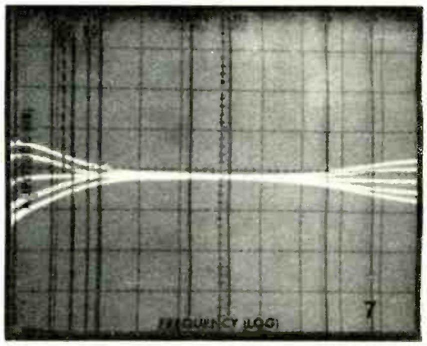

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TABLE III

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **U.S. Pioneer Electronics** Model: **SX-1250**

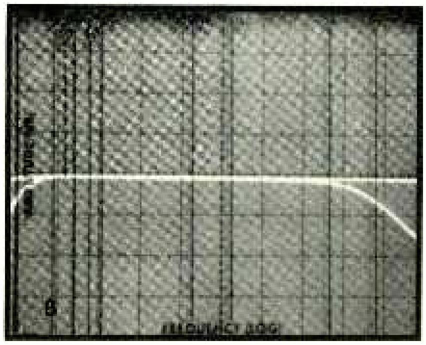
AMPLIFIER PERFORMANCE MEASUREMENTS

	R-E Measurement	R-E Evaluation
POWER OUTPUT CAPABILITY		
RMS power/channel, 8-ohms, 1 kHz (watts)	169.0	Very good
RMS power/channel, 8-ohms, 20 Hz (watts)	166.0	Excellent
RMS power/channel, 8-ohms, 20 kHz (watts)	167.0	Excellent
RMS power/channel, 4-ohms, 1 kHz (watts)	235.0	Excellent
RMS power/channel, 4-ohms, 20 Hz (watts)	232.0	Superb
RMS power/channel, 4-ohms, 20 kHz (watts)	200.00	Good
Frequency limits for rated output (Hz-kHz)	15-20	Very good
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output, 1 kHz (%)	0.077	Excellent
Intermodulation distortion, rated output (%)	0.095	Very good
Harmonic distortion at 1 watt output, 1 kHz (%)	0.018	Excellent
Intermodulation distortion at 1 watt output (%)	0.002	Excellent
DAMPING FACTOR, AT 8 OHMS	30	Good
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ± ___ dB)	0.2	Excellent
Maximum input before overload (mV)	540	Superb
Hum/noise referred to full output (dB) (at rated input sensitivity)	75 (weighted)	Excellent
HIGH LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± ___ dB)	11-54	Excellent
Hum/noise referred to full output (dB)	85 (weighted)	Very good
Residual hum/noise (min. volume) (dB)	96 (weighted)	Very good
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls	See Fig. 6	Excellent
Action of secondary tone controls	See Fig. 7	Excellent
Action of low frequency filter(s)	See Fig. 8	Very good
Action of high frequency filter(s)	See Fig. 8	Very good
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	2.2/2.2	
Input sensitivity, auxiliary input(s) (mV)	150	
Input sensitivity, tape input(s) (mV)	150	
Output level, tape output(s) (mV)	N/A	
Output level, headphone jack(s) (V or mW)		
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Very good
Adequacy of input facilities		Excellent
Arrangement of controls (panel layout)		Very good
Action of controls and switches		Excellent
Design and construction		Very good
Ease of servicing		Good
OVERALL AMPLIFIER PERFORMANCE RATING		Very good

HI-FI TEST REPORTS

continued from page 82

cise tone control settings. Filter responses are combined (low cut and high cut) in Fig. 8 and cut-off points (−3 dB) were precisely at the frequencies specified, with slopes in both instances at 12 dB per octave as claimed.



A summary of our reactions to the SX-1250 will be found in Table I. We were especially pleased with the price and with all the controls on the panel of the receiver and particularly so with that master VOLUME control. Those multiple, well defined steps of attenuation are extremely practical to use and give the receiver a professional feel besides. The tape monitoring facilities, coupled with the tape DUPLICATE feature will appeal to anyone owning more than one tape deck, regardless of the tape format, and the extra ADAPTOR jacks make it easy to add a Dolby decoder without having to give up one of the other tape monitor circuits for this purpose.

FM reception was excellent and that audible multipath indicator really works (as we proved by deliberately rotating our outdoor antenna to a less-than-optimum position). This multipath-minimizing scheme is actually easier to use than some of the visual indicators (meters or scopes) that have been used for this purpose.

AM reception was better than average, with considerably less variation of output level with change in signal strengths than we are accustomed to hearing on AM sections of all-in-one hi-fi receivers.

But by far the most impressive thing about the SX-1250 is its unbelievably high power-output capability. We were fortunate in having a brand new pair of full-range electrostatic speakers in the lab at the time we were testing this receiver. These speakers, while extremely smooth and well balanced in response, are notoriously inefficient and require lots of power to produce reasonable sound levels in a large listening room. They posed no problem whatever for this high powered Pioneer receiver. With conventional dynamic speaker systems of varying efficiencies, there were times when we felt that the bass reproduction could have been a bit tighter, but this is largely a matter of personal taste. $900.00 may seem like quite a lot of money to spend for an all-in-one receiver, but if you try to assemble this much power and equivalent performance using "separates" you will quickly conclude that the new Pioneer SX-1250 is a bargain at that! **R-E**

BUILD A COMPUTER
(continued from page 48)

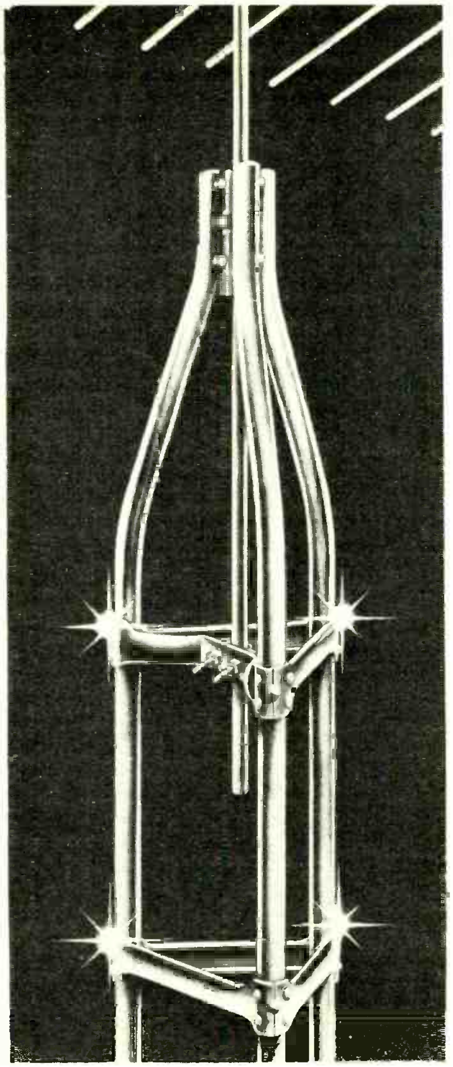
the Dyna-Micro to select one of four possible onboard devices. These are the three groups of LED's and the keyboard. Address bits A3—A7 are all gated together in IC17, an OR gate made from a series of open-collector inverters in an SN74LS05 chip. If the 8-bit LO address specifies a value greater than seven, the OR gate's output becomes a logic 1. Address bits A0—A2 are used in IC18, an SN74L42 decoder chip to provide a one-out-of-eight code for devices 0 to 7. The OR gate's output is used to enable the decoder for the device coded 0—7, but to disable it for other codes. The decoding scehme is shown in Table VI.

TABLE VI—ON-BOARD I/O DEVICE DECODER

OR Gate	A2	A1	A0	Device
1	X	X	X	NONE
0	0	0	0	LED Port 0, Keyboard
0	0	0	1	LED Port 1
0	0	1	0	LED Port 2
0	0	1	1	Available for user
0	1	0	0	Available for user
0	1	0	1	Available for user
0	1	1	0	Available for user
0	1	1	1	Available for user

X = Don't care condition. Can be either a logic 1 or a logic 0.

You will notice that device-code 0 selects both the LED PORT 0 and INPUT PORT 0 (the keyboard.) How can the computer output and input data at the same time. It can't, and some means must be used to distinguish between them. The Control Logic section outputs two control signals, $\overline{\text{IN}}$ and $\overline{\text{OUT}}$ that indicate whether data will be input to the CPU or output to an external device. Both signals are exclusive, never taking place at the same time. The pulses are generated by the 8080A and the Control Logic section under control of the software. Only when we execute an I/O type instruction will either of these signals be generated. The device codes for the SN7475 latches are gated with the $\overline{\text{OUT}}$ signal in IC19, and the $\overline{\text{IN}}$ signal is gated with the keyboard device code in the DM8095 buffer chip associated with the keyboard, IC31. Data is input or output only when we have a valid device code *and* the presence of either the $\overline{\text{IN}}$ or $\overline{\text{OUT}}$ signals. **R-E**



KOMPUTER KORNER

(continued from page 24)

the ease with which it can manipulate addresses as data and convert data into addresses. Were it not for the 8080's ability to use the register file on either the "data" or "address" side, its ability in this area would be severely limited. As it is, we have the option of using the registers either way, with conversion between the two being readily accomplished using the instruction set. This makes this register structure much more versatile than its simple appearance would first indicate. It also makes this organization much more useful than having either three 16-bit registers or six 8-bit registers.

The stack pointer (SP) is a special type of memory address register. It maintains the address of a special region in read/write memory called, appropriately, the stack. The stack operates as a LIFO (last in, first out) memory buffer. Certain 8080 instructions cause the contents of the internal registers to be transfered into or out of the stack. When this happens, the stack pointer is automatically incremented or decremented so that it always contains the address of the top (last in) element in the stack. This makes it easy to save and restore the registers during program operation. All you have to remember is to take the data out of the stack in the opposite order that it was placed into it. This ease of saving the register contents and status makes the stack architecture very powerful, particularly for interrupt and subroutine programming. Ways to take maximum advantage of a stack will be mentioned in later columns.

The program counter (PC) is used to determine the address in memory where the next instruction or data is to be found. In normal, sequential instruction execution, the program counter is incremented-by-one everytime an instruction- or data-byte is fetched from memory. Certain instructions, however, can cause the contents of the program counter to be modified in various ways. When this is done, program execution is transfered to the location specified by the new contents of the program counter. This is known as a program branch or jump. Program branches can be either unconditional or conditional. An unconditional branch is always executed, no matter what the state of the processor is when the instruction is executed. A conditional branch, on the other hand, will only execute if the state of the processor matches some specified condition. (For example, branch if the carry flag is set.) If the condition is not met, the processor ignores the branch instruction and continues executing where it is. Conditional branching is the way that any computer is able to make decisions based on the results of operations.

The eight-bit accumulator (A) is used in a variety of ways. For all 8-bit operations with ALU, the accumulator holds one of the operands and receives the result of the operation. For I/O operations, the accumulator servies as the I/O register with all data transfered to or from the various I/O devices passing through it. It serves as the primary memory data regis-

ter with most memory-to-CPU and CPU-to-memory data transfers taking place through it. It is obvious that the accumulator is a very busy register. If there is one place that the 8080 might be subject to criticism, it is that the accumulator is overworked. In programs requiring many I/O and memory transfers, the accumulator can become the bottleneck.

Memory addressing modes

With its 16-bit address bus fully decoded, the 8080 is capable of directly addressing 65,536 bytes of memory. To access all this memory, the 8080 provides three basic modes of memory addressing —direct, register indirect, and immediate. Direct addressing instructions contain the address of the memory location that contains data to be used in an operation in the second and third bytes of the instruction. Register indirect addressing instructions use the contents of one of the 16-bit registers (BC, DE, HL, or SP) to specify the memory location that contains the data to be used in the operation. Immediate addressing instructions contain the actual data to be used in the operation in the second and, if necessary, third bytes of the instruction.

Of the three address modes, the register indirect mode is the most versatile. It allows us to use the various instructions that manipulate the registers to form addresses for memory references.

Timing and control

The timing and control section of the 8080 decodes instructions, senses the state of the control inputs, and generates a sequence of control signals for both the processor and the external devices attached to the control output lines. The 8080 instructions are one-, two-, or three-bytes long, depending on the function performed. The first byte is always decoded to provide the operation to be executed. For two-byte instructions, the second byte provides either immediate data or an I/O address. For three-byte instructions bytes two and three provide either double-length immediate data or a memory address.

To decode and execute these multiple byte instructions, the 8080 uses from one to five machine cycles (M_1–M_5). Each machine cycle consists of from three to five states (T_1–T_5). All instructions require a four- or five-state first machine cycle, M_1. Additional cycles, if required, are all three-states long. A general timing waveform is shown in Fig. 2.

During the first machine cycle (M_1), one instruction is fetched from memory, decoded, and either fully or partially executed. This is accomplished during four or five machine-states. During state T_1, the processor sends the SYNC signal to indicate the start of a machine cycle, places the processor status word on the data bus, places the memory address contained in the program counter on the address bus, and enters state T_2. This sequence causes the memory to decode the address on the address bus and place the contents of the location referenced on the data bus. The 8080 uses state T_2 to wait for the data from the memory. At maximum speed it will remain in state T_2 approximately 500 ns. However, if the READY signal is low at the end of this time, the 8080 issues the WAIT signal high (indicating it is not executing) and enters the WAIT state (an extension of T_2). The processor remains in the WAIT state until the READY line is again high, at which time it resets the WAIT signal low and enters state T_3. Thus by controlling the READY line, peripherals and memories of varying speeds can be synchronized with the 8080. Once in state T_3, the 8080 loads the contents of the data bus into the instruction register. The instruction is then decoded and executed during states T_4 and, if necessary, T_5. If the instruction executed was a 1-byte instruction, the processor then enters state T_1 of cycle M_1 for the next instruction. Otherwise, it enters state T_1 of cycle M_2 for the current instruction.

For instructions requiring more than one machine cycle, cycles M_2—M_5 provide additional times for the 8080 to transfer data or addresses between the various internal registers and memory or I/O devices. Cycles M_2—M_5 are all three states long and all operate according in the same general sequence. During state T_1, the processor issues the SYNC signal, places the processor status word onto the data bus, places some address information onto the address bus and enters state T_2. The address information placed onto the address bus will depend upon the instruction being executed. It can be a memory address (specified by the contents of register BC, DE, HL, PC, or SP) or the address of an I/O device specified by an IN or OUT instruction. (In the case of I/O addresses, the same 8-bit I/O address apears on both A_0—A_7 and A_8—A_{15}.) Once in state T_2, the processor waits for the READY line to indicate that the memory I/O device is prepared for the data transfer. State T_3 is then entered and the required data transfer is performed. The DBIN and WR signals are used to indicate to peripherals and memory whether the 8080 is accepting input data or writing output data. If execution of the current instruction is complete, the processor enters cycle M_1 of the next instruction. Otherwise it continues executing with the next cycle of the current instruction.

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Conclusion

The hardware architecture of the 8080 is obviously too complex to be treated thoroughly in this short space. Hopefully this brief overview will give you enough information to follow and understand references made to the various registers and other structures that will occur in later columns. **R-E**

STATE OF SOLID STATE

(continued from page 28)

tions. At this point the chip has been protected from the hostile environment. What remains are the steps to metallize the wafer and bond to the package terminals so that this environmental screen is maintained.

Contact windows in the silicon dioxide are next opened up with conventional photomask operations. The wafer is sputtered with platinum and sintered in, forming platinum silicide low-resistance contacts. Titanium and platinum layers are sputtered on next. The platinum is etched with the metallization interconnect pattern and a gold layer electrolytically plated onto the paltinum. So the three layers of the tri-metal process are titanium, platinum, and gold. The titanium layer has very good adherence to the silicon nitride contact areas. Platinum, the middle layer, is a diffusion barrier between the titanium and gold. Gold has very low resistivity, does not corrode and is perfect as a bonding surface for the connecting wires. The last wafer step is silicon dioxide passivation to protect against damage during handling in the wafer testing, pellet separation, and packaging steps.

RCA says that the product passed 5,000 hours of a standard 15-volt reverse bias test at 85 degrees C and 85% humidity life test with *no failures.* One hundred percent failure of standard product with aluminum metallization occurs within 1,500 hours; a strong contrast.

The price schedule for the 741CG and 747G op-amps is $.50 and $1.50 respectively at the 100 to 999 level. Other prices in the same quantity are: CA324G Quad Op-Amp, $2.50; CA3724G High-Current NPN Transistor Array, $1.50; and the CA339G Quad Voltage Comparator, $2.25.

Let's hope that your next TV set with its probable complement of a half-dozen IC's will be closer to par with that communications satellite in the sky with its unserviceable electronics package.

New Motorola releases

Motorola's CMOS MSI logic line has two new additions. They are the MC14560 NBCD Adder and the MC14561 9's Complementer.

The MC14560 is a 4-bit binary full-adder. It adds two 4-bit *N*atural *B*inary *C*oded-*D*ecimal words (NBCD). This term refers to the normal 8-4-2-1 weighting convention.

An NBCD word at the data input of the MC14561 is transferred to its output terminals either complemented or uncomplemented as instructed by the complement control input. Putting the two IC's together gives a 4-Bit NBCD Adder/Subtracter.

The circuits are mounted in either ceramic or plastic DIPs and are grouped into two operating temperature ranges. The MC14560CP is a plastic —40 to +85°C unit which sells for $4.71 in small quantities. In the same lowest cost package and temperature range, the MC14561 goes for $1.45.

Motorola is also moving ahead with LSI MOS. Their new MCM6590L is a 2048 by 8 bit read only memory useful as a look-up table, for program storage, and in display terminals. The 16K ROM is mask programmable. Six conversion codes are factory programmed into the MCM6591L version. They are ASCII to and from Selectric (IBM), EBCDIC, and a modified 8 bit Hollerith. The same chip also has 128 USACII characters in mixed character fonts of 5 x 7 and 7 x 7 dot matrixes. They cost $23.95 each in 24 pin ceramic DIP packages in 100 quantities.

In the linear market, Motorola has the new MPC900 Negative Voltage Regulator. It covers a range of —4 to —30 volts at load currents up to 10 amps. These ratings do not lean on any external transistors since the MPC900 power dissipation rating is 100 watts. The regulator's TO-3 style package plugs into a noval tube socket. Price is $20.66 each in small quantities.

For more information on any of these new products, write to: Technical Information Center, Motorola Inc., Semiconductor Products Division, P.O. Box 20294, Phoenix, AZ 85036.

New microprocessor

MOS Technology has announced an 8-bit microprocessor, the MCS6501, first of a family. It is plug-compatible with the Motorola M6800. The new device uses N-channel, silicon gate, ion implanted, depletion load technology. It operates from a single 5-volt supply.

MOS Technology says the MCS6501 combines the compatibility of the M6800 bus system, the ready and indirect memory access of the 8080 and the on-chip clock of the F-8.

True address indexing, two types of indirect addressing and two index registers are powerful features. It is designed for cost effectiveness with a price of under $20 in quantity.

Software plans include an efficient Cross Assembler and a Fortran-like software emulator. **R-E**

next month

AUGUST 1976

■ CB Transceiver Roundup

What's new and available in CB gear. We look at the equipment and the features. We've included the new products our editors have seen at both the Personal Communications show in Las Vegas and the NEWCOM show in New Orleans.

■ Digital Clock Kits—1976

A special survey of the 35 different digital clock kits you can buy today. We examine how they work, list their specifications and tell you where you can get them.

■ New Digital Clock Module

Just announced by National Semiconductor, here's a preview of a new digital clock module that requires only the addition of a power supply and switches (and a case) to make a complete electronic digital clock.

■ Mindpower: Alpha

Unique brainwave monitor that has visual feedback. This month we get into the circuitry and take a look at the circuit boards.

■ Darkroom Countdown Timer

A digital darkroom timer that you set by using a calculator-type keyboard. It counts down and you can add an audio tone to the seconds.

PLUS

State-Of-Solid-State
Jack Darr's Service Clinic
Komputer Korner
Hi-Fi Lab Test Reports
Looking Ahead
Equipment Reports

BRAINWAVE: ALPHA
(continued from page 39)

and horizontal control amplifier IC14, IC15, provide control voltages to the horizontal and vertical comparators that can vary the "detect" points of the stages with respect to the horizontal and vertical ramp inputs. Since this determines the coordinates at which the electron beam will turn-on and shut-off, the apparent size of the rectangle is determined by the respective levels of the display control signals.

As we have now established the method for producing and sizing the on-screen display, let us now examine the method by which the minute alpha wave potentials produced by the brain achieve control of the display.

The *Mindpower: Alpha* user wears an elastic headband that places three electrodes against the skin of the forehead and scalp. Two of these lie opposite the brain's right frontal lobe and left occipital lobe, thus establishing differential signal-measuring points that traverse most of the brain's neural mass. These two electrodes provide the differential input to an FET differential amplifier, comprising Q15 and Q16. The third electrode connects to the isolated ground of the EEG amplifier, establishing a neutral reference on the skin of the skull that aids in the elimination of stray signal pickup. The FET-input stage provides extremely high common-mode rejection and a high input impedance, thus making it a most efficient processor of the very low-level brain wave signals obtainable at the cranial skin surface and picked up by the head-band electrodes.

All front-end stages of the unit are operated from a dual 9-volt battery power supply for user safety, and the amplified output of the EEG amplifier is safely isolated from the remaining stages by means of a photo-isolator (IC27). This ensures complete user safety.

The amplified neurological potentials of the FET input stage are applied to cascaded operational amplifier stages IC25 and IC26, that are optimized for response to signals in the 8- to 13-Hz alpha wave frequency range. Overall gain of the amplifier is approximately 100,000 and output appears across threshold control R92. This control can be set so that amplified alpha waves of increasing level are required to achieve audible or visual response. The selected alpha voltage is applied to isolator driver Q14. It drives the light-emitting diode section of optical isolator IC27. Hence, as alpha wave bursts are detected and amplified, IC27 converts these to light pulses which are transmitted across a space to a phototransistor. This, in turn, provides the alpha pulse to pulse shaper/differentiator Q8, Q7, in the display/beep control section (that is transformer-powered from the AC line).

The output signal of the isolated EEG amplifier section, for a given signal input, is a train of about-equal amplitude pulses, which are differentiated and applied to both 1-KHz beep oscillator IC20, and display motion generator IC18, IC19, Q5. The differentiated pulses key IC20 on and off so that an audible indication of alpha occurrence is provided to the user by the speaker. (This can be silenced by opening a switch.) The pulses also control the display motion generator's response in either of two ways, depending upon the units selected mode.

In Mode 1 (fixed display), incoming alpha pulses subtract from a fixed reference voltage, so that the display motion generator produces an output causing the display rectangle to shrink in size in proportion to the alpha produced. Return to normal size is automatic, if alpha is not sustained. In Mode 2 (moving display), the generator produces a rising ramp voltage which can be reduced by the arrival of an alpha wavetrain. This makes it possible for the user to hold the display "in check" on screen, or to move it down to smaller size by sustained alpha. Failure to sustain alpha causes the display to grow in size. **R-E**

VERTICAL JITTERS

This Magnavox 1T5502 has a bad vertical jitter and intermittent roll. I've checked tubes and changed the 17JZ8 twice. Scope seems to show everything OK around the vertical circuits. It's not the 2.0-μF capacitor in the AGC; I changed that! Where to go from here?—E.D., Tappan, NY.

Go to the DC power supply. Scope all of the DC supply lines feeding the sync separator. You may find some vertical-frequency pulses floating around. If so, one of the electrolytic filter capacitors isn't doing its job.

(Field Feedback: Right! A 200-μF electrolytic that reads less than 80-μF isn't too good. That did it.)

SAME PROBLEM, TWO TV SETS

I've got an Admiral PG910 and an RCA 172-A049 with the same problem. No high voltage. All of the DC voltages in both of them check out, including the boost. What have I done wrong?—M.B., Jackson, MS.

If your boost voltage is up to normal, you must have the right amount of driving pulse to the flyback. So, this will almost have to be something in the high-voltage rectifier tubes, sockets or the heater wiring to them. For a quick check, try replacing the tube with one of the solid-state rectifiers such as RCA SK-3067 or SK-3068. If this gives you high voltage, OK.

FLOATING COLOR BARS

I asked for help on finding the cause of two floating bars of color in the picture, on an Admiral. You suggested several things, but your post-script was the right one. The autodegauss coil was bad. Glad you had that last-minute thought! —L.B., Wallkill, NY.

So am I! **R-E**

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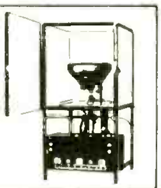

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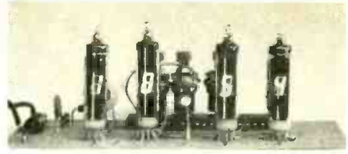

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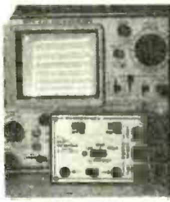

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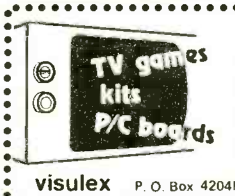

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2SA705	.55	2SB492	1.25	2SC681	2.50	2SC1172B	4.25	2SD315	.75
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		2N967	.50	2N2221A	.30	2N2916A	3.65	2N3772	1.90	2N4403	.20
2N173	1.75	2N1136	1.35	2N2222	.25	2N3019	.50	2N3773	3.00	2N4409	.20
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2N334	1.20	2N1305	.30	2N2322	1.00	2N3055	.75	2N3856	.20	2N4441	.85
2N336	.90	2N1377	.75	2N2323	1.00	2N3227	1.00	2N3866	.85	2N4442	.90
2N338A	1.05	2N1420	.20	2N2324	1.35	2N3247	3.40	2N3903	.20	2N4443	1.20
2N398B	.90	2N1483	.95	2N2325	2.00	2N3250	.50	2N3904	.20	2N4852	.55
2N404	.30	2N1540	.90	2N2326	2.85	2N3375	6.50	2N3905	.20	2N5061	.30
2N443	1.75	2N1543	2.70	2N2327	3.80	2N3393	.20	2N3906	.25	2N5064	.50
2N456	1.10	2N1544	.80	2N2328	4.20	2N3394	.17	2N3925	3.75	2N5130	.20
2N501A	3.00	2N1549	1.25	2N2329	4.75	2N3414	.17	2N3954	3.50	2N5133	.15
2N508A	.45	2N1551	2.50	2N2368	.25	2N3415	.18	2N3954A	3.75	2N5138	.15
2N555	.45	2N1552	3.25	2N2369	.25	2N3416	.19	2N3955	2.45	2N5198	3.75
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2N706B	.40	2N1605	.35	2N2903	3.30	2N3563	.20	2N4093	.85	2N5354	.20
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2N711B	.60	2N1711	.30	2N2904A	.30	2N3638	.20	2N4126	.20	2N5400	.40
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7417— .33	7492— .55	74191—1.10
7420— .16	7493— .55	74192— .75
7426— .35	7494— .80	74193— .95
7427— .28	7495— .80	74194—1.25
7430— .16	7496— .73	74195— .74
7432— .30	74107— .34	74196—1.10
7437— .29	74121— .50	74283—1.50
7438— .29	74123— .70	75324—1.75
7440— .18	74125— .70	75491— .60
7441— .82		75492— .60

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4002— .24	4019— .50	4047—2.20
4006—1.20	4022—1.00	4049— .50
4007— .30	4023— .25	4050— .50
4009— .50	4024— .85	4055—1.95
4010— .50	4025— .25	4066—1.10
4011— .25	4027— .55	4071— .25
4012— .25	4028— .95	4077— .25
4013— .35	4029—1.25	4081— .25
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200	.70	1.10	1.75	.60	.70	1.60
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IN5225B	3.0	.45	.40	IN5248B	18	.45	.40
IN5226B	3.3	.45	.40	IN5249B	19	.45	.40
IN5227B	3.6	.45	.40	IN5250B	20	.45	.40
IN5228B	3.9	.45	.40	IN5251B	22	.45	.40
IN5229B	4.3	.45	.40	IN5252B	24	.45	.40
IN5230B	4.7	.45	.40	IN5253B	25	.45	.40
IN5231B	5.1	.45	.40	IN5254B	27	.45	.40
IN5232B	5.6	.45	.40	IN5255B	28	.45	.40
IN5233B	6.0	.45	.40	IN5256B	30	.45	.40
IN5234B	6.2	.45	.40	IN5257B	33	.45	.40
IN5235B	6.8	.45	.40	IN5258B	36	.45	.40
IN5236B	7.5	.45	.40	IN5259B	39	.45	.40
IN5237B	8.2	.45	.40	IN5260B	43	.45	.40
IN5238B	8.7	.45	.40	IN5261B	47	.45	.40
IN5239B	9.1	.45	.40	IN5262B	51	.45	.40
IN5240B	10	.45	.40	IN5263B	56	.55	.50
IN5241B	11	.45	.40	IN5264B	60	.55	.50
IN5242B	12	.45	.40	IN5265B	62	.55	.50
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P2102-2	2.70	2.60
P2102A	2.90	2.70
P2102A-2	3.00	2.80
P2102A-4	2.95	2.75
P2111	5.70	5.50
P2111-1	5.80	5.60
P2111-2	5.90	5.70
P2112	5.90	4.70
P2112-2	6.00	4.80
P2401	9.90	9.80
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IM7552-1CPE	2.80	2.65
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TMS4034NL	2.70	2.60
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P8102	2.48	2.30
P8102-2	2.70	2.60
P8111	5.70	5.50
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AM2856PC	7.15	5.75
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AM25S09PC	5.40
AM25S10PC	4.50
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AM25LS07PC	2.79
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AM25LS14PC	31.00
AM25LS15PC	2.14
AM25LS138PC	2.12
AM25LS139PC	2.12
AM25LS151PC	2.14
AM25LS153PC	2.14
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AM25LS161PC	2.94
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75138N	2.95
75150N	3.10
75154N	4.10

75107

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75452N	1.00
75453N	1.00

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7400N TTL

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7400N	.14	.13	7470N	.40	.30	74152N	1.04	.94
7401N	.18	.16	7472N	.40	.30	74153N	.85	.75
7402N	.18	.16	7473N	.42	.38	74154N	1.08	.94
7403N	.18	.16	7474N	.44	.40	74155N	1.02	.92
7404N	.21	.19	7475N	.55	.50	74156N	1.02	.92
7405N	.20	.19	7476N	.44	.40	74157N	.90	.80
7406N	.36	.28	7480N	.80	.72	74158N	1.50	1.30
7407N	.36	.28	7481N	1.30	1.25	74160N	1.02	.92
7408N	.24	.21	7482N	.98	.96	74161N	1.10	1.00
7409N	.28	.21	7483N	.82	.76	74162N	1.40	1.30
7410N	.22	.19	7484N	1.80	1.70	74163N	1.00	.90
7411N	.26	.20	7485N	1.20	1.08	74164N	1.16	1.05
7412N	.34	.32	7486N	.44	.40	74165N	1.20	1.10
7413N	.45	.42	7489N	2.20	2.10	74166N	1.20	1.10
7414N	.98	.95	7490N	.56	.51	74167N	5.00	4.50
7416N	.35	.32	7491N	.84	.76	74170N	2.00	1.80
7417N	.35	.32	7492N	.56	.50	74173N	1.66	1.50
7418N	.30	.27	7493N	.62	.56	74174N	1.00	.90
7420N	.15	.14	7494N	.88	.80	74175N	.96	.90
7421N	.30	.26	7495N	.80	.72	74176N	1.08	1.00
7422N	.50	.45	7496N	.75	.68	74177N	1.08	1.00
7423N	.37	.36	7497N	5.00	4.50	74178N	1.42	1.30
7425N	.30	.23	74100N	1.10	1.00	74179N	1.80	1.70
7426N	.28	.26	74104N	1.00	.90	74180N	1.12	1.02
7427N	.28	.25	74105N	1.00	.90	74181N	3.00	2.70
7428N	.40	.33	74107N	.40	.36	74182N	1.00	.90
7430N	.26	.20	74109N	.40	.36	74184N	2.80	2.50
7432N	.32	.30	74110N	1.00	.90	74185N	3.00	2.70
7433N	.44	.40	74111N	1.00	.90	74188N	5.00	4.80
7437N	.29	.20	74116N	2.00	1.80	74190N	1.20	1.10
7438N	.29	.27	74118N	2.20	2.00	74191N	1.20	1.10
7439N	.44	.40	74119N	4.00	3.60	74192N	.98	.90
7440N	.17	.16	74121N	.60	.54	74193N	.92	.88
7441N	.85	.83	74122N	.48	.43	74194N	1.36	1.23
7442N	.40	.39	74123N	.68	.62	74195N	.75	.70
7443N	.72	.65	74125N	.50	.45	74196N	1.40	1.30
7444N	.72	.65	74126N	.50	.45	74197N	1.40	1.30
7445N	.90	.81	74128N	.50	.45	74198N	1.40	1.30
7446N	.90	.81	74132N	.92	.85	74199N	1.40	1.30
7447N	.98	.90	74136N	.80	.72	74200N	9.00	8.00
7448N	.98	.90	74141N	1.70	1.50	74221N	1.36	1.25
7450N	.14	.13	74145N	1.10	1.00	74247N	2.40	2.20
7451N	.14	.13	74147N	1.90	1.70	74251N	1.90	1.80
7453N	.14	.13	74148N	1.60	1.35	74278N	2.90	2.50
7454N	.14	.13	74150N	1.52	1.40	74279N	.66	.60
7459N	.20	.18	74151N	1.02	.92	74298N	2.00	1.80
7460N	.14	.13						

HIGH SPEED TTL

74H00N	.33	74H20N	.33	74H52N	.36	74H73N	.80
74H01N	.25	74H21N	.33	74H53N	.36	74H74N	.80
74H04N	.33	74H22N	.33	74H54N	.36	74H76N	.75
74H05N	.33	74H30N	.33	74H55N	.36	74H102N	.75
74H08N	.40	74H40N	.36	74H60N	.36	74H103N	.90
74H10N	.33	74H50N	.36	74H71N	.75	74H106N	.95
74H11N	.33	74H51N	.36	74H72N	.75		

LOW POWER TTL

74L00N	.24	74L10N	.24	74L51N	.34	74L90N	1.62
74L02N	.24	74L20N	.33	74L73N	.43	74L93N	1.51
74L03N	.39	74L42N	1.33	74L74N	.90	74L95N	1.62
74L04N	.33						

74LS00

	1-9	10up		1-9	10up		1-9	10up
74LS00N	.36	.35	74LS55N	.39	.38	74LS161N	3.00	2.70
74LS01N	.44	.40	74LS73N	.58	.55	74LS162N	3.06	2.80
74LS02N	.36	.35	74LS74N	.56	.54	74LS163N	3.00	2.70
74LS03N	.45	.43	74LS76N	.65	.64	74LS170N	5.80	5.30
74LS04N	.44	.40	74LS78N	.92	.90	74LS174N	2.20	2.00
74LS05N	.45	.44	74LS95N	2.08	2.00	74LS175N	2.40	2.20
74LS08N	.38	.37	74LS107N	.59	.58	74LS181N	3.69	3.68
74LS09N	.44	.40	74LS109N	.92	.86	74LS190N	2.85	2.70
74LS10N	.36	.35	74LS112N	.58	.55	74LS191N	2.85	2.70
74LS11N	.46	.42	74LS113N	.92	.85	74LS193N	2.50	2.40
74LS15N	.58	.54	74LS114N	.92	.85	74LS194N	2.25	2.20
74LS20N	.44	.20	74LS123N	1.60	1.50	74LS195AJ	2.40	2.20
74LS21N	.58	.54	74LS138N	1.89	1.80	74LS196AJ	2.76	2.50
74LS22N	.58	.54	74LS139N	2.00	1.80	74LS197AJ	2.20	2.10
74LS27N	.44	.40	74LS151N	1.68	1.50	74LS251AJ	2.08	1.90
74LS30N	.39	.38	74LS153N	1.80	1.79	74LS253AJ	2.42	2.20
74LS32N	.45	.44	74LS157N	1.55	1.54	74LS257AJ	1.89	1.80
74LS38N	.58	.53	74LS158N	1.68	1.60	74LS258AJ	2.06	1.90
74LS51N	.39	.38	74LS160N	3.00	2.70	74LS260AJ	.44	.40
74LS54N	.58	.54						

SCHOTTKY TTL

74S00	.44	74S32	.80	74S113	1.50	74S174	3.30
74S01	.76	74S40	.65	74S114	1.20	74S175	2.90
74S02	.60	74S50	.76	74S133	.80	74S181	6.00
74S03	.75	74S51	.80	74S138	2.20	74S189	4.40
74S04	.55	74S60	.80	74S139	2.20	74S194	3.30
74S05	.76	74S64	.80	74S140	.80	74S195	3.30
74S08	.80	74S65	.80	74S151	2.20	74S251	2.20
74S09	.76	74S74	.90	74S153	3.40	74S253	2.40
74S10	.55	74S76	1.15	74S157	2.40	74S257	2.40
74S11	.65	74S78	1.15	74S158	2.00	74S258	2.40
74S15	.75	74S85	6.10	74S160	3.90	74S260	1.20
74S20	.65	74S86	2.50	74S161	4.70	74S280	5.70
74S21	.76	74S112	1.00	74S172	6.00	74S289	4.00
74S30	.80						

9300 SERIES

9300PC	$1.00	9318PC	2.30	9366PC	1.75	93L18	3.50
9301PC	1.20	9321PC	1.20	93L00	1.50	93L21	1.50
9304PC	1.50	9322PC	1.30	93L01	1.60	93L22	1.80
9306PC	6.90	9324PC	2.00	93L08	3.20	93L24	2.80
9308PC	2.50	9328PC	2.50	93L09	1.80	93L28	3.70
9309PC	1.60	9334PC	2.95	93L10	2.80	93L34	4.00
9310PC	1.50	9338PC	3.30	93L11	4.20	93L38	4.20
9311PC	2.30	9340PC	5.00	93L12	1.80	93L40	6.50
9312PC	1.20	9341PC	4.10	93L14	1.70	93L41	6.50
9314PC	1.30	9342PC	1.15	93L16	3.20	93L60	3.00
9316PC	1.50	9360PC	1.75	93L18	3.50	93L66	2.70

CMOS

	1-9	10up		1-9	10up		1-9	10up
4000AE	.15	.14	4021BE	1.35	1.25	4056AE	1.99	1.98
4000AF	.28	.24	4022AE	1.05	1.00	4056BE	2.04	2.03
4000BE	.19	.18	4022BE	1.10	1.05	4060AE	1.70	1.68
4001AE	.24	.20	4023AE	.24	.22	4063AE	2.50	2.49
4001BE	.27	.24	4023BE	.30	.28	4066AE	.90	.89
4002AE	.24	.15	4024AE	.80	.70	4068AE	.44	.43
4002AF	.34	.25	4024AF	.95	.85	4068BE	.53	.48
4002BE	.30	.18	4024BE	.85	.75	4069AE	.44	.43
4004AE	4.00	3.80	4025AE	.24	.20	4069BE	.53	.48
4006AE	1.30	1.20	4025AF	.40	.35	4070BE	.60	.59
4006AF	1.50	1.30	4025BE	.30	.28	4071AE	.45	.44
4006BE	1.35	1.25	4026AE	1.50	1.49	4072AE	.34	.33
4007AE	.24	.23	4027AE	.55	.50	4073AE	.40	.39
4007AF	.40	.35	4027BE	.60	.55	4075AE	.40	.39
4007BE	.27	.28	4028AE	.95	.90	4075AE	1.24	1.22
4008AE	1.15	1.14	4028BE	1.00	.95	4077AE	.40	.39
4008AF	1.30	1.25	4029AE	1.20	1.10	4077BE	.44	.43
4009AE	.50	.45	4029BE	1.25	1.15	4078AE	.40	.39
4009BE	.55	.50	4030AE	.48	.40	4078BE	.44	.43
4010AE	.50	.45	4030AF	.65	.60	4081BE	.40	.39
4010BE	.55	.50	4030BE	.55	.50	4082AE	.39	.38
4011AE	.24	.23	4033AE	2.00	1.90	4082BE	.43	.42
4012AE	.24	.22	4035AE	1.20	1.10	4093AE	1.65	1.64
4012AF	.34	.32	4035BE	1.25	1.15	4095BE	1.95	1.94
4012BE	.29	.27	4040AE	1.20	1.10	4098AE	1.30	1.29
4013AE	.30	.28	4040AF	1.50	1.40	4099AE	2.90	2.89
4013AF	.45	.43	4040BE	1.30	1.20	4502AE	1.50	1.49
4014AE	1.05	1.00	4041AE	1.25	1.00	4507BE	.60	.55
4014AF	1.30	1.15	4042AE	1.00	.85	4508BE	2.20	2.19
4014BE	1.10	1.05	4043AE	.95	.90	4510AE	1.40	1.39
4015AE	1.15	1.10	4044AE	.95	.90	4510BE	1.45	1.44
4015BE	1.20	1.15	4046AE	3.10	3.05	4511BE	2.00	1.99
4016AE	.55	.49	4047AE	2.00	1.90	4512BE	1.30	1.29
4016BE	.60	.54	4048AE	1.43	1.40	4514AE	5.00	4.99
4017AE	1.05	1.00	4049AE	.58	.53	4515AE	5.00	4.99
4017BE	1.10	1.05	4049BE	.63	.58	4515AE	1.75	1.74
4018AE	1.24	1.23	4050AE	.58	.53	4518AE	1.28	.98
4018BE	1.30	1.28	4051AE	1.49	1.48	4520AE	1.28	.98
4019AE	.54	.49	4052AE	1.40	1.39	4528AE	2.20	2.19
4019AF	.70	.68	4052BE	1.45	1.44	4528BE	2.25	2.24
4019BE	.60	.55	4053AE	1.40	1.39	4585AE	2.05	1.95
4020AE	1.45	1.35	4053BE	1.45	1.44	4901AE	.32	.31
4021AE	1.30	1.20	4055AE	1.95	1.94	4911AE	.32	.31

INDUSTRIAL QUALITY COMPONENTS

What is more important?
QUALITY or PRICE?
We have decided to offer only the highest quality components. When quality counts, you can count on Ancrona

FIRST QUALITY ONLY

IC SOCKETS

WIRE-WRAP GOLD DIP

PIN	1-24	25	100
14	.45	.41	.37
16	.54	.49	.44

SOLDER — GOLD DIP

PIN	1-24	25	100
14	.34	.31	.28
16	.37	.34	.31

SOLDER-TIN DIP

	1-24	25	100
8	.21	.19	.17
14	.25	.22	.20
16	.28	.25	.23
18	.34	.31	.28
22	.37	.36	.35
24	.47	.43	.40
28	.88	.80	.70
36	1.09	.98	.89
40	1.24	1.12	.90

TO-5 SOCKETS TEFLON

3 PIN	.55 EA
4 PIN	.65 EA
6 PIN	.90 EA
8 PIN	1.10 EA
10 PIN	1.40 EA

PLASTIC TO-5

8 PIN .40 EA

INTERSIL 8038 PRECISION WAVEFORM GENERATOR & VCO

For simultaneous sine, square and triangular waveforms <.001 Hz to 1MHz.

Part No.	1-9	10 up
8038CCPD	$3.90	$3.70

1-AMP RECTIFIERS

	10	100	1000
1N4001	1.00	7.00	60.00
1N4002	1.10	8.00	70.00
1N4003	1.20	9.00	80.00
1N4004	1.30	10.00	90.00
1N4005	1.40	11.00	100.00
1N4006	1.50	12.00	110.00
1N4007	1.60	13.00	120.00

HYBRID POWER AMPLIFIERS

SI-1010G	10W	$6.40
SI-1020G	20W	9.90
SI-1030G	30W	18.70
SI-1050E	50W	24.90
SI-1050G	50W	24.90

HIGH VOLTAGE TRANSISTORS

BU204	3A	1300V	$4.14
BU205	3A	1500V	4.95
BU206	3A	1700V	5.94
BU207	6A	1300V	5.85
BU208	6A	1500V	6.93
BU209	6A	1700V	8.64

MATSUO DIPPED TANTALUM CAPACITORS

MFD	WVDC	1-9	10up	50up	MFD	WVDC	1-9	10up	50up
.1	35	$.30	$.25	$.20					
.15	35	.30	.25	.20	4.7	35	$.40	$.32	$.26
.22	35	.30	.25	.20	6.8	35	.40	.32	.26
.33	35	.30	.25	.20	10.0	16	.38	.30	.24
.47	35	.30	.25	.20	10.0	25	.39	.31	.25
.68	35	.30	.25	.20	10.0	35	.40	.32	.26
1.0	35	.30	.25	.20	15.0	35	.95	.64	.56
1.5	35	.35	.28	.23	22.0	16	.40	.32	.26
2.2	20	.30	.25	.20	33.0	20	.95	.64	.56
2.2	35	.35	.28	.23	47.0	20	1.40	1.05	.90
3.3	35	.38	.30	.24	68.0	16	1.40	1.05	.90

CARBON FILM RESISTORS . . . ¼ WATT 5%

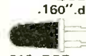
150 STANDARD VALUES . . . . $1.69 per 100
10 ohm to 10 megohms . . . . Only in multiples of 100 per value

LEDs

.125" dia.

209	RED	$.25
209	YELLOW	.35
209	GREEN	.35

.160" dia.

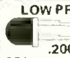


216	RED	$.25
216	YELLOW	.30
216	GREEN	.30

.200" dia.

220	RED	$.25
220	YELLOW	.30
220	GREEN	.30

LOW PROFILE



.200" dia.

226	RED	$.25
226	YELLOW	.30
226	GREEN	.30
226	ORANGE	.30

.200" dia.

5053	RED	$.35
5053	YELLOW	.40
5053	GREEN	.40
5053	ORANGE	.40

MV50 RED $.30

216 = MV5024
5053 = MV5053

DISPLAYS

0.6" IN.

EP62R	RED	3.00
EP62G	GREEN	3.60
EP62Y	YELLOW	3.60

Data sheet for EP62 $.25

LARGE 1"

EP1000	RED	5.50
3 pcs	EP1000	15.00
5 pcs	EP1000	22.50

Data sheet for EP1000 $.25

XCITON

XAN72	RED	2.00
XAN52	GREEN	2.00
XAN82	YELLOW	2.00

LITRONIX

DL80	RED	6.00	DL44	RED	6.00
DL81	RED	6.00	DL402	RED	4.00
DL10	RED	6.00	DL701	RED	3.40
DL10A	RED	4.00	DL704	RED	2.25
DL101	RED	4.90	DL707	RED	2.35
DL57	RED	9.90	DL747	RED	2.50
DL61	RED	12.00	DL33	RED	4.00

OPTOISOLATORS

LITRONIX

IL1	$1.30	IL16	$1.80	ILD74	$1.00
IL12	1.40	IL74	1.35	ILQ74	3.40

MONSANTO

MCT2 .60

WAVEFORM GENERATOR KIT

EXAR XR205K $25.00

Here's a highly versatile lab instrument at a fraction of the cost of conventional unit. Kit includes 2 XR205 IC's, data & applications, PC board (etched and drilled, ready for assembly) and detailed instructions.

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SGS-ATES RHYTHM GENERATORS

Designed specifically for electronic organs and other musical instrument designs. Detailed applications book, only . . . . $1.95.

M252BIAA 16 PIN DIP $15.00
15 programmable rhythms which cannot be superimposed

M253BIAA 24 PIN DIP $19.50
12 programmable rhythms which can be superimposed

16-page data sheet for both devices only $.90

Circle 89 on reader service card

DIGITAL REVERB

(continued from page 45)

second speakers. One hears only expanded space as the buttons on the device are successively depressed—from shortest time delay interval to maximum delay. We were able to easily duplicate acoustic space ranging from a "nightclub" environment to a spacious cathedral-like sound.

According to the inventors of the device, this first version of the time delay system is a "high end" product intended for use with relatively high-priced stereo component systems. There was more than a hint, however, that other products are planned—all based upon digital time delay principles. In our own view, a device of this kind (suitably proportioned downward in size, price and features) might make a wonderful addition to a car stereo system, for example. When we offered this suggestion to the people at Audio Pulse, they smiled slyly—as if they knew something and we didn't—and they very probably do! **R-E**

STEP-BY-STEP

(continued from page 61)

resistor. You'll read 1.0 volt for each 1.0 ampere flowing. This type will *not* give you an accurate reading on an unloaded power transformer, which is a pure inductive load. You will see a reading of about 35-40 watts on a *good* transformer. However, this trick is reasonably accurate on a fully loaded power transformer.

"Load-shedding"

Power companies use a trick called "load-shedding" to locate a short. They disconnect all the loads and then put them back one at a time. The one that trips the breaker is the bad one. You can do the same thing, if necessary. Disconnect the high-current loads; in a hybrid or tube TV, these are the horizontal output stage, vertical output stage and audio output stage. The other stages normally take only small currents.

You can make this easier by opening the main DC power supply lead at the filter output and hooking in a DC milliammeter. This is point A in Fig. 9, a typical TV power supply circuit from a Sams Photofact schematic. Note that they show the *normal* load current; this is found on all Sams schematics, and should be used on all. Note this current; if it's far too high, disable the high current stages one at a time, and you'll be able to tell which one is faulty.

In transistor power supply stages, particularly in high-powered audio amplifiers, you'll see two current readings. One will be the resting or "no-signal" current. The other will be the full-volume current, and will be much greater. This is typical of class-B output stages.

"Visible symptoms"

In TV sets, there will often be visible symptoms of power-supply trouble. One of these is the small raster; it will be pulled in on both sides, top and bottom. This shows that neither the horizontal or vertical sweeps have full output. The cause is something common to both, meaning the DC power supply.

Another visible symptom is "hum-bars" in the raster. Fig. 10 shows how these look. In sets with full-wave rectifier circuits, the hum (ripple) has a frequen-

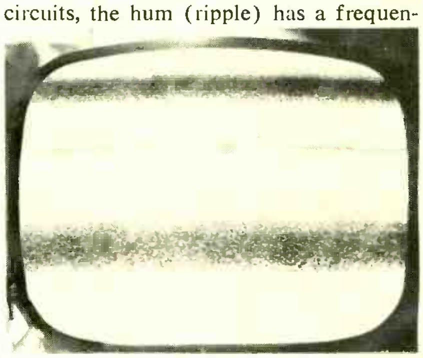

FIG. 10—OPEN FILTER CAPACITOR is the commonest reason for these hum bars.

cy of 120 Hz; so you see two hum-bars on the raster. In sets with half-wave power supplies, the ripple is at 60 Hz, so

(Continued on page 108)

S. D. SALES CO. P. O. BOX 28810 DALLAS, TEXAS 75228

ALARM CLOCK KIT SIX DIGIT LED

Thousands of hobbyists have bought and built our original clock kit and were completely satisfied. But we have received many requests for an alarm clock kit with the same value and quality that you have come to expect from S.D. So, here it is!

THE KIT INCLUDES:

- 1 Mostek 50252 Alarm Clock Chip
- 6 Hewlett Packard .30 in. common cathode readouts.
- 15 NPN Driver Transistors
- 2 Switches for time set
- 2 Slide Switches for alarm set and enable
- 1 Filter Cap
- 4 IN4002 Rectifiers
- 1 IN914 Diode
- 1 .01 Disc Cap
- 15 Resistors
- 1 Speaker for alarm
- 1 LED lamp for PM indicator.

$9.95

PCB - 3.00
VFMR - 1.50

60 Hz. Crystal Time Base

FOR DIGITAL CLOCKS

S. D. SALES EXCLUSIVE!

$5.95

BUY TWO FOR $10.00

KIT FEATURES:

A. 60 Hz output with accuracy comparable to a digital watch.
B. Directly interfaces with all MOS clock chips.
C. Super low power consumption (1.5 Ma typ.)
D. Uses latest MOS 17 stage divider IC.
E. Eliminates forever the problem of AC line glitches.
F. Perfect for cars, boats, campers, or even for portable clocks at ham field days.
G. Small size, can be used in existing enclosures.

Kit includes crystal, divider IC, P.C. Board plus all other necessary parts and specs.

MOS 4 DIGIT COUNTER I C

All in one 28 PIN DIP. 4 Decade counters, latches, MUX circuits, display decoders, etc. Features: 5VDC operation, 25 MW power consumption, BOTH 7 segment and BCD outputs. Perfect for DVM's, frequency meters, tach's, etc. Can be cascaded for more digits. #5002 - $8.95.

8008-1 MICRO PROCESSOR

New Units. High speed 8008. Almost twice as fast as units sold by others. Still a very versatile and widely used MPU. No data book, only pinout date included at this price. $12.50 LIMITED QTY.

1101 A RAM IC

256 XI BITS. Perfect for 8008 or small systems such as telephone dials that do not require a lot of memory. Special 59c. 8 FOR $4.

C & K MINI TOGGLE SWITCH

#7103 SUB MINI SPDT Center OFF. Special - 99c.

TTL IC'S

7400 - 19c	7420 - 19c	74153 - 75c	74154 - 1.00
7402 - 19c	7432 - 34c	7437 - 39c	74157 - 75c
7404 - 19c	7485 - 95c	7438 - 39c	74161 - 95c
74204 - 29c	7486 - 45c	7447 - 85c	74164 - 1.10
7406 - 29c	7490 - 65c	7448 - 85c	74165 - 1.10
7408 - 19c	7492 - 75c	7473 - 39c	74174 - 95c
74504 - 44c	7495 - 75c	7474 - 35c	74181 - 2.50
7410 - 19c	74121 - 38c	7475 - 69c	74191 - 1.25
7411 - 29c	74123 - 65c	7476 - 35c	74192 - 1.25
7413 - 50c	74141 - 75c	7483 - 95c	74193 - 1.00

2102 1K RAM's - 8 FOR $12.95

New units ——— We bought a load on a super deal, hence this fantastic price.
Units tested for 500NS Speed.

MOTOROLA RTL IC'S

Brand new, factory prime. Hard to find, but still used in a variety of projects. (See the RTL Cookbook by Howard W. Sams.)

MC724P-59c	MC780P-89c	MC791P-69c
MC725P-59c	MC785P-49c	MC792P-59c
MC764P-49c	MC787P-89c	MC799P-59c
MC767P-69c	MC788P-49c	MC9704P-89c
MC771P-49c	MC789P-59c	MC9709P-69c
MC775P-89c	MC790P-89c	MC9760P-69c

MV-50 TYPE LED's
by LITRONIX
10 for $1
Factory Prime!

3 DIGIT LED ARRAY — 75c

by LITRONIX
DL33MMB. 3 MAN-3 Size Readouts in one package. These are factory prime, not retested rejects as sold by others. compare this price! 75c 3 for $2.

SALE ON CUT LEAD SEMICONDUCTORS

Leads were cut for PCB insertion. Still very useable.

1N914/1N4148	100/$2
1N4002 1 Amp 100 PIV	40/$1
1N4745A 16V 1W Zener	20/$1
EN2222 NPN Transistor	25/$1
EN2907 PNP Transistor	25/$1
2N3904 NPN Driver Xstr.	25/$1
2N3392 GE Pre-amp Xstr.	25!$1
C103Y SCR. 800MA. 60V.	10/$1

ALL NEW. UNUSED. SOME ARE HOUSE #

SLIDE SWITCH ASSORTMENT

Our best seller. Includes miniature and standard sizes, single and multi-position units. All new, first quality, name brand switches. Try one package and you'll reorder more. *Special — 12 for $1* (Assortment)

DISC CAP ASSORTMENT

PC leads. At least 10 different values. Includes .001, .01, .05, plus other standard values.
60 FOR $1

UPRIGHT ELECTROLYTIC CAPS

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Brand new by Sprague. PC leads.

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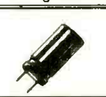

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A big .50 inch easy to read character. Now available in either common anode or common cathode. Take your pick. Super low current drain, only 5 MA per segment typical.

FND - 510 Common Anode
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Mini dip. New house numbered units by RAYTHEON.
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FROM THE PEOPLE WHO BROUGHT YOU VECTORBOARD...THE WIRE PENCIL.. THE ALTAIR PROTOTYPE BOARD... AND NOW, THE "SLIT-N-WRAP", A SPEEDY MANUAL WRAPPING DEVICE WHICH SUPPLIES INSULATED WIRE (#28 GA.) FROM A SPOOL DIRECTLY TO WRAP POSTS **WITHOUT ANY** PRE-STRIPPING OR PRECUTTING. SAY GOODBYE TO PRE-MEASURING, TOO. THE SECRET? A TINY SLIT IN THE WIRE EXPOSES COPPER TO THE WRAP POST. WITH TOOL, INSTRUCTIONS, 200' OF WIRE. ADD 1 LB. SHPNG.

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4 BIG ½" DIGITS---SQUINT NO MORE! Snooze function, timed turnoff, speaker included for alarm beeps; transformer, circuit board, and 7 pushbutton switches included in the kit. Opto - isolator for alarm and sleep out (so you can trigger triacs and play other games). Readouts may be remoted. Use with 60 Hz time base for battery operation. +1 lb. shpng.

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4 MHz (PACE clock frequency), 5 MHz, 8 MHz, 10 MHz, 12 MHz, 15 MHz, 18 MHz (8080 clock frequency), and 20 MHz.

NEW! Low-cost, full feature 4k×8 kit

ALTAIR 8800/IMSAI PLUG-IN COMPATIBLE. Buffered addresses--data out--and data in lines, 0 wait states, 1A typ power, sockets for all ICs, low power Schottky TTL support ICs, onboard regulation, lots of bypassing, DIPswitch address select, documentation, and a quality double-sided board...

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Circle the reader service no. below, and you'll receive our flyer listing lots of stuff.

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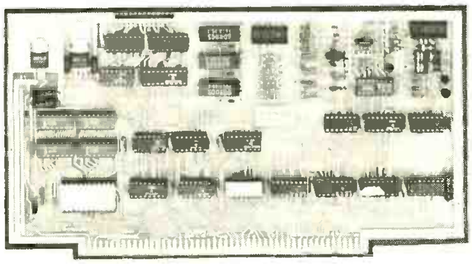
"Gentlemen, start your cassettes"



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-5K and 200K
-½" x ¼" x ¼"
-4 leads spaced .3" x .2"
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25K Trimmer
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CD4009	.59	CD4025	.34
CD4010	.59	CD4030	.65
CD4011	.29	74C20	.65
CD4013	.69	74C42	2.00
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1 Amp OP AMP
Similar to National LH0021 General purpose operational amplifier in a TO-3 package. Capable of large output currents.
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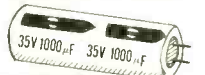
PCB vertical mount electrolytic capacitors. 2" long, 3/4" dia.
59¢ ea. 10 for $5.00



TTL

7400	$ .20	74L54	$ .25
74H00	.25	74L55	.25
7401	.14	7460	.16
74H01	.25	74L71	.20
7402	.25	7472	.40
7404	.25	74L72	.60
74H04	.30	7473	.35
7405	.30	74L73	.75
7406	.40	7474	.45
7408	.30	74H74	.75
7410	.12	7475	.8-
7413	.75	7476	.35
7417	.40	74L78	.70
7420	.12	7480	.50
74L20	.25	7483	.70
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74H40	.22	74107	.25
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74H50	.30	74174	1.00
7451	.10	74180	1.00
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More Capacitors
Vertical mount PCB capacitors--smaller size. Values:10ufd 25V; 6.8ufd 6V; 33 ufd 10V; 4.7ufd 16V.
25¢ each

SPACE AGE CLOCK KIT

Instructions & parts - 12 or 24 hour format.
Four digit clock kit includes all parts for complete clock: 3⅛"x 2":
-FND 70 readouts
-MM5314 clock chip & all transistors, etc.
-extruded aluminum case
-cord with transformer plug
$16.95

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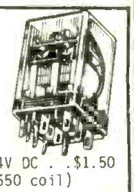

24V DC . . $1.50 (650 coil)
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SN7403N	.16	SN7460N	.22	SN74154N*	1.25
SN7404N*	.16	SN7470N	.45	SN74155N	.99
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SN7406N	.20	SN7472N	.39	SN74157N	.99
SN7407N	.29	SN7473N*	.37	SN74160N	1.25
SN7408N	.25	SN7474N*	.32	SN74161N	.99
SN7409N	.25	SN7475N*	.50	SN74163N*	.99
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SN7425N	.29	SN7492N	.49	SN74180N	.99
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SN7427N	.37	SN7494N	.79	SN74182N	.95
SN7429N	.42	SN7495N	.79	SN74184N	1.95
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SN7438N	.27	SN74107N	.39	SN74190N	1.19
SN7439N	.25	SN74121N*	.39	SN74191N	1.25
SN7440N	.15	SN74122N	.39	SN74192N*	.89
SN7441N	.89	SN74123N*	.70	SN74193N*	.89
SN7442N	.59	SN74125N	.60	SN74194N	1.25
SN7443N	.75	SN74126N	.60	SN74195N	.75
SN7444N	.75	SN74132N	1.09	SN74196N	1.25
SN7445N	.75	SN74136N	.95	SN74197N	.75
SN7446N	.81	SN74141N	1.15	SN74198N	1.75
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SN7448N	.79	SN74143N*	4.50	SN74200N	5.59
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MANY OTHERS AVAILABLE ON REQUEST
20% Discount for 100 Combined 7400's

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CD4006	2.50	CD4044	1.50	74C30N	.65
CD4007	.25	CD4046	2.51	74C42N	2.15
CD4009	.59	CD4047	2.75	74C73N	1.50
CD4010	.59	CD4049	.79	74C74	1.15
CD4011	.25	CD4050	.79	74C90N	3.00
CD4012	.25	CD4051	2.95	74C95N	2.00
CD4013	.47	CD4053	2.95	74C107N	1.25
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CD4017	1.35	CD4066	1.75	74C154	3.00
CD4019	.55	CD4069	.45	74C157	2.15
CD4020	1.49	CD4071	.45	74C160	3.25
CD4022	1.25	CD4072*	.45	74C161	3.25
CD4023	.25	CD4081	.45	74C163	3.00
CD4024	1.50	CD4511	2.50	74C164	3.25
CD4025	.25	CD4518	2.50	74C173	2.60
CD4027	.69	74C00N	.39	74C193	2.75
CD4028	1.65	74C02N	.55	74C195	2.75
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LM311N	.90	NE560B*	5.00	LM7525N	.90
LM318CN	1.50	NE561B*	5.00	LM7535N	1.25
LM319N	1.30	NE562B*	5.00	8038B*	4.95
LM319D	9.00	NE565H*	.99	LM75450	.49
LM320K-5	1.35	NE565N*	1.25	75451CN	.39
LM320K-5.2	1.35	NE566CN*	1.95	75452CN	.39
LM320K-12	1.35	NE567H*	1.25	75453CN	.39
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LM340T-8*	1.75	LM747N	.79	CA3082	2.00
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LM340T-12	1.75	LM748N	.39	CA3086	.59
LM340T-15	1.75	LM1303N	.90	CA3089	3.25
LM340T-24	1.75	LM1304N	1.19	CA3091	8.25
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Includes monolithic function generator IC, PC board, and assembly instruction manual.

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Same as XR 2206KA above and includes external components for PC board.

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This watch is manufactured by National Semiconductor. It provides 5 functions: hours, minutes, seconds, date, A.M. indicator dot. Accuracy is assured to 5 seconds per month by precision quartz crystal. If something should go wrong with the watch, repair is assured within 48 hours after it is received. Complete with steel black leather band.

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$29.95
NOT A KIT

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R - RED
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Y - YELLOW
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125" dia.

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XC209Y	4/$1
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.185" dia.

XC526R	5/$1
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.190" dia.

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XC111Y	4/$1
XC111O	4/$1

.200" dia.

XC22R	5/$1
XC22G	4/$1
XC22Y	4/$1
XC22O	4/$1

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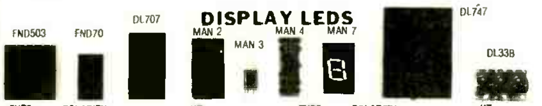
XC556O	4/$1

.085" dia.

MV50
085" dia. Micro red led
6/$1

DISPLAY LEDS



TYPE	POLARITY	HT		TYPE	POLARITY	HT	
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MAN 3	COMMON CATHODE	.125	.39	DL747	COMMON ANODE	.600	2.25
MAN 4	COMMON CATHODE	.187	1.95	DL750	COMMON CATHODE	.600	2.49
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MAN 7G	COMMON ANODE-GREEN	.300	2.50	FND70	COMMON CATHODE	.250	.50
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14 pin	.20	.19	.18	28 pin	.45	.44	.43
16 pin	.22	.21	.20	36 pin	.60	.59	.58
18 pin	.29	.28	.27	40 pin	.63	.62	.61
22 pin	.37	.36	.35				

SOLDERTAIL STANDARD (TIN)

14 pin	$.27	.25	.24	28 pin	$.99	.90	.81
16 pin	.30	.27	.25	36 pin	1.39	1.26	1.15
18 pin	.35	.32	.30	40 pin	1.59	1.45	1.30
24 pin	.49	.45	.42				

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	.27	.24	24 pin	$.70	.63	.57
14 pin	.35	.32	.29	28 pin	1.10	1.00	.90
16 pin	.38	.35	.32	36 pin	1.75	1.40	1.26
18 pin	.52	.47	.43	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	.41	.37	24 pin	$1.05	.95	.85
14 pin	.39	.38	.37	28 pin	1.40	1.25	1.10
16 pin	.43	.42	.41	36 pin	1.59	1.45	1.30
18 pin	.75	.68	.62	40 pin	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.

ALL OTHER RESISTORS FROM 2.2 OHMS - 5.6M AVAILABLE IN MULTIPLES OF 5 ea. 5-25 PCS. .05 ea. 30-95 PCS. .04 ea. 100-495 PCS. .03 ea. 500-995 .0275 ea.

14 PCS. POTENTIOMETER ASSORTMENTS

ASST. A 2 ea. 10 OHM-20 OHM-50 OHM-100 OHM-200 OHM-250 OHM-500 OHM
ASST. B 2 ea. 1K, 2K, 2.5K, 10K, 20K, 25K, 50K
ASST. C 2 ea. 50K, 100K, 200K, 250K, 500K, 1M, 2M

$9.95 Per Asst.

Each assortment contains 14 pcs of 10 turn pots. All pots are available in single unit quantities $.99 ea.

Astrisk Denotes Items On Special For This Month
Satisfaction Guaranteed. $5.00 Min. Order. U.S. Funds.
California Residents — Add 6% Sales Tax — Data Sheets 25c each
Send a 13c Stamp (postage) for a FREE 1976 Catalog

JAMES

1021 HOWARD ST., SAN CARLOS, CA. 94070
PHONE ORDERS — (415) 592-8097

74LS00 TTL

74LS00	.39	74LS55	.39	74LS151	1.55
74LS02	.39	74LS73	.65	74LS153	1.89
74LS03	.39	74LS74	.65	74LS157	1.55
74LS04	.45	74LS75	.79	74LS162	2.25
74LS05	.45	74LS76	.65	74LS163	2.25
74LS08	.39	74LS83	2.19	74LS164	2.25
74LS10	.39	74LS86	.65	74LS181	3.69
74LS13	.79	74LS90	1.25	74LS190	2.85
74LS14	2.19	74LS92	1.25	74LS191	2.85
74LS20	.39	74LS93	1.25	74LS192	2.85
74LS26	.49	74LS95	2.19	74LS193	2.85
74LS27	.45	74LS96	1.89	74LS194	2.25
74LS28	.49	74LS107	.65	74LS195	2.25
74LS30	.39	74LS112	.65	74LS257	1.89
74LS32	.45	74LS132	1.55	74LS260	.55
74LS40	.49	74LS136	.65	74LS279	.79
74LS51	.39	74LS138	1.89	74LS670	5.95

DL728
The DL728 is a dual 0.5" common cathode red display. It is ideal for use with clock chips, as segments are already multiplexed. **$2.95**

MINATURE TOGGLE

DPDT				PART	1	2-9	10-29	30-99
	ON	OFF	ON	221	3.06	2.86	1.97	1.78
	ON	NONE	ON	223	2.88	2.26	1.68	1.61
	ON	OFF	ON	121	2.35	1.95	1.43	1.30
	ON	NONE	ON	123	2.05	1.65	1.21	1.10

PUSH BUTTON

SPDT - SERIES PB, PB1

	Model Number	1 Each	2-9	10-29	30-99
Momentary Action Switch — Push to Make Contact, And Push Again To Reserve Action	PB-123	$2.35	$1.95	$1.47	$1.30
Momentary Action Switch — Normally Open or Normally Closed 1 or N.C. contact use terminals 2 & 1, for N.O. 2 & 3; for N.C and N.O. 1, 2 & 3	PB-126	$2.35	$1.95	$1.47	$1.30

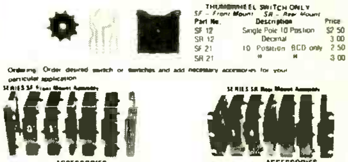
5 AMP RATINGS

THUMBWHEEL SWITCHES

THUMBWHEEL SWITCH ONLY
SF - Front Mount SR - Rear Mount

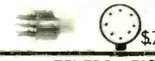
Part No.	Description	Price
SF 10	Single Pole 10 Position	$2.50
SR 12	Decimal	3.00
SF 21	10 Position BCD only	2.50
SR 21		3.00

Ordering: Order desired switch or switches and add necessary accessories for your particular application



Part No.	ACCESSORIES Description	Price	Part No.	ACCESSORIES Description	Price
SF EP	End Plate (Pair)	$.50	SR EP	End Plates (pair)	$.50
SF DP	Divider Plate (each)	.40	SR DP	Divider Plate (each)	.40
SF BB	Blank Body (each)	.40	SR BB	Blank Body (each)	.40
SF HB	Half Body (each)	.40	SR HB	Half Body (each)	.40

8 POSITION ROTARY SWITCH



$.79

These switches are a 7 position, one position open, rotary switch enclosed in a TO-5 can. They have a standard 8 pin configuration and will mount perfectly on printed circuit board.

ZENERS—DIODES—RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
IN746	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
1N965B	15	400m	4/1.00	1N4154	35	10m	12/1.00
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
IN485A	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	IN1186	200 PIV	35 AMP	1.80
1N4003	200 PIV	1 AMP	12/1.00	1N1188	400 PIV	35 AMP	3.00
1N4004	400 PIV	1 AMP	12/1.00				

TRANSISTORS

MPS A05	5/$1.00	PN3567	3/$1.00	PN4249	4/$1.00
MPS A06	5/$1.00	PN3568	4/$1.00	PN4250	4/$1.00
2N2219A	3/$1.00	PN3569	4/$1.00	2N4400	4/$1.00
2N2221	4/$1.00	2N3704	5/$1.00	2N4401	4/$1.00
2N2222A	5/$1.00	2N3705	5/$1.00	2N4402	4/$1.00
2N2369	5/$1.00	2N3706	5/$1.00	2N4403	4/$1.00
2N2369A	4/$1.00	2N3707	5/$1.00	2N4409	5/$1.00
FN2415	5/$1.00	2N3711	5/$1.00	2N5086	4/$1.00
2N2484	4/$1.00	2N3724	$.65	2N5087	4/$1.00
2N2906A	4/$1.00	2N3725	$1.00	2N5088	4/$1.00
2N2907A	5/$1.00	2N3903	5/$1.00	2N5089	4/$1.00
2N2925	5/$1.00	2N3904	4/$1.00	2N5129	5/$1.00
2N3053	2/$1.00	2N3905	4/$1.00	2N5138	5/$1.00
2N3055	$.89	2N3906	4/$1.00	2N5139	5/$1.00
MJE3055	$1.00	2N4013	3/$1.00	2N5209	5/$1.00
MJE2955	$1.25	2N4014	3/$1.00	2N5951	5/$1.00
2N3392	5/$1.00			C106B1SCR	2/$1.00
2N3398	5/$1.00			2N5432	$2.00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
	.05	.04	.03	.001µF	.05	.04	.035
	.05	.04	.03	.0047µF	.05	.04	.035
	.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	.15	.13	.10	1.0 16V	.15	.13	.10
4.7 25V	.16	.14	.12	1.0 25V	.16	.14	.11
10 25V	.15	.13	.10	1.0 50V	.16	.14	.11
10 50V	.16	.14	.12	4.7 16V	.15	.13	.10
22 25V	.17	.15	.12	4.7 25V	.15	.13	.10
22 50V	.24	.20	.18	4.7 50V	.16	.14	.11
47 25V	.19	.17	.15	10 16V	.14	.12	.09
47 50V	.25	.21	.19	10 25V	.15	.13	.10
100 25V	.24	.20	.18	10 50V	.16	.14	.12
100 50V	.35	.30	.28	47 50V	.24	.21	.19
220 25V	.32	.28	.25	100 16V	.19	.15	.14
220 50V	.45	.41	.38	100 25V	.24	.20	.18
470 25V	.33	.29	.27	100 50V	.35	.30	.28
1000 16V	.55	.50	.45	220 16V	.23	.17	.16
2200 16V	.70	.62	.55	470 25V	.31	.28	.26

Circle 98 on reader service card

CRYSTALS
THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33/U	$4.95
CY2A	2.000 MHz	HC33/U	$4.95
CY3A	4.000 MHz	HC18/U	$4.95
CY7A	5.000 MHz	HC18/U	$4.95
CY12A	10.000 MHz	HC18/U	$4.95
CY14A	14.31818 MHz	HC18U	$4.95
CY19A	18.000 MHz	HC18/U	$4.95
CY22A	20.000 MHz	HC18/U	$4.95
CY30B	32.000 MHz	HC18/U	$4.95

CLOCK CHIPS — CALCULATOR CHIPS

MM5309	6 Digit, BCD Outputs, Reset PIN.	$5.95
MM5311	6 Digit, BCD Outputs, 12 or 24 Hour	4.95
MM5312	4 Digit, BCD Outputs, 1 PPS Output	4.95
MM5313	6 Digit, BCD Outputs, 1PPS Output	4.95
MM5314	6 Digit, 12 or 24 Hour, 50 or 60 Hz	4.95
MM5316	4 Digit, Alarm, 1PPS Output	6.95
MM5318	Video Clock Chip, For Use With MM5841	9.95
CT7001	6 Digit, Calander, Alarm, 12 or 24 Hour	6.95

CALCULATOR CHIPS

MM5725	6 Digit, Four Function, Less Decimal	$2.95
MM5738	8 Digit, 5 Function, +, =, ×, ÷, %	2.95
MM5739	8 Digit, 4 Function, Floating Decimal	2.95
CT5001	12 Digit, 4 Function	3.95
CT5005	12 Digit, 4 Function with Memory	5.95
CT5030	12 Digit, 4 Function and %	7.95

MISC. MOS

MM5320	TV Camera Sync. Generator	$19.95
MM5330	4½ Digit DVM Chip	9.95
MM5369	60 Hz Timebase Circuit From 3.58 MHz	5.00
MM5841	Video Generator For MM5318	18.00
MC1408-L7	7 Bit Digital to Analog Converter	9.95
MK5007	4 Decade Counter with Latches	10.95
LD110/LD111	3½ Digit DVM Chip Set	25.00
95H90	100 MHz ÷ 10 Counter For Prescalers	13.95

Filament Transformers

FILAMENT single secondary 50-60 Hz

Type No.	Secondary Volts	Amps	Primary Volts	Test Voltage	Price
F-7X	6.3 CT	1.2	115	1500	5.10
F-13X	6.3	6	115	1500	3.80
F-14X	6.3 CT	1.2	115	Pri 1500 Sec 2500	4.15
F-16X	6.3 CT	3	115	Pri 1500 Sec 2500	5.35
F-25X	12.6 CT	1.5	115	1500	5.25
F-40X	26.8 CT	1	115	1500	7.00
F-45X	24.0 CT	1	115	1500	7.50
F-54X	35.0 CT	1.5	115	1500	8.50

Add 50¢ Postage

VECTOR WIRING PENCIL

Vector Wiring Pencil P173 consists of a hand held featherweight (under one ounce) tool which is used to guide and wrap insulated wire, fed off a self-contained replaceable bobbin, onto component leads or terminals installed on pre-punched "P" Pattern Vectorbord* Connections between the wrapped wire and component leads, pads or terminals are made by soldering. Complete with 250 FT of red wire. **$9.50**

REPLACEMENT WIRE — BOBBINS FOR WIRING PENCIL

W36-3-A-Pkg. 3	250 ft. 36 AWG GREEN	$2.40
W36-3-B-Pkg. 3	250 ft. 36 AWG RED	$2.40
W36-3-C-Pkg. 3	250 ft. 36 AWG CLEAR	$2.40
W36-3-D-Pkg. 3	250 ft. 36 AWG BLUE	$2.40

1/16 VECTOR BOARD

0.1" Hole Spacing P-Pattern

	Part No	L	W	Price 1-19	Price 20-49
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 02XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062	4.50	6.50	2.07	1.86
	84P44 062	4.50	8.50	2.56	2.31
	169P44 062	4.50	17.00	5.04	4.53
	169P84 062	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062C1	4.50	17.00	6.80	6.12

VECTOR TERMINALS

Series	Part No. Finish Gold	Part No. Finish Tinned	Post Size	25 pcs Gold	25 pcs Tin	50 pcs Gold	50 pcs Tin
T44	T44-1	T44	.025" sq	1.50 lot	1.00 lot	2.75 lot	1.75 lot
T46	T46-1	T46	.028 sq	1.75 lot	1.25 lot	3.00 lot	2.25 lot
T49	T49A	T49	.025 sq	1.75 lot	1.25 lot	3.10 lot	2.25 lot

T42-1 PKG 100 Terminals $3.50 C $13.00M

DIP SWITCH

These switches feature seven SPST slide switches in a molded dip. They are ideally suited for microprocessor applications. $1.95

100 PER STRIP

MOLEX PINS

Intended for use as an inexpensive substitute for IC sockets. Also perfect for use as board connectors and in subassemblies.

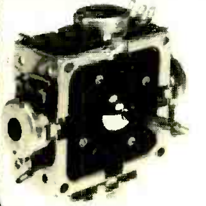
SPECIAL — 100/1.49 — 1000/12.00

64 KEY KEYBOARD

The ideal item for the real homebrew computer hobbyist. This keyboard features 64 unencoded SPST keys, unattached to any kind of P.C.B. A very solid molded plastic 13" x 4" base suits most applications.

$24.95 ea.

JOYSTICK



These joysticks feature four 100K potentiometers, that vary resistance proportional to the angle of the stick. Sturdy metal construction with plastics components only at the movable joint. Perfect for electronic games and instrumentation.

$9.95 ea.

MICROPROCESSOR COMPONENTS

8080 SUPPORT DEVICES

8080A $37.95

8212	8 BIT INPUT/OUTPUT PORT FOR 8080	$ 5.95
8224	CLOCK GENERATOR AND DRIVER FOR 8080	12.95
8228	SYSTEM CONTROLLER AND BUS DRIVER FOR 8080	12.95

8080 $24.95

CPU'S			RAM'S			
8008	8 BIT CPU	$19.95	2601	256 x 1	FAST	5.00
8080	Super 8008	24.95	1101	256 x 1	Static	$ 2.25
8080A	Super 8008	37.95	1103	102 x 1	Dynamic	2.95
SR'S			2101	256 x 1	Static	6.95
2504	1024 Dynamic	$ 9.00	2102	1024 x 1	Static	1.95
2518	Hex 32 BIT	7.00	2107	4096 x 1	Dynamic	19.95
2519	Hex 40 BIT	4.00	2111	256 x 4	Static	7.95
2524	512 Dynamic	2.95	7010	1024 x 1	MNOS	29.95
2525	1024 Dynamic	6.00	7489	16 x 4	Static	2.49
2527	Dual 256 BIT	3.95	8101	256 x 4	Static	7.95
2529	Dual 512 BIT	4.00	8111	256 x 4	Static	7.95
2532	Quad 80 BIT	3.95	8599	16 x 4	Static	3.49
2533	1024 Static	7.95	91L02	1024 x 1	Static	2.49
3341	Fifo	6.95	74200	256 x 1	Static	6.95
74LS670	16 x 4 Reg.	3.95	93410	256 x 1	Static	1.75
UART'S			**PROMS**			
AY-5-1013	30K Baud	$ 6.95	1702A	2048	Famos	$15.95
ROM'S			5203	2048	Famos	14.95
2513	Char. Gen.	$11.00	82S23	32 x 8	Open C	5.00
7488	Random Bits	3.50	82S123	32 x 8	Tristate	5.00
2516	Char. Gen.	13.00	74S287	1024	Static	7.95

2K RAM SPECIAL

MM5262 Fully decoded 2Kx1 dynamic RAM. All inputs except clocks are TTL compatible. Provides a 635 ns minimum access time, and requires, a +5, +8.5, and −15V power supply. Low power provides non volatile memory using battery back up.

$0.99 ea. (0.05 cents per bit)

Special Requested Items

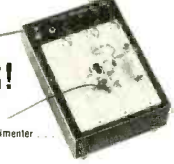
RC4194	Dual Track V Reg	$ 5.95	N8T97	$ 2.00	MK5007	$10.95	MC4044	$ 4.50
RC4195	±15V Track Reg	3.25	4024P	2.25	8263	5.95	LM3909	1.25
F9368	Decoder	3.95	DM8130	3.25	8267	2.75	MM5320	19.95
LD110/111	DVM Chip Set	25.00	9322	1.30	8288	1.15	4072AE	.45
CA3130	Super CMOS Op Amp	1.49	MC14016	.56	8826	3.00	7422	1.50
MC1408L7	D/A	9.95	2525	6.00	8880	.80	7497	4.00
F3341	FIFO	6.95	2527	3.95	4511AE	2.50	74186	5.00
MM5841	Character Gen.	18.00	CD4518	2.50	XR4136	2.00	74279	.90
AY5-9100	Push Button Dialer	17.50	MM5309	5.95	4566AE	3.00		

WE'LL BE HAPPY TO QUOTE ON YOUR SPECIAL PARTS —

Continental Specialties

PROTO POWER!

POWER FOR THE PROFESSIONAL



Made in USA
Patents Pending

$75 Proto Board 203

Breadboard Prototesting with 5 Volt 1 AMP Regulated Power Supply Included!

A total ready-to-use power breadboard prototest device with a built-in regulated, short-proof power supply. Just plug-in and start building! 2 extra floating 5 way binding posts for external signals. Self-contained with power switch indicator lamp and power fuse. 24 14 pin DIP capacity. Attractive two tone quality case. All metal construction. 9¾" L x 6½" W x 2¾" H. 5 lbs. Order today!

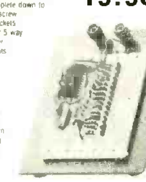
For the economy-minded experimenter . . .

NEW

Proto Board 100

19.95

Here's a low cost, big 10 IC capacity breadboard kit with all the quality of QT Sockets and the best of the Proto-Board series . . . complete down to the last nut, bolt and screw. Includes 2 QT 35S Sockets, 1 QT 35B Bus Strip, 2 5 way binding posts, 4 rubber feet, screws, nuts, bolts and easy assembly instructions.

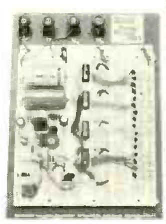


THE MINI-BREADBOARD BUDGET KIT

Proto Board 101. Compact, inexpensive 10-14 pin DIP capacity 5.8" long x 4.5" wide **29.95**

Proto Board 102. Compact 12-14 pin DIP capacity 7" x 4½" **39.95**

Proto Board 103. 2,250 solderless tie points, (4) 5-way binding posts 24-14 pin DIP capacity 9" x 6" **59.95**

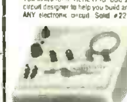


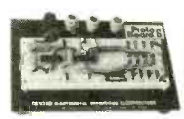
Proto Board 104. Huge 3,060 solderless tie points, (4) 5-way binding posts 32 14 pin DIP capacity 9½" long x 8" wide **79.95**

COMPLETE KIT

DESIGN MATE 1

CIRCUIT DESIGNER
You asked for it. HERE IT IS! CSC's basic circuit designer to help you build and test ANY electronic circuit. Solid #22 AWG wire interconnects any discreet component without solder. Resistors, Transistors, Linear/Digital ICs in TO-5 DIP packages (from 8-40 pins) and more. Components fit directly into Sockets and Bus strips instantly and easily. Plus DESIGN MATE ONE's (DM-1) variable regulated power supply gives 5-15VDC up to 600ma (9 watts). Now that's design flexibility for you! You can even monitor the DM-1's internal power supply or external circuits thanks to the built-in 0-15V voltmeter. If you're into electronics, DM-1 is a must for your laboratory. It comes to you completely wired, tested and ready to use for only $49.95

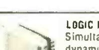


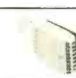


PROTO BOARD 6
The PB-6 lets the user test and build circuits without soldering or patch cords . . . all interconnections between components are made with common #22 AWG hook up wire. This quality breadboarding kit includes 830 component tie points at less than 2.5 cents each. It measures 6" long by 4" wide. Designed specifly to Breadboard Microprocessor Circuits. $15.95

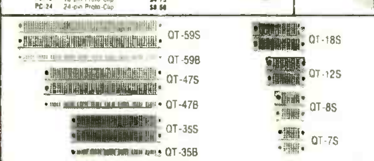
Now trace signals or troubleshoot fast. Inject signals or wire unused circuits into existing boards. Scope probes, test leads lock onto Dynagrip inset. Plastic construction — no springs or pivots. Thousands of operations. Narrow throat for high density PC boards.

PC 14	14-pin Proto-Clip	$4.50 ea
PC 16	16-pin Proto Clip	$4.75
PC 24	24-pin Proto-Clip	$8.50





LOGIC MONITOR
Simultaneously displays static and dynamic logic states of DTL, TTL, HTL or CMOS DIP ICs
Pocket size $84.95.



QT Proto Strips

QT type	#holes	price
QT-59S	590	12.50
QT-59B	bus strip	2.50
QT-47S	470	10.00
QT-47B	bus strip	2.25
QT-35S	350	8.50
QT-35B	bus strip	2.00
QT-18S	180	4.75
QT-12S	120	3.75
QT-8S	80	3.25
QT-7S	70	3.00

DIGITAL CLOCK KIT — 3½ INCH DIGITS

This clock features big 3½" high digits for viewing in offices, auditoriums, etc. Each digit is formed by 31 bright 0.2" LED's. The clock operates from 117 VAC, has either 12 or 24 hr. operation. The 6 digit version is 27" x 3½" x 1½" and the 4 digit is 18" x 3½" x 1½". Kits come complete with all components, case and transformer.
Specify 12 Or 24 Hr. When Ordering

4 DIGIT KIT $49.95	4 DIGIT ASSEMBLED $59.95
6 DIGIT KIT $69.95	6 DIGIT ASSEMBLED $79.95

Satisfaction Guaranteed. $5.00 Min. Order. U.S. Funds.
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AUTOTEL ™
WARNING LIGHTS ARE NOT ENOUGH

AN AUDIBLE ALARM INDICATING POTENTIAL ENGINE DAMAGE

AUTOTEL is an effecient (15 ma current standby) device by which every owner of an automobile, truck or vehicle equipped with indicator lights for temperature and oil pressure can be assured of a reliable warning before an impending failure.

AUTOTEL, by means of an audible signal 70 db pulsing) immediately forewarns the vehicle operator of a malfunction or failure, allowing time to correct and prevent major engine failures. It is programmed so there is no sound during normal operating conditions.

AUTOTEL features CMOS circuitry, packaged in a 2½" sq. x ⅞" case. The kit comes complete with all components, hardware and case to hook directly into your car's warning light system.

$14.95 Assembled $9.95 Per Kit

IMK 3½ DIGIT DVM KIT

This 0-2 VDC .05 per cent digital voltmeter features the Motorola 3½ digit DVM chip set. It has a .4" LED display and operates from a single +5V power supply. The unit is provided complete with an injection molded black plastic case complete with Bezel. An optional power supply is available which fits into the same case as the 0-2V DVM allowing 117 VAC operation.

A. 0-2V DVM with Case	$49.95
B. 5V Power Supply	$14.95

JE700 CLOCK

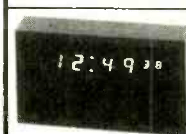
12 or 24 Hour
115 VAC

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.

$19.95

Liquid Crystal Temperature Display
Six Digit Light Emitting Diode Display
DL 33 Display

This clock makes an attractive addition to any desk. It has an extruded, black anodized aluminum case. It displays hours, minutes, and seconds with .11 inch displays, and comes complete with a liquid crystal thermometer. It operates off 115 VAC at 50 or 60 Hz. **$24.95**



This large digit clock (.6" hours & minutes, .3" seconds) features the MM5314 clock chip. It operates from 117 VAC, and will operate in either a 12 or 24 hour mode. The clock is complete with a walnut grain case, and has fast set, slow set, and hold time set features.

KIT - ALL COMPONENTS & CASE $34.95
WIRED & ASSEMBLED $39.95

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) - 1 (LOW) - o (PULSE) - P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.

$9.95 Per Kit
printed circuit board

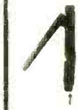
ELECTRONIC TOOLS

QUICK CHARGE CORDLESS SOLDERING IRON

This versatile tool weighs only six ounces, and can be operated without power anywhere. It gives the performance of a 50 watt iron with a tip temperature of over 700°F. It will solder an average of 160 3 twist 22 guage wire joints on one charge. It has a charge time of 4 hours, and heats in 5 seconds. Complete with recharger.

$29.95 EACH

NIBBLING TOOL



This Nibbling Tool is perfect for cutting, trimming or notching sheet metal up to 18 guage. It operates like a punch and die and also works well on aluminum or plastic up to 1/16" thick. We feel that this tool can be a real time-saver for our customers when working on chassis, printed circuit boards and prototype model parts.

Nibbling Tool	$6.95
Replacement Punch	$3.75 Each

DIAGONAL CUTTER

½" Semi-Flush Cut Fine Diagonal

4 in. long. Most popular cutter on assembly lines, cuts at extreme tip. Semi-flush cut. For fine wire work only. No 20 soft copper wire and smaller. Width across joint 13/32", thru joint 7/32", tip length 1/2".

Light Blue Handle
A97MS **$8.50 ea.**

SOLDER

Part No.	Wire Dia	Price/1 lb Spool
SN60	.031	6.85/Spool
SN60	.040	6.50/Spool

Solder Wick

STOCK	WIDTH	PRICE
40-1	.025	$2.00 ea
40-2	.050	2.00 ea
40-3	.075	2.00 ea

DL727

One of our best readouts .5 in. high, 20mA per segment. Common anode.
$3.75

HP7730

.33 in. high red very bright 25mA per seg. Common anode.
$1.20

FND 807 ANODE / FND 800 CATHODE

.8 in. High. The Best on the market. Ideal for large readout application.
$4.95

.25 in high orange digit. 160v dc. Free socket.
$2.50

New .5 in. display by Fairchild. Common Cathode.

FND503

$1.60
5/$7.50

LEDS

Mini red .12
Jumbo red .15
Jumbo green .20
Jumbo yellow .25

BURROUGHS 12 DIGIT

DL33

If you like an array of displays, we have it. Common cathode.
$1.45

TI

Fully multiplexed common cathode. Goldplated. Idea for mini 6 digit clock.
$1.30

4 & 6 DIGIT PC BOARDS

PC Board for 4 digit display FND 800 or 807	$2.75
PC Board for 6 digit display FND 800 or 807	$3.50
PC Board for 4 digit display MAN series or DL707	$1.75
PC Board for 6 digit display MAN series or DL707	$2.25
PC Board for 4 digit display FND503	$2.00
PC Board for 6 digit display FND503	$3.00
PC Board for 4 digit display DL747	$2.50
PC Board for 6 digit display DL747	$3.00
PC Board for 4 digit display DL727	$2.25
PC Board for 6 digit display DL727	$3.00
PC Board for 4 digit display FND70	$1.75

All PC display boards are multiplexed for adding additional digits.

$$$ SAVE! 4-DIGIT ALARM CLOCK

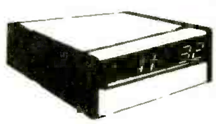
KIT NO.1 $13.95 (with PC Board)

FEATURES:

Direct drive display outputs, * Current control regulation on chip, * Low power brightness control on chip, * RFI eliminating slowup circuitry, * Sleep Radio feature, * 24 hr. snooze alarm, * Independent digit setting, * Non multiplexed output circuitry. 12VAC CT 1/2 amp transformer for Kit No. 1
$2.00

***KIT NO. 2**

Complete kit with components, PC Board, Transformer, wood grain case and filter for display window. Includes .25 in. readouts.
$21.50



KIT NO. 3

Complete kit with components, PC Board, Transformer, wood grain case, and filter for display window. Includes .5 inch readouts.
$22.50

* Components for Kit No. 2 or Kit No. 3 sleep radio feature, add $.95

THE KING OF ALTAJ INTRODUCING: TANYA

(60 Hz. Crystal Time Base)

ADDITIONAL FEATURES:
1.) Low Power Consumption
2.) Directly Interfaces with King MOS Clock Chip.
3.) 60 Hz output with crystal time base accuracy
4.) Ideal for Cars, Boats, & Campers.

Kit Includes All Components, P.C. Board, and Instructions for Interfacing with 'THE KING' 6-Digit Alarm Clock.

DELILA APPLIANCE STARTER $9.95

(Example) Set your alarm for 7: a.m., set timer for 15 min. At exactly 7: a.m., the appliance will start; at 7:15 your clock alarm will wake you.

Kit includes all components, PC Board and instructions for interfacing with THE KING 6-digit alarm clock. Addition Number 2

FATIMA 4-DIGIT TEMP. KIT $19.95

Features 4-digit temperature display; farenheit or centigrade; complete C-Mos application; uses 7002 4-digit counter.

Kit includes all components, PC Board and instructions for interfacing with THE KING 6-digit alarm clock. Addition Number 1

THE KING $23.50

6-DIGIT ALARM CLOCK

THE KING FEATURES:
1) 6 digit, 12 hr. 60 cycle or 24 hr. 50 cycle alarm clock.
2) Time sharing capability for display of additional information
3) Single 12v. supply and a minimum of interface components.
4) AM-PM and automatic power failure indications.
5) 10 minute snooze
6) Intensity control of LEDs.

Kit No. 70250-1R (Red readouts)
Kit No. 70250-1G (Green readouts)
Kit No. 70250-1Y (Yellow readouts)
Kit No. 70250-2R (DL727 readouts) $28.50
Kit No. 70250-3R (FND807 readouts) $29.50

All kits include components, PC Boards; Transformer, case, and construction manual.

TTL

7400	.21	7447	.94	74151	.80
7402	.21	7448	.94	74153	.94
7404	.21	7453	.21	74154	1.00
7406	.29	7473	.42	74161	1.04
7408	.21	7474	.42	74163	1.24
7410	.21	7475	.70	74164	1.94
7413	.54	7476	.44	74165	1.54
7420	.21	7483	.90	74174	1.34
7427	.29	7490	.74	74175	1.44
7430	.21	7492	.80	74181	2.80
7437	.44	7493	.80	74192	1.30
7438	.39	7495	.80	74193	1.30
7440	.21	7496	.80	74195	.84
7442	.74	74121	.43	74197	.84
		74123	.80		

CMOS

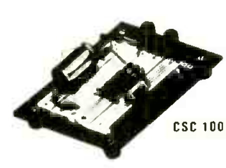
4000	.24	4018	1.49	4035	1.39
4001	.24	4019	.59	4037	4.50
4002	.24	4020	1.59	4040	1.59
4006	1.49	4021	1.49	4041	.89
4007	.24	4022	1.19	4042	.79
4008	1.15	4023	.24	4043	.80
4009	.59	4024	.99	4044	.59
4010	.55	4025	.24	4047	.59
4011	.24	4026	1.49	4049	.59
4012	.24	4027	.59	4050	.59
4013	.59	4028	.99	4066	.99
4014	1.49	4029	1.39	4077	.39
4015	1.19	4030	.49	74C92	.29
4016	.59	4032	.24	74C04	.29
4017	1.29	4033	1.49	74C107	1.29
		4034	3.25		

LSI INTEGRATION

MM5316	4-6 digit alarm clock 40 pin dip w/spec	$ 4.25
7002	4 digit counter/latch decoder; 7 segment and BCD outputs. 28 pin dip w/spec	$12.50
7005	4 digit counter/latch decoder; 7 segment output only. 24 pin dip w/spec	$ 9.50
7007	4 digit counter/latch decoder with BCD output only. 16 pin dip w/spec	$ 7.00
70250	4-6 digit alarm clock 28 pin dip w/spec	$ 5.50
PC Board for 70250		$ 4.25
70380	4 digit non-multiplexed radio alarm clock featuring direct drive display output 40 pin dip w/spec	$3.50
PC Board for 70380		$ 3.75
8008	8 bit parallel CPU	$19.50
2102	1K static RAM for 8008	$ 2.25
MM5203	2K UV eraseable PROM	$12.25
75491	segment driver	$ 0.35
75492	digit driver	$ 0.45
7020	6 function calculator chip with direct segment drive. 8 digit	$ 2.25

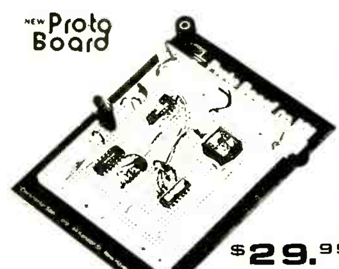
CONTINENTAL SPECIALTIES

THE ONE SOURCE FOR EVERYTHING NEW IN BREAD BOARDING



CSC 100

NEW Proto Board



$29.95

CSC 101

Write for our FREE Brochure

GE TRANSISTOR ASSORTMENT

T098 cased Darling., SCRs, NPN,PNP, ect.
50 for $0.95
100 for $1.75
300 for $5.00

TTL BOARDS

MEMDREX computer boards with TTL's Diodes and Transistors, etc.

5 Boards containing 150-250 IC's **$3.95**

LINEARS

555 Timer Mini dip	0.65
8038 Functional generator	4.25
RCA 3043 FM If, Aud Preamp.	1.20
565 Phase Lock Loop	1.95
567V Tone Decoder	1.50
LM723 Pos. Volt. Reg.	0.55
LM309 5v. Lamp Reg'	1.10
LM380 2w. Audio Amp. 8 pin dip	1.00
LM741 Operational Amp.	0.25

TRANSISTORS-DIODES

RCA200V 115W T05 NPN		1.25
GE D40C1 NPN Darl.		0.25
2N4443SCR 400v8A T0220		0.65
2N2222 NPN Gen Ampl.		0.20
2N3904 NPN Driver		0.15
2N3906 PNP Compl. 2N3904		0.15
2N4400 NPN Low level noise		0.20
2N5401 PNP Nixie driver		0.25
1N4004	400PIV	15 for 1.00
1N4007	4000PIV	10 for 1.00
1N746	3.3 Zen.	4 for 1.00
1N4148	Switch	20 for 1.00

GOT A CASE? HERE'S THE CURE!

Ideal for Frequency counter case function generator, etc. Overall height 4", length 12", width 7 1/2".

(Includes top, bottom, and hardware.)

$5.95

MASTER II

LIGHTS MUSIC 60 WATT COLOR ORGAN

Completely self contained unit with 120 volt power cord included.
$1.50

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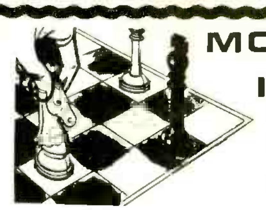
Power Supply Kit: 5 Volt 1 Amp. Req
Line regulation .005%
Load regulation 50mV

Kit includes Components, PC Board, Transf., Fuse, Pilot Light
Nothing else to buy: **$5.50**

MSI

Wise move

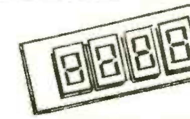


MODULAR SCIENTIFIC INSTRUMENTATION

Now you can build some of the most advanced digital electronic instruments with our new series of low-cost modular scientific kits. These kits will expand the range of your electronic applications enormously--and all at a surprisingly low cost.

The heart of the system is our 4-digit Decade Counter (Kit 012) which features a full 4-digit LED readout (you choose the size best suited to your application). Combine this with a 5-volt regulated power supply (Kit 030) and you have the basis of a wide range of sophisticated electronic instruments, including:

A Digital Voltmeter (DVM) .. Kit 012 + Kit 030 + Kit 017
Frequency Counter................ Kit 012 + Kit 030 + Kit 016 +Time Base
RPM Counter......................... Kit 012 + Kit 030 + Kit 020 + Kit 018



4-DIGIT DECADE COUNTER KIT

$19.95 KIT 012

One chip 4 digit decade counter kit, with both 7 segment and BCD output.

1. Chip features internal oscillator for scanning speed.
2. Overflow and count extent outputs.
3. Transfer, reset, count, blanking and true compliment control inputs.
4. PC Boards can be cascaded to 8-12-16, etc. digits.
5. Kit includes counter chip, drive circuit for 4 cathode type displays and PC Board. (For readout board see (FND70-FND503)

KIT 016 FREQ. COUNTER

Features FET input front end with trigger circuit for measuring complex waveforms. Measures from 0.1Hz to 10MHz when used with Kit 015 or 019. Measures from .01Hz to 35MHz when used with Kit 013 and 014.
$24.50

KIT 017 DVM

1.999V as basic, with polarity indication. 1 M ohm input impedance and accuracy to 1% if properly adjusted
$13.50

KIT 020 RPM COUNTER

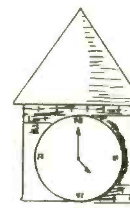
Counts from 1 to 100,000 RPM. RPM counter kit contains components and PC board.
$8.95

KIT 030 POWER SUPPLY

*Input voltage: 25V max. *Output current: 1 amp max. *Load regulation: 50mV. *Output voltage: 5V. *Line regulation: .01%. (requires 8-20V transformer)
$4.55

(Contains all parts except transformer)

TIME BASES



1 Mhz crystal chain time base divider. Outputs; 1Mhz-100Khz-10Khz-1Khz-100Hz-10Hz-1Hz-0.1Hz. Accuracy better than .005% with proper adjustment.

Kit 013 complete CMos with PC board $15.75
Buffer Circuit for TTL Interfacing

Kit 014 Same as Kit 013, but with TTL......... $13.75

Kit 015 50Hz or 60Hz chain time base using line frequence as reference. Accuracy 0.1-0.05%. Outputs 10Hz-1Hz-0.1Hz. Complete with CMos shaping circuit and PC Board.. $9.75

Kit 019 Same as Kit 015, but with TTL and 60Hz only.. $7.75

Kit 018 60Hz chain time base using line frequence for Kit 020 RPM counter.

*Outputs: .6 sec. = 100th of RPM
6 sec.= 10th of RPM
60 sec. = full revolution

$9.75

MORE TO COME

Watch this space in future issues for additional kits, including Multimeter, Timer, Capacitance Meter, Thermometer and many more. With our kits and your imagination, you'll find dozens of new and exciting applications.

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Send for your membership card to the Modular Scientific Instrumentation Club and receive a **big 10% off** on future purchases of M.S.I. kits. Send $3.00 with your name and address. We will promptly send your very own registered membership card. Don't miss out on the savings. Write now.

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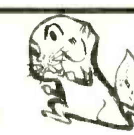

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Same day shipment
First line parts only. Factory tested. Guaranteed money back. Quality IC's and other components at factory prices.

INTEGRATED CIRCUITS

7400 TTL

SN7400N	17
SN7404N	19
SN7408N	23
SN7410N	17
SN7416N	39
SN7420N	17
SN7430N	17
SN7438N	37
SN7440N	17
SN7447N	78
SN7450N	17
SN7473N	36
SN7474N	39
SN7475N	69
SN7489N	3 00
SN7490N	45
SN7492N	60
SN74107N	39
SN74121N	49
SN74123N	59
SN74145N	89
SN74150N	95
SN74154N	1 10
SN74157N	1 15
SN74161N	1 35
SN74174N	1 40
SN74175N	1 10
SN74181N	3 55
SN74190N	1 25
SN74193N	1 15
SN74198N	2 20
SN74251N	2 50
SN74298N	1 65

74LS00 TTL

SN74LS00N	34
SN74LS04N	39
SN74LS08N	39
SN74LS10N	39
SN74LS20N	34
SN74LS38N	39
SN74LS74N	59
SN74LS75N	75
SN74LS90N	1 10
SN74LS93N	1 10
SN74LS95N	1 89
SN74LS107N	52
SN74LS132N	1 50
SN74LS151N	1 28
SN74LS157N	1 40
SN74LS160N	2 05
SN74LS170N	2 85
SN74LS192N	2 60
SN74LS197N	2 00
SN74LS258N	2 20
SN74LS290N	2 00
SN74LS670N	3 50

LINEAR

CA3018	1 00
CA3026	1 00
CA3045	90
CA3046	95
CA3047	90
CA3054	1 00
CA3082	1 90
CA3089	2 25
LM301AN	35
LM301AH	35
LM307N	35
LM308N	89
LM309K	1 25
LM311H	90
LM339N	1 55
LM350N	1 00
LM351N	60
LM380N	1 25
LM710N	65
LM723N	44
LM733N	89
LM741N	35
LM1303N	82
LM2111N	1 95
LM3900N	55
MC1458V	59
NE540L	5 00
NE550N	65
NE553B	2 30
NE555V	43
NE556A	1 00
NE565A	1 95
NE566V	1.85
NE567V	1 75
SN75450CN	47
SN75451CN	39
SN75452CN	39
SN75453CN	37
SN75454CN	37

CMOS

CD34001	42
CD4001	25
CD4011	.25
CD4012	25
CD4013	75
CD4016	50
CD4017	2 00
CD4020	2 30
CD4027	55
CD4030	55
CD4049	62
CD4050	62
CD4071	40
CD4072	40
CD4082	45
CD4511	2 20
CD40192	3 00

INTERFACE

N8T25V	3 20
N8T26V	2 75
N8T28B	2 75
N8T80A	2 75
N8T90A	2 75
N8T97B	2 00

DISPLAY LEDS

MAN1	CA	270	1 80
MAN3	CC	125	30
MAN4	CC	187	1 95
MAN7	CA	300	1 35
MAN72	CA	300	1 35
MAN74	CC	300	1 35
DL707	CA	300	1 35
DL727	CA	500	2 55
DL747	CA	600	2 00
FND503	CC	500	1 75
FND510	CA	500	1 75

MOS/MEMORY RAM

2102	2 75
2102-1	2 75
2102-2	2 75
21L02	2 75
2107	18 50
2112-2	7 90

UART

AY5 1013	6 20

A to D CONVERTER

8700CN	16 00

PROM

1702A	13 00
N82S23	2 90
N82S123	2 90
N82S126	4 85

MICRO-PROCESSOR

8080	24 50
8080A	39 50

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Signetics Bipolar
SK3000KT1000 A $234 00 value Just $100 00
INCLUDES
4- 3002 3- 82S114
1- 3001 2- 8T26
1 74S182 1-8T31
6K of Memory

CRYSTALS

1 MHz	4 50
2 MHz	4 50
4 MHz	4 25
5 MHz	4 25
10 MHz	4 25
18 MHz	3 90
20 MHz	3 90
32 MHz	3 90
32768 Hz	8 80

CLOCKS

MM5311	3.60
MM5312	4 80
MM5313	3 60
MM5314	3 30
MM5315	4 00
MM5316	6 35
CT7001	5 80

IC SOCKETS
Solder Tin
Low Profile

PIN	1 UP	PIN	1 UP
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14	18	28	43
16	20	36	58
18	27	40	61
22	35		

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Not a Cheap Clock $17.45
Includes everything except case.
2-PC boards, 6-.50 LED Displays, 5314 clock chip transformer, all components and full instructions.

IC UPDATE MASTER MANUAL
Complete IC data from all Manufacturers. 14,000 cross references. $30.00 complete with quarterly update service. For Domestic Air, add $2.00. Foreign $6.00.

Miles Per Gallon Circuit
As described Jan. 1976 EDN mag
Digital Flow sensor $29.50
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Circle 103 on reader service card

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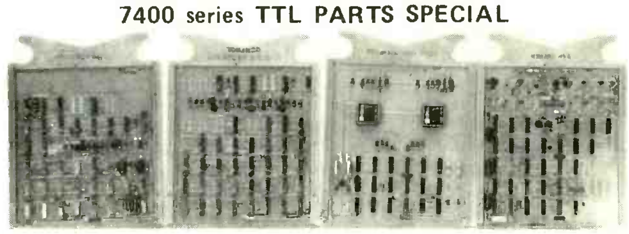
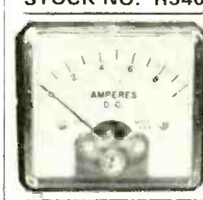
7400 series TTL PARTS SPECIAL



These boards are loaded with 7400 series TTL ICs, which are easily removed for reuse. Shown above is a representative sample of these 7½" x 8" computer boards. We select 2 boards and guarantee at least 60 ICs, but most will have more than 70. These ICs, mostly made by T.I., are gates, counters, flip flops, one-shots, decoders, shift registers, etc. Less than .10 per IC, many of which sell for over $1.00. Shipping weight 2 lbs./set of 2 boards.

STOCK NO. R5409 2 board set $5.00, 5 boards/10.00

1 AMP DC PANEL METER



HOYT 0 to 1 amp DC panel meter. Clear plastic case, 2 3/8" x 2 5/8", mounts in 2¼" dia. hole. Black scale on white face. 1 lb.

STOCK NO. R5408 $4.95 ea, 3/14.00

ELECTRONIC TIMER

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STOCK NO. R6312 $1.75 each, 4/6.00

Send for latest free catalog. Minimum order $5, phone orders welcome: (617) 388-4705. Include sufficient postage; excess will be refunded. BANKAMERICARD & MASTERCHARGE welcome, ALL numbers needed for processing. Minimum charge $15.

Circle 104 on reader service card

STEP-BY-STEP

(continued from page 100)

you'll see only one hum-bar. Same cause; probably an open filter capacitor in the DC power supply. A related symptom is the "floating bar": a horizontal bar about an inch high, which drifts up or down in the picture. It may be light or dark. This is caused by *insufficient* filtering in the DC power supply. The bar comes from the normal pulse of current drawn by the vertical output stage once each field. It gets back into the DC power supply, if the filters don't have enough capacitance to get rid of it, you'll see it in the picture. Cure: check filter capacitors. If necessary, ADD more capacitance! The original design may have been a little short of capacitance to start with.

Other troubles

One problem is actually caused by failure of a part in the DC power supply. However, it fools a lot of us if we forget it! This is the sudden appearance of multiple symptoms; loss of sync or instability; AGC problems, color problems, and so on. What does it is "non-zero impedance to ground" in the filter circuits! One of the electrolytic capacitors has developed high power factor, etc., and isn't doing the job. So, this lets a great many different *signals* show up on the DC power supply lines, and you have the mother and father of all *feedback loops!*

Only one tool in the shop will catch this, and that is the scope. In a normally operating DC power supply, you should see absolutely no signals of any kind on the DC supply lines: scope's vertical gain set high. Whenever you run across multiple-symptom problems, always scope the filter capacitors *first*. If you see any kind of signal, replace them.

Hint: if you find a bad section in a multiple electrolytic, always replace the whole thing. Don't hook a replacement across the bad section. Whatever happened inside the can to make that one section go bad will get the rest very soon, and you'll have a call-back.

To sum up:

The DC power supply is an ideal subject for logical step-by-step test methods. You start out with the primary voltage supply, then check the DC voltage output, then the current drain. You simply walk it out, one step at a time. Follow the Trouble-Free Chart, and checking will be much easier. **R-E**

VIDEO GAME KIT

5IVE GAMES TO PLAY

A CHALLENGE TO BUILD, A CHALLENGE TO PLAY.

This is a unit featuring a true "state of the art" design. It is something you will be proud to show your friends.

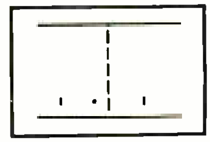
With a basic knowledge of electronic circuitry, this kit can be assembled and playing in just a few hours. If you have trouble, test facilities are available at nominal cost to remedy the problem.

FEATURES

1. Unique curve button adds extra thrill and skill to game.
2. Disappearing score - allows full vision of playing field when ball is in action.
3. 16 different angles of deflection for the ball compared to 3 with most competitive designs.
4. Fast action paddles.
5. Commercial quality design.

PRICES FOR THE UNITS ARE:

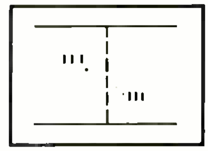
VK-1	PC board only Includes parts list & wiring diagram.	25.00 net
VK-2	PC board with parts Includes PC board, 78 IC's (those necessary are pre-programmed), resistors & capacitors to stuff the board.	125.00 net
VK-3	Hardware, wire, controls, switches Does not include housing or case.	17.50 net
VK-4	RF Module To convert video signal to TV receiver signal eliminates internal "wire in" on TV set. This unit can be used with other manufactured or kit type video games.	22.50 net
VK-5	Power Supply Kit	12.50 net
	Trouble shoot & Test Buyer assembled set	25.00 net
	Preassemble & Test	75.00 plus components



GAME 1

Let's start with a Tennis **"MATCH"**. Fun for all, particularly beginners. This is the game that started the craze.

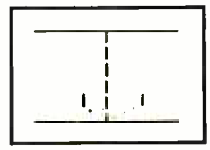
Scores to 12 points



GAME 2

Then go to the **"PRO MATCH"**. You'll need 3 paddles to return the ball on this one, almost as fast as a Hockey Puck. A challenge for the 2 players this is designed for.

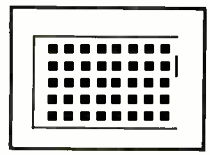
Scores to 12 points.



GAME 3

Now to deflate the ego's of the "Pros" put them to a **"GRAVITY MATCH"**. A bouncing ball adds more fun and excitement plus it plays havoc with the skill of the 2 players.

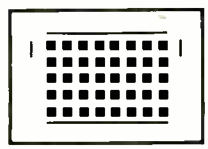
Scores to 12 points.



GAME 4

WIPE OUT I

A game for a single player. Test your reflexes and see how many squares you can knock out. As your score increases so does the speed of the ball.
Top Score is 2400 points in 6 trys.



GAME 5

WIPE OUT II

If you can't beat the machine by yourself, get someone to help you. Together you can (that is it is possible to) score 2800 points in 6 trys.

All games have sound.

C-MOS

34001	FSC Quad 2-Input NOR Gate	1.00
4000	Dual 3-Input NOR Gate/Inver	3/1.00
4001	Quad 2-Input NOR Gate	3/1.00
4002	Dual 4-Input NOR Gate	3/1.00
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4007	Dual Comp Pair + Inverter	1.25
4008	4-bit Full Adder	1.25
4009	Hex Buffer Inverter	2/1.50
4010	Hex Buffer Converter	2/1.50
4011	Quad 2-Input NAND Gate	3/1.00
4012	Dual 4-Input NAND Gate	3/1.00
4013	Dual Type D FlipFlop	2/1.00
4014	8-bit St. Shift Register	1.25
4015	Dual 4-bit Static Shift Reg	1.25
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4018	Divide by N Counter	1.25
4019	Quad AND-OR select gate	1.50
4020	14-bit Binary Counter	1.40
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4030	Quad Exclusive OR Gate	2/1.25
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4033	Decade counter/divider	2.00
4035	4-bit Parallel IN&OUT Shift Reg.	1.45
4040	12-Binary Counter	1.50
4041	QD True/Comp Buffer	1.45
4042	Quad Latch	1.00
4043	Quad 3-state NOR R/S latch	1 50
4044	Quad 3-state NAND R/S lat	1.25
4049	Hex Inverter/Buffer	1.00
4050	Hex Non Inverting Buffer	1.00
4051	8 Input Analog Multi	1.50
4052	Diff 4 Input Analog Mx.	1.50
4053	Triple 2 channel Mltplx	1.50
4066	Quad Bilateral Sw.	1.00
4068	8 Input NAND	2/1.00
4069	Hex Inverter	1.00
4070	Quad Exclusive OR	1.00
4071	Quad 2 Input OR Gate	1.00
4077	Quad Exclusive OR	1 00
4081	Quad 2 Input AND Gate	1 00
4402		1.00
4403		1.00
4404		1.00
4412		1.00
4416		1.50
4426		2.00
4508		2.60
4510		1.75
4511	BCD TO 7 Seq Latch/DEC	2 00
4512	8 Input Multiplexer	1.50
4518	Dual 4 Bit Decade Counter	1.50
4520	Dual 4 Bit Binary Counter	1.65
4528	Dual One Shot	1.50

LINEAR IC's

309K	5-V Reg	1.25
310H	V Fol	1.95
310M	Fol	2.25
311H	V Comp	1.25
311M	V Comp	1.25
311N	V Comp	1.50
312H	Op Amp	2.00
318H	Hi Per Op Amp	2.00
320T-5V	Neg Reg	1.75
320T-6V	Neg Reg	1.75
320T-8V	Neg Reg	1.75
320T-12V	Neg Reg	1.75
320-15V	Neg Reg	1.75
320T-18V	Neg Reg	1.75
324N	Quad Op Amp	2.50
339N	Lo V Quad Comp	1.50
340T-5V	Pos Reg	1.75
340-8V	Pos Reg	1.75
340T-12V	Pos Reg	1.75
340T-15V	Pos Reg	1.75
340T-18V	Pos Reg	1.75
370N	AGC/Sg Amp	1.75
373N	AM/FM IF Det	2.00
380M	Audio Amp	1.00
380N	Audio Amp	1.00
381N	Dual Pre Amp	1.50
531H	Op Amp	2.00
555M	Timer	2/1.25
556N	Dual Timer	1.35
566M		2.00
567M	Tone Decoder	2.50
702H	Linear	1.50
703H	RF/IF Amp	1.50
709H	Op Amp	1.25
709N	Op Amp	2/1.25
710H	V Comp	1.00
711H	Dual Comp	1.00
711N	Dual Comp	1.00
723H	V Reg	2/1.25
723N	Reg	2/1.25
725H	Ins Op Amp	3.75
733H	Dif Vid Amp	1 00
733N	Dif Vid Amp	1.00
739N	Dual Aud Pre Amp	1.00
740H	FET Op Amp	7.00
741H	Op Amp	2/1.00
741M	Op Amp	2/1.00
747H	Dual Op Amp	1.00
747N	Dual Op Amp	1.50
748H	Op Amp	3/1.25
748M	Op Amp	3/1.25
749N	Dual Aud Pre Amp	1.50
760N	Dif V Comp	3.00
781N	Gain Cont IF Amp	2.00
909H	Buffer	3.00
1458M	Dual Op Amp	2/1.15
2900N	Quad Amp	1.00
3065N	TV Snd Sys	2/1.50
3900N	Quad Amp	1.00
4136N	Quad 741	2.00
4558M	Dual 741	1.00

TTL IC's

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74L00	3/1.25
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74L03	2/1.00
74L04	3/1.25
74L10	3/1.25
74L20	3/1.25
74L30	3/1.25
74L42A	2.25
74L51	3/1.25
74L54	3/1.25
74L55	3/1.25
74L71	2/1.25
74L73	2/1 00
74L75	2/1.25
74L86	2/1.35
74L90	1.50
74L93	1.50
74L95	1 50
74L98	2.50
74L122	1.00
74L123	1.00
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74L164	2.00
74L191	2.00
74L192	2 50
74L193	2.50

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1N749A	4.3V	7/1.00	100/11.00
1N750A	4.7V	7/1.00	100/11.00
1N751A	5.1V	6/1.00	100/13.00
1N752A	5.6V	6/1.00	100/13.00
1N753A	6.2V	6/1.00	100/13.00
1N754A	6.8V	6/1,00	100/13.00
1N755A	7.5V	6/1.00	100/13.00
1N756A	8.2V	5/1.00	100/15.00
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Circle 106 on reader service card

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7406	.40	7470	.35	74160	1.60
7407	.40	7472	.35	74161	1.44
7408	.21	7473	.40	74162	1.71
7409	.22	7474	.40	74163	1.60
7410	.18	7475	.66	74164	1.83
7411	.29	7476	.45	74165	1.83
7413	.63	7483	.91	74166	1.71
7414	.81	7485	1.27	74170	2.65
7416	.40	7486	.46	74173	1.71
7417	.40	7489	2.48	74174	1.86
7420	.18	7490	.59	74175	1.60
7422	.30	7491	1.12	74176	1.02
7423	.33	7492	.82	74171	.97
7425	.31	7493	.69	74180	1.04
7426	.30	7494	1.08	74181	3.43
7427	.33	7495	.91	74182	.91
7430	.23	7496	.91	74184	2.29
7432	.26	74100	1.50	74185	2.29
7437	.40	74105	.51	74187	4.50
7438	.40	74107	.46	74190	1.35
7440	.20	74121	.48	74191	1.35
7441	1.13	74122	.52	74192	1.25
7442	.89	74123	.69	74193	1.19
7443	1.00	74125	.62	74194	1.25
7444	1.00	74126	.72	74195	1.02
7445	1.02	74132	1.02	74916	1.44
7446	1.07	74141	1.20	74197	1.02
7447	1.02	74145	1.20	74198	2.06
7448	1.20	74150	1.12	74199	2.06
7450	.20	74151	.91	74200	5.90
				74279	1.08

LOW POWER

74L00	.29	74L51	.33	74L90	1.71
74L02	.29	74L55	.38	74L91	1.67
74L03	.29	74L71	.29	74L93	1.94
74L04	.29	74L72	.45	74L95	1.94
74L06	.29	74L73	.56	74L98	3.21
74L10	.29	74L74	.56	74L164	3.21
74L20	.38	74L78	.91	74L165	3.21
74L30	.38	74L85	1.44		
74L42	1.71	74L86	.79		

LOW POWER SCHOTTKY

74LS00	.36	74LS32	.38	74LS95	2.09
74LS02	.36	74LS40	.45	74LS107	.59
74LS04	.36	74LS42	1.40	74LS164	2.20
74LS08	.38	74LS74	.59	74LS193	2.20
74LS10	.36	74LS90	1.30	74LS197	2.20
74LS20	.36	74LS93	1.30		

HIGH SPEED

74H00	.25	74H22	.25	74H61	.25
74H01	.25	74H30	.25	74H62	.25
74H04	.25	74H40	.25	74H74	.39
74H08	.25	74H50	.25	74H101	.39
74H10	.25	74H52	.25	74H102	.49
74H11	.25	74H53	.25	74H103	.58
74H20	.25	74H55	.25	74H106	.58
74H21	.25	74H60	.25	74H108	.60

SCHOTTKY

74S00	.38	74S08	.52	74S22	.38
74S02	.45	74S10	.38	74S32	.52
74S03	.38	74S20	.38	74S74	.38
74S04	.45				

8000 (NATIONAL)

8091	.61	8220	1.49	8811	.65
8092	.61	8230	2.19	8812	1.02
8095	1.25	8288	1.49	8822	2.19
8121	.80	8520	1.16	8830	2.19
8123	1.43	8552	2.19	8831	2.19
8130	1.97	8563	.62	8836	.29
8200	2.33	8810	.70	8880	1.19
8214	1.49				

8000 (SIGNETICS)

8263	5.79	8267	2.59

9000

9002	.40	9309	.79	9601	.89
9301	1.03	9312	.79	9602	.79

DTL

930	.15	937	.15	949	.15
932	.15	944	.15	962	.15
936	.15	946	.15	963	.15

6 DIGIT LED CLOCK KIT

INCLUDES:
- MM314 clock circuit
- 6 FND70 LED displays (.250" red 7 segment)
- All necessary transistors, resistors & capacitors
- 1 double sided PC board accommodates LED's & clock circuitry
- Schematic & instructions
- Does not include 12V-300 ma transformer, switches & case **$12.95**

QUANTITY DISCOUNT NOT APPLICABLE ON THIS ITEM

DATA SHEETS ON REQUEST. ADD 10¢ EACH IF ITEM IS PRICED BELOW $1.00 EACH.

IC SOCKETS

Solder Tail - low profile

8 pin	$ .19	24 pin	.45
14 pin	.22	28 pin	.59
16 pin	.24	40 pin	.69
18 pin	.35		

WIRE WRAP - gold plate

14 pin .59

CMOS

4000A	.30	4018A	1.39	4066A	1.02
4001A	.29	4020A	1.49	4068A	.51
4002A	.29	4021A	1.39	4069A	.51
4006A	1.55	4022A	1.10	4071A	.30
4007A	.30	4023A	.29	4072A	.40
4008A	1.79	4024A	1.02	4073A	.45
4009A	.66	4025A	.29	4075A	.45
4010A	.62	4027A	.68	4078A	.45
4011A	.33	4028A	1.13	4082A	.40
4012A	.29	4030A	.51	4518A	1.89
4013A	.52	4035A	1.46	4528A	1.84
4014A	1.49	4040A	1.39	4585A	2.10
4015A	1.49	4042A	1.69	4901A	.45
4016A	.56	4049A	.68		
4017A	1.19	4050A	.68		

74C00	.25	74C74	1.20	74C162	2.93
74C02	.30	74C76	1.54	74C163	3.06
74C04	.51	74C107	1.30	74C164	3.06
74C08	.78	74C151	3.00	74C173	2.61
74C10	.40	74C154	3.62	74C195	2.66
74C20	.40	74C157	2.02	80C95	1.35
74C42	1.55	74C160	2.85	80C97	1.13
74C73	1.20	74C161	2.93		

CALCULATOR CHIPS

CT5002	12 digit, 4 function fixed decimal — battery operation 40 pin	2.79
CT5005	12 digit, 4 function plus memory, fixed decimal 28 pin	2.99
MM5725	8 digit, 4 function, floating decimal 28 pin	1.98
MM5736	6 digit, 4 function, 9V battery operation 18 pin	3.95
MM5738	8 digit, 5 function plus memory and constant floating decimal, 9V battery operation 24 pin	4.50
MM5739	9 digit, 4 function, 9V battery operation 22 pin	5.35

MEMORIES

1101	1.50	5262	2.25
1103	1.95	82S23	3.69
1702A	14.95	F93410	1.95
2102	2.95	7489	2.48
5203	10.95	74187	5.95
5260	1.95	74200	5.90
5261	2.19		

CLOCK CHIPS

MM5311	$4.45	MM5314	4.45
MM5312	3.95	MM5316	5.39
MM5313	4.45	CT7001	7.95

POCKET CALCULATOR

5 function plus constant — addressable memory with individual recall — 8 digit display plus overflow — battery saver — uses standard or rechargeable batteries — all necessary parts in ready to assemble form — instructions included.

Calc. Kit. Kit only	$10.95
Batteries (alkaline, disp.)	2.00
Adapter 60Hz	3.95
Kit, Batteries & Adapter	15.95

QUANTITY DISCOUNT NOT APPLICABLE ON THIS ITEM

TANATLUM CAPACITORS SOLID-DIPPED ±20%

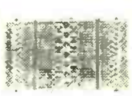
.1 mfd	35V	.25 ea.	6.8 mfd	6V	.30 ea.
.33 mfd	35V	.25 ea.	6.8 mfd	50V	.40 ea.
1 mfd	35V	.25 ea.	10 mfd	25V	.40 ea.
2.2 mfd	20V	.25 ea.	15 mfd	10V	.40 ea.
2.2 mfd	35V	.30 ea.	33 mfd	10V	.40 ea.
4.7 mfd	16V	.30 ea.	47 mfd	6V	.40 ea.

SHIFT REGISTERS

MM5013	1024 bit accum. dyn. 8 pin	1.75
MM5016	500/512 bit dyn. 8 pin	1.59
SL5-4025	Quad 25 bit	1.29
2504	1024 bit multiplexed dyn 8 pin	4.95

UNIVERSAL BREADBOARD

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



JULY SPECIALS

CT5005 CALCULATOR CHIP
12 digit — 4 function with memory
$1.39

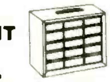
7001 CLOCK CHIP
4-6 digit, 12-24 hr, alarm; timer and date circuits — with data **$6.95**

DVM CHIP 4½ DIGIT
MM5330 — P channel device provides all logic for 4½ digit volt meter, 16 pin DIP with data **$12.95**

ALARM CLOCK CHIP
MM5375AA 4-6 digit, 12 hour, 60Hz snooze alarm, brightness control capability, alarm tone output 24 pin DIP **$4.95**

1103	Memory	10/$10.00	100/$88
5260	"	10/$11.90	100/$104
5261	"	10/$11.90	100/$104
5262	"	10/$13.90	100/$122
5002	Calculator Chip	10/$11.90	100/$104
5005	" "	10/$13.90	100/$122
5738	" "	10/$20.00	100/$176
309K	5V Regulator	10/$10.00	100/$89
741	Operational Ampl.	10/$2.50	100/$22
3900	Quad amplifier DIP	10/$3.20	100/$29
74123	Dual Monostable Multivibrator	10/$5.60	100/$50
MAN 1	Display	10/$11.90	100/$104

RESISTOR KIT



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¼ OR ½ WATT
455 RESISTORS 44 VALUES
SUPPLIED IN A 15 DRAWER, 60 COMPARTMENT STORAGE CABINET — TABLE OR WALL MOUNT. READY TO USE

$24.95 ea.

¼ WATT — 01255
½ WATT — 01505

RESISTOR ASSORTMENT
R (OHMS)

R	QTY	R	QTY	R	QTY	R	QTY	R	QTY	R	QTY
1.5	5	68	5	1.0K	20	10K	20	100K	20	1.5M	5
3.3	5	100	10	1.5K	10	15K	10	150K	10	2.2M	5
6.8	5	150	10	2.2K	20	22K	10	220K	10	3.3M	5
10	10	220	10	2.7K	10	27K	10	270K	5	4.7M	5
15	5	270	5	3.3K	10	33K	20	330K	10		
22	5	330	10	3.9K	10	39K	10	470K	10		
33	5	470	20	4.7K	20	47K	10	680K	10		
47	10	680	10	6.8K	10	68K	10	1.0M	20		

MISC DEVICES

ULN 2208	FM gain block 34dB mDIP	1.39
ULN2209	FM gain block 48dB mDIP	1.59
2513	64 x 8 x 5 character generator	11.00
CA 3046	Transistor array 14 pin DIP	.86

METAL FILM RESISTORS

±1% ¼ WATT

QTY	PRICE EACH	PRICE MINIMUM 10 PER VALUE	PRICE MINIMUM 100 PER VALUE
0 - 10	$.20		
10 - 100	.20	$.15	
100 - 1000		.10	$.09
1000 -		.10	.08

RESISTANCE (OHMS)

22.6	71.5	182	887	11.8K	40.2K
23.7	78.7	187	1.15K	13.0K	45.3K
25.5	84.5	191	1.5K	15.0K	48.7K
30.9	105	205	2.49K	18.2K	54.9K
34.8	110	232	3.57K	19.1K	60.4K
40.2	115	243	4.75K	19.6K	64.9K
45.3	137	499	5.49K	22.6K	69.8K
51.1	147	604	6.04K	24.9K	84.5K
61.9	158	715	7.15K	28.0K	
64.9	178	806	8.25K	37.4K	

Zener Diodes, Diodes & Rectifiers

IN 4868	Diode	250V	$ .25 ea.
IN 715A	Zener	11V	.25
IN 747A	Zener	3.6V	.25
IN 754A	Zener	6.8V	.25
IN 756A	Zener	8.2V	.25
IN 904	Sw. Diode	30V	.10
IN 914	Sw. Diode	100V	.10
IN 4858	Zener	120V	.25
IN 5230A	Zener	4.7V	.25
IN 5242B	Zener	12V	.25

DISPLAYS

MAN1	$1.95
MAN2	3.95
MAN3A	.19
MAN5	2.95
MAN6	3.95
MAN7	1.49
MAN8	2.95
MAN66	2.95
DL10A	2.19

DISCRETE LED'S

ME4	$ .29
MV50	.15
NSL100	.15
NSL101	.15
NSL102	.15
XC209-R	.18
MV5020	
RED	.18
GREEN	.18
AMBER	.18
CLEAR	.18

MULTIPLE DISPLAYS

NSN33	3 digit .12" red LED	1.79
HP5082-7405	5 digit .11 red LED	3.49
HP5082-7414	4 digit .11 red LED	3.25
SP-425-09	9 digit .25 gas disch.	1.79

5% OFF ON ORDERS OVER $50.00
10% OFF ON ORDERS OVER $100.00
15% OFF ON ORDERS OVER $500.00

LINEAR CIRCUITS

300	Pos V Reg (super 723) TO-5	$ .82
301	Hi Perf Op Amp mDIP TO-5	.33
302	Volt follower TO-5	.61
304	Neg V Reg TO-5	.92
305	Pos V Reg TO-5	.82
307	Op AMP (super 741) mDIP TO-5	.30
308	Micro Pwr Op Amp mDIP TO-5	1.02
309K	5V 1A regulator TO-3	1.35
310	V Follower Op Amp mDIP	1.23
311	Hi perf V Comp mDIP TO-5	1.09
319	Hi Speed Dual Comp DIP	1.30
320T	Neg Reg 5, 12, 15 TO-220	1.60
320K	Neg Reg 5.2, 12 TO-3	1.60
322	Precision Timer DIP	1.96
324	Quad Op Amp DIP	1.75
339	Quad Comparator DIP	1.69
340K	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-3	1.94
340T	Pos V reg (5V, 6V, 8V, 12V, 15V, 18V, 24V) TO-220	1.71
370	AGC/Squelch AMPL DIP	1.20
372	AF-IF Strip detector DIP	2.93
373	AM/FM/SSB Strip TO-5	2.42
376	Pos V Reg mDIP	.68
380	2w Audio Amp DIP	1.30
380-8	.6w Audio Amp mDIP	1.25
381	Lo Noise Dual preamp DIP	1.75
382	Lo Noise Dual preamp DIP	1.75
531	High Slew rate Op Amp	2.95
540	Power driver TO-5	2.95
550	Prec V Reg DIP	1.02
555	Timer mDIP	.69
556A	Dual 555 Timer DIP	1.71
560	Phase Locked Loop DIP	4.54
562	Phase Locked Loop DIP	4.54
565	Phase Locked Loop DIP TO-5	1.39
566	Function Gen mDIP TO-5	2.59
567	Tone Decoder mDIP	2.49
709	Operational AMP TO-5 or DIP	.30
710	Hi Speed Volt Comp DIP	.69
711	Dual Difference Compar DIP	.30
723	V Reg DIP	.71
733	Diff. video AMPL TO-5	1.02
739	Dual Hi Perf Op Amp DIP	1.23
741	Comp Op Amp mDIP TO-5	.37
747	741 Dual Op Amp DIP or TO-5	.82
748	Freq Adj 741 mDIP	.40
1304	FM Mulpx Stereo Demod DIP	1.23
1307	FM Mulpx Stereo Demod DIP	.85
1456	Op Amp mDIP	1.83
1458	Dual Comp Op Amp mDIP	.71
1800	Stereo multiplexer DIP	2.85
3900	Quad Amplifier DIP	.49
7524	Dual core memory sense Amp	.52
7525	Dual core memory sense Amp	1.13
8038	Voltage contr. osc. DIP	4.89
8864	9 DIG Led Cath Drvr DIP	2.59
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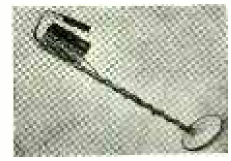

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Get superior .1% *accuracy* with under-$200 professional Electronic Digital Multimeter comparable to units at $320 up! Fast, one-hand op'n. Measures AC, DC voltages from .001V to 750V, resistances from 1 ohm to 19.99 megohms. Feats.: 3½ digit LED display; autoranging; autopolarity; auto decimal; overload indicator. Incls. AC adaptor/charger, NiCd batts., case, op. manual.
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WITH TEMPERATURE MEAS. PROBE
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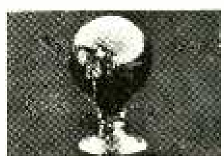
GOES 3000 RPM IN BRIGHT SUN!



Handsome new aluminized version of Crooke's Radiometer demonstrates solar energy . . . by continuous vane-spinning up to 3000 rpm . . . & gives you fascinating "fisheye" hemispherical mirror to see all around you. Even works by light-bulb or infrared (cigarette), but most fun is sun. Your own solar engine to show light-stimulated molecular activity. Req. no fuel, lubrication or repairs; partial vacuum; 4 vanes spin. "Silvering" on ½ of glass globe. Great conversation piece!
No. 60,529EH **(5" HIGH, 3" DIA.) $4.75 Ppd.**

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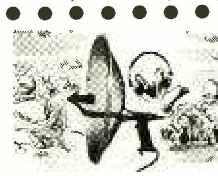

Parabolic mike w/18¾" transparent reflecting shield & 2 I.C.'s in amplifier magnifies signals 100x that of omni-direction mikes. Catch sounds never before heard! Highest signal to noise ratio poss. Earphones, tape recorder output, tripod socket; req. two 9V trans. batt. (not incl.).
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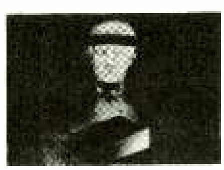

Yes, because **you** built it! Use your ability to tune in your brainwaves, an aid to relaxation, concentration. Kit incls. everything you need (except 9v trans. batt.) to own a portable self-cont. BIOFEEDBACK unit for a pittance: steth. earphones, electrode headband, solid-state circuitry; 5 microvolt sensitivity, more! Compl. assembly instructions & op. manual. With basic electronics knowledge, you can do it!
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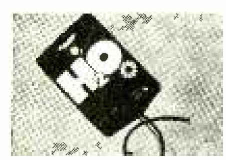

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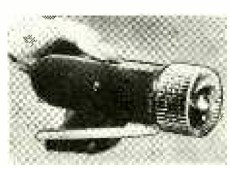

Never needs batteries! Lights the way **free** by using flywheel energy. Each time you squeeze handle the alternator generator spins, flywheel disengages from the clutch, and your flashlight lights for about 2 seconds. By continuous squeezing (generating a soft hum), the light stays bright. Energy-saving 6-oz. flashlight pays for itself many times over. And demonstrates flywheel generator principle. Never buy flashlight batteries again!
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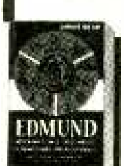

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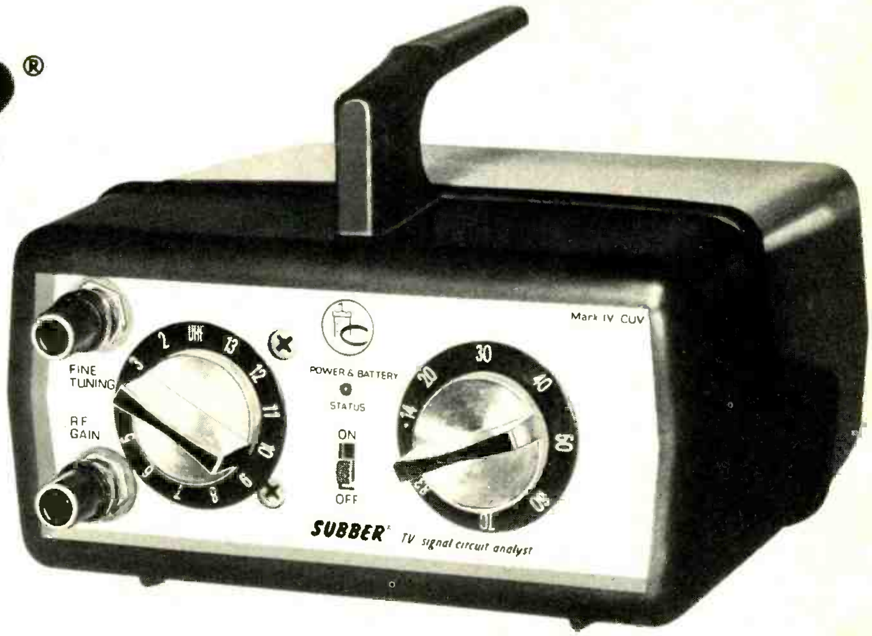

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- BATTERY CONDITION INDICATOR. IC comparator driven LED shows when inbuilt 9v transistor batteries require replacement. Battery & 120-vac line powered.

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