CB ANTENNAS–FACTS AND FALLACIES

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Radio-Electronics

34140

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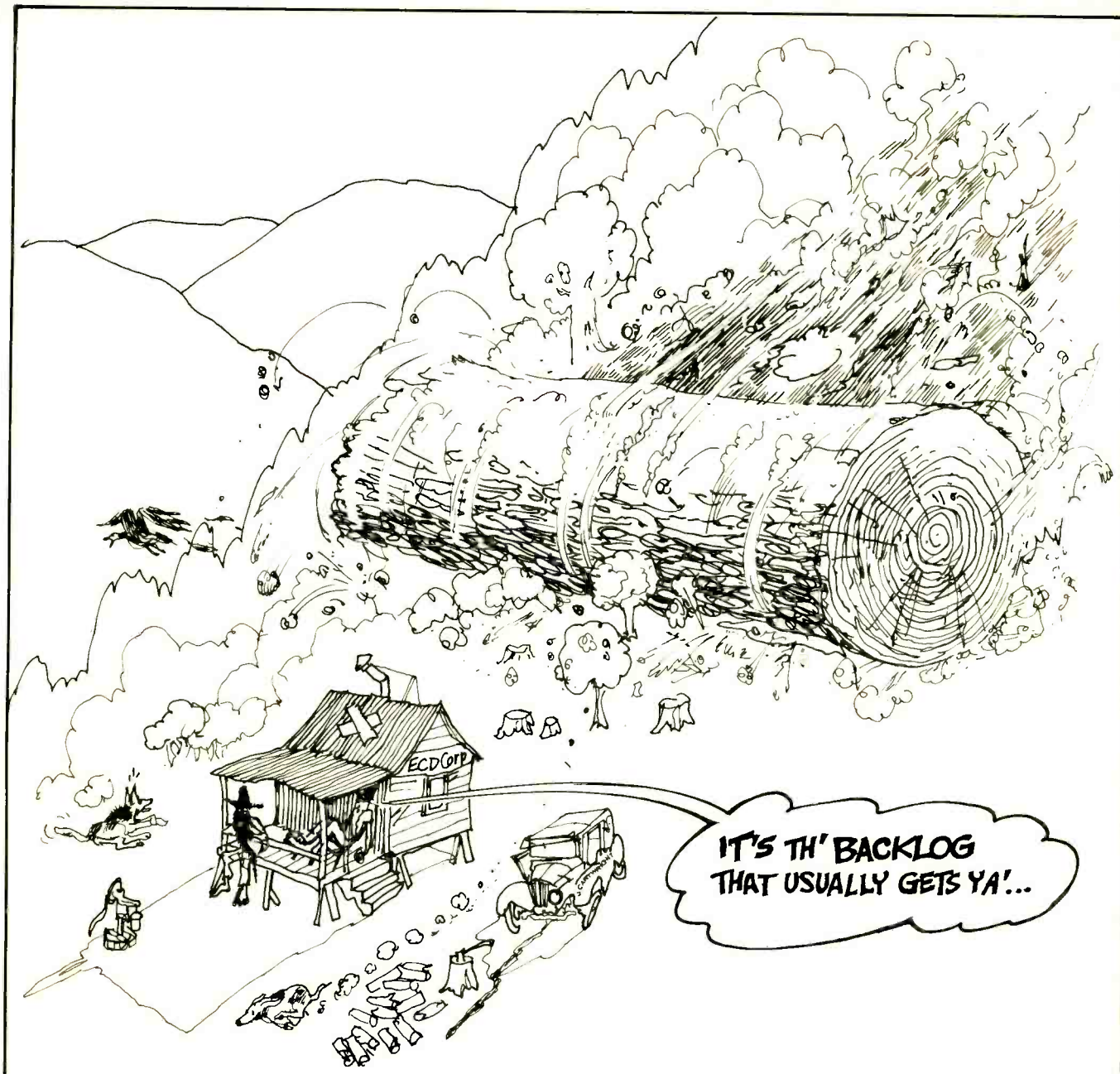

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INNOVATIONS IN ELECTRONICS

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off ... and rolling!

CIRCLE 19 ON FREE INFORMATION CARD

Burglar Alarm Breakthrough

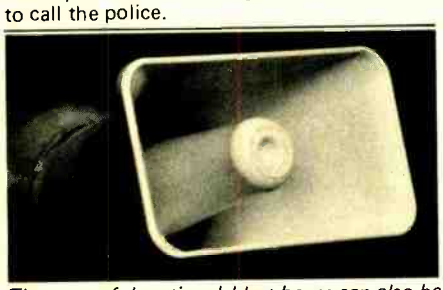
A new computerized burglar alarm requires no installation and protects your home or business like a thousand dollar professional system.

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

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

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

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



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

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

NO MORE FALSE ALARMS

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

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

DEFENSE AGAINST PEEPING TOMS

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

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

PROFESSIONAL SYSTEM

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

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

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

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

COMPARED AGAINST OTHERS

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

YOU JUDGE THE QUALITY

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

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

PEOPLE LIKE THE SYSTEM

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

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

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

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

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

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

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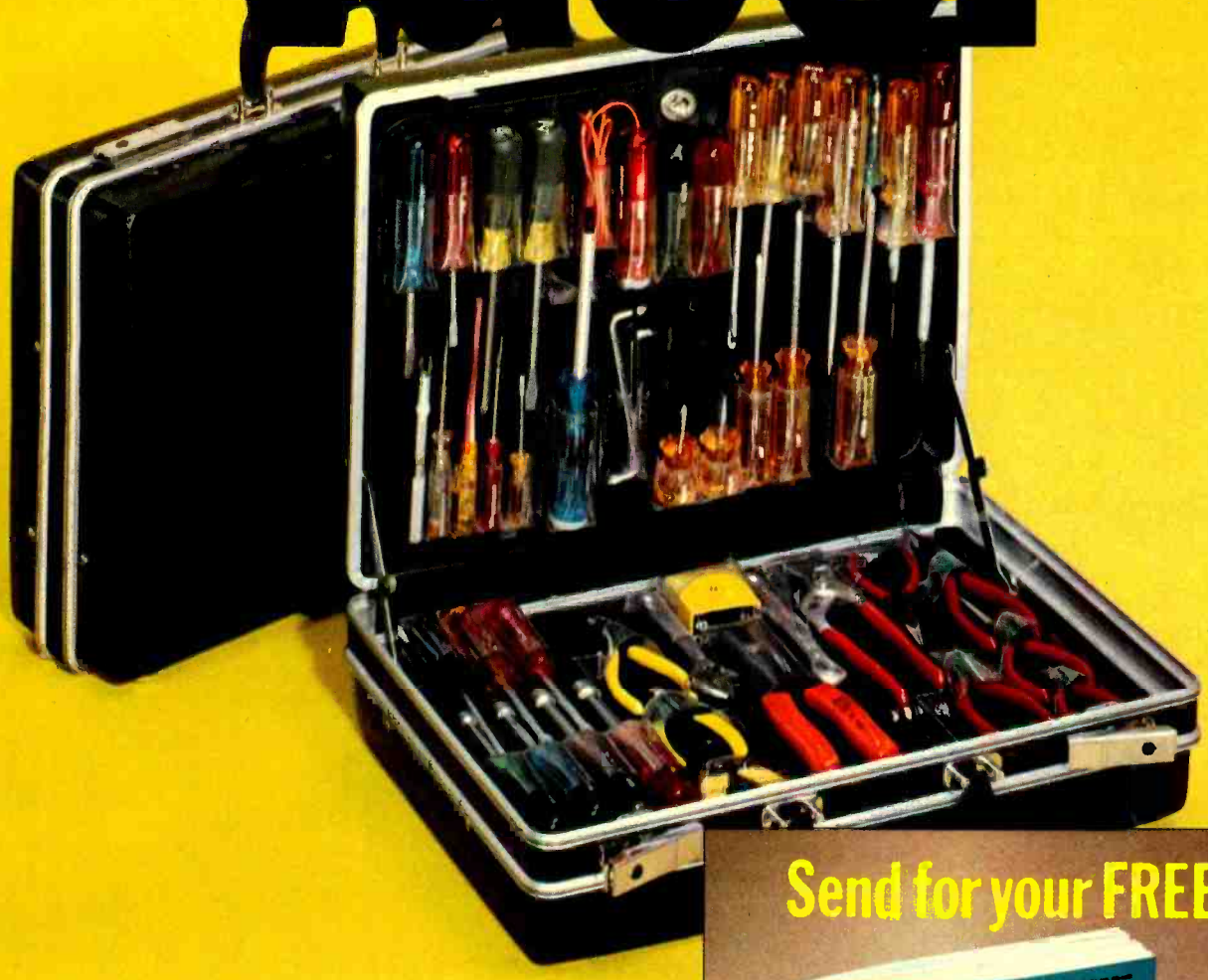
Vaco.



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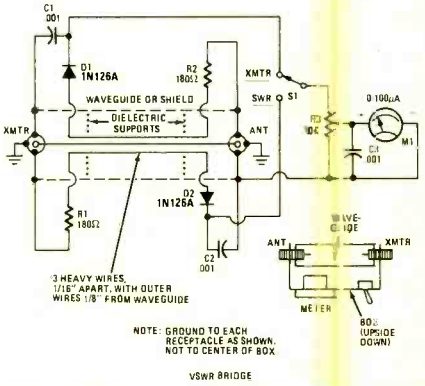
OCTOBER 1977 Vol. 48 No. 10

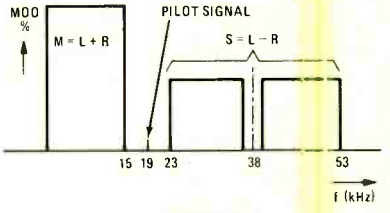
ON THE COVER

Special music effects just your style? Then try building the Phlanger—it's a honey of an effect generator, and you use it with your hi-fi system. Complete details start in this issue on page 42.



VSWR BRIDGE

SWR BRIDGE is only one of 3 inexpensive CB test meters. . . . see page 40



FREQUENCY

THIS IS A PROPER FM signal. A misaligned FM tuner will destroy it. Restore the good sound by realignment. . . . see page 50

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looking ahead

Restricting Japan: The political tide has begun to turn sharply against electronic imports from Japan, with recent U.S. Government actions now certain to restrict imports and/or increase prices of Japanese goods. The most important move was negotiating voluntary quotas on exporting color sets from Japan to the U.S. after the American International Trade Commission had determined that domestic industry had been injured by Japanese imports. Under the quota agreement, Japan is permitted to export about 1.75 million complete color sets and chassis to the U.S. per year for the next three years—or about 35% less than its 1976 exports.

A second blow to the Japanese was a U.S. Customs court ruling that the Japanese government was subsidizing exports of consumer electronic products by exempting them from commodity taxes. This ruling is being challenged in court by the State Department, but if the ruling is upheld, it could mean imposing additional duties on Japanese electronics. In a third action, five Japanese television manufacturers signed an agreement settling a case brought against them by Sylvania, agreeing to refrain from future price-fixing, market-splitting and predatory price practices. More anti-Japanese actions are pending, including a billion-dollar anti-trust suit brought against Japan's TV manufacturers by Zenith and National Union Electric.

In addition to these actions, the rising value of the Japense yen is putting the squeeze on importers and Japanese manufacturers doing business with the U.S. By midsummer, Japanese TV and audio brands had posted price increases of about 5%, and there were indications of steeper price hikes to come around the end of the year.

One other aspect of the troubled situation may actually work against audio price increases. Since the quotas are restricting Japanese color TV exports to the U.S., manufacturers are expected to try to compensate for the lost volume with audio gear exports, perhaps flooding the American market with more audio equipment than it can accommodate. The result could be a real disaster, with prices collapsing despite increased costs.

AM stereo, FM quad: The FCC is inexorably moving into new areas of radio. It has started two new proceedings to determine whether it should adopt standards for AM stereo and/or FM quadriphonic broadcasting. In the AM stereo case, the National AM Stereophonic Radio Committee, which has tested various systems, will help the FCC select the best parameters for AM stereo. As a matter of fact, AM stereo (distasteful as it may be to some purists) is considered virtually a shoo-in. Radio manufacturers want it. Car manufacturers want it. And AM broadcasters want it (as a weapon against FM). It's expected to sound pretty good (at least reasonably middle-fi), so why not let your AM tuner take advantage of your stereo amplifier?

The quadriphonic FM proceeding has been on the FCC's books for some time, and now the rug has been swept out from under it as a result of the four-channel equipment bomb. But the FCC must follow the rulebooks. Its proceeding asks for comments on the merits of discrete 4-4-4 systems, matrix-discrete 4-3-4 and matrix 4-2-4, which can now be broadcast without any rule changes. However, the Commission had some questions about quadriphonic broadcasting—whether sufficient software was available for four-channel broadcasting, whether existing stereo receivers could be converted to quadriphonic receivers, and how much it would cost to do so. But, it sounds as if the FCC is just going through the motions.

VTR guide: You can't tell the players without a program. Well, here's one—showing which manufacturer has which home videocassette system, subject to change. In the table, Beta-2 means the Sony Betamax system with two-hour cassette, VHS-2 means the JVC-Matsushita Video Home System with 2-hour cassette, VHS-4 is the same unit with switchable 2- and 4-hours per cassette.

Brand	Format	Manufacturer
Aiwa*	Beta-2	Sony
Hitachi	VHS-2	Hitachi
JVC	VHS-2	JVC
Magnavox	VHS-4	Matsushita
Curtis Mathes	VHS-4	Matsushita
MGA	VHS-2	JVC
Panasonic	VHS-4	Matsushita
Pioneer*	Beta-2	Sony
Quasar	VX-2000	Matsushita
RCA	VHS-4	Matsushita
Sanyo	V-Cord II	Sanyo
	Beta-2	Sanyo
Sears	Beta-2	Sanyo
Sharp	VHS-2	JVC
Sony	Beta-2	Sony
Sylvania	VHS-4	Matsushita
Toshiba	Beta-2	Toshiba
Zenith	Beta-2	Sony

* U.S. plans not disclosed.

New broadcast standard: Since the development of the videotape recorder in 1956, the two-inch quadruplex VTR has been the TV broadcasting industry's standard for the interchange of tapes for programs and commercials. Time has marched on since Ampex first announced and demonstrated practical video recording—and so has technology. Despite attempts to keep the two-inch quad machine up to the times by upgrading quality and reducing tape speed, new lower-cost, high-quality formats have increasingly attracted broadcasters. The two-inch format has remained the standard for only one reason: It started out as the standard and everybody has it.

Within the last 18 months, several new and economical formats have been introduced. In Europe, the Bosch/Fernseh group's one-inch segmented helical-scan format attracted immediate attention and is a strong candidate to replace the existing standard there. In the U.S., a nonsegmented format is widely preferred, and both Ampex and Sony have fielded their own versions. Broadcasters were enthusiastic about both formats as vastly more economical, easier to use and technically superior videotape systems, but, unfortunately, they were

continued on page 105

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new & timely

Single-sideband transmission triples phone system capacity

Bell Labs is now testing out, between Ashburnham and Wendell, Massachusetts, an advanced microwave system that will carry more than three times as many phone calls as the highest capacity radio link now used by the Bell System. It will be the first of its kind to use single sideband (SSB) for high-capacity, long-distance microwave telephone transmission.

The new system—AR6A—will carry

PART OF THE AR6A SINGLE SIDEBAND microwave transmitter, with one of its designers, Bell Laboratories engineer William Robinson.

6,000 calls per channel, as compared with 1,800 for the highest-capacity radio link now used by Bell. It will operate at six gigahertz (6 GHz) and will handle both voice and data signals. The present tests will continue through 1978 and—if the system works as well as expected—AR6A will go into commercial operation by the middle of 1980.

The single-sideband technique, widely used by amateurs and commercial two-way communications on the high- and very-high frequencies, has been hard to adapt to microwave. By eliminating one of the sidebands of a radio transmission, SSB immediately doubles the available spectrum space. By eliminating the carrier, and thereby greatly reducing the power required, it is possible to increase further the number of signals that can be carried on a given band of frequencies. But the technique requires extreme linearity—the output must be an exact replica of the input—and until recently distortion has prevented its use at microwave frequencies.

This problem was overcome in large part by a greatly improved traveling-wave amplifier. Some nonlinearity still existed, and is being combatted by *predistortion*—a controlled amount of distortion is introduced in such a way as to exactly cancel out the distortion introduced by the equipment.

Mammoth iceberg spotted by RCA environmental satellite

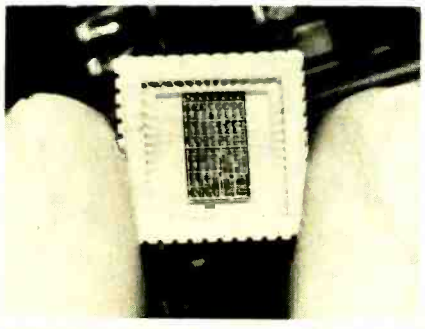
A giant iceberg, 45 miles long and 25 miles wide (or about the size of Rhode Island), has been observed off Antarctica's Palmer Peninsula by an RCA-built polar-orbiting satellite. The iceberg's ultimate destination is the South Atlantic, where it will dissolve in the warmer waters. It is estimated that the huge ice mass contains enough fresh water to supply all of California for the next 1,000 years!

The weather satellite, launched by NASA, is one of series built by RCA for NOAA (National Oceanic and Atmospheric Administration). The satellites are used by the U.S. Navy and ships of other countries to provide information on safe shipping routes through Antarctica's ice-choked waters. In addition to providing vital weather information, the satellites help predict snow runoff and aid fishermen in locating their catches.

New technology simplifies custom LSI circuit design

A simple and inexpensive way of custom designing LSI circuits has been developed by Hughes Aircraft Company. The new technology, termed SCAT (*S*chottky *C*ell *A*rray *T*echnology) uses a custom interconnection process to outline LSI circuits. This method results in reduced mounting space and greater reliability. A library of standard MSI and SSI Schottky TTL cells provides arrays of up to eight cells that can be interconnected in one-fourth the time and cost of full custom design configurations.

A multilayer metallization process with two extra layers of thin metal film is used. Logic functions are implemented in a manner similar to that done on a two-layer PC board. The logic interconnections and cell types are left up to the customer.

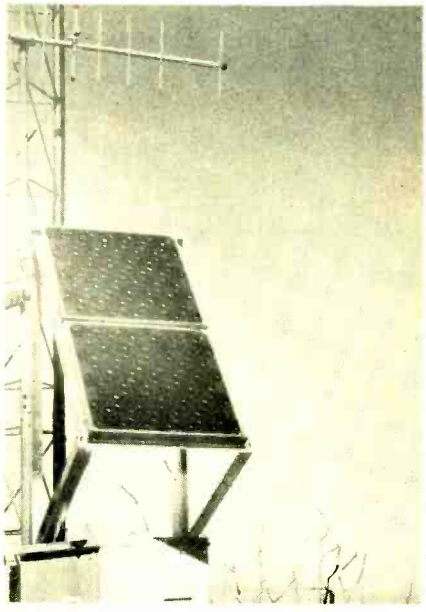


CUSTOM LSI DESIGN is simplified with SCAT (*S*chottky *C*ell *A*rray *T*echnology), using two thin metal layers to implement logic functions.

The SCAT technique eliminates the circuit layout and computer analysis steps of a full custom design. Layout details for the library cells are stored as a set of photoplates for mask generation, thus reducing development to designing two layers of interconnections and mask fabrication. Included in the cell library are a wide range of MSI/SSI gates, counters, flip-flops, multiplexers, arithmetic elements and shift registers.

Motorola introduces two new solar modules

Motorola Semiconductor Products, Inc., has taken a step in the direction of harnessing solar power to meet some of our



TYPICAL REMOTE SOLAR INSTALLATION, using Motorola's 48-cell module.

energy problems. They have developed two new solar modules that can be used to supply moderate amounts of energy to remote locations.

The modules, a 48-cell array and a 36-cell array, are composed of interconnected 3-inch row-mounted silicon wafers. The surface of each wafer (cell) consists of tiny pyramids that impinge light rays, resulting in a less than 1% loss of sunlight from reflection.

Module outputs are proportional to the number of cells used. For instance, in the 48-cell array, because each cell produces less than ½-watt peak power at 25°C, 26 watts of power is produced. However, there are a number of series-parallel interconnection schemes that allow voltage/current

continued on page 12

Where superior technology makes the musical difference: Sansui's new DC integrated amplifier and matching tuner.

Sansui is proud to introduce the new AU-717 DC integrated amplifier and matching TU-717 tuner, designed for your greatest listening pleasure. We are proud of the superlative specifications that our sophisticated research has achieved. The finest available at any price.

But the best specs alone don't always mean the finest music reproduction. And so we are proud that our precision engineering and superior circuitry design create pure and brilliantly clean tonal quality that's distinctly superior.

Listen to what we offer: Frequency response of the AU-717 from main in 10Hz to 200kHz (+0dB, −3dB), (the widest of any DC integrated amplifier available), gives you sharp, clean transients and greatly reduced phase shift problems. Total harmonic distortion is astoundingly low less than 0.025%, from 20-20,000Hz. 85 watts/channel min. RMS, both channels driven into 8 ohms.

Dual independent power supplies provide truest stereo separation and a large power reservoir. For uncolored phono reproduction equalization is within ±0.2dB (20-20,000Hz, extended RAA curve). And the calibrated-attenuator level control guarantees volume precision.

The matching TU-717 tuner features dual IF bandwidth to let you select for lowest distortion (0.07% mono, 0.09% stereo) or maximum selectivity (80dB). S/N is excellent: 80dB mono, 77dB stereo.

In addition, the AU/TU 717's are elegantly styled, offer rack mounting adapters and are most attractively priced. Less than $450* for the AU-717 and less than $320* for the TU-717.

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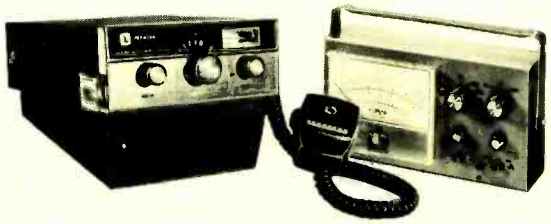
NEW CB SPECIALIST COURSE NOW OFFERED



NRI now offers a special course in CB Servicing. You get 37 lessons, 8 reference texts, your own CB Transceiver, AC power supply and multimeter . . . for hands-on training. Also included are 14 coaching units to make it easy to get your commercial radio telephone FCC license—enabling you to test, install, and service communications equipment.

NRI offers you five TV/Audio Servicing Courses

NRI can train you at home to service TV equipment and audio systems. You can choose from 5 courses, starting with a 48-lesson basic course, up to a Master Color TV/Audio Course, complete with designed-for-learning 25" diagonal solid state color TV and a 4-speaker SQ™ Quadraphonic Audio System. NRI gives you both TV and Audio servicing for hundreds of dollars less than the two courses as offered by another home study school.

All courses are available with low down payment and convenient monthly payments. All courses provide professional tools and "Power-On" equipment along with NRI kits engineered for training. With the Master Course, for instance, you build your own 5" wide-band triggered sweep solid state oscilloscope, digital color TV pattern generator, CMOS digital frequency counter, and NRI electronics Discovery Lab.

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continued from page 6

tradeoffs to meet different applications.

The modules can be used to energize microwave relays, navigational aids and forestry systems, among others. Continuous energy storage is provided by batteries recharged during sunlight hours.

NBS seminar on time and frequency calibration

On October 17-19, the National Bureau of Standards is presenting a time and frequency seminar at NBS headquarters in Boulder, CO. Aimed at scientists, engineers and lab technicians, the three-day course will offer a practical approach to making time and frequency measurements. Featured will be many discussions and "hands on" workshops dealing with such topics (among others) as establishing traceability, lab equipment and techniques, using high- and low-frequency time and frequency broadcasts, satellite methods and using LORAN.

The $300 registration fee includes handbooks and other publications, workshops, coffee and refreshments, one seminar dinner (with cash bar), and a certificate of completion. A side trip to radio stations WWV and WWVB in nearby Fort Collins is planned. Accommodations can be made at the Broker Inn, about a mile from the NBS site. For further information, write Sandy Howe (General Information) or George Kamas (Technical Information), NBS, 325 Broadway, Boulder, CO 80302, or call (303) 499-1000.

Sencore CB/stereo seminars for service technicians

Sencore, Inc., test-equipment manufacturers, recently conducted a series of CB and stereo troubleshooting seminars across the country for service technicians. The main thrust of the learning sessions was to show how new techniques can be applied to repair combination in-dash CB/stereo units. A highlight of the meeting was a video/tape presentation of Sencore's AM/FM/stereo analyzer and CB analyzer.

A HIGHLIGHT OF THE RECENT SENCORE troubleshooting seminar was the company's all-in-one AM/FM/stereo and CB analyzer, developed to help service in-dash combo units.

". . . CB's are going in-dash," stated a company spokesman. "Communications with many CB manufacturers indicate that many of these units will be AM/FM/stereo and CB combinations." And, to prepare for this growing market, he continued, CB dealers have been expanding into stereo service, while hi-fi service centers have been taking on CB's.

Sencore feels that its analyzers will provide a lower-cost, more efficient way to service the combination units. The analyzers are essentially self-contained "service centers" that eliminate the expensive, time-consuming set-ups and intra-instrument cable connections required if separate instruments are purchased.

Telecommunications forum predicts world market growth

The phenomenal growth in the worldwide demand for telecommunications equipment was the subject of a recent Executive Forum on International Telecommunications sponsored by Arthur D. Little, Inc., that was held this past June in the nation's capital.

More than 20 international telecommunications executives and a team of experts from Arthur D. Little participated in the Forum, which examined world market growth trends. Participants heard experts predict an 8% total world market growth by 1985, as contrasted to only 6.5% for North American countries. The most dramatic growth in demand will be reflected in Middle Eastern, Third World and European nations, with the U.S. accounting for less than half the total market. These trends and the inevitable changes they will produce were examined on a market-by-market basis, with the emphasis being on the differences between the U.S. and other world markets.

Teledyne Acoustic Research "has computer, will travel"

A new "Mini" computer, devised by Teledyne Acoustic Research, is the star of a unique AR "Science of Sound" traveling show aimed at demonstrating some of AR's capabilities in the high-fidelity field.

The "Mini" is a sophisticated digital unit that has been preprogrammed by AR's in-house computer. On-the-spot calculations and data drawn from storage banks use room-dimension and speaker-placement information to provide the ideal listening conditions desired. The computer does all its mathematical tricks before your very eyes. Additionally, performance data of various AR models and their use in specific installations can be shown on the readout screen.

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Cover photo by Walter Herstatt

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

Radio-Electronics magazine is published by Gernsback Publications, Inc.
200 Park Ave. S., New York, NY 10003
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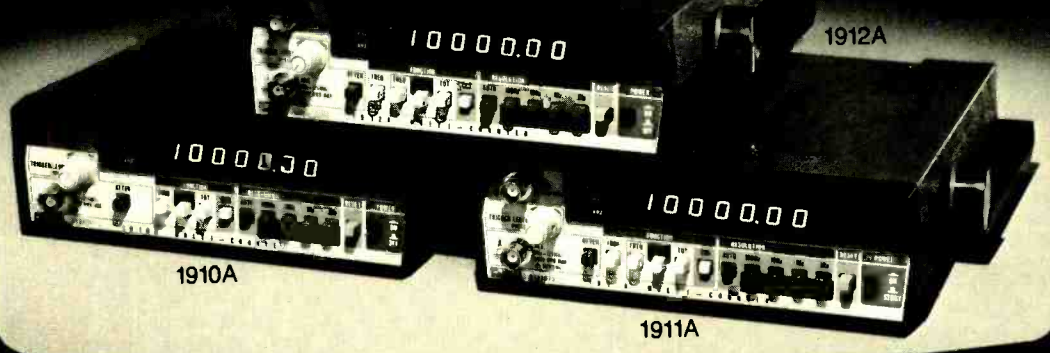


Tired of Reruns?

Fluke counters with a new series in the 5 Hz-520 MHz/time slot.

If you're paying over $345 for a counter and getting frequency only, tune in on our new 1900-series of priced-right multicounters.

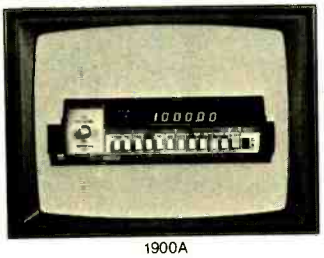
Five different models offer both time *and* frequency, with award-worthy performance and features; the ratings are terrific!

New Time and Frequency.

Last year's hit, the model 1900A, set the stage for this new series of multicounters by offering frequency, period, period average and totalize *standard* in one great counter.

Now all models in the series offer comparable features and value, with autoranging and autoreset as well.

Most models feature a trigger level control and battery option for reliable field use or line-cord-free bench operation. All typically have a 15 mV sensitivity (guaranteed on most!), plus a 0.5 ppm/month time base for long-term stability.


1900A

The Price is Right.

From this shared base of solid performance features, we've built a series of counters with one model just right for your needs.

The new **1912A**, with a 520 MHz range and an extensive package of standard features, offers more capability for $620* than you're likely to find anywhere. For 250 MHz measurement perfection, the **1911A** multicounter is a best-buy for only $495.*


1925A

For lower frequency (125 MHz) applications, specify the **1910A** for $395.* The **1900A** years ahead in value, has been reduced to $345* for even more cost-effective 80 MHz measurement.

For rugged environment applications in the 125 MHz area, you'll want the **1925A** with its RFI shielding and dust-resistant steel case. $750.* (For only $225* more, a special prescaler option extends the 1925A's range to 520 MHz.)

Tune In and Count.

Call (800) 426-0361, toll free, for the location of the closest office or for complete technical literature. Then stop in for the great family picture, and review the extensive option list for better TCXOs, data outputs, and more. John Fluke Mfg. Co., Inc., P.O. Box 43210, Mountlake Terrace, WA 98043.

*U.S. price only.

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letters

TELEPHONE DIALER

I would like to compliment you on the telephone dialer construction article that appeared in the June issue. This is the kind of article that makes me kick myself for not subscribing.

The only thing that I did not like about the article was the size of the PC layout. Printing the foil diagrams half size is inconsiderate of the hobbyist, especially now that there are kits for transferring PC layout from magazine to board. I have no idea how I am going to be able to use the layout published in **Radio-Electronics.** I'll probably end up using it as a guide to construct my own artwork.

Even if I could find a place that would enlarge the layout at a price that I could afford, I would still have a lot of work to do. There are several traces on the layout that seem to have bled together as a result of the reduction.

In summary, thanks for the article but why the heck don't you print foil patterns full size?

K. MATTHEWS
Langley, B.C., CANADA

This very question has been batted around our editorial offices for many moons. Basically, the problem boils down to the fact that we have just so many editorial pages to work with. Within this certain number of pages, we must fit in all our departmental material and our feature articles. Of course, we could gain some space by either cutting down the amount of information that is provided (as is done by one of our competitors) or by printing fewer feature articles. Printing fewer articles means that we might not print the article that would cause you to kick yourself for not subscribing. Obviously, neither of these approaches would work. So we opted for a third approach. That is, to keep the space required for the artwork to a minimum, which creates the problem that you raise.

That's the problem and the solution. Believe me, we are not happy with the solution and are constantly searching for a better one. A suggestion was recently made that we might provide full-size artwork to those readers that want it. This, too, has been batted around the office. We're reluctant because we feel it would be unfair to charge our readers for the printing, handling and postage.

Perhaps it's time for you to decide what you want rather than for us to decide. So, let's put it to a vote. We can provide full-size printed foil-patterns for about $2 or full-size photographic film for about $5. Let us know whether you would want this service or not and whether you would want printed sheets or film. Even if you have a completely different solution, let us know by writing to the Editorial Department, **Radio-Electronics,** *200 Park Ave. So., New York, NY 10003. We'll publish the results in a forthcoming Letters column.*—Editor

QUAD SCOPE

The article by Stephen Dunifer, *"Display Quad Signals on Your Scope,"* in the June issue, reminded me of a similar circuit I built in 1972.

Your readers might be interested to read of some of my experiences building the scope:

1. Matrix resistors must be closely matched. The exact value is not as important as having resistors of the same value (or as close as you can match them). I selected a group of 5.6K 10% carbon resistors from my "junk box" and used any that fell within a reasonable selected range.

2. When it was put in operation, I found a pattern displaying a very high level signal in one quadrant and a very low level in the diagonal quadrant, compared with the other two quadrants. This was caused by mismatched gain in one section of a bargain-priced dual op-amp. Installing a good IC provided normal operation.

3. Always use IC sockets. It saves wear and tear on both the circuit and one's brain.

4. I used an MC1458 in my final version.

In Mr. Dunifer's article, Fig. 1 has a typographical error at IC2—the "−" voltage should read "−9V." Also, I feel that the reference to Fig. 5 could be clarified by explaining that, when correctly connected, the upper left and right scope quadrants represented the left and right front quad (or stereo), while the lower left and right quadrants represent the corresponding rear quad channels.

Keep up the good work.

MAYNARD BERGER
Chicago, IL.

TV TUNER SERVICE

Broken feed-through capacitors that are caused by a technician incorrectly removing the wires from TV tuners has always been a problem for TV tuner services.

It is advisable not to desolder wires from any tuners. Clip them off and resolder, using the least amount of heat and "getting off" the joint as soon as possible.

Not only will your favorite tuner service appreciate the courtesy, but it will save you time and trouble.

TED FOSTER
Texas Tuner Service
Fort Worth, TX

MAGNET CAN'T "SOLVE ENERGY CRISIS"

In the "Letters Column" in the July 1977 issue, John Ecklin stated "we could solve our energy crisis" by controlling the magnetism of materials.

By reviewing your high school physics book, you'll find that energy is the "ability to do work." Magnetism is a *property* of

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LETTERS

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some materials (as is color, for example) and has about the same potential for doing useful work as would a change in color.

Mr. Ecklin implies that you can get *work* from magnetic *material,* while leaving that material intact—a direct contradiction of the law of conservation of energy. He overlooks the fact that if he wants to lift something with a magnet, he first has to lift the magnet to the elevated position, a procedure that takes at least as much energy as lifting the item itself.

Although it would be indeed delightful to get something for nothing, the laws of nature are not so easily bent to accomplish it.

MARC W. SCHARF
Kokomo, IN

RG-8/U COAX DANGEROUS

There are a number of CB installers headed for possible financial disaster from their use of RG-8/U coax in power leads to CB radios.

RG-8/U is not approved for power wiring due to the low temperature "flow" of its inner insulation and the insulation's "flame" temperature. Using this cable for power leads invites setting the vehicle on fire and a very possible legal judgment against the installer for the vehicle's loss.

If CB installers insist on using RG-8/U cable for power wiring, even though there is approved shielded power cable available, they should at least install the fuse at the battery and not at the radio.

VERN MOMBERG
MEG Communications Inc.
Hood River, OR

NEW COMPUTER CLUB

Your readers may be interested to know of our new 50-member computer club.

Monthly meetings are open to anyone with an interest in hobbyist computer systems. Ideas are shared, information exchanged and experiments and problems discussed. The yearly dues of $5 entitles members to discounts on classes, club purchases and an occasional special program, as well as receiving the monthly newsletter.

For further information, write: Inland Empire Computer Club, Box 1434, Spokane, WA 99210.

STEPHEN L. SALA
Spokane, WA

MAGNETIC SEMICONDUCTOR

John Ecklin's letter in the August 1977 issue prompted me to re-read some of the earlier letters on the same subject. The hypothetical "magnetic semiconductor" in particular is interesting.

Suppose the system shown in Fig. 1 is constructed. The magnetic field blocking screen (a variable permeability device that would "short-circuit" the normal lines of force, thereby removing them from the side opposite the magnet) would be connected to a squarewave oscillator of a suitable frequency. The magnet used would be strong enough to lift the iron block from the ground and then some.

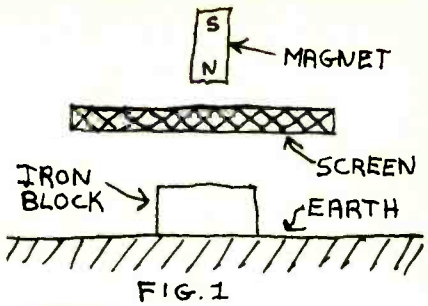


FIG. 1

Everything is positioned as shown, and the oscillator turned on. We now have an iron block bouncing up and down. The excess strength in the magnet and the weight of the block would allow a generator or some other device to extract work from the system. Given values for the distances and masses, it should be possible to calculate the minimum power requirements for the screen, based on the law of conservation of energy.

Something like an LED display, with molecules in suspension with an electric charge parallel to their magnetic axis might form such a screen.

ANDREW S. FRASER
Montreal, Canada

New Sinclair Cambridge Programmable. An astonishing $29.95!

How pocket calculators grew up

A couple of years ago, calculators took a step forward. Programmability transformed the slick slide-rule calculator into an advanced scientific machine.

Sadly, it also transformed a cheap little calculating aid into a piece of capital investment.

Now the all-new Sinclair Cambridge Programmable puts programmability where it belongs: in the palm of your hand, for less than $30.

The features of the Sinclair Cambridge Programmable

The Cambridge Programmable is genuinely pocketable. A mere 4½" x 2", it weighs about 2oz.

Yet there is absolutely no compromise in the package of functions it offers.

Because the Cambridge Programmable is both a *scientific calculator* with memory, algebraic logic and brackets (which means you enter a calculation exactly as you write it), and a *programmable calculator* which offers simple, flexible through-the-keyboard program entry and operation.

The Cambridge Programmable has a 36-step program memory, and features conditional and unconditional branch instructions (*go to* and *go if negative*).

There is also a step facility, which allows you to step through the program to check that it has been entered correctly. If there is any programming error, the learn key allows you to correct single steps without destroying any of the remainder of the program.

To achieve this, each program key-stroke has an identifying code, or 'check symbol'. (The symbols for the digit keys are the digits themselves, while the symbols for the operator keys are letters printed beside the keys.)

The check symbol for ⊟, for example, is F. So if, as you step through the program, the display shows

it means that ⊟ is programmed as step 26. If step 26 should have been ⊞, all you have to do is press

learn

[▲/▼] [RUN] [+]

puts machine into 'learn' mode. — the correct step

It's as simple as that!

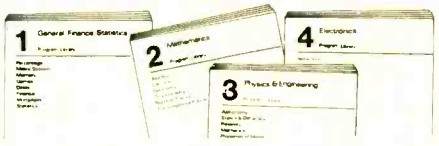
These facilities make the Cambridge Programmable exceptionally powerful, whether it's running programs you devise for yourself or the programs in the Program Library.

Use the 294-program library to tailor the machine to your own specialty

Like a full-size computer – and *unlike* far more expensive specialist calculators – the Sinclair Cambridge Programmable can be programmed to handle calculations concerned with *any* specialty.

And of course, whatever it's doing the Programmable is error-free – in fact, once it's programmed, it can even be given to an operator who doesn't understand the program!

To save you time, and to help inexperienced programmers, Sinclair have produced a library of 294 programs ready to be entered straight into the calculator.



Using these standard programs, the Cambridge Programmable solves problems from quadratic equations (where the program gives both real and imaginary roots) to twin-T filter design, and from linear regression to bond yields. It even plays a lunar landing game! To realise the full power of the Cambridge Programmable, the Program Library is a must.

(The calculator is supplied with 12 sample programs, and full instructions for entering your own program. The four books in the program library are available at $4 each, or $10 for the complete set.)

Why the Cambridge Programmable costs so little

The Sinclair Cambridge Programmable uses the Sinclair talent for miniaturisation to the full – as you'd expect from the company that pioneered the truly pocketable pocket calculator, and recently introduced the world's first pocket TV.

Chip and circuitry design are unique to Sinclair, and the Cambridge Programmable is assembled by Sinclair's own staff at their headquarters plant. Shipped direct, and sold to you direct, the Cambridge Programmable accumulates no middleman's profits on the way.

The result is a pocket programmable calculator of advanced design, sold by the manufacturer with the manufacturer's own 1-year comprehensive guarantee, at a price unmatched by any comparable calculator.

10-day no-obligation offer

There's a lot more to this remarkable calculator than a brief written description can cover.

You need to see it and handle it... to program it yourself in a few seconds to save you hours... to check its performance against tables and graphs... to test the full range of programs available... to evaluate, perhaps, its use as an educational aid in developing a student's computer understanding.

So we're offering a 10-day trial. Send your check or money order with the order form below, and you'll receive a calculator direct. Use it for 10 days, and if you don't feel it's the finest $29.95 you've ever invested, send it back. We'll refund your money without question.

There's nothing to lose, and so much calculating power to gain.

Post your order today.

sinclair

Sinclair Radionics Inc., Galleria, 115 East 57th Street, New York, N.Y. 10022 USA. Tel: (212) 355 5005.

To: Sinclair Radionics Inc., Galleria, 115 East 57th Street, New York, N.Y. 10022, USA. RE-10

Please send me_____(qty) Sinclair Cambridge Programmable(s) at $29.95 each, including full instructions, and sample programs. $_____

_____ (qty) AC line adaptor(s) at $4.95 $_____

_____ (qty) Program Library **Book 1** at $4 **General/Finance/Statistics** (percentage, metric system, memory, games, dates, finance, mortgages, statistics) $_____

_____ (qty) Program Library **Book 2** at $4 **Mathematics** (algebra, calculus, geometry, trigonometry, number theory, transcendental functions) $_____

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_____ (qty) Program Library **Book 4** at $4 **Electronics** (networks, circuits, filters, electrodynamics, radiation and propagation) $_____

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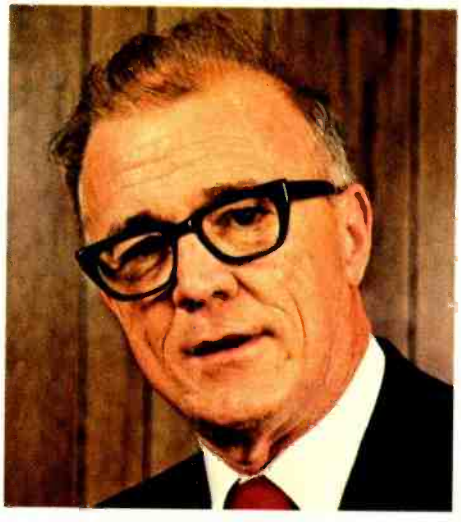

John E. Cunningham

Special Projects Director
Cleveland Institute of Electronics

My father always told me that there were certain advantages to putting all your eggs in one basket. "John," he said, "learn to do one important thing better than anyone else, and you'll always be in demand."

I believe he was right. Today is the age of specialization. And I think that's a very good thing.

Consider doctors. You wouldn't expect your family doctor to perform open heart surgery or your dentist to set a broken bone, either. Would you?

For these things, you'd want a specialist. And you'd trust him. Because you'd know if he weren't any good, he'd be out of business.

Why trust your education and career future to anything less than a specialist?

You shouldn't. And you certainly don't have to.

FACT: CIE is the largest independent home study school in the world that specializes exclusively in electronics.

We have to be good at it because we put all our eggs in one basket: electronics. If we hadn't done a good job, we'd have closed our doors long ago.

Specialists aren't for everyone.

I'll tell it to you straight. If you think electronics would make a nice hobby, check with other schools.

But if you think you have the cool – and want the training it takes – to make sure that a sound blackout during a prime time TV show will be corrected in seconds – then answer this ad. You'll probably find CIE has a course that's just right for you!

At CIE, we combine theory and practice. You learn the best of both.

Learning electronics is a lot more than memorizing a laundry list of facts about circuits and transistors. Electronics is interesting because it's based on some fairly recent scientific discoveries. It's built on ideas. So, look for a program that starts with ideas – and builds on them.

That's what happens with CIE's Auto-Programmed® Lessons. Each lesson uses world-famous "programmed learning" methods to teach you important principles. You explore them, master them completely . . . before you start to apply them!

But beyond theory, some of our courses come fully equipped with the electronics gear to actually let you perform hundreds of checking, testing and analyzing projects.

In fact, depending on the course you take, you'll do most of the basic things professionals do every day – things like servicing a beauty of a Zenith color TV set . . . or studying a variety of screen display patterns with the help of a color bar generator. Plus there's a professional quality oscilloscope you build and use to "see" and "read" the characteristic waveform patterns of electronic equipment.

You work with experienced specialists.

When you send us a completed lesson, you can be sure it will be reviewed and graded by a trained electronics instructor, backed by a team of technical specialists. If you need specialized help, you get it fast . . . in writing from the faculty specialists best qualified to handle your question.

People who have known us a long time, think of us as the "FCC License School."

We don't mind. We have a fine record of preparing people to take . . . and pass . . . the government-administered FCC License exams. In fact, in continuing surveys nearly 4 out of 5 of our graduates who take the exams get their Licenses. You may already know that an FCC License is needed for some careers in electronics – and it can be a valuable credential anytime.

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equipment reports

Fluke Model 8020A Digital Multimeter

CIRCLE 90 ON FREE INFORMATION CARD

THE JOHN FLUKE MANUFACTURING CO., INC., PO Box 43210, Mountlake Terrace, WA 98043, has been making high-quality test equipment for a long time. They specialize in high-precision lab-type instruments, especially digital voltmeters. Their latest product, *model 8020A*, is a compact, versatile and accurate digital multimeter.

Despite its small size, the *model 8020A* is a true multimeter. It reads AC/DC voltages, current and resistance and has a 10-megohm/100-pF input impedance. Its accuracy is 0.25% for AC voltages. The 3.5 digit LCD readout has 0.5-inch-high digits, readable at any practical distance.

It will also perform tricks that some other DMM's can't! It will read conductance directly on two ranges: 2 millisiemens and 200 nanosiemens. (A siemens is the new international unit of conductance, once called an mho. It represents the reciprocal of resistance, or 1/R.) Reading the conductance gives the effect of increasing the resistance range to 10,000 megohms. A simple chart in the instruction manual shows you how to do this. There's no trigger-work involved. Just take the reading and look it up. We tried it out on a couple of high-voltage multiplier resistors of 400 and 800 megohms, and it works.

The same function, with a simple adapter made of a SPDT switch, two banana plugs, a 750K resistor and a transistor socket allows you to check transistors for type, open, shorts, and also gives you a direct reading of the I_{CES} leakage and the *beta*! This procedure is really simple. Look at the reading and move the decimal point three places to the right. A reading of .125 means the transistor has a beta of 125.

The regular ohms ranges of the *model 8020A* are set up to make our favorite "high one way, low the other" transistor tests easy. The unit has six ohms ranges, and every other one is a high-power range that will turn on a transistor junction. These high-power ranges are plainly marked with a diode symbol. The low-power ohms ranges in between permit in-circuit tests without turning on transistors or diodes.

The AC volts ranges can be read with accuracy up to 5 kHz. The readout is RMS for sinewaves. Since waveforms other than sinewaves cause errors, the manual includes a very detailed chart that shows practically every possible waveform from a half-wave rectified AC to a sharp pulse and even a triangle wave. Also shown are peak, peak-to-peak, average and RMS voltages that will be read out; the duty-factor correction for pulses is also indicated.

This type of correction is also included for the current ranges. If the reading must be very precise, you can read the "burden voltage" (the actual drop across the shunt in use), and find the correction factor that must be added to the reading to get the true current. Another very handy chart in the manual shows exactly which buttons to push to set up on any given range or function. This was helpful when we were trying to get the conductance test to work. It *does* pay to read the instruction book!

(Incidentally, an LCD readout shows up brighter in bright light. In a room so dark the panel could barely be seen, the digits were still visible.)

The heart of the *model 8020A* is a special CMOS-LSI IC that can do everything except walk the dog. Every one of the analog and digital functions are in this IC. It also includes the crystal-controlled *clock*, which has 3.84-MHz crystal to provide all clock signals. The *model 8020A* uses dual-slope integration. The crystal clock provides almost complete freedom from any AC line interference.

This is an autopolarity-type DMM. A normal readout means that the hot lead is positive. A negative voltage is indicated by a minus sign to the left of the readout. For overload readings, only the left-hand "1" digit is lit, which is also the normal open-circuit reading for the ohmmeter ranges. Decimal-point placement is also automatic on all ranges. The ohms range reads out kilohms; a full-scale reading of "2" (actually "1.999") means 2000 ohms.

All of the switching is done by eight pushbuttons. There are six range pushbuttons that are interlocked. However, the CONDUCTANCE pushbutton and any one of the remaining five range pushbuttons can be locked down at once, which is necessary for the conductance tests. Another pushbutton selects either AC or DC measurement and the final pushbutton selects either milliampere/volts or 1000k ohms/nanosiemens.

The ON-OFF switch is a slide type, located on the upper left-hand side of the case, right under your thumb when you hold it in the normal way (or under your forefinger if you happen to be left-handed).

The *model 8020A* is powered by one No.

continued on page 24

Bearcat® 210 $289.

The Bearcat® 210 is a sophisticated scanning instrument with the ease of operation and frequency versatility you've dreamed of. Imagine, selecting from any of the public service bands and from all local frequencies by simply pushing a few buttons. No longer are you limited by crystals to a given band and set of frequencies. It's all made possible by *Bearcat* spaceage solid state circuitry. You can forget crystals forever.

Pick the 10 frequencies you want to scan and punch them in on the keyboard. It's incredibly easy. The large decimal display reads out each frequency you've selected. When you want to change frequencies, just enter the new ones.

Automatic search lets you scan any given range of frequencies of your choice within a band. Push-button lockout permits you to selectively skip frequencies not of current interest. The decimal display with its exclusive "rolling zeros" tells you which channels you're monitoring. When the *Bearcat* 210 locks in on an active frequency the decimal display shows the channel and frequency being monitored.

With the patented track-tuning system, the Bearcat 210 automatically aligns itself so that circuits are always "peaked" for any broadcast. Most competitive models peak only at the center of each band, missing the frequencies at the extreme ends of the band.

The Bearcat 210's electronically switched antenna eliminates the need for the long low band antenna. And a quartz crystal filter rejects adjacent stations as well as noise interference.

Call toll-free 800-521-4414 now to place a BankAmericard or Mastercharge order. This is our 24 hour phone to our order department and only orders may be processed on this line. To order in Michigan or outside of the U.S. dial 313-994-4441.

Add $5.00 for U.S. shipping or $9.00 for air UPS to west coast. Charge cards or money orders only please. International orders invited. Michigan residents add tax. Please write for quantity pricing.

Bearcat® 210 Features

- **Crystal-less**—Without ever buying a crystal you can select from all local frequencies by simply pushing a few buttons.
- **Decimal Display**—See frequency and channel number—no guessing who's on the air.
- **5-Band Coverage**—Includes Low, High, UHF and UHF "T" public service bands, the 2-meter amateur (Ham) band, plus other UHF frequencies.
- **Deluxe Keyboard**—Makes frequency selection as easy as using a push-button phone. Lets you enter and change frequencies easily . . . try everything there is to hear.
- **Patented Track Tuning**—Receive frequencies across the full band without adjustment. Circuitry is automatically aligned to each frequency monitored.
- **Automatic Search**—Seek and find new, exciting frequencies.
- **Selective Scan Delay**—Adds a two second delay to prevent missing transmissions when "calls" and "answers" are on the same frequency.
- **Automatic Lock-Out**—Locks out channels and "skips" frequencies not of current interest.
- **Simple Programming**—Simply punch in on the keyboard the frequency you wish to monitor.
- **Space Age Circuitry**—Custom integrated circuits . . . a *Bearcat* tradition.
- **UL Listed/FCC Certified**—Assures quality design and manufacture.
- **Rolling Zeros**—This *Bearcat* exclusive tells you which channels your scanner is monitoring.
- **Tone By-Pass**—Scanning is not interrupted by mobile telephone tone signal.
- **Manual Scan Control**—Scan all 10 channels at your own pace.
- **3-Inch Speaker**—Front mounted speaker for more sound with less distortion.
- **Squelch**—Allows user to effectively block out unwanted noise.
- **AC/DC**—Operates at home or in the car.

Bearcat® 210 Specifications

Frequency Reception Range

Low Band	32—50 MHz
"Ham" Band	146—148 MHz
High Band	148—174 MHz
UHF Band	450—470 MHz
"T" Band	470—512 MHz

*Also receives UHF from 416—450 MHz

Size
10⅝" W x 3" H x 7⅝" D

Weight
4 lbs. 8 oz.

Power Requirements
117V ac, 11W; 13.8 Vdc, 6W

Audio Output
2W rms

Antenna
Telescoping (supplied)

Sensitivity
0.6μv for 12 dB SINAD on L & H bands
U bands slightly less

Selectivity
Better than −60 dB @ ± 25 KHz

Scan Rate
20 channels per second

Connectors
External antenna and speaker; AC & DC power

Accessories
Mounting bracket and hardware
DC cord

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CIRCLE 68 ON FREE INFORMATION CARD

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1604 9-volt battery. The specifications list a service life of 200 hours with an alkaline battery, or up to 150 hours with a carbon-zinc battery. For bench use, the *model A81* AC adapter can be plugged into a socket on the right-hand side of the case. This adapter is available in 110-, 115-, or 230-volt inputs, or in 230 volts with the European-type line plug.

If the battery is low, the letters BT appear on the display at the upper left. However, you've still got time to finish the job, since this readout means that there are about 20 hours of battery life left. A padded carrying case is available, with pockets for the test leads and even the instruction card.

Also available are accessory probes to let you use the unit in many other applications. An AC clamp-on adapter (*model 801-600*) permits AC current readings up to 600 amperes. A high-voltage probe (*model 80K-40*) extends the range to 40 killivolts DC, or 28 killivolts RMS AC. The RF probe (*model 81RF*) reads RF voltages from 100 kHz to 100 MHz with a ± 1.0-dB accuracy. It can be used up to 250 MHz for relative readings. The universal temperature probe (*model 80T-150*) converts the *model 8020A* to an accurate thermometer covering a wide range from −50° to +150°C (−58° to +302°F). This probe has a special fast-response sensor, so that no surface preparation is needed, which is very useful for finding hot spots, checking the case temperature of suspect transistors, etc.

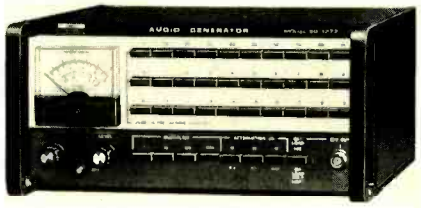
The *model 8020A* uses very sensitive CMOS technology; however, the whole circuit is well protected against accidental overloads, transients and all the catastrophes that can strike unprotected testers. Even the ohms ranges are protected against applications up to 300 volts DC. Voltage ranges are protected against overloads up to 1000 volts, and 2 amperes on the current ranges. In addition, special protection against transients is provided, up to 6 killivolts on all functions. This could be very useful in TV repair or in other situations where transients are commonly experienced.

Here's the best feature of all. Many high-precision DMM's also have high prices. The *model 8020A* is in the affordable area, at $169.00, complete with battery and test leads. The accuracy of this instrument makes it suitable even for fields such as avionics, where 0.25% readings are required by the FAA and others.

I must also say a kind word about the instruction manual. It is written in plain English! Charts and illustrations are clearly drawn, with a very complete coverage of everything that is needed. The back pages have full instructions for calibration and maintenance tests, a schematic and chassis layout and a parts list. In fact, even a printed label is included so that you can send the instrument to the nearest Fluke service center! A list of these world-wide service centers is included with the meter.

All in all, the *model 8020A* is an impressive piece of test equipment. **R-E**

Heath SG-1272 Low-Distortion Audio Generator



CIRCLE 50 ON FREE INFORMATION CARD

THE HEATH COMPANY HAS DEVELOPED AN audio signal generator, *model SG-1272*, that produces low-distortion sinewaves with good stability. The distortion rating is 0.1% from 10 to 40 Hz; 0.04% from 40 Hz to 20 kHz; and rises to 0.1% at 100 kHz!

The output is really flat; within ± 0.2 dB from 20 Hz to 100 kHz. We fed the output into a wideband oscilloscope and checked for flatness. The result was that the amplitude at 100 kHz was the same as at about 40 Hz. The sinewave displayed at the maximum frequency showed no visible distortion.

The *SG-1272*'s output voltage is constantly metered and fully adjustable to a maximum of 10 volts RMS. A LEVEL control adjusts the output to any desired level. Three pushbutton attenuators on the panel provide precision-control of the output. These attenuators total 70 dB in 10- , 20- and 40-dB steps, or 0.3%, 0.1% and 0.01% of the voltage. For example, set the meter to 10 volts and depress the 10-dB pushbutton. The output voltage will then drop

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TOWERS' INTERNATIONAL TRANSISTOR SELECTOR—2ND EDITION

Transistor substitutions, outline diagrams, terminal identifications, manufacturers' codes, and specs for more than 13,000 devices manufactured in the U.S., Japan, Continental Europe, and the United Kingdom. If you want data on a specific transistor, for which you know only the type number, or if you want to know which supplier makes it, or if you need a good substitute, or if you want the complete specifications for any given transistor, there's really only one practical source of data: Towers' International Transistor Selector. This brand-new and completely updated edition is an ultra-complete reference guidebook which is an absolute MUST for anyone who deals with transistors or the equipment in which they're used. This comprehensive volume makes it as easy to locate transistor substitutes for Japanese and European imports as for mass-market U.S. consumer electronic products. And that's not all! This transistor compendium is a comprehensive tabulation of more than 13,000 individual bipolar transistor specifications, with accurate, reliable information on device ratings, characteristics, case details, terminal identifications, applications, manufacturers (domestic and foreign) and their addresses. From start to finish, the emphasis is on practicality. So, you won't see page after page of meaningless engineering data you'll never use. What you WILL see are the kinds of facts you HAVE to know to understand the functional applications of the devices listed. 200 pps., 7" x 10".

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to 0.3% of the meter reading, or 3.33 volts.

A 0- to 3-volt scale reads the lower voltages. For example, to feed a 50-mV signal to the input of a high-gain amplifier, just set the LEVEL control to 5 volts on the meter and depress the 40-dB pushbutton. The output signal will be 5 × .01, or .050 volt (50 mV).

The *model SG-1272* output signal is fed to an internal 600-ohm load. The meter reads the true voltage across this load; external loads can be used by pushing the LOAD/SELECTOR switch near the output jack.

Three rows of 10-position pushbuttons, (0–90, 0–9 and 0–0.9) select the output frequency. At the bottom of the panel are four interlocked MULTIPLIER pushbuttons (marked ×1, ×10, ×100 and ×1000). A desired frequency can be obtained by pushing the frequency selection pushbuttons and then the multiplier. For example, for a 1,000-Hz frequency, press pushbuttons 90, 9 and 0.9 and the ×10 multiplier; the result is 999.9 Hz, a close enough approximation. When the controls were set to the extreme upper limit of 100 kHz, the frequency counter read 99.999 kHz, changing to 100000 periodically. This upper-limit reading was stable.

To use the *model SG-1272* as a continuously variable frequency generator, press all three "0" pushbuttons simultaneously. The output frequency can now be controlled by the VARIABLE FREQUENCY control (on the panel near the LEVEL control) together with the multiplier switches.

The oscillator circuit used in the *model SG-1272* is a Wien-bridge type. The precision-frequency selection is made possible by using extremely high-precision IC resistor packs. One resistor pack is used with each selector-switch deck, along with 1% capacitors.

A special output jack on the rear panel feeds external sync to a scope, and provides a sample of the output frequency for triggering.

The circuit is powered by a transformer-isolated, dual-voltage DC supply. A slide switch on the rear panel sets the transformer primary for either a 120-volt or a 240-volt input. The −24- and +24-volt DC supplies are tightly controlled by separate IC voltage regulators. The oscillator frequency is stabilized by heavy negative feedback.

The *model SG-1272* comes in a metal and plastic cabinet, with handles that also protect the controls. All controls are conveniently placed for easy operation. **R-E**

B&K Model 530 Semiconductor Tester

THE B&K DIVISION OF DYNASCAN HAS BEEN making semiconductor testers for some time, using their "Dynapeak" circuit. The top of the line, *model 530*, the latest and most elaborate, uses the basic Dynapeak transistor test system. It locates base connections and identifies them, at the same time testing the transistor for type and quality. All this is done by moving the six-position test switch through all positions.

The device under test can be plugged into a socket on the panel, or hooked up to three color-coded test leads with clips. Once it's

hooked up, all tests except F_t may be made by moving switches. The dual LED indicators tell whether it is PNP or NPN, and good. For in-circuit testing, an audible beep is heard when you hit the right switch position. This can be turned off if not needed.

Beside the clips, a special probe, FP-5 Dynaflex, may be used for on-the-board tests, especially if the transistors are identified in any way. Once again, all you have to do is make contact to each transistor terminal. The FP-5 has three color-coded, very sharp ball-joint pins, that are spring-loaded. Push them onto the transistor connections with one hand, and move the switch with the other. You don't have to look up if you're using the beeper. When you hit the right connections, the little window on the panel by the switch shows which color lead is on each element.

The *model 530* indicates whether a device is a bipolar transistor or an FET, in- or out-of-circuit. The typical bipolar transistor will given an indication in either HI or LO drive, in switch two positions. In LO drive, only one position will give an indication. (Most bipolar transistors will show a small gain with emitter and collector reversed.) However, FET's will show good in two test positions having the same *base* color (FET gate) because practically all junction FET's are symmetrical. The Dynapeak system uses two "Drive" positions: One HI and one LO. In HI, enough drive is available to turn on transistors in-circuit with more than 10-ohm shunt resistance. The drive voltage is applied with a 3% duty cycle, so that you cannot damage a transistor by excessive conduction.

With the transistor hooked up and identified, out-of-circuit, you can make a great many tests by switching. You can read all kinds of breakdown voltages and leakage currents: BV_{CES}, I_{CES}, BV_{CBO}, I_{CEO}, BV_{ECS}, I_{ECS}, BV_{ECO}, I_{ECO}, BV_{EBO} and I_{EBO}. Simply set the switches as described in the instruction manual. Leakage is read on a meter with a special nonlinear scale: It starts out at 10 microamps per division, and ends with a full-scale reading of 5 mA. The beta or g_m can be read on dual HI-LO scales below.

Beta readings can be made for comparison, for example, a direct-coupled driver transistor in an audio output stage. You can take the one out of the working channel and read its beta, then select a replacement with the same beta. A mismatched driver transistor can honk up the bias on an output transistor and cause trouble.

For working with VHF or UHF stages, the *model 530* provides a separate test for F_t, the gain-bandwidth product. A direct reading is obtained of the actual F_t, which is the maximum frequency this transistor will amplify. Three ranges are used: 0-100 MHz, 0–500

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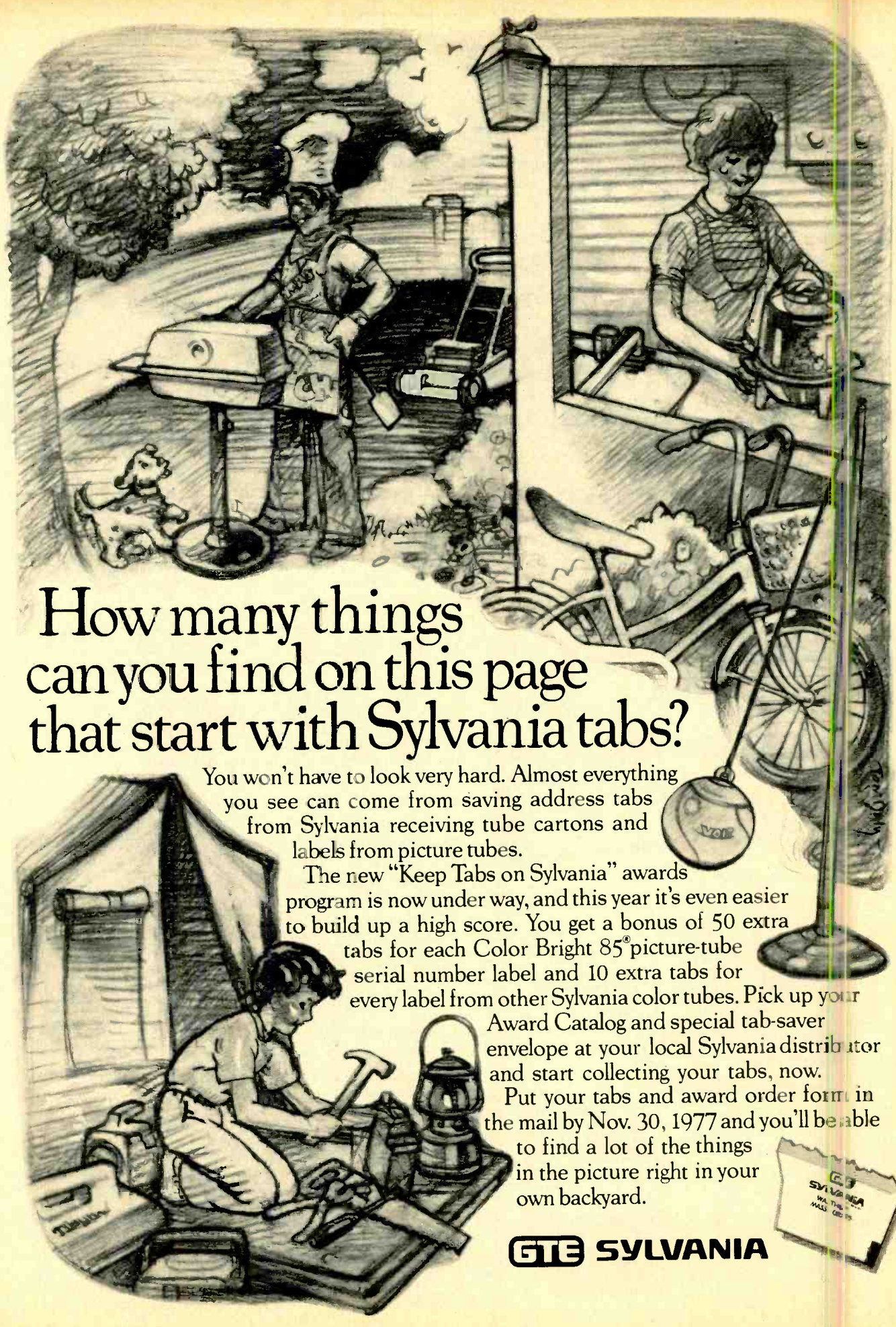

How many things can you find on this page that start with Sylvania tabs?

You won't have to look very hard. Almost everything you see can come from saving address tabs from Sylvania receiving tube cartons and labels from picture tubes.

The new "Keep Tabs on Sylvania" awards program is now under way, and this year it's even easier to build up a high score. You get a bonus of 50 extra tabs for each Color Bright 85® picture-tube serial number label and 10 extra tabs for every label from other Sylvania color tubes. Pick up your Award Catalog and special tab-saver envelope at your local Sylvania distributor and start collecting your tabs, now.

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NEW H11 16-bit Computer. Heath, world leader in kit form products, and Digital Equipment Corporation, world leader in minicomputers, combine to bring you the ONLY 16-bit personal computer priced within reach of the general public. Based on the powerful LSI-11.

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NEW AD-1304 Active Audio Processor. Minimizes background noise from records or broadcast sources. Also adds 7 dB dynamic range to your hi-fi system. Provides greatly enhanced sound reproduction.

NEW IO-4555 Single-Trace Oscilloscope. A bright, easy-to-read scope ideal for radio-TV servicing, design experiments, general-purpose troubleshooting. Has super-bright trace, easy to operate controls, TV trigger switch, lots more.

NEW IM-5225 deluxe FET Multimeter. Quality general-purpose tester measures AC and DC volts, AC and DC current and resistance. Checks semiconductors in or out-of-circuit too! Has pushbutton function switches, full overload protection, easy-to-read meter with color-coded scales.

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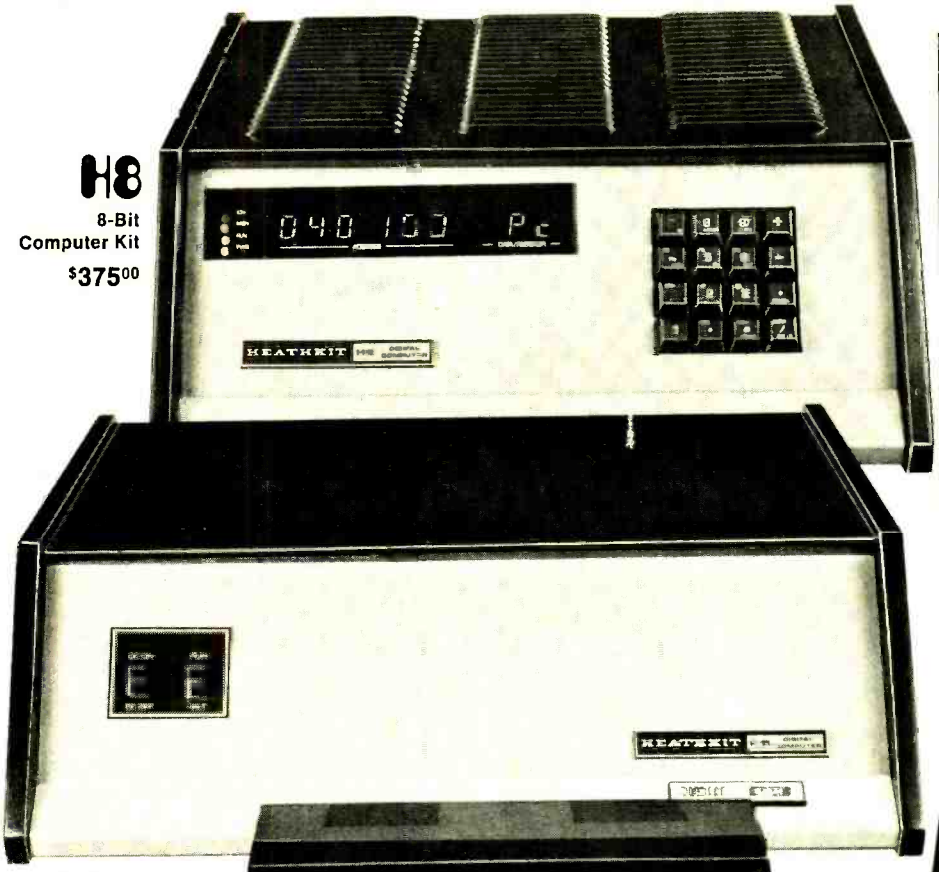

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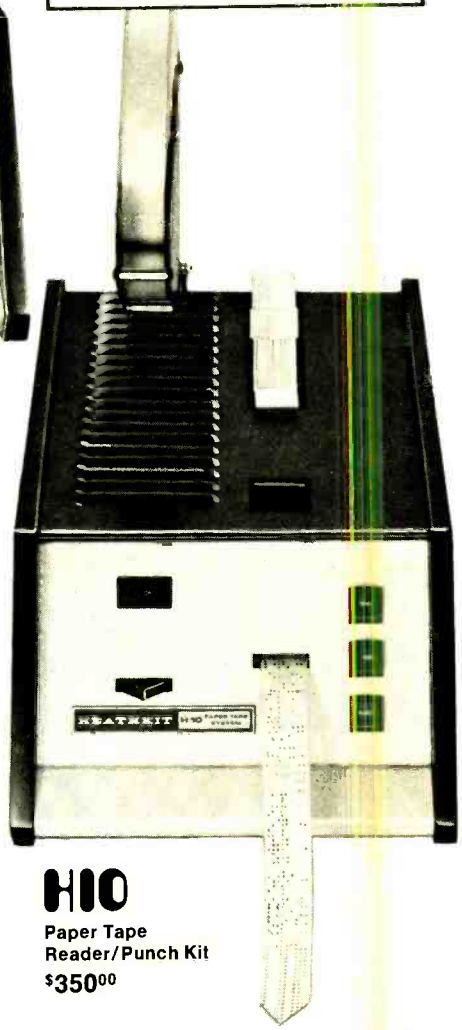

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MHz and 0–1500 MHz. The test actually feeds an RF signal into the transistor and then reads its current gain on the meter; three oscillators are used, at 1.0, 10.0 and 30.0 MHz. The device under test is plugged into one of two sockets on the F_t test panel. If it has a nonstandard base, a little plug-in adaptor with three tiny clips can connect any type. Most transistors will show a reading on two of the scales. Use the highest reading, but don't take a reading below about "10" on any of them, for maximum accuracy. For example, a transistor with an F_t of 500 MHz will show a reading on both the 0–500 MHz and 0–1500 MHz scales.

The instruction manual discusses in detail the instrument's operation and circuitry. Full maintenance and calibration test procedures are given. A complete Appendix, with a glossary of transistor terminology, as well as a two-page list of transistor and semiconductor symbols, is in the back of the book.

The *model 530* is housed in a neat "lay down" type case. The panel is well designed; all controls and switches are easy to get at and use. All identification, leakage and beta tests are on the right side, with the F_t test on the left by itself.

We gave it a good workout on some units we had, including a transistor remote control receiver panel that had been zapped by lightning. The *model 530* picked out the bad transistors very quickly, out of a large number. We checked all the numerous transistors very quickly using the FP-5 probe. We consider this tester useful for any kind of work involving semiconductors. **R-E**

Lunar Electronics DX-555 Signal Generator/ Frequency Counter

CIRCLE 92 ON FREE INFORMATION CARD

LUNAR ELECTRONICS, BOX 82183, SAN DIEGO, CA 92138, has developed a compact little combination instrument, the *Model DX-555* frequency counter and RF signal generator.

The *model DX55* signal generator has no dial; it uses the frequency-counter readout. Therefore, the generator can be accurately tuned to any desired frequency. It covers a range from 440 kHz to 30 MHz in three ranges—0.44–1.7, 1.7–7.0 and 7.0–30 MHz. It is tuned by a main tuning knob and a separate fine-tuning control marked SPREAD accurately determines the signal output. The RF output can be modulated by an internal 600-Hz audio tone, which is controlled by a front-panel switch.

The frequency counter has a range from 10 Hz to 30 MHz. A built-in prescaler expands the range to slightly more than 220 MHz. A rocker switch on the back panel marked VF/VHF controls the prescaler. A 5-digit LED display reads in kHz or MHz and is controlled by the front-panel slide switch. By adjusting the frequency with the selector switch in the kHz position and then switching to MHz, an extra digit can be gained. Simply move the left digit one position off the screen. This provides one more digit for accurate setup or readout.

The counter accuracy was checked against WWV. The signal-generator frequencies were then checked against the same standard. Both results came out very well, even when we set the generator to 1.0 MHz and beat the 10th harmonic against the 10.0-MHz WWV signal. The counter input jack is on the front panel and a shielded cable is provided. The signal-generator output jack is on the back panel. A short test lead and plug are also provided for this.

The *model DX-555* is AC-powered and the line is fused for protection. The DC power supply uses a full-wave bridge rectifier and is regulated by a solid-state voltage-regulator circuit. A 10-MHz crystal-controlled oscillator provides the clock signals for the digital circuitry. Provisions are made for zeroing the frequency counter against WWV if recalibration is necessary.

Standard 7400-series IC's are used in the dividers, buffers, oscillator stages, etc., and two FET's are used in the RF oscillator.

The *model DX-55* is a compact little instrument that should be very useful in CB, Ham radio, two-way radio and many other applications. **R-E**

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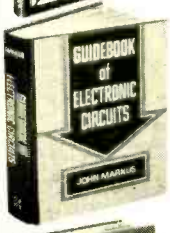

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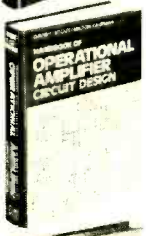

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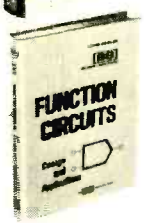

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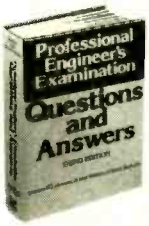

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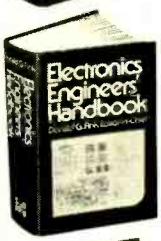

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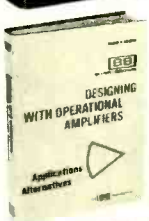

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Mix and match. Use large and small chips in the same circuit without problems. There are two sizes of EXPERIMENTOR sockets with 0.3" and 0.6" centers.

Full fan-out. A CSC exclusive. The only solderless breadboard sockets with full fan-out capabilities for **microprocessors** and other larger (0.6") DIP's.

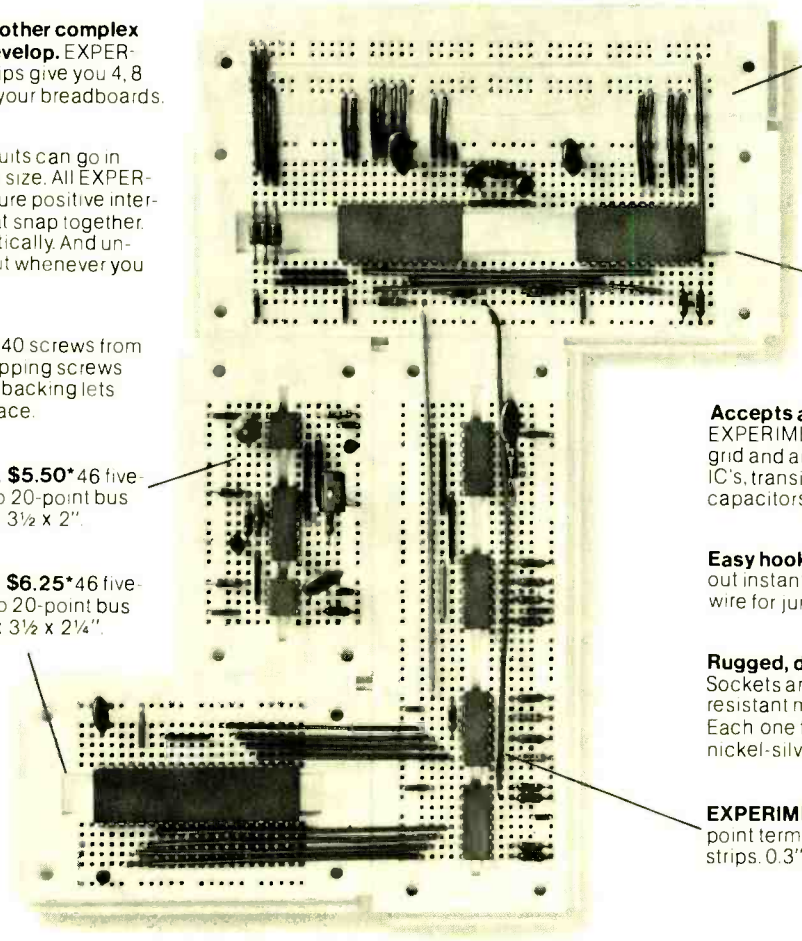
Microprocessors and other complex circuits are easy to develop. EXPERIMENTOR quad bus strips give you 4, 8 or 16 buses to simplify your breadboards.

Infinitely flexible. Circuits can go in any direction, up to any size. All EXPERIMENTOR sockets feature positive interlocking connectors that snap together. Horizontally and/or vertically. And unsnap to change a circuit whenever you wish.

Easy Mounting. Use 4-40 screws from the front or 6-32 self-tapping screws from the rear. Insulated backing lets you mount on any surface.

EXPERIMENTOR 350. $5.50* 46 five-point terminals plus two 20-point bus strips. 0.3" centers; ⅜ x 3½ x 2".

EXPERIMENTOR 650. $6.25* 46 five-point terminals plus two 20-point bus strips. 0.6" centers; ⅜ x 3½ x 2¼".



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CIRCLE 28 ON FREE INFORMATION CARD

ROUNDUP

Digital Clock Kits For Your Car

FRED BLECHMAN, K6UGT

IN THE AUGUST AND SEPTEMBER 1976 ISSUES OF **RADIO-ELECTRONICS**, we reviewed in detail over 30 digital electronic clock kits. Only three were designed for car use, and one of those is no longer available. Since then a number of manufacturers have turned their attention to the huge untapped market of cars, vans, mobile homes, trailers and even airplanes, since standard electromechanical automobile clocks have the reputation of being notoriously poor timekeepers, and often fail long before the useful life of the vehicle.

In the last two years, electromechanical digital clocks have been available as optional equipment on some new cars. It's a little too soon to tell what their long-term accuracy and life span will be. This much is evident: They mostly have small quarter-inch-high digits, and need to be illuminated at night.

But look at the features *electronic* (as opposed to electromechanical) car clocks can offer: (1) large digits (up to 0.5 inch high); (2) self-illumination; (3) display of seconds, month and date; (4) reminder alarm; (5) elapsed-time readout; (6) no moving parts that wear out or need lubrication; (7) accuracy of better than 1 minute per month; (8) simple time-setting with switches, usually to the second; (9) easy installation above or below the dashboard of an existing car—or even *in* the dashboard! (Not all these features are available in all electronic clocks, but most have practically all of them.)

The Comparison Chart shows the various features and characteristics of each clock, as well as the suggested kit or assembled price. Although kit prices are usually stable, check with the manufacturer or distributor for their possible minimum order, latest price, sales tax and shipping/handling charges.

Clocks for mobile use

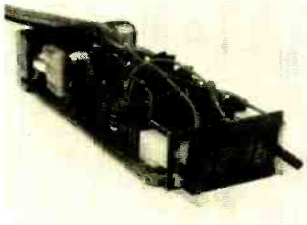
Some clocks being offered in kit form are simply warmed-over 117-VAC designs originally intended for in-home use but

APPLIED MARKETING VC-502 in dash-mounting.

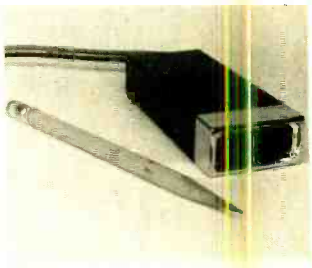
APPLIED MARKETING LC-101 with DS-99 desk stand.

APPLIED MARKETING LC-101. LCD readout visible in sunlight.

APPLIED MARKETING DC-101 has red or green LED's.



THE AUDIOVOX LED-76 is the smallest of the cased units.



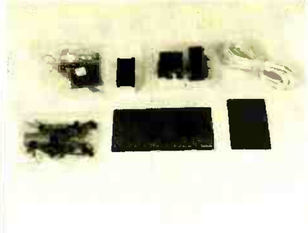
THE AUDIOVOX IN ITS CASE.

ELECTRONIC CAR CLOCKS—COMPARISON CHART

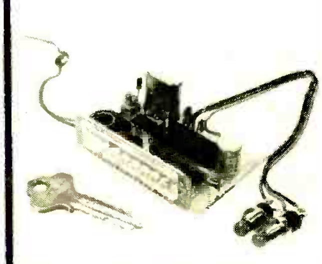
MANUFACTURER OR DISTRIBUTOR	MODEL (* BUILT BY AUTHOR)	PRICE ($) KIT (ASSEMBLED)	DISPLAY FEATURES: NUMBER OF DIGITS	DIGIT HEIGHT (IN.)	RED LED	FLUORESCENT	ORANGE NEON	COLON(S)	AUTO. BRIGHTNESS	AM/PM INDICATOR	12 OR 24 HOUR FORMAT	SECONDS	CALENDAR	ELAPSED TIME	REAL TIME RETAINED	ALARM	MULTIPLEXED	BATTERY BACKUP	CLOCK IC	CASE: COLOR	CASE: MATERIAL	SIZE (INCHES): HIGH	WIDE	DEEP	ASSEMBLY INSTRUCTIONS	APPROXIMATE ASSEMBLY TIME (HRS.)	REMARKS
ALPHA ELECTRONICS (TEXAS) BOX 64726 DALLAS, TX 75206	DIGITAL CLOCK FOR VEHICLES	29.95	6	.15	●						●	●							NATIONAL MM5314	ALUMINUM		CLOCK .9 2.5 / CASE 1.2 2.6		2.8 / 2.9	GOOD	1½	CASE, WITH MAGNIFIER: $4.50.
APPLIED MARKETING CORP. 808 PHOENIX DRIVE ANN ARBOR, MI 48104	ON-DASH MODELS: LC-101 LIQUID CRYSTAL DIGITAL CLOCK	(49.95)	4	.5	LIQUID CRYSTAL			●	●	●	12	●	●					●	FAIRCHILD SPECIAL	BLACK OR BROWN PLASTIC WITH CROME RIM		2.0	2.5	.5			CONSTANT READOUT. PORTABLE. WIRED WITH BACKLIGHT: LC-102. IN-DASH; LC-104 (PORTABLE); LC-103 (WIRED) — ALL SAME PRICE. DS-99 DESK STAND FOR LC-101: $2.00.
	DC-201 DIGITAL CAR CLOCK	(49.95)	4	.3	●						12						●		NATIONAL MM5378			1.4	2.4	.7			SMALLEST CLOCK IN THIS REPORT. GREEN DIGITS AVAILABLE–SAME PRICE IN-DASH DC-202 SAME PRICE.
	VC-501 DIGITAL CLOCK	(39.95)	4	.3		●		●			12								NATIONAL MM5316			2.0	2.5	1.2			RED, GREEN OR BLUE DISPLAY. NO ZERO SECONDS. IN DASH VC-502 SAME PRICE. DIMS WHEN LIGHTS ON.
AUDIOVOX CORP. 150 MARCUS BLVD. HAUPPAUGE, NY 11787	LED-76 AUTO DIGITAL CLOCK	(52.50)	4	.25	●			●			12						●		NATIONAL MM5378	BLACK AND GOLD	METAL	.9	1.6	3.9			SMALLEST 4-DIGIT CLOCK IN THIS REPORT. DISCOUNT PRICE: $39.95.
BULLET ELECTRONICS P.O. BOX 19442 R DALLAS, TX 75219	* MK-03 AIRCRAFT CLOCK/TIMER	26.95	6	.38	●			●		●	24	●		●	●	●	●		MOSTEK 50252 (2 REQ'D)	NOT AVAILABLE		1.4	2.5	3.8	VERY GOOD	5	ELAPSED TIME IN SECONDS FOR 24 HOURS. MANY OPTIONS; SWITCHES NOT INCLUDED. FITS IN RADIO SHACK CASE.
	MK-05 MINI-MOBILE CLOCK	15.95	6	.15	●					●	12	●		●		●	●		NATIONAL MM5375AB	BLACK	ALUMINUM	CLOCK .9 2.6 / CASE 1.7 3.1		2.0 / 3.1	VERY GOOD	1.5	MAGNIFIED DISPLAY. AM/PM SHOWN ONLY WHEN ALARM BEING SET. SMALL ALARM SPEAKER NOT INCLUDED.
CC & SS INC. 2309 SANTA MONICA BLVD. SANTA MONICA, CA. 90404	* CC-6A DIGITAL CALENDAR FLUORESCENT AUTO CLOCK	45.00 (19.95)	4	.3		●		●	●	●	12	●	●					●	FAIRCHILD FWA-6003	BLACK	PLASTIC	2.8	2.8	3.0	FAIR	2½	GREEN DISPLAY. GIMBAL MOUNTING. CAN ALTERNATE TIME, SECONDS & DATE OR DISPLAY SECONDS CONTINUOUSLY.
CONCEPT ENTERPRISES, INC. 1308 WILSHIRE BLVD. LOS ANGELES, CA. 90017	AC-05 DIGITAL AUTOMOTIVE CLOCK	(34.95)	4	.3	●			●	●		12						●		NATIONAL MM5314	BLACK	PLASTIC	2.5 DIA.		2.0			AC-05-1: 24 HR; AC-06 FLUORESCENT; IN-DASH $32.95; AC-03 (12 HR) & AC-04 (24-HR) NO ZERO SECONDS; SHIELDED CABLE; TOUCH SWITCHES.
FAIRCHILD CAMERA & INST. CORP. OPTOELECTRONICS DIVISION 4001 MIRANDA AVE. PALO ALTO, CA. 94303	* FTK0106 AUTO CLOCK	40.00	4	.38	●			●	●	●	12	●	●				●		FAIRCHILD FWA-6004PC	NOT AVAILABLE		1.4	1.8	4.0	POOR	2	HIGH RFI. RUNS HOT. DIFFICULT SHAPE TO ENCLOSE.
HEATH COMPANY BENTON HARBOR, MI 49022	* GC-1093 DIGITAL CAR CLOCK	64.95	4	.5			●	●	●	●	12	●		●	●		●		S-1856A	BLACK AND WALNUT	METAL	1.9	4.6	4.8	EXCELLENT	5	20-HOUR ELAPSED TIME. SECONDS SHOWN ONLY FOR FIRST 20 MINUTES IN ELAPSED TIME MODE. NO TIME BASE ADJUSTMENT.
	GI-1154 AIRCRAFT CLOCK/TIMER	149.95	8	.36	●				●		24	●		●	●	●			FAIRCHILD 3817 (3 REQ'D.)	BLACK	METAL	3.3	3.3	6.0	EXCELLENT	8	2 4-DIGIT DISPLAYS, GMT SHOWN CONTINUOUSLY ON ONE DISPLAY. 24-HOUR ELAPSED TIMER, WITH ALARM THAT FLASHES DISPLAY ON AND OFF.
JAMES ELECTRONICS 1021-A HOWARD AVE. SAN CARLOS, CA. 94070	* QUARTZ DIGITAL AUTO CLOCK OR ELAPSED TIMER	29.95 (39.95)	6	.36	●						●	●		●			●	●	NATIONAL MM5314	GRAY	PLASTIC	1.8	4.0	4.8	FAIR	1½	BASIC FOSKET CLOCK WITH HOLD AND RESET SWITCHES.
	* AUTO WARBLE ALARM CLOCK AND HEADLIGHT ALARM	35.95 (45.95)	4	.5	●			●		●	12	●		●		●			LITON LT 601 A MODULE	GRAY	PLASTIC	1.8	4.0	4.8	FAIR	2	TWO-TONE ALARM SOUNDS AT PRE-SET TIME OR IF HEADLIGHTS ON WITH IGNITION OFF.
JBS ELECTRONICS 3050 VALMONT BOULDER, CO. 80301	MOD-U-CLOCK (4 PC BOARDS)	5.95	6	.3	●						●	●					●		NATIONAL MM5314	TWO-PART ALUMINUM AND PLEXIGLAS		CLOCK 1.5 4.0 / CASE 1.8 4.5		1.4 / 3.3	FAIR	3	CAN USE GREEN OR YELLOW DIGITS. NO COMPONENTS INCLUDED–JUST PC BOARDS AND INSTRUCTIONS. CASE: $6.95.
JEFF 3015 EATON ROAD CLEVELAND, OH. 44122	* CAR CLOCK	19.99 (24.99)	4	.5	●			●		●	12								NATIONAL MM5316	SEE REMARKS		CLOCK 2.2 4.0 / CASE 3.5 4.5		2.4 / 4.3	VERY POOR	2	CASE IS HEAVY FIBREBOARD COVERED IN WOODGRAIN VINYL. IN-DASH MODEL, WITH BEZEL INSTEAD OF CASE: $16.99 KIT, $21.99 ASSEMBLED.
NATIONAL SEMICONDUCTOR CORP. 2900 SEMICONDUCTOR DR. SANTA CLARA, CA. 95051	* MA-1003 CAR CLOCK	24.95	4	.3		●		●			12								NATIONAL MM5377	NOT AVAILABLE		1.8	3.1	1.0	GOOD	½	FILTERABLE TO BLUE, GREEN OR YELLOW. BRIGHT/DIM CONTROLLABLE. COMPLETELY ASSEMBLED MODULE.
NEXUS TRADING CO. BOX 3357 SAN LEANDRO, CA. 94578	* CAR CLOCK	29.95 (45.95)	6	.3	●						●	●					●		NATIONAL MM5314	BLACK	PLASTIC	1.8	3.5	3.2	GOOD	2	MOLDED CASE AND SWIVEL MOUNT: $5.00.
OPTOELECTRONICS, INC. P.O. BOX 219 HOLLYWOOD, FL. 33022	* #2001 MOBILE LED CLOCK	29.95 (39.95)	6	.38	●						●	●					●	●	NATIONAL MM5314	GRAY	PLASTIC	1.8	4.0	4.8	VERY GOOD	1½	POSTPAID USA. BASIC FOSKET CLOCK WITH MODIFIED DISPLAY ENABLE.
	* #2001-R MOBILE LED CLOCK	29.95 (39.95)	6	.38	●						●	●		●			●	●	NATIONAL MM5314	GRAY	PLASTIC	1.8	4.0	4.8	VERY GOOD	2	POSTPAID USA. SUPERSEDES #2001. MODIFIED FOSKET CLOCK WITH EXCELLENT NEW PC BOARD DESIGNS AND 3 MORE SWITCHES.
	#7005 MOBILE CALENDAR CLOCK	39.95 (49.95)	6	.38	●					●	●	●	●	●	●	●	●	●	CAL-TEX CT 7001	GRAY	PLASTIC	1.8	4.0	4.8	GOOD	2½	POSTPAID USA. 4-YEAR CALENDAR. 9 HOUR AND 59 MINUTE TIMER.

QUEST ELECTRONICS P.O. BOX 4430 SANTA CLARA, CA. 95054	* AUTO DIGITAL CLOCK	15.95	4	.5	●			●	●	●	12	●		●		●			NATIONAL MA1012 MODULE	GRAY	PLASTIC	1.8	4.0	4.8	GOOD	2½	CASE: $3.95 ALARM PARTS: $1.50
RAMSEY ELECTRONICS P.O. BOX 4072 ROCHESTER, NY 14610	* DC-7 CAR CLOCK	25.95 (35.95)	6	.38	●						●	●					●		NATIONAL MM5314	SEE REMARKS	ALUMINUM	2.2	4.3	1.8	VERY GOOD	1½	MODERN EXTRUDED CASE AND 3 PUSHBUTTON SWITCHES INCLUDED. CHOICE OF CASE COLORS: GOLD, BLACK, BRONZE, SILVER, BLUE.
	* DC-11D AUTO DIM CAR CLOCK	29.95 (39.95)	6	.38	●				●		●	●					●	●	NATIONAL MM5314	GRAY	PLASTIC	1.8	4.0	4.8	VERY GOOD	1½	BASIC FOSKET CLOCK WITH DIMMER ADDED. DEDUCT $3 WITHOUT DIMMER (DC-11 $26.95).
SABTRONICS INT'L. P.O. BOX 64683-R DALLAS, TX 75206	* SI 204 DIGITAL AUTO CLOCK	26.95 (36.95)	6	.38	●						●	●					●		NATIONAL MM5314	GRAY	PLASTIC	1.8	4.0	4.8	FAIR	1½	BASIC FOSKET CLOCK WITH HOLD SWITCH ADDED.
S.D. SALES CO. P.O. BOX 28810 DALLAS, TX 75228	* JUMBO LED CAR CLOCK	16.95	4	.5	●			●	●	●	●					●	●		MOSTEK 50252	NOT SUPPLIED		DISPLAY 2.0 / CLOCK 1.5	DISPLAY 3.3 / CLOCK 4.4	1.5 / 3.0	FAIR	4	OPTOELECTRONICS CABINET II IS SUITABLE. DISPLAY & CLOCK SEPARATE. ALARM PARTS: $1.50 AC XFMR: $1.50. DIFFICULT ASSEMBLY.
TONITRON INDUSTRIES P.O. BOX 2251 ELKHART, IN 46514	TC-76 CLOCK	(39.95)	4	.4	●			●		●				●					NATIONAL MM5387AA	BLACK	METAL AND PLASTIC	1.2	4.2	5.1			BRIGHT/DIM SWITCH; SECONDS SWITCH. OTHER MODELS COMBINE CLOCK WITH FM, CB & WEATHER BAND CONVERTERS.
XANTECH CORP. 13038 SATICOY ST. NORTH HOLLYWOOD, CA 91605	1611.00 DIGITAL CLOCK	(54.99)	4	.4		●		●			12								NATIONAL MA1003 MODULE	BLACK AND WALNUT	PLASTIC	2.2	4	1.4			DISCOUNT PRICE: $39.95. GIMBAL MOUNTED. MODEL 1611.10 DASH MOUNT: $49.99 LIST PRICE. BLUE-GREEN MAGNIFYING LENS.

The Fosket clock, mentioned in the Remarks column, is an innovative design based on the MM5314 clock IC and MM5369 programmable oscillator/divider.



BULLET MK-03, PARTS LAYOUT.

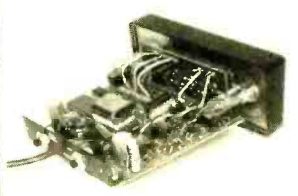


BULLET MK-05 MINI-MOBIL.

CC & SS INC., PARTS.

CC & SS INC. DISPLAY BOARD.

FAIRCHILD FTK0106. Panel switches set time and calendar.



HEATH GC-1093 CHASSIS VIEW.

THE HEATH GC-1093 has a bright, easy-to-read display.

modified to allow them to operate in a car; other designs have been created from scratch expressly for mobile use. Tonitron even offers some models with built-in FM, CB or weather radio converters. For a digital clock to work in a car, certain requirements must be met that are different from those for home clocks: It must be capable of operation from approximately 11 to 14 VDC and it cannot depend on the 60-Hz home power frequency for timekeeping.

The display should have sufficient contrast for daytime visibility, but not be so bright that it distracts the driver at night. Also, the display should be disabled when the car is not in use to conserve power and not attract the attention of potential thieves. The clock must cope with car voltage transients without false triggering or part destruction; and it must be capable of reasonably accurate timekeeping through a broad range of temperature and humidity extremes while exposed to jarring and vibration—a hostile environment for any electronic circuit. It should be small, attractive and easy to install. Finally, it must be competitively priced, and if a kit, it should be capable of assembly by nonskilled builders.

Making time

Timekeeping is handled by some form of oscillator countdown circuit. In most of the clocks reviewed in this article, the circuit consists of a 3.58-MHz quartz crystal and an MM5369 17-stage oscillator/divider integrated circuit. Some designs use other IC's, and one uses a ceramic resonator instead of a quartz crystal. Almost all the clocks have some means of trimming the frequency for perfect accuracy at a particular temperature. However, even though temperature-compensating capacitors are used in an attempt to stabilize the oscillator frequency, there is bound to be some "drift" due to temperature change and crystal aging.

Assembled units are "calibrated" (frequency-adjusted) at the factory. If you build one from a kit, a frequency counter makes adjustment a simple, easy operation, since most clock circuits have a test point just for that purpose. If you don't have a frequency counter, you'll have to substitute patience for perhaps several days—depending on how fanatic you want to be about accuracy! Unfortunately, despite the attractive feature of not being subject to power interruptions, as AC clocks are, the long-term accuracy of oscillator-based clocks is poor compared to AC clocks. That's the way the cookie crumbles!

Displays

Designers vary considerably in their selection of displays. By far the most popular readout—but not necessarily the best—are the red light-emitting diode (LED) seven-segment digits, varying in height from .15 inch (magnified) to 0.5 inch. They are used in all but four of the clocks described. These can be made really bright if they are run hot. Of course, this shortens their life and increases power consumption. But even bright red LED's wash out considerably in daylight, and can't be seen at all in direct sunlight.

The orange-neon (gas discharge) display used by Heath in their *model GC-1093* has high visibility, due both to size and color, but requires an internally generated high voltage. The Applied Marketing *LC-100* series has large liquid crystal digits

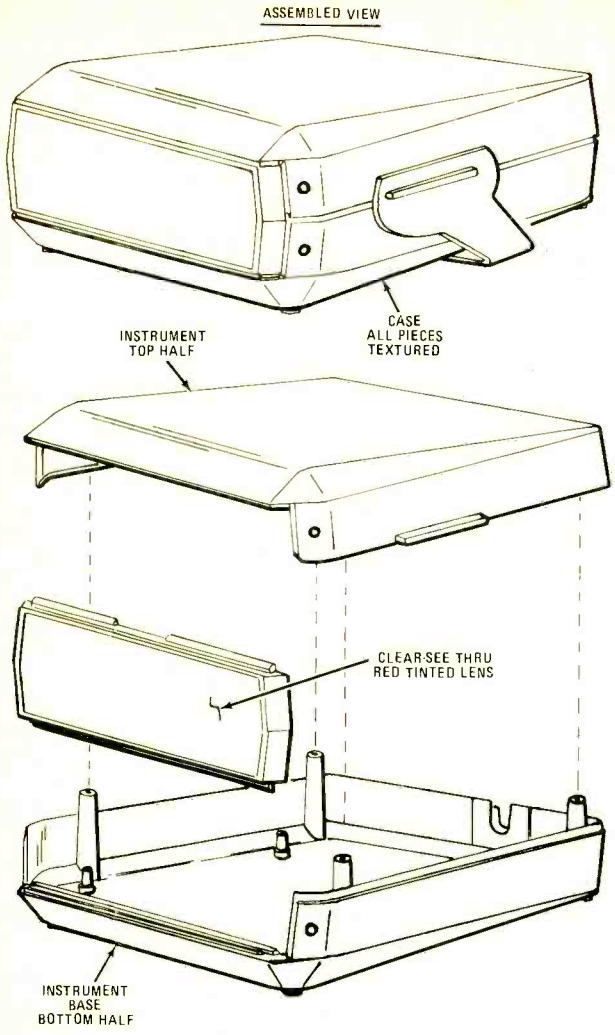


FIG. 1—THE GRAY PLASTIC CASE used with many of the clocks described here is built up of four pieces.

that can be read in direct sunlight, or backlighted for night viewing. The display that appears to be the choice of the Detroit car-makers for future models is the blue-green fluorescent display, used in the National *model MA-1003* car clock module. This display is also used in the CC & SS, Inc. *model CC-6A*, the Applied Marketing *models VC-501* and *VC-502* and the Xantech. Although the actual digits are only 0.3 inch high, Xantech uses a curved lens to increase the apparent height. These fluorescent displays are clear and sharp even in a high ambient lighting situation—but direct sunlight still wipes them out. The CC & SS, Inc. display is recessed behind a green lens in an instrument case for high visibility and to avoid direct sunlight.

Many of the clocks have all the digits in a single display—others use individual digits. The JBS *Mod-U-Clock* has *no* digits—you supply your own—so you can use different colors, such as red for hours, green for minutes and yellow or orange for seconds!

To achieve proper contrast with the ambient lighting (since it is *contrast* that makes the digits visible, not just brightness), photocells or phototransistors are used in some clocks to dim the display brightness automatically as the surrounding light is reduced. Liquid crystal displays, which reflect existing light, by their nature maintain good contrast in all lighting, but require backlighting in darkness. Colons are used to separate digit groups visually on many displays. They are either on constantly, or blink at a 1- or 2-second rate.

Some of the kits can be built to display either a 12- or a 24-hour format. Most read seconds continually, or seconds can be read by operating a switch. The Heath *model OI-1154* Aircraft Clock/Timer has a separate four-digit display for Greenwich Mean Time (GMT or "Zulu" time), used for navigational purposes. Several clocks advertise an elapsed-time feature, but be careful! Both Heath clocks, the Bullet *model MK-03* and the Optoelectronics *model 7005* display the elapsed time without destroying the actual time—all the others *cancel out* the local time to display elapsed or trip time!

A few clocks (CC & SS, Inc., Fairchild and Optoelectronics) even keep track of the month and date, and display them on command. These contain four-year calendars and need to be corrected only on February 29 of a leap year.

An alarming feature

While at first thought it might seem like gilding the lily, some of these car clocks have reminder alarms. Not a bad idea, since you might spend a great deal of time in your car and could use the alarm to help you keep appointments. For van or camper use, these alarms could get you up in time to hit the road before the traffic jams, or time your cooking. The James *Warble Alarm* not only has a two-tone sound, but will also sound off if you leave your lights on after turning off the ignition. This could save you the cost of towing and a new battery!

The alarms are all 24-hour repeatable—just turn them off when they sound, turn them right back on and they're reset for 24 hours later. To do that, these clocks have an AM/PM indicator if they display in the 12-hour format. A "snooze" feature with all the alarms, except for the Heath *model OI-1154*, lets you disable the alarm tone for a short period—usually about 10 minutes—after which it sounds again. Don't plan on using these alarms as burglar alarms—they aren't that loud, and you'd need some special circuitry to trigger them at "rip-off" time! The alarms are simply audio oscillators with speakers—some have a steady tone, some beep.

Possible radio interference

To reduce component count and power consumption in many clocks, a digital scanning technique called multiplexing is used. This turns on digits in sequence so quickly that they seem to be on continuously—a sort of rapid strobing. Unfortunately, this generates radio-frequency interference (RFI) that can create a buzzing sound in your AM car radio, or in CB or ham receivers. A metal case, such as used by Audiovox and Heath, contains the RFI pretty well. Also, the use of two-conductor shielded cable, with the shield as the ground connection, will all but eliminate this potential problem. The Fairchild clock, which offers no case at all, seemed to have the highest RFI of all the units checked.

Many designs use "direct drive" clock IC's instead of multiplexing. This eliminates all RFI but a small amount that might be generated by the crystal oscillator circuit.

Battery backup

A backup battery and oscillator are sometimes provided in an in-home clock to keep time during a power failure. While this is not a significant problem in most large cities except during severe weather or a summer "brownout," some smaller cities and towns have frequent power outages. But why a battery backup in a mobile clock? How often does a car battery go dead? Well, not often—so that's *not* the reason some of these clocks have a battery. The self-contained battery allows these clocks to keep time *outside* the vehicle, and most will even display time for short periods. This allows you, for example, to set your clock accurately to a time standard in the home.

Radio Shack's *WWV Converter Kit* (No. 28-133 for $5.95) will allow you to use any AM radio to receive precise time signals—including your car radio. Of course, you can use an accurate clock or the telephone company time signal as a standard. Once set on battery, you simply carry the clock out to your vehicle and install it. Or you can carry the clock around with you for any other time-critical purpose and display the time only when necessary (such as for synchronizing your next commando raid or space launch!). The CC & SS, Inc. module uses a 1.5-volt AAA alkaline battery to perform all timekeeping

with a *watch* IC, and only uses the vehicle's 12 volts to illuminate the fluorescent display! The Applied Marketing *model LC-101* is completely portable with self-contained watch batteries and a constantly on liquid crystal display.

The case for a case

The size and appearance of your clock case might well dictate its location in your car, camper or van. The case is also important for environmental protection from dirt and vibration. Unless you're a skilled craftsman, it would be wise to avoid any clock kit that doesn't come with a case, or have a suitable case as an option.

Another consideration in selecting a clock for your vehicle should be *shape*. The Fairchild clock, for example, has a small frontal size, but it's very deep. This makes it ideal for dashboard panel installation (you'll have to make your own faceplate), but it takes a special enclosure, not made by Fairchild, for mounting this clock above or below the dashboard. The S.D. Sales clock is another example of trade-off versatility; the display and the clock boards are entirely separate. The clock board is relatively large and is joined to the display board by 17 wires. While this allows you to "remote" the display above or below the dashboard in a small enclosure and mount the clock board under the dash somewhere else—in another enclosure—it means one *large* case if you mount them together!

Many of the clocks reviewed in this article include a beautifully molded four-piece gray plastic case 1¾ high × 4 wide × 4½-inches deep. Figure 1 shows how the top and bottom halves snap together over a fitted chrome-rimmed red front bezel. An angled mounting bracket that can be snapped onto side lugs from either above or below provides four different mounting choices. This case is sold separately by Radio Shack stores for $3.95 (No. 270-285).

Optoelectronics offers two modern cases of Plexiglas, bent to form a transparent red chassis with your choice of a clear, white or black cover. They come complete with two aluminum angle brackets and self-tapping screws to accommodate any red LED display. *Cabinet I* is the larger of the two and is 3 high × 6¼ wide × 5½-inches deep. *Cabinet II* is 2½ high × 5 wide × 4-inches deep. They cost $6.50 each, and Optoelectronics pays the postage on U.S. orders of $15 or more. *Cabinet II*, for example, is an excellent choice for the S.D. Sales clock if you want to package it in one case.

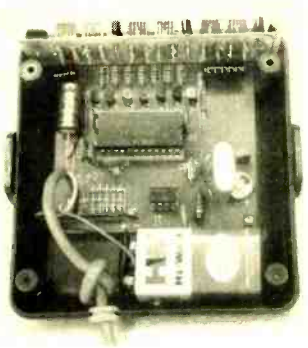
Custom plastic cases can be ordered to your specifications in any quantity, from Robert C. Arp, Enclosure Engineering, 3491 Butcher Drive, Santa Clara, CA 95051.

Can you follow instructions?

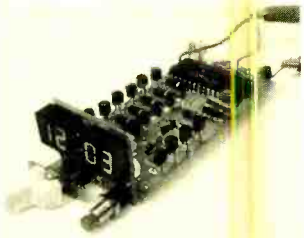
Apparently most manufacturers and distributors of these mobile clock kits expect the builder to be somewhat experienced with electronic assembly work. The notable exception is Heath, whose instructions are excellent and for many years have set a standard most others don't even approach. A *beginner* could build the Heath kits, since every part is illustrated and every color code, part identification or polarity is noted. This is not the story with many of the instructions.

Fairchild, for example, had the nicest-looking instructions, complete with photos of the assembled unit. Unfortunately, they had errors and omissions and virtually no step-by-step assembly instructions. The Jeff instructions were on one side of a single sheet with hand-drawn sketches and with just barely enough information. On the other hand, Optoelectronics, Ramsey and Bullet use lots of text and illustrations, and provide detailed schematics in case troubleshooting is necessary.

The assembly time for a particular clock will vary with the builder's experience. It's wise not to rush and to be very careful in soldering and getting the right parts in the right place, "checking twice and soldering once," and observing polarities where noted. Miniature parts are used in all these clocks, so a small-tip soldering iron, small-diameter solder, a jeweler's loupe or magnifying glass and *patience* are essential. Examine all connections for solder bridges or poor soldering—it's a lot easier to do this during construction than to spend lots of time scratching your head in troubleshooting or replacing "zapped" parts!

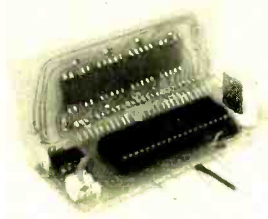


JAMES QUARTZ DIGITAL CLOCK.



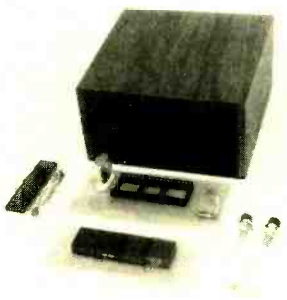
FAIRCHILD FTK0106 shape is suited for dashboard mounting.

JAMES CLOCK, PARTS LAYOUT.



JEFF CAR CLOCK, showing the 30 jumpers between PC boards.

JAMES DIGITAL AUTO CLOCK with under-dash bracket mount.



JEFF CLOCK, CASE AND PARTS.

JAMES ALARM CLOCK, with setting and seconds switches.

Installation

Installing almost any mobile accessory can be a real job for the inexperienced builder. However, installing most of these clocks in your vehicle is almost as easy as putting on a side-view mirror, if you have a meter or light to find the positive voltage and ground points at your fuse block. Most clocks use only three wires—positive voltage, ground and "accessory" (switched positive voltage). The positive and ground connections power the clock counting circuitry (except for the CC & SS, Inc. and Applied Marketing *LC-101* and *LC-104* clocks). The accessory connection turns on the display when the ignition is turned on.

At your fuse box, locate a point where positive voltage appears all the time and connect the "positive" clock lead there. A fuse location that shows positive voltage only when the ignition is on, or in the accessory position, is where you connect the "accessory" clock lead. The vehicle chassis is "ground." The Applied Marketing *model LC-101* is simply attached to the dashboard with Velcro hook-and-loop, or double-sided tape, since no wiring connections at all are required! In some clocks, the manufacturer recommends connecting the positive lead direct to the battery, to reduce voltage transients into the clock. Also, it is advisable to fuse the positive and accessory wires to the clock to protect both the clock and vehicle wiring in the event of a dead short in the clock. Also, don't forget that two-conductor shielded wire might be necessary in multiplexed clocks to eliminate RFI problems. *To be continued.*

Build 3 Low Cost CB Test Meters

1. Signal Strength 2. SWR 3. Power

Get maximum performance by peaking your CB rig with these easy to build low-cost meters

W. E. OSBORNE*

WITH AN ESTIMATED 12–15 MILLION CB TRANSCEIVERS—LICENSED and unlicensed—now in use, reliable communication on the 27-MHz band in large cities leaves a lot to be desired. Unnecessary chatter on cluttered channels drowns out legitimate messages, while dense traffic and large buildings attenuate transmission and contribute to a serious reduction in range. In addition, many CB rigs operate with a poor impedance match between transmitter and antenna, and suffer a higher-than-necessary SWR figure.

Every connection between transmitter and antenna will set up standing waves, and this problem is often compounded by lumpy solder joints, sharp bends in the line and unclean connections. The net result is a high ratio of power loss in the form of stationary waves on the transmission line—the well-known VSWR, or voltage standing-wave ratio. Adding to the trouble, and often the worst offender, is a mismatch of antenna impedance that reflects power back down the line.

In simple terms, SWR is the loss factor between the total energy leaving the transmitter and the amount accepted and then radiated by the antenna. At least, it translates that way. Obviously the ideal ratio would be 1:1, but there will always be some loss and a very efficient level would be 1.15:1.

Some base rigs have done better than this, but the problems of the average CB'er, with his car installation and lack of test instruments, make a figure of 1.5:1 reasonably acceptable. In this case, the total losses (line, connectors, joints and slight mismatch) would be, in the average case, about 5% of the 4-watt limit. Many CB rigs today, however, are operating at 3:1, or worse, and thus losing more than a quarter of their power.

As a first step, using the smallest of the test instruments described here—a field-strength indicator—will enable any CB owner to quickly determine the relative efficiency of his installation, even without measuring the SWR. Figures 1, 2 and 3 are schematics of a field-strength indicator, an RF power meter, and an SWR bridge, respectively. The field-strength indicator (FSI) can be built from surplus components for one dollar or less, is smaller than a pack of cigarettes, and will enable the CB'er to adjust his antenna and rig for maximum radiated output. The FSI must remain in the same position, relative to the antenna, during adjustments. Construction time is only about half an hour.

Field-strength indicator

Figure 1 shows the extreme simplicity of the FSI. The FSI antenna consists of about 8 inches of insulated stranded wire glued or taped around the inside of a small plastic box (the box shown originally contained a power transistor). The antenna RF current is rectified by two diodes, and a 10K potentiometer

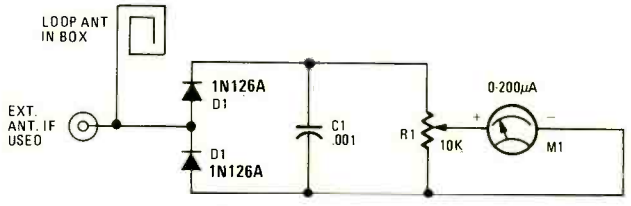


FIG. 1—FIELD-STRENGTH INDICATOR uses a loop antenna and an envelope detector to measure RF signal strength.

PARTS LIST

All resistors are ¼-watt, 10%, unless noted.

Field-Strength Indicator:

C1—.001 μF ceramic disc, lowest voltage
D1, D2—1N126A or equal (1N457, etc.)
R1—10,000-ohm potentiometer (optional)
M1—Subminiature surplus meter, Gemmeter, 200 μA or equal
Misc.—Wire, screw, nut, plastic box, etc.

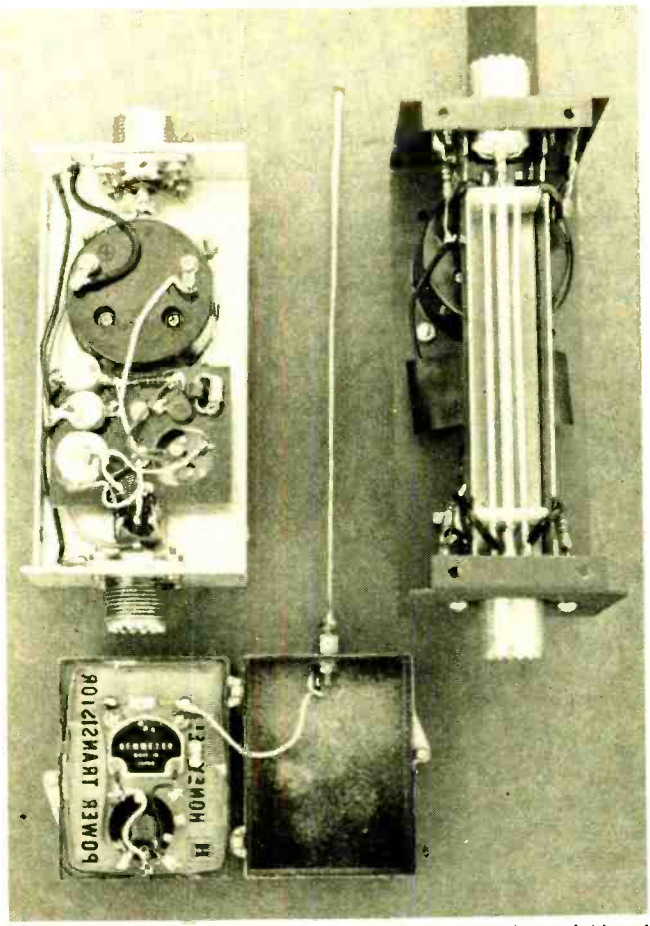
RF Power Meter:

R1—20,000 ohms
R2—300,000 ohms
R3—3 megohms
R4—50,000-ohm potentiometer
R5—500,000-ohm potentiometer
C1—5 pF, 50-volt disc, or 3–18-pF ceramic trimmer
C2—10 pF, 50-volt disc, or 3–18-pF trimmer
C3—.001, 50-volt disc
D1—1N126A or equal
S1—SPDT toggle switch
M1—Meter, 0–100 μA, 1¼ inches
Misc.—Coax receptacles (2), 4 × 2 × 1-inch aluminum box, 12-inch coax lead with plugs.

VSWR Bridge:

R1, R2—180 ohms
R3—10,000-ohm potentiometer
C1–C3—.001 μF, 50-volt ceramic disc
D1, D2—1N126A or equal
S1—SPDT toggle switch
M1—Meter, 0–50 or 0–100 μA, 1½ inches
Misc.—Coax receptacles (2), aluminum box, 12-inch coax lead with 2 male plugs, waveguide shield tube and sensing wires.

*Dinki-Di, KDZ 7553.



INSIDE VIEWS of the power meter (top left), FS meter (lower left) and SWR bridge (right).

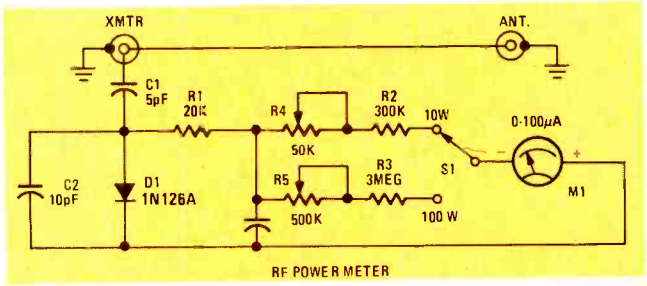


FIG. 2—POWER METER has two ranges and can measure a maximum of 100 watts full-scale.

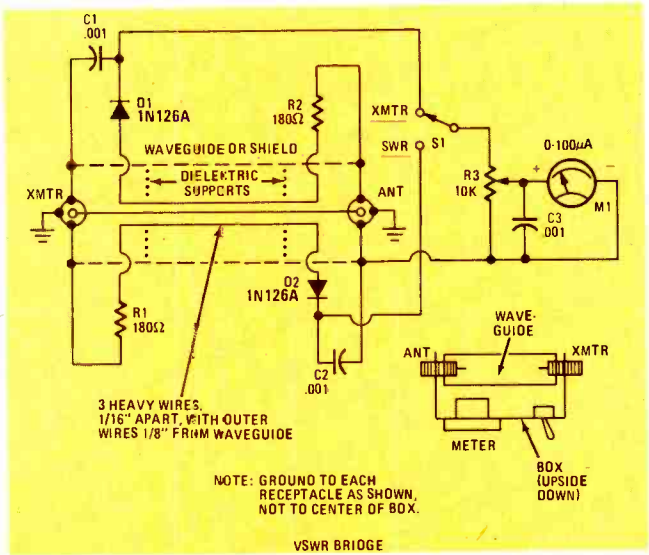


FIG. 3—SWR BRIDGE uses an open waveguide to sense the forward and reflected signals.

provides variable attenuation for the meter. This potentiometer may be omitted (and a 100K fixed resistor substituted) if the unit is always used more than 6 inches away from the CB antenna. The meter is a tiny Japanese surplus item costing 69 cents. With a 200-μA movement, it had been used as a battery indicator. If not obtainable in your area, use any 50-, 100-, or 250-μA meter.

All components, except the potentiometer, can be mounted on the meter and its two mounting screws. A flexible lead from the antenna connection (diode junction) was also taken to a stud nut on the rim of the box to provide for a short external antenna at a distance of several feet from the CB antenna. Solder a 4-40 screw to one end of a 6-inch length of 14- or 16-gauge bus-bar wire for this antenna. It then screws into the matching stud nut on the box rim, if and when used.

To test your CB transceiver, set (or tape) the FSI box about 6 inches from the base of the CB antenna. Switch on the transceiver, press the TRANSMIT switch and note the reading on the FSI. Now, with the CB power switched off, adjust the antenna length one-eighth of an inch at a time, until maximum FSI reading is obtained.

RF power meter

The RF power meter shown in Fig. 2 is inserted in the coax line between transmitter and antenna. A 12-inch length of 50-ohm coax, with a male plug at each end, is used for this. The housing is a 4×2×1-inch aluminum box. Although a 100-μA meter is shown (hand-calibrated in watts), the surplus meter of Fig. 1 can also be used here, with the series resistors reduced to 100K and 1 meg. A small switch provides two power ranges, 0–10 and 0–100 watts, in case it is used in higher-power rigs. The frequency maximum is about 60 MHz.

Two potentiometers are used, mainly for initial calibration, and could be fixed values after this is done. Incidentally, an easy way to calibrate is on another CB rig, whose output is known. The meter shows actual RF power at the transmitter output (not antenna-radiated power). Check the output on all channels. It should be a fraction under 4 watts, with a slight maximum at the center (Channel 11). Be sure to switch off the power before loosening antenna connections.

(For a more precise power meter calibration, connect the CB set to the XMTR *terminal and plug a 50-ohm dummy load into the antenna output connector. Use a VTVM and RF probe to measure the voltage across the dummy load. Calculate the power from the formula* $P=E^2/R$. *With S1 in the 10-watt position, adjust potentiometer R4 so the meter reading corresponds to the calculated power output. Throw the switch to the 100-watt position and adjust R5 so the meter reads correctly.*—Editor*)*

SWR bridge

To measure the actual standing-wave ratio, some mechanical work is needed to cut and shape a slotted line or open "waveguide". For the 11-meter band, it can be a three-sided piece of square metal tube, 4⅜ inches long and 11/16 inches square (I.D.). The top side is open (the "slotted line"), and sitting in it, on an insulating block at each end, are three heavy No. 14-gauge wires. The center wire is the transmission line. The outer wires are spaced ⅛-inch from the inner edges of the grounded waveguide tube that runs the length of the chassis. The input and output coax receptacles are mounted in holes at each end of the waveguide. This assembly then fits inside a 5×2¼×2¼-inch box.

Figure 3 shows the schematic of the SWR bridge, for which a 50- or 100-μA meter is recommended. The potentiometer is for meter calibration and protection. Hand-calibrate the meter on a friend's CB rig and antenna with a known SWR. The same 12-inch length of coax used for the RF power meter will also connect the SWR bridge between transceiver and antenna. The SWR is determined by first switching to XMTR and then (with the transmitter on) adjusting the potentiometer for maximum

(continued on page 105)

HI-FI ACCESSORY

Build The PHLANGER for Dramatic Music Effects

Built around an analog delay line, this device connects easily to your hi-fi system to produce dramatic special effects

MARVIN JONES

PHLANGING CAN MAKE YOUR HEAD spin: the effect can gently roll and sway, or it can seem to turn your whole mind inside out. Phlanging was discovered accidentally in 1958 by recording producer Phil Spector while recording "The Big Hurt." Thinking the vocal part was weak, Spector instructed his engineer to make two tapes and play them back simultaneously to achieve a voice-doubling effect. The dramatic "swooshing" effect that resulted was immediately recognized as a hit sound, and the record indeed received considerable attention.

After its initial success, many musicians and producers wanted to use the phlanging effect in recordings, but the technique of producing small controlled variations of tape recorder playback speed was time-consuming and cumbersome. Then in the 1970's, operational amplifiers and active filters were developed to produce this type of sound in a low-cost unit called a phase shifter. Phase shifters became a craze with musicians, but the octavely related cancellation frequencies of the all-pass networks used in phase shifters provide a much more bland sound than the harmonically related notches of true time-delay phlanging. Now that charge-coupled technology has come of age, we have bucket-brigade analog delay lines that allow true phlanging.

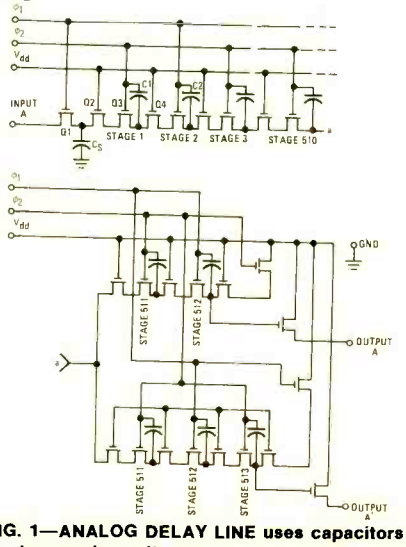


FIG. 1—ANALOG DELAY LINE uses capacitors to store analog voltages.

How it works

The most important component in the phlanger is the *Reticon SAD-1024* analog delay line made by Reticon Corp., 910 Benicia Rd., Sunnyvale, CA 94086. This new and special IC (See IC *Application of the Month*, in the April 1977 issue) uses N-channel technology to substantially improve both quality and ease of operation. The *SAD-1024* contains MOS transistors and capacitors in two identical arrays, one of which is shown in Fig. 1. The input accepts a maximum signal swing of 0.5 volts peak-to-peak, riding a bias that is 40% of the supply potential. The supply V_{dd} can range from 4 volts to 15 volts, with 9 volts to 15 volts providing the best specifications. The ϕ_1 and ϕ_2 are inputs for the biphase high-frequency clock. These signals must switch between V_{dd} and ground, and be complementary with minimum overlap. When ϕ_1 is high, the input signal is gated through Q1 to input capacitor C_s (see Fig. 1). At the next clock transition, C_s is isolated and the last voltage applied to C_s is held. As ϕ_1 goes low, ϕ_2 goes high allowing the charge on C_s to be gated to storage capacitor C1.

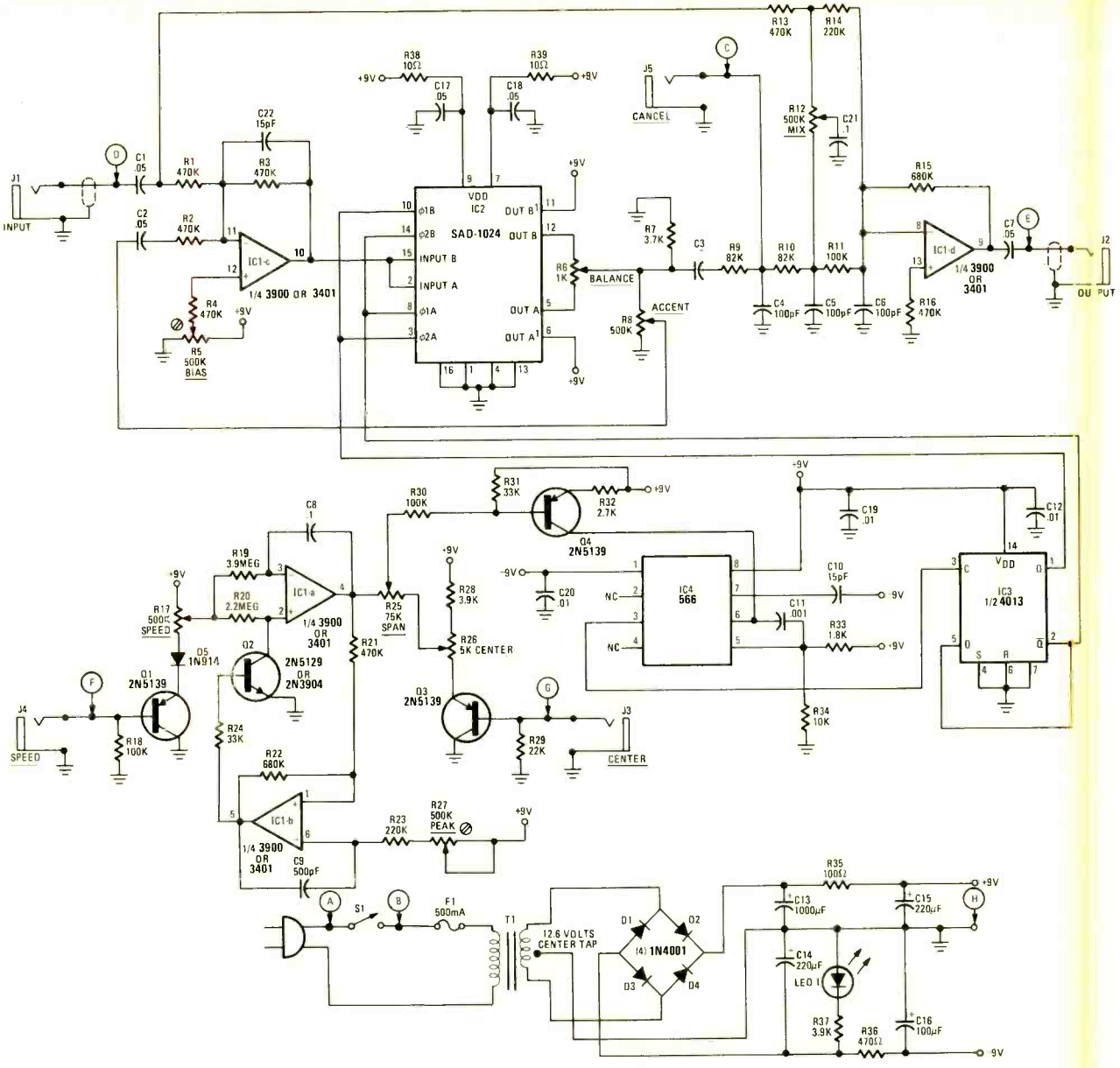


FIG. 2—PHLANGER uses an analog delay line to add "swooshing" effect to music.

PARTS LIST

All resistors ½ watt, 5% unless otherwise noted.

R1-R4, R13, R14, R21—470,000 ohms
R5, R27—500,000-ohm, linear PC-mount trimmer
R6—1000-ohm, linear PC-mount trimmer
R7, R32—2700 ohms
R8, R12, R17—500,000-ohm linear potentiometer
R9, R10—82,000 ohms
R11, R18, R30—100,000 ohms
R14, R23—220,000 ohms
R15, R22—680,000 ohms
R19—3.9 megohms
R20—2.2 megohms
R24, R31—33,000 ohms
R25—75,000-ohm linear potentiometer
R26—5000-ohm linear potentiometer
R28, R37—3900 ohms
R29—22,000 ohms
R33—1800 ohms
R35—100 ohms
R36—470 ohms
R38, R39—10 ohms
C1-C3, C7, C17, C18—0.05 μF, ceramic disc
C4-C6—100 pF, ceramic disc
C8, C21—0.1 μF, Mylar
C9—500 pF, ceramic disc
C10, C22—15 pF, ceramic disc
C11—0.001 μF, ceramic disc
C12, C19, C20—0.01 μF, ceramic disc
C13—1000 μF, 10 volt, electrolytic
C14, C15—250 μF, 10 volt, electrolytic
C16—100 μF, 10 volt, electrolytic
D1-D4—1N4001 diode
D5—1N914 or 1N4148 diode
LED1—MLS 750
Q1, Q3, Q4—2N5139 transistor
Q2—2N5129 or 2N3904 transistor
IC1—LM3900 or CA3401, quad Norton amp
IC2—SAD-1024 analog delay line (Reticon)
IC3—4013-type dual-D flip-flop
IC4—566-type VCO
F1—500-mA fuse, with surface mount holder
J1-J5—¼-inch phone jacks
S1—SPST slide switch
T1—12.6 volt, center-tapped, 300-mA power transformer
MISC.—Hookup wire, line cord, 16-pin IC socket for IC2, knobs, case and hardware.

The following parts are available from Paia Electronics, Inc., Box 14359, Oklahoma City, OK 73114.

Etched, drilled and punched PC board, No. 1500PC, $9 postpaid.

Complete kit of parts including PC board, case and step-by-step instructions, No. 1500, $59.95 plus 4-lb. shipping charge.

Oklahoma residents add state and local taxes as applicable.

On the next clock transition, gating transistor Q3 is disabled, and Q4 is enabled to allow the charge in C1 to pass to the next stage. While ϕ_1 is again high, another input sample is taken. The discrete voltage levels continue to be clocked through the circuitry until, 512 clock half-cycles later, the original input voltage appears at output A. This same voltage appears also at output A′ during the next, or 513th, clock period. Mixing these two outputs allows a more continuous output waveform to be generated, and also provides a means of improved suppression of clocking glitches.

The overall time delay generated by this circuit can be calculated from: $T_d = N/(2\ F_c)$, where N is the number of shift register stages (512 in this case), and F_c represents the clock frequency at ϕ_1 and ϕ_2. Output filtering should be used to remove any residual clock signals that are superimposed on the output and to smooth the sampled stair-step signal into a duplicate of the original input.

Consideration must also be given to the number of samples required per input waveform period to accurately reproduce the waveform. When the sampling frequency is greater than 10 times the input frequency, oversampling occurs. However, higher sample rates yield higher reproduction accuracy. Critical sampling occurs when the input frequency is one-half the clock frequency, and this is the maximum limit to which the system should be pushed for accurate audio reproduction.

The schematic for the full phlanger is shown in Fig. 2. The input signal is buffered by IC1-c. Bias trimmer R5 adjusts the DC output to 40% of the supply voltage to provide minimum clipping of the signal as it enters the delay circuit. The signal is fed simultaneously to both delay line inputs of IC2. Note that the clock signals to each delay line are reversed so that ϕ_1 for one section is ϕ_2 for the other. This operation, known as parallel multiplexing, causes each delay line to alternately sample the input signal. Thus, twice as many samples are provided for a given clock frequency, and reproduction accuracy is increased at the output. One output from each delay line are mixed together at BALANCE control R6, while unused outputs are tied to the supply voltage. The ACCENT control R8 feeds a portion of the delayed signal back to the input for regeneration. Low-pass filters R9–C4, R10–C5 and R11–C6 eliminate the remaining clock signal and smooth the sampled waveform into a more linear duplicate of the original. The MIXING control R12 allows selection of the normal input signal, the delayed signal or any blend of the two. The mixed signal is amplified by IC1-d to provide unity gain from the input to the output of the phlanger.

The remaining two sections of IC1 form the low-frequency triangle oscillator used to sweep the phlanging effect. The slope of integrator IC1-a is voltage-controlled. The control voltage is supplied by SPEED control R17 or remote SPEED input J4. Schmitt trigger IC1-a switches the integrator between a positive or negative slope. A fine adjustment of the triangle output amplitude of IC1-a is provided by PEAK control R27. This allows for optimum compatibility with following circuitry. The amount of triangle amplitude used to modulate the high-frequency clock is selected by SPAN control R25. As the voltage from the SPAN control is decreased, more of the fixed DC voltage from CENTER control R26 is used to set the clock to a fixed frequency.

With minimum SPAN and maximum

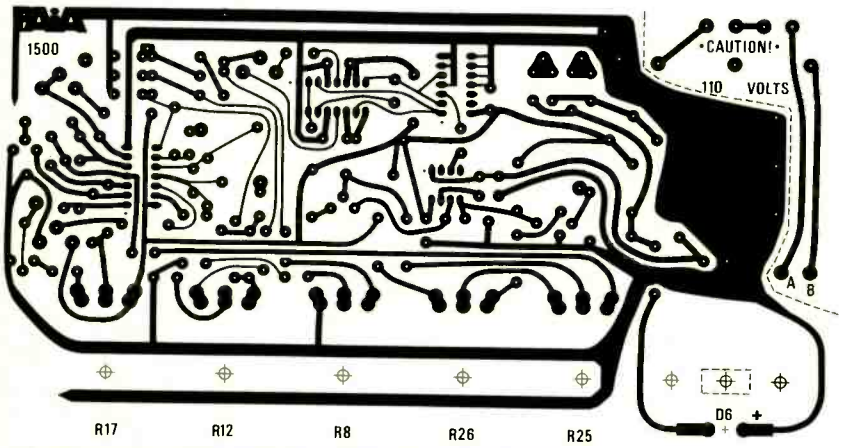
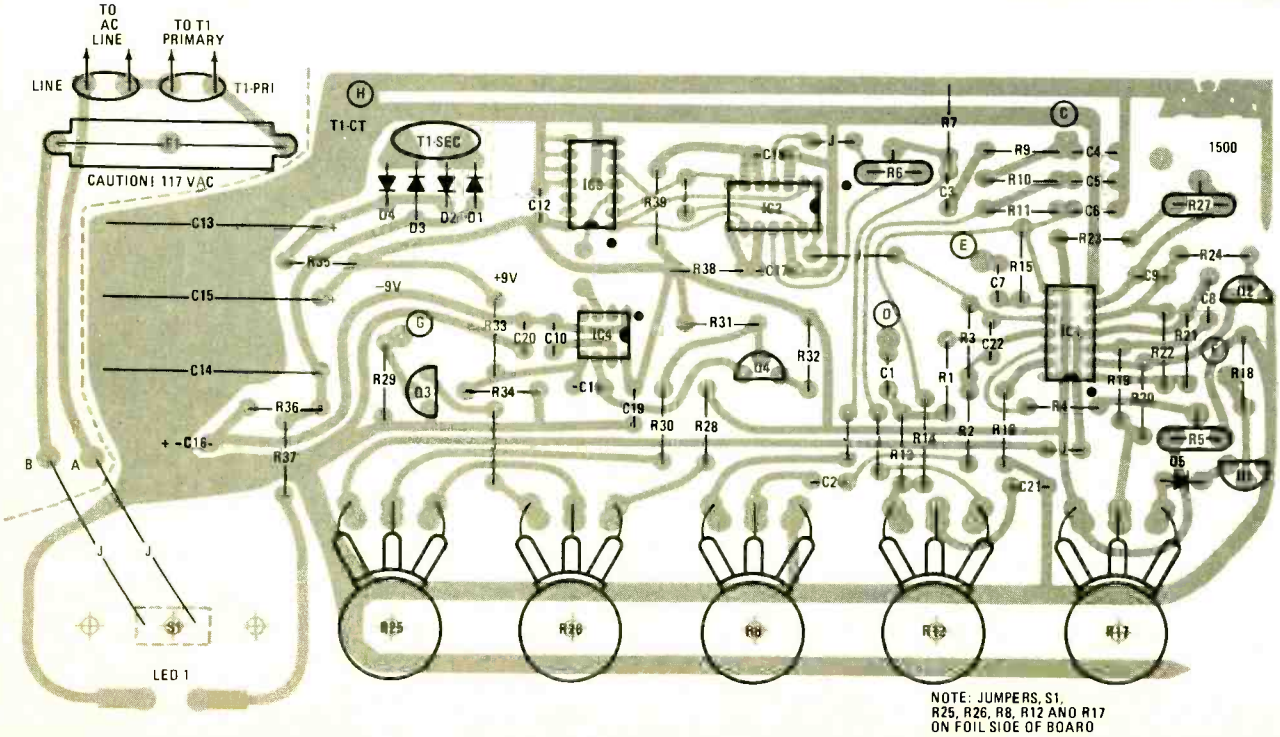


FIG. 3—FOIL PATTERN of single-sided PC board shown half-size.



NOTE: JUMPERS, S1, R25, R26, R8, R12 AND R17 ON FOIL SIDE OF BOARD

FIG. 4—COMPONENT PLACEMENT diagram.

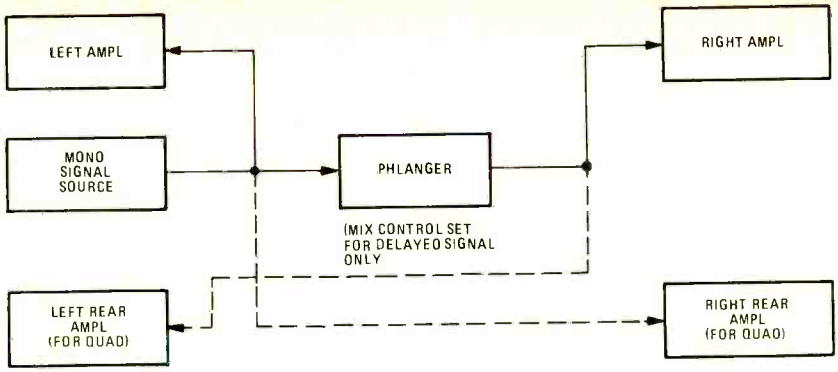


FIG. 5—STEREO EFFECT is produced from mono signal using this hook-up.

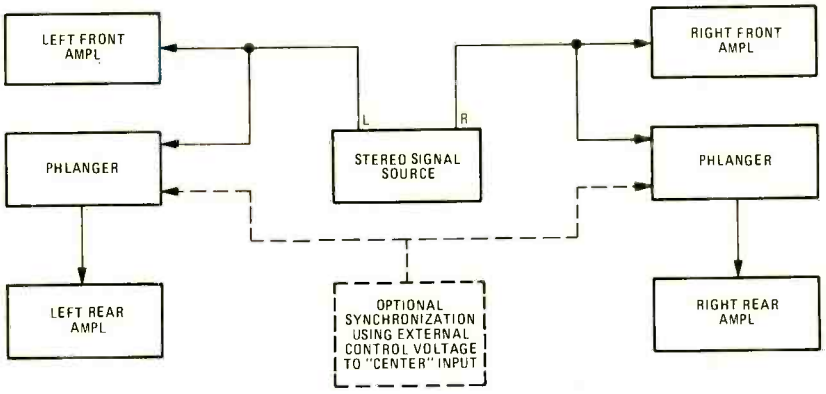


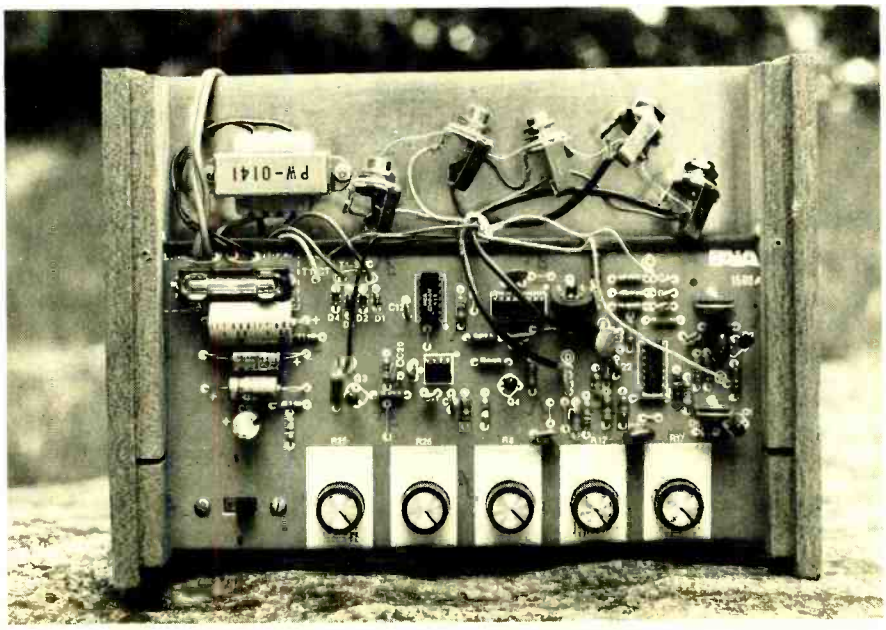
FIG. 6—QUADRIPHONIC EFFECT is produced from stereophonic source using two phlangers.

CENTER control settings, an external control voltage can be applied to J3 to modulate the clock frequency and, in turn, sweep the phlanging effect. The mixed voltage from this control network is applied to current source Q4, which acts as a voltage-controlled timing resistor for high-frequency oscillator IC4. Timing capacitance is provided by C10. The squarewave output of IC4 switches between positive supply and half-supply, so a bipolar supply is used for this IC to make the squarewave switch between positive supply and ground. This signal is now directly compatible with the input of D-type flip-flop IC3. This circuit divides the frequency in half, but, most important, it provides a set of complementary squarewaves that are very clean and with very little overlap. These signals are used to directly drive the clock inputs of the delay IC. The resulting clock frequency range is 30 kHz to 500 kHz. The power supply is a standard full-wave center-tapped bridge that provides a ±9-volt supply to the circuitry.

Construction

Assembly is straightforward, since all components are mounted on the circuit board except for five jacks and the power transformer. The foil pattern for the circuit board is shown in Fig. 3 and the parts placement is shown in Fig. 4. Use only rosin core solder and a soldering iron (not a gun) with no more than a 35-watt power rating. When installing electrolytic capacitors, transistors, diodes and IC's, be sure to observe proper polarity. Note there are nine wire jumpers indicated by solid lines on the parts placement diagram (Fig. 4). Since the *Reticon SAD-1024* IC is expensive, use a socket for installation safety. The *SAD-1024* and the 4013 flip-flop are both CMOS units, and must be handled carefully. Do not wear synthetic clothing while handling these devices, and ground yourself and your soldering iron before handling or installing the units.

Power switch S1 is installed in the rectangular hole in the circuit board using No. 4-40 hardware. Use two 1½-inch long insulated wire jumpers to connect the switch lugs to points A and B on the foil side of the circuit board. Press power indicator LED1 into the hole below the power switch from the foil side of the board. Then solder the leads to the adjacent foil pads. Before mounting the five potentiometers, bend their solder lugs nearly 180° so that the lugs point toward the shaft rather than the rear of the potentiometer. Install one ¼-inch nut on the control bushing to act as a spacer, then mount the control as usual, making sure the altered solder lugs lie directly on top of the three oval pads on the foil side of the board. Flow solder into these connections. Mount the power transformer on the case with all five leads connecting to the rear of the circuit board. The letter-designated holes connect to the five jacks mounted on the case. Use coax cable for the input and output connections, with the shield connected to ground only at the jack. Connect point H to the common chassis ground of the five jacks. The remaining three connections can be made with single-conductor insulated wire.



PHLANGER with top cover removed.

Testing and calibration

Before applying power to the phlanger, double-check for cold solder joints, solder bridges and correct parts values and placement. Set the three trimmers to the midpoint of their rotation. Set all potentiometers fully counterclockwise, except CENTER control R26 which should be at maximum. Plug the line cord into a wall outlet and slide the power switch to the right. Power indicator LED1 should glow.

Apply a signal to input J1 with a maximum 0.5-volt amplitude peak-to-peak. Feed output J2 to an appropriate guitar amplifier or hi-fi system input. The normal signal should now be passing unaltered through the unit. Turn MIX control R12 fully clockwise. Adjust BIAS

continued on page 92

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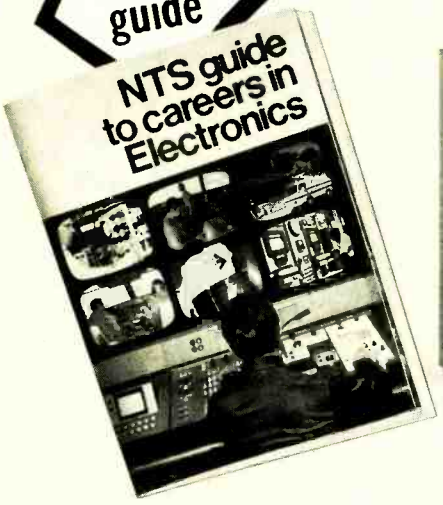

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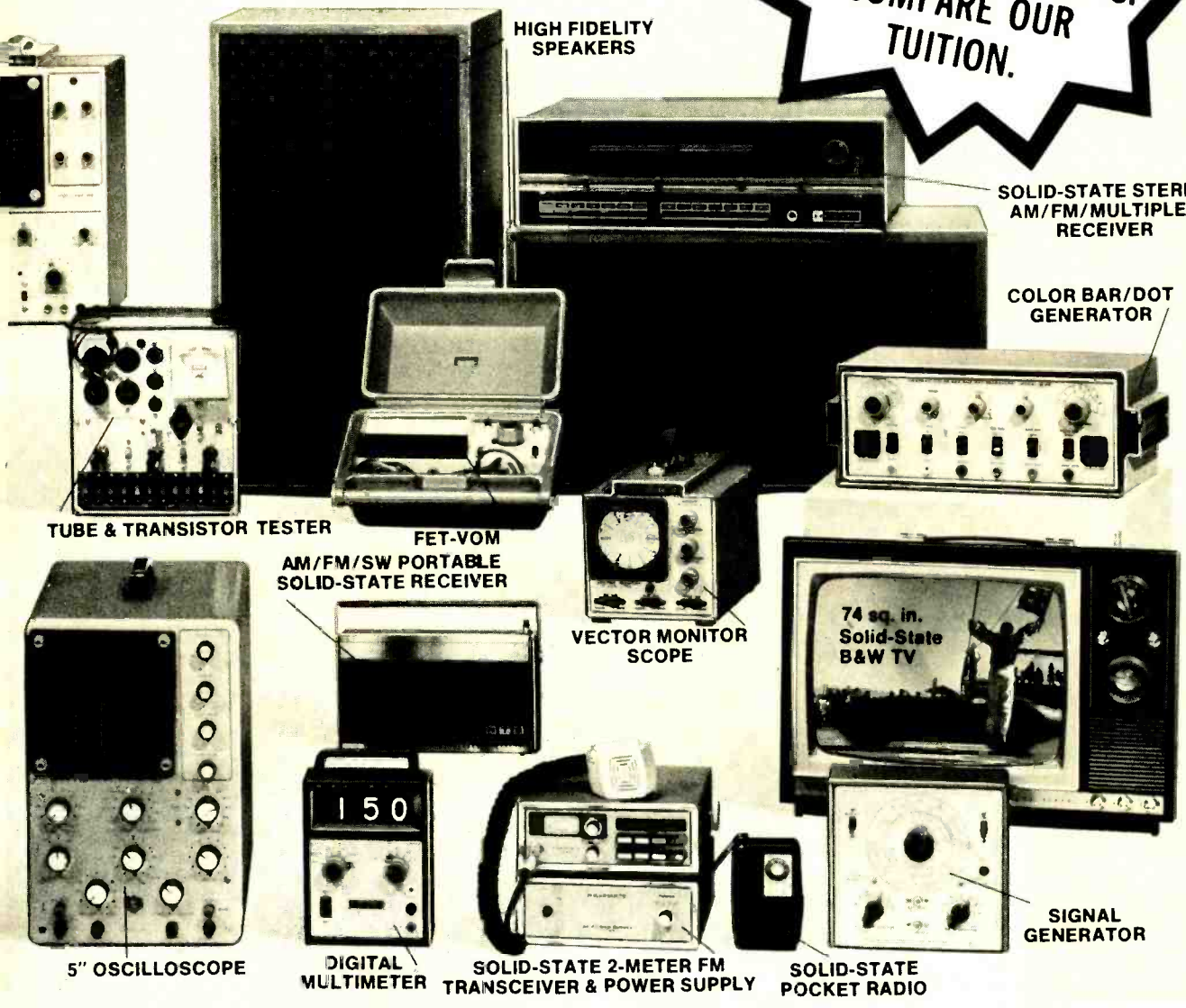

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Realign Your FM Receiver

Crosstalk, modulation-time errors and phase-shift problems all result from misaligned FM receivers. Here's how to realign your FM receiver yourself

T.J.C. MOLLE*

THE ALMOST UNIVERSAL USE OF STEREO FM receivers makes stereo receiver test equipment an essential in any modern consumer electronics service shop. With today's high-performance receivers, sophisticated test equipment is needed. There are times when the customer must be convinced that the reason for not receiving a good stereo signal is not a fault in his stereo FM tuner but that the trouble is a defective antenna, for example.

Most faults are caused by a failure in the FM decoder circuitry or by component drift. These troubles can be located and corrected fairly simply; the latter simply by realigning the receiver.

But the problem with the normal transmitted stereo signal is that it is difficult to quantify. The signals are not adequate for use as test signals. Even the relatively few stereo test transmissions are useful for little more than balancing the speakers.

The need is for some form of signal source that can provide a complete easy-to-measure stereo signal. One solution is the *Philips PM 6456* FM stereo generator. It simulates a transmitter signal with signals that can be selected, reproduced and measured.

The FCC standards

Stereo broadcasting brings with it problems not imaginable with a simple domestic record or tape player that has separate right and left channels. The result is that standards are very exacting. The system most widely used is based on the FCC requirements, which insure good reproduction both in stereo and monophonic receivers.

The transmitted stereo FM signal is split into three components:

- The sum of the left and right channels (L + R), containing all information for monophonic transmission, called the M signal.
- The sideband formed by amplitude modulation with a suppressed subcarrier of the difference signal (L – R), called the Sm signal; and
- A pilot signal, with a frequency one-half that of the suppressed subcarrier, which is used to regenerate the subcarrier in the receiver, called the P signal.

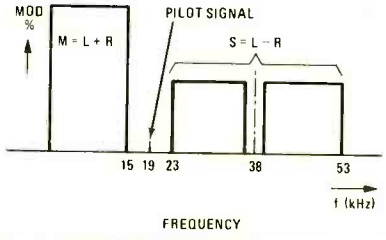


FIG. 1—THE FREQUENCY SPECTRUM of the FCC stereo multiplex signal shows the relative positions of the pilot, M, and Sm signals.

Fig. 1 shows the spectrum of the resulting stereo multiplex signal.

Some idea of the technical demands of stereo transmission can be gathered from the FCC requirements for a stereo transmission system:

- The 19-kHz pilot signal must be accurate within ±2 Hz.
- The phase relationship between the pilot and the subcarrier must be rigidly maintained; zero-axis crossings of the subcarrier in the positive direction must coincide with those of the pilot.
- If only the L or R signal is used for modulation, the amplitude of the M signal must not be more than 3% different from the Sm signal.
- If only the L or R signal is used for modulation, then the phase difference between the M signal and the envelope of the Sm signal must not be less than 3°.

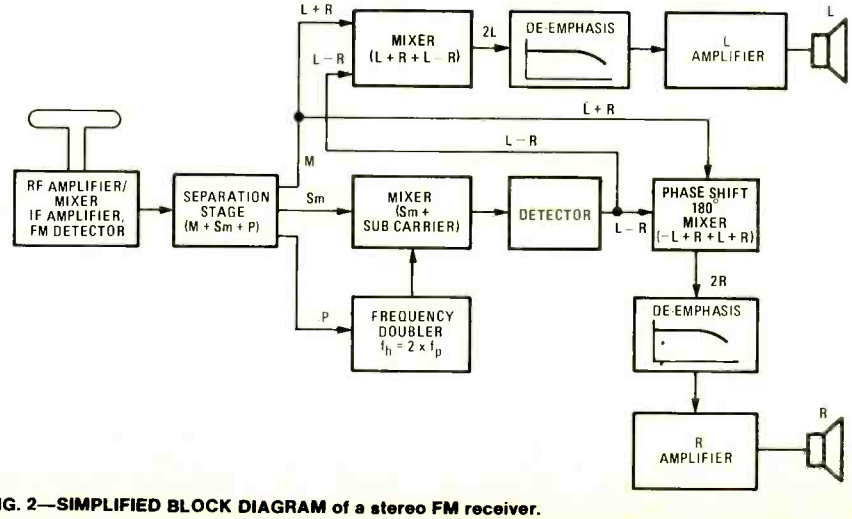
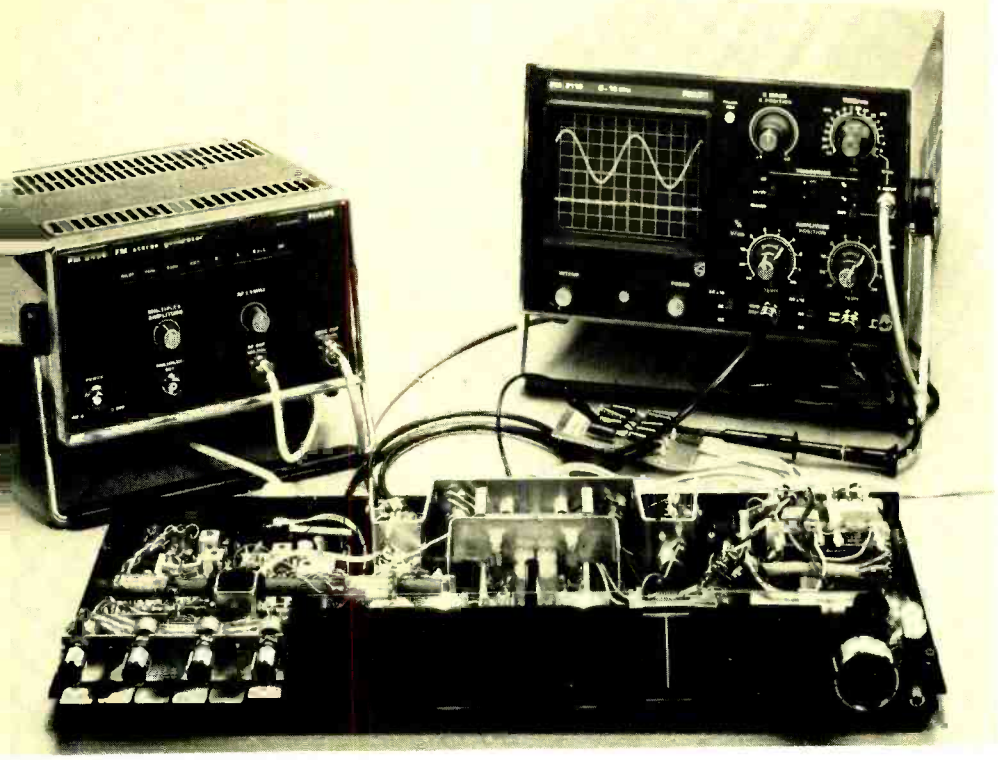


FIG. 2—SIMPLIFIED BLOCK DIAGRAM of a stereo FM receiver.

*Philips Test & Measuring Instruments Dept., Eindhoven, The Netherlands.



• Crosstalk of the L signal on the right audio channel and vice-versa must be lower than 30 dB.

Obviously if the transmitted signal has to meet such stringent standards, a great deal of attention must be paid to receiver adjustment.

To align or troubleshoot a stereo FM receiver, the only suitable method is to use an FM stereo generator that provides a suitable signal source. It must simulate the transmitter signal, yet provide a choice of stable signals, which—in contrast to music and speech—can be accurately reproduced and measured.

Another indispensable instrument is an oscilloscope, so that the amplitude, frequency and distortion (if any) can be measured directly and in full detail.

Receiver operation

Figure 2 is a simplified block diagram of a typical stereo FM receiver/decoder. The receiver detects the multiplex stereo signal and splits it into its three components—M, Sm and P. The pilot signal is fed through a frequency doubler to regenerate the subcarrier for the Sm signal, to which it is added. The L–R signal is detected from the resulting Sm signal. This L–R signal is then added to the L + R signal (M). In this way, a 2L signal is obtained. [(L+R)+(L–R)=2L]. To get the R signal, the L – R signal is phase-shifted by 180° and added again to the L – R signal, resulting in a 2R signal [(L+R) – (L–R)=2R].

One final stage is de-emphasis. Before the original left- and right-channel signals are fed to the transmitter, the higher frequencies are given pre-emphasis to help increase the high-frequency signal-to-noise ratio. This emphasis has to be removed. After de-emphasis and amplification the left and right signals are applied to their loudspeakers.

Alignment faults

Typical troubles that arise are phase shift between the 19-kHz pilot signal and the 38-kHz signal regenerated in the decoder; demodulation time errors; and, perhaps most common of all, crosstalk between the left and right channels.

All these faults can be cured by realignment, using a stereo generator. Adding an oscilloscope to the test set-up makes possible direct measurement not only of amplitude and frequency, but also of crosstalk, phase-relation and distortion.

The equipment should provide a logical sequence of test signals to enable accurate and fast alignment of a stereo decoder or a complete receiver. The test sequences should include a 19-kHz pilot, internal AF modulation with provision for external modulation, right-channel- and left-channel-only signals, and a right equals minus left signal. A 100-MHz ± 1 MHz RF signal is also very useful, and is essential for checking a receiver.

Generator description

Figure 3 is a block diagram of the type of FM generator mentioned earlier in this article.

Signals of 1 and 5 kHz are produced by an audio-frequency oscillator and are pushbutton-selected for channel R, channel L, or both channels in antiphase (R=–L). The selected AF signal is also available as an external trigger signal—for an oscilloscope, for example.

The 38-kHz subcarrier is derived from the 19-kHz crystal-stabilized pilot-tone oscillator. The pilot tone is also pushbutton-selected.

In the 19-kHz to 38-kHz frequency converter, the pilot signal is doubled to create the subcarrier signal and is applied to the stereo modulator.

The audio input signal (R or L or both) is modulated together with the 38-kHz subcarrier frequency.

At point 4 of the stereo modulator the input signal is phase-shifted 180° to insure that the channels are in antiphase when R =–L is selected.

If the EXT pushbutton is depressed, the complete stereo signal of a recorder or record player can be introduced. The adder circuit adds the 19-kHz pilot tone, when selected, to the stereo multiplex signal. The attenuator adjusts the multiplex signal continuously for the required input level of a stereo FM decoder.

From the moment the RF button is depressed the multiplex stereo signal is RF-modulated at a 100-MHz carrier frequency.

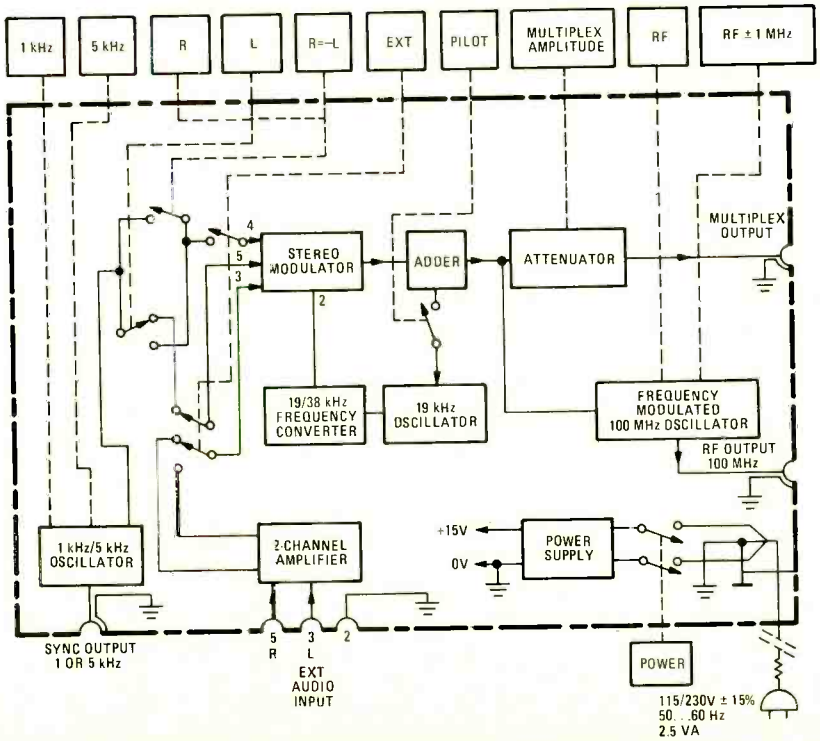


FIG. 3—THIS BLOCK DIAGRAM of a stereo FM generator gives some idea of the facilities available.

The center frequency is adjustable ±1 MHz to avoid interference with transmitters on adjacent frequencies.

The complete stereo multiplex signal comprises three components: The sum of the L and R channels, the difference of the L and R channels modulated at the subcarrier frequency, and the pilot frequency.

It will be clear that, although a stereo FM generator is simple compared to a real transmitter, its specifications must be close to the requirements that have to be met by the transmitter signal.

The *Philips PM 6456* FM stereo generator offers:

- Crosstalk suppression between the L and R signals for 1 and 5 kHz > 40 dB.
- Phase shift between the pilot and subcarrier 3°
- Subcarrier suppression > 40 dB.
- Accuracy of the pilot frequency, 19 kHz ±2 Hz.

Stereo FM alignment

The measuring set-up is simple. The multiplex output of the generator is connected to the decoder input.

The alignment is performed step-by-step (see Fig. 4).

1. **The 19-kHz pilot signal** is applied without an M and Sm signal (Fig. 5). The input voltage is adjusted to 200 mV peak-to-peak on the scope, using the attenuator in the multiplexer output. The pilot and subcarrier filters are adjusted at this stage. After the pilot and subcarrier frequencies are measured, the oscilloscope—preferably dual-trace—is connected to the right- and left-channel outputs, respectively.

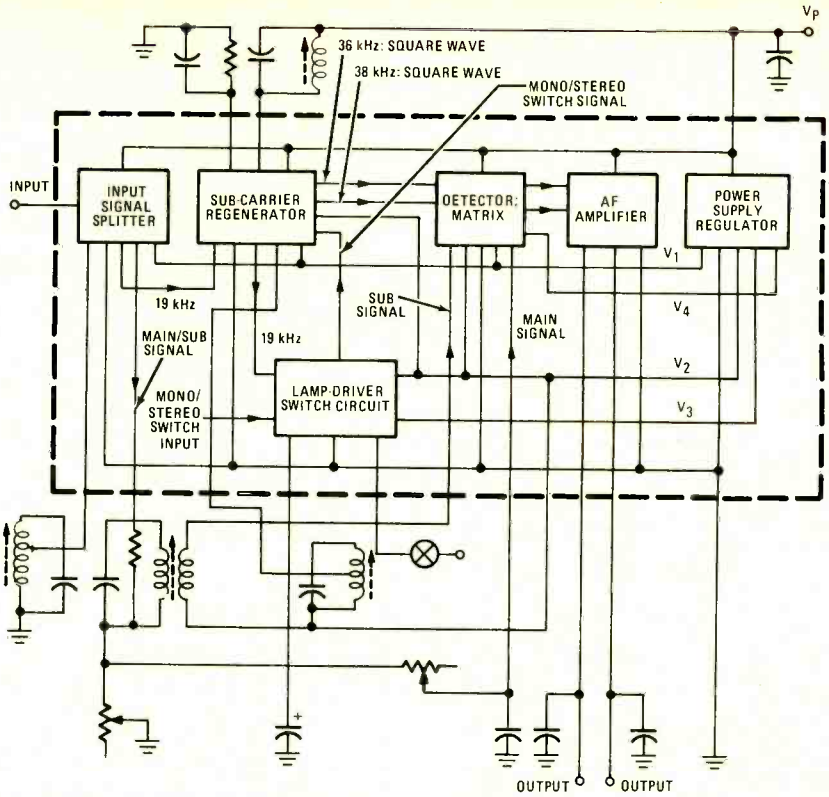


FIG. 4—A STEREO FM DECODER ready for checking and realigning.

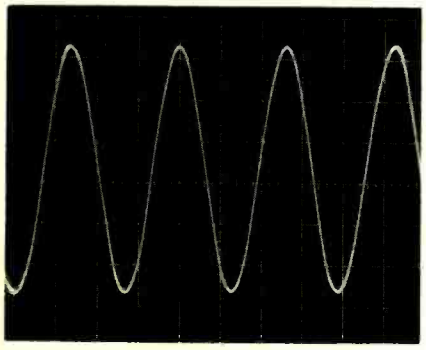


FIG. 5—THE FIRST STEP is to apply the 19-kHz pilot signal, without the M or Sm signals.

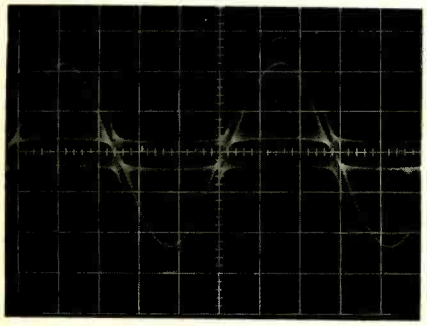


FIG. 6—THE AMPLITUDE OF the multiplex signal at the input is adjusted for 1 volt peak-to-peak.

2. **A multiplex signal** modulated with only one channel—say L—is now applied, and the decoder adjusted for minimum channel crosstalk. The amplitude of the multiplex signal at the input is 1 volt peak-to-peak (Fig. 6). Figure 7 shows a typical display of part of the L signal causing crosstalk in the R channel. Amplitude and phase then have to be adjusted to minimize this crosstalk (Fig. 8). The process is repeated to check the second channel, in this case, the R channel (Fig. 9). Now the crosstalk in the left channel is minimized.

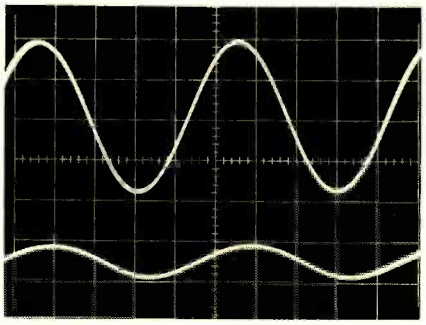


FIG. 7—A DUAL-BEAM OSCILLOSCOPE facilitates the examination of crosstalk between L and R channels. The upper trace shows the signal on the L channel, which results in the crosstalk on the R channel in the lower trace.

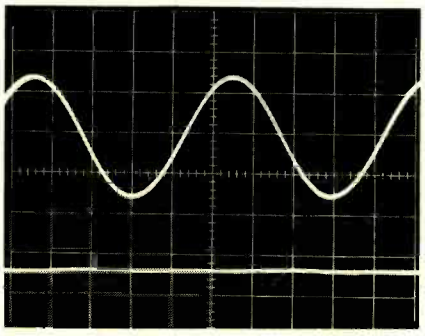


FIG. 8—THE STEREO GENERATOR provides a 1-kHz signal with a pilot to the L channel. Adjustment is made to minimize crosstalk.

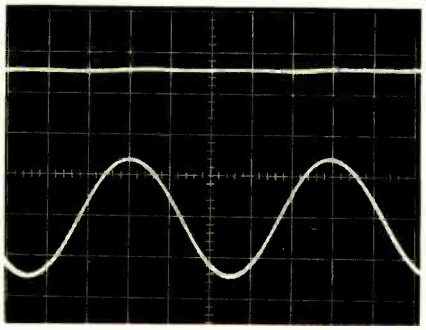


FIG. 9—THE SAME SIGNAL is then applied to the R channel, and crosstalk on the L channel is minimized.

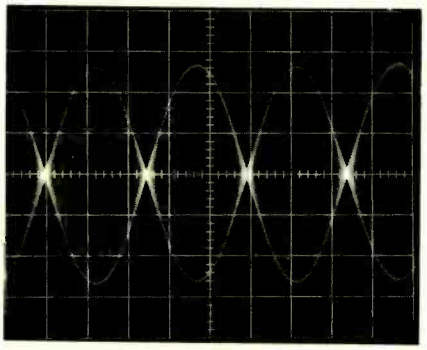


FIG. 10—THE AMPLITUDE OF the Sm signal is adjusted to give zero-axis crossing.

3. **Applying only a sideband signal**—the addition of the modulating L or R signal in phase opposition in the mixer stage, without the pilot—should result in Sm signals with equal amplitude and phase, providing a display with a sharp zero-axis crossing (Fig. 10).

4. **The sideband signal** is then applied with the pilot signal, and the resulting L and R output signals are adjusted to the same

(continued on page 106)

New for Hi-Fi

CLASS-H Variproportional Amplifier

New approach to audio amplification provides high efficiency and rates a new class designation. Here's how it works

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

FOR MANY YEARS HIGH-FIDELITY AMPLIfier designers and manufacturers concentrated on Class-A, Class-AB and Class-B circuitry. At the relatively low power-output levels demanded by audiophiles during the beginning of the hi-fi era, power-amplifier efficiency was of little concern. But, as audio enthusiasts began to seek ever more powerful amplification (the newest leader in the receiver "power race" this year is a 250-watt-per-channel heavyweight from Marantz), the efficient conversion of wall-outlet AC power into low-distortion audio power began to be more important. The nation's energy crisis has caused audio enthusiasts to think about the electrical energy consumed by their hi-fi components.

Audio designers have recently turned their attention to new circuits and can more efficiently convert input AC line power to useful audio power. Some time ago, we discussed the so-called Class-G amplifier circuitry developed by Hitachi. Essentially, the Class-G circuit uses two levels of output-transistor devices, each powered by its own supply voltage. Low-power pairs handle signals up to a predetermined amplitude, while the higher-powered pairs, operating at higher supply voltages, take over the job when signal levels exceed the lower supply voltage. In this way, each pair of transistors operates over its most efficient range for a longer period.

Now, Soundcraftsmen of Santa Ana, CA, have produced another class of audio amplifier that they have tentatively called "Class H." Paul E. Rolfes, Soundcraftsmen chief engineer and the inventor of the new amplification scheme, provided us with information regarding his invention (for which patents are pending) at the recent Consumer Electronic Show in Chicago, IL.

How it works

A simplified schematic of the Class-H vari-proportional circuitry is shown in Fig. 1. The first thing to note in examining the power-supply arrangement on the left side of Fig. 1 is that the circuit uses two positive- and negative-supply voltage levels (derived from the two take-off points, per polarity, at the power-

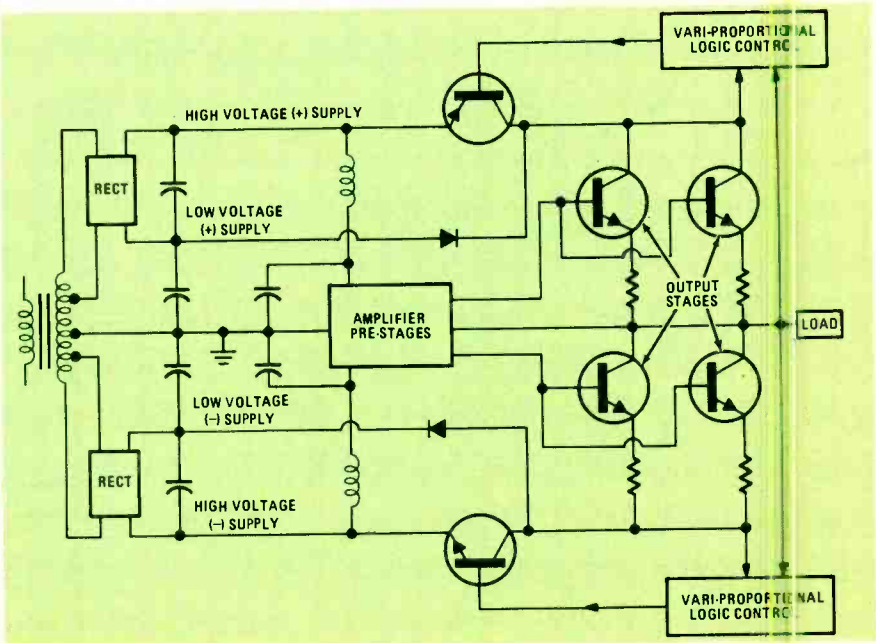


FIG. 1—CLASS-H AMPLIFIER uses a dual polarity low- and high-voltage power supply. The logic circuit varies the supply voltage to the output transistors.

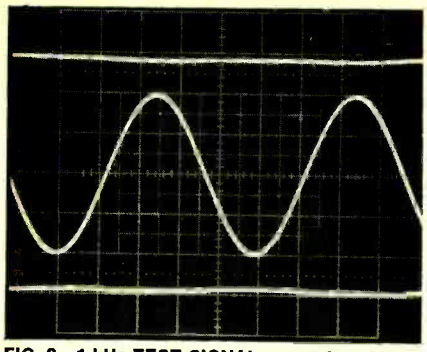


FIG. 2—1 kHz TEST SIGNAL appearing at output of Class-H amplifier. Upper and lower traces show the positive and negative voltage levels supplied to the output transistors.

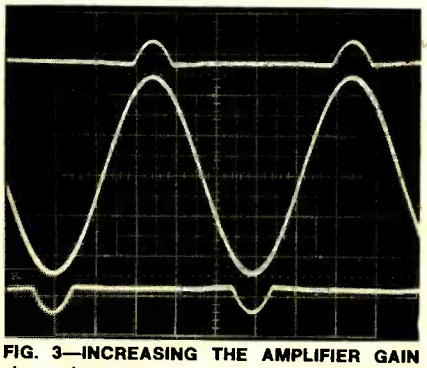


FIG. 3—INCREASING THE AMPLIFIER GAIN shows that as the output signal approaches the supply voltage, the logic circuits increase the supply voltage.

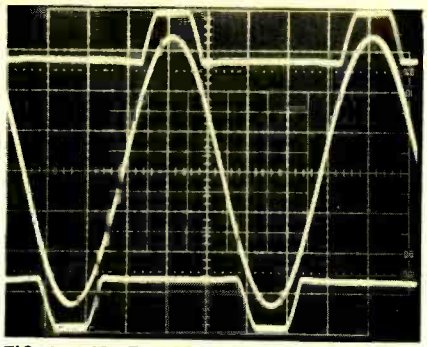


FIG. 4—LARGE OUTPUT SIGNAL swings force the power supply to saturate.

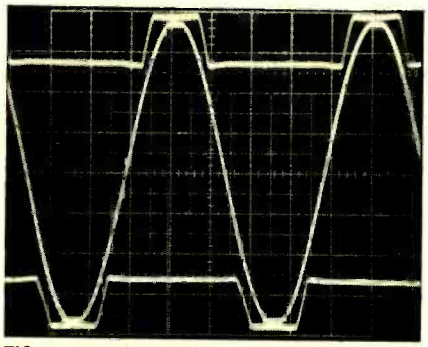


FIG. 5—OUTPUT SIGNAL CLIPS when the output voltage reaches the maximum supply voltage.

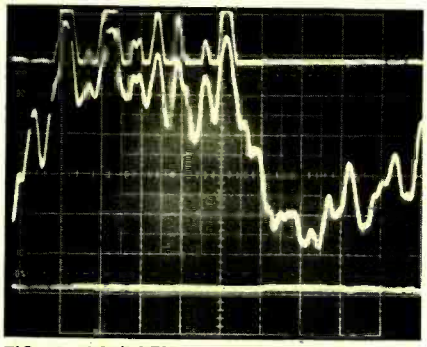


FIG. 6—COMPLEX WAVEFORM is shown in center trace. Upper and lower traces show output of power supply.

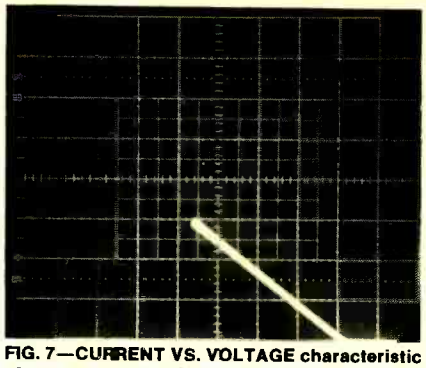


FIG. 7—CURRENT VS. VOLTAGE characteristic of an output transistor. The amplifier is operated at one-third in the Class-AB mode. Area to left of trace is heat dissipation.

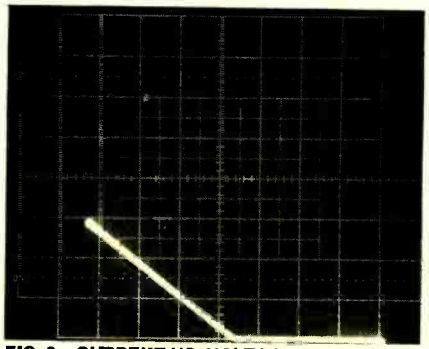


FIG. 8—CURRENT VS. VOLTAGE characteristic of an output transistor operating in the new Class-H mode.

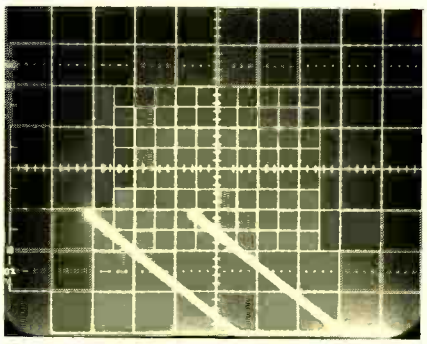


FIG. 9—HEAT DISSIPATION DIFFERENCE between Class-AB and Class-H modes is shown by superimposing Figs. 7 and 8.

transformer secondary). The ratio of these power-supply voltages is arranged so that the low-voltage supply is two-thirds that of the high-voltage supply. In operation, the amplifier appears to work exactly like a conventional Class-AB amplifier at low-power outputs. However, as the signal level approaches the low-voltage supply limit, a difference in operation becomes apparent.

Figure 2 shows two horizontal lines that represent the B+ and B− supplies to the output stages. A 1,000-Hz sinewave signal at the amplifier output is operating within the voltage limits of these supplies. As the output signal increases, you would normally expect clipping to occur when the output level reaches the supply-voltage levels.

Referring to Fig. 3, however, note that the vari-proportional logic-control circuits (of Fig. 1) have anticipated the sinewave's approach to the supply-voltage level and have begun to increase the B+ and B− voltages to allow for additional head room or power output. This action continues, as required, until the vari-proportional system reaches its maximum, or the limit of the high-voltage supply. Figure 4 shows that the supply voltages have reached their upper limits, and, if the amplifier is driven still harder, clipping finally takes place against the high-voltage supply, as shown in Fig. 5.

The amplifier operates at a lower voltage most of the time. This conserves energy because it reduces output-stage dissipation, since this dissipation is directly proportional to the voltages applied across the output transistors. Actually, there is energy conservation even under high-powered sinewave conditions too. Figures 4 and 5 show that although the high-voltage supply is being "turned on" to its maximum level, it only reaches that level during the brief period required by the peak of the output sinewave. It is off (and the lower supply voltage applied) during most of the "duty cycle" of each sinewave-signal polarity.

When we first learned of this circuit, several questions came to mind. First, unless the supply-voltage control circuits are fast-acting, what if a high-frequency musical transient signal caused the amplifier to clip before the higher supply voltage had a chance to turn on. Second, the supply voltage should rise *before* it is actually needed, to avoid any switching blips or discontinuities in signal waveforms.

Obviously, the inventors foresaw the same possible problems. Referring once more to Fig. 3, note that the sinewave peaks are still below the level that would require an increase in supply voltage. Still, the vari-proportional logic circuitry has already detected a rising waveshape and is anticipating that the supply voltage *may* have to be increased. Therefore, it begins to turn on the higher supply voltage before the sinewave actually reaches the lower supply voltage level. In Fig. 4, the slope or rate of increase of the upper waveshape (positive supply voltage) is greater than the slope of the audio-signal sinewave that is "entering" the upper supply. Since the turn-on gain of the upper supply voltage is greater than the amplifier gain, the sinewave signal can never catch up with the higher supply (until it reaches final, upper clipping, as shown in Fig. 5).

Soundcraftsmen also notes that the

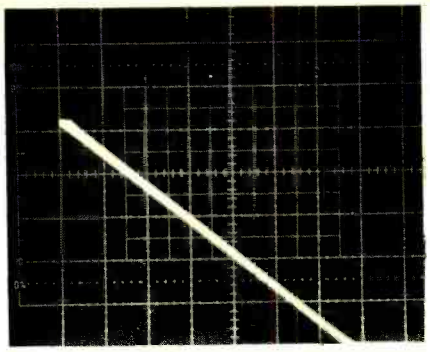


FIG. 10—CURRENT VS. VOLTAGE characteristic of an output transistor when the amplifier is operated at full-rated output in the Class-AB mode.

FIG. 13—SOUNDCRAFTSMEN MODEL MA5002 Class-H amplifier.

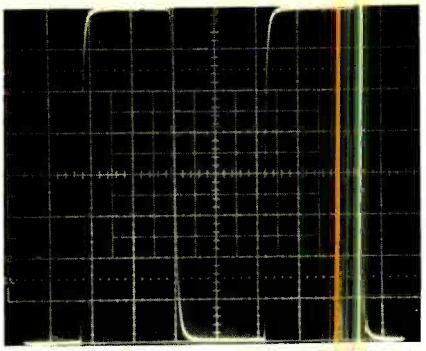


FIG. 16—10 kHz SQUAREWAVE OUTPUT from Class-H amplifier.

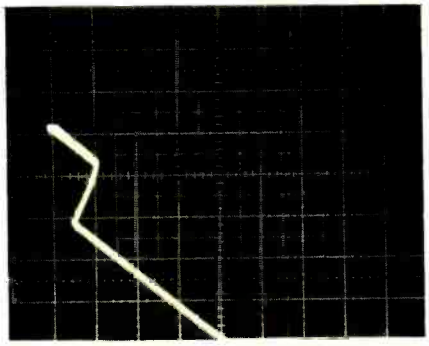


FIG. 11—CURRENT VS. VOLTAGE characteristic of an output transistor in a Class-H amplifier operated at full-rated output.

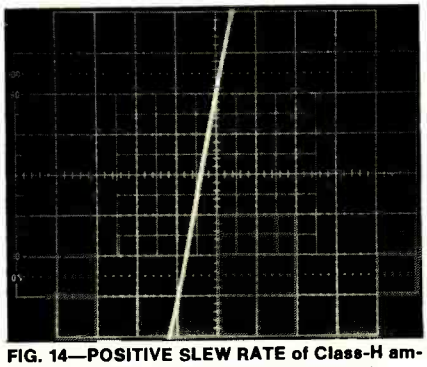


FIG. 14—POSITIVE SLEW RATE of Class-H amplifier operating at 250 watts-per-channel.

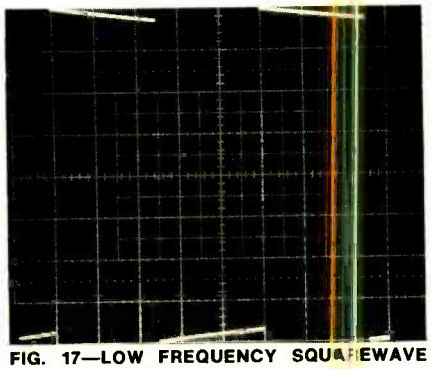


FIG. 17—LOW FREQUENCY SQUAREWAVE output from Class-H amplifier.

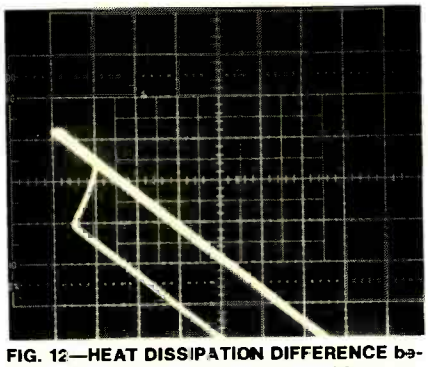


FIG. 12—HEAT DISSIPATION DIFFERENCE between Class-AB and Class-H amplifiers operated at full-rated power is obtained by superimposing Figs. 10 and 11.

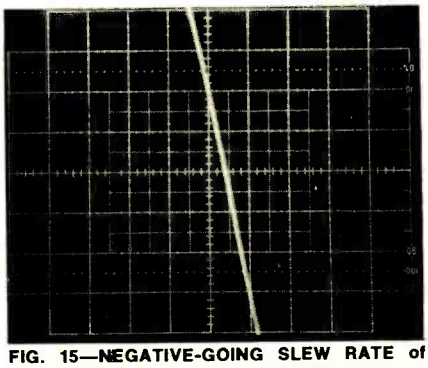


FIG. 15—NEGATIVE-GOING SLEW RATE of Class-H amplifier operating at 250 watts-per-channel.

inherent slew rate of the higher-voltage supply is greater than that of the audio-amplifier circuits themselves, which is approximately 50 volts-per-μs. Therefore, regardless of the signal waveshape, the vari-proportional supply logic anticipates the rising waveshape and turns the higher supply on with gain and slew rate exceeding those of the amplifier itself. It is as if the increased voltage supply gets out of the way of the rising audio signals appearing at the amplifier output.

Figure 6 shows the complex waveforms produced when this amplifier was used to reproduce rock music. As the output signal reaches the lower positive supply voltage, the higher supply voltage is switched in by the vari-proportional control system.

Figures 7 through 12 show the current-versus-voltage characteristic taken on one of the audio-amplifier output transistors. Each figure shows transistor heat loss in the area bounded by the scope trace and the X- and Y-axes to the left. In Figs. 7 and 8, a 250-watt amplifier is operated at one-third its rated output power (the required preconditioning test point of the FTC's rule on amplifier-power disclosure).

Figure 7 shows the amplifier operating in conventional Class AB, without the vari-proportional control system. In Fig. 8, the same amplifier is operated at the same power-output level but using the Class-H concept. Figure 7 shows that the area representing transistor dissipation is obviously greater for the conventional amplifier. A double exposure of the two curves on the same film is shown in Fig. 9; the area between the two curves is a direct measurement of the savings in heat dissipation on each output transistor with the vari-proportional concept.

Figure 10 shows the same amplifier now delivering its full rated 250-watt output, but without vari-proportional control. In Fig. 11 the same amplifier is delivering full rated output, this time using the vari-proportional dual-supply circuit. The change in slope of the curve in Fig. 11 is caused by the vari-proportional system increasing the voltage available to the output transistors. Again, the area to the left of the trace and bounded by the left and lower X- and Y-axes is substantially greater than that of Fig. 10. Figure 12 again shows a double exposure of two curves; the area between the curves represents the savings in heat dissipation or heat loss for each output device.

The major advantage claimed for this method over other efficiency improving schemes is that there is no switching or changing of signal paths within the basic amplifier itself. All the controls for increasing the power-output capability on an as-required basis act only within the power supply and are therefore outside the feedback loop of the audio amplifier circuits and have no effect on the distortion, stability or slew rate of the basic amplifier circuit.

New power amplifier

Soundcraftsmen's first commercially available product using this circuit approach is their new *model MA5002* power amplifier, which is rated at 250 watts-per-channel, into 8-ohm loads, both channels driven from 20 Hz to

continued on page 106

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Radio-Electronics Tests Dynaco SCA-50

1

CIRCLE 99 ON FREE INFORMATION CARD

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

DYNACO, INC., IS ONE OF THE FEW MANufacturers who still offer their products in both wired and kit form. The unit we evaluated was factory-wired, but we explored its internal construction in enough detail to state that, with a few hand tools, a soldering iron, and the will to follow the step-by-step assembly instructions to the letter, the *model SCA-50* would make an ideal beginner's project, even if you have never built any hi-fi equipment before.

The *model SCA-50*, shown in Fig. 1 (the cabinet is an option), has a silver extruded front panel whose dimensions far exceed the height and width of the perforated black metal cover normally supplied with the unit. Thus, it is easy to "custom-mount" the unit into any cabinet by making a single cutout.

The two large rotary controls at the upper left section take care of program source selection (there are two TAPE play positions, PHONO, TUNER and a spare or AUX position) and master VOLUME adjustment. Smaller rotary control knobs at the upper right section handle channel BALANCE, BASS and TREBLE. Pushbutton switches below are used for the tape monitor circuit, mono/stereo switching, tone control defeat, and to select one or both pairs of speakers, which can be connected to the rear panel of the unit. A headphone jack adjoins these pushbuttons, while at the extreme lower right section are a POWER on/off button and an indicator light.

Two switched and one unswitched AC convenience receptacles are located at the left end of the rear panel (Fig. 2), next to which are

2

thumb-screw, color-coded speaker terminals, inscribed with printed speaker-symbol diagrams and polarities to insure proper connection of up to two pairs of speaker systems. Tape-out and tape-in phono tip jacks come next, followed by the other pairs of input jacks; the phono jacks and their associated ground terminal are located as far away from the AC and power-supply parts as possible. The diagram of Fig. 3 shows the assortment of components that can be connected to and used with *model SCA-50*.

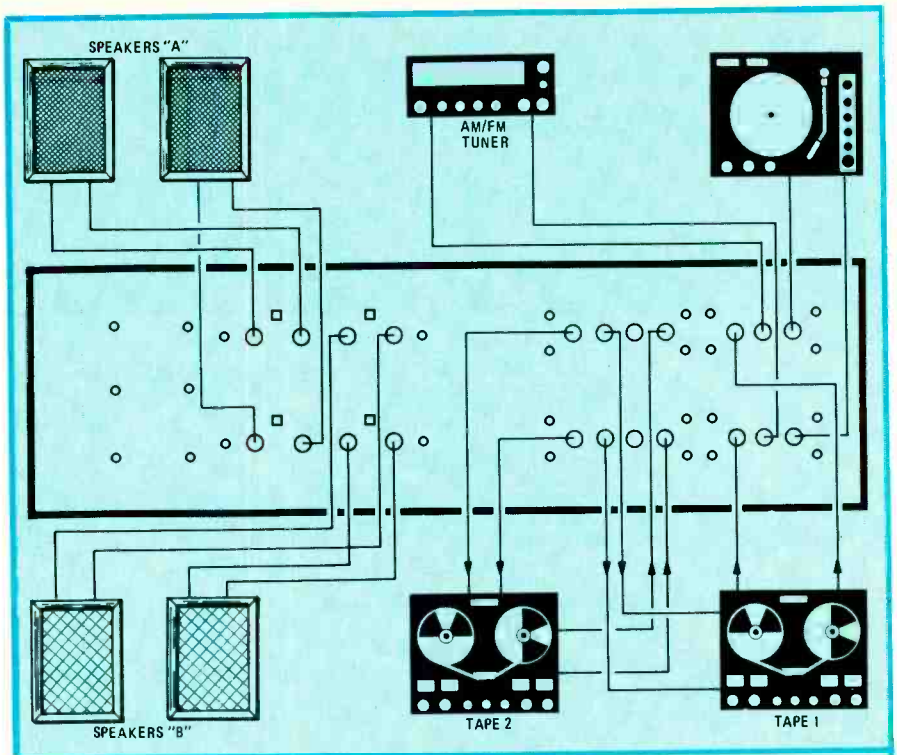
An internal view of the completed amplifier is shown in Fig. 4. Note that the three major PC boards (the preamp-control board and two power-amplifier modules) come preassembled, so that what appears like a great deal of wiring really is the only major work in assembling the kit aside from the usual mechanical procedures.

Circuit highlights

The preamp section consists of two active low-noise circuit elements, both using integrated circuits with Class-A output and powered by regulated ±15 volts DC. The phono-equalizer section uses DC-connected feedback

TABLE I
AMPLIFIER PERFORMANCE MEASUREMENTS

	R-E MEASUREMENT	R-E EVALUATION
POWER OUTPUT CAPABILITY		
Rms power/channel, 8 ohms, 1 kHz (watts)	32.0	Very good
Rms power/channel, 8 ohms, 20 Hz (watts)	29.0	Excellent
Rms power/channel, 8 ohms, 20 kHz (watts)	30.0	Excellent
Rms power/channel, 4 ohms, 1 kHz (watts)	30.7	Good
Rms power/channel, 4 ohms, 20 Hz (watts)	29.0	Very good
Rms power/channel, 4 ohms, 20 kHz (watts)	25.0	Good
Frequency limits for rated output (Hz-kHz)	10-40	Excellent
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output, 1 kHz (%)	0.022	Excellent
Intermodulation distortion, rated output (%)	0.05	Very good
Harmonic distortion at 1-watt output, 1 kHz (%)	0.018	Excellent
Intermodulation distortion at 1-watt output (%)	0.015	Excellent
DAMPING FACTOR, AT 8 OHMS	50	Very good
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ± dB)	0.1	Superb
Maximum input before overload (mV)	110	Very good
Hum/noise referred to full output (dB) (at rated input sensitivity)	63	Good
HIGH-LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± dB)	10-40	Excellent
Hum/noise referred to full output (dB)	82	Very good
Residual hum/noise (minimum volume) (dB)	82	Good
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls Action of secondary tone controls Action of low-frequency filter(s) Action of high-frequency filter(s)	See Fig. 5	Very good
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	1.65	
Input sensitivity, auxiliary input(s) (mV)	130	
Input sensitivity, tape input(s) (mV)	130	
Output level, tape output(s) (mV)	130	
Output level, headphone jack(s) (V or mW)	250 mW (8 ohms)	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Good
Adequacy of input facilities		Very good
Arrangement of controls (panel layout)		Excellent
Action of controls and switches		Excellent
Design and construction		Very good
Ease of servicing		Excellent
OVERALL AMPLIFIER PERFORMANCE RATING		Very good



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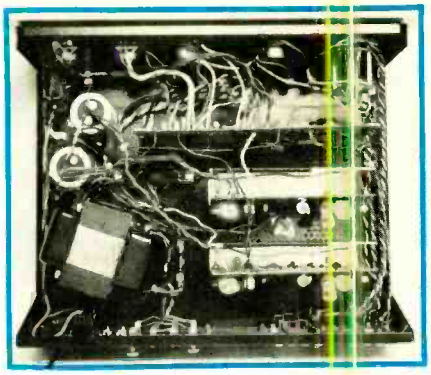

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TABLE II

OVERALL PRODUCT ANALYSIS

Retail price	**$249 (wired); $149.00 (kit)**
Price category	**Low**
Price/performance ratio	**Excellent (kit); Very good (wired)**
Styling and appearance	**Very good**
Sound quality	**Excellent**
Mechanical performance	**Very good**

Comments: Dynaco has obviously carried over many of their design ideas incorporated in their more expensive integrated amplifiers into this lowest-powered and lowest-priced unit in the line. The kit price is outstandingly low, but the large difference between the wired and unwired prices makes it something less than a bargain if you lack the inclination (or skill) to assemble and wire the unit yourself. That large price difference is also a clue to the undeniable fact that this unit requires quite a bit of labor if you are going to purchase it in kit form. There seems to be a high density of interconnecting, point-to-point wiring and cabling—more so than on some competitive kits we have examined recently. Kit instructions are easy to follow and well written, and the wiring is made much easier to follow thanks to a large, multi-colored overall wiring diagram, which is separable from the rest of the construction manual and can be kept in full view on your workbench.

If you are looking for the latest frills found in some other preamps or integrated amplifiers, this unit may not be for you. Such niceties as low- and high-cut filters are absent, as is a second tape-monitor circuit (now common on many amplifiers) or a second phono input pair. However, parts used are of top quality, and it is obvious that Dynaco set out to deliver as much performance for a product in this price range as they possibly could, even if that meant leaving out some of the less often used frills or switches that add flexibility and overall versatility in a component system made up of separates. In terms of pure sound, when driving speakers of reasonably high efficiency, we could not fault the *model SCA-50*. The somewhat higher than usual phono input sensitivity was also welcome, and would enable the user to choose a cartridge that delivers somewhat lower output than the norm. Generally (but not always) that means a somewhat higher quality cartridge. All in all—good value, good sound within its power limitations and excellent for the budget-minded.

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Power Output: 25 watts continuous per channel, 20 Hz to 20 kHz, 8-ohm loads. **Rated THD:** 0.25%. **(Power at "Clipping":** 35 watts, 1 kHz, 8 ohms; 35 watts, 4 ohms; 20 watts, 16 ohms). **IM Distortion:** 0.1%. **Frequency Response:** Phono: RIAA ± 1.0 dB. High Level: 15 Hz to 45 kHz, ±0.5 dB. **Hum and Noise:** Phono: 72 dB below 10-mV reference; High Level: 89 dB below 0.5-volt input. **Phono Overload:** 100 mV at 1 kHz. **Input Sensitivity:** Phono: 1.65 mV; High Level: 125 mV. **Tone Control Range:** ± 10 dB at 50 Hz and 15 kHz. **Dimensions:** 13½ x 12 x 4¼ inches high. **Net Weight:** 15 lbs. **Power Consumption:** 20 watts at "no signal"; 240 watts maximum, 50 to 60 Hz, 120 or 240 volts. **Suggested Retail Prices:** $249 (wired); $149 (kit).

for RIAA equalization, and the tone-control circuit also uses DC feedback around another IC, with AC feedback used for varying bass and treble response. Turn-on or turn-off "thumps" are attenuated by means of a low-resistance FET at the tone-control output. Power amplifier stages are of the full complementary configuration and are DC-coupled to the speaker terminals, while a differential input pair of transistors is used in the first stage of the power amplifier section.

For circuit and speaker protection, a pair of diodes limit available current for each signal-waveform polarity. In addition, each polarity has a fuse to protect against excessive output current. If the heat-sink surface temperature rises to 80°C., a built-in thermal circuit breaker will shut down the amplifier until safe operating temperatures are achieved. Major power supply parts (transformer, filters, rectifiers, etc.) are all separately mounted and wired; and, since the unit is intended for home construction, the overall layout is open.

Amplifier performance measurements

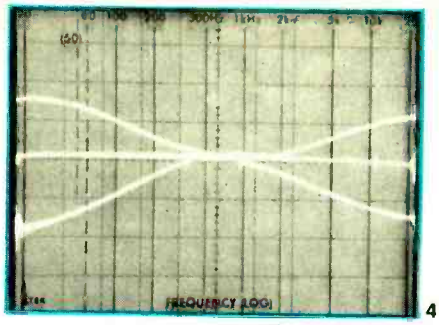
Table I summarizes results of our lab measurements made on the Dynaco *model SCA-50*. Comparing these results with the published specifications in this report, a few comments are in order.

Our measured 32.0 watts (at 1 kHz into 8 ohms) does not contradict Dynaco's claim of "35 watts at clipping." Clipping represents around 1.0% of harmonic distortion, whereas we measured 1-kHz output for rated distortion, which is a lower 0.25%. The amplifier more than met its 25-watt-per-channel "FTC" rating over the entire 20-Hz-to-20-kHz power band. Intermodulation distortion and total harmonic distortion at rated output were, in fact, all well below the rated figures given—often by a whole order of magnitude. The disparity between our hum-and-noise findings and Dynaco's represents a bit of "specsmanship." Dynaco's phono hum-and-noise spec is based upon a 10-mV input signal. On the other hand, our measurement was based upon an actual input sensitivity of 1.65 mV. Our figure of 63 dB, if referenced to 10 mV, would exceed 78 dB—much better than the 72 dB claimed. In the case of high-level input signal-to-hum and noise, Dynaco references a 0.5-volt input signal, whereas in fact the input sensitivity of the high-level circuitry is 130 mV, and it is to that level that our 82-dB result is referenced. Again, if we were to translate that figure to a 0.5-volt reference, hum and noise would result in –93.7 dB—or better than Dynaco's claim. The fact is that the hum and noise figures for both input levels were good—and better than specified. Tone control and loudness control at various levels are shown in Figs. 5 and 6.

Summary

The Dynaco *Model SCA-50* is a straightforward preamp/amplifier that does not have some of the secondary control features found in more expensive and more powerful units. However, it is well designed for what it is and offers the ambitious kit-building audiophile a chance to win a reasonably priced integrated amplifier in this power class.

Table II contains our overall product evaluation as well as additional summary comments. **R-E**



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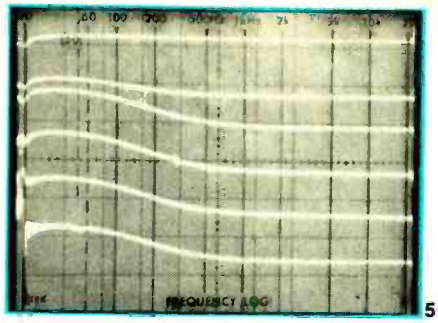
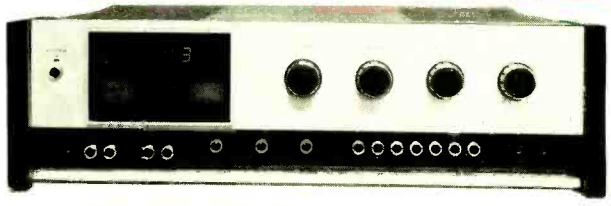


5

Heath AR-1515 AM/FM Receiver



1

CIRCLE 50 ON FREE INFORMATION CARD

HEATH'S MODEL AR-1515 IS A TOTALLY NEW design that is different in appearance from any of Heath's earlier all-in-one receivers. Digital frequency readout has been borrowed from the company's earlier *Modulus* tuner-preamplifier (and works for both the AM and FM frequencies). While the latter separate component, when coupled to a single stereo basic amplifier sells for a total of $780.00 and delivers 60-watts-per-channel, by combining amplifier and tuner-preamplifier on a single, elegantly designed chassis, Heath offers a 70-watt-per-channel receiver for $550.00. The receiver, shown in Fig. 1, is available only in kit form, and if building hi-fi kits is evening recreation in your home, figure on several weeks' work at least.

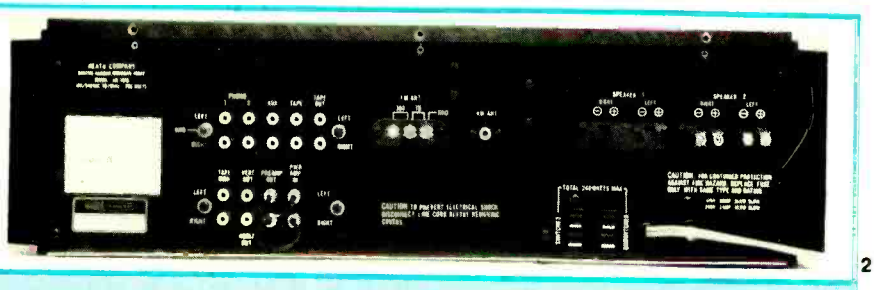
Figure 1 shows the front panel's hinged flap or "trap door" in its open position, disclosing both the major and less-used controls; but when the flap is closed, only the major rotary controls along the top are exposed: The TUNING knob, MODE switch (mono or stereo), SELECTOR switch for program selection and the VOLUME control. Behind the hinged flap are two speaker-selector pushbutton switches, BASS, TREBLE and BALANCE controls, a tone defeat switch, high and low filter switches, FM mute switch (Heath calls it a SQUELCH defeat button), BLEND switch (for reduced noise in weak-signal stereo FM reception), LOUDNESS switch, tape monitor and dubbing switches, and a Dolby FM switch (active only if you buy the Dolby board available as an option). The lower section of the panel also contains a headphone jack and a pair of dubbing jacks (input & output).

The upper left area of the front panel is highlighted by giant frequency-readout illuminated digits. This section of the front panel also contains the center-of-channel and signal-strength meters as well as illuminated words indicating mode, program source selected and the presence of a received stereo signal. (Interestingly, Heath uses the words FM PILOT for this last indication, probably in recognition of the fact that a station could have its 19-kHz pilot "on the air," but at the same time be transmitting monophonic material—either in error or deliberately.)

The rear panel of the *model AR-1515*, shown in Fig. 2, is equipped with the usual array of input jacks, tape-in and out jacks, a chassis ground terminal, 300- and 75-ohm external FM antenna terminals, a pair of preamplifier output and main amplifier input terminals (interconnected by means of plug-to-plug wire jumpers), one switched and one unswitched convenience AC receptacles, an AM antenna jack, and two pairs of speaker-connection sockets designed to accept mating, polarized screw-terminal plugs that are supplied separately. The advantage of this arrangement is that if the speakers have to be disconnected, the polarized plugs remain with the speaker wires so that when they are reconnected, proper phase relationships are maintained between left and right speakers.

The AM antenna jack referred to earlier is for connection of Heath's "built-in" antenna loop. Heath maintains (and we agree) that a traditional large AM loop antenna (the one you build from kit parts ends up as a loop having approximately a two-foot diameter) is a better AM signal interceptor than the more common ferrite "sticks" used on hi-fi receivers.

An internal view of the completed receiver is shown in the photo of Fig. 3. Thirteen sepa-



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MANUFACTURER'S PUBLISHED SPECIFICATIONS:

FM TUNER SECTION:

Usable Sensitivity: mono, 1.8 μV (10.3 dBf); stereo, 3.5 μV (16.1 dBf). **S/N Ratio:** mono, 70 dB; stereo, 60 dB. **Selectivity:** 100 dB. **Capture Ratio:** 1.5 dB. **Image, IF and Spurious Rejection:** 90 dB. **AM Suppression:** 65 dB. **50-dB Quieting:** mono, 2.3 μV (12.5 dBf); stereo, 35 μV (36.1 dBf). **Harmonic Distortion:** 1 kHz: mono, 0.3%; stereo, 0.35%. **Stereo Separation:** 40 dB at 1 kHz; 25 dB at 10 kHz. **Frequency Response:** ± 1 dB, 20 Hz to 15 kHz. **Carrier and SCA Suppression:** 60 dB. **Mute Threshold:** 0 μV to 5 μV (variable).

AM TUNER SECTION:

Sensitivity: 5 μV (50-ohm direct input). **Selectivity:** 20 dB at 10 kHz. **Image Rejection:** at 600 kHz, 70 dB. **IF Rejection:** at 1400 kHz, 60 dB. **Hum and Noise:** –45 dB. **THD:** 3%. **Frequency Response:** ±3 dB, 20 Hz to 4 kHz.

AMPLIFIER AND PREAMPLIFIER SECTIONS:

Power Output: 70 watts continuous per channel, 8-ohm loads, 20 Hz to 20 kHz. **THD:** 0.08%. **IM Distortion:** 0.1%. **Damping Factor:** 60. **Frequency Response:** –1 dB, 8 Hz to 45 kHz. **Input Sensitivity:** phono 1 & 2, 2 mV; high level, 200 mV. **Phono Overload:** 100 mV. **Phono Frequency Response:** RIAA ±0.5 dB. **Hum-and-noise:** phono, 65 dB; high level, 80 dB, minimum volume, 100 dB. **Tone Control Range:** Bass, ± 12 dB at 20 Hz; Treble, ± 12 dB at 20 kHz. **Filter Cutoff:** low, –3 dB at 30 Hz; high, –3 dB at 7 kHz.

GENERAL SPECIFICATIONS:

Power Requirements: 108 to 132 volts or 216 to 264 volts, 50/60 Hz, 60 watts at no signal to 260-watts maximum. **Dimensions:** 21½ W. × 6⅜ H. × 15 inches D. **Weight:** 36 lbs. **Price (kit):** $549.95; ($589.90 with Dolby option).

TABLE I

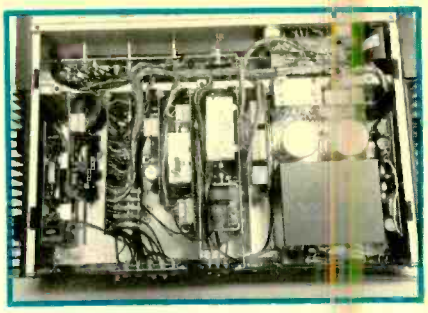
FM PERFORMANCE MEASUREMENTS

SENSITIVITY NOISE AND FREEDOM FROM INTERFERENCE	R-E Measurement	R-E Evaluation
IHF sensitivity, mono (μV) (dBf)	1.8 (10.3)	Very good
Sensitivity, stereo (μV) (dBf)	3.5 (16.1)	Excellent
50-dB quieting signal, mono (μV) (dBf)	2.3 (12.4)	Excellent
50-dB quieting signal, stereo (μV) (dBf)	29.0 (34.4)	Excellent
Maximum S/N ratio, mono (dB)	73	Excellent
Maximum S/N ratio, stereo (dB)	64	Good
Capture ratio (dB)	1.3	Very good
AM suppression (dB)	65	Superb
Image rejection (dB)	93	Excellent
IF rejection (dB)	90	Excellent
Spurious rejection (dB)	92	Excellent
Alternate channel selectivity (dB)	100+	Superb
FIDELITY AND DISTORTION MEASUREMENTS		
Frequency response, 50 Hz to 15 kHz (±dB)	1.0	Very good
Harmonic distortion, 1 kHz, mono (%)	0.12	Excellent
Harmonic distortion, 1 kHz stereo (%)	0.40	Good
Harmonic distortion, 100 Hz, mono (%)	0.12	Excellent
Harmonic distortion, 100 Hz, stereo (%)	0.60	Fair
Harmonic distortion, 6 kHz, mono (%)	0.14	Excellent
Harmonic distortion, 6 kHz, stereo (%)	0.64	Good
Distortion at 50-dB quieting, mono (%)	1.4	Fair
Distortion at 50-dB quieting, stereo (%)	0.55	Very good
STEREO PERFORMANCE MEASUREMENTS		
Stereo threshold (μV) (dBf)	1.0 (5.2)	Fair
Separation, 1 kHz (dB)	44	Excellent
Separation, 100 Hz (dB)	40	Excellent
Separation, 10 kHz (dB)	30	Very good
MISCELLANEOUS MEASUREMENTS		
Muting threshold (μV) (dBf)		See text
Dial calibration accuracy (±kHz at MHz)	"Perfect"	See text
OVERALL FM PERFORMANCE RATING		Very good

TABLE II

AMPLIFIER PERFORMANCE MEASUREMENTS

POWER OUTPUT CAPABILITY	R-E Measurement	R-E Evaluation
RMS power/channel, 8-ohms, 1 kHz (watts)	80.0	Excellent
RMS power/channel, 8-ohms, 20 Hz (watts)	75.0	Excellent
RMS power/channel, 8-ohms, 20 kHz (watts)	75.0	Excellent
RMS power/channel, 4-ohms, 1 kHz (watts)	117.0	Excellent
RMS power/channel, 4-ohms, 20 Hz (watts)	108.0	Excellent
RMS power/channel, 4-ohms, 20 kHz (watts)	108.0	Excellent
Frequency limits for rated output (Hz-kHz)	18-23	Very good
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output, 1 kHz (%)	0.013	Superb
Intermodulation distortion at rated output (%)	0.05	Very good
Harmonic distortion at 1-watt output, 1 kHz (%)	0.013	Excellent
Intermodulation distortion at 1-watt output (%)	0.022	Excellent
DAMPING FACTOR, AT 8 OHMS	60	Excellent
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ± dB)	−1.5 dB	Fair
Maximum input before overload (mV)	120	Very good
Hum/noise referred to full output (dB) (at rated input sensitivity)	65	Very good
HIGH LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± dB)	10-37, 1.0	Very good
Hum/noise referred to full output (dB)	91	Excellent
Residual hum/noise (minimum volume) (dB)	95	Very good
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls	See Fig. 9	Very good
Action of secondary tone controls		
Action of low-frequency filter(s)	See Fig. 10	Excellent
Action of high-frequency filter(s)	See Fig. 10	Excellent
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	1.7	
Input sensitivity, auxiliary input(s) (mV)	150	
Input sensitivity, tape input(s) (mV)	150	
Output level, tape output(s) (mV)	150	
Output level, headphone jack(s) (V or mW)	105 mW	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Good
Adequacy of input facilities		Very good
Arrangement of controls (panel layout)		Excellent
Action of controls and switches		Good
Design and construction		Excellent
Ease of servicing		Excellent
OVERALL AMPLIFIER PERFORMANCE RATING		Excellent



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rate PC boards are used (including the optional Dolby FM board that our test sample included). The elaborate wiring harness is supplied completely ready for wiring when purchasing the kit and is fully color-coded for easy identification of wire terminating points.

FM measurements

Table I summarizes the major performance measurements made for the FM tuner section. The results can be readily compared with the manufacturer's specifications listed elsewhere in this report. In general, sensitivity and quieting for both mono and stereo signals were excellent. THD in stereo, for mid-frequencies, was a shade higher than specified but was deemed acceptable. The stereo threshold level was set a bit lower than we would have liked, so that even very noisy, weak stereo signals are able to switch the circuitry into stereo decoding. Of course, it is always possible to switch the MODE switch to mono; or, in less objectionable situations, to depress the BLEND switch for reduced stereo FM noise at the expense of some high-frequency stereo separation. In our sample, the SQUELCH control (and internal adjustment) had been adjusted so that no muting took place. Of course, a kit builder (we did not assemble ours) could easily set this control for best noise rejection when tuning between stations. We did so, setting the threshold at a comfortable 3.0 μV or so. Naturally, dial calibration was perfect, since the digital counter when properly assembled can only read the "true" received frequency (within 100-kHz increments). Since the readout is governed only by the frequency of the local

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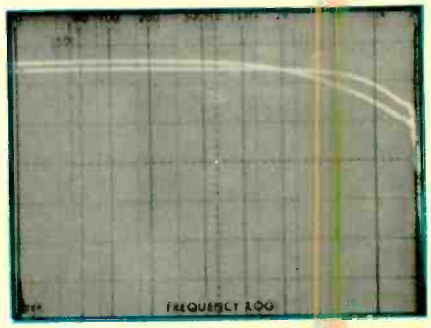

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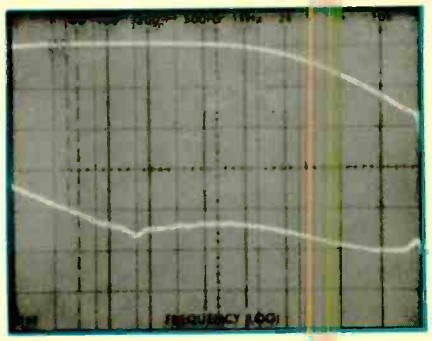


5

What You Should Know About CB Antennas

The facts and fallacies surrounding CB antennas, mounts and installation techniques

MILTON R. FRIEDBERG*

NEXT TO GREEK LITERATURE, THE MOST prolific source of myth and misinformation can be found in discussions about Citizens band radio antennas. Many CB'ers are so concerned with "standing-wave ratio," "antenna performance" and "gain" that they totally ignore how an antenna's design affects its performance.

Starting with the question of which antenna is best for mobile applications, the most common answer is a quarter-wave 108-inch whip. This is not necessarily so. When a car stands still, there is no doubt that the long whip is the best antenna you can use. Unfortunately, the car does not always stand still and as the long whip bends back during car movement, it will detune. The extent of the detuning depends on the car speed. In addition, this antenna layback changes the angle of radiation. The same is true of top- and center-load antennas.

So, while on paper a long whip, a top- or a center-loaded antenna may appear the best, a base-loaded antenna is actually the best. The base load has the least amount of change when the car begins to move because the coil does not move. The antenna's capacitance, therefore, changes much less and the chances of dangerous detuning during motion is less.

Antenna performance therefore is affected by mechanical design. The electrical theory that mechanical designers must follow can be summarized as follows: A quarter-wavelength vertical antenna at resonance develops a radiation pattern that is essentially the shape of its associated mounting plane. Since the quarter-wavelength design operates as a ground-plane antenna, it uses its mirror image in the ground plane to provide essentially the same performance as a halfwave antenna.

On the other hand, a ground plane whose radius is greater than two wavelengths has little practical effect upon the radiation pattern of a vertical CB antenna. A ground plane shorter than two wavelengths will result in a pattern deterioration equal to the relative ground-plane length in any direction.

In mobile applications, the car body acts as the ground plane. This means that, theoretically, the antenna's position on the car has a definite bearing on the relative length of the ground plane from the antenna. An antenna that is mounted near the rear right-hand corner of the vehicle results in a radiation pattern in which the maximum direction is over the left front fender, on a diagonal line from the right rear corner through the left front fender. If the antenna is centered on the trunk deck close to the rear window, the directionality of the pattern is reduced. Mounting the antenna in the center of the car roof provides as omnidirectional a pattern as possible.

Antenna height

A popular fallacy concerning mobile antennas is that raising the antenna height on the vehicle will effectively increase the range. Actually changing an antenna's location from the bumper to the trunk deck or roof will increase range very little.

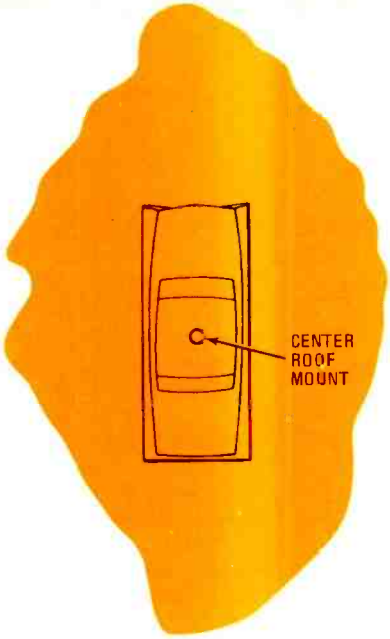
The supposed increased gain fails to materialize because the angular change in pattern caused by a three-foot height increase in the position of a mobile antenna is insignificant when compared with a range of one mile or longer. Height can contribute to gains in range, but it requires a sizable height difference. A 50-foot change, for example, is effective because it can result in an appreciable gain in both the radiation angle and the line-of-sight.

While height changes may not add much to performance, changing an antenna's position can be devastating for other reasons. An antenna designed for a rooftop mount will not work as well when it is trunk-mounted. The better manufacturers specifically design and factory-pretune antennas for specific applications. Therefore, you cannot assume that any antenna will work anywhere.

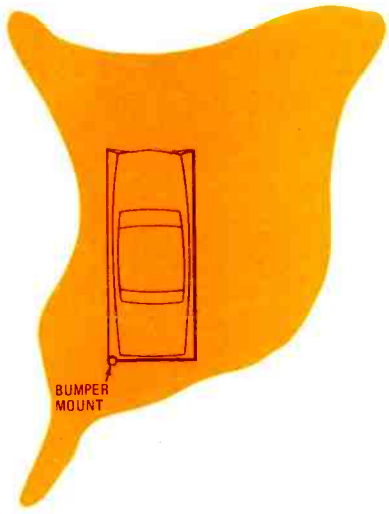
Range is affected more by RF interference than by the antenna's location; your Good Buddies, not your antenna, are doing you in. The best place to mount an antenna, therefore, is wherever it is the simplest and most convenient. The rooftop mount is still considered the best in terms of radiation pattern; but with the growth of CB's popularity, many other equally effective mounts are now available, and the performance and range depend on the quality of the mechanical construction of the antenna and its mount.

The mount has two basic functions: It electrically insulates the radiating portion of the antenna from the vehicle, and it physically supports the radiator in its proper position. Obviously, the mount should act as a feed-through from the 50-

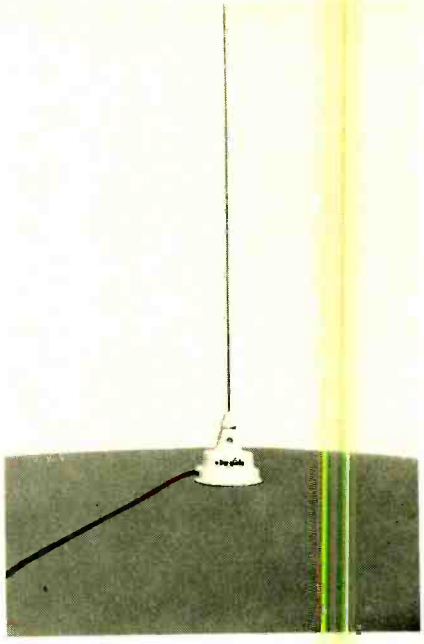
*President, Antenna Incorporated, Cleveland, OH.



CENTER-ROOF MOUNT provides the best omnidirectional response. This location requires a magnetic mount or a hole cut into the roof.



BUMPER MOUNT does not provide optimum directional response but antenna attaches directly to bumper.



MAGNETIC ROOF MOUNT is a cinch to install and remove. It has a 48-inch whip and the magnet is covered with a layer of clear plastic to protect the car roof against scratches.

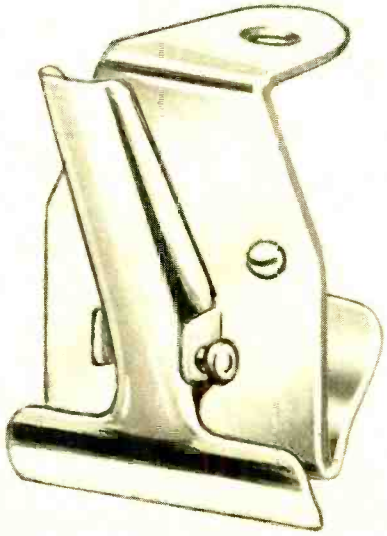
ohm cable to the whip, and, as in all feed-through insulators, the internal capacitance should be minimized and insulation qualities maximized.

Electrical connections should not be made through compression springs, which can act as loading coils or inductances. Maximum effort should be directed towards making a perfect connection to the vehicular grounding metal, making sure that the ground connection maintains this pristine condition. Those small swivel balls that allow a three-foot whip to stand vertically are totally unnecessary. They only serve to add one more joint in the electrical path and, consequently, more resistance.

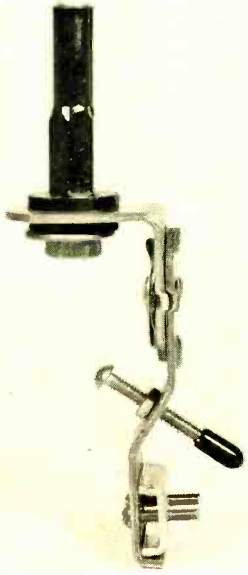
This is not to say that the antenna should not be vertical. Antennas mounted at angles will not perform as well as those mounted vertically, but a simple bend of the whip at the top of the adaptor will do a better job without affecting performance. Long whips on large swivel ball mounts are helpful because they can be mounted almost anywhere on any vehicle while still permitting the whip to be vertical.

Faulty designs, however, do not allow the swivel ball to be properly tightened, and poorly designed units only bear on the inner surface of the half-ball. If the half-balls tighten so that they touch at the center of the ball, the whip motion is resisted by a very short lever arm and the ball turns. Ball size is extremely important. Small swivel balls, even where properly designed and constructed, just do not have a long enough lever to support 102-inch whips!

Obviously, there must be no stress concentrations to break the swivel ball or crack the insulator. Most plastic materials flow under heavy compressive loads. Other inexpensive materials also distort, allowing the ball to loosen on its support, so that it again rotates. No matter how often you tighten that big nut, the whip just comes loose again! With proper design and good materials, you can install the ball once and for all, and while good materials are expensive, corner cutting is a false economy.



THE SPRING CLAMP gutter mount adjusts to the car's rain gutter and needs no screws.



GUTTER-MOUNT ANTENNA has a fold-over mount.

Long whip mounts

Other styles of long whip mountings have problems different from those of the swivel mount. For example, there are two styles of chain bumper mounts. One uses a dog-chain type of link which somehow can't ever be made to stay in place. The stamped-link style is too small to be flexible enough to conform to bumper shapes, and the links stretch when tightened under normal whip movement. In addition, both the dog-chain type and the stamped-link style are subject to either stretching or breaking when the bumper is subjected to any form of impact. If you back into a parking barrier, you usually part company with your chain-mounted antenna.

There is a simple solution to the problem. Since the advent of the impact

safety bumper in 1972, most bumpers have a lip to which a sturdy clamp can be affixed without using chains. The Antenna Incorporated design, for example, combines two adjustments at right angles to each other so that the whip can be put into a vertical position by rotation in either the horizontal or vertical planes (sometimes called "equatorial mounting" by astronomers). This type of mount, when made of a heavy enough material, is an ideal support for long or heavy antennas.

Trunk-lid mount

The trunk-lid mount is the easiest antenna to install and is inoffensive to the eye. A metal bracket supports the antenna, which is held to the edge of the trunk by two setscrews. Since the bracket is hidden by a decorative covering cup, the bracket can and should be of stiff steel, heavily cadmium-plated to prevent rust. The setscrews should be cup-pointed (as opposed to cone points) to cut through the paint for grounding while still preventing the setscrews from digging in too deeply.

The bracket should also make room for cable clearance at the trunk edge. If that clearance is missing, what results is a crushed cable, and eventual cable shorting or tearing.

Since even a slight movement of the cup tends to scuff and cut the body paint, a polypropylene plastic cup plus a soft gasket should be used to prevent damage to the trunk-lip paint. Even if the soft gasket is lost, the plastic minimizes the paint damage.

If metal cups are used, they should be nonferrous, and have a decorative finish. Chrome-plated steel cups are the cheap way to cover the mounting bracket, and you can also be sure that the manufacturer has also economized on the support bracket thickness and plating. You get what you pay for!

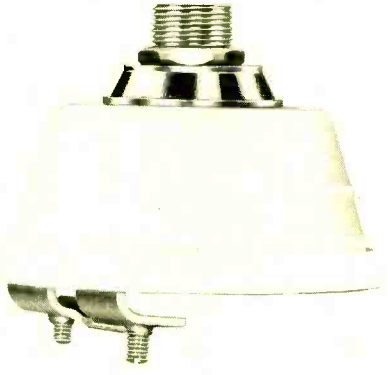
Obviously, the coax cable termination at the antenna should be secure and include lockwashers for a tight connection. It is best to buy preassembled connections whether you are an installer or a do-it-yourself'er. Make sure the manufacturer has soldered the preassembled connections for maximum reliability. This can save you up to 15 minutes of tedious assembly.

Ideally, the cable should also have an in-line connector so that you can easily feed the cable through from the set to the antenna location. This connector should be the same size as the cable, so that you do not have to drill holes. In installing rear-mount antennas, the easiest cable-feeding method is to remove the bottom rear-seat cushion and feed the in-line connector up behind the vertical cushion to the trunk-hinge area. The secret is that the small in-line connector goes where the cable goes without requiring a large hole. It is virtually impossible to feed the large PL-259-type connector through from the trunk without completely removing the rear seat back and tearing a large hole in the rear wall.

Hatchback mounts

Hatchback mounts have been fostered by the small cars with their lift-up combination trunk lid and rear window. The prime criterion here is innovation to meet all possible mounting positions, and the quality of the mount should be measured by its strength and plating, as well as its ability to bite through paint for a ground.

SWIVEL-BALL MOUNT permits vertical orientation of antenna.



TRUNK-LID MOUNT has clearance to prevent coaxial cable damage.

We recommend a hatchback mount that combines a full 360-degree horizontal swivel plus a full 180-degree vertical swivel for a vertical or horizontal mounting on any edge. Obviously, the hardware must be heavily plated and use stainless-steel fastening devices.

The cophase syndrome

One of the greatest fallacies of antenna mounting pertains to the cophase, or dual-antenna. A long-time favorite among truckers, the dual antenna does not work in mobile applications.

If you mount a vertical antenna parallel to another vertical antenna exactly 108 inches away, and there is no vertical metal within two wavelengths, or 73 feet, the resulting radio radiation is increased in a "figure-8" pattern along the bisector of the line between the two antennas. However, if the spacing is not exactly 108 inches, or if the vertical metal is closer than two wavelengths, the results are not the same. Even worse, in a mobile situation, the results become difficult to predict because the base impedance is no longer 50 ohms.

If the antennas do not provide a 50-ohm impedance, the standing-wave ratio goes out of sight. You may actually be losing power that would have been radiated if only a single antenna was used.

Nevertheless, if cophased antennas are used, the easiest way to tune them is to use an auxiliary length of RG-58/U cable from the set to one antenna, trim that antenna with the cable instead of the harness provided with the two antennas, and then trim the other antenna using the same piece of cable. When both antennas are tuned, reconnect the harness and you should be in resonance, provided that the individual legs of the harness are exactly equal in length.

Again, if the antennas are base-station units mounted exactly 108 inches apart, you will end up with true cophasing. However, on a mobile unit, a field strength meter, at least one-fourth of a mile distant directly ahead or behind the car, will not show any real improvement over a single antenna unless you have been lucky and have found a true cophase situation.

Theft protection

There are service problems associated with devices that mount antennas on the trunk-lid rim and then fold up to hide the antenna. The ground connection is the culprit. All the devices have a hinge that acts as a high resistance. Moreover, the ground path is from the hinge to the scratched paint at the trunk-lip edge, which can result in no ground. All these things tend to blow those expensive transistors in the final output stage of the transceiver.

Magnetic mounts

A magnetic mount or a true disguise antenna are the obvious answers to the theft problem. There are many forms and variations of magnetic mounts on the market.

The number of pounds of lift is not the best measure of a magnetic mount's effectiveness. The ability to lift 900 paper clips or pull a Volkswagen with the antenna is as significant as a pen's ability to write under water. Straight vertical pull is unimportant because cars are not lifted by their antennas. The most important criterion is the magnet's resistance to being dislodged when tipped. Two other important factors: The mount must not "walk" along the roof from the vibration caused by either whip sway or car

continued on page 78

all about RF signal generators

PART III—A continuation of a series on one of the most versatile and useful test instruments

CHARLES GILMORE*

LAST MONTH WE TOOK A LOOK AT SOME OF the fundamentals of signal generators. Now let's examine some important features that affect its overall performance.

Output level stability

Output level stability, as with output frequency stability, is given through a range of environmental factors including time and temperature, which are of major interest. Other factors that may be included are changes in load and in operating voltage. Again, these are given as plus-minus a number of decibels for the indicated change. Output level stability specifications are usually confined to newer, more expensive generators.

Spectral purity of output signal

The spectral purity specifications indicate the amplitude and frequency of signals other than the desired frequency which appear at the output of the RF signal generator. Although in simple servicing or home experimentation these may be of little or no consequence, they are of the utmost importance for exacting design work. Even the more sophisticated servicing of communications equipment may be disrupted by signals appearing at undesired frequencies.

*Manager Design Engineering, Heath Co., Benton Harbor, MI.

Harmonic content

Harmonic content is a specification indicating the maximum amplitude of any harmonics of the output signal. The specification indicates the greatest amplitude of a harmonic in decibels below the fundamental amplitude. This is not necessarily the second harmonic, as push-pull amplifiers are frequently used at the generator output. These amplifiers have a high order of second-order product rejection but permit the passage of third and other odd-order harmonics.

When dealing with the bandswitched LC oscillator where the RF oscillator is oscillating directly on the output frequency, there should be no unwanted signals other than those harmonically related to the fundamental frequency, or those caused by modulation of the fundamental frequency. Harmonics at 20 dB to 30 dB below the fundamental are common on low cost and older generators. The newer high-priced generators operate with 30-dB to 50-dB harmonic suppression.

Residual FM

Residual FM is a specification indicating undesired signals that are caused by unwanted frequency modulation of the basic oscillator. This specification is not confined to FM generators, but is given on both AM and FM generators. Frequently, on low-cost generaters, this is a 60-Hz modulation. Residual FM is specified in one of two ways. First it may be listed as a maximum peak deviation in Hz. Second, it may be specified as a maximum deviation expressed as a percentage of the oscillator frequency.

The residual FM has two effects. When measuring an amplitude modulated system, moderate amounts of residual FM cause no problems at all except the purity of the beat note in the receiver decreases as the amount of residual FM is increased. In other words, a 1-kHz beat note produced in a single-sideband communications receiver would contain a 60-Hz buzz if 60-Hz residual FM existed in the generator. The amplitude of this buzz is directly dependent upon the amount of residual FM.

When making FM measurements, the residual FM becomes significant when it is a reasonable percentage of the desired deviation, or if extremely low-distortion measurements are made, such as those on broadcast FM receivers. For example,

residual FM with 60-Hz deviation would only produce 0.08% noise (that would show up as total harmonic distortion in such an analysis) on a 75-kHz deviation measurement. However, the same 60-Hz residual FM would show up as 1.2% total harmonic distortion when that measurement was made on a system with 5-kHz deviation.

In either case, the acceptability is dependent upon the measurements to be made. In the particular previous example, the 0.08% total harmonic distortion at 75 kHz may be much more significant because total harmonic distortion figures in the area of 0.1% are sought after in high fidelity equipment, whereas total harmonic distortion figures in the area of 5% to 10% are acceptable in the communications industry.

Residual AM

In a like manner, a signal generator may have residual AM. Residual AM is specified in decibels below the carrier for the RMS value of all AM sidebands lying within a specified frequency range of the carrier. Residual AM has little or no effect on FM measurements, and unless it is a significant factor, it produces no real effect on AM measurements. Residual AM levels of 40 dB or greater need only be of concern in very exacting measurements.

Phase noise

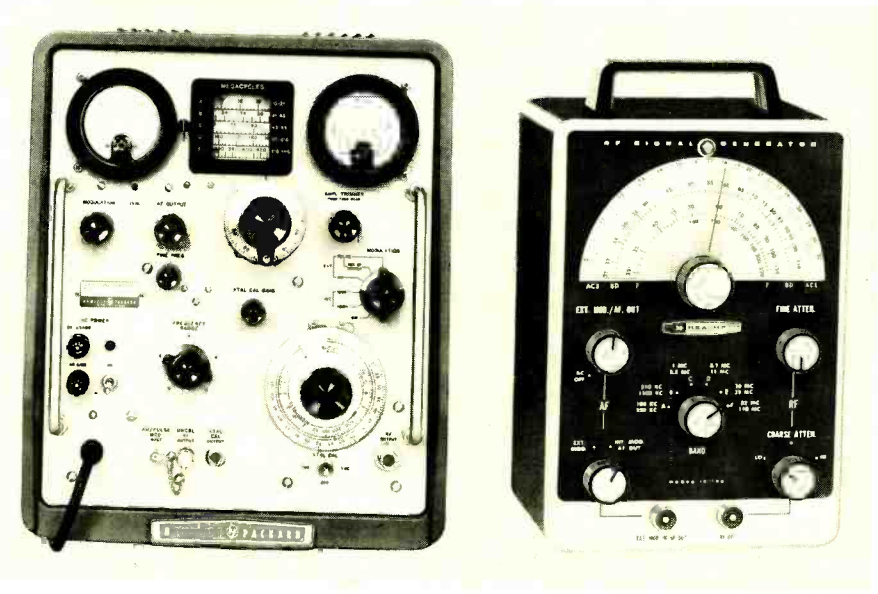
Phase noise consists of random noise extending above and below the carrier for some considerable range, such as a MHz or more. This noise is generated by the random noise in the generator circuits, creating minor carrier phase shifts. Each of these phase shifts causes frequency or phase modulation and therefore creates a number of sidebands above and below the carrier. As the noise is random, so are the sidebands. Therefore, this group of sidebands appears as random noise.

Phase-noise measurements are usually made as single-sideband measurements. That is, they are made on the upper or lower side of the carrier. Being a random noise, the specification indicates the RMS value of the noise over a small bandwidth, usually 1 Hz, at varying distances from the carrier. It is therefore graphically represented in most cases. On top of the line generators, specifications might include a plot of the single sideband phase noise amplitude relative to the carrier amplitude (expressed in decibels) for frequencies 1 kHz to 1 MHz above the carrier frequency. Phase noise, when specified, is normally found 120 dB to 140 dB below the carrier amplitude. When not specified, it may be considerably higher, but is not normally of concern to the operator.

Subharmonic signals

Subharmonic signals are those that are fractionally related to the desired RF output frequency. Non-harmonically related spurious signals are those that can neither be identified as products of modulation nor as harmonics or subharmonics of the basic oscillator frequency. All such products are specified in decibels below the desired output amplitude. Both of these types of spurious signals are generally the result of sophisticated signal generating systems. Subharmonically related signals may be a function of the dividers used for signal generation, and non-harmonically related spurious signals may be the result of third or higher order mixing products when two signals are combined to produce a desired output signal.

Radio-frequency signal generators that use digital frequency meters as part of the readout system are particularly guilty of generating such non-harmonically related spurious signals. The time-base oscillator (often 1 MHz) may have harmonics because it is generated as a squarewave, or subharmonics because it is divided down to a much lower frequency before it is used as a gating signal. These spurious or unwanted signals may well appear in the output of the signal generator. Typical specifications for such signals show them in the −30 dB to −40 dB area, or even lower, depending again on the price of the generator and the nature of signals.



Amplitude modulation

The most common form of modulation found on RF signal generators is amplitude modulation. The low-cost generators are all AM. With the exception of a few specialized generators, older vacuum tube generators of the moderately expensive variety were all AM. Even though a generator has only AM capability, it can be used on FM equipment, although there are test procedures that are not possible.

The modulation sources

Modulation signals can be derived from one of two sources; either an internal generator or an external signal source. The internal modulating frequencies are usually 400 Hz or 1 kHz, or both. The accuracy of these frequencies is usually in the order of 10%. External modulation input specifications include operating frequency range, which is frequently the classical audio range of 20 Hz to 20 kHz, and may extend to DC on generators with automatic leveling circuitry. Often, the external modulating input specifications include the input impedance of the external modulation amplifiers and the amplitude range over which modulation can be achieved from an external source.

Percent of modulation

Depth of modulation, or maximum percentage of modulation, indicates the ability of the generator to provide different percentages of modulation. Most circuits are geared to provide lowest distortion at 30% modulation. Many generators, however, do extend to well above 30% modulation capability, with an upper limit between 60% and 90% characteristic for older vacuum tube generators. The newer solid-state generators tend to have a modulation depth range of 0% to 100%. An extremely inexpensive generator may have a fixed percentage of modulation.

Many generators specify a maximum modulation that cannot be achieved at full output. The limitation at full output is a limitation placed on modulation capability by the power amplifier. If the maximum capabilities of the power amplifier are at or near the maximum with an unmodulated output, the power amplifier is not able to handle the added 50% power required for 100% amplitude modulation. A reduction in power amplifier

output amplitude by one-third permits 100% modulation.

Accuracy of modulation percentage

Modulation percentage accuracy depends on two factors: the type circuit used to make the measurements, and the accuracy of the metering circuit itself. The simpler modulation monitoring technique offers poorer specifications. Modulation accuracy is specified as a percentage of full scale. Typical accuracy figures extend from the worst case ±10% to the more conventional ±5%. Remember, these figures are given as a percentage of full scale, so a meter with 100% full scale and ±5% accuracy set at 30% modulation can only guarantee the modulation depth to be between 25% and 35%.

Modulation distortion

The best distortion specification for an AM generator is given at 30% modulation, the depth chosen for many standard AM receiver tests. Typical figures range from 1% distortion on some of the better generators to 5% distortion on very low-cost generators. Additional specifications show percentage of distortion at greater modulation depths. Usually the distortion increases significantly at higher modulation levels.

AM induced FM

In the process of amplitude modulating a generator, especially one of the MOPA (*M*aster *O*scillator/*P*ower *A*mplifier) type, some frequency modulation of the carrier is likely. The amount of FM produced this way is different than generator incidental FM. Additional FM is either specified as a percentage of operating frequency, or less than a certain peak deviation.

The incidental FM created by amplitude modulating the generator does not interfere with most routine uses of the signal generator. However, when attempting to measure the susceptibility of an FM receiver to AM modulation, the amount of incidental FM must certainly be taken into consideration. Peak deviation values for most generators run from less than 100 Hz on the best to the area of a few kHz on generators with greater susceptibility.

Frequency modulation and deviation

Frequency-modulation capability is becoming more and more common as newer generators are being developed with both communications and laboratory use in mind. Maximum peak deviation is the specification equivalent to depth of modulation on an AM generator. Generators may have a maximum peak deviation that varies from band to band, or that is range-switched to maintain uniformity over a number of bands.

The peak-deviation capability of the generator is highly dependent on its use. One designed primarily as a common communications servicing tool normally has peak-deviation capability in the area of 25 kHz. Generators built for applications involving commercial FM receivers in the 88- to 108-MHz range have peak deviations in excess of 75 kHz and frequently upwards of 300 kHz.

FM modulation sources

Frequency-modulation sources are typically the same as amplitude modulation sources, offering internal generator and external capability; 400 Hz and 1 kHz are also commonly used with FM generators. External modulation capability also covers the audio range, with an extension to DC for generators providing an electronic frequency offset capability. External inputs specify the required amplitude for the external modulating signal and the input impedance that must be driven.

Deviation accuracy

Deviation accuracy depends on both compensating networks to insure uniform deviation across the band, and meter accuracy. Once again, this is given as a plus-minus percentage of full scale, which one must take into consideration when setting low levels of deviation.

FM modulation distortion

Distortion of the modulating waveform is extremely important for certain measurements on FM receivers. This is especially true in receivers designed to receive commercial FM broadcasts. Generators designed to work in this area specify distortion for ±75 kHz deviation. Distortion is usually 1% or less. Distortion specs for generators designed for other use may be somewhat higher than this.

FM induced AM

When frequency modulating the generator, some AM may be introduced. The amount of AM created by the FM process is specified as a percentage depth of AM, and is normally 2% or less. Such AM caused by the frequency modulating process should not be confused with incidental AM.

Pulse and video modulation

Pulse and video modulation are rather specialized characteristics found only on a few generators. Both are special cases of amplitude modulation. Some earlier vacuum tube generators had built-in pulse generators, as they were designed for radar systems and other such pulse oriented equipment. Video modulation simply indicates an extremely wide bandwidth on the external input so video signals can be handled in the modulation system. Bandwidths in the area of 4 MHz to 6 MHz are required so the video signal can be properly processed. Both pulse and video capability are confined to generators that operate in the high VHF and the UHF regions, as extremely wide bandwidth is required for these services.

Many different features

The RF generator is much like the oscilloscope. Both are extremely complex instruments and both command a relatively high price. Both instruments have extensive specifications and both are available with a wide number of optional features. Not all manufacturers include all features or make all features available on all RF generators. Thus, to insure a particular desired feature, another may have to be deleted, or additional features purchased, depending upon what you need. The following is a list of the major ones available today.

Special outputs

When thinking of RF signal generators, we usually think in terms of a single output that contains the RF signal whose amplitude is controlled by the attenuator and whose frequency is determined by the internal oscillator frequency. Frequently an unattenuated signal is provided that is identical to the signal fed to the attenuator. This unattenuated output may be used to drive an external digital frequency meter so precise signal generator frequency setting can be made. It may also serve as a reference signal in systems where the output signal has been buried in noise, and detection or extracting the signal from the noise depends on having such a reference signal available.

Any time this special output is used, we must make certain that it does not reduce the integrity of the RF shielding. Some generators have a special capacitor that must be connected to this output connector before the generator meets full shielding specifications. In addition to the RF output, some generators have audio frequency outputs consisting of the internal modulation frequencies. Once again, these may be used on special demodulators to test for coherency of the modulated signal with reference to the signal derived from the generator itself.

Synchronizer input

A number of RF signal generators have an input that permits a slight adjustment of the generator frequency, typically ±1% or ±2%, by means of an applied DC voltage. If the generator is used with an external synchronizer, the generator can be locked to an exact frequency. The unattenuated radio-frequency output is applied to the synchronizer input.

The synchronizer compares the generator frequency with a digitally derived version of the same frequency generated from a crystal timebase within the synchronizer. Frequency difference generates a DC output that is used to return the generator to the desired frequency.

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hobby corner

Timers, timers, timers—555, 7490, 7448—they all work together.

EARL R. (DOC) SAVAGE K4SDS
HOBBY EDITOR

TIMERS SERVE A VARIETY OF PURPOSES. Perhaps the most useful timer is the 10-minute kind that times eggs, long-distance telephone calls, darkrooms, Ham identification and repeater time-outs.

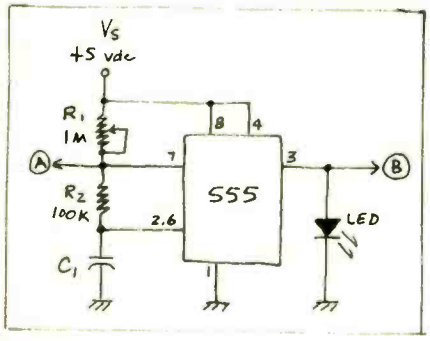

FIG. 1

Figure 1 shows the basic 555 unit. The LED flashes once for each timing interval or period (T), and that interval can be varied from milliseconds to several minutes by the value of C_1 and the setting of R_1. Table I shows the values of C_1 that produce ranges including certain useful T values.

TABLE I

C_1	T
5μF	1 sec.
20μF	15 sec.
25μF	30 sec.
50μF	1 min.

Many other R and C values will produce similar ranges. For example, for 30 seconds: C_1 = 10μF, R_1 = 1 megohm, R_2 = 1 megohm; for 1 minute: C_1 = 25μF, R_1 = 2 megohm, R_2 = 100K. Note that normal 10%-tolerance components can give slightly different results. Increasing any one or more of these three parts will increase T.

There are two precautions to observe with the 555 circuit. First, when using larger values of C_1, avoid units with high leakage. Second, the initial interval after each turn-on is always longer than those that follow. The addition of the parts in Fig. 2-a will make the first T interval more equal to the others. This can be done more accurately by using the Fig. 2-b circuit, but be sure not to adjust the 4K potentiometer so far that it affects the intervals following T_1.

To actually count the pulses, add the 7490 circuit shown in Fig. 3. The four LED's light up to count from 0 to 9 in the binary (base 2) system. If you have trouble keeping up with the binary counting, you could add the circuit of Fig. 4 for the usual Arabic numbers. Although you can remove the individual LED's, you could leave them in place and become more familiar with binary numbers while watching both counts.

Circuit refinements

The counter can be started and

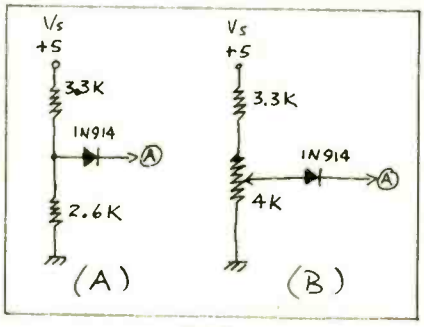

FIG. 2

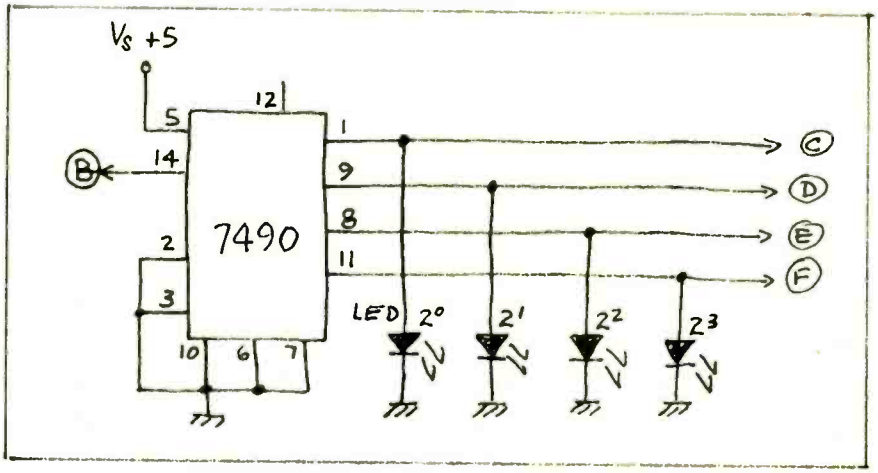

FIG. 3

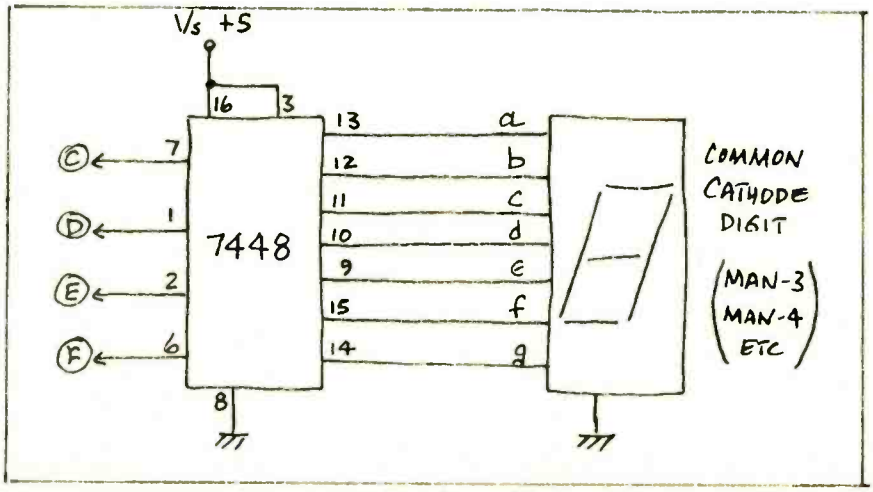

FIG. 4

stopped most conveniently by putting an SPDT switch on pin 4 of the 555 circuit. When pin 4 is grounded, the counter stops; when it is connected to V_s (+5), the counter runs.

The 7490 circuit can be reset to 0 by connecting pins 2 or 3 to V_s; it can be reset to 9 by also connecting pins 6 or 7 to V_s. The reset and start/stop functions can be combined in a single DPDT switch.

Things to try

1. You can have an audible time signal by connecting a Sonalert between pin 3 of the 555 circuit and ground. If the Sonalert is connected between pin 11 of the 7490 and ground, it will sound a tone warning at count 8.

2. A second digit can be added so that the counter indicates up to 99 intervals. This will require a second 7490 circuit and four LED's for binary; or a second 7490, a 7448 circuit and a 7-segment digital unit for Arabic. In either case, connect the input (pin 14) of the second 7490 to pin 11 of the first 7490. Of course, a third, fourth and more digits can be added similarly.

3. A common anode digit and a 7447 circuit can be substituted for the 7448 and common-cathode digit.

4. Follow the 7490 with a 74145 (BCD-to-decimal decoder-driver) and 10 LED's to make a 0-to-9 sequential light counter. If interval T is made short, the light will appear to sweep up the line of LED's.

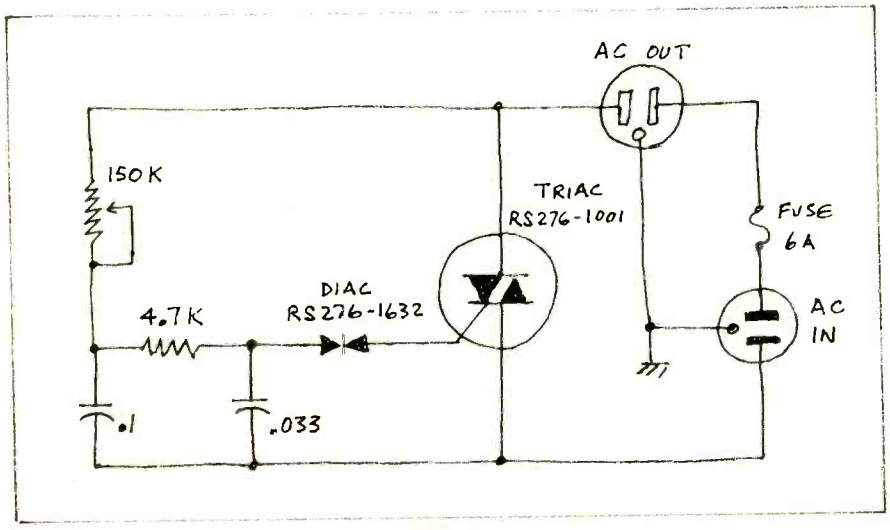

FIG. 5

Troublesome circuits

If you have trouble with any of these circuits, there could be three causes:

1. You may have made a wiring error, which is easy to correct unless something went up in smoke when you applied power. That's why wiring should *always* be checked before throwing the ON switch—we all make wiring errors from time to time.

2. One of the components may be bad or it may have a value outside of acceptable tolerance. Since sometimes this information is difficult to find, we'll try to call your attention to any parts that seem critical.

3. Typographical errors do occur on rare occasions. This is a toughie to correct in your project. About all we can say is that a correction will be printed as soon as possible.

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state of solid state

Applications of National's tachometer/speed switch IC, plus microcomputer notes and HP's alphanumeric display in a dual in-line package. **KARL SAVON,** SEMICONDUCTOR EDITOR

BY NATURE, MACHINERY AND ELECtrical signals have a related intrinsic characteristic—both exhibit rate of change or frequency. In all kinds of measurement and control applications, frequency is an essential parameter that must be monitored directly or used to regulate an open or closed loop system.

Frequently an electrical signal originates from an electromechanical sensor responding to motion of a machine part. Electronic processing systems can be put together from off-the-shelf reservoirs of analog IC's, digital IC's and the exotic microprocessors. It's not hard to see how such a scheme often outperforms the mechanical alternatives.

The frequency-to-voltage converter is a subsystem that appears over and over again in electronic systems. You will find them in speedometers, tachometers, speed-limit sensing; and automotive lock, clutch and brake controls.

Tachometer IC

National Semiconductor has added the LM2907 and LM2917 Tachometer/Speed Switch IC's to their analog line. It combines a precision frequency-to-voltage converter with an operational-amplifier/comparator.

The circuits are available in the four possible combinations with and without active Zener regulation and in 8- or 14-pin packages. The 8-pin configuration saves two pins by internally grounding the inverting reference tachometer input and forming an internal connection between the tachometer charge-pump output and the non-inverting input of the operational-amplifier/comparator. Four terminals of the 14-pin package are not used.

The basic concept of the system is to take the input signal and convert it to constant-width output pulses so that the average value of the current is proportional to frequency. In switching the internal currents, the input frequency is doubled. This simplifies the external filtering problem for the user.

First the circuit must interface with the outside world and receive a signal that as a rule is contaminated with noise. Hysteresis sensing is the usual way of dealing with noise caused by imperfections in pickup devices and harsh environments, and the LM2907 and LM2917 IC's are no exception.

The input signal can be applied differentially to the 14-pin package or single-ended with respect to ground in the 8-pin version. In either case the input feeds a PNP differential amplifier that has emitter-follower input stages with 10-μA current-source loads. Current-source loads provide the necessary transistor DC current while presenting a high AC impedance. The input amplifier has offsets in the 3.5- to 10-mV range that are about 50 percent higher in the 8-pin version. Input bias current is typically 0.1 μA and has a maximally specified value of 1 μA.

Grounding the inverting input of the 8-pin circuit gives the luxury of full input protection. Once one input is connected to ground, the useful range of the remaining signal input terminal is within about 100 mV of ground. The amplifier is protected by a diode from positive voltage swings that exceed V_{cc} on pin 6. The diode does not restrict the negative voltage swing since the diode is back-biased. Positive swings are limited to V_{be} (base-to-emitter voltage drop) above ground which is much greater than the voltage needed to completely switch the differential amplifier.

Perhaps the most natural of applications for the LM2907/LM2917 is a tachometer. Figure 1 shows the hookup for an engine tachometer that connects to the breaker points on the distributor. The 14-pin package is used with internal Zener regulation to hold the system calibration. The output operational-amplifier is wired as a unity-gain buffer amplifier with the output connected directly to the inverting input. Indication of engine speed is displayed on a current meter located in the collector of output-transistor Q45. The collector current is approximately equal to the output voltage divided by the emitter calibration resistor.

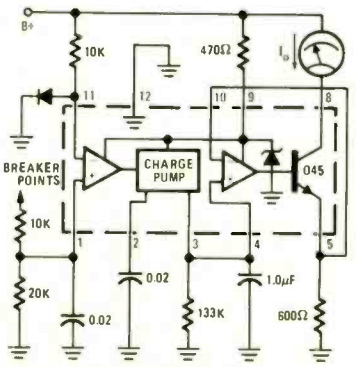


FIG. 1—ENGINE TACHOMETER connects to the breaker points on the distributor and has internal Zener regulation to maintain system calibration.

The output voltage is proportional to the capacitance connected to pin-2 of the charge pump. Based on this idea, the circuit in Fig. 2 makes a neat capacitance meter that works over a range of 0.01 to 0.1 μF with R_a set at 111K. Over this range of capacitance, the output voltage varies from 1 to 10 volts with a 15-volt power supply. A constant frequency reference is taken from the 60-Hz line.

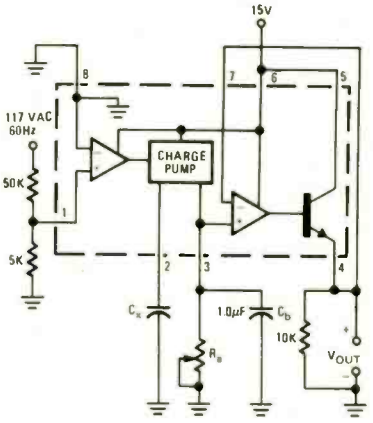


FIG. 2—CAPACITANCE METER, the output voltage is proportional to the capacitance connected to pin 2 of the charge pump.

Figure 3 is one possible overspeed alarm where the operational-amplifier comparator is used to compare the converter output with a DC threshold voltage. The circuit flashes the LED when the input frequency exceeds 100 Hz. Increases in frequency raise the average current out of terminal 3 so that frequencies above 100 Hz reduce the charge time of C2, increasing the LED flashing rate.

Anti-skid controllers may require an input proportional to the lower of two wheel-speed input sensors or an input proportional to the greater of the two.

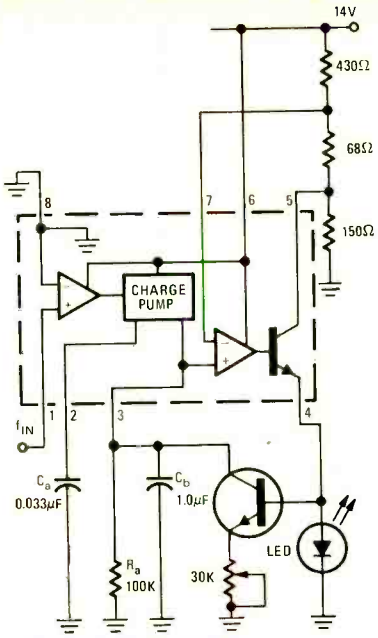


FIG. 3—OVERSPEED ALARM uses operational amplifier to compare the converter output with the DC threshold voltage.

Figure 4 is a circuit that generates the second function. The two output-follower transistors Q45 and Q45-a act as rectifiers giving the more positive of the two outputs preference. The transistor with the lower base voltage will be cutoff by the other device.

The average of the wheel sensors could be produced by simply summing the charge-pump outputs of two IC's.

In quantities of 100, the LM2907 and LM2917 cost $1.65 each. They are available from National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, CA 95051.

Microcomputers

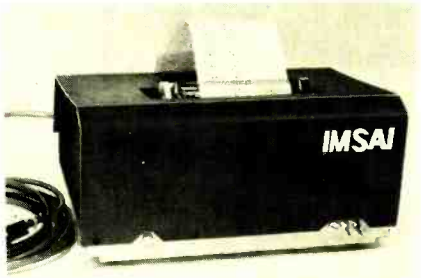
IMSAI's Intelligent Breadboard console is both a learning and developmental tool useful in the conversion of hardware to software. The board connects to an IMSAI-8080 computer.

Circuits including I/O-interface and memory systems can be breadboarded outside of the computer chassis. IC's, resistors, capacitors, and other components are inserted into solderless terminal strips. LED's are used for indicators.

As a kit the breadboard console with space for 40 16-pin IC's, 10 LED's, two 5-volt regulators, two 50-pin and one 26-pin connectors is priced at $435. The assembled-unit price is $625.

Another accessory for the IMSAI-8080 and other computers is a $399 printer kit. The printer uses the standard 64 character ASCII subset. Lines with more than the 44-character limit are automatically continued on the next line.

Information on both products is available from IMS Associates, Inc., 14860 Wicks Blvd., San Leandro, CA 94577.



IMSAI PRINTER uses the standard 64-character ASCII subset.

North Star Computers, Inc., has introduced an 8080 compatible hardware floating-point board. The floating-point board performs decimal floating-point addition, subtraction, multiplication and division with up to 14 digits. Ten digit multiplications typically take only 111 microseconds compared to 5.5 milliseconds for the best 8080 firmware.

The *model-A* floating-point board has the Altair-IMSAI bus structure and the *model-B* is compatible with the Intel SBC and MDS bus structure. An extended BASIC interpreter is planned to take advantage of the speed and memory savings of the floating-point board. Price is $359 for the kit and $499 assembled. For further information write to North Star Computers, Inc., P.O. Box 4672, Berkeley, CA 94704.

RCA now has a high-level language for their CDP1800 microprocessor family. MicroFORTH executes 10 to 1000 times faster than BASIC. The language is compatible with other languages developed by FORTH, Inc. of Manhattan Beach, CA, for other microcomputers. 8K of memory is used by micro-FORTH with more than 2K of room left for application software. An assembler, compiler, cross compiler, inner interpreter, and outer interpreter support the high-level language. RCA/Solid State Division, Route 202, Somerville, NJ 08876.

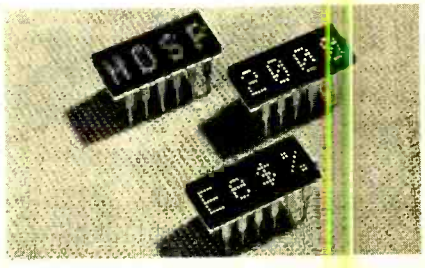
EPA's 66-page User's Manual includes programming examples and a flow chart listing of the MON-1 monitor program. The $5 price is refundable with the purchase of a Micro-68 computer. Inquiries should be sent to Electronic Product Associates, Inc., 1157 Vega Street, San Diego, CA 92110.

Fairchild will manufacture and market the Motorola 6800 microprocessor family. Under an agreement between the two companies Motorola will provide photomasks and technical assistance. Fairchild also manufactures the low cost 8-bit F8 microprocessor. Fairchild Camera and Instrument Corp., 464 Ellis St., Mountain View, CA 94042

HP components

Hewlett-Packard is producing a low cost Schottky-barrier diode for clipping, clamping, sampling, Baker Clamp transistor speed-up, RF signal detection and power monitoring applications. At 1 mA, the forward voltage is 410 millivolts. Low quantity prices of the HSCH-1001 is 80¢.

The HP HDSP-2000 is a four character 5×7 dot-matrix alphanumeric display including built-in shift registers and externally-programmable constant-current drivers. Upper and lower case letters, punctuation marks, and mathematical symbols and numbers can be displayed. In clusters of 125 the displays are priced at $47 each. Unit quantity price is $80. Inquiries: Manager, Hewlett-Packard Company, 1501 Page Mill Road, Palo Alto, CA 94304. **R-E**



HEWLETT-PACKARD HDSP-2000 5×7-dot matrix alphanumeric display.

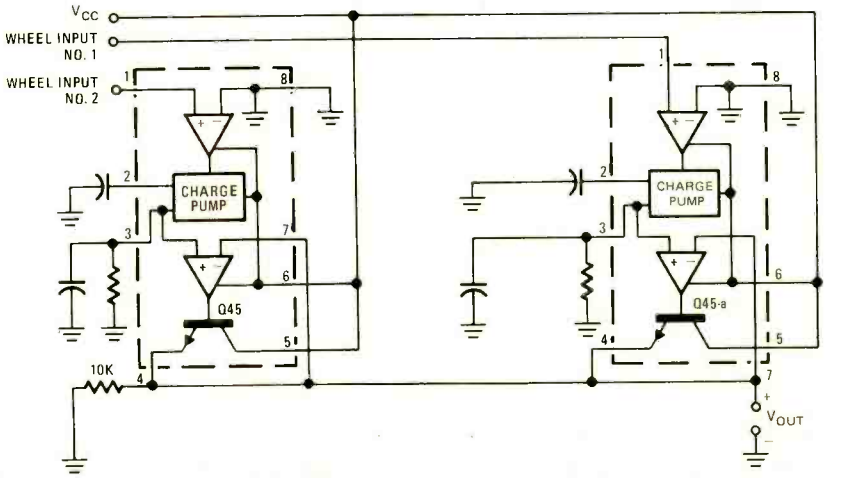


FIG. 4—AUTOMOTIVE WHEEL—SPEED detector provides output voltage proportional to the greater of the two wheel speeds.

service clinic

A logical look at digital circuits. *Don't panic, troubleshoot.*

JACK DARR, SERVICE EDITOR

I'VE JUST READ AN EDITORIAL BY WARREN Baker in the latest edition of *TSA Newsletter* published by Television Service Association of Northeast New York. He reminds his readers that new things are coming out all the time and that a lot of these items are going to use digital logic, such as video games, remote controls, TV tuners with digital readouts, etc. His main point, which I shall appropriate with deep gratitude, is that someone out there is going to have to service the things.

Guess who? Yep, us. Warren makes another major point: Technicians who don't know digital theory and refuse to learn it are going to be left all alone—way out in left field! Actually, while digital circuitry *looks* quite complex as a whole, most of it is made up entirely of a lot of very simple circuits connected together.

Digital circuits really do only one thing—mostly turn on or off. So, here is a very basic primer on what you will find in such circuits. (These tips are based on several years of scrabbling around trying to find out information myself.)

To start with, the symbols used are confusing because many of them don't show a DC power-supply connection. The fact is, each unit *does* have a DC power supply. Sometimes, the symbols are drawn as shown in Fig. 1, which helps somewhat. Some use a dual-polarity DC power supply, usually +5 and −5 volts. Some use a single-polarity power supply of +5 volts, and others use −5 volts, of course.

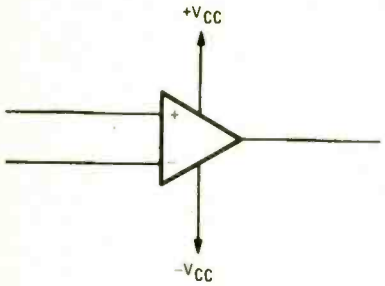
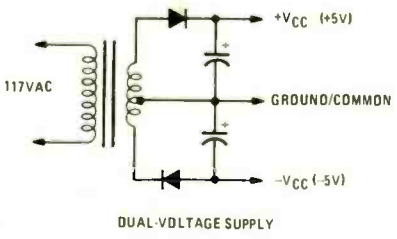
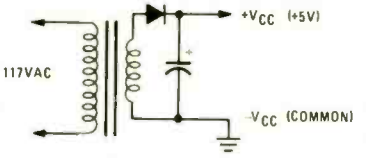


Fig. 1

Another confusing thing is the lack of any *ground* connections. This applies to both power and signal circuits. In the dual-polarity power supplies, ground is the center tap of the power transformer (see Fig. 2). In the single-polarity circuit, the "other end" of the DC power supply is the ground or common. This is the negative lead with a +5-volt supply, but could be the positive lead if the DC supply is −5 volts. We'll see a better way to do this shortly.



DUAL-VOLTAGE SUPPLY



SINGLE-VOLTAGE SUPPLY

Fig. 2

Gates and states

Digital circuits have only two "states." The signals used in these circuits are mainly pulses. These may be very short or very long pulses. For example, if an output went from +5 volts to zero and stayed there for quite a while, it can be considered as a very long zero-pulse.

The term "state" is often used. This refers to the voltage on the output of a device. If the output voltage changes from "high to low," it means that the output changes from +5 volts (high) to zero (low). The opposite is true, for a change from low to high. This is one of the good clues that we can use in servicing. Incidentally, I used the term "zero" for low.

In many actual circuits, low may not go to zero but only drop from about +5 to maybe +2 volts. The *change* of level is the actual signal pulse, and if it's enough to activate or cause a change in the state of the following device, fine.

The term "edge" is another mystifier. Digital circuits use pulses. Each pulse has a negative-going edge and a positive-going edge. These circuits detect the *transition* and it is the edge that is used as the actuating signal. Only the positive-going or negative-going edge is needed to make the next device operate.

Practically all digital circuits use a clock oscillator. The output of this is a squarewave and it is used to control and *time* other devices; such as counters, frequency dividers, switches, etc. Some clock oscillators are simple IC circuits using a single op-amp with feedback; others are crystal-controlled types. One interesting application in a video game uses a 3.58-MHz crystal oscillator and frequency dividers to come out with the horizontal and vertical sync frequencies to control the TV set.

How to fix them

Now comes the most interesting part: How do you service these units? The answer is not "with great difficulty," but "with logic." We have been using logical troubleshooting methods to fix all kinds of things for many years. Just because it's called "digital logic" is no reason to back off from it. Fortunately, a lot of the circuitry is divided into separate logic blocks or functions. You should be able to pin down the function or stage that is not working properly and replace it by changing an integrated circuit or replacing a module.

For example, in a TV tuner with a digital readout and varactor tuning, if the set tunes to the proper station but the readout doesn't work or shows the wrong channel, we've narrowed down the section that isn't working. Video games are the same. If one player can be controlled normally but the other one can't, here again the fault can be isolated in a hurry.

Plain DC voltmeters will check state levels, etc., as well as DC power supplies. Our present scopes will do very well for tracing pulse signals, checking clock oscillators for operation, and so forth. Most of the original test methods can be used. For example, if the "tune higher" function of a TV tuner isn't working, you can go back to the old cross-check method used in stereo service. Check the channel that isn't working against the one that is. You could use the "tune lower" circuits, for a cross check to see what you should be reading, what DC levels should be found at certain points, and so on.

A product inspired by space technology

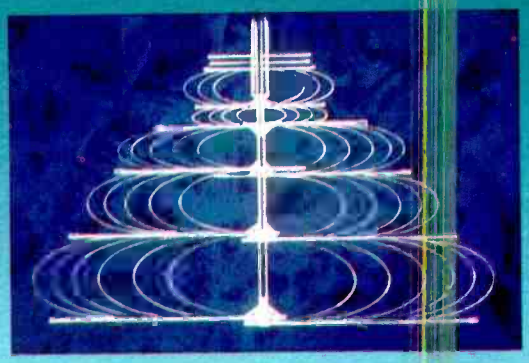
RCA Permacolor Outdoor TV Antennas... designed to provide the best possible picture in the home.

Permacolor is a product of the RCA Distributor and Special Products Antenna Engineering Laboratory, a specialized facility dedicated to the engineering and development of antenna technology. Permacolor . . . designed by the same corporation which developed the microwave antenna used on the Apollo lunar landing missions.

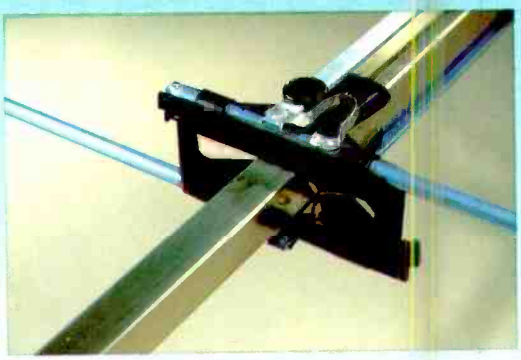
The Permacolor line is a complete line with advanced engineering features that offer the best possible reception in almost any area, from deep fringe to metropolitan locations. The line consists of: 10 UHF-VHF/FM all band combo models, 7 VHF/FM models, 5 UHF models, an FM only model, and a selection of 75 ohm and 300 ohm antenna kits; plus the amazing Mini-State — the first true miniaturized rotating antenna system.

Permacolor is the first antenna with solid, permanent connections from elements to feed line. The first antenna with pivoting, polypropylene insulators. And, the first antenna with a weather-resistant blue and gold vinyl finish.

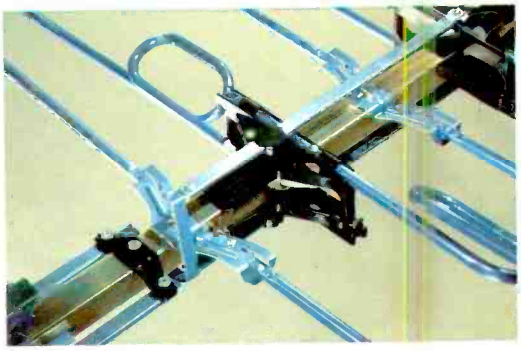
Remember. . .Permacolor Antennas are the only outdoor TV antennas that are designed, engineered, and manufactured by RCA — a world leader in electronics.



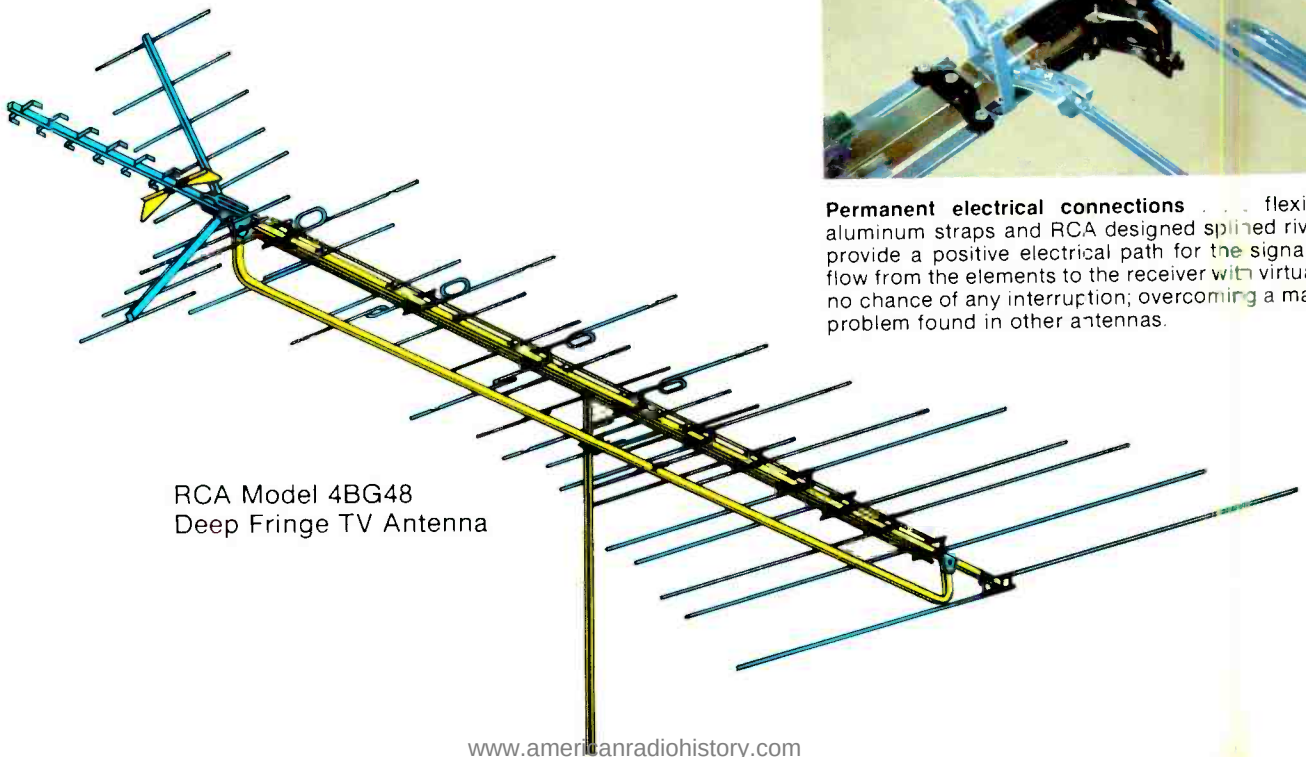
Perma-tuned circuits . . . an original RCA development. Arrangement of elements forming tuned circuits results in full-range, all-channel reception which is maintained throughout the life of the antenna by means of solidly riveted connections of flexible aluminum between elements and feed lines.



Polypropylene insulators . . . an extremely low loss material that resists weathering for peak performance and long life. Entire insulator pivots and snaps into place. Holds its element over a span of almost 6 inches, for great strength.

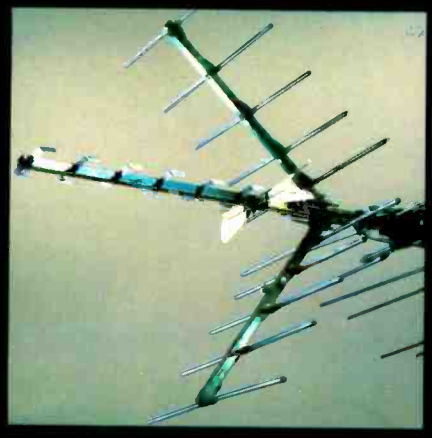


Permanent electrical connections . . . flexible aluminum straps and RCA designed splined rivets provide a positive electrical path for the signal to flow from the elements to the receiver with virtually no chance of any interruption; overcoming a major problem found in other antennas.

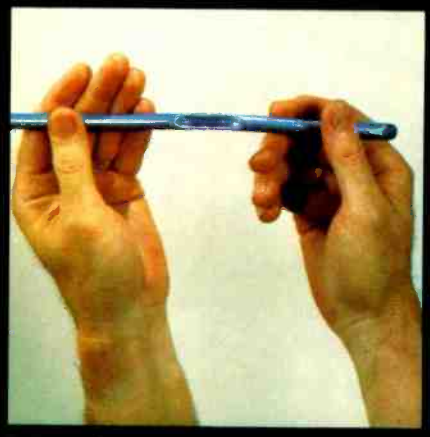


RCA Model 4BG48
Deep Fringe TV Antenna

RCA Permacolor Outdoor TV Antennas... so advanced you'll never be satisfied with anything less.



Combination bowtie and corner reflector on UHF-VHF/FM models result in full-range, no compromise, all-channel reception.

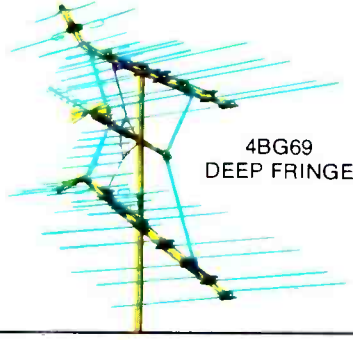


Break-off elements allow you to control FM broadcast reception to suit local conditions. UHF response can be extended to bring in channels 70 to 83 if desired.

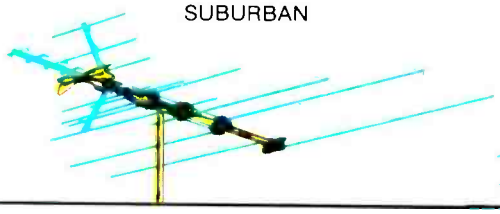
V shaped mast clamps . . . double set of teeth bites into mast, prevents antenna from slipping, and keeps it aimed in the proper direction. Antenna is preassembled, elements unfold with ease and lock into place.

A few of the Permacolor Antenna models available:

UHF-VHF/FM OUTDOOR ANTENNAS



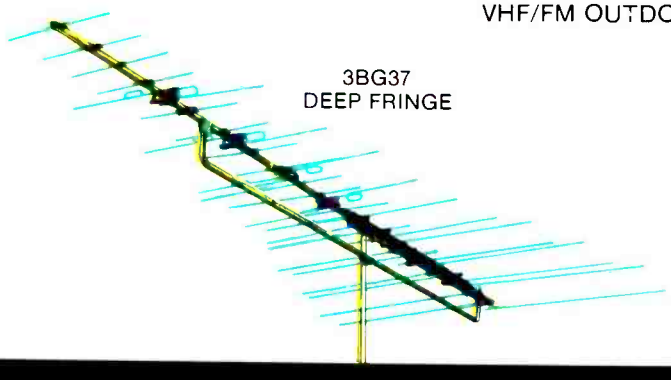
4BG69
DEEP FRINGE



4BG20
SUBURBAN

4BG10
METROPOLITAN

VHF/FM OUTDOOR ANTENNAS



3BG37
DEEP FRINGE

3BG09
METROPOLITAN

UHF ONLY

2BG17

RCA Antenna Mounting Kit

Some models are also available with a kit that includes everything needed for a normal installation — perfect for do-it-yourselfers.

A complete line of quality RCA accessories — including rotators, reception aids, and installation hardware is available.

RCA Permacolor Outdoor Antennas — your TV picture will show you the difference.

RCA Permacolor

Tmk (s) ®

RCA | Distributor and Special Products Division | Deptford, NJ 08096

1W4453

Service data

For maximum efficiency, you should have clear, well-written, simple service data. Warren Baker's editorial suggests that the obvious source for this data is the manufacturers. He also feels that the manufacturers should conduct schools for training in digital theory and logic. The courses should be conducted on the basis of general theory, not restricted to only one make or model set.

Several manufacturers are beginning to bring out such material. Magnavox, RCA, Sylvania and others have published some useful data, most of which does pertain only to their own products, but it is very handy. Try to track down the manufacturer's service data, it should be a big help when servicing these circuits. **R-E**

reader questions

SOUND PROBLEM

There is a sound problem in this CTC-68 RCA. I changed the MAN002A module, which didn't help. Sound is pretty low and distorted. The speaker is good.—R.G., Mena, AR.

Most likely cause for this would be an open speaker-coupling capacitor which is C314, a 50-μF electrolytic on the mother board. Don't bridge it with another one. Lift one end and tack in a new one.

QUICK SHUTOFF

When I turn this EO-8 Sylvania on, I hear a little sound and see a thin horizontal line, momentarily, then it all shuts down. The +170-volt source reads about +140 volts, the +107-volt source is about +140 volts, and there is nothing on the +27-, +29- and +165-volt sources at all. Can you tell me where to start looking?—J.K., Wellsville, OH.

I believe I'd check out the +107-volt regulator circuit in the DC power supply. The input to the regulator is supposed to be +145 volts, and the output not more than +107 volts. Since the +107-volt line feeds the horizontal output stage, and the output of this stage is directly proportional to its supply voltage, the shut-down circuit on the horizontal driver is evidently acting— as it should! The loss of vertical sweep can be explained by the fact that the vertical is fed *from the flyback*. So, all you get is a short "burst" of high voltage and then it turns off everything.

From the voltages, it looks as if you have a problem in the +107-volt regulator. With the same voltages on both collector and emitter, the transistor could be shorted. There can also be some fault in the regulator-driver transistor, or one of the parts in the rest of the circuit could be making the pass transistor turn out and conduct very heavily. Even if the pass transistor is shorted, check *all* of the other transistors, Zener diodes, resistors, etc., before you try it again. Some of these parts may have been damaged.

You don't see anything on the +27-, +29- and +165-volt lines because these come from the flyback and horizontal-output stage.

HORIZONTAL OSCILLATOR PROBLEM

This G-E HC Porta-Color chassis has a bizarre horizontal problem. When turned on, the horizontal oscillator won't start. The output tube gets red hot and no raster. After about 5-10 minutes it will start, but the raster has 7-8 "ripples" down each side and the picture is naturally torn up. After about 30 minutes it will snap in, make a perfect picture and stay that way till turned off! Would appreciate help.—T.H. Rockville, MD.

Going on "probabilities", I'd try replacing the .0033 μF and .0068 μF capacitors across the oscillator coil. This seems to help most of the cases with similar symptoms. The odd appearance of the raster after it does start trying to oscillate is due to the circuit going in and out of oscillation rapidly; "squegging".

(Feedback: That did it!)

continued on page 84

computer corner

Interfacing a D/A converter. CHRISTOPHER A. TITUS, DAVID G. LARSEN, PETER R. RONY* and JONATHAN A. TITUS

AN ANALOG-TO-DIGITAL CONVERTER (A/D converter) is an electronic device that converts analog signals to digital signals. Typical commercial converters are based upon successive approximation, dual-slope integration, staircase-ramp conversion or voltage-to-frequency conversion.[1] An A/D converter is generally used to convert the output from an analog transducer or instrument into digital form suitable for direct observation on a digital display or as input into a computer. All digital panel meters and multimeters contain built-in A/D converters. Modern A/D converters provide standard TTL outputs that can be coded in binary, binary coded decimal (BCD) or perhaps other less frequently used codes.

To demonstrate how an A/D converter can be interfaced to an 8080-based microcomputer, consider the generalized 10-bit A/D module shown in Fig. 1. In addition to the 10-bit output and analog input pins, the module also contains a START input and a DONE/$\overline{\text{BUSY}}$ output. It is obviously not possible to simultaneously transfer all 10 bits from the A/D converter into an 8-bit microcomputer. For the 10-bit converter, data is transferred by placing bits D0 through D7 (the 8 least significant bits) in the first input byte and the remaining two bits, D8 and D9 (the 2 most significant bits), in the second byte.

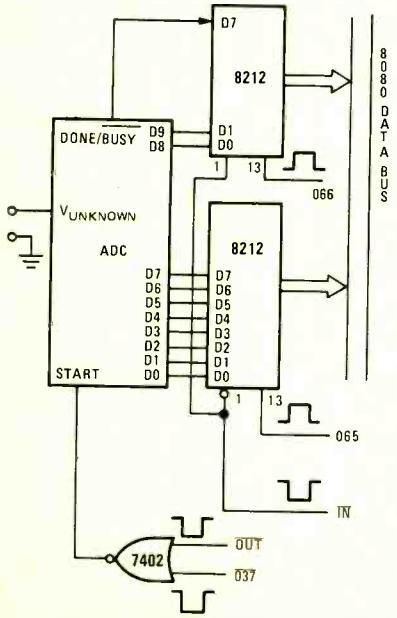


Fig. 1—ANALOG-TO-DIGITAL CONVERTER (ADC) interfaced to an 8080 microcomputer with a pair of 8212 buffer chips.

To gate data onto the data bus and into the 8080, 8212 8-bit 3-state buffer chips are used between the A/D outputs and the 8080 data bus. Gating is required so that the 3-state buffers are enabled only when the 8080 requests data. In the case of the 8212 buffer, the gate is incorporated within the IC, so all that is required is a negative $\overline{\text{IN}}$ control signal, and positive 065 and 066 decoded pulses derived from the address bus decoding logic.

The remaining control signals include a START pulse to reset the A/D converter and start internal conversion, and a DONE/$\overline{\text{BUSY}}$ output flag that indicates a conversion has taken place and the 10-bit digital output is ready. These important control signals synchronize the operation of the conversion. Analog-to-digital converters do not continuously convert voltages into digital outputs—the conversions take a finite period of time. The A/D converter must be pulsed or strobed to start each conversion, and a 10-bit binary value cannot be output by the converter immediately after the strobe pulse is applied. In Fig. 1, a 21-μs conversion time was required. We used a successive approximation technique that converges on the unknown voltage by making successively smaller tests and comparing the results of such tests to the unknown voltage.

The DONE/$\overline{\text{BUSY}}$ flag, which indicates the converter is either done (logic 1) or busy (logic 0), is input into the microcomputer as a single bit; since there are 6 unused bits at input port 066, bit D7 is assigned to the flag. The START pulse to initiate a conversion must be short and positive. It can be obtained by gating the control signal $\overline{\text{OUT}}$ with a negative device address pulse, $\overline{037}$, using a 7402 2-input NOR gate.

A typical software subroutine used to perform a single conversion is shown in Table 1.[3] The 10-bit binary result is left in the B and C registers of the 8080, with the least significant 8 bits in register C and the most significant 2 bits in register B in positions D0 and D1. The microcomputer spends time in the test loop as it checks and rechecks the flat bit during conversion. Our A/D conversion took only 21 microseconds, so the computer is in the loop for a short time. For other types of converters, the conversion time may take much longer, perhaps milliseconds or even hundreds of milliseconds for a digital multimeter. In such a case, the microcomputer would spend considerable time waiting for the A/D converter to "flag" the 8080, indicating that the conversion was complete.

An alternative approach is to use the DONE/$\overline{\text{BUSY}}$ flag as an interrupt input to the 8080. After initiating a conversion by

```
      TYCHON EDITOR-ASSEMBLER V-2                          PAGE 01-001

                    /       TABLE 1   TYPICAL ADC INPUT ROUTINE FOR A
                    /       10 BIT ANALOG-TO-DIGITAL CONVERTER

                            *100 000
100 000 365   ADC,   PUSHPSW /SAVE REGISTER A & FLAGS
100 001 323          OUT     /STROBE THE ADC TO START A CONVERSION
100 002 037          037
100 003 333   TEST,  IN      /INPUT STATUS BIT AND 2 MSB'S
100 004 066          066
100 005 306          ADI     /ADD 1 TO THE FLAG BIT TO CAUSE AN
100 006 200          200     /TO CAUSE A CARRY IF IT IS SET
100 007 322          JNC     /NO OVERFLOW, CHECK IT AGAIN
100 010 003          TEST
100 011 100          0
100 012 107          MOVBA   /OVERFLOW, FLAG=1, SO SAVE MSB'S
100 013 333          IN      /INPUT THE 8 LSB'S
100 014 065          065
100 015 117          MOVCA   /STORE THEM IN REGISTER C
100 016 361          POPPSW  /RESTORE REGISTER A & FLAGS
100 017 311          RET     RETURN TO MAIN PROGRAM
```

*This article is reprinted courtesy American Laboratories. Dr. Rony, Department of Chemical Engineering, and Mr. Larsen, Department of Chemistry, are with the Virginia Polytechnic Institute & State University. Mr. Titus is president of Tychon, Inc.

outputting a START pulse, the microcomputer proceeds to some other software task during conversion. When the conversion is complete, the A/D converter starting at 000 070 inputs the 10 data bits and stores them in a data file. As we have stated previously,[4] interrupts should be used with caution. **R-E**

```
     TYCHON EDITOR-ASSEMBLER V-2                    PAGE 01-001

                    /       TABLE 2   TYPICAL ADC SUBROUTINE FOR AN
                    /       INTERRUPT TYPE CONVERTER INTERFACE.  THIS
                    /       ASSUMES THE CONVERTER WILL INTERRUPT WITH
                    /       A RST7 INSTRUCTION VECTORING TO 000 070.


                             *100 000
100 000 373   ADC,    EI       /ENABLE THE 8080'S INTERRUPT
100 001 323           OUT      /START A CONVERSION
100 002 037           037
100 003 311           RET      /RETURN TO MAIN PROGRAM


                    /       THIS IS THE ADC'S INTERRUPT SERVICE SOFTWARE

                             *000 070
000 070 365   ADCSVC, PUSHPSW /SAVE REGISTER A & FLAGS
000 071 345           PUSHH    /SAVE REGISTERS H & L
000 072 052           LHLD     /GET MEMORY POINTERS INTO H & L
000 073 000           POINT    /SO THE DATA MAY BE STORED
000 074 120           0
000 075 333           IN       /INPUT 8 LSB'S
000 076 065           065
000 077 167           MOVMA    /STORE THEM IN MEMORY
000 100 043           INXH     /INCREMENT MEMORY POINTER
000 101 333           IN       /INPUT 2 MSB'S
000 102 066           066
000 103 167           MOVMA    /STORE THEM, TOO
000 104 043           INXH     /INCREMENT MEMORY POINTER AGAIN
000 105 042           SHLD     /SAVE THE STORAGE AREA ADDRESS
000 106 000           POINT
000 107 120           0
000 110 341           POPH     /RESTORE REGISTERS H & L
000 111 361           POPPSW   /RESTORE REGISTER A & FLAGS
000 112 311           RET      /RETURN TO MAIN PROGRAM


                             *120 000
120 000 000   POINT,  000      /THIS IS WHERE THE ADDRESS OF THE ADC
120 001 020           020      /STORAGE AREA IS KEPT.  IN THIS PROGRAM
                               /THE STORAGE AREA STARTS AT
                               /ADDRESS 020 000.  YOU COULD PLACE YOUR
                               /OWN POINTER ADDRESS HERE, BUT THESE
                               /TWO LOCATIONS MUST BE IN R/W MEMORY
```

interrupts the computer and points it to the A/D converter's service software, which, in this case, is located at 000 070. (A software example is provided in Table 2.[3]) In this example, the A/D converter subroutine is used only to start conversion. The subroutine at 000 070 is called by the interrupt with the aid of a jammed RST 7 instruction byte. The A/D converter interrupts the 8080 only when it has finished a conversion. The software

Reference

1. *Analog-Digital Conversion Handbook*, Analog Devices, Inc., Norwood, MA 02062. Copies may be still available for $3.95.
2. Rony, P.R., Larsen, D.G., Titus, C., and Titus, J.A., "Microcomputer Interfacing: Interfacing a 10-bit DAC," *Amer. Lab.* 9 (1977).
3. The assembly language format shown is that of the resident editor/assembler developed by Tychon, Inc., for 8080 systems.
4. Titus, J. A., Larsen, D. G., and Rony, P. R., "Microcomputer Interfacing: Microcomputer interrupts," *Amer. Lab* 8 (1976).

Second European CB Congress establishes a federation

CB'ers from several European countries, meeting in Geneva for a two-day conference, have set up the European CB Federation, with a president, Dirk Dewaele, from Belgium, vice president, Thierry De Pasquier, from Switzerland, and general secretary, Enrico Campagnoli, from Italy.

The new organization was constituted for the liberalization and regulation of CB in Europe. While "private radio" is permitted in some European countries, it is not in others, and some CB'ers have been operating illegally since 1970 on the 27-MHz band set aside by international convention for private radio.

At its final session the Congress voted a common proposal on CB regulation in Europe, and on the establishment of an Emergency Radio Service, in which members will monitor channel 1 for marine and channel 9 for terrestrial emergencies.

The proposals are to be forwarded to government administrations and particularly to the International Telecommunications Union (ITU) with the object of a renewal of the Geneva Convention in 1979 that will allow an adequate existence for CB in Europe.

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motion; and the mount must provide a consistent electrical capacitance to the vehicle ground.

The properly designed magnetic mount bears on the outer edge of its mounting support to present the longest lever arms to counteract tipping forces.

The magnet-mount antenna will work as well, or better, than the standard snap-in rooftop mount—if the loading coil is tuned properly. There is no direct ground with the magnet-mount antenna, but rather a capacitive coupling. The better manufacturers specially tune the loading coil for the magnet mount, thus eliminating the variables that arise from this capacitive coupling. A standard base-loaded antenna with a magnet added will perform poorly.

Cable cutting

The last and most important myth regarding antennas is that you can improve the standing-wave ratio (SWR) by cutting the coax cable. Cable cutting, matchboxes and the like serve only to fool your radio into thinking that there is a 50-ohm match where a true match does not exist. In fact, cutting the cable will result in no change in SWR, and could in some cases result in a higher SWR.

An exception is the cophase antenna. If the 75-ohm cables that connect the two antennas to the phasing harness are not exactly the same length, performance will be very poor indeed. Another exception is the magnet-mount antenna. Since the magnet mount has a capacitance coupling rather than a true ground at its base, the cable can be hot if the length is not just right. That is, the coaxial cable will radiate RF power rather than transmitting that power directly to the antenna with minimum loss. We have found that unless the cable is either 12-feet or 24-feet long, it will be hot.

Summary

In selecting and mounting mobile antennas, two points should be kept in mind:

1. Choose your antenna based on practicality, not what your friends are using. A 102-inch whip may look great, but it won't do much good if you have to park in a garage.
2. Always look for and buy quality. Cost-cutting will always show up in antenna performance, and a poorly constructed antenna will not stand up to the test of time.

Remember—you get what you pay for! **R-E**

SWTPC announces first dual minifloppy kit under $1,000

Now SWTPC offers complete best-buy computer system with $995 dual minifloppy, $500 video terminal/monitor, $395 4K computer.

$995 MF-68 Dual Minifloppy
You need dual drives to get full benefits from a minifloppy. So we waited to offer a floppy until we could give you a dependable dual system at the right price.

The MF-68 is a complete top-quality minifloppy for your SWTPC Computer. The kit has controller, chassis, cover, power supply, cables, assembly instructions, two highly reliable Shugart drives, and a diskette with the Floppy Disk Operating System (FDOS) and disk BASIC. (A floppy is no better than its operating system, and the MF-68 has one of the best available.) An optional $850 MF-6X kit expands the system to four drives.

$500 Terminal/Monitor
The CT-64 terminal kit offers these premium features: 64-character lines, upper/lower case letters, switchable control character printing, word highlighting, full cursor control, 110-1200 Baud serial interface, and many others. Separately the CT-64 is $325, the 12 MHz CT-VM monitor $175.

$395 4K 6800 Computer
The SWTPC 6800 comes complete with 4K memory, serial interface, power supply, chassis, famous Motorola MIKBUG® mini-operating system in read-only memory (ROM), and the most complete documentation with any computer kit. Our growing software library includes 4K and 8K BASIC (cassettes $4.95 and $9.95; paper tape $10.00 and $20.00). Extra memory, $100/4K or $250/8K.

Other SWTPC peripherals include $250 PR-40 Alphanumeric Line Printer (40 characters/line, 5 x 7 dot matrix, 75 line/minute speed, compatible with our 6800 computer and MITS/IMSAI); $79.50 AC-30 Cassette Interface System (writes/reads Kansas City standard tapes, controls two recorders, usable with other computers); and other peripherals now and to come.

Enclosed is:

_____ $1,990 for the full system shown above (MF-68 Minifloppy, CT-64 Terminal with CT-VM Monitor).
_____ $995 for the Dual Minifloppy
_____ $325 for the CT-64 Terminal
_____ $175 for the CT-VM Monitor
_____ $395 for the 4K 6800 Computer
_____ $250 for the PR-40 Line Printer
_____ $79.50 for AC-30 Cassette Interface
_____ Additional 4K memory boards at $100
_____ Additional 8K memory boards at $250
_____ Or BAC # _____ Exp. Date_____
_____ Or MC # _____ Exp. Date_____

Name_____ Address_____
City_____ State _____ Zip_____

SWTPC Southwest Technical Products Corp.
219 W. Rhapsody, San Antonio, Texas 78216
London: Southwest Technical Products Co., Ltd.
Tokyo: Southwest Technical Products Corp./Japan

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oscillator, it is more significant that zero-center readings on the center-of-channel meter corresponded exactly to lowest observed distortion when tuning in FM signals.

Figure 4 is a spectrum analysis showing the frequency response of the tuner section, including high-frequency de-emphasis. Since our unit was equipped with the Dolby option, the two sweeps show the de-emphasis modes provided (25-μs de-emphasis, required for Dolby FM reception, is depicted by the upper-trace roll-off). Stereo separation, although listed for three test frequencies in Table I, was excellent across the entire audio spectrum, as can be seen in Fig. 5 (the upper trace is desired channel signal; the lower trace is the undesired channel output).

Amplifier and preamplifier measurements

The amplifier of the *model AR-1515* exceeded its rated output at mid-frequencies before reaching the low, 0.08%-rated harmonic-distortion level. Even at the frequency extremes of 20 Hz and 20 kHz, 75-watts-per-channel output was obtained for a 0.8% THD reading (see Table II). Operation into 4-ohm loads produced significantly higher output levels, as expected, although Heath does not offer 4-ohm power specifications. RIAA response was a bit off (–1.5 dB at the high end), but phono overload capability exceeded specifications, at 120 mV for a 1-kHz input signal.

TABLE III

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Heath Company** Model: **AR-1515**

OVERALL PRODUCT ANALYSIS

Retail price	**$549.95 (kit only) (Add $39.95 for Dolby)**
Price category	**Medium/High**
Price/performance ratio	**Very good**
Styling and appearance	**Excellent**
Sound quality	**Excellent**
Mechanical performance	**Very good**

Comments: There are two ways to evaluate the *model AR-1515*. Since it is only available in kit form, it is important to consider the receiver in terms of ease of assembly. The instruction manual supplied with the unit (265 pages long, believe it or not) is written very clearly and, if followed carefully, not only insures successful construction of a complex product, but can serve as a veritable "course" in high fidelity.

In terms of performance, we would give higher marks to the amplifier than to the tuner, although both parts certainly represent high fidelity at its best. Readers are cautioned not to confuse "digital frequency readout" with frequency synthesis. In other words, the tuning mechanism of the *model AR-1515* is conventional; a 4-gang tuning capacitor is used and tuning is only as accurate as that of a pointer/dial-string-calibrated receiver or tuner. The center-of-channel tuning meter must be relied upon and properly aligned if its indications are to correspond with "lowest distortion point" tuning. The hinged trap door (behind which are located the "secondary" controls) makes for a good-looking and uncluttered front panel. A receiver in this price and power class could have included two sets of tape monitors, although this omission is in part offset by the front-panel dubbing-in-and-out jacks. In terms of listeneability, we could not fault the *AR-1515* in any of its modes, and its 70-watt-per-channel capability makes the receiver compatible with just about any high-quality speaker system you connect to it, including low-efficiency acoustic suspension types.

As we have commented before in reviewing some of Heath's other excellent "kit-only" products, it's too bad this fine receiver is not available in wired form—even if it means adding a couple of hundred dollars to its price tag.

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From Dynascan Corporation

Good things DO come in small packages...

ACTUAL-SIZE PHOTO (5.24" x 7.25" x 11.2")

Model 1403A $219

B&K-PRECISION ANNOUNCES A NEW 5MHz 3" SCOPE

The B&K-PRECISION Model 1403A is a real example of taking a good idea and making it even better. We've redesigned our most popular 3" scope to bring you new features and higher performance but retained the same ultra-compact cabinet.

The new high-brightness 3" CRT produces sharp waveforms on a P31 blue phosphor. A smoked glass graticule helps increase image contrast for clear viewing in the brightest rooms. The 1403A is conservatively rated at a 5MHz bandwidth for 10mV/div. vertical sensitivity and will typically sync on signals at 8MHz. This rugged small scope has DC amplifiers on both vertical and horizontal axes and direct deflection terminals for waveform display up to 450MHz! Maximum input is 600Vp-p. Input impedance is 1 megohm for both vertical and horizontal inputs. A Z-axis is also provided.

Perhaps the most striking feature of the 1403A is its ultra-compact size, (HWD) 5.24 x 7.44 x 11.2". This feature, combined with a sturdy integral handle, makes the 1403A ideal for field service applications. When bench or storage space is at a premium, you'll come to appreciate the convenient size even more.

We think the 1403A is the most cost-effective small scope available. Compare the specs, features, size and price, and we're sure that you'll agree. Available options include the LC-14 carrying case and PR-21 isolation/ direct probe.

For immediate delivery, contact your B&K-PRECISION distributor.

B&K PRECISION DYNASCAN CORPORATION

6460 W. Cortland Avenue, Chicago, IL 60635 312/889-9087

In Canada: Atlas Electronics, Ontario

International Sales: Empire Exporters, Inc., 270 Newtown Road, Plainview, L.I., N.Y. 11803

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RF GENERATORS

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Thus the synchronizer actually establishes the basic generator frequency, while the generator maintains the leveling characteristics, spectral purity, modulation, and wide range attenuator. In order to utilize the synchronizer, both the uncalibrated RF output and the synchronizer input must be available. The cost of synchronizers is typically the same as the generator itself.

Output connectors

Many RF signal generators use the BNC connector for all RF connections and binding posts for audio connections. On the low-cost generators and some older generators, the SO-239 or UHF connector is popular. Occasionally the button-type microphone connector is used. On better generators, a type-N connector is often used. Certain generators, primarily those manufactured by General Radio, incorporate the GR coaxial connector, an extremely uniform impedance connector.

Solid-state construction

The radio-frequency signal generator is rare, in that it is one of the few instruments left where solid-state design is an optional feature. There are a number of major RF signal generators on the market today that are very serviceable, extremely desirable products, but are constructed with vacuum tubes. Even in this day and age, they offer the most cost effective compromise. Solid-state generators do offer faster warmup and therefore instantaneous use, as well as lighter weight. However, both types of generators must be warmed up for some considerable period of time if maximum stability is desired. Vacuum tube generators often do not offer the wide range of features found on the newer solid-state generators. Vacuum tubes are not being used in new generator designs.

Fine frequency adjustment

The ultimate resolution of the frequency controls is usually limited by the mechanics of the system. Some RF signal generators have an additional electronic or "delta frequency" control. It permits the user to make slight adjustments in the operating frequency of the generator. The range of such controls is slight, but they permit a high resolution or setability. As they are electronic in nature, they overcome the problem of mechanical backlash in the main tuning system.

Crystal calibrator

The higher priced dial readout RF

signal generators usually offer an internal crystal calibrator. It can be turned on and its signal, plus a sample of the output signal from the generator, are mixed in a detector. The user may listen to a beat note indicating the signal generator is at an exact multiple of the crystal frequency. Earphones connect to the detector output connector. Depending on the frequency range of the generator, crystals may be supplied in increments of 0.1, 1 or 10 MHz. Generator accuracy is improved by permitting recalibration at fairly small intervals. Crystal oscillator accuracy is usually 0.01% or better.

Digital frequency display

As noted earlier, some RF signal generators use a digital frequency meter to accurately display the generator frequency. An internal digital frequency meter gives a high degree of resolution and accuracy for a bandswitched L-C oscillator. A few generators offer an alternative form of digital readout by replacing the circular dial with a mechanical counter similar to the odometer on an automobile. However, the accuracy and resolution of such a system does not significantly exceed the circular or slide rule dial. Some of the RF signal generators that have a digital frequency meter offer an external input so the digital frequency meter may be used in other ways.

Variable frequency audio oscillator

Some generators offer an optional variable frequency audio oscillator in place of the usual two-tone audio oscillator. This generator is configured as a fairly simple audio oscillator with relatively low distortion, for the purpose of generating modulation signals over a fairly wide range of audio frequencies.

High-power outputs

Certain RF signal generators generate high-power or high-level signals. These generators, or broadband amplifiers designed to be attached to generators, may produce signals with output levels of 10 to 100 watts, depending on the make or model. External power amplifiers may be of the tuned variety or the broadband variety. Tuned amplifiers tend to have higher output power, while broadband generators are much easier to use.

This concludes our coverage of RF signal generators. If you would like to see similar articles on other kinds of test equipment send us a postcard or a short note. Address it to Test Equipment Editor, Radio-Electronics, 200 Park Ave. South, New York, NY 10003. If you have any specific comments, send them too. **R-E**

AUDIO TRANSISTOR TOO HOT

The audio output transistor, Q202, in this RCA CTC-30AE runs too hot. However, the voltages and current seem to be in tolerance. All the resistors checked, and those that seemed slightly out of tolerance were replaced. No luck. Any ideas would be appreciated.—K.K., Passaic, NJ

I'll go along with you on the DC voltages, current, etc. It doesn't seem to be dissipating too much power. You might try increasing the heat-sink area just for luck.

(Feedback: "I couldn't locate the heat sink you recommended, so I made one out of a 3- × 6-inch copper sheet, sprayed it flat black, cut it into fins and bolted it to the existing heat sink. Works fine now! Thanks.")

HIGH-VOLTAGE PROBLEMS

This Zenith 20X1C38 seems to have a high-voltage regulation problem. However, this problem only shows up when the picture has a brightly colored background, or if the color control is turned all the way up. When these happen, the picture smears and goes out of focus. Regulator circuit voltages seem to be pretty close, as is the boost voltage. I changed tubes in the color demodulators and the bandpass amplifier just to see if that would help. It didn't; can you?—R.M., Greenville, MS

I hope so! This looks very much like what's called "color blooming," which is what happens if the color control is cranked all the way up.

Try running a grey-scale setup. Turn each picture tube screen control up until you can barely see a line, then back off until it goes out. You could be overdriving if the screens are too high.

(Feedback: "Frankly, I didn't think this would work, but it did. Colors are good, and customer is very satisfied. Thanks!")

NO HIGH VOLTAGE, NO BOOST

There's no high voltage on this Zenith black-and-white portable. The boost voltage source reads only 17 volts. The flyback transformer checks good, and my analyst shows a shorted winding in the yoke. Do you think this is right?—J.P., Old Town, FL

Yes.

SERVICE DATA

I can't seem to find the service data for my Zenith MPS-90W stereo record player. I need the phono cartridge part number.—R.L., Los Alamos, NM

Sams Photofact *Folder 839-11* shows the cartridge is a Zenith Part No. 142-151, and the stylus is S68567, which can be replaced by a Sonotone 19T2S for the whole thing.

NO RASTER

I've checked everything I can think of in this Zenith 12A13C52—there's no raster. The cathode current of the 6LB6 is 180 mA instead of 220 mA. Boost voltage is down to +500 volts instead of +875 volts. Flyback and yoke seem to be good. Grid drive waveform of the 6LB6 is only half the normal amplitude. Where do I go from here?—J.G., Astoria, NY

You didn't give me the DC grid voltage on that 6LB6. With only half the normal drive, the cathode current should be up to about 350 to 400 mA. Try a new 6LB6; this one may be weak. Read the grid voltage and see if it shows too much negative. This would also make the cathode current drop. Check that VDR in the 6LB6 grid circuit. If this is bad it could cause your problem.

NO SYNC AT ALL

I'm going around in circles. I have neither horizontal nor vertical sync on a Philco 3CY90. I tried most of the modules; no change. Picture, color, etc., OK, still no sync.—D.F., Reading, PA

Stop running in circles. Scope the input to the AGC/sync module. See if you have normal input (which you seem to have) and, if so, you should have normal output. Also check the +20-volt

supply. As a last resort, you should make *sure* that all the contacts on the module are making good contact.

NO FM STEREO

After rewiring the output stages according to directions, this Fisher 600T stereo is working nicely. Now, however, I can't seem to get FM stereo. The stereo lamp lights, though. What goes on?—C.H., Homewood, IL

If the stereo lamp is lighting up, the 19-kHz pilot carrier must be getting at least that far. Scope the rest of the circuit. You should find 8 volts P-P of 38-kHz pilot on the demodulator-transformer primary, and 1.7 volts P-P on the secondary that feeds the demodulators. If the 38-kHz doubler stage isn't working, this would kill the stereo effect.

PICTURE TUBE SUBSTITUTE

I have a high-voltage problem with this Singer HE8-101. It uses an A23-10W 8-inch diagonal picture tube. The picture blurs and loses brightness after about 10 seconds. Is there a substitute for this tube?—R.K., Los Angeles, CA

This really seems to be a defective picture tube. See if the HV will stay up with the ultor lead disconnected. A type 9XP4 can be used to replace the A23-10W.

BAD CAPACITOR

Thank you for the reply to my question about all the troubles I was seeing in a CTC-38 RCA chassis. You suggested checking capacitor C104 and the DC bus with the scope. I did, replaced the capacitor and cured the problems.

This one capacitor was causing a magenta band in the top of the picture; nonlinearity of the vertical sweep; very critical horizontal hold; and even a problem in the audio stage, which caused me to detune the quad coil. All this from only one capacitor!—J.L., Seattle, WA

Yep. I don't think anyone could ever trace out *all* the possible feedback paths that could result from one capacitor being bad! Not even a computer.

TAPE DECK DISTORTION

I can play a prerecorded tape through this Lafayette RK-725 tape deck, and it sounds fine. However, if I record on it, the sound is badly distorted. I notice that it doesn't erase, either. Any suggestions?—F.A., W. Hartford, CT

Both these symptoms could be caused by the bias oscillator. The oscillator transformer and the transistors on this unit seem to be encapsulated. If so, you'll have to get an exact duplicate from Lafayette; you can find service data on it in Sams *Tape Recorder Manual TR-156*.

GE HELPFUL HINTS

The latest issue of GE's *TV Service News* has a very helpful hint: If you have

the GE TV model number, you can instantly tell what the chassis number is. This is the quickest way to find the service data.

If the set is a model WYA5523WD, the chassis is a YA. A WHE5264WH is an HE chassis, etc. Here's another hint: If the model number is WYA6330WD A 01, the "A" means a *chassis change*. The last two digits show only cabinet and appearance changes. The whole number is the service number, which you must be sure to give when ordering parts. This number will be found located with the serial number.

VERTICAL PROBLEM

I've got foldover at the bottom and vertical compression in the middle of the raster on this Truetone GEC-3420B-57,19XA chassis. If I crank the controls down enough to see about two-thirds height, the symptoms go away. I've checked all the transistors, resistors and capacitors. The first place the symptom shows up on a scope is on the base of vertical amplifier transistor Q208. Any suggestions, I hope?—D.D., Apalachicola, FL

The vertical stage in this set is a Class-B audio output amplifier. From the symptoms, you have *crossover distortion*. The only difference is that you're seeing instead of hearing it. This is normally a *bias* problem, which could also be causing the foldover.

There's one stage marked "Vert. Crossover," Q212, which would be good to check. You should also check the clamp diodes since these can also affect the output bias.

(Feedback: "Bingo! It turned out to be Q212, the crossover transistor. I had checked it once, but I replaced it and that did it.")

BRIGHTNESS LEVEL PROBLEM

I replaced a very bad 23EGP22 picture tube in this Admiral G13, model LK5315. Now there's too much brightness. At minimum brightness control, the picture looks fairly good, but raising the brightness level causes severe blooming, and the raster goes out. I replaced the high-voltage rectifier; no luck. I can't locate the master screen control, although it's shown on the schematic.—D.F., Reading, PA

You have a later-production 3G13 series chassis that doesn't have a master screen control. The picture-tube screen voltages are fixed and fed from the +660-volt boost. Your problem could be in the screen voltage. Try checking right at the picture-tube socket, and the picture-tube grid and cathode voltages. If the grids are too far positive, the tube could be drawing so much beam current that it overloads the high-voltage supply.

Alternate: Run the setup adjustment using the three "background" controls.

Since these controls affect the bias, if they're set too high this could be the answer.

DIODE FAILURE

After replacing quite a few transistors in the horizontal-output stage in a Teledyne 3C174WL, diode D773 burned up. I replaced the diode but it burned up again! This diode supplies the +21.6-volt supply. I can't find any short in this. Everything else seems OK. I'm baffled!—R.W., Springfield, MA

I checked the service data and found that this chassis is also sold by Sears, Broadmoor, W.T. Grant, and other companies; they all have the same problem.

My suggestion is to replace D773 with a *fast-recovery* diode, such as RCA SK-3175 or SK-3516.

(Feedback: "That was it. *Now* I see your article on the subject in the January 1977 issue!")

FOCUS-VOLTAGE PROBLEM

I have a Sears model 41101, Ch. 564.80162. The original picture tube is a 490BZB22; suggested substitutes are 490AHB22 or possibly 19EXP22. I can't find the original tube listed anywhere. I put in the 490AHB22 and can't get it to work. Apparently the set's focus voltage is wrong, although Sams shows 4 to 5 kV on the focus anode. Any ideas?—J.F., Minot AFB, ND

Well, I can't find any mention of the 490BZB22 either. I did find the specs on the 490AHB22; it uses about 24 kV of high voltage and a 4.2 to 5.0 kV focus voltage.

When I checked both the Sams schematic and the Sears data, I saw they show three taps for the focus voltages—+270, +385 and +650 volts. However, the voltage at the focus pin is shown as 4.2 kV! It's quite probable that the original picture tube was a low-focus-voltage type.

If so, you'll have to develop a focus-voltage source that will give you the correct voltage. A Pennsylvania technician solved the problem by using a couple of high-resistance focus-dropping resistors and a big variable 15- to 20-megohm control. If you are getting about 22 kV on the high voltage, the focus should be around 3.9 to 4 kV to sharpen up the scanning lines.

TRANSISTOR OVERHEATING

The output transistors in the left channel of this Akai 8080 heat up very quickly after turn-on. Resistance tests of both channels seem about the same. I hope you can help.—G.S., Westmont, IL

First, disable the left channel by taking out the output transistors or disconnect the collector voltage supply. Second, open the collector supply circuit to the working right channel and hook a DC milliammeter in series. Third, plug the line cord into a variable-voltage transformer and begin at zero.

Now, bring the line voltage up slowly, watching the current reading. (Turn the volume all the way *off*.) Note the "resting"-current reading at full-line voltage. Check the DC voltages around the output stage and driver(s), and write them down.

Next, disable the right channel and repeat the test. You will probably find that the resting current is much greater in the bad channel. Read all the DC voltages. By keeping the line voltage low, you can hold the current down to a safe level. The most likely cause of the burn-out would be something that is upsetting the *bias* on the bad channel, making it draw far too much current. Look for defective bias diodes, driver transistors or even output transistors. For a quick check, replace the outputs in the bad channel with the ones in the working channel.

NO COLOR

A GE 19CD chassis has a very good black-and-white picture and sound, but no color at all. Tubes and transistors check good. Thanks for any help.—E.Z., Middletown, OH

Count your blessings. You have high voltage, sweeps, a good IF/video circuit *and* a good picture tube! Unless all three

tube guns are working, you won't have a good black-and-white picture. So, you lose *only* the color signals.

A quick-check: Feed a color-bar signal into the set. Scope the video signal on the collector of the first video amplifier transistor; the signal should be 5 volts P-P. Now scope the signal on the emitter, where the color signals are taken off. You should see the characteristic "comb" pattern here, at 2.5 volts P-P. Follow this pattern to the control grid of the 8CB11 bandpass amplifier, then to its plate, and finally to the color control. (This might be a bit easier to see with a crystal-detector probe on the scope, but you can use any fairly good scope to identify the color signals.)

If you see a good comb pattern on the color-control slider, set wide open, the bandpass-amplifier stage is working; the signal here should be about 10 volts P-P. If you haven't found where the color signal is lost, check the picture-tube grids for a *flat-topped* comb pattern instead of the normal "lazy S" or rocker pattern. If you see the comb pattern, the 3.58-MHz oscillator has gone out. You're not demodulating the color signals, although the 6AC10 color-amplifier stages are working.

Check the burst gate, the 3.58-MHz amplifier transistor and the 6AU6 3.58-MHz output stage to see where the color or oscillator signals are being lost. Just "walk it out" with the scope.

RF TRANSISTOR BAD

The RF input transistor checked bad in this Genie garage door opener receiver. I can't find a cross reference to the number in any of the manuals. A HEP-0014 works, but the sensitivity is so low that it won't close the relay with the transmitter more than six feet away. The transmitter output is OK, by the way. Do you have any information?—J.S., Prospect Heights, IL

I can't find anything under the original part number either. However, your substitute transistor should work; it has plenty of frequency range, etc.

However, I also checked the service manual. The RF transistor is installed on the PC board with the base lead pulled through between leads C and E! This reverses the position of the C-E leads with respect to the base. A great many bipolar transistors *will* show just a little gain with the C-E leads reversed.

Quite some time ago, I had the same experience with a little FM tuner. I tried a new RF transistor in every possible position and finally found the right one. Good luck! **R-E**

FM ALIGNMENT

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amplitude (Fig. 11). Some readjustment may then be necessary for crosstalk and maximum pilot because the same adjustment is used for all three.

The result should be a correctly adjusted stereo decoder.

For further refinement, the RF output of the generator in the FM band allows complete checking on the RF, IF, and AF sections of monophonic and stereo FM receivers. This RF output should be on 100 MHz, as this frequency is seldom used, so that external transmissions will not interfere with the test. But facilities for adjusting this frequency up to ±1 MHz are useful.

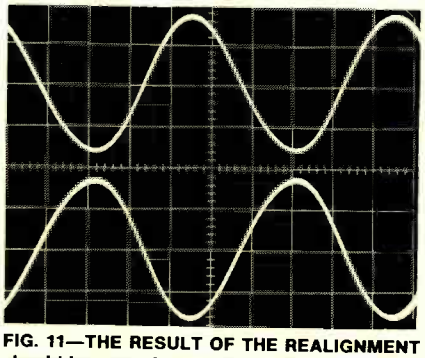

FIG. 11—THE RESULT OF THE REALIGNMENT should be a good clean stereo signal as shown here. The test signal applied is R = –L, so the signals should have equal amplitude and opposite phase.

The external modulation allows a final check by applying an external signal, such as a record player or stereo cassette recorder. This also makes a useful stereo demonstration tool. **R-E**

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Telematic SG-785 Ferret Tuner Substituter And Digital Pattern Generator

CIRCLE 111 ON FREE INFORMATION CARD

A FERRET IS A LITTLE ANIMAL THAT YOU SEND into a rat's nest to clean up trouble. Telematic Corp., 108-02 Otis Ave., Corona, NY 11368, remembered this; they named their latest piece of test equipment after it. Their "Ferret," the *SG-785*, can go into the rat's nest of TV circuitry and clean up troubles that otherwise would be hard to get at.

The Ferret is a combination instrument: it has VHF and UHF tuners for substitution tests which are the fastest and most reliable way of isolating tuner problems. Beside these, it has a built-in crystal-controlled digital pattern generator. This produces either dot or crosshatch patterns. The signal may be injected into the IF or antenna of any TV set. These are very useful for not only color TV servicing, but for many tests in black-and-white TV as well.

The VHF and UHF tuners in the Ferret may be used together or separately. VHF and UHF inputs are provided. Output jacks and a selector switch on the back panel let you use them in any combination desired. They may be substituted for the set's VHF/UHF tuners, feeding the signal directly into the IF input. Also, the Ferret's UHF tuner may be fed into the set's VHF tuner for a cross-check of calibration, sensitivity, etc., of the set's UHF tuner. The INT-EXT switch on the back is used to make this test.

The IF output of the tuners can be connected directly into the IF input of the TV set. Or, by using the clip-leads provided, this signal can be fed into any IF stage, including the last one, for a stage-by-stage test of the IF strip. By feeding the test signal (either the patterns or a TV signal may be used) directly into the input of the last IF stage, a simple AGC test can be made. The last IF is not normally controlled by the AGC. So, this gives you a normal video signal input to the AGC stage, and as a bonus, to the sync-separator as well. If you can get a picture through from this point, you know that the last IF, the video detector and the video stages are working.

Using the GEN OUT jack on the back panel, a signal of up to 1,000 microvolts is available. This is a complete video signal. The digital generator provides very sharp sync pulses. These can be used for signal-tracing through the video stages to spot distortion, loss of gain and so on. Incidentally, the dot pattern comes in very handy for making grey-scale adjustments, purity checks, and as a bonus, it is very good for digging out the cause of the "floating hum-bar" problems that can be so annoying!

The dot and crosshatch are the most needed patterns for convergence work on color TV sets. The digital generator produces very sharp and clear patterns. Of course, they can also be used for linearity, sync and many other problems in all types of TV circuits. The GAIN control adjusts not only the RF gain of the tuners but the level of the digital-pattern signal as well.

You can cross-connect the GEN OUT jack to the Ferret's VHF antenna terminals and feed the IF output into the set's IF input. Tuning to Channel 3, you can see the patterns—the harmonics of the IF signal fall in this range. Or, you can hook directly to the set's VHF input and tune to Channel 3 and still get a very good clean pattern. Of course, as with all tuner substituters, the Ferret can be used to check the antenna. If you obtain no signals on either the set tuner or the Ferret, the home antenna (or cable) should definitely be suspected. Flipping on the digital pattern generator will verify this.

The Ferret is AC-powered and all outputs are decoupled so that there is no danger when doing signal tracing tests on either tube, hybrid or solid-state sets. The convergence patterns are generated by digital circuitry. This starts with a crystal-controlled oscillator at 377.622 kHz. This signal is divided down by a flip-flop chain to obtain the 15.734 kHz for the horizontal sync. More dividers count this down to obtain the vertical sync. The numerous sharp pips needed for the dot and crosshatch patterns are also obtained from the original oscillator signal. So, the whole thing is all

tightly locked together and the patterns are very stable. The resulting video signal can be used to check frequency response through the video stages, etc., for the sync pulses are very clean squarewaves and any distortion shows up immediately.

Connecting cables are included for any type of IF input. The standard phono jacks and plugs are used. One has a plug on one end and a jack on the other for the most common type, and another has a pair of miniature insulated clips for off-breed types.

If it should be necessary, the RF frequency of the Ferret can be easily adjusted. Just hook it up to the IF input of a working TV set and adjust the trimmer that is accessible through a hole in the bottom. Tune for maximum sharpness of the crosshatch pattern. You can also cross-connect this to the VHF tuner in the Ferret and tune up on Channel 3 for maximum sharpness.

As I have said, this is a combination instrument capable of making quite a few different tests with ease. These are always very useful; anything that makes servicing easier makes it faster and more profitable, and this is what we need! **R-E**

Tri-Star Corp., Tiger CB Alarm

THE UNNERVING BLAST OF THE HORN INTERrupts the thief as he begins to remove your shiny new rig from under the dash. He abandons his objective, slips out of the car and rapidly moves off. That's the envisioned response to the triggered *Tiger CB Alarm*,

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manufactured by Tri-Star Corporation.

The $9.95 alarm system is contained in a 1⅝ × 1⅛ × ¾-inch metal case. A three-foot red wire and an eight-foot black wire extend from the potted bottom of the case. The bubble package includes two self-tapping screws to fasten the alarm, and a solderless connector to make a single direct connection into the car's electrical wiring system.

The installation of the alarm takes three uncomplicated steps. First, fasten the three terminal device to the car with the screws to make the ground connection. The unit can be mounted in either the engine compartment or under the dash after checking that the two wires reach.

Second, route the black wire through the

equipment to be protected. More than one accessory can be guarded with a single alarm device by daisy-chaining the black wire through each one. Terminate the black wire by connecting it to ground under a convenient sheet-metal screw on the case of the last instrument in the chain. Make sure, of course, that the final ground connection is made to a device that is electrically connected to chassis ground. Keep the black wire taut so that it is broken as early as possible during a robbery attempt. Interweaving the wire with nearby car wiring is suggested as a camouflage.

Last, splice the red wire to the horn-button side of the horn relay using the supplied connector. The connector is forced onto the wire so that its spring-clip blade slices through the insulation to contact the conductor. The connector has a feedthrough section for the continuous horn wire and a blocked-off section that accepts the alarm's red wire.

Even though the manufacturer lists CB radios, tape players, tachometers, scanners and radar detectors as protectable devices, any accessory can be used, even a nonelectronic one. It is important only that it have a grounded conductive part or that there is a way to snake the black wire through it and then attach it to ground.

When an illegal attempt is made to remove a piece of equipment from the car, one of two things happens. Either the black wire is severed as the accessory is removed, breaking the ground continuity through the black wire; or the ground is directly disconnected when the accessory is physically separated from the car chassis.

Isolation of the black wire from ground causes the alarm device to internally connect the red wire to ground. Since one end of the horn relay is connected to the car battery, the relay is energized and the horn blows. The horn continues to blow until the black wire is reconnected to ground; the red wire is disconnected from the horn relay or the battery is depleted of charge. (The hope is that the thief is unaware of the function of the black wire.)

The heart of the *Tiger CB Alarm* is an NPN power transistor with a biasing resistor connected between the collector and base terminals. The red wire connects to the collector, the black wire to the base and the case to the emitter. The transistor is held cutoff by the base connection to the black wire, which is wired to ground. Since the case is grounded, the base-to-emitter junction of the transistor is shorted, keeping it cutoff.

If the black wire is disconnected from ground, the base of the transistor is free to rise above ground potential. The resistor between the collector and base supplies current to the base to turn the transistor on. Actually, for the transistor to remain on it must continue to have sufficient collector voltage to supply base current through the biasing resistor. The transistor does not saturate and the collector remains slightly above the forward-biased base-to-emitter potential. The drop is only a small part of the total battery voltage, and the remainder that appears across the horn-relay coil is sufficient to energize it.

If the *Tiger CB Alarm* is damaged during an attempted burglary, return it to Tri-Star with $1 and they will repair or replace it; the address is Tri-Star Corporation, Box 1727, Grand Junction, CO 81501. **R-E**

continued from page 45

trimmer R5 until the signal is passed with minimum clipping (distortion).

If you have an oscilloscope, view the signal at the wiper of BALANCE trimmer R6. Set the scope controls so you can easily see the clocked audio signal. Two identical signals will seem to appear at different DC levels. Adjust BALANCE trimmer R6 until the two signals converge into one; this is the proper setting. If you do not have a scope, leave R6 at approximate midrotation and proceed with the calibration.

With the delay section properly trimmed, set MIX control R12 to the middle of its range. Decrease the CENTER control R26 setting and listen for the phlanging effect dropping through the audio spectrum. When the CENTER control is at minimum, advance ACCENT control R8 to maximum. You will hear the increased "hollowness" of the filter; and if you sweep CENTER control R26 through its range the phlanging effect becomes more pronounced. With the CENTER control at maximum, advance SPAN control R25 to maximum. The internal low-frequency oscillator will sweep the phlanging effect. At the bottom of each sweep you may hear a short "wheep" or squeal. Adjust PEAK trimmer R27 until this sound is heard, and then return the trimmer to the point at which the squeals stop. As the internal oscillator sweeps the effect, advance SPEED control R17, which will increase the phlanging speed from approximately one sweep every five seconds to about one cycle per second.

With all calibration and checkout completed, all that remains is to mount the circuitry in a suitable enclosure. The phlanger is now ready to be used in its many applications. Here's a few of those applications.

Using the phlanger

A phlanger can reproduce the sound of tape-reel phlanging with an equal mix of normal and delayed signal. The ACCENT control should be set at minimum, and sweep SPEED and SPAN can be set as you wish. Increasing the ACCENT control will increase the "hollowness" of the sound and will add subjective depth to it. Experiment with the control settings. You'll find many of the effects quite interesting.

Many other effects can be obtained: For example, when the delay-circuit clock speed changes, the delay-line output provides a slight pitch shift. If the clock frequency continually increases, the audio signal will be sampled into the delay line at one frequency, but will be fed out at a higher frequency. Thus, the input frequency will be shifted up by an amount dependent on the rate of increase of clock frequency. In similar fashion, when the clock rate decreases, the input is shifted *down* in frequency. Using this phenomenon several unique effects can be achieved.

Vibrato effects can be generated with the MIX control set for a 100% delayed signal. The phlanger's triangle wave will then produce a squarewave modulation of pitch; or, by minimizing the SPAN control, an external sinewave can be fed into J3 for the familiar smooth vibrato. Most organs, guitars and synthesizers have provisions for vibrato generation. But imagine, if you will, providing vibrato on a recording of a grand piano, a choir or chimes. If you have recorded several basic instrument tracks and later decide you should have used vibrato on the sax solo, you can easily process that track through a modulated delay line during mixdown rather than going to the trouble of rerecording the entire track.

The phlanger can also be used to generate stereophonic or quadriphonic spatial effects with a monophonic signal. The original signal is fed to the phlanger input *and* to one of the amplifiers. The phlanger output is then fed to the remaining amplifier (see Fig. 5). The same control settings are used as for vibrato, except the sweep oscillator is set to a lower speed. When a harmonically complex signal is fed through this setup,

certain frequencies will be emitted from the two speakers in-phase. These frequencies will appear to have a source between the speakers. Other frequencies will have varying amounts of phase difference between the two speakers. This will cause a psychoacoustical phenomenon in which the sound seems to emanate from one side of the center. The actual phase relationship will determine whether the source is to the left or the right, and the amount of phase difference will determine how far off-center the sound is located. This dramatic effect sounds even better in a quadriphonic system where opposite corners are driven with the former stereo outputs (see Fig. 6). The sound appears to float and drift above your head. To generate a quadriphonic signal from a stereo source, use a separate phlanger for each side, with the normal signal feeding the front channels and the delay-modulated signals (phlanger outputs) feeding the rear channels. The internal-sweep oscillators can vary the delay times independently causing apparent random motion around the room; or an external modulation signal can be applied to the CENTER remote jack for a synchronized front-to-back motion on each side.

When the phlanger is interfaced with a voltage-controlled music synthesizer, astounding effects can be obtained using sequencers, envelope generators or envelope followers as control voltage sources for the SPEED and CENTER inputs. To get a full rich sound process the output of one voltage-controlled oscillator through a phlanger. This will give the effect of two voltage-controlled oscillators being used simultaneously.

A phlanger used in conjunction with an organ provides an excellent simulation of large mechanical rotating speakers. With the SPAN, CENTER and ACCENT controls below midrange, the speed can be adjusted for the desired rotating effect, using an equal mix of normal and delayed signal.

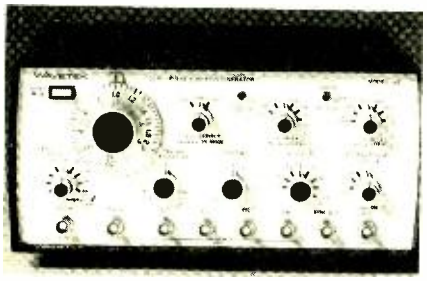
Processing miked drums through the phlanger gives an effect of tuning the drum sounds. With the controls set for automatic sweep, the drums sound as if they are constantly being retuned as they are played. The increased tonality of the drums greatly enhances their presence and solo potentials.

A phlanger that has controls for so many sections of the circuitry need not be limited to music processing. For example, you can add delayed triggering to a scope's horizontal-sweep sync circuit or a voice-operated switch to a transmitter that won't chop off the beginning of the message. **R-E**

new products

More information on new products is available from manufacturers of items identified by a Free Information number. Free Information Card follows page 114.

PULSE/FUNCTION GENERATOR, *model 145,* is a convenient dual-purpose instrument, offering pulse-generator outputs with up to 20-MHz cali-



bration rates. Fixed-amplitude outputs are available for TTL and ECL; variable-pulse output, up to 30 volts peak-to-peak. Unit also allows selection of five operational modes.

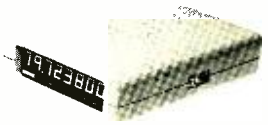
The function generator provides sine, square and triangular waveforms with continuous, triggered or gated output. A variable trigger start/stop allows selection of haversine or other outputs.

Unit weighs 11 lbs and measures 11¼ × 5¾ × 10¾-inches. Price: $895.—**Wavetek,** 9045 Balboa Ave., San Diego, CA 92123.

CIRCLE 93 ON FREE INFORMATION CARD

FREQUENCY COUNTER, *model MAX-100,* gives readings of 20 Hz to 100 MHz, with 1-second gatetime throughout range and ±1 accuracy (plus timebase error). Features large LED display of readout with 1-second update; overflow signals indicated by left-hand display digit. Crystal-controlled timebase has 3-ppm accuracy and high temperature stability.

Unit operates on 6 AA alkaline or NiCad cells; 110 or 220 VAC (with charger/eliminator), 12 VDC (with mobile charger/eliminator), or any 7.2–10 VDC supply. Supplies include input cable and instruction manual. Optional accessories are mobile charger/eliminator; charger/eliminators for 100-VAC and 220-VAC supply; low-loss tap-



off; antenna and case. Price of the *MAX-100:* $139.95.—**Continental Specialties Corp.,** 44 Kendall St., P.O. Box 1942, New Haven, CT 06509.

CIRCLE 94 ON FREE INFORMATION CARD

DUAL TRACE 15-MHz SCOPE, *model 452,* has internal or external triggering with sync positions for TTV, TVH, and VITS. Sensitivity is 5 mV/cm and risetime is rated at 24 ns. Mode automatically shifts from CHOP to ALTERNATE on faster sweeps. Dual matched vertical and horizontal inputs are voltage-calibrated (11 steps in 1-2-5 sequence). Unit includes a built-in 0.5 VP-P 1-kHz squarewave calibrator.

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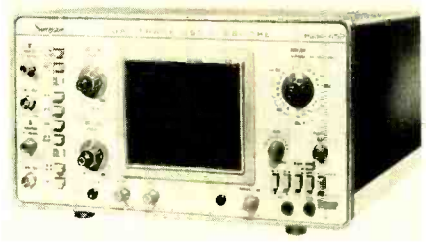
The scope weighs 20 lbs and measures 6½ × 12 × 16 inches. Available with combination stand



and handle, and optional probes. Priced at $635.—**Simpson Electric Co.,** 853 Dundee Ave., Elgin, IL 60120.

CIRCLE 95 ON FREE INFORMATION CARD

ANTENNA CARE PRODUCTS, *Tennacap (18-1080), Tennalube (18-927),* protect against rust and corrosion. *Tennacap* fits over threads of all

standard base-loaded units. *Tennalube* waterproofs threads and facilitates easy removal of antenna when necessary.—**GC Electronics,** 400 S. Wyman, Rockford, IL 61101.

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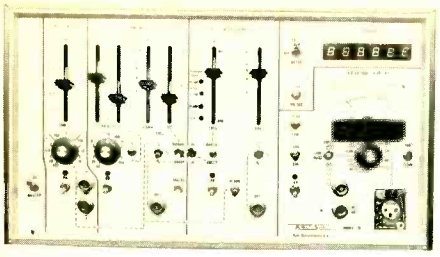
WRAPPED-WIRE TOOL, *model P150-4T1,* cuts wiring time, eliminates wire stripping and reduces operator fatigue during long wrapping runs. The

lightweight 6.7-inch, 100-volt AC, 60-Hz tool takes either a *P180 Slit-N-Wrap* bit or a *P160-2A*



MODEL 101 AUDIO TEST SYSTEM consists of two sine/square/triangle function generators, pulse generator, frequency counter and AC voltmeter. As a system it will generate a frequency response plot on an X-Y recorder or scope.

Time base generator offers symmetrical or independent control of the positive and negative sides of the ramp providing a duty cycle of 1% to 99%. Frequency range is .002 Hz to 100k Hz. Amplitude is 16 Vpp into 500 Ohms with ±5 VDC offset. The time base output drives the X axis of an X-Y recorder. Manual mode provided for setup.

Audio sweep generator provides manual frequency adjustment or log/linear sweep of 20 Hz to 20k Hz. Blanking mode provides zero reference line on an X-Y recorder or tone burst. Amplitude is 16 Vpp into 500 Ohms or 10 Vpp into 8 Ohms.

Pulse generator frequency range is .002 Hz to 800k Hz. Pulse width is adjusted independent of frequency from 4 seconds to 40 nanoseconds. Outputs are complementary TTL.

AC Voltmeter has full scale sensitivities from 1 mV to 250 V. Fast/slow, peak/true RMS and log/linear modes are provided. Output drives Y axis of X-Y recorder.

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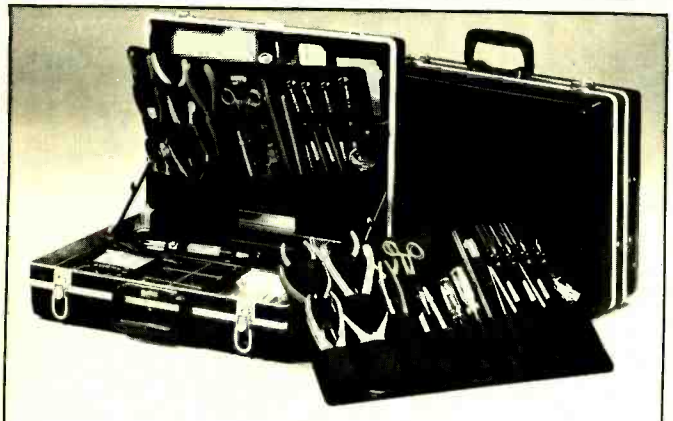

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wrapping bit. A permanent-magnet motor, operating at 4500 to 5100 rpm, powered by a remotely located converter, helps reduce tool weight. High-impact plastic protects against damage and electrical shocks. The *P160-4T1,* together with the *P180* bit, two 100-foot spools of 28-AWG wire and *P183* forming and wire cutoff tool, retails for $80; *P160-2A* wrapping bit, $7.95. Battery-powered cordless models available.—**Vector Electronic Co.,** 12460 Gladstone Ave., Sylmar, CA 91342.

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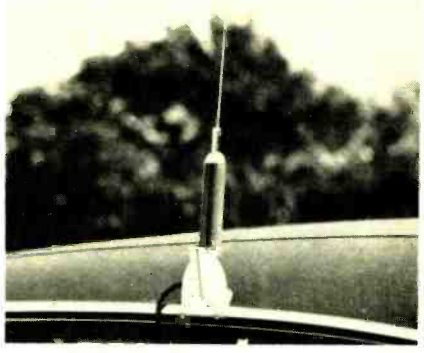
40-CHANNEL GUTTER-MOUNT ANTENNA, *model MS131,* is designed for use with grounded metal gutters. A stainless steel whip for strength



and flexibility, a 17-foot coax cable with attached radio connector, and all mounting hardware are included. Suggested price, $21.95.—**The Antenna Specialists Co.,** 12435 Euclid Ave., Cleveland, OH 44106

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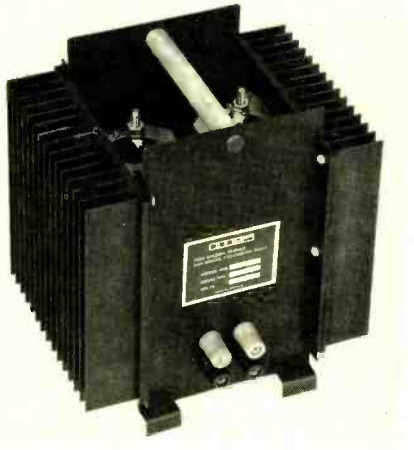
HIGH-POWER LOAD BANK, *model 230,* is a 2-channel precision device to be used as a dummy load for audio equipment. It provides an 8-ohm, 1%, 250-watt output per channel. Five-way binding posts permit parallel (4-ohm) or series (16-



ohm) connections and 500-watt dissipation. Load resistors are heat-sink-mounted. Free-standing unit is mounted on a base for adequate air flow. Price: $125.—**BPI-Audio Test Instruments,** 7853 Balboa Ave., San Diego, CA 92111

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IN-DASH CB/CAR STEREO, *model 860CB,* combines 8-track stereo tape player and AM-FM-MPX radio as well as all 40 channels. CB controls include mike, radio-tape mode selector, variable squelch, receive/transmit indicator, lights and patented standby monitor.

Stereo section contains indicator lights and manual selector. AM-FM-MPX section provides in-door dial, local/distance switch, mode selector, MPX indicator light and antenna trimmer. Unit delivers 6 watts-per-channel RMS with

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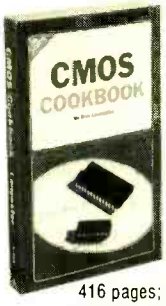

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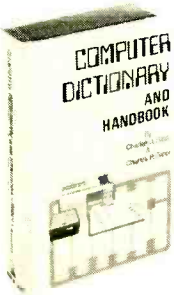

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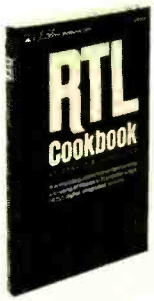

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dard ASCII RS-232C input and includes 14 24-volt solenoid drivers. In kit form w/o power: $325. (Power versions available.) Manual: $12.—**Center for the Study of the Future,** 4110 N.E. Alameda, Portland, OR 97212

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CB CARRYING CASE, the *Universal.* This case has a simple design that permits safe transport of mobile units. Special compartments hold mikes,

power cable and antenna. Top, bottom and rear openings permit in-case operation of all standard-make CB's. Case measures approximately 3 × 9 × 12-inches.—**Motorola, Inc.,** Automotive Products Div., 1299 E. Algonquin Rd., Schaumburg, IL 60196.

CIRCLE 103 ON FREE INFORMATION CARD

MICROCOMPUTER, *model Z-2,* is a powerful yet low-cost tool adaptable to many applications. The unit incorporates the *Z-80* microprocessor, providing higher throughput in real-time operations such as timesharing. The *Z-80* memory boards have a bank-select feature that allows eight independent banks of memory, each with 64 kilobytes of memory.

The microcomputer uses an S-100 bus with compatible peripherals such as a 7-channel A/D and D/A converter, a "BYTESAVER" with PROM programming, color graphics interface, and digital interface. Heavy-duty power supply provides 30 amps from 8 volts and 15 amps from both +18 and −18 volts, sufficient for most power needs, including floppy-disc drive.

The unit comes in a black metal case for rack mounting, or is available in a blue-color, stylized bench cabinet. The microcomputer kit contains the *Z-2,* a 4-MHz microprocessor card, 21-slot motherboard, power supply, one card socket and card-guide set and front panel. Assembled, the *Z-2* includes all the foregoing, plus 21 sockets, card guides and a cooling fan. Kit sells for $595; assembled, $995.—**Cromemco, Inc.,** 2432 Charleston Rd., Mountain View, CA 94043.

CIRCLE 104 ON FREE INFORMATION CARD

AM/MOBILE CB RADIO, *'T' Bear,* is top-of-line of a 13-model series designed for the 40-channel market, ranging from in-dash AM/FM/CB's to

base-to-base mobile radios. Suggested price: $199.99. Other prices from $144.99 to $439.99.—**Teaberry Electronics Corp.,** 6330 Castleplace Drive, Indianapolis, IN 46250.

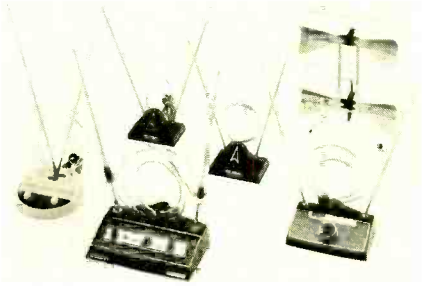
CIRCLE 105 ON FREE INFORMATION CARD

TVI FILTER CABLE is designed to eliminate or reduce CB-generated front-end overload and harmonic interference to TV Channels 2 and 6. Separate cables are available for either Channel

2 or Channel 6 areas. Cable is fitted with connectors for easy attachment to back-of-set antenna connection and to roof antenna.—**Vitek Electronics, Inc.,** 200 Wood Ave., Middlesex, NJ 08846.

CIRCLE 106 ON FREE INFORMATION CARD

INDOOR ANTENNAS, *Color King.* This antenna line lets you choose from among four UHF-VHF-FM console models, an FM stereo consolette and a specialty UHF model for use with Channels 14



to 83. This broad selection has been designed not only for superior sound, clarity and color reception, but an attractive appearance as well. Details on request.—**Antennacraft,** P.O. Box 1005, Burlington, IA 52601.

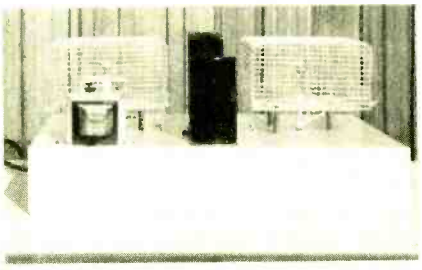
CIRCLE 107 ON FREE INFORMATION CARD

IN-DASH CB STEREO RADIOS, *models SR-42, SR-44, SR-46, and SR-48,* is a full line of AM/FM/FM stereo units, all with CB circuitry designed to

be used with the *model CBM-1* 40-channel transceiver module. Models range from the *SR-42,* with manual tuning, to the *SR-48* (shown above), with stereo cassette. All have standard switches and controls. Prices: $89.95 to $149.95; *CBM-1,* $149.95.—**Sparkomatic Corp.,** Milford, PA 18337.

CIRCLE 108 ON FREE INFORMATION CARD

NEGATIVE-ION GENERATOR, *Ion-Air,* is a highly sophisticated unit that generates negative ions in sufficient quantities for serious experimentation. Many scientists believe that negative-ion generation contributes to human health and well being, and helps relieve tension, irritability and fatigue. The *Ion-Air* is a dual-stage unit, using highly charged needles controlled by Faraday cages; the ions are exhausted into the atmosphere by a high-speed fan. Unit is effective in areas up to 14



× 14 feet, produces 25,000 volts, with an output of about 9×10^9 ions per second. Housed in unfinished mahogany, it weighs 18 pounds and measures 20 × 14 × 7 inches. The *Ion-Air* comes in kit form, with instructions, schematic, pictorial and construction diagrams and parts list. It also comes assembled or as instructions only. Kit sells for $165; assembled, $275; instructions, $7.50.—**Golden Enterprises,** P.O. Box 1282, Glendale, AZ 85311.

CIRCLE 109 ON FREE INFORMATION CARD

new books

QUAD SOUND, by Marvin Tepper. Hayden Book, Co., Inc., 50 Essex St., Rochelle Park, NJ 07662. 128 pp. 5¼ × 8¼ in. Softcover $4.95.

A simple, easy-to-understand explanation of how four-channel, or quadriphonic, sound differs from stereo, what constitutes it, how it is obtained and how to best use it for personal pleasure. The book starts with fundamentals like fidelity, psychoacoustics and the characteristics of both two- and four-channel sounds. Subsequent chapters explain four-channel tape and record, playback and recording, FM broadcasting, four-channel speaker systems, system selection and installation, and equipment troubleshooting, along with easy-to-use charts to help pinpoint system troubles in an easy to understand way.

HOW TO HEAR AND SPEAK CB IN A SHORT-SHORT, produced by Roland; written by Martin; designed by Gene. TAB Books, Blue Ridge Summit, PA 17214. 162 pp. 4¾ × 8¼ in. Hardcover $6.95.

"This is Whiskerman you're cruising with, modulating on the Space Vibes. Unseen by most but copied by all. Cruise with me, Old Buddy, and in a couple of wild hours you will know enough to modulate with any ACE (a cool CB Dude.)

We'll saddle you up in the CAT DRAGGER so you can dig our fractured chase on Interstate Niner. But if you don't know the lingo, friend, you'll be in Fog City thru Tuesday. 'Cause out here it's Crash Helmets and T-Shirts. We don't fool around!

Lay back . . . it's a 10-4 trip . . . great laughs. Might be wacky, but everybody will surely remember we've been there.

3's and 8's and a lot of great numbers I haven't even told you yet."

SOLID-STATE ELECTRONICS, by Frank P. Tedeschi and Margaret R. Taber. Van Nostrand Reinhold Co., 450 West 33 St., New York, NY 10001. 204 pp. 8 × 10½ in. Hardcover $8.95.

Provides an introduction to fundamental semiconductor and electronic principles. The book does require a familiarity with algebra and basic electricity. All information presented reflects the current state of the art in electronics technology. The book is divided into eleven self-contained sections, each concentrating on specific semiconductor components. Numerous example problems and laboratory experiments bridge the gap between theory and practice.

BASIC, by Robert L. Albrecht, LeRoy Finkel and Jerald R. Brown. John Wiley & Sons, Inc., Publishers, 605 Third Ave., New York, NY 10016. 125 pp. 6¾ × 10 in. Softcover $4.95.

This is the latest printing of this programmed instruction-formated book that teaches BASIC, one of the primary computer programming languages. At the end of each chapter, a self-test is provided to aid the reader in reviewing the material covered in the chapter and to test himself on his progress. Each chapter begins with a list of objectives—what you will be able to do after completing that chapter. If the reader has had some previous experience using BASIC and these objectives look familiar, the book can be used as both a review and guide, showing where you should start following the text. What the reader will learn from the book will be theoretical, until he can actually sit down at a computer terminal and apply his knowledge. Therefore, the publisher recommends that you and the book get together with a computer.

ADVANCED AND EXTRA CLASS AMATEUR LICENSE Q & A MANUAL, by Marvin Tepper. Hayden Book Co., Inc., 50 Essex St., Rochelle Park, NJ 07662. 160 pp. 6 × 9 in. Softcover $5.95.

A guide for the amateur radio operator with a General Class license, who wants to upgrade his license status to the Advanced and then the Extra Class license. Based on the latest FCC syllabus-type study guide, this book asks questions and gives answers, and then explains most answers in a detailed, easy-to-understand way. It also covers Advanced and Extra class license privileges and filing fees. There is also a special section on code copying and an appendix containing the latest FCC rules and regulations.

BIG EAR, by John Kraus. Cygnus-Quasar Books, P.O. Box 85, Powell, OH 43065. 228 pp. 5⅛ × 8¼ in. Softcover $2.95; hardcover $5.95.

An adventure story of the exploration of the universe and the search for other men. "Big Ear" is a personal, behind-the-scenes account of astronomers, engineers, inventors—their successes and failures. It is the story about the steel and aluminum structures we have raised to probe the cosmos and of our attempts to answer the question 'are we alone?'.

Radio-Shack's New Computer System

A user oriented system that includes a video terminal, keyboard, cassette recorder, 4K RAM, 4K ROM and Basic.

ART KLEIMAN
MANAGING EDITOR

EVERY ONCE IN A WHILE, JUST AS THIS magazine is ready to go to press, a manufacturer will introduce a new gadget or gizzmo that will make us say "stop the presses." That's exactly what happened when Radio-Shack introduced their new TRS-80 microcomputer system at a press conference held in New York City.

I'm not saying that this new microcomputer is the best system on the market. I don't know if it is or isn't since the answer to that question has to be based on what the user intends to do with the system. But what is amazing is the price—$599 for a working system, assembled and tested.

Hardware

The system consists of three modules—keyboard (measuring 16½×8×3½ inches), video terminal (measuring 16½×13½×12 inches), and cassette recorder. Housed within the keyboard module is a single PC board that contains the Z-80 microprocessor, 4K of dynamic RAM, 4K of ROM and an interface for the cassette recorder. The memory is internally expandable to 12K of ROM and 16K of RAM (available as an option for $280). The keyboard is a standard 53-key ASCII unit. An external power supply comes with keyboard module.

Input and output jacks are located on the back panel of the keyboard for connecting the cassette recorder, the external power supply and the video terminal. Also provided on the back panel of the keyboard is an access port to the TRS-80 bus. This is a non-standard 44-pin bus.

The 12-inch black-and-white video terminal is capable of handling 16 lines of text. Each line has a maximum length of

64 characters, upper-case only. In the graphics mode, the screen converts to 48 lines by 128 horizontal line-segments. Text and graphics can be interspersed by software.

The cassette recorder is a standard audio unit. Connecting the remote input of the recorder to the keyboard permits the CPU to turn the recorder on and off.

Software

The TRS-80 comes complete with a high-level language stored in the ROM—Radio-Shack's own version of Basic, which they have termed Level I Basic. This Basic features floating-point arithmetic; numeric, array and string variables; video graphic commands and cassette save and load commands.

Included are such commands as NEW, LIST, RUN, CONTinue, REMark, LET, FOR-NEXT-STEP, GOSUB-RETURN, STOP, END, GOTO, IF-THEN, ON..GOTO, ON..GOSUB, PRINT, CSAVE, CLOAD, DATA, READ, and RESTORE.

There are also functions that include MEM, TAB, INT, ABS, RND, and math operations such as add, subtract, multiply, divide, less than, greater than and equals.

Special commands include graphic statements such as CLS(clear screen), SET(x,y), RESET(x,y), POINT(x,y), and formatted PRINT. Array and string capability, data storage and retrieval are all part of the Basic.

A high-level language, such as Basic, is great for those readers that know something about how to program. But what about those that have had no computer experience at all? What do they do when they take the TRS-80 home, unpack it and plug it in? In answer to this, Radio-Shack will be selling applications software packages. These fall into five categories—games, business, education, home and personal finance. Initially available in the game category is a single cassette containing programs for Blackjack and Backgammon, available free with the TRS-80. A payroll cassette that can handle 15 people will sell for $19.95. An education in basic math will cost $19.95. For the home, a kitchen program that includes menus, conversion tables and a message center is $4.95. In the personal finance category is a seven-cassette portfolio for $14.95.

Expansion

As already stated, all of the computer electronics is contained on a single PC board housed within the keyboard module. This may be a disapointment to the avid computer hobbyists who commonly expand their system by dropping PC boards into slots on the motherboard. You can't do it with the TRS-80 since there are no slots and no motherboard. You can add a slotted motherboard by connecting it to the TRS-80 bus through the access port in the keyboard module. However, the TRS-80 has a non-standard 44-pin bus. So, if you want to be able to use all those 100-pin S100-bus compatible PC boards that are available on the market, you'll need a bus converter. The bus converter is not available, so you'll have to design your own. Not an overly difficult task.

What about memory expansion? The lack of a slotted motherboard means that you can't simply purchase a memory board and drop it into the TRS-80. If you purchase the basic system with 4K of ROM and 4K of RAM and decide at a later time that you need more, you'll have to return the keyboard module to Radio-Shack for a retrofit. Of course, if you're not interested in S100 expansion, the TRS-80 bus will not be a drawback.

Radio-Shack also plans on expanding their system as they go along. Plans call for the introduction of a floppy disc with provisions for an additional 16K of IC memory. Also planned is the introduction of an extended Basic, printer, MODEM, Serial I/O, and an expansion unit for PC boards that is not S100 compatible.

That's the TRS-80. Quite a system for the price. Oh, before I forget, the modules are also available separately. The keyboard sells for $399, the terminal for $199 and the cassette deck for $50. **R-E**

next month

NOVEMBER 1977

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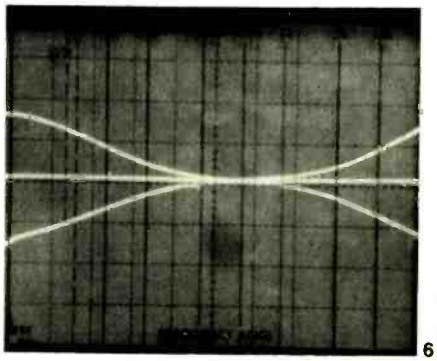
RE TESTS HEATH AR1515

continued from page 80

Hum and noise in phono was as good as claimed and, for high-level inputs, exceeded published claims.

The tone-control range, shown in Fig. 6, was typical of that obtained with simple, hinged BASS and TREBLE controls. Selectable turnover tone controls would have been welcome. The high-cut filter action is shown in Fig. 7.



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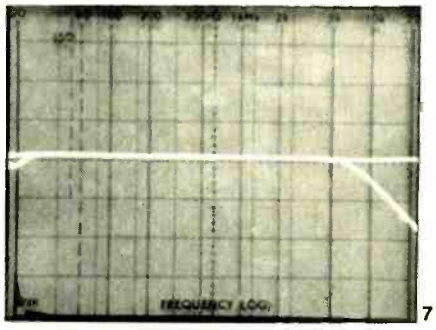

7

However, the low-cut filter action, with a 30-Hz cutoff point, is barely visible because the analyzer sweep extends only from 20 Hz to 20 kHz.

Summary

The overall product analysis is found in Table III, together with our summary comments concerning the features of the *model AR-1515*. We found the tuning knob was a bit stiff (its shaft is coupled via a rather long and complex path to separate AM and FM tuning gangs). The lack of a flywheel seemed strange and was difficult to get used to. Aside from these minor flaws, the control layout is excellent. It is obvious that a lot of "human engineering" went into this newest Heath design. Even if your area has no Dolby broadcasts at the present, the Dolby option can be purchased in the future and easily added to the finished receiver. **R-E**

LOOKING AHEAD
continued from page 4

mutually incompatible. So broadcasters merely held off and waited.

Clearly this was a case for the SMPTE, the technical association that sets TV and motion picture standards. The SMPTE set up a working group, which deliberated, then brought both manufacturers together. The result: a compromise system consisting of the best features of each format. Unheralded behind-the-scenes hard work by broadcast and VTR engineers was responsible for what will become the first major change in video recording broadcast standards in 21 years.

Energy: The advent of solid-state circuits has been lucky for the TV industry, which is now making a large contribution to the reduction in nationwide energy consumption, at least on paper. Television has never been as much of an energy-gulper as an air conditioner or refrigerator, but it has had a great energy-reducing record in recent years. The Federal Energy Administration has assigned TV the following energy-saving goals by 1980, in terms of power consumption as compared with the base year of 1972: For color sets, a 35% reduction in energy use (28% as a result of switching to solid-state, 7% by eliminating instant-on); for monochrome sets, a 65% cut in energy (52% by going to solid-state, 13% by removing instant-on).

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

CB METERS
continued from page 41

meter reading. Then, switch to SWR and read the ratio directly.

(Another way to calibrate the SWR bridge is to measure the forward and reflected voltages and use the formula

$$SWR = \frac{V_f + V_r}{V_f - V_r}.$$

Connect the SWR bridge in the transmission line close to the transmitter; preferably before any baluns, antenna tuners, TVI filters or other devices. With the antenna connected to the bridge output and S1 in the XMTR *position, key the CB rig and adjust potentiometer R3 for a full-scale reading (100 μA). This is a reference figure for forward voltage V_f. Without changing the setting of R3, throw switch S1 to* SWR *and read reflected voltage V_r. For example, if V_r is 20, the* SWR *is 100 + 20/100 − 20 or 1.5, a pretty good match between the radio and its antenna.*—Editor)

A final word: while all three instruments make a very useful addition to any CB or ham rig, the tiny field-strength indicator alone provides the means to obtain maximum radiated output—and for only a dollar! The other two instruments add the details of power in watts and the actual standing-wave ratio. All three can be combined into one by adding a 3-pole, 4-position switch. **R-E**

CLASS H AMPLIFIER

continued from page 55

20,000 Hz at no more than 0.1% total harmonic distortion. The amplifier, which carries a suggested retail price of just under $700.00, is shown in Fig. 13. Among its other features are two LED indicators located near each of the input-level control knobs. These indicators are labelled VARI-PROPORTIONAL SYSTEM and light up when the higher-voltage supply is activated by higher-level input and output signals. This provides a visual indication of the vari-proportional system.

In order to confirm Soundcraftsmen claims that the vari-proportional control system does not in any way degrade transient performance of their new *model MA5002* amplifier, Figs. 14 and 15 represent the positive- and negative-going amplifier slew rates. The vertical scale in both figures is 5 volts-per-division, while the horizontal sweep rate is 0.5 μs-per-division. The rising (or falling) sloped lines in Figs. 14 and 15 represent the leading or trailing edges of a 10-kHz squarewave applied to the amplifier at a power-output level of 250 watts-per-channel into 8-ohm loads. A full representation of the 10-kHz squarewave output signal at this rated power level is shown in Fig. 16, while a low-frequency squarewave output at the same 250-watt-per-channel level is shown in Fig. 17.

To summarize the differences between Class-G amplifiers and the "Class-H" design: A Class-G amplifier uses two sets of output transistors, each powered by a different supply voltage. When a signal exceeds the power-supply level applied to the low-power output transistors, the higher-powered transistors (using a higher voltage supply) are switched on while the lower-powered pair are switched off. The Class-G approach, therefore, also reduces power dissipation at all operating levels, but requires two types of output devices, with one type operating while the other is cut off. In the Soundcraftsmen vari-proportional system, only one type of output device is used, and it must have a sufficiently high rating to handle the full output of the amplifier in which it is used. However, for most of its operating time, it is *powered* by a lower supply voltage than might be safely applied to it, and its internal dissipation is thereby reduced and the efficiency is therefore increased significantly.

Clearly, with solid-state amplifier design having reached a point of lowest possible distortion, reduced transient distortion and more-than-adequate bandwidth capability, designers seem to be turning their attention to increased efficiency and, thereby, lower cost and greater value for the consumer. Chances are we'll be running out of the alphabet soon if amplifier design innovations continue at their present pace. **R-E**

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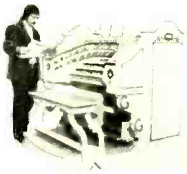

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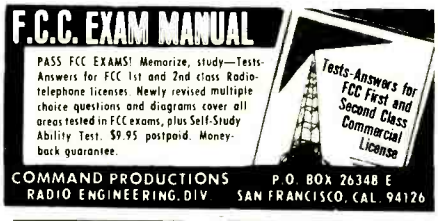

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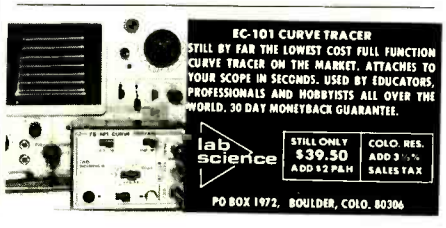

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Quest ELECTRONICS

INTEGRATED CIRCUITS

7400TTL		74LS38N	33	LM377	4 50	CD4011	22	74C14	2 10
7400N	17	74LS74N	38	LM379	5 00	CD4012	22	74C20	28
7402N	17	74LS75N	51	LM380N	1 00	CD4013	39	74C30	28
7404N	19	74LS90N	55	LM381	1 50	CD4014	94	74C48	2 95
7409N	23	74LS93N	55	LM382	1 60	CD4015	94	74C74	75
7410N	17	74LS95N	1 89	LM703H	10	CD4016	39	74C76	1 40
7414N	63	74LS107N	38	LM709H	28	CD4017	1 00	74C90	1 15
7420N	17	74LS112N	38	LM723H/N	50	CD4018	1 00	74C93	1 40
7427N	1 39	74LS113N	58	LM733N	1 00	CD4019	50	74C106	2 10
7430N	20	74LS132N	79	LM741CH	35	CD4020	1 11	74C107	85
7442N	50	74LS136N	38	LM741N	25	CD4021	1 11	74C154	3 00
7445N	59	74LS151N	73	LM747H-N	62	CD4022	94	74C160	1 44
7447N	60	74LS155N	73	LM748N	35	CD4023	22	74C192	2 40
7448N	69	74LS157N	73	LM1303N	82	CD4024	83	74C221	2 75
7450N	17	74LS158N	1 00	LM1304	1 10	CD4025	22	74C905	3 00
7474N	29	74LS163N	1 00	LM1305	1 27	CD4026	1 60	74C906	1 50
7475N	49	74LS174N	1 03	LM1307	2 00	CD4027	39	74C914	1 95
7485N	88	74LS190N	1 15	LM1310	2 75	CD4028	85	74C925	10 50
7489N	2 00	74LS221N	1 95	LM1458	59	CD4029	1 11	74C926	10 50
7490N	43	74LS258N	73	LM1800	75	CD4030	22	74C927	10 50
7492N	43	**LINEAR**		LM1812	7 50	CD4035	1 11	**INTERFACE**	
7493N	43	CA3045	90	LM1889	3 00	CD4040	1 11	8095	65
7495N	69	CA3046	95	LM2111	1 75	CD4042	72	8096	65
74100N	90	CA3049	85	LM2902	1 50	CD4043	68	8097	65
74107N	29	CA3081	1 80	LM3900N	55	CD4046	1 82	8098	65
74121N	34	CA3082	90	LM3905	1 75	CD4049	39	8T09	1 25
74123N	59	CA3089	1 95	LM3905N	69	CD4050	39	8T10	1 50
74125N	39	CA3090AQ	4 75	MC1458V	50	CD4051	1 22	8T13	3 00
74145N	69	LM301AN/AH	35	NE540L	2 00	CD4060	1 54	8120	5 50
74150N	95	LM308H	87	NE550N	65	CD4066	78	8123	3 10
74151N	68	LM307N	35	NE555V	43	CD4068	35	8124	3 50
74154N	1 05	LM308N	89	NE556A	80	CD4069	40	8125	3 20
74157N	69	LM309H	1 15	NE565A	1 00	CD4070	40	8126	1 69
74161N	87	LM309K	95	NE566V	1 22	CD4071	22	8128	2 75
74162N	87	LM311H/N	90	NE567V	1 25	CD4072	22	8197	1 69
74163N	87	LM317T	2 95	78L05	90	CD4073	22	8198	1 69
74174N	96	LM318	1 35	78L08	90	CD4075	22	**MOS/MEMORY RAM**	
74175N	90	LM320K-5	1 35	79L05	1 00	CD4076	1 75	2101-1	4 50
74190N	1 15	LM320K-12	1 35	78M05	75	CD4078	40	2102-1	1 95
74192N	87	LM323K-5	6 95	75108	1 75	CD4081	22	2107B	4 00
74193N	85	LM320K-15	1 35	75491CN	50	CD4082	22	2111-1	5 00
74221N	1 55	LM320T-5	1 60	75492CN	55	CD4116	1 30	2112-2	10 90
74298N	1 65	LM320T-8	1 60	75494CN	89	CD4160	1 50	21168	65 00
74365N	66	LM320T-12	1 50			CD4161	1 50	2513B	8 75
74366N	66	LM320T-15	1 60	**A to D CONVERTER**		CD4508	4 25	5101L-1	1 90
74367N	66	LM324N	1 24	8700CJ	12 95	CD4510	1 10	MM5262	50
74LS00 TTL		LM339N	1 55	8701CN	22 00	CD4511	1 00	MM5320	5 95
74LS00N	28	LM340K-5	1 60	8750CJ	13 95	CD4516	1 10	MM5330	5 94
74LS02N	28	LM340K-8	1 60	D1136	13 75	CD4518	1 10	PD411D-3	2 72
74LS04N	28	LM340K-12	1 60	9400CJ V to F	7 10	CD4520	1 10	PD411D-4	4 00
74LS05N	28	LM340K-15	1 60	**CMOS**		CD4527	1 60	91L02A	2 20
74LS08N	28	LM340K-24	1 60	CD3-0001 Fair	50	CD4528	85	**CLOCKS**	
74LS10N	28	LM340T-5	1 20	CD4000	18	CD4553	5 75	MM5309	3 00
74LS13N	46	LM340T-8	1 20	CD4001	22	CD4566	2 25	MM5311	3 60
74LS14N	1 00	LM340T-12	1 20	CD4002	22	CD4583	4 50	MM5312	4 80
74LS20N	28	LM340T-15	1 20	CD4006	1 19	CD4585	1 15	MM5313	3 60
74LS22N	28	LM340T-18	1 20	CD4007	22	CD40192	3 00	MM5314	3 90
74LS28N	41	LM340T-24	1 20	CD4008	75	74C00	28	MM5315	4 00
74LS30N	28	LM342H	4 50	CD4009	43	74C04	33	MM5316	5 00
74LS33N	39	LM370	1 15	CD4010	43	74C10	28	MM5318	8 95

MM5369	2 10
MM5841	10 80
MM5865	9 00
CT7001	9 60
CT7002	6 25
CT7010	6 95
CT7015	7 25
MM5375AA/N	3 90
MM5375AB/N	4 90
7205	16 50
DS0026CN	3 75
DS0056CN	9 00
MM53104	2 50

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8	15	24	36
14	18	28	43
16	20	36	58
18	27	40	61
22	35		

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8080A with data 19 00

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8214	8 00		
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8251	11 95		
8255	11 55		
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UART/FIFO

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3341	6 95

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1702A	3 95
N82S23	2 95
N82S123	3 50
N82S126	3 75
N82S129	3 75
N82S131	3 75
5708	23 00
DM8577	2 90
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7716	45 00

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Green Orange Yellow T01¾ .20
Jumbo Red .20
Green Orange Yellow Jumbo .25
Dialite LED Mounting Clips 6 51 25
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1 MHz	5 50	2 0100 MHz	3 50
2 MHz	3 90	2 09152 MHz	7 75
3 MHz	4 25	2 4576 MHz	7 50
5 MHz	4 25	3 2768 MHz	7 50
10 MHz	4 25	5 0688 MHz	4 50
18 MHz	3 90	5 185 MHz	4 50
20 MHz	3 90	5 7143 MHz	4 50
1 8432 MHz	6 50	8 9336 MHz	4 50
32768 Hz	4 00	18 432 MHz	4 50
1 8432 MHz	6 50	22 1184 MHz	4 50
3 5795 MHz	1 20		

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DL707, DL707R	CA	300	1 00
DL722-1	CC	500	1 00
DL727	CA	500	1 90
DL728	CC	500	1 90
DL747	CA	600	1 95
DL750	CC	500	1 90
FND359	CC	357	70
FND503	CC	500	90
FND510	CA	500	90
FND800	CC	800	2 20
FND807	CA	800	2 20
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Batt. oper. general purpose or medical 32°–230°F. Disposable probe cover ± .2° accuracy. Comp. assy. w/compact case.

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74C76	276-2312	$1.59	89¢
74C90	276-2315	$2.29	1.49
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4027	276-2427	$1.29	89¢
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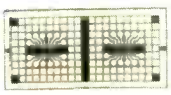
7815	276-1772	$1.59	1.29

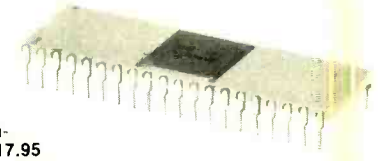
Experimenter's PC Board

Simplifies IC Projects



Ideal for two-circuit projects. Fire-retardant copper-clad board is only $2\frac{1}{2}$x5x$\frac{1}{16}$". Really simplifies integrated circuit projects by extending leads for easy soldering.
276-151 ..... **2.99**

Microcomputer Chip



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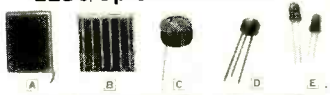

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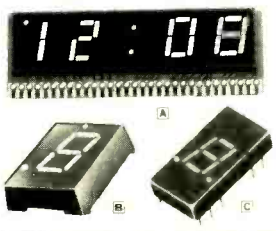
Digital Displays



Digits	Size	Drive	Cat No	Last Year	NOW ONLY
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C 1	0.3"	Anod.	276-053	$2.99	1.99
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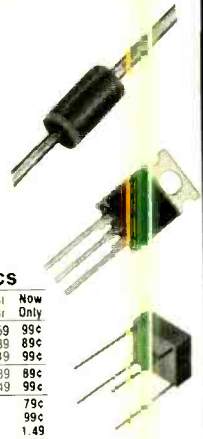

Type	Cat No	Last Year	Now Only
1N4001	276-1101		2/39¢
1N4003	276-1102	2/59¢	2/49¢
1N4004	276-1103	2/69¢	2/59¢
1N4005	276-1104	2/79¢	2/69¢
1N4735	276-561		2/89¢
1N4739	276-562		2/89¢
1N4742	276-563		2/89¢
1N4744	276-564		2/89¢
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1N5401	276-1141		2/69¢
1N5402	276-1142	2/89¢	2/79¢
1N5403	276-1143	2/99¢	2/89¢
1N5404	276-1144	2/$1.19	2/99¢
PTC205	276-1114		3/1.39¢

SCR's and Triacs

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SCR	200V.6A	276-1067	$1.39	89¢
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Triac	200V.6A	276-1001	$1.39	89¢
Triac	400V.6A	276-1000	$1.49	99¢
BR	50PIV 1.4A	276-1151		79¢
BR	100PIV 1.4A	276-1152		99¢
BR	100V.4A	276-1171		1.49
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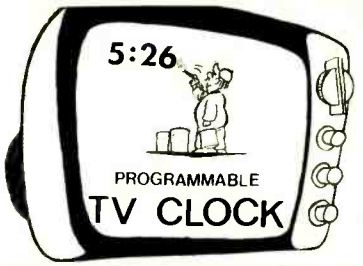

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2SB54	.70	2SC1000	.65	2SC1908	.70	SK3049	4.75
2SB56	.70	2SC1013	1.50	2SC1909	4.75	SK3054	1.25
2SB186	.60	2SC1014	1.50	2SC1957	1.50	2SK19	1.75
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2SB415	.85	2SC1096	1.20	2SC2091	1.10	3SK40	2.75
2SB461	1.25	2SC1098	1.15	2SC2092	4.75	3SK45	2.75
2SB463	1.65	2SC1115	2.75	2SD72	1.00	3SK49	2.75
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1N60	.25	2N2906	.25	2N3904	.16
		2N2906A	.30	2N3905	.16
1N270	.25	2N2907	.25	2N3906	.16
1N914	.10	2N2907A	.30	2N3954A	3.75
2N173	1.75	2N2913	.75	2N3955	2.45
2N404	.75	2N2914	1.20	2N3957	1.25
2N443	2.50	2N3019	1.00	2N3958	1.20
2N508A	.45	2N3053	.30	2N4037	.60
2N718	.25	2N3054	.70	2N4093	.85
2N930	.25	2N3055	.75	2N4124	.16
2N956	.30	2N3227	1.00	2N4126	.16
2N1302	1.25	2N3247	3.40	2N4141	.20
2N1305	.75	2N3250	.50	2N4142	.20
2N1540	.90	2N3393	.20	2N4143	.20
2N1544	.80	2N3394	.17	2N4220A	.45
2N1560	2.80	2N3414	.17	2N4234	.95
2N1605	1.75	2N3415	.18	2N4400	.16
2N1613	.50	2N3416	.19	2N4401	.16
2N1711	.50	2N3417	.20	2N4402	.16
2N2102	.70	2N3442	1.85	2N4403	.20
2N2160	.70	2N3553	1.50	2N4409	.16
2N2218	.25	2N3563	.20	2N4410	.16
2N2218A	.30	2N3565	.20	2N4441	1.00
2N2219	.25	2N3638	.20	2N4442	1.15
2N2219A	.30	2N3642	.20	2N4443	1.35
2N2221	.25	2N3643	.20	2N4852	.55
2N2221A	.30	2N3645	.20	2N5061	.30
2N2222	.25	2N3646	.14	2N5064	.50
2N2222A	.30	2N3731	3.75	2N5130	.20
2N2270	.40	2N3740	1.00	2N5138	.15
2N2369	.25	2N3771	1.75	2N5296	.50
2N2484	.32	2N3772	1.90	2N5306	.20
2N2712	.18	2N3773	3.00	2N5400	.40
2N2904	.25	2N3819	.40	2N5401	.50
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7401	.21	7448	1.15	74121	.55
7402	.21	7450	.26	74122	.49
7404	.21	7451	.27	74123	1.05
7405	.24	7453	.27	74125	.60
7407	.45	7454	.41	74126	.81
7408	.25	7460	.22	74132	3.00
7409	.25	7472	.39	74141	1.15
7410	.20	7473	.45	74150	1.10
7411	.30	7474	.45	74151	1.25
7413	.85	7475	.80	74153	1.35
7416	.43	7482	1.75	74154	1.54
7417	.43	7483	1.15	74157	1.30
7420	.21	7485	1.12	74161	1.45
7422	1.50	7486	.45	74164	1.65
7425	.43	7489	2.49	74165	1.65
7427	.37	7490	.69	74166	1.70
7428	.35	7491	1.20	74174	1.95
7430	.26	7492	.82	74175	1.95
7432	.31	7493	.82	74180	1.05
7437	.47	7494	.91	74181	3.55
7438	.40	7495	.91	74191	1.50
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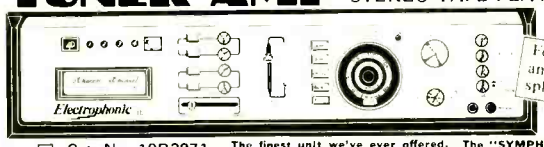

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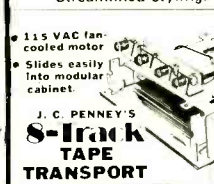

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- Shielded preamp

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SN7413	.39
SN7414	.61
SN7416	.24
SN7417	.24
SN7420	.14
SN7423	.26
SN7427	.26
SN7430	.14
SN7432	.24
SN7437	.24
SN7438	.24
SN7440	.14
SN7441	.79
SN7442	.49
SN7443	.61
SN7444	.61
SN7445	.69
SN7447	.69
SN7450	.14
SN7451	.14
SN7453	.14
SN7454	.14
SN7455	.14
SN7460	.20
SN7462	.14
SN7464	.14
SN7465	.14
SN7470	.28
SN7471	.69
SN7472	.26
SN7473	.31
SN7474	.31
SN7475	.48
SN7476	.33
SN7478	.79
SN7480	.33
SN7482	.59
SN7483	.69
SN7485	.88
SN7486	.29
SN7488	2.95
SN7490	.69
SN7491	.63
SN7492	.45
SN7493	.45
SN7494	.69
SN7495	.69
SN7496	.69
SN7498	.69
SN74107	.29
SN74112	.19
SN74113	.19
SN74114	.19
SN74121	.31
SN74123	.48
SN74125	.39
SN74126	.39
SN74132	.83
SN74140	1.00

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SN7413	.92
SN7413	.89
SN7413	1.25
SN7415	.63
SN7415	.99
SN7415	.78
SN7415	.68
SN7415	.64
SN7415	.89
SN7415	.87
SN7416	.87
SN7416	.95
SN7416	1.15
SN7417	1.19
SN7417	.93
SN7417	.88
SN7417	.77
SN7417	1.49
SN7418	.69
SN7418	1.95
SN7418	.69
SN7419	1.15
SN7419	.99
SN7420	.83
SN7420	.83
SN7420	.83
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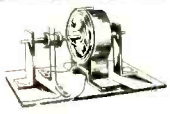

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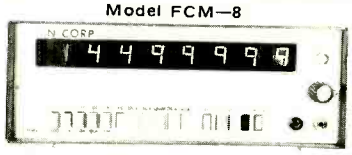

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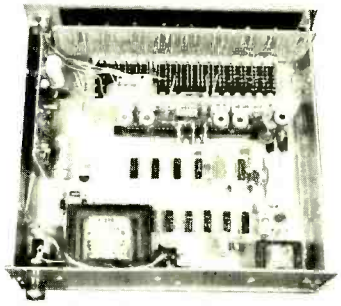

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SN7412N	.21	SN7483AN	.65	SN74153N	.61	SN74221N	1.14
SN7413N	.39	SN7484AN	1.50	SN74154N	.95	SN74246N	1.95
SN7414N	.62	SN7485N	.84	SN74155N	.70	SN74247N	1.70
SN7416N	.24	SN7486N	.30	SN74156N	.64	SN74248N	1.75
SN7417N	.29	SN7489N	1.85	SN74157N	.59	SN74249N	1.75
SN7420N	.14	SN7490AN	.43	SN74159N	2.50	SN74251N	1.05
SN7421N	.20	SN7491AN	.59	SN74160N	.85	SN74259N	1.35
SN7422N	.20	SN7492AN	.44	SN74161N	.85	SN74265N	.85
SN7423N	.25	SN7493AN	.44	SN74162N	.85	SN74273N	1.35
SN7425N	.25	SN7494N	.69	SN74163N	.85	SN74276N	.75
SN7426N	.22	SN7495AN	.67	SN74164N	.98	SN74278N	1.99
SN7427N	.25	SN7496N	.65	SN74165N	.97	SN74279N	.57
SN7428N	.28	SN7497N	2.50	SN74166N	1.09	SN74283N	1.39
SN7430N	.14	SN74100N	.97	SN74167N	2.75	SN74284N	4.50
SN7432N	.23	SN74104N	.42	SN74170N	1.69	SN74285N	4.50
SN7433N	.30	SN74105N	.42	SN74172N	8.75	SN74290N	.85
SN7437N	.21	SN74107N	.28	SN74173N	1.24	SN74293N	.83
SN7438N	.21	SN74109N	.47	SN74174N	.94	SN74298N	1.64
SN7440N	.14	SN74110N	.52	SN74175N	.84	SN74351N	1.92
SN7442N	.37	SN74111N	.69	SN74176N	.77	SN74365N	.65
SN7443N	.68	SN74116N	1.50	SN74177N	.76	SN74366N	.65
SN7444N	.85	SN74120N	1.40	SN74178N	1.19	SN74367N	.65
SN7445N	.65	SN74121N	.34	SN74179N	1.49	SN74368N	.65
SN7446AN	.70	SN74122N	.38	SN74180N	.67	SN74376N	.75
SN7447AN	.59	SN74123N	.48	SN74181N	1.94	SN74390N	1.40
SN7448N	.69	SN74125N	.40	SN74182N	.59	SN74393N	1.40
SN7450N	.14	SN74126N	.40	SN74184N	1.75	SN74426N	.45
SN7451N	.14	SN74128N	.59	SN74185AN	1.74	SN74490N	1.90

CMOS

CD4000BE	.13	CD4052BE	1.15	74C14/40014PC	.75
CD4001BE	.16	CD4053BE	.89	74C85/40085PC	1.20
CD4002BE	.16	CD4055BE	1.29	80C97/40097PC	.65
CD4006BE	.99	CD4060BE	.99	80C98/40098PC	.65
CD4007BE	.16	CD4066BE	.59	74C160/40160PC	1.50
CD4008BE	.80	CD4068BE	.24	74C161/40161PC	1.50
CD4009BE	.37	CD4069BE	.24	74C162/40162PC	1.50
CD4010BE	.37	CD4070BE	.24	74C163/40163PC	1.50
CD4011BE	.16	CD4071BE	.24	74C174/40174PC	1.40
CD4012BE	.16	CD4072BE	.29	74C175/40175PC	1.40
CD4013BE	.29	CD4073BE	.29	74C192/40192PC	1.50
CD4014BE	.74	CD4075BE	.29	74C193/40193PC	1.50
CD4015BE	.74	CD4076BE	.98	74C194/40194PC	1.40
CD4016BE	.29	CD4078BE	.24	74C195/40195PC	1.40
CD4017BE	.79	CD4081BE	.24		
CD4018BE	.79	CD4082BE	.29		
CD4019BE	.38	CD4085BE	.75		
CD4020BE	.84	CD4086BE	.75		
CD4021BE	.89	CD4502BE	1.15		
CD4022BE	.89	CD4507BE	.39		
CD4023BE	.16	CD4510BE	1.05		
CD4024BE	.67	CD4511BE	1.25		
CD4025BE	.16	CD4512BE	.69		
CD4026BE	1.39	CD4514BE	2.50		
CD4027BE	.38	CD4515BE	2.50		
CD4028BE	.74	CD4516BE	.84		
CD4029BE	.78	CD4518BE	.84		
CD4030BE	.37	CD4519BE	.79		
CD4033BE	1.60	CD4520BE	.79		
CD4034BE	2.95	CD4522BE	1.98		
CD4035BE	.98	CD4526BE	1.50		
CD4040BE	.99	CD4527BE	1.50		
CD4041BE	.67	CD4528BE	1.20		
CD4042BE	.58	CD4531BE	1.25		
CD4043BE	.45	CD4539BE	1.20		
CD4044BE	.45	CD4555BE	.75		
CD4046BE	2.45	CD4556BE	.75		
CD4047BE	2.45	CD4581BE	2.25		
CD4049BE	.34	CD4582BE	.95		
CD4050BE	.34	CD4585BE	1.80		
CD4051BE	.89				

TEXAS INSTRUMENTS I.C. SOCKETS
(Low Profile Solder Tail)

Description		Unit Price
8 Pin DIL	(C840802)	.15
14 Pin DIL	(C841402)	.18
16 Pin DIL	(C841602)	.19
18 Pin DIL	(C841802)	.29
20 Pin DIL	(C842002)	.35
22 Pin DIL	(C842202)	.34
24 Pin DIL	(C842402)	.34
28 Pin DIL	(C842802)	.45
40 Pin DIL	(C844002)	.65

VOLTAGE REGULATORS

SG3501AT	3.60	+5V Dual Tracking Regulator
SG3524J	7.25	Switching Regulator Converter
SG4501T	1.80	+15V Dual Tracking Regulator
RC4194TK	3.95	Variable Dual Tracking Regulator +35V +9.5V
RC4195T	2.35	Fixed +15V Dual Tracking Regulator T05
RC4195TK	3.15	Fixed +15V Dual Tracking Regulator T066
78H05KC	6.35	5 Amp 5 Volt Positive Regulator T03
7800 Series TO-220 / LM340T	.99	Positive Voltage Regulators (Plastic) 1 amp 5, 6, 8, 12, 15, 18, 24 Volts
78M00 Series TO-5 / LM340H	1.39	Positive Voltage Regulator 1/2 Amp 5, 6, 8, 12, 15, 18, 24 Volts
7800 Series TO-3 / LM340K	1.49	Positive Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
78L00 AWC Series TO-92	.29	Positive Voltage Regulator 100 MA 2.6, 5, 6.2, 8.2, 12, 15 Volts
7900 Series TO-220 / LM320T	1.25	Negative Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
79M00 Series TO-5 / LM320H	1.35	Negative Voltage Regulator 1/2 Amp 5, 6, 8, 12, 15, 20, 24 Volts
7900 Series TO-3 / LM320K	1.75	Negative Voltage Regulator 1 Amp 5, 6, 8, 12, 15, 18, 24 Volts
78MGT2C	1.20	Dual In Line Adjustable 4 Terminal Positive Voltage Regulator
79MGT2C	1.20	Dual In Line Adjustable 4 Terminal Negative Voltage Regulator
78GU1 TO 220	1.45	1 Amp Adjustable Positive Voltage Regulator
79GU1 TO-220	1.25	1 Amp Adjustable Negative Voltage Regulator
78GKC TO 3	1.80	1 Amp Adjustable Positive Voltage Regulator
79GKC TO-3	2.10	1 Amp Adjustable Negative Voltage Regulator

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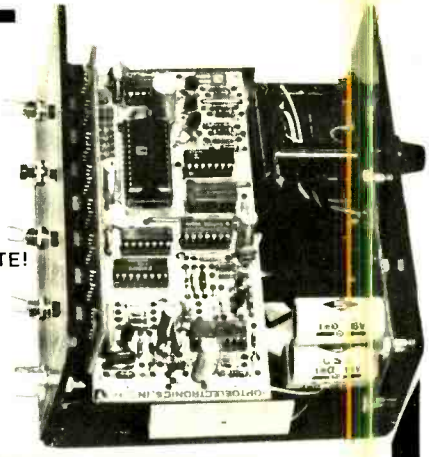
MINIMUM ORDER $10.00 ★ ADD $1.00 TO COVER POSTAGE & HANDLING ★ Canadian customers add 30% for duty and handling. All federal and provincial taxes extra

CIRCLE 53 ON FREE INFORMATION CARD

NEW LSI TECHNOLOGY

FREQUENCY COUNTER

TAKE ADVANTAGE OF THIS NEW STATE-OF-THE-ART COUNTER FEATURING THE MANY BENEFITS OF CUSTOM LSI CIRCUITRY. THIS NEW TECHNOLOGY APPROACH TO INSTRUMENTATION YIELDS ENHANCED PERFORMANCE, SMALLER PHYSICAL SIZE, DRASTICALLY REDUCED POWER CONSUMPTION [PORTABLE BATTERY OPERATION IS NOW PRACTICAL], DEPENDABILITY, EASY ASSEMBLY AND REVOLUTIONARY LOWER PRICING!



KIT #FC-50C . . . . . 60 MHZ COUNTER WITH CABINET & P.S. . . . . $119.95 COMPLETE!
KIT #PSL-650 . . . . . 650 MHZ PRESCALER [NOT SHOWN] 29.95
MODEL #FC-50WT . . . . . 60 MHZ COUNTER WIRED, TESTED & CAL. 165.95
MODEL #FC-50/600 WT . . 600 MHZ COUNTER WIRED, TESTED & CAL. 199.95

SIZE:
3" High
6" Wide
5½" Deep

FEATURES AND SPECIFICATIONS:

DISPLAY: 8 RED LED DIGITS .4" CHARACTER HEIGHT
GATE TIMES: 1 SECOND AND 1/10 SECOND
PRESCALER WILL FIT INSIDE COUNTER CABINET
RESOLUTION: 1 HZ AT 1 SECOND, 10 HZ AT 1/10 SECOND.
FREQUENCY RANGE: 10 HZ TO 60 MHZ. [65 MHZ TYPICAL].
SENSITIVITY: 10 MV RMS TO 50 MHZ. 20 MV RMS TO 60 MHZ TYP
INPUT IMPEDANCE: 1 MEGOHM AND 20 PF.
[DIODE PROTECTED INPUT FOR OVER VOLTAGE PROTECTION]
ACCURACY: ± 1 PPM [± .0001%]; AFTER CALIBRATION TYPICAL.
STABILITY: WITHIN 1 PPM PER HOUR AFTER WARM UP [.001% XTAL]
IC PACKAGE COUNT: 8 [ALL SOCKETED]
INTERNAL POWER SUPPLY: 5 V DC REGULATED.
INPUT POWER REQUIRED: 8-12 VDC OR 115 VAC AT 50/60 HZ.
POWER CONSUMPTION: 4 WATTS

KIT #FC-50C IS COMPLETE WITH PREDRILLED CHASSIS ALL HARDWARE AND STEP-BY-STEP INSTRUCTIONS. WIRED & TESTED UNITS ARE CALIBRATED AND GUARANTEED.

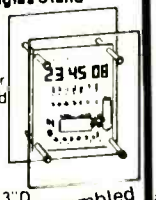
PLEXIGLAS CABINETS

Great for Clocks or any LED Digital project. Clear-Red Chassis serves as Bezel to increase contrast of digital displays.

CABINET I 3"H,6¼"W,5½"D
CABINET II 2½"H,5"W,4"D
Black, White or Clear Cover
$6.50 ea

RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS
3"x6"x1/8" 95¢ ea. 4/$3

SEE THE WORKS Clock Kit Clear Plexiglas Stand



- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches
- Plug transformer
- all parts included

Plexiglas is Pre-cut & drilled
Kit #850-4CP
Size: 6"H,4½"W,3"D
Assembled $23.50 ea. 2/$45. $29.95

60 HZ. XTAL TIME BASE

Will enable Digital Clock Kits or Clock-Calendar Kits to operate from 12V DC. 1"x2" PC Board Power Req: 5-15V (2.5 MA. TYP.) Easy 3 wire hookup Accuracy: ± 2PPM
#TB-1 (Adjustable)
Complete Kit $4.95
Wir & Cal $9.95

SPECIAL PRICING!

PRIME - HIGH SPEED RAM
21L02-3 400 NS
LOW POWER - FACTORY FRESH

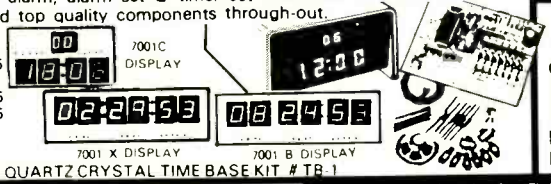
1-24	$1.75 ea.	100-199	$1.45 ea.
25-99	1.60 ea.	200-999	1.39 ea.
1000 AND OVER			$1.29 ea

6-DIGIT LED CLOCK CALENDAR KIT

DATE-TIME-SNOOZE ALARM & MORE... KIT 7001

FOR THE BUILDER THAT WANTS THE BEST. FEATURING 12 OR 24 HOUR TIME — 29-30-31 DAY CALENDAR. ALARM, SNOOZE AND AUX. TIMER CIRCUITS

Will alternate time (8 seconds) and date (2 seconds) or may be wired for time or date display only, with other functions on demand. Has built-in oscillator for battery back-up. A loud 24 hour alarm with a repeatable 10 minute snooze alarm, alarm set & timer set indicators. Includes 110 VAC/60Hz power pack with cord and top quality components through-out.



KIT - 7001B WITH 6 - .5" DIGITS $39.95
KIT - 7001C WITH 4 - .6" DIGITS & 2 - .3" DIGITS FOR SECONDS $42.95
KIT - 7001X WITH 6 - .6" DIGITS $45.95

KITS ARE COMPLETE (LESS CABINET)
ALL 7001 KITS FIT CABINET I AND ACCEPT QUARTZ CRYSTAL TIME BASE KIT # TB-1

JUMBO DIGIT CLOCK

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC 12/24 Hr. time, PC Boards, Transformer Line Cord, Switches and all Parts. Ideal Fit in Cabinet II

Kit #5314-5 $19.95 2/$38.

JUMBO DIGIT CONVERSTION KIT $9.95 ea.

Convert small digit LED clock to large .5" displays. Kit includes 6 - LED's, Multiplex PC Board & Hook up info.
Kit #JD-1CC For Common Cathode
Kit #JD-1CA For Common Anode

PRINTED CIRCUIT BOARDS for CT-7001 Kits sold separately with assembly info. PC Boards are drilled Fiberglass, solder plated and screened with component layout.

Specify for 7001
B, C or X - $7.95

AUTO BURGLAR ALARM KIT

AN EASY TO ASSEMBLE AND EASY TO INSTALL ALARM PROVIDING MANY FEATURES NOT NORMALLY FOUND. KEYLESS ALARM HAS PROVISION FOR POS & GROUNDING SWITCHES OR SENSORS. WILL PULSE HORN RELAY AT 1HZ RATE OR DRIVE SIREN. KIT PROVIDES PROGRAMMABLE TIME DELAYS FOR EXIT, ENTRY & ALARM PERIOD. UNIT MOUNTS UNDER DASH. REMOTE SWITCH CAN BE MOUNTED WHERE DESIRED. CMOS RELIABILITY. RESISTS FALSE ALARMS & PROVIDES FOR ULTRA DEPENDABLE ALARM. DO NOT BE FOOLED BY LOW PRICES! THIS IS A TOP QUALITY COMPLETE KIT WITH ALL PARTS INCLUDING DETAILED DRAWINGS AND IN-STRUCTIONS OR AVAILABLE WIRED AND TESTED

KIT #ALR-1 $9.95
#ALR-1WT WIRED & TESTED $19.95

VARIABLE REGULATED 1 AMP POWER SUPPLY KIT

- VARIABLE FROM 4 to 14V
- SHORT CIRCUIT PROOF
- 723 IC REGULATOR
- 2N3055 PASS TRANSISTOR
- CURRENT LIMITING AT 1 Amp

KIT IS COMPLETE INCLUDING DRILLED & SOLDER PLATED FIBERGLASS PC BOARD AND ALL PARTS (less TRANSFORMER) KIT #PS-01 $8.95

TRANSFORMER 24V CT will provide 300MA at 12V and 1 Amp at 5V. $3.50

MOBILE LED CLOCK

12/24 HR .4" DIGITS!

MODEL #2001
12 VOLT AC or DC POWERED

- 6 JUMBO .4" RED LED'S BEHIND RED FILTER LENS WITH CHROME RIM
- SET TIME FROM FRONT VIA HIDDEN SWITCHES • 12/24-Hr. TIME FORMAT
- STYLISH CHARCOAL GRAY CASE OF MOLDED HIGH TEMP. PLASTIC
- BRIDGE POWER INPUT CIRCUITRY — TWO WIRE NO POLARITY HOOK-UP
- OPTIONAL CONNECTION TO BLANK DISPLAY [Use When Key Off in Car, Etc.]
- TOP QUALITY PC BOARDS & COMPONENTS - INSTRUCTIONS.
- MOUNTING BRACKET INCLUDED

KIT #2001 COMPLETE KIT $27.95 EA. 3 OR MORE $25.95 ea. 115 VAC Power Pack #AC-1 $2.50 EA.

ASSEMBLED UNITS WIRED & TESTED ORDER #2001 WT [LESS 9V. BATTERY] Wired for 12-Hr. Op. if not otherwise specified. $37.95 EA 3 OR MORE $35.95 ea.

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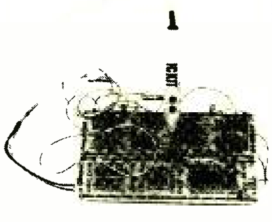
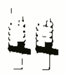
BOX 219 HOLLYWOOD, FLA. 33022
PHONE [305] 921-2056 / 921-4425

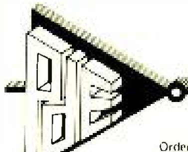
ORDERS TO USA & CANADA ADD 5% FOR SHIPPING, HANDLING & INSURANCE. ALL OTHERS ADD 10%. ADDITIONAL $1.00 CHARGE FOR ORDERS UNDER $15.00 - COD FEE $1.00. FLA. RES. ADD 4% STATE TAX.

master charge
BANKAMERICARD

CIRCLE 37 ON FREE INFORMATION CARD







HOBBY CORNER

continued from page 71

You will notice that nothing has been said about a circuit being bad in the first place. That's because everything you see in this column has been checked out and built at least on a breadboard. *Any exceptions will be clearly marked "UNTESTED."*

Iron temperature control

Do you have a light dimmer or motor speed control on your workbench? Of course, it's handy for slowing down the drill or grinder when working in soft materials such as plastic. But at our workbench the soldering iron is usually connected to it.

Just having one all-purpose soldering iron instead of two or three for various uses can cause trouble with many solid-state circuits because excess heat can quickly ruin a part or even a circuit board. However, you can keep your iron at just the right temperature with a dimmer/speed control.

The control shown in Fig. 5 can be assembled quickly and easily. Be sure to provide a good heat sink for the triac. Although the 6-amp unit specified can readily handle any normal electronics iron, you might want to use the control with something heavier.

Once you use the dimmer/speed control with your iron you'll find you destroy fewer parts and boards and your iron and tip will last longer.

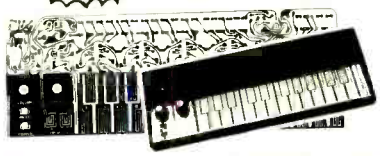
New CB guide

For beginning CB'ers, Radio Shack has published a second edition of *All About CB Two-Way Radio* (RS #68-1046). This updated nontechnical guide covers such topics as how CB got started, types of radios and antennas, how to set up fixed and mobile stations, FCC rules and regulations and plenty of ideas on using CB. **R-E**

Please remember that we want to hear from you—your needs, suggestions, ideas and circuits. Drop us a note. *73, Doc*

You shouldn't be mad at your husband for giving you a TV that doesn't work—this happens to be a microwave oven!

NEW! ELECTRONIC TOUCH ORGAN KIT



Fantastic new design uses CMOS I.C. and a total of 39 semi-conductors to give a touch control keyboard, all the electronic parts in one PC Board. This organ is easy to build, yet has features like a full two-octave range touch keyboard, variable tremolo; two voices; built-in I.C. amplifier with volume control, complete with speaker and a specially designed plexi-glass case.

BATTERIES NOT INCLUDED *Ideal kit for beginner or gift for children **$24.50 ea.**

SLIM LINE CALCULATOR

6 Functions with % and memory
8 Digits LED display
*One full year guarantee
Special Price Only
$8.50 Ea.
BATTERIES NOT INCLUDED

CALCULATOR with STOPWATCH

6 Functions with % and memory
8 Digits big green display
*Built-in X'tal controlled stop watch count to 1/10 of a second.
Special Price Only
$16.50 Ea.
BATTERIES NOT INCLUDED

I.C. TEST CLIPS

Same as the E-Z clips
With 20" Long Leads
In Black and Red Colors
$1.75 Per Pair

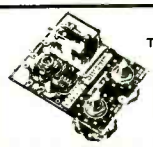
5W AUDIO AMP KIT

2 LM 380 with Volume Control
Power Supply 6~18V DC
only $5.00 ea.

Multi-Color LED Indicator

Red—Green Colors in one LED with Plastic Housing
99¢ Ea.
Voltage 2V 20 MA per LED

TIMER KIT



Time Controlled from 1-100sec.
Ideal to be used as time delay unit for burglar alarm, photo service, and other purposes. Max. loading 110V, 2 AMP. Supply voltage 12-18V D.C.
PT-80 ELECTRONIC IC TIMER
$11.50 each

ELECTRONIC ALARM SIREN

COMPLETE UNIT
Ideal for use as an Alarm Unit, or hookup to your car back-up to make a reverse indicator. Light Output up to 130 dB.
Voltage Supply 6~12V **$7.50**
AU—999

19 KEY HEXADECIMAL KEY PAD

• 1—0 • Homekey
• ABCDEF •←→Key
SPECIAL $10.50 ea.
Low Cost Hexadecimal 16 Key Pad

Designed for Calculator
Can be used for Computer
Data Entry Pad or Digital Lock
All key tops blank with super good touch feeling $0.95 ea.

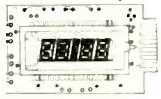
DIGITAL ELECTRONIC LOCK KIT

$6.50 ea. CMOS I.C. IN CIRCUIT
for auto ignition, entry door, burglar, alarm, etc. 4 Digits Programable to Any Combination
400Ω RELAY AND KEY PAD NOT INCLUDED

POWER SUPPLY KIT

0-35V D.C. REGULATED
Uses UA723 and ZN3055 Power TR output can be adjusted from 0-35V, 2 AMP. Complete with PC board and all electronic parts.
035 POWER SUPPLY **$9.50 each**
Transformer for Power Supply, 2 AMP 24V $3.90 ea.

MA1003, 12V DC CLOCK MODULE



Built in X'TAL controlled time base. Protected against automotive volt transients. Automatic brightness control with 0.3" green color display. Display turnoff with ignition "OFF".
$23.50 EACH

EDGE CONNECTORS (IMSA1 Type)

Dual 50 (100 pin)
0.125 spacing wire-wrap
$4.50 EACH

DB25 Type CONNECTOR

Male	$3.40 each
Female	$3.75 each

Plastic Housing for Connector $1.00 each

MULTI-COLOR RIBBON CABLES

Type	Conductors	AWG	Price Per Ft.
A	15	20	0.40
B	12	24	0.40
C	18	24	0.45
D	26	26	0.50
E	13	30	0.25
F	22 prs.	26	0.40

red/white twisted prs
(over 50 ft. per type—less 15%)

QUARTZ CRYSTALS

1 MHZ	$4.95
2 MHZ	$5.25
4 MHZ	$5.25
10 MHZ	$5.25
3.579 MHZ	$1.25

Color TV Type

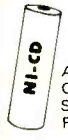
CB MICROPHONE

500 MIC for CB Unit
Talk Switch with Connector and Cord
$2.50 each
CLOSE OUT SALE

TV GAME MODULATOR UNIT

FCC Approved
For channel 3 and 4 with Occ. Coil
ONLY $4.50
TI 1955
Alternative AY3-8500-1
6 Game (28 Pin Dip) TV Game Chip with Data Tennis Squash hockey, practice & 2 shooting.
Special Only $11.00
PC Board for TV Game with Data $2.50 ea.
Switch Box between Game & TV $1.25 ea.

NI-CD RECHARGEABLE BATTERIES



AA size	1.5V	$1.25 ea.
C size	1.5V	$1.50 ea.
Sub C size		$1.50 ea.
F size	1.5V	$2.50 ea.

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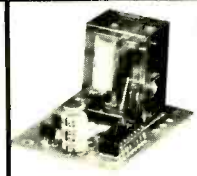
The Crimefighter Auto Alarm is an electronic, self-controlled auto protection system, normally mounted within the glove box of an automobile. Two minutes after turning off the ignition, the alarm automatically turns itself "on". When the auto is re-entered, the horn will sound after a 10-45 second entry delay. The automobile owner, by inserting the ignition key, will activate the alarm. Once activated, the alarm will sound for two minutes before automatically turning off. The alarm then resets and is ready to again protect the vehicle from unwanted entry.

FEATURES Simple installation 5 wires. Automatically turns on when auto is parked. Adjustable entry time. Extended exit time to allow for unhushed exit from vehicle. Numerous applications include protection of boats, campers, trailers, motorcycles, trucks. Cannot be deactivated by "hot wiring" an auto. Cannot be turned off without ignition key. Negative ground only.

ONLY $10.00 PER KIT

ELECTRONIC SWITCH KIT



CONDENSER TYPE
Touch on Touch Off
use 7473 I.C. and 12V relay
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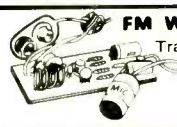
FM WIRELESS MIC KIT



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FET Transistor Built-in

SIGMA 78REI, 12DC RELAY

400Ω COIL SPDT
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Power Supply 12V AC
Ideal for panel clock, desk clock, or auto clock without time base
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MS 244	SPDT		0.90
MS 245	DPDT		1.10

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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
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DB25S	SOCKET	$4.95

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205-CB	Beryllium Copper w-black finish for TO-5	$ .25
291-.36H	Aluminum for TO-220 Transistors & Regulators	$ .25
680-.75A	Black Anodized Aluminum for TO-3	$1.60
401-A	Black Anodized Aluminum — predrilled mounting holes for TO-3 — 4¾ x 1¼ x 2"	$1.75

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#206-8 (16 pin dip) 8 switch unit $2.25 ea.

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22/44	Mating connector for plugboard — 22 pin double readout	$ 2.95 ea.
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	169P44 062 XXP	4.50	17.00	4.69	3.32
EPOXY GLASS	84P44 062	4.50	6.50	2.10	1.85
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	169P44 062	4.50	17.00	5.04	4.53
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- Slits and opens insulation exposing bare wire
- No pre-cutting or pre-stripping
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- Return Key
- Optional Key (Period)
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AY-5-1013	30k Baud	$5.95

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2107 5280	1096 x 1	Dynamic	4.95
2111	256 x 4	Static	6.95
2112	128 x 4	Static	2.49
8101	256 x 4	Static	6.95
8111	256 x 4	Static	6.95
8599	1k x 4	Static	1.98
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93200	256 x 1	Static	6.95
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82S23	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	7.00
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115 VAC
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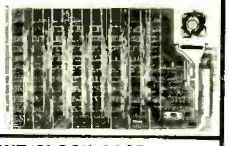

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Injection molded unit. Complete with red bezel. 4½" x 4" x 1-9/16"

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$9.95 Per Kit

printed circuit board

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SN7407N	29	SN7476N	32	SN74164N	1 10
SN7408N	25	SN7479N	5 00	SN74165N	1 10
SN7409N	25	SN7480N	50	SN74166N	1 25
SN7410N	18	SN7482N	98	SN74167N	5 50
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SN7423N	37	SN7494N	79	SN74182N	95
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SN7430N	26	SN74107N	39	SN74188N	3 95
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SN7437N	27	SN74122N	39	SN74191N	1 25
SN7438N	27	SN74123N	50	SN74192N	89
SN7439N	25	SN74125N	60	SN74193N	89
SN7440N	15	SN74126N	60	SN74194N	1 25
SN7441N	89	SN74132N	1 09	SN74195N	75
SN7442N	59	SN74136N	95	SN74196N	1 25
SN7443N	75	SN74141N	1 15	SN74197N	75
SN7444N	75	SN74142N	4 00	SN74198N	1 75
SN7445N	75	SN74143N	4 50	SN74199N	1 75
SN7446N	81	SN74144N	4 50	SN74200N	5 59
SN7447N	69	SN74145N	1 15	SN74279N	90
SN7448N	79	SN74147N	2 35	SN74251N	1 79
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CD4007	25	CD4047	2 75	74C20N	65
CD4009	59	CD4049	79	74C30N	65
CD4010	59	CD4050	79	74C42N	2 15
CD4011	25	CD4051	2 95	74C73N	1 50
CD4012	25	CD4053	2 95	74C74	1 15
CD4013	47	CD4059	9 95	74C90N	3 00
CD4016	56	CD4060	3 25	74C95N	2 00
CD4017	1 35	CD4066	1 75	74C107N	1 25
CD4019	55	CD4069	45	74C151	2 90
CD4020	1 49	CD4070	95	74C154	4 00
CD4022	1 25	CD4071	45	74C157	2 15
CD4023	25	CD4081	45	74C160	3 25
CD4024	1 50	CD4082	45	74C161	3 25
CD4025	25	CD4508	6 75	74C163	3 00
CD4026	$3 95	CD4511	2 50	74C164	3 25
CD4027	69	CD4515	6 50	74C173	2 60
CD4028	1 65	CD4518	2 50	74C193	2 75
CD4029	2 90	CD4520	2 70	74C195	2 75
CD4030	65	MC14556	3 00	MC4044	4 50
CD4035	1 85	MC14566	3 00	MC14016	56

LINEAR

LM300H	80	78MG	1 75	LM1458C	65
LM301H	35	LM370N	1 15	LM1496N	95
LM301CN	35	LM373N	3 25	LM1556V	1 85
LM302H	75	LM377N	4 00	LM1812N	5 95
LM304H	1 00	LM380N	1 39	LM2111N	1 95
LM305H	95	LM380CN	1 05	LM2901N	2 95
LM307CN	35	LM381N	1 79	LM3053	1 50
LM308H	1 00	LM382N	1 79	LM3065N	69
LM308CN	1 00	NE501K	8 00	LM3900N	55
LM309H	1 10	NE510A	6 00	LM3905N	1 75
LM309K	99	NE511H	3 00	LM3909	1 25
LM310CN	2 95	NE531H	3 00	LM5556N	1 85
LM311H	90	NE536T	6 00	MC5558V	1 00
LM311N	90	NE540L	6 00	LM7525N	90
LM317K	6 50	NE550N	79	LM7535N	1 25
LM318CN	1 50	NE555V	39	8038B	4 95
LM319N	1 30	NE560B	5 00	LM75450	49
LM320K-5	1 35	NE561B	5 00	75451CN	39
LM320K-5 2	1 35	NE562B	5 00	75452CN	39
LM320K-12	1 35	NE565H	1 25	75453CN	39
LM320K-15	1 35	NE565N	1 75	75454CN	39
LM320T-5	1 75	NE566CN	1 25	75491CN	79
LM320T-5 2	1 75	NE567H	1 95	75492CN	89
LM320T-8	1 75	NE567V	1 50	75494CN	89
LM320T-12	1 75	LM703CN	45	**RCA LINEAR**	
LM320T-15	1 75	LM709H	29	CA3013	2 15
LM320T-18	1 75	LM709N	29	CA3023	2 56
LM320T-24	1 75	LM710N	79	CA3035	2 48
LM323K-5	9 95	LM711N	39	CA3039	1 35
LM324N	1 80	LM723H	55	CA3046	1 30
LM339N	1 70	LM723N	55	CA3053	1 50
LM340K-5	1 95	LM733N	1 00	CA3059	3 25
LM340K-6	1 95	LM739N	1 00	CA3060	3 25
LM340K-8	1 95	LM741CH	55	CA3080	85
LM340K-12	1 95	LM741CN	55	CA3081	2 00
LM340K-15	1 95	LM741-14N	39	CA3082	2 00
LM340K-18	1 95	LM747H	79	CA3083	1 60
LM340K-24	1 95	LM747N	79	CA3086	85
LM340T-5	1 75	LM748H	39	CA3089	3 75
LM340T-6	1 75	LM748N	39	CA3091	10 20
LM340T-8	1 75	LM1303N	90	CA3053	1 50
LM340T-12	1 75	LM1304N	1 19	CA3102	2 95
LM340T-15	1 75	LM1305N	1 40	CA3123	2 15
LM340T-18	1 75	LM1307N	35	CA3130	1 39
LM340T-24	1 75	LM1310N	2 95	CA3140	1 25
LM350N	1 00	LM1351N	1 65	CA3600	1 75
LM351CN	65	LM1414N	1 75	RC4194	5 95
				RC4195	3 25

74LS00 TTL

74LS00	29	74LS74	49	74LS139	1 95
74LS02	29	74LS76	69	74LS151	1 55
74LS03	29	74LS78	49	74LS153	1 89
74LS04	35	74LS83	1 75	74LS157	1 55
74LS05	35	74LS85	2 49	74LS162	2 25
74LS08	29	74LS86	49	74LS163	2 25
74LS10	29	74LS90	1 25	74LS164	1 95
74LS13	69	74LS92	1 25	**74LS175**	**1 95**
74LS14	1 75	74LS93	1 25	74LS181	3 69
74LS20	29	74LS95	1 55	74LS190	2 85
74LS26	39	74LS96	1 89	74LS191	2 85
74LS27	39	74LS107	59	74LS192	2 85
74LS28	39	74LS109	59	74LS193	2 85
74LS30	29	74LS112	59	74LS194	1 89
74LS32	39	74LS122	1 25	74LS195	1 89
74LS40	39	74LS132	1 25	74LS257	1 75
74LS51	29	74LS136	59	74LS260	55
74LS55	29	74LS138	1 89	74LS279	79
74LS73	49			74LS670	3 95

CLOCK CHIPS

MM5309	6 Digit, BCD Outputs, Reset PIN	$9 95
MM5311	6 Digit, BCD Outputs, 12 or 24 Hour	4 95
MM5312	4 Digit, BCD Outputs, 1 PPS Output	4 95
MM5314	6 Digit, 12 or 24 Hour, 50 or 60 Hz	4 95
MM5316	4 Digit, Alarm, 1 PPS Output	6 95
MM5318	Video Clock Chip, For Use With (MM5841 - $9 95)	9 95
C7001	6 Digit, Calendar, Alarm, 12 or 24 Hour	5 95

Timeband™ by FAIRCHILD — Watches —

Men's & Ladies

- Solid State
- Displays hour, minute, second, month & day
- Free set of replacement batteries
- Choose LED or LCD styles
- One year factory warranty

T249 White w/bracelet **$19.95**
T248 Yellow w/bracelet **$22.95**
LED

T237 White w/bracelet **$22.95**
T236 Yellow w/bracelet **$25.95**
LED

TC437 White w/bracelet **$29.95**
TC436 Yellow w/bracelet **$34.95**
LCD

Ladies LCD

TC625 White w/strap **$29.95**
TC624 Yellow w/strap **$34.95**
LCD

LADIES LED

T325 White w/strap **$24.95**
T324 Yellow w/strap **$27.95**

CHANNEL F™ FAIRCHILD VIDEO ENTERTAINMENT SYSTEM

$159.95

- Freeze Action • Speed Option
- Automatic time and scorekeeping
- Battery-free AC operation
- Dual controls with 8-way action
- Built-in Pro Hockey and Tennis games
- Easy hook-up on any B/W or Color TV
- Factory warranty

Channel F — additional cartridges — $17.95 ea.

0811 — Tic-Tac-Toe/Shooting Gallery
Quadra-doodle/Doodle/
0812 — Desert Fox/Shooting Gallery
0813 — Blackjack (1 or 2 players)
0814 — Spitfire (1 or 2 players)
0815 — Spacewar (2 players)
0819 — Drag Strip (1 or 2 players)
0818 — Magic Numbers (computer logic)
0820 — Maze (2 players)
0822 — Baseball (2 players)

DISCRETE LEDS

	.125" dia			.185" dia			.200" dia		
XC209	Red	10/$1	XC526	Red	5/$1	XC556	Red	5/$1	
XC209	Green	4/$1	XC526	Green	4/$1	XC556	Green	4/$1	
XC209	Orange	4/$1	XC526	Yellow	4/$1	XC556	Yellow	4/$1	
XC209	Yellow	4/$1	XC526	Orange	4/$1	XC556	Orange	4/$1	
	.200" dia		XC526	Clear	4/$1	XC556	Clear	4/$1	
XC22	Red	10 $1							
XC22	Green	4 $1							
XC22	Yellow	4/$1							
XC22	Orange	4/$1							
SSL 22	RT	4 $1							

	.190" dia.		
XC111	Red	10 $1	
XC111	Green	4 $1	
XC111	Yellow	4 $1	
XC111	Orange	4 $1	
	.085" dia.		
MV50	Red	6 $1	
INFRA-RED LED			
¼ x ¼ x 1 16 Flat		5/$1.00	

DISPLAY LEDS

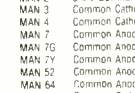
DL707

TYPE	POLARITY	HT	
MAN 1	Common Anode	270	2 95
MAN 2	5 x 7 Dot Matrix	300	4 95
MAN 3	Common Cathode	125	3 1 00
MAN 4	Common Cathode	187	1 95
MAN 7	Common Anode	300	1 25
MAN 7G	Common Anode-green	300	1 55
MAN 7Y	Common Anode yellow	300	1 95
MAN 52	Common Anode green	300	99
MAN 64	Common Anode red	400	99
MAN 74	Common Cathode	300	1 50
MAN 82	Common Anode yellow	300	99
MAN 84	Common Cathode-yellow	300	99
MAN 3620	Common Anode orange	300	1 75

DL33B

TYPE	POLARITY	HT	
MAN 3640	Common Cathode orange	300	1 75
MAN 4710	Common Anode Red	400	1 95
DL701	Common Anode red	300	99
DL704	Common Cathode	300	99
DL707	Common Anode	300	99
MAN 4740	Common Anode-Red	400	99
DL741	Common Anode	600	1 50
DL 747	Common Cathode	600	2 25
DL 750	Common Cathode	600	2 49
DL 338	Common Cathode	110	50
FND70	Common Cathode	250	75
FND503	Common Cathode	500	1 00
FND507	Common Anode	500	1 00

FCS 8000A — 3½ Digit — .8" Display
NEW! 25 Pin Version with colon & am/pm indicator



FRONT VIEW - FSC8000
SPECIAL
$4.95 EA.

- Connects almost one for one with 3817 3817A or D (3817 available at $5 00 each)
- Typical segment current 8mA except colon 10 hrs b & c and 10 min a & d which are 16 mA
- Forward voltage drop 1 5 volts
- MAXIMUM FORWARD CURRENT — 25 mA

HP 5082-7300 Series — Multi-Digit

- ⅛" ht. • Common Cathode Red
- 3-5 volts @ 5 mils/second
- 7 segment Monolithic
- Dip Package

	10 or more
2 Digit $ .79	.69
3 Digit .89	.79
4 Digit .99	.89
5 Digit 1.19	.99

TV GAME CHIP SET — $14.95
Includes AY-3-8500-1 Chip and 2.010 mhz crystal (2.010 crystal — $1.95 ea/AY-3-8500-1 chip — $13.95 ea.)

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1 24	25-49	50-100
8 pin	$ 17	16	15
14 pin	20	19	18
16 pin	22	21	20
18 pin	29	28	27
22 pin	37	36	35
24 pin	49	45	42

	1 24	25 49	50 100
24 pin	$ 38	37	36
28 pin	45	44	43
36 pin	60	59	58
40 pin	63	62	61

SOLDERTAIL STANDARD (TIN)

14 pin	$ 27	25	24
16 pin	30	27	25
18 pin	35	32	30
24 pin	49	45	42

28 pin	$ 99	90	81
36 pin	1 39	1 26	1 15
40 pin	1 59	1 45	1 30

SOLDERTAIL STANDARD (GOLD)

8 pin	$ 30	27	24
14 pin	35	32	29
16 pin	38	35	32
18 pin	52	47	43

24 pin	$ 70	63	57
28 pin	1 10	1 00	90
36 pin	1 75	1 40	1 26
40 pin	1 75	1 59	1 45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$ 45	41	37
14 pin	39	38	37
16 pin	43	42	41
18 pin	75	68	62

24 pin	$1 05	95	85
28 pin	1 40	1 25	1 10
36 pin	1 59	1 45	1 30
40 pin	1 75	1 55	1 40

50 PCS. RESISTOR ASSORTMENTS — $1.75 PER ASST.

		10 OHM	12 OHM	15 OHM	18 OHM	22 OHM		
ASST. 1	5 ea	27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5%	50 PCS
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM		
ASST. 2	5 ea	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5%	50 PCS
		470 OHM	560 OHM	680 OHM	820 OHM	1K		
ASST. 3	5 ea	1 2k	1 5K	1 8K	2 2k	2 7k	1/4 WATT 5%	50 PCS.
		3 3k	3 9K	4 7k	5 6k	6 8K		
ASST. 4	5 ea	8 2k	10K	12K	15K	18K	1/4 WATT 5%	50 PCS
		22K	27K	33k	39K	47K		
ASST. 5	5 ea	56K	68K	82K	100K	120K	1/4 WATT 5%	50 PCS
		150K	180K	220K	270K	330K		
ASST. 6	5 ea	390K	470K	560K	680K	820K	1/4 WATT 5%	50 PCS
		1M	1 2M	1 5M	1 8M	2 2M		
ASST. 7	5 ea	2 7M	3 3M	3 9M	4 7M	5 6M	1/4 WATT 5%	50 PCS
ASST. 8R		Includes Resistor Assortments 1-7 (350 PCS.)						$10.95 ea.

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax
Spec Sheets - 25¢ — Send 35¢ Stamp for 1977A Catalog
Dealer Information Available

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WIRE WRAP CENTER

HOBBY-WRAP TOOL W-630

$34.95 (batteries not included)

- Battery Operated (Size D)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (0 6 inch)
- Complete with built-in bit and sleeve

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire

$11.95

WIRE WRAP TOOL WSU-30

WRAP • STRIP • UNWRAP - $5.95

WIRE WRAP WIRE — 30 AWG

25 ft. min $1.25 50 ft. $1.95 100 ft $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

$3.45 ea.

- 50 ft. roll 30 AWG KYNAR wire wrap wire
- Cuts wire to desired length
- Strips 1" of insulation

Specify — Blue-Yellow-White-Red

B&K PRECISION **New**

3½-Digit Portable DMM

- Overload Protected • 3" high LCD display
- Battery or AC operation • Auto-Zero
- 1mv, 1Va, 0 1 ohm resolution • 5 range reading
- 10 meg input impedence
- DC Accuracy 1% typical

Ranges: DC Voltage ±0 1000V AC Voltage 0-1000V
Freq. Response 50-400 HZ/DC Current 0-1000mA
Resistance 0 10 meg ohm
Size 6 4" x 4 4" x 2"

Comes with test leads, operating manual and spare fuse

Model 2800	**$99.95**
AC Adapter BC-28	**8.00**
Rechangeable Batteries BP-28	**20.00**
Carrying Case LC-28	**6.00**

DATA HANDBOOKS

7400	Pin out & Description of 5400/7400 Series	$2.95
CMOS	Pin out & Description of 4000 Series ICs	$2.95
Linear	Pin out & Functional Description	$2.95

ALL THREE HANDBOOKS $6.85

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3 3	400mm	4/1 00	1N4005	600 P-V	AMP	10/1 00
1N751A	5 1	400m	4/1 00	1N4006	800 PIV	1AMP	10/1 00
1N752	5 6	400m	4/1 00	1N4007	1000 PIV	1AMP	10/1 00
1N753	6 2	400m	4/1 00	1N3600	50	1Amp	6/1 00
1N754	6 8	400m	4/1 00	1N4148	75	10m	15/1 00
1N959	8 2	400m	8 1 00	1N4154	35	10m	12/1 00
1N965B	15	400m	4 1 00	1N4305	75	2Amp	20/1 00
1N5232	5 6	500m	28	1N4734	5 6	1w	28
1N5234	6 2	500m	28	1N4735	6 2	1w	28
1N5235	6 8	500m	28	1N4736	6 8	1w	28
1N5236	7 5	500m	28	1N4738	8 2	1w	28
1N456	25	40m	6 1 00	1N4742	12	1w	28
1N458	150	7m	6/1 00	1N4744	15	1w	28
1N485A	180	10m	6/1 00	1N1183	50 PIV	35 AMP	1.60
1N4001	50 PIV	1 AMP	12/1 00	1N1184	100 PIV	35 AMP	1 70
1N4002	100 PIV	1 AMP	12/1 00	1N1185	150 PIV	35 AMP	1 50
1N4003	200 PIV	1 AMP	12/1 00	1N1186	200 PIV	35 AMP	1 80
1N4004	400 PIV	1 AMP	12/1 00	1N1188	400 PIV	35 AMP	3 00

SCR AND FW BRIDGE RECTIFIERS

C36D	15A @ 400V	SCR	$1 95
C38M	35A @ 200V	SCR	95
2N2328	1 6A @ 200V	SCR	50
MDA 980-1	12A @ 50V	FW BRIDGE	1 95
MDA 980-3	12A @ 200V	FW BRIDGE	1 95

TRANSISTORS

MPS A05	5 $1 00	PN3567	3 $1 00
MPS A06	5 $1 00	PN3568	3 $1 00
2N2219A	3 $1 00	PN3569	4 $1 00
2N2221	4 $1 00	PN3704	5 $1 00
2N2222A	5 $1 00	PN3705	5 $1 00
2N2369	5 $1 00	PN3706	5 $1 00
2N2369A	4 $1 00	PN3707	5 $1 00
2N2484	4 $1 00	PN3708	5 $1 00
2N2906A	4 $1 00	PN3711	4 $1 00
2N2907A	5 $1 00	PN3724	5 $1 00
2N2925	5 $1 00	PN3725	5 $1 00
2N3053	2 $1 00	PN3903	5 $1 00
PN3055	5 $9	PN3904	5 $1 00
MJE3055	$1 00	PN3905	4 $1 00
MJE2955	$1 25	PN3906	4 $1 00
2N3392	5 $1 00	2N4013	3 $1 00
2N3398	5 $1 00	2N4014	3 $1 00
		2N4123	10 $1 00

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

	1 9	10-49	50-100		10-49	50-100
10 pf	05	04	03	001µF	04	035
22 pf	05	04	03	0047µF	04	035
47 pf	05	04	03	01µF	04	035
100 pf	05	04	03	022µF	05	04
220 pf	05	04	03	047µF	05	04
470 pf	05	04	035	1µF	09	075

100 VOLT MYLAR FILM CAPACITORS

001mf	12	10	07	022mf	11	08
0022	12	10	07	047mf	17	13
0047mf	12	10	07	1mf	23	17
01mf	12	10	07	22mf	37	27

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

1/35V	28	23	17	1 5/25V	35	26	21
15/35V	28	23	17	2 2/35V	37	27	22
22/35V	28	23	17	3 3/25V	37	27	22
33/35V	28	23	17	4 7/25V	37	28	23
47/35V	28	23	17	6 8/25V	35	31	25
68/35V	28	23	17	10/25V	35	29	
1 0/35V	28	23	17	15/25V	50	40	

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

	Axial Lead				Radial Lead	
47/50V	15	13	10	47/25V	13	10
1 0/50V	16	14	11	47 5/16V	14	11
3 3/50V	15	13	10	1 0/16V	13	10
4 7/25V	16	14	12	1 0/25V	14	11
10/25V	15	13	10	1 0/50V	14	11
10/50V	16	14	12	4 7/16V	13	10
22/25V	17	15	12	4 7/25V	13	10
22/50V	24	20	18	4 7/50V	14	11
47/25V	19	17	15	10/16V	12	09
47/50V	25	21	19	10/25V	13	10
100/25V	24	20	18	10/50V	14	12
100/50V	35	30	28	47/50V	21	19
220/25V	32	28	25	100/16V	15	14
220/50V	45	41	38	100/25V	20	18
470/25V	33	29	27	100/50V	30	28
1000/16V	55	50	45	220/16V	17	16
2200/16V	70	62	55	470/25V	28	26

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Sonar

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3-Channel VHF RECEIVER 150-174 MHZ

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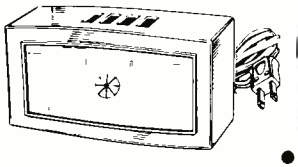
BSR SMOKE & FIRE DETECTOR

XM-646



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XM-670

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NI-CAD BATTERY "AA SIZE"

$1 EA. BA-341 REG. ~~1.50~~

•1.2 Volts

•Rechargeable

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2" PM Speaker, 8 Ohms, SS-295		.29
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2¼" 60 Ohm Speaker, SP-435	1.19	.69
AM-FM-MPX Receiver Chassis, Solid State 11-12 VAC Input, Tape Out Jacks, RA-574	9.99	7.99
Universal AC Adapter, 117 VAC Input, 6, 7.5 and 9 VDC Output @ 300 Ma, BA-159	7.00	4.99

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QTY.	STK #	DESCRIPTION	PRICE EA.	TOTAL

CIRCLE 71 ON FREE INFORMATION CARD

BONUS SALE

With a $25 prepaid order get an intel data catalog

With a $50 prepaid order get the 8080 user manual

8K RAM BOARD

FULLY ASSEMBLED & TESTED, JUST PLUG IT IN - 64 21L02's (in sockets) ALTAIR & IMSAI 8080 COMPATIBLE, ON BOARD REGULATORS, FULLY BUFFERED

$189.95

WHO NEEDS A KIT? BUY IT, PLUG, & GO

IC SOCKETS

SOLDER TAIL TIN

pins	ea.	10	100
8	25¢	22	18
14	25	22	18
16	27	23	20
24	50	45	36
28	80	75	68
40	99	94	89

WIRE WRAP TIN (3)

pins	ea.	10	100
14	45	40	32
16	48	43	35
24	75	70	60

molex

500	$4.75	5K	$38
1K	8.50	10K	70
2K	16	50K	325

CARBON FILM RESISTORS

High quality .25W 5% All STANDARD VALUES FROM 2.7Ω to 2.2m STOCKED IN DEPTH

each 10¢ | ten 40¢ | hundred $1.60 — no mix of values

thousand $14 — 100 minimum per value

RESISTOR ASSORTMENTS

LEADS TRIMMED FOR PRINTED CIRCUIT BOARD

200 ¼W 5% $2-

200 ½ 5% $2-

COUNTER DISPLAY KIT

Ideal module for home built counter projects. Includes 7490 decade counter 7475 latch, 7447 driver, and RCA .6" NUMITRON display. PCB with plated thru hole and instructions supplied..... KITS SUPPLIED FROM ONE TO TEN DIGITS PER BOARD (all interconnects plated)..

$5.89 per digit

-SUPER SPECIALS-

74S206	DIP 256x1 45NS RAM	$ .90
93410	" " " "	.90
LM308AH	OP-AMP μ/pwr.	.90
μA776	" " PROGRAMMABLE	.90
78L05	TO92 .1A + REGULATOR	.30
78L12	" " "	.30
78L24	" " "	.30
MM5369	CRYSTAL OSC. TIME BASE	1.75
MM5058	1024 BIT STATIC S.R. MINI.	2.00
LM300	ADJUSTABLE REGULATOR	.60
LM723	" "	.50
747	DUAL OP-AMP	.50
ZENER	16V 1W on tape	.10
DIAC	27 VOLT TRIGGER DIODE	.20
CERAMIC FILTER	10.7 Mhz.	1.25
7812	TO-3 1amp REGULATOR	.69
78M05	TO220 .5A "	.69

Numeric Display ¼" Single Digit GaAsP LED

FND 70

COMMON CATHODE WITH RH DECIMAL
COMPACT - 10 DIGITS IN 3" PANEL WIDTH
HIGHLY LEGIBLE - BRIGHT RED ¼" CHARACTER EASILY READ WITHIN 10 FEET OVER A WIDE VIEWING ANGLE (140°)
LOW POWER - 125 mW PER DIGIT AT TYPICAL BRIGHTNESS

79¢ each - ten $6.95

100 - $49

-SWITCHES-

RED PUSH BUTTON N.O. MOMENTARY CONTACT, ¼" HOLE

30¢ each

8 $ 2

100 22

1000 195

actual size

MINI MINI TOGGLE

EXTRA SMALL D.P.D.T 3A 125VAC CONTACTS

each $1.50

8 — 10.

100 — 95.

actual size

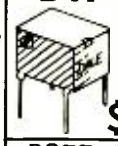
JBT MR1-223 5 AMP DPDT ROCKER SWITCH WITH PANEL MOUNTING HARDWARE.....

79¢ ea.

ten $6

$49/c

DIP TRIMMER



12 TURN, ¼"x¼"x¼" 5K or 200K only

mfg. DALE

$.50 TEN FOR **$4**

POTTER BRUMFIELD

Type KHP Relay
4 PDT 3A Contacts
24VDC COIL
650 ohms
120VAC
10.5MA

$1.60 ea.

150 Mhz Prescaler

Use your low frequency counter to measure VHF or UHF frequencies. This kit will divide the input signal by ten (10 or 100 with 650MHz option) Kit contains drilled circuit board, 2 MC10131 IC's, all parts needed and instructions.

150/170MHz KIT $12.95

650MHz option W/11C90 IC.....$29.95

-requires 5v at app. .2A, power supply and case are not part of kit---

SUPER LED's

This family of LED's are mounted on a TO-5 header with a 6/32 threaded stud to secure to a heat sink.. TWO AMPERES max. continuous current rating (with heat sink). LED's can be pulsed at up to 25A with low duty cycle. Data supplied w/order

MV2 Infra Red w/low lens
MV5 Infra Red w/high lens
MV4 Visible Red with low lens
MV4H Visible Red with high lens

$2.99 ea.

TO-92 TRANSISTORS

50 FIRST QUALITY PLASTIC TRANSISTORS ASSORTED TYPES PNP, NPN, AND EVEN A FEW DARLINGTONS.. THESE ARE NOT U-TEST SPECIALS FROM FACTORY REJECT BARRELS, BUT FIRST QUALITY PARTS WITH HOUSE NUMBERS. JUST 250K AVAILABLE-SO STOCK UP NOW ... FIFTY FOR **$2-**

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7401	.16	7453	.17	74154	1.20
7402	.15	7454	.17	74155	.97
7403	.15	7460	.17	74156	.97
7404	.16	7464	.35	74157	.99
7405	.19	7465	.35	74158	1.79
7406	.20	7470	.30	74160	1.23
7407	.28	7472	.30	74161	.97
7408	.18	7473	.35	74162	1.39
7409	.19	7474	.28	74163	1.09
7410	.16	7475	.49	74164	.99
7411	.25	7476	.30	74165	.99
7413	.43	7483	.68	74166	1.25
7414	.65	7485	.88	74170	2.10
7416	.35	7486	.40	74173	1.49
7417	.35	7489	2.25	74174	1.23
7420	.16	7490	.43	74175	.97
7422	.30	7491	.75	74176	.89
7423	.29	7492	.48	74177	.84
7425	.27	7493	.48	74180	.90
7426	.26	7494	.78	74181	2.45
7427	.29	7495	.79	74182	.79
7430	.20	7496	.79	74184	1.90
7432	.23	74100	.98	74185	2.20
7437	.25	74105	.44	74187	5.75
7438	.25	74107	.37	74190	1.15
7440	.15	74121	.38	74191	1.25
7441	.89	74122	.38	74192	.95
7442	.59	74123	.65	74193	.85
7443	.73	74125	.54	74194	1.25
7444	.73	74126	.58	74195	.74
7445	.73	74132	.89	74916	1.25
7446	.81	74141	1.04	74197	.73
7447	.79	74145	1.04	74198	1.73
7448	.79	74150	.97	74199	1.69
7450	.17	74151	.79	74200	5.45

LOW POWER

74L00	.29	74L51	.29	74L90	1.40
74L02	.29	74L55	.29	74L91	1.20
74L03	.23	74L71	.29	74L93	1.50
74L04	.29	74L72	.45	74L95	1.50
74L06	.29	74L73	.56	74L98	2.25
74L10	.29	74L74	.56	74L164	2.25
74L20	.29	74L78	.75	74L165	2.30
74L30	.29	74L85	1.09		
74L42	1.39	74L86	.65		

LOW POWER SCHOTTKY

74LS00	.36	74LS32	.38	74LS95	2.09
74LS02	.36	74LS40	.45	74LS107	.59
74LS04	.36	74LS42	1.30	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	.58
74H10	.25	74H52	.25	74H102	.58
74H11	.25	74H53	.25	74H103	.60
74H20	.25	74H55	.25	74H106	.72
74H21	.25	74H60	.25	74H108	.72

CMOS

4000A	.26	4018A	1.19	4066A	.89
4001A	.25	4020A	1.72	4068A	.44
4002A	.25	4021A	1.18	4069A	.44
4006A	1.35	4022A	.94	4071A	.26
4007A	.26	4023A	.25	4072A	.35
4008A	1.52	4024A	.89	4073A	.39
4009A	.57	4025A	.25	4075A	.39
4010A	.54	4027A	.59	4078A	.39
4011A	.29	4028A	.98	4082A	.35
4012A	.25	4030A	.44	4518A	1.56
4013A	.45	4035A	1.27	4528A	1.56
4014A	1.27	4040A	1.19	4585A	2.10
4015A	1.27	4042A	1.47		
4016A	.48	4049A	.59		
4017A	1.01	4050A	.59		

74C00	.19	74C74	1.04	74C162	2.49
74C02	.26	74C76	1.34	74C163	2.66
74C04	.44	74C107	1.13	74C164	2.66
74C08	.68	74C151	2.62	74C173	2.22
74C10	.35	74C154	3.15	74C195	2.26
74C20	.35	74C157	1.76	80C95	1.15
74C42	1.61	74C160	2.48	80C97	.96
74C73	1.04	74C161	2.49		

CALCULATOR CHIPS

CT5002	12 digit, 4 function fixed decimal battery operation — 40 pin	1.95
CT5005	12 digit, 4 function plus memory, fixed decimal — 20 pin	2.49
MM5725	8 digit, 4 function, floating decimal 18 pin	1.98
MM5736	6 digit, 4 function, 9V battery operation — 18 pin	2.95
MM5738	8 digit, 5 function plus memory and constant floating decimal, 9V battery operation — 24 pin	3.95
MM5739	9 digit, 4 function, 9V battery operation — 22 pin	3.95

6 Digit Clock Kit

MM5314 with 6 NS71 .27" displays 2 P.C. boards — Display board may be remote. Internal or wall transformer can be used. 50-60 Hz, 12-24 hour. Includes all necessary transistors, resistors, capacitors, diodes, 3 switches and complete assembly instructions.

CK6-3 ..... **$14.95**

MM 5330 4½ DIGIT DVM LOGIC **$6.95**

LH 0070 BCD BUFFERED REF **$6.95**

MM 5616 QUAD BI-LATERAL SWITCH **$1.25**

IC SOCKETS
Solder Tail - low profile

8 pin	$ .17	24 pin	.42
14 pin	.20	28 pin	.59
16 pin	.22	40 pin	.69
18 pin	.29		

SPECIAL DEVICES

372	AF-IF Strip Detector DIP	2.93
546	AM Radio Receiver Subsystem DIP	.75
1310	FM Stereo Demodulator DIP	2.90
1496	Balanced Modulator-Demodulator	.99
1800	Stereo multiplexer DIP	2.48
ULN2208	FM Gain Block 34db (typ) mDIP	1.18
ULN2209	FM Gain Block 48db (typ) mDIP	1.35
2513	Character Generator 64x8x5 DIP-24	10.70
3046	Transistor Array DIP-14	.73

LINEAR CIRCUITS

100	$ .71	171	2.42	723	.62
301	.29	376	.68	733	.89
302	.53	680	1.80	739	1.07
304	.80	680-8	1.25	741	.32
305	.71	681	1.75	747	.71
307	.26	682	1.75	748	.15
308	.89	683	2.95	1458	.62
309k	1.15	540	2.95	1800	2.48
310	1.07	550	.79	1900	.49
311	.95	555	.45	7524	.71
319	1.13	556A	1.19	7525	.90
320	1.19	560	3.39	8038	4.75
320k	1.19	562	3.39	8864	2.25
322	1.70	565	1.18	75150	1.75
324	1.52	566	1.95	75451	.35
339	1.58	567	1.95	75452	.35
340k	1.69	709	.26	75453	.35
3401	1.49	710	.35	75491	.71
372	2.93	711	.26	75492	.80

DISCRETE LED's

			EACH
ME4	INFRARED CLEAR DOME	.170"	.29
MV10B	CLEAR DOME	.170"	.25
MV50	CLEAR — AXIAL	.09"	.12
MV50	RED — AXIAL	.09"	.12
NSL100	RED	.19"	.12
RL209	RED DIFF. SUBMINIATURE	.12"	.12
RLT-T1-03	WHITE DIFF. SUBMINIATURE NO FLANGE	.124"	.15
RLC-200	RED DIFF. CURRENT REG. CONST. BRIGHTNESS 4.5-12.5V	.190"	.25
RLC-201	RED DIFF. CURRENT REG. CONST. BRIGHTNESS 4.5-12.5V	.190"	.25
RL-4403	RED DIFF. FULL FLOOD	.190"	.15
GREEN	SPOT	.190"	.18
CLEAR	POINT	.190"	.15

LEDs

			EA.
DL10A	RED CA	.27" LHD	$1.89
DL 707	RED CA	.30" RHD	1.49
DL 507	RED CA	.50" RHD	1.49
FND 359	RED CC	.375" RHD	.89
DL 702	RED CC	.30" LHD	1.39
NSN 74R	RED CC	.30" RHD	1.49
DL 500	RED CC	.50" RHD	1.49
MAN5	GREEN CA	.27" LHD	1.39
MAN8	YELLOW CA	.27" LHD	1.39
MAN82	YELLOW CA	.3" LHD	1.89
MAN66	RED CA	.6" LHD	2.19
DL747	RED CA	.6" LHD	2.39

DIGITAL

7416	.29
7427	.24
7437	.19
7454	.12
7493	.39
7495	.69
74145	.89
9602	.59
74C154	2.49

SPECIALS

MEMORIES

1101	$.69
1103	.69
1702A	5.95
5262	.99
74S200	3.25
82S23	2.75
93410	1.39

LED DISPLAYS

DL10A	$1.49
NSN 74R	.99
FND 359	.59
MAN 72	.99
DL702	.99

MV10B 6/$ .00
MV50 16/$ .00
556 .99
567 1.19

2102 **$1.29**
1024X1 STATIC RAM 16 PIN

2708 **$15.95**
1 x 8K EROM

CENTRAL PROCESSING UNIT

8008 $16.95
8080A $19.95

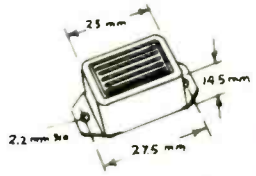
CALCULATOR DISPLAY

9 MAN 3 M ON PC BOARD
99 ¢

KEYBOARD

20 KEYS
2 SLIDE SW
3 x 3
99 ¢

MINIATURE SOLID STATE ELECTRONIC BUZZER



TONE CHIP — HIGH RELIABILITY
LOW CURRENT DRAIN
NO MOVING CONTACTS

78 dB min AT 1 FT. — 450 Hz

EB-106	6V	15mA	4-9 VDC	$1.99
EB-112	12V	15mA	8-20 VDC	1.99

CLOCK CHIPS

MM5314	6 digit multiplexed 12-24 Hr. 50-60 Hz 24 pin	4.45
MM5316	4 digit, 12-24 Hr. 50-60 Hz, alarm 40 pin	4.95
S1754A	4-6 digit, 12 hour, 60 Hz snooze alarm brightness control capability, alarm tone output — 24 pin	4.95
CT7001	6 digit, 12-24 Hr. 50-60 Hz, alarm, timer and date circuits — 28 pin	6.95

SHIFT REGISTERS

		EACH
2502	1024 bit MULT DYN 16 pin	$2.95
2504	1024 bit MULT DYN 8 pin	2.95
2511	Tri-State Dual 50-100-200 bit STATIC 14 pin	2.95
2518	Hex 32-bit STATIC 16 pin	2.95
2519	Hex 40-bit STATIC 16 pin	2.95
2527	Dual 256 bit STATIC 8 pin	2.95
2532	Quad 80 bit STATIC 16 pin	3.95
5013	1024 bit accum. Dynamic 8 pin	1.75
5016	500/512 bit Dynamic 8 pin	1.59

OPTO ISOLATORS

MOC 70	Opto-isolator diode	$1.19
MOC 72	Opto-isolator transistor	.79

Data sheets on request. Add 30¢ each if item is priced below $1.00 each.

UART
AY51013A **$6.95**

SP-425-09 9 digit .25" neon direct interface with MOS/LSI. 180 VDC, 7 seg. 1.79

MEMORIES

		EACH
1101	256 bit RAM MOS 16 pin	$ .99
1103	1024 bit RAM MOS Dynamic 18 pin	.99
1702A	2048 bit PROM-STATIC Elect. Programmable, UV Erasable 24 pin	9.95
2102	1024 bit Ram Static 16 pin	1.29
2101	256 bit PROM-STATIC Elect. Programmable, UV Erasable 22 pin	9.95
2107	1024 bit RAM MOS Dynamic 16 pin	.99
2602	1024 bit RAM MOS Dynamic 22 pin	1.29

MM5369 Divider mDIP 2.49
Crystal 3.58 MHZ color TV 1.75
Crystal 2.010 MHZ 3.95

4 Digit Clock Kit

MM5312 and 4 NS71 .27" displays 12-24 hours, 50-60 Hz. One P.C. board accommodates clock, displays, and all necessary transistors, resistors, capacitors, diodes, 2 switches, complete instructions and schematics for assembly.

CK4-2 **$10.95**

CARBON FILM RESISTORS ±5%
ALL STANDARD VALUES
¼ OR ½ WATT

QTY.	PRICE (each)	PRICE (Minimum 10 per value)
0-10	$.10 ea	
10-100	$.10 ea	$.05 ea
100-1000		$.04 ea

METAL FILM RESISTORS
ALL STANDARD VALUES
± 1% ¼ WATT

QTY.	PRICE (each)	PRICE (Minimum 10 per value)
0-10	$.20 ea	
10-100	"	$.15 ea
100-1000	"	$.10 ea

TANTALUM CAPACITORS
Solid dipped +20%

1 mfd	35V	$ .25	10 mfd	16V	$ .40
.33 mfd	35V	.25	10 mfd	25V	.45
1 mfd	35V	.25	15 mfd	10V	.40
2.2 mfd	20V	.25	15 mfd	20V	.45
2.2 mfd	35V	.30	22 mfd	16V	.45
3.3 mfd	35V	.30	33 mfd	10V	.40
4.7 mfd	16V	.30	47 mfd	6V	.40
6.8 mfd	6V	.30	56 mfd	6V	.45
6.8 mfd	50V	.40	150 mfd	15V	.50

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MINI-KITS

FM WIRELESS MIKE KIT FM-1 $2.95
Transmit up to 300 to any FM radio. Sensitive mike. Input requires dynamic, crystal or ceramic mike. Runs on 3 to 9 volts.

TONE DECODER KIT
A complete tone decoder on a single PC Board. Features 400 to 5000 Hz adjustable frequency range, voltage regulator, 567 IC. Useful for touch-tone decoding, tone burst detection, FSK demod, signaling, and many other uses. Use 7 for 12 button touchtone decoding. Runs on 5 to 12 volts.
Complete Kit, TD-1 ..... $4.95

LED BLINKY KIT
A great attention getter which alternately flashes 2 jumbo LEDs. Use for name badges, buttons or warning type panel lights.

Complete Kit, BL-1 ..... $2.95

SUPER-SNOOP AMPLIFIER
A super-sensitive amplifier which will pick up a pin drop at 15 feet! Great for monitoring baby's room or as a general purpose test amplifier. Full 2 watts of output, runs on 6 to 12 volts, uses any type of mike. Requires 8-45 ohm speaker.
Complete Kit, BN-9 ..... $4.95

MUSIC LIGHTS KIT
See music come alive! 3 different lights flicker with music or voice. One light for lows, one for the mid-range and one for the highs. Each channel individually adjustable, and drives up to 300 watts. Great for parties, band music, nite clubs and more.
Complete Kit, ML-1 ..... $7.95

SIREN KIT
Produces upward and downward wail characteristic of police siren. 200mw audio output, runs on 3-9 volts, uses 8-45 ohm speaker.
Complete Kit, SM-3 ..... $2.95

CODE OSCILLATOR KIT
Powerful 1 watt audio oscillator of approx. 1 kHz, good for many uses. Great for warning alarm, battery checker, voltage indicator and code oscillator.
Complete Kit, CPO-1 ..... $2.50

POWER SUPPLY KIT
Complete triple regulated power supply provides variable ±15 volts at 200ma and +5 volts at 1 amp. 50mv load regulation, good filtering and small size. Kit less transformers. Requires 6-8V at 1 amp and 18 to 30VCT.
Complete Kit, PS-3LT $6.95

DECADE COUNTER PARTS KIT
Includes 7490A 33 MHz counter, 7475 latch, 7447 LED driver, LED readout, current limit resistors, hook up details and instructions on how to build an easy low cost freq. counter.
Kit of Parts, DCU-1 ..... $3.50

NEW

Frequency Counter $79.95 KIT

You've requested it, and now it's here! The CT-50 Frequency Counter Kit has more features than counters selling for twice the price. Measuring frequency is now as easy as pushing a button, the CT-50 will automatically place the decimal point in all modes, giving you quick, reliable readings. Want to use the CT-50 mobile? No problem, it runs equally as well on 12 VDC as it does on 110 VAC. Want super accuracy? The CT-50 uses the popular TV color burst freq. of 3.579545 MHz for time base. Tap off a color TV with our adapter and get ultra accuracy — .001 ppm! The CT-50 offers professional quality at the unheard of price of $79.95. Order yours today!

CT-50, 60MHz Counter Kit $79.95
CT-50WT, 60 MHz counter, wired and tested $159.95
CT-600, 600 MHz prescaler option for CT-50, add .. $29.95

UTILIZES NEW MOS-LSI CIRCUITRY

SPECIFICATIONS

Sensitivity: less than 25MV
Frequency range: 5Hz to 60MHz, typically 65MHz
Gate time: 1 second, 1/10 second, with automatic decimal point positioning on both direct and prescale
Display: 8 digit red LED .4" height
Accuracy: 10 ppm, .001 ppm with TV time base!
Input: BNC, 1 meg ohm direct, 50 ohm with prescale option
Power: 110 VAC 5 watts or 12 VDC @ 1 Amp
Size: Approx. 6" x 4" x 2", high quality aluminum case
Color burst adapter for .001 ppm accuracy available in 6 weeks. CB-1, Kit $14.95

VIDEO TERMINAL KIT $149.95

A compact 5 x 10-inch PC card that requires only an ASCII keyboard and a TV set to become a complete interactive terminal for connection to your microprocessor asynchronous interface. Its many features are single 5-volt supply, crystal controlled sync and baud rates (up to 9600 baud), 2 pages of 32 characters by 16 lines, read to and from memory, computer and keyboard-operated cursor and page control, parity error display and control, power-on initialization, full 64-character ASCII display, block-type see-thru cursor. Keyboard/computer control backspaces, forward spaces, line feeds, rev. line feeds, home, returns cursor. Also clears page, clears to end of line, selects page 1 or 2, reads from or to memory. The card requires 5 volts at approx. 900 ma and outputs standard 75 ohm composite video.

TH3216 Kit $149.95
TH3216, Assembled and Tested $239.95
VD-1, Video to RF Modulator Kit ..... $ 6.95

600 mHz Prescaler

Fully assembled and tested
Extend the range of your counter to 10 times higher in frequency. Works with any counter. High sensitivity input with built-in on-chip pre-amp.
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Want a clock that looks good enough for your living room? Forget the competitor's kludges and try one of ours! Features: jumbo .4" digits, Polaroid lens filter, extruded aluminum case available in 5 colors, quality PC boards and super instructions. All parts are included, no extras to buy. Fully guaranteed. One to two hour assembly time. Colors: silver, gold, black, blue and bronze (specify)

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12/24-Hour 12-Volt AC or DC
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- Easy, no-polarity hookup
- Display blanks with ignition
- Case mounting bracket included
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Automatically adjusts display brightness according to ambient light level. For DC-11 or Clock

LINEAR		REGS		TRANSISTORS	
555	.50	309K	.99	NPN 2N3904 type	10/$1.00
556	.75	340K-12	.99	PNP 2N3906 type	10/$1.00
566	1.49	7805	.99	NPN Power Tab 40W	3/$1.00
567	1.49	7812	.99	PNP Power Tab 40W	3/$1.00
324	1.49	7815	.99	FET MPF-102 type	3/$2.00
1458	.49	78MG	1.50	UJT 2N2646 type	3/$2.00
380	1.49	723	.49	2N3055 NPN Power	.75

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4K BASIC FOR FAIRBUG F8 on paper tape $25.00

C/MOS (DIODE CLAMPED)

74C10	.22	4012	.22	4023	.22	4042	.78
74C193	1.50	4013	.40	4024	.75	4046	2.25
4001	.22	4015	.95	4025	.22	4049	.40
4002	.22	4016	.40	4027	.40	4050	.40
4006	1.20	4017	1.05	4028	.88	4055	1.50
4007	.22	4018	1.00	4029	1.10	4066	.80
4009	.42	4019	.25	4030	.22	4071	.27
4010	.42	4020	1.05	4033	1.50	4076	1.05
4011	.22	4022	.95	4035	1.10		

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8 PIN	.22	24 PIN	.40
14 PIN	.25	28 PIN	.50
16 PIN	.28	40 PIN	.60
18 PIN	.30		

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2708 8K EPROM	$20.95
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2102-1 1024 BIT RAM	$ 1.29
2107B	$ 4.25
MK4008P	$ 1.95
5280 4K DYNAMIC RAM	$ 4.75
1101A 256 BIT RAM	$ .85
MM5203 UV PROM	$ 6.95
1702A UV PROM	$ 4.95
5204 4K PROM	$10.95
AY 5-1013 UART	$ 6.95
LIGHT ACTIVATED SCR's TO 18, 200V, 1A	$ 1.10
1N 4148 (1N914)	15 $1.00
MCA 81 OPTICAL LIMIT SWITCH	$1.50

LED READOUTS

FND 359 C.C. .4"	$ .50	HP 7740 .3" C.C.	$1.25
FND 70 C.C. .4"	$ .55	MAN-7 .3" C.A.	$ .95
FND 503 C.C. .5"	$ .85	NS 33-3 dig. array	$ .75
FND 510 C.A. .5"	$ .85	DL 747 C.A. .6"	$1.95

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2N 3820 P FET	$ .45		
2N 5457 N FET	$ .45		
2N2646	$ .45		
ER 900 TRIGGER DIODES	4	$1.00	
2N 6028 PROG. UJT	$ .65		

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MULTI TURN TRIM POTS Similar to Bourns 3010 style 3/16"x5/8"x1/4" .50 100 ohm, 1K, 10K, 50K ohms $1.50 ea. 3 $4.00

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This board is a 1/16" single sided paper epoxy board, 4" x 6" DRILLED and ETCHED which will hold up to 21 single 14 pin IC's or 8, 16, or LSI DIP IC's with busses for power supply connector $4.00

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FP 100 PHOTO TRANS	$ .50		
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IL-5 (MCT-2)	$ .75		
MOLEX PINS	100/$1.00		
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MC6860 MODEM CHIP	$9.95		

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PRV	1A	3A	12A	50A	125A
100	.06	.14	.30	.80	3.70
200	.07	.20	.35	1.15	4.25
400	.09	.25	.50	1.40	6.50
600	.11	.30	.70	1.80	8.50
800	.15	.35	.90	2.30	10.50
1000	.20	.45	1.10	2.75	12.50

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723	$ .50		or 24V	$ .85	
LM 376	$ .60		340T-5, 6, 8, 12		
320K-5 or 15V	$1.40		15, 18 or 24V	$1.10	
320T-5,12,15			78 MG	$1.35	
or 24V	$ .85		79 MG	$1.35	

RS232 CONNECTORS	DB 25P male	$2.95
	DB 25S female	$3.50

TRANSISTOR SPECIALS

2N3585 NPN Si TO 66	$ .95		
2N3772 NPN Si TO 3	$ 1.60		
2N1546 PNP GE TO-3	$ .75		
2N4908 PNP Si TO 3	$ 1.00		
2N6056 NPN Si TO 3 Darlington	$ 1.70		
2N5086 PNP Si TO 92	4	$1.00	
2N4898 PNP TO 66	$ .60		
2N404 PNP GE TO-5	5	$1.00	
2N3919 NPN Si TO-3 RF	$ 1.50		
MPSA 13 NPN Si TO 92	3	$1.00	
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TTL IC SERIES

7400	.14	7445	.55	74151	.60
7401	.14	7446	.65	74153	.60
7402	.14	7447	.65	74154	.95
7403	.14	7448	.65	74155	.70
7404	.18	7450	.15	74157	.58
7405	.18	7472	.29	74161	.85
7406	.25	7473	.29	74163	.80
7407	.25	7474	.29	74164	.95
7408	.18	7475	.45	74165	.95
7409	.17	7476	.30	74173	1.20
7410	.14	7480	.35	74174	.95
7411	.20	7483	.62	74175	.82
7412	.20	7485	.87	74176	.75
7413	.39	7486	.30	74177	.75
7414	.63	7489	1.85	74180	.65
7416	.25	7490	.42	74181	1.90
7417	.25	7491	.58	74190	1.00
7420	.14	7492	.43	74191	1.00
7425	.25	7493	.45	74192	.83
7426	.22	7494	.70	74193	.83
7427	.25	7495	.65	74194	.85
7430	.14	7496	.65	74195	.52
7432	.25	74107	.28	74196	.86
7437	.21	74121	.33	74257	1.25
7438	.21	74123	.65	74279	.87
7440	.14	74125	.40	75324	1.75
7441	.70	74126	.40	75491	.65
7442	.40	74150	.90	75492	.65

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1UF 35V	5/$1.00	30UF 6V	5/$1.00
2.2UF 20V	5/$1.00	3.3UF 6V	$ .20
3.3UF 35V	4/$1.00	47UF 20V	$ .35
4.7UF 15V	5/$1.00	68 UF 15V	$ .50
6.8UF 35V	4/$1.00		

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74LS00	.23	74LS125	.65
74LS02	.23	74LS126	.65
74LS03	.23	74LS132	.80
74LS04	.28	74LS136	.39
74LS05	.28	74LS138	.72
74LS08	.23	74LS139	.72
74LS09	.33	74LS151	.98
74LS10	.23	74LS153	.93
74LS11	.23	74LS155	1.40
74LS13	.50	74LS156	.95
74LS15	.28	74LS157	.98
74LS20	.23	74LS160	1.02
74LS21	.23	74LS161	1.02
74LS22	.23	74LS162	1.02
74LS26	.33	74LS163	1.02
74LS27	.27	74LS168	1.10
74LS30	.23	74LS169	1.10
74LS32	.33	74LS170	1.72
74LS37	.37	74LS173	1.39
74LS38	.37	74LS174	1.05
74LS40	.27	74LS175	1.22
74LS51	.23	74LS179	.75
74LS54	.23	74LS190	1.50
74LS74	.49	74LS191	1.50
74LS90	.95	74LS192	1.75
74LS42	.88	74LS193	1.75
74LS73	.40	74LS195	1.25
74LS74	.40	74LS196	.99
74LS76	.40	74LS197	.99
74LS90	.89	74LS221	1.25
74LS92	.85	74LS257	1.35
74LS93	.85	74LS258	1.38
74LS109	.50	74LS365	.66
74LS112	.43	74LS366	.66
74LS113	.43	74LS367	.66
74LS114	.43	74LS368	.66
		74LS390	2.20

LINEAR CIRCUITS

LM 101	.75	LM 381	1.25
LM 301, 748	.31	LM 382	1.25
LM307	.30	LM 387	2.50
LM 308	.95	LM 553	2.50
LM 311	.95	LM 555	.44
LM 318	1.35	LM556	.85
LM 319	.95	560	2.00
LM 324	1.05	565	1.10
LM 339	1.10	566	1.50
LM 358	1.40	567	1.50
LM 377	2.50	703	.90
LM 380	.95	709	.25
		710	.35
		711	.35
		741C or V	.31
		747	.65
		LM 1310	2.50
		1456	.95
		1458	.50
		CA3046	.75
		CA3047	.95
		3900	.49
		8038CC	3.90

TRIACS

PRV	1A	10A	25A
100	.40	.70	1.30
200	.70	1.10	1.75
400	1.10	1.60	2.60
600	1.70	2.30	3.60

SCR'S

PRV	1.5A	6A	35A
50	.40	50	1.20
100	.60	70	1.60
200	1.00	1.20	2.20
400		1.50	3.00

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74LS01	.28	74LS32	.33	74LS92	.57	74LS158	.75	74LS249	.79
74LS02	.28	74LS37	.33	74LS93	.57	74LS160	1.02	74LS253	.84
74LS03	.28	74LS38	.33	74LS107	.39	74LS161	1.02	74LS257	.75
74LS04	.29	74LS40	.28	74LS109	.39	74LS162	1.02	74LS258	.75
74LS05	.29	74LS42	.67	74LS112	.39	74LS163	1.02	74LS266	.39
74LS08	.29	74LS47	.79	74LS113	.39	74LS164	1.02	74LS283	.79
74LS09	.29	74LS48	.77	74LS114	.39	74LS168	1.14	74LS290	.65
74LS10	.28	74LS51	.28	74LS125	.49	74LS169	1.14	74LS293	.65
74LS11	.28	74LS54	.28	74LS126	.49	74LS170	1.73	74LS365	.67
74LS12	.28	75LS55	.28	74LS132	.81	74LS173	1.34	74LS366	.67
74LS13	.47	74LS73	.39	74LS136	.39	74LS174	1.06	74LS367	.67
74LS14	1.02	74LS74	.39	74LS138	.73	74LS175	.84	74LS368	.67
74LS15	.28	74LS75	.53	74LS139	.73	74LS190	1.18	74LS386	.39
74LS20	.28	74LS76	.39	74LS151	.75	74LS191	1.18	74LS670	2.34
74LS21	.28	74LS78	.39	74LS153	.75	74LS196	.86	81LS95	.77
74LS22	.28	74LS83	.79	74LS154	1.10	74LS197	.86	81LS96	.77
74LS26	.33	74LS86	.39	74LS155	.75	74LS247	.79	81LS97	.77
74LS27	.33			74LS156	.75			81LS98	.77

INTEGRATED CIRCUITS

TTL, CMOS, LINEAR

7400	.21	7476	.32	74181	2.15	4012	.23	4520	1.14
7401	.21	7480	.70	74182	.79	4013	.40	4527	1.68
7402	.21	7482	.70	74184	2.19	4014	.96	4528	.88
7403	.21	7483	.70	74185	2.19	4015	.96	4585	1.23
7404	.21	7485	.89	74188	3.50	4016	.40	2102-1	1.79
7405	.28	7486	.28	74189	3.50	4017	1.05	8080A	12.95
7406	.25	7489	2.19	74190	1.23	4018	1.05	CA3046	.75
7407	.25	7490	.44	74191	1.23	4019	.23	LM2111N	1.25
7408	.21	7491	.70	74192	.88	4020	1.14	LM309K	1.80
7409	.21	7492	.44	74193	.88	4021	1.14	LM324A	1.28
7410	.21	7493	.44	74194	.88	4022	.96	LM340T-5	1.25
7411	.21	7494	.70	74195	.88	4023	.23	LM340T-6	1.25
7412	.21	7495	.70	74196	.88	4024	.84	LM340T-8	1.25
7413	.25	7496	.70	74197	.88	4025	.23	LM340T-12	1.25
7414	.89	74100	1.28	74198	1.49	4026	1.68	LM340T-15	1.25
7416	.25	74107	.30	74199	1.49	4027	.40	LM340T-18	1.25
7417	.25	74109	.33	74221	1.09	4028	.89	LM340T-24	1.25
7420	.21	74121	.35	74279	.55	4029	1.14	LM3900N	.88
7421	.25	74122	.44	74365	.67	4030	.23	LM3909N	.69
7423	.35	74123	.61	74366	.67	4033	1.51	MC1456V	1.00
7425	.35	74125	.40	74367	.67	4034	3.50	MC1458V	.53
7426	.25	74126	.40	74368	.67	4035	1.14	MC3302P	1.15
7427	.33	74132	.80	8093	.40	4040	1.14	NE536T	3.24
7428	.28	74141	.88	8094	.40	4041	.79	NE540L	2.04
7430	.21	74145	.70	9095	.67	4042	.79	NE555V	.48
7432	.25	74147	1.63	8096	.67	4043	.70	NE556A	.88
7433	.30	74148	1.30	8097	.67	4044	.70	NE560B	3.83
7437	.25	74150	1.16	8098	.67	4046	1.86	NE561B	3.83
7438	.25	74151	.70	75150	1.16	4049	.40	NE567B	3.83
7440	.21	74153	.65	75450	.88	4050	.40	NE565A	1.25
7442	.53	74154	1.03	75451	.61	4051	1.26	NE566V	1.28
7443	.63	74155	.70	75452	.61	4052	1.26	NE567V	1.36
7445	.70	74156	.70	75453	.61	4053	1.26	uA709CV	.44
7446	.70	74157	.70	75454	.61	4060	1.58	uA710CA	.44
7447	.70	74160	.88	75491	.81	4066	.79	uA711CA	.53
7448	.70	74161	.88	75492	.84	4071	.23	uA723CA	.60
7450	.21	74162	.88	75493	1.09	4072	.23	uA733CA	.75
7451	.21	74163	.88	75494	1.19	4073	.23	uA741CV	.44
7453	.21	74164	.96	82525	2.19	4075	.23	uA747CA	.70
7454	.21	74165	1.15	4000	.23	4081	.23	uA748CV	.49
7459	.21	74166	1.26	4001	.23	4082	.23	uA7805CU	1.25
7460	.21	74170	2.64	4002	.23	4502	.79	uA7806CU	1.25
7470	.30	74173	1.42	4006	1.23	4510	1.14	uA7808CU	1.25
7472	.30	74174	.98	4007	.23	4511	1.05	uA7812CU	1.25
7473	.30	74175	.93	4008	.79	4514	2.80	uA7815CU	1.25
7474	.30	74176	.79	4009	.44	4515	2.80	uA7818CU	1.25
7475	.49	74177	.79	4010	.44	4516	.93	uA7824CU	1.25
		74180	.70	4011	.23	4518	1.14		

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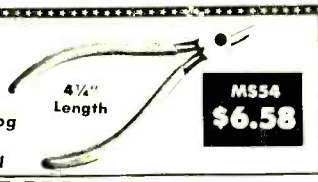

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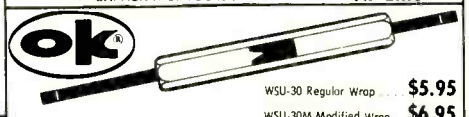

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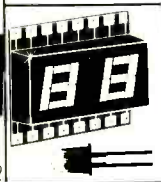

LED DIGITS and LAMPS

FND357	.375" Single Digit, CC		$1.35
FND500	.5" Single Digit, CC		$1.35
FND507	.5" Single Digit, CA		$1.35
FND800	.8" Single Digit, CC		$2.50
FND807	.8" Single Digit, CA		$2.50
NSN373	.3" Dual Digits, CC		$2.20
NSN374	.3" Dual Digits, CA		$2.20
NSN583	.5" Dual Digits, CC		$2.60
NSN584	.5" Dual Digits, CA		$2.60
NSN783	.7" Dual Digits, CC		$3.00
NSN784	.7" Dual Digits, CA		$3.00
NSL5053	T-1¾ Lamp	$1.80/10	$16.00/100
NSL5056	T-1¾ Lamp	$1.80/10	$16.00/100

SILICON TRANSISTORS

MPS918	.16	1.55/10	MPS3640	.16	1.55/10	PN5133	.16	1.55/10
MPS930	.16	1.55/10	MPS3641	.16	1.55/10	PN5134	.16	1.55/10
MPS2222A	.16	1.55/10	MPS3643	.16	1.55/10	PN5137	.16	1.55/10
MPS2369A	.16	1.55/10	MPS3646	.16	1.55/10	PN5138	.16	1.55/10
MPS2712	.16	1.55/10	2N3904	.16	1.55/10	PN5139	.16	1.55/10
MPS2907A	.16	1.55/10	2N3906	.16	1.55/10	2N5210	.16	1.55/10
MPS3392	.16	1.55/10	2N4124	.16	1.55/10	DK3055	.68	6.59/10
MPS3393	.16	1.55/10	2N4126	.16	1.55/10	2N3055	.99	9.20/10
MPS3394	.16	1.55/10	2N4401	.16	1.55/10	MJ2955	.99	9.20/10
MPS3395	.16	1.55/10	2N4403	.16	1.55/10	MPF102	.36	3.35/10
MPS3563	.16	1.55/10	2N4410	.16	1.55/10	2N5457	.48	4.50/10
MPS3565	.16	1.55/10	2N5087	.16	1.55/10	MPSA13	.28	2.60/10
MPS3638	.16	1.55/10	2N5089	.16	1.55/10	MJ2955	.99	9.20/10
			PN5129	.16	1.55/10	TIP120	.99	9.20/10

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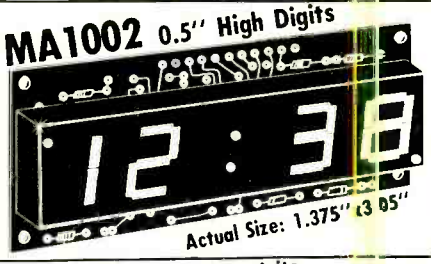
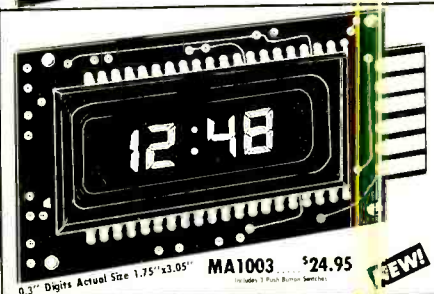
MA1002A SET	Module with Transformer & Switches	$13.95	MA1010A SET Module w/Transformer & Switches	$16.45
MA1002C	.5" LED 24 Hour Clock Module	$10.50	MA1010C .84" LED 24 Hour Clock Module	$13.00
MA1002C SET	Module w/Transformer & Switches	$13.95	MA1010C SET Module w/Transformer & Switches	$16.45
MA1003	12 Volt Car Clock with Switches	$24.95		





ELECTROLYTIC CAPACITORS

VALUE	RADIAL LEADS	AXIAL LEADS	VALUE	RADIAL LEADS	AXIAL LEADS
.47/50V	.08 .65/10	.11 .90/10	100/50V	.21 1.70/10	.29 2.30/10
1/50V	.08 .65/10	.11 .90/10	220/10V	.13 1.05/10	.18 1.42/10
2.2/50V	.08 .65/10	.12 .90/10	220/16V	.15 1.16/10	.20 1.55/10
3.3/50V	.08 .65/10	.12 1.00/10	220/25V	.21 1.70/10	.29 2.35/10
4.7/35V	.08 .65/10	.12 .95/10	220/35V	.25 2.05/10	.35 2.79/10
4.7/50V	.08 .68/10	.12 1.00/10	220/50V	.29 2.30/10	.40 3.23/10
10/16V	.08 .65/10	.11 .90/10	330/6V	.14 1.16/10	.19 1.48/10
10/25V	.08 .65/10	.12 1.00/10	330/10V	.15 1.16/10	.21 1.64/10
10/35V	.09 .70/10	.13 1.10/10	330/16V	.21 1.64/10	.31 2.45/10
10/50V	.10 .75/10	.14 1.15/10	330/25V	.23 1.84/10	.38 3.07/10
22/16V	.08 .67/10	.12 1.00/10	330/35V	.33 2.64/10	.43 3.43/10
22/25V	.09 .70/10	.13 1.05/10	330/50V	.54 4.32/10	.60 4.81/10
22/35V	.11 .85/10	.15 1.19/10	470/6V	.15 1.20/10	.20 1.61/10
22/50V	.12 1.00/10	.17 1.32/10	470/16V	.21 1.70/10	.31 2.45/10
33/16V	.09 .75/10	.12 1.00/10	470/25V	.23 1.84/10	.33 2.66/10
33/25V	.10 .81/10	.14 1.15/10	470/35V	.29 2.30/10	.43 3.43/10
33/35V	.13 1.05/10	.17 1.34/10	470/50V	.41 3.27/10	.47 3.78/10
33/50V	.14 1.13/10	.19 1.52/10	1000/6V	.22 1.90/10	.35 2.76/10
47/10V	.09 .71/10	.13 1.04/10	1000/10V	.24 1.99/10	.38 3.07/10
47/16V	.10 .81/10	.14 1.15/10	1000/16V	.29 2.30/10	.43 3.43/10
47/25V	.13 1.05/10	.17 1.30/10	1000/25V	.42 3.33/10	.68 5.42/10
47/35V	.14 1.13/10	.19 1.51/10	1000/35V	.60 4.81/10	.75 6.03/10
45/50V	.15 1.21/10	.21 1.71/10	2200/6V	.26 2.08/10	.43 3.43/10
100/10V	.10 .77/10	.14 1.13/10	2200/16V	.36 2.88/10	.43 3.43/10
100/16V	.11 .85/10	.17 1.30/10	2200/10V	.42 3.33/10	.60 4.81/10
100/25V	.13 1.10/10	.20 1.55/10	2200/16V	.54 4.32/10	.68 5.42/10
100/35V	.17 1.41/10	.25 1.93/10			

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CMOS 4000 278 p	$3.00
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16 Pin Solder	.22	2.10/10
18 Pin Solder	.29	2.75/10
24 Pin Solder	.38	3.60/10
28 Pin Solder	.45	4.25/10
40 Pin Solder	.63	6.00/10
8 Pin W-W	.24	2.30/10
14 Pin W-W	.26	2.50/10
16 Pin W-W	.30	2.85/10
18 Pin W-W	.60	5.70/10
24 Pin W-W	.96	9.10/10
28 Pin W-W	1.12	10.00/10
40 Pin W-W	.92	8.75/10

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24 ga PVC	2.10/100'	8.50/500'
26 ga PVC	2.10/100'	8.50/500'

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220 pf	.40/10	3.50/C
470 pf	.40/10	3.50/C
.001 uf	.40/10	3.50/C
.0022 uf	.40/10	3.50/C
.0047 uf	.40/10	3.50/C
.01 uf	.45/10	3.65/C
.022 uf	.50/10	4.00/C
.047 uf	.70/10	5.60/C
.1 uf	1.35/10	11.50/C

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1N5230B	4.7v	15 $11/C
1N5231B	5.1v	15 $11/C
1N5232B	5.6v	15 $11/C
1N5233B	6.0v	15 $11/C
1N5234B	6.2v	15 $11/C
1N5235V	6.8v	15 $11/C
1N5236B	7.5v	15 $11/C
1N5237B	8.2v	15 $11/C
1N5238B	8.7v	15 $11/C
1N5239B	9.1v	15 $11/C
1N5240B	10v	15 $11/C
1N5241B	11v	15 $11/C
1N5242B	12v	15 $11/C
1N5243B	13v	15 $11/C
1N5244B	14v	15 $11/C
1N5245B	15v	15 $11/C

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1N4001	.64/10	5	$/C $49/M
1N4002	.66/10	5	$/C $51/M
1N4003	.68/10	5	$/C $52/M
1N4004	.70/10	5	$/C $54/M
1N4005	.82/10	7	$/C $63/M
1N4006	.90/10	7	$/C $69/M
1N4007	.99/10	8	$/C $77/M
1N4148	.40/10	3	$/C $29/M

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4-40 1/2 Screw	.60	8	4.05/M
6-32 1/4 Screw	.65	8	4.40/M
6-32 1/2 Screw	.75	8	4.85/M
8-32 3/8 Screw	.90	8	5.85/M
8-32 5/8 Screw	.99	8	7.00/M
2-56 Hex Nut	.55	8	3.60/M
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6-32 Hex Nut	.60	8	4.00/M
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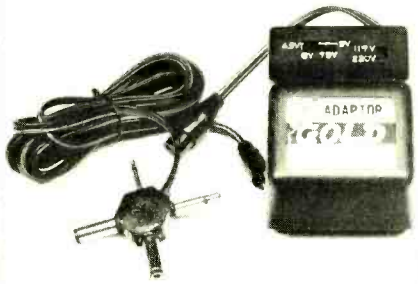

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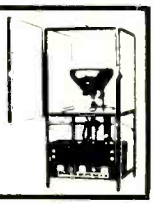

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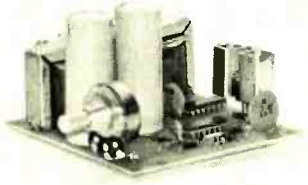

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2N1711	.29
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2N1893	.38
2N2219	.24
2N2222	6/$1
2N2222A	5/$1
2N2369	5/$1
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2N4091	3/$1
2N4092	$0.75
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2N4122	3/$1
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2N5486	2/$1
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E102	3/$1
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MPF102 to* MPF104	3/$1
MPF112	4/$1
MPS6515	3/$1
SE1001	4/$1
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SE2001	4/$1
SE2002	4/$1
SE5001 to SE5003	3/$1
SE5020	$3.00
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MM5738N	$2.95
SN7400N	.16
SN7410N	.16
SN7420N	.16
SN7430N	.16
SN7451N	.18
SN7473N	.36
SN7475N	.48
SN7476N	.35
SN7490N	.44

LINEAR IC's

LM100H	$7.50
LM301AN	.27
LM307H	.27
LM308N	.88
LM309K	.84
LM311N	.90
LM320K-5	1.35
LM320K-12	1.35
LM320K-15	1.35

LINEAR IC's

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LM340T-5	1.20
LM340T-6	1.20
LM340T-12	1.20
LM340T-15	1.20
LM340T-24	1.20
LM376N*	.55
LM377N	2.50
LM380N	1.29
NE555V*	2/$1
NE556A	$0.90
LM709CH	.29
LM709CN	.29
LM723H	2/$1
LM723N*	3/$1
LM739N	$1.00
LM741CH	3/$1
LM741CN*	4/$1
LM741CN14	.34
LM747CN	.65
748CJ DIP	.35
749CJ DIP	1.00
8440P mDIP	.80
LM1304N	1.15
LM1458N*	3/$1
LM2111N	$1.40
XR2556CP	1.55
2740DE	1.95
CA3028A	1.75
CA3046	.84
LM3075N1	1.45
CA3086*	.62
LM3900N	.55
RC4194D	1.50
RC4194TK*	2.50
RC4195DN*	1.25
RC4195TK*	2.25
LM4250CN	2.00
RC4558DN	.55
NE558V	.95
NE559V	.90
µA7805UC	1.25
8038 DIP*	3.75
DM7492	.89

*SUPER SPECIALS:

1N34 Germanium Diode	10/$1
1N914 100V/10mA Diode	20/$1
1N4001 50V/1A Rectifier	15/$1
1N4154 30V 1N914	25/$1
BR1 50V ½A Bridge Rec	4/$1
2N2222 NPN Transistor	6/$1
2N2907 PNP Transistor	6/$1
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LM376 Pos Volt Reg mDIP	.55
NE555 Timer mDIP	.38
LM723 2-37V Reg DIP	3/$1
LM741 Comp Op Amp mDIP	6/$1
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RF391 RF Power Amp Transistor 10-25W @ 3-30MHz TO-3	$5.00
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Z–80 Chip & Manual – $49.95; Add $5.00 for Z–80A
Z–80 Manual – $7.50 Separately.

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Kit includes speaker which operates from your door bell. When door bell is pushed your favorite tune is played. Car/boat kit includes speaker which operates from car/boat horn ring. Allow 4 weeks delivery on both kits.

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$9.95 kit

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7407 –11c	7451 – 9c	74155 –22c
7410 – 9c	7474 –16c	74193 –35c
7416 –13c	7475 –24c	8233 – 35c
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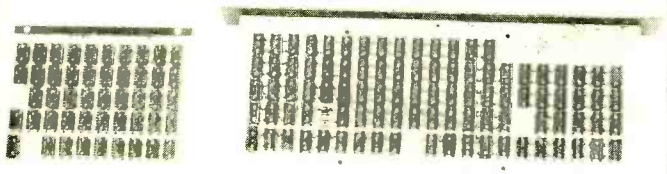

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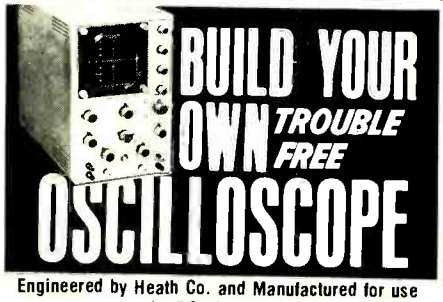

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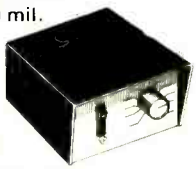

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74LS03	.26	74LS153	.70
74LS04	.30	74LS155	.69
74LS05	.32	74LS156	.76
74LS08	.26	74LS157	.95
74LS09	.26	74LS158	.95
74LS10	.26	74LS160	.85
74LS11	.35	74LS161	.85
74LS13	.58	74LS162	.85
74LS14	1.05	74LS163	.85
74LS15	.26	74LS168	.85
74LS20	.24	74LS169	.85
74LS21	.35	74LS170	2.00
74LS22	.35	74LS173	1.10
74LS26	.35	74LS174	1.00
74LS27	.35	74LS175	1.00
74LS30	.34	74LS190	.95
74LS32	.35	74LS191	.95
74LS37	.33	74LS192	.95
74LS38	.38	74LS193	.95
74LS40	.34	74LS194	.95
74LS42	.80	74LS195	.95
74LS51	.26	74LS196	.85
74LS54	.26	74LS197	.85
74LS55	.26	74LS251	.85
74LS73	.75	74LS253	.85
74LS74	.49	74LS257	.85
74LS76	.49	74LS258	.85
74LS86	.45	74LS260	.26
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CD4019	.39
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CD4021	.90
CD4022	.90
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CD4046	.90
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CD4049	.35
CD4050	.35
CD4051	.90
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7401	.17	74H74	.45
7402	.17	7474	.35
7403	.17	7475	.55
74H04	.25	7476	.35
74S04	.30	7480	.45
7404	.17	7483	.76
7406	.25	7485	.89
7408	.17	7486	.35
7409	.17	7490	.71
7410	.17	7491	.71
7411	.25	7492	.71
7413	.45	7493	.67
7420	.17	7494	.90
7421	.17	7495	.71
7423	.35	7496	.85
7425	.27	74100	.96
7426	.25	74121	.31
7427	.17	74123	.61
7430	.25	74125	.44
7432	.30	74141	.71
7437	.35	74145	.97
7438	.35	74151	.71
7440	.17	74153	.81
7442	.60	74154	.97
7443	.60	74161	.91
7444	.65	74163	1.05
7446	.85	74164	1.05
74L47	1.75	74174	.91
7447	.81	74175	1.40
7448	.81	74180	.76
7450	.20	74181	2.25
7451	.17	74191	1.20
7453	.17	74192	1.20
7454	.17	74193	.95
7470	.35	74S195	1.05
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LM741	.25
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CIRCLE 65 ON FREE INFORMATION CARD

Nikko's Mix and Match Components

The separate components series from Nikko Audio features two well-designed tuners and three integrated amps. New this year is the NA 550 integrated amplifier with 45 watts* per channel, with less than 0.05% THD.

Also new in the Nikko line is the NA 850 with 60 watts* per channel, and less than 0.05% THD. Both the NA 550 and NA 850 integrated amps have myriad features like responsive VU meters with variable control, 5-position tape control switch (for dubbing), speaker protection circuitry, and Nikko's exclusive circuit breakers. The NA 850 also features a subsonic filter and tone defeat.

The TRM 750 integrated amp, like all Nikko products, is a superb performer, from its quality features to its built-in reliability. The TRM 750 delivers 55 watts* per channel, and no more than 0.15% THD.

Nikko's NT 850 AM/FM tuner is uncannily quiet and station grabbing. Normal and narrow IF circuitry provides high selectivity and low distortion while a front mounted multipath switch aids in reducing noise.

Last, but not least, is the FAM 450 AM/FM tuner. It's an established performer with excellent specifications and a typically modest Nikko price.

Now that you've read about our exciting separate components, we invite you to write to us for complete product information and the name of a Nikko Audio dealer near you.

Once you have seen and heard Nikko Audio products, we think you'll make this your year of Nikko.

***Minimum RMS per channel, both channels driven into 8 ohms from 20Hz to 20kHz.**

Nikko Audio

For those who take their stereo seriously

Nikko Electric Corp. of America
16270 Raymer St., Van Nuys, Calif. 91406
(213) 988-0105 ©Nikko Audio, 1977

In Canada: Superior Electronics, Montreal, Quebec

CIRCLE 89 ON FREE INFORMATION CARD

ATTENTION DEALERS:

Announcing

Jim-pak®

electronic components

One-Stop Component Center

- Over 200 quality items including integrated circuits, resistors, diodes, transistors, capacitors, connectors, switches, sockets, LEDs and Data Books covering all JIM-PAK® items.
- Immediate delivery on all orders
- Store display racks available
- Stock rotation and return policy
- Direct mail program available from list of active electronic buyers in dealers' area
- National advertising campaign in leading electronics magazines to include list of qualifying dealers
- Nationally known manufacturers' products at prices every dealer can afford
- Guaranteed products
- Standard industry part numbers

A component line of proven sellers developed for the independent dealer. Ideal for computer shops, school stores, electronic dealers, hobby shops, or any location where there is a potential market for electronic sales.

A product line which supplies most of your needs from one distributor with a reputation for fast and efficient service. Attractive and compact display racks make initial installation of the JIM-PAK® line easy.

Your customers deserve the best. Now you can profitably retail name brand components at competitive prices. Be the first in your area to announce and sell the JIM-PAK® line. Write or call today.

Jim-pak® electronic components

FOR MORE INFORMATION AND PRICING SCHEDULE CONTACT:

, a division of James Electronics, 1021 Howard Avenue, San Carlos, California 94070, (415) 592-8097

CIRCLE 4 ON FREE INFORMATION CARD

Revolutionary breakthrough in CB antenna design

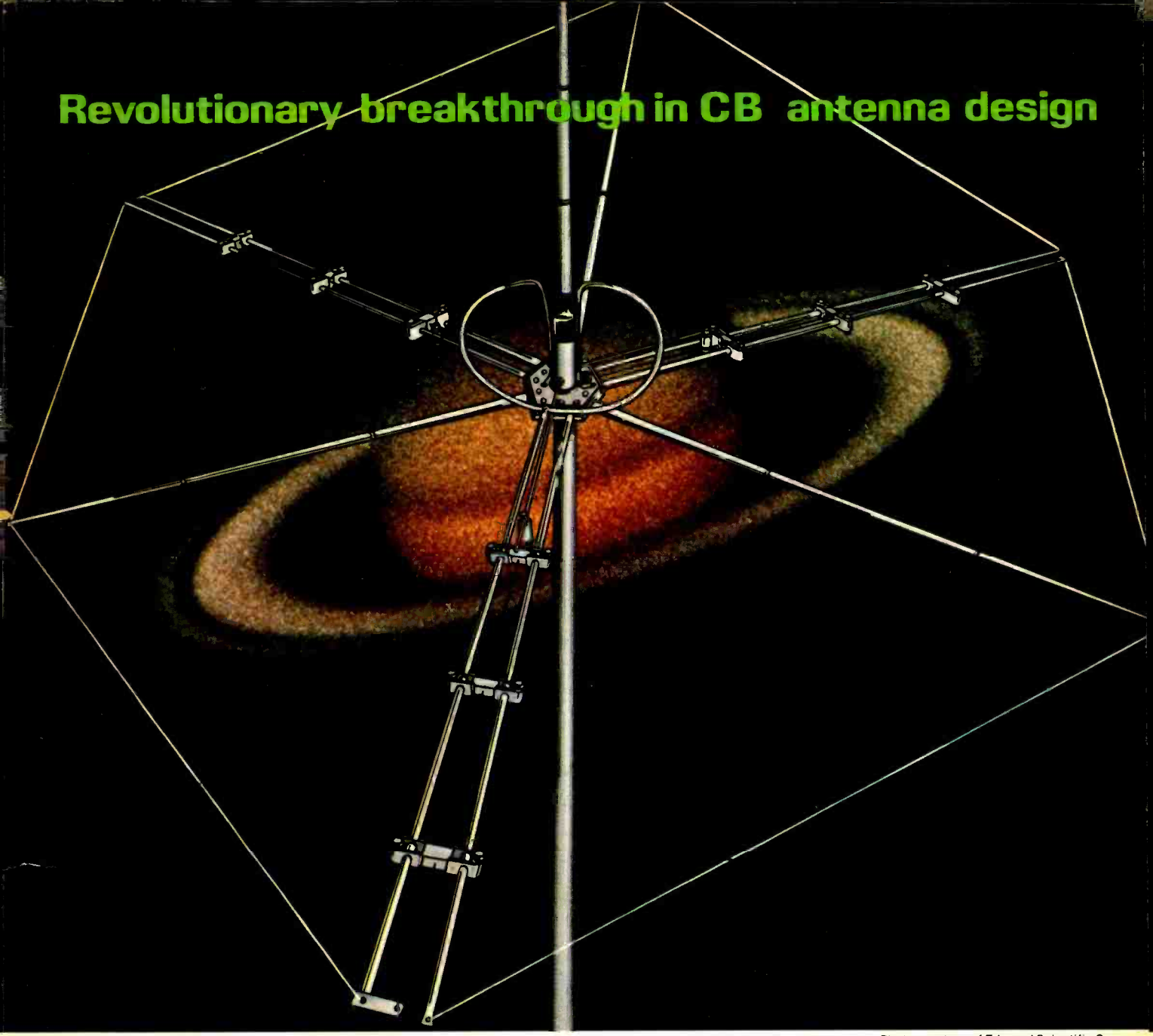


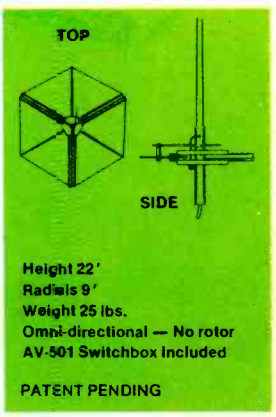
Photo courtesy of Edmund Scientific Co.

AVANTI Invents the Saturn™ Base

The reason the "Saturn" is so revolutionary is that it is absolutely the only **combination vertical *and* horizontal omni-directional antenna.** That's right, it needs no rotor! You can pick up mobiles (which are vertical) or horizontal and vertical beams.

The "Saturn", invented after years of research by Avanti engineers, is the latest development using AVANTI's unique CO-INDUCTIVE principle to give you the performance of two antennas combined into one.

The "Saturn" not only works on both polarities, but pounds out signals like an air hammer and picks them up like a magnet. Both polarities offer high gain figures.



Those of you who are worried about sun spots and "skip" can relax too. This antenna really helps. When the sun spots cause a signal shift, you can often change polarity (just like our P.D.L. or Moonraker) and still pick up the desired channel with no loss of transmission.

The P.D.L. and Moonraker made dual polarity famous as the only antennas to have during the last sun spot cycle, and this time around any serious C.B.'er will want to have the "Saturn."

In fact, having a "Saturn" and a "P.D.L." or "Moonraker" will put you in the elite group of C.B.'ers who "always seem to get out better."

Avanti makes a complete line of high performance base and mobile CB antennas from $11.95 to $404.00. Write for free Avanti catalog.

avanti®

AVANTI RESEARCH AND DEVELOPMENT, INC.,
340 Stewart Avenue, Addison, IL 60101

Creators of the famous MOONRAKER®

CIRCLE 86 ON FREE INFORMATION CARD