SPECIAL 40-CHANNEL CB SECTION

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CB SPECTACULAR
special 16-page bonus

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1977 COLOR TV
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Until now, the toughest problem in handling CB repair jobs was getting the right replacement part.

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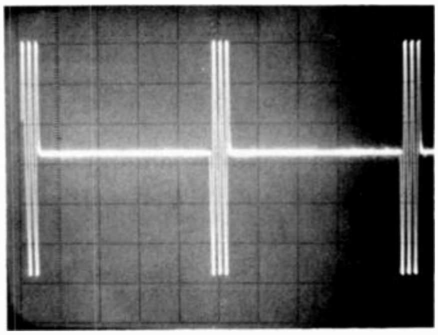
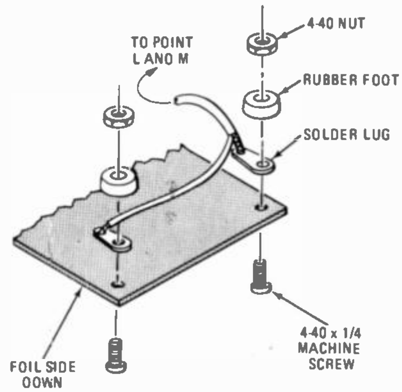
FEBRUARY 1977 Vol. 48 No. 2

ON THE COVER

40-channel CB went into effect January 1, 1977. Right now, all kinds of 40-channel gear is on sale. The 40-channel dial on our cover symbolizes this development. To bring you all the latest information we have produced the special 16-page section starting on page 39 of this issue.



THIS TEST SIGNAL was used to test a new concept in speaker design. Get the whole story. See story starting on page 64.



PITCH BENDER BOARD is important part of keyboard synthesizer. See page 58.

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looking ahead

TED visits United States: The only videodisc system currently on the market anywhere—the TED system, developed by Telefunken of Germany and Decca of Great Britain—was shown recently for the first time in the United States in NTSC color format. The player and a small selection of discs have been on the market in Germany since March 1975 with less than spectacular public acceptance. TED discs measure 8¾ inches (21 cm) in diameter, and each thin flexible disc has a playing time of 10 minutes. Recording is done on the hill-and-dale principle and a diamond-tipped "pressure stylus" reads the "bumps" as the disc revolves at 1800 RPM on a cushion of air.

In Germany, the player sells for $500-$600, with discs at $4-$10 each, but Telefunken officials maintain that in large-scale production players could retail as low as $200-$300. A prototype automatic changer that can accommodate up to 12 discs, with a four-second changing time, was also demonstrated. Picture quality and color produced by the player and changer were extremely good during the demonstration.

Despite the slow consumer acceptance in Germany—which Telefunken attributes to low program quality and quantity—the TED player will be manufactured for the NTSC color market by two Japanese firms, Sanyo and General. Two other Japanese companies will manufacture discs, with marketing scheduled to start in Japan in April, well ahead of the estimated December 1977 "test-marketing" date for the Philips-MCA-Magnavox and RCA LP videodisc systems in the U. S. The TED system could show up in this country before the year is over. Sanyo markets television sets here under its own brandname and is also a principal supplier to Sears, Roebuck and Co. General's sets are handled on a private-label basis, and under the Teknika brandname, principally by department stores.

Home VTR suit: A legal challenge to the very concept of home videocassette recording has been filed against Sony by two movie companies. Universal Pictures and Walt Disney Studios jointly sued Sony, its advertising agency, a group of Southern California Sony dealers and one owner of a Betamax home videocassette recorder, charging that Sony is encouraging copyright violations by making VTR's available to consumers to tape copyrighted movies shown over TV. The suit asks injunctions against manufacture, sale and use of the machines for this purpose and seeks to have the court order all tapes of the studios' copyrighted shows destroyed.

Sony promptly denied that Betamax violates copyrights, calling it a "time-shift machine" that makes it possible for viewers to watch programs at more convenient times. Sony indicated it felt the movie companies were trying to invade consumers' homes and tell them how and when they could see programs broadcast on the publicly owned airwaves. The entire future of home videotape recording of broadcast programs could rest on the outcome of the case.

It's generally agreed that taping a copyrighted show from television and then exhibiting the tape for an admission charge, or selling the tape, would be illegal. But the concept of making tapes from the air for personal use has rarely been challenged in the past. In fact, a 1972 phonograph record anti-piracy law expressly exempts audio recordists who make tapes off the air for their own use from being penalized by law. Whether that precedent extends to video presumably will be decided by the courts.

TV makers' blues: Is the American television manufacturing industry destined to go the way of the domestic radio industry—in other words, out of existence? The substantial increase in total U.S. TV sales in 1976 over 1975 appears almost totally to reflect a substantial increase in imports. In the first nine months of 1976, imports represented 32.8% of the color TV supply, up from 17.1% in the same months of 1975, and 70.5% of black-and-white, as compared with 67.4% a year earlier. Imports' share of the color market in the third quarter rose to a record 43.9%.

One of the casualties of low sales of domestically produced TV sets was Westinghouse's color tube business. The company stopped production last December, leaving only four firms manufacturing color tubes for U. S. set manufacturers—G-E, GTE Sylvania, RCA and Zenith. Meanwhile, some U. S. TV set and component manufacturers, along with labor unions, are seeking government action to trim imports of Japanese color sets on the grounds of "unfair competition" and damage to the domestic industry.

The Elcaset arrives: Cassette convenience with open-reel sound comes at a relatively high price in the new Elcaset decks now being introduced. The Elcaset is about 2½ times as large as a conventional compact cassette and contains ¼-inch tape that moves at a speed of 3¾ IPS. The system is designed for audio automation—special cut-out holes in the case are used to automatically set bias and equalization circuits for any of three different types of tape (low-noise, chrome and Ferrichrome) and switch Dolby circuits in or out. Provision is also made for the use of a special control head in professional models for automatic cueing and program control. Frequency response is claimed to be equal to open-reel tapes.

Elcaset's operation differs from that of a conventional cassette in that the tape is pulled out of its case when inserted in the deck, and three heads can be used (record, playback and erase)—four, with the addition of the control head. The system was developed in Japan by Sony and Teac. Technics by Panasonic will introduce a single-motor Elcaset deck next June at $750, and a four-motor professional model at about $2,000. Superscope and Teac also have scheduled sale of Elcaset decks in the U. S. Sony, Toshiba, Aiwa and JVC have also shown models in Japan.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

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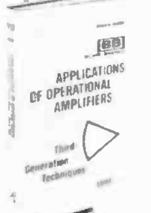

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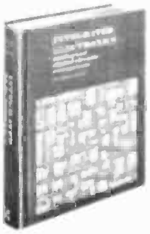

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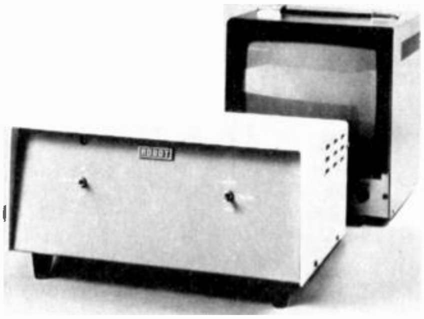

THE ROBOT 500 SCAN CONVERTER

The Phoneline Television System uses a scan converter that converts the broadband 525-line image to a 128-line by 128-element image. The camera "frame-grabs" a complete image every eight seconds and transmits it to the monitor during the period between then and picking up the next image. At the monitor, the picture is displayed eight seconds, then replaced by the next one with a wiping effect. The new image begins at the top of the screen and goes to the bottom.

The manufacturer, Robot Research, San Diego, CA, reports that the system is based on their Robot Series 500 scan converter, which does the frame-grabbing and converting to a signal that can be transmitted at audio frequencies.

"You must raise your prices" RCA official tells technicians

"You should raise your prices," RCA vice president Arnold Valencia told the National Electronics Service Dealers Association at their 1976 convention in San Antonio, TX. "It is important," he said, "that you try to cut your costs by raising efficiency. But I realize that there is a limit to how much you can increase that efficiency. When you reach bottom costs, you have no choice. You have to raise your prices."

He continued: "But I warn you, RCA will challenge you if you raise your charges for doing warranty work on our products. You'll have to justify any request for a price increase by substantiating your costs. Therefore, you'd better understand those costs."

Unfortunately, not all manufacturers were in agreement as to the need for receiving at least cost for doing warranty work. Ray Yeranko, national service manager of Magnavox, said his firm was "a friend of the independent service industry." Yet just the day before, the convention had heard the text of a 7-page telegram that Yeranko had used to defeat a California Senate bill prohibiting below-cost warranty work. Magnavox's reasoning, as expressed in the telegram, was that "Service agencies accept warranty business 'below-cost' only because they can obtain out-of-warranty business as a result of prior contracts." (Apparently the out-of-warranty customers are to be expected to pay part of the manufacturer's cost for in-warranty servicing.) The telegram went on to state that higher prices "could result in a manufacturer's decision to discontinue the use of independent agencies, and to perform the service himself."

The convention was also informed that a General Electric lobbyist, Robert Jordan, had appeared personally before the Finance, Insurance and Commerce committee of California's lower legislative house to defeat the measure.

FCC seizes record quantity of illegal CB radio equipment

More than $65,000 worth of illegally used radio equipment was confiscated late last October in a crackdown on illegal radio transmission in Baltimore and the surrounding five counties, according to Jervis S. Finney, US Attorney for Maryland. This was the largest simultaneous execution of search and seizure warrants against illegal radio operators in this country, he said.

The illegal radio stations were reported to have been transmitting on unauthorized frequencies, operating overpowered equipment, invading and overpowering CB channels, and disrupting the communications of legitimate CB users.

No less than 19 search warrants were executed simultaneously by United States Marshals from Baltimore and Washington, accompanied by FCC agents from the Baltimore, Washington, Philadelphia and Norfolk field offices. Operators of the stations, if convicted, face possible fines of up to $500 per day of illegal operation, and a maximum of one year of imprisonment and a $10,000 fine for unlicensed use of CB or amateur equipment.

British cable TV programs transmitted over optical line

Cable TV subscribers in the Hastings area of England are now watching TV programs that have made part of their journey to the viewer through a glass cable instead of a metal conductor. Rediffusion Ltd. of London reports that some 34,000 subscribers are now receiving their programs over a line that consists in part of a 1.4-kilometer (about 0.9-mile) length of optical cable.

Electrical signals are converted into light by a Plessey gallium-arsenide light-emitting diode, and back to electrical signals at the other end of the optical line with a photodiode. The cable consists of two strands of extremely pure optical glass, made by Corning in the United States. They are encased in a 7 × 4-millimeter polyethylene sheath with two 1-mm steel wires for mechanical strength. The optical fibers are carried loosely in a rectangular cavity.

Rediffusion reports that information-carrying capacity, compactness and lightness, and eventually lower cost are the three factors leading the company to experiment with optical cable, which can carry 10,000 times as much information per cable as coax.

Greager, Holman and Wiles win Gernsback Awards

This month's winner of the Hugo Gernsback Memorial Scholarship Award, a check for $150 presented annually to an outstanding student in each of eight leading electronics home-study schools, is Alan B. Greager of Nucla, CO.

ALAN B. GREAGER

Mr. Greager completed studies in a technical trades institute, then enrolled with the International Correspondence Schools in their FCC Radiotelephone License program. He states that one of his reasons for taking the course was that he needed additional knowledge about circuits on which he was working.

"From the first lesson," he says, "I have been able to incorporate the knowledge presented by ICS with my job skills. I found that ICS would give me credit for my previous schooling, and offered a toll-free number on which any student can have a direct conversation with instructors. I was also allowed to add to my course lessons that were not required but which I desired.

continued on page 12

Only NRI 25" designed-
DIAGONAL
Color TV

Quadraphonic

Two home training schools give you a hobby-kit Color TV to assemble. Two others give you a commercial set right off the shelf. Neither was designed to teach you how to repair Color TV's. Only NRI invested the time and money to design equipment with learning in mind!

No other home training school gives you both a solid state Color TV and SQ* Quadraphonic Receiver complete with four speakers . . . all in one course. In fact, to even match this kind of thorough training at another school, you'd have to take an extra course costing hundreds of dollars more. And only NRI courses in Color TV/Audio servicing let you learn on equipment designed specifically for training.

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

NRI passes the savings on to you

NRI engineering eliminates the cost of buying from an outside source. We pay no salesman's commission. Students are enrolled by mail only. The savings are passed on to you in the form of low tuition fees, extras like the TV's console cabinet and the Quadraphonic System; professional test instruments like a 5" triggered sweep oscilloscope, CMOS digital frequency counter, and integrated circuit Color TV pattern generator. You can pay hundreds of dollars more for similar courses and not

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gives you this for-learning ...plus complete Audio Center.

get a nickel's worth more in training and equipment.

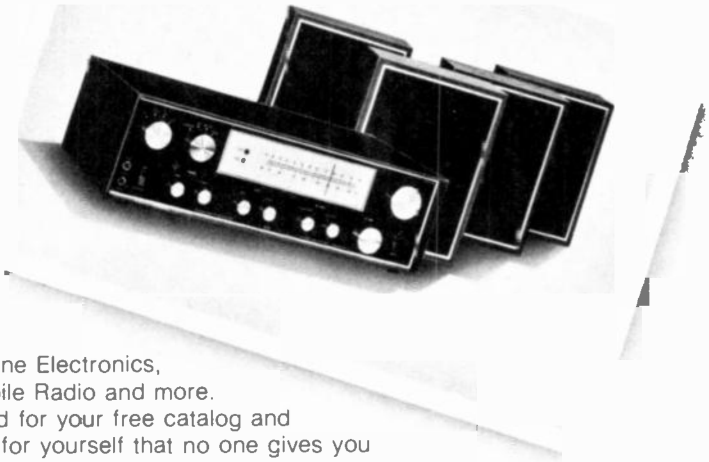
More know-how per dollar

It all boils down to the quality of training you get for your money. In our 62-year history, more than a million students have come to NRI and we're fully approved for career training under the G.I. Bill. We know the right way to make home training pay dividends for you.

Some of those "right" things are bite-size lessons to ease understanding and speed learning . . . personal consultation, and prompt grading of all tests . . . a full-time staff of engineer/instructors to help if you need it . . . the right kind of kits and experiments to give you hands-on training . . . and fully professional programs oriented to full or part-time career needs.

Also CB, Computer, & Other Courses

NRI offers not one, but five TV/Audio servicing courses so you can tailor your training to your budget. Or you can study other opportunity fields like Digital Computer Electronics, Citizens Band Radio, Communications, Aircraft or



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new & timely continued from page 6

Second most outstanding student in the ICS screening is David Holman of Dickson, TN. He writes in part:

"When I started my course in Electronics I was doing manual work in a small repair shop. As I progressed in my studies the job got better and better, and in a few months I was running all the service calls. The shop was then moved to a new location, with me running it. Since then I have left that job and started 'Holman's TV Repair.' In seven months it has grown from a small repair shop to a very nice sales and service center. Without the superior education in electronics I gained

DAVID HOLMAN

from ICS, I would probably still be helping to set TV's up on the bench for someone else."

Mr. Holman receives a model 280 digital multimeter donated for the purpose by B & K.

In third place this month is Terry W. Wiles of Plattsmouth, NE, a graduate of the ICS TV Service Technician program,

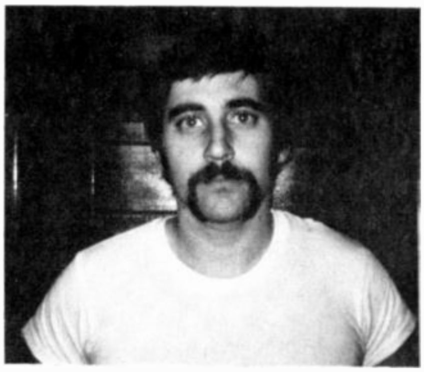
TERRY W. WILES

who receives a WV-529A special service VOM through the generosity of VIZ Manufacturing Co. He writes:

"I started my ICS TV course in late 1973 and completed it in March, 1975. Since then, I have opened a TV-radio service shop and am doing service work in eastern Nebraska and southwestern Iowa. I'm also working with a store in Melvern, IA. I don't believe things would have gone so smoothly if it had not been for the fine training and knowledge I gained through my ICS course. . . ."

OOOOOOPS!

We blew it! It seems we made an error in reporting the Hugo Gernsback Memorial Scholarship Award winners in the December, 1976, issue. The photographs for the second place winner, Mr Joseph E. Homay, and the third place winner, Mr. Robert Graham, were inadvertantly mixed up so that the names appeared under the wrong photographs. To set things straight, we would like to apologize to Mr. Homay and Mr. Graham for the mix up. The photographs, with the correct names, are shown below.



JOSEPH E. HOMAY

ROBERT GRAHAM

The first place winner Mr. A. H. Christ, was correct as it appeared.

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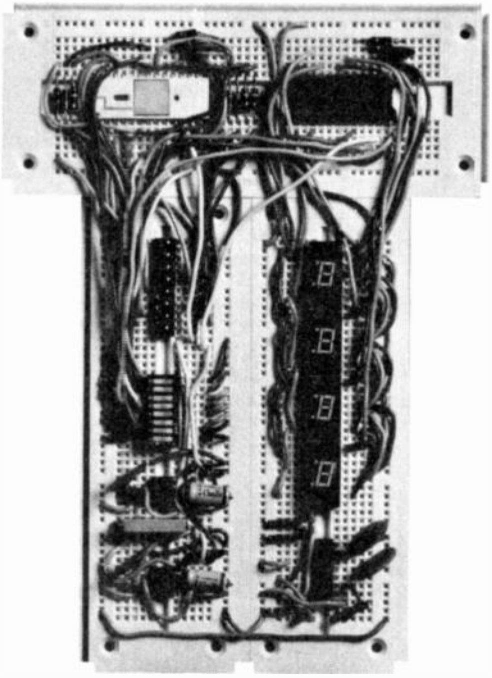
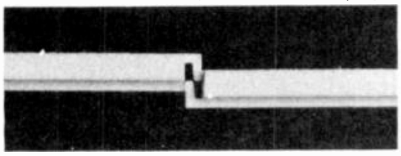
ANNOUNCING THREE NEW BREAKTHROUGHS IN SOLDERLESS BREADBOARDING.



Whether you design or build circuits for fun or for profit, you owe it to yourself to discover how fast and easy CSC solderless breadboarding can be. Now, more than ever. Because of three new breakthroughs in breadboard design. And our new EXPERIMENTOR™ sockets** that make the most of them.

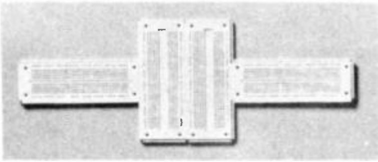
1. Price Who says a quality breadboard has to be expensive? For as little as $9.95, CSC's EXPERIMENTOR sockets let you design, assemble and modify circuits as fast as you can push in—or pull out—component leads. On a rugged one-piece socket with 550 solderless tie-points (94 five-point terminals *and* two 40-point bus strips).



Sockets lock together, snap apart to handle any size circuit with ease.

But don't let the low price fool you: EXPERIMENTOR sockets are precision-molded of durable, abrasion-resistant material, and feature CSC's non-corrosive, prestressed nickel-silver contacts for positive connections and longer life. All contacts are identified, too...with molded-in designations for easier circuit assembly and diagramming.

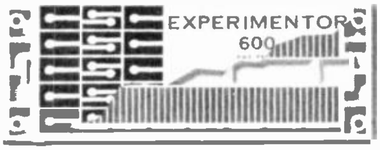
2. Compatibility CSC EXPERIMENTOR sockets end the "big-chip blues." They're the only ones with full fan-out capabilities for microprocessors and other larger DIP's, as well as 4-16-pin units. EXPERIMENTOR 600's 6/10" center is ideal for microprocessor's, clock chips, RAM's, ROM's, PROM's, etc. While EXPERIMENTOR 300's smaller 3/10" center is perfect for smaller DIP's. Both units, of course, accept transistors, LED's, resistors, capacitors, pot's—virtually all types of components with plug-in ease. As well as #22-30 solid hook-up wire for interconnections. Eliminating heat and lead damage to expensive components. And saving you more money, on parts.



Mix or match both models; arrange them vertically or horizontally.

3. Flexibility With CSC EXPERIMENTOR sockets, you can arrange your breadboard to suit your circuit...instead of vice versa. An exclusive snap-together interlocking system lets you instantly connect them. Vertically or horizontally. So you can mix or match 3/10 and 6/10" centers...expanding or contracting to meet your requirements.

CSC EXPERIMENTOR sockets can be used alone, or mounted on any convenient flat surface, thanks to molded-in mounting holes and vinyl insulation backing that prevents shorts. You can mount them with 4-40 flat-head screws from the front, or 6-32 self-tapping screws, from the rear. But however you use them, EXPERIMENTOR sockets are an unbeatable way to build and test twice the projects in half the time.



Both models feature 94 five-point terminals (vertical lines) and two 48-point bus strips (one strip shown).

WHY WAIT? CSC EXPERIMENTOR sockets are available now from your CSC dealer, or by phone from CSC, at $9.95* for the 300 and $10.95* for the 600. Call 203-624-3103 (East Coast) or 415-421-8872 (West Coast)—major credit cards are accepted.

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CIRCLE 67 ON FREE INFORMATION CARD

letters

DIGITAL SINEWAVES

Don Lancaster's article entitled "Create Sinewaves Using Digital IC's" that appeared in the November, 1976, issue was both interesting and useful. Using a 4018 IC, we built the five-stage synthesizer shown in Fig. 6 of the article. With 1% summing resistors, the output waveform shown in Fig. 1 was obtained. The scope was set to 1 ms-per-division and 0.5 volts-per-division. The harmonic content of the output signal was analyzed and is listed in Table 1.

TABLE 1—HARMONIC CONTENT of five-stage synthesizer.

Harmonic	Frequency (Hz)	Amplitude (dB)
1	200	0
3	600	–17
5	1000	<–60
7	1400	–14
9	1800	–20
11	2200	–21
13	2600	–27
15	3000	<–60
17	3400	–21
19	3800	–16
21	4200	–17
23	4600	–33
25	5000	<–60

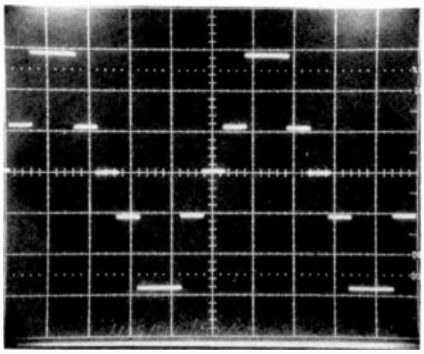

FIG. 1

TABLE 2—HARMONIC CONTENT of modified synthesizer.

Harmonic	Frequency (Hz)	Amplitude (dB)
1	200	0
3	600	–57
5	1000	<–60
7	1400	–54
9	1800	–19
11	2200	–20
13	2600	–60
15	3000	<–60
17	3400	–60
19	3800	–25
21	4200	–26
23	4600	<–60
25	5000	<–60

In the waveform of Fig. 1, the distance between the bottom level and the first step is larger than the distance between the first step and the second step. A better sinewave approximation would have a larger distance between the 1st and 2nd steps, than between the bottom level and the first step. If the 22.1K and 35.7K resistors are switched, the output waveform shown in Fig. 2 is obtained. The scope settings are the same as before. The harmonic content of this output signal was analyzed and is listed in Table 2.

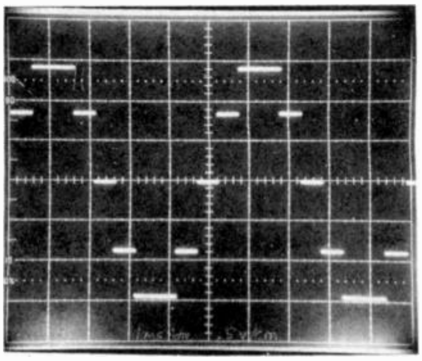

FIG. 2

The modification produces a better approximation that follows the harmonic content specified in the article.

The resistor values obtained in Table 1 of the article are also incorrect. The proper values can be determined from the reciprocal of the numbers shown in the parenthesis in Table 1 of the article. For a six stage counter, the resistors should be: 44.2K (1.000), 25.5K (.577), 22.1K (.500), 25.5K (5.77), and 44.2K (1.000).

Thanks again for a useful and interesting article, keep up the good work.

JOHN PEASE and
GIL JOHNSON
Marquette Electronics
Milwaukee, WI

OPEN LETTER—AM STEREO

Secretary
Federal Communications Commission
Washington, DC

Dear Sir:

The Federal Communications Commission has announced tender of a petition for rule-making (RM-2717) submitted by Kahn Communications, Inc., of Freeport, New York. I, as an individual, a taxpayer and broadcaster, wish to endorse issuance of a notice of proposed rule-making in this matter.

There are several reasons for this endorsement of the Kahn System:

1) Since I am Program Director at WFBR, I have worked with the Kahn Stereo equipment and I know it works.

continued on page 16

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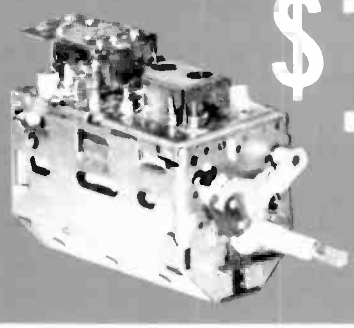

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CIRCLE 49 ON FREE INFORMATION CARD

LETTERS

continued from page 14

2) My tests, although not as sophisticated as those of an engineer, have all proved positive. During WFBR's test authority, I had two radios installed in my car and set them to the upper and lower sidebands. I drove the entire prime signal coverage area to test for any signal difficulty. There was none and the separation was maintained.

3) I drove the same route listening to mono to ascertain any difference in apparent loudness and comparison to other stations. There was none.

4) I had the engineers at WFBR switch from mono to stereo and back again (while listening in mono with the tuner in the center position) to see if there was any interference or effect on the regular single-radio system. I found there was none.

5) I checked to see if there was any interference with any near-by station on the dial or any splatter. There was none.

6) All of the tests that I conducted proved to me that the system is compatable with current broadcast requirements.

7) In my own mind, I question FCC authority in this matter. A broadcaster is authorized to broadcast material over a commercial frequency. He must meet certain specifications and broadcast within the guidelines set by the Rules and Regulations of the FCC. Since the Kahn System has no effect on these specifications and does not change them in any manner, I see no reason for FCC involvement, thus I see no reason to deny this petition.

8) Tuning to the sidebands is no problem and takes no special education. It is as simple to do as changing from one radio station to another.

9) An adaptor could easily be made for stereo tuning. However, the beauty of the Kahn System is that there is no need for the radio listener to run out and buy a new radio. If he wishes to continue listening to a radio station in the mono mode, he may continue to do so. If he has two radios and desires to listen in stereo, he may do so. If he prefers to buy a new receiver with the stereo tuner, and the manufacturers decide to build it, he may do so.

With all of these plus factors, it is hard for me to see why the FCC or any other body would even hesitate to approve use of the Kahn System. It is cheap to install for the broadcaster. It is easily adaptable to present equipment. It opens the vista of stereo broadcasting and listening to people who can't afford the luxury of buying new equipment.

In my opinion it is the duty of the Commission to afford AM broadcasters the right to equally compete with their FM counterparts.

Kahn Communications has followed the proper procedure by placing its request with the FCC rather than an ad-hoc committee.

Delayed action smacks of politics and corporate jealousy. It also deprives the public of present United States technology. It discourages the private individual from making contributions to our society.

Restrictive and delayed action is never positive action.

NO SYSTEM should be considered unless it is 100 percent compatible with today's AM braodcasting codes.

This letter is being submitted to the Commission on a personal basis by me as a citizen and taxpayer. I have no financial interests in Kahn Communications, Inc., WFBR, or any manufacturing, broadcasting or media-related industries.

Respectfully submitted,
NORMAN H. BROOKS
Brooklandville, MD

HELP!

I am an ardent but occasional reader of your fine magazine. However, it is not regularly available in this country at local stores. Hence I am requesting the help of some of your readers who would not mind to do a good turn to a not so well placed member of their technical fraternity. I would like someone to send me copies of **Radio-Electronics** magazine after they've finished using them.

I would also like to correspond to some of your readers who are interested in the exchange of small electronic components not readily available in this country, for Indian curios.

V. N. SURENDRAN
Southern College of
Engineering and Technology
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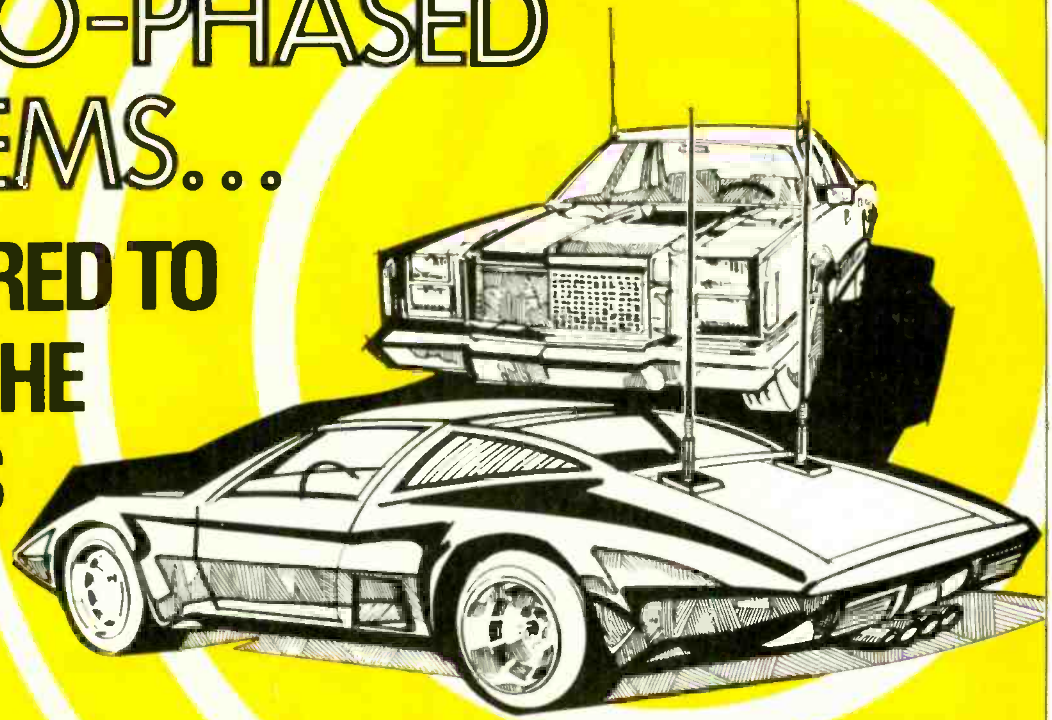

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Because unlike all others, GC Co-Phased Systems feature Mixer-Balun Circuitry (Pat. Pend.). This unique GC design allows you to cut the cables to any desired length with no detrimental affect upon the performance of your system. You maintain a perfect match with no unnecessary cable to hide. So if you're buying a co-phased system, ask for GC. If you don't, we hope you won't mind holding all the extra cable on your lap.

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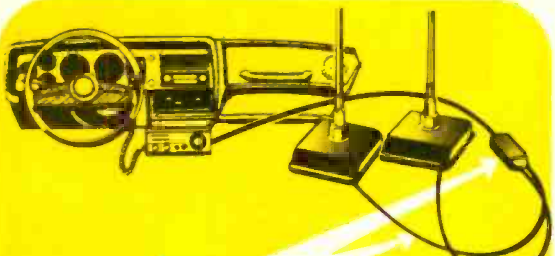

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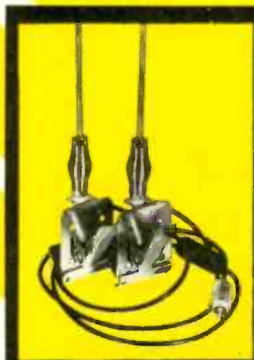

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CIRCLE 1 ON FREE INFORMATION CARD

CIRCLE 100 ON FREE INFORMATION CARD

KOMPUTER KORNER

JOHN TITUS, DAVID LARSEN, and PETER RONY*

ONE OF THE MOST IMPORTANT PROGRAMMING characteristics possessed by any digital computer, including a microcomputer, is the ability to make a decision. For a typical microcomputer, we can define a *decision* as the process of determining further action based upon the logic state of a *flag*. A *flag* is a single flip-flop that can be either set or cleared in response to operations occurring within the microcomputer system. A change of state of the flag is usually an indication that either a particular operation has been completed or that a certain condition exists as a result of a microcomputer operation. Flags can be located either internal or external to the microprocessor chip; the ones that we shall discuss in this column are the internal flags that are set or cleared in response to specific types of microprocessor instructions such as arithmetic and logical instructions.

The flags that are located within the microprocessor chip are typically associated with the *arithmetic-logic unit (ALU)*, a region within the chip where all arithmetic and logical operations are performed. In the 8080 microprocessor chip, for example, there exists five flags that indicate the following conditions:

zero flag—If the result of an arithmetic or logical operation is zero, the zero flag is set to logic 1. If non-zero, the zero flag is reset to logic 0.

sign flag—If the result of an arithmetic or logical operation is negative, the sign flag is set to logic 1. If positive, the sign flag is reset to logic 0.

parity flag—If the result of an arithmetic or logical operation has even parity, the parity flag is set to logic 1. If odd parity, the parity flag is reset to logic 0.

carry flag—If the result of an arithmetic or rotate operation has a carry of the most significant bit of the 8-bit result, the carry flag is set to logic 1. If not, the carry flag is reset to logic 0. The carry flag is reset to logic 0 after all logical operations.

auxiliary carry-flag—If the result of an arithmetic operation has a carry of bit-3 into bit-4 of the 8-bit result, the auxiliary carry flag is set to logic 1. If not, the auxiliary carry flag is reset to logic 0. The auxiliary carry flag is reset to logic 0 after most logical operations.

* 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, Tychon, Inc.

Since insufficient space is available in this column to discuss all of the above flags, we shall restrict our attention to the zero flag.

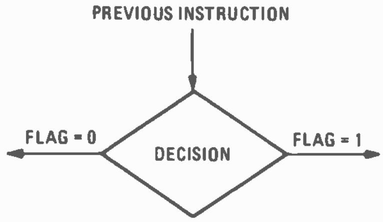


FIG. 1

Figure 1 shows the traditional flowchart *decision symbol*. The next instruction that is executed depends upon the logic state of the flag that is associated with this specific decision. For example, consider the JNZ instruction, where JNZ means "*J*ump *I*f *N*ot *Z*ero:"

Instruction code	Mnemonic	Description
302 <B2> <B3>	JNZ	If the zero flag is at logic 0, jump to the 16-bit memory address given in bytes <B2> and <B3> of this three-byte instruction. If the zero flag is at logic 1, ignore this instruction and proceed to the following instruction.

The statement, "Jump If Not Zero," refers to the 8-bit result of a preceding instruction, not the logic state of the zero flag. When this result is zero, the zero flag is set and program control passes to the next instruction.

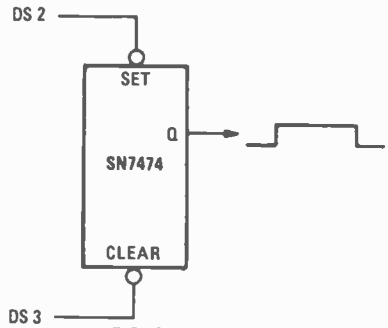


FIG. 2

The JNZ instruction is widely used in the creation of programmed *time-delay loops*, an

continued on page 24

continued from page 22

example of which is provided in Table 1. In this program, both the address and instruction bytes are in octal code; it is assumed that the HI memory address byte is 000. The program first moves an 8-bit timing byte into register B. This byte, indicated by an asterisk (*) has any value between 000 and 377. The value of the byte will determine the duration of the time delay.

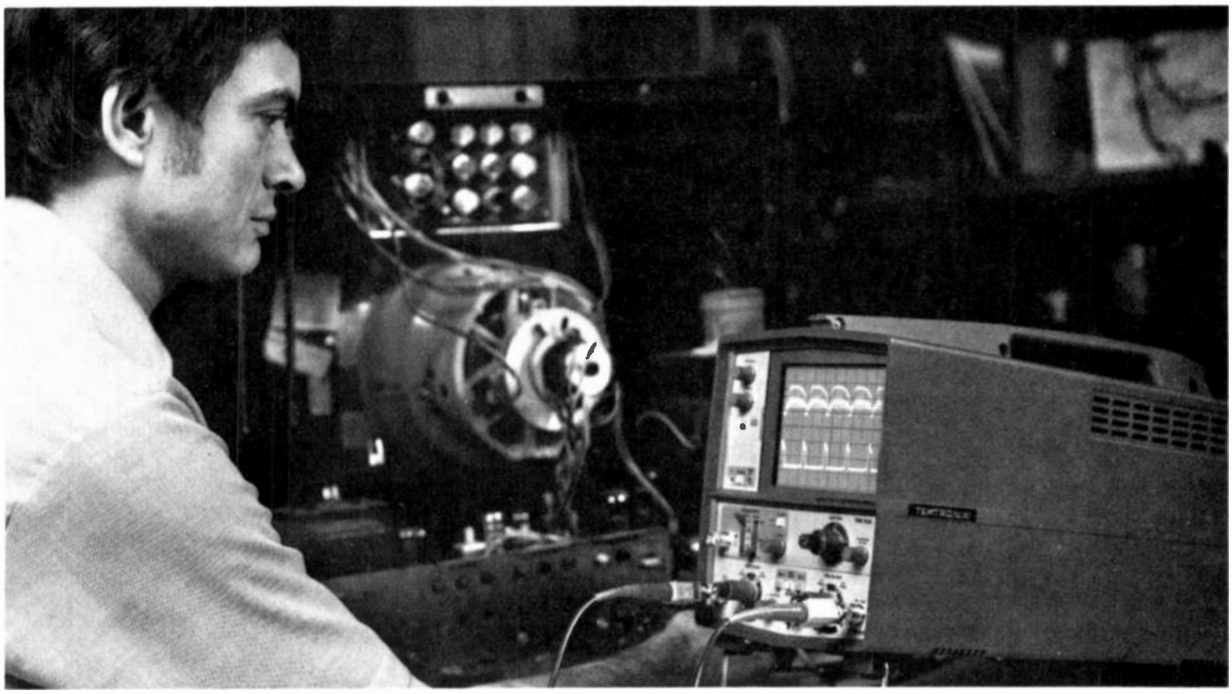
At LO memory address 002, a device-select pulse is generated to set the SN7474 flip-flop shown in Fig. 3. The contents of register B are then decreased by 1. The JNZ instruction immediately tests the logic state of the zero flag. If the contents of register B are not zero, the flag is at logic 0 and a jump occurs back to LO memory address 004. The DCR B and JNZ instructions are executed repeatedly until the contents of register B becomes zero, at which time the zero flag becomes logic 1. The JNZ instruction tests the flag for the last time and shifts program control to the OUT 3 instruction at LO memory address 010. This output instruction generates a device-select pulse that clears the SN7474 flip-flop. Once this has been done, the microcomputer comes to a halt.

The program shown in Table 1 generates a single output-pulse the duration of which can take any value between 0.0125 and 1.925 ms in steps of 0.0075 ms. The calculations associated with the conversion of clock cycles to pulse widths are discussed in the *Bugbook III, Microcomputer Interfacing Experiments Using the Mark 80 Microcomputer, an 8080 System* (E&L Instruments, Inc., Derby, Conn., 1975). The number of clock cycles is a measure of the actual time that it takes the microcomputer to execute a single instruction or group of instructions. For a 2 MHz microcomputer, a single clock cycle has a duration of 500 ns.

The program in Table 1 and associated SN7474 flip-flop provide an example of what we mean by "the substitution of hardware by software," *viz.*, a simple program and a single flip-flop replace a much more complicated hardwired programmable monostable circuit. **R-E**

TABLE 1—SIMPLE TIME-DELAY LOOP

LO memory address	Instruction byte	Mnemonic	Clock cycles	Description
000	006	MVI B	7	Move following timing byte into register B
001	*	—	—	Timing byte for register B
002	323	OUT 2	10	Generate device select pulse that sets the SN7474 flip-flop
003	002	—	—	Device code for set input to SN7474 flip-flop
004	005	DCR B	5	Decrement contents of register B by 1
005	302	JNZ	10	If zero flag is at logic 0, jump to the memory address given by the following two address bytes; otherwise, ignore this instruction
006	004	—	—	LO memory address byte
007	000	—	—	HI memory address byte
010	323	OUT 3	10	Generate device select pulse that clears the SN7474 flip-flop
011	003	—	—	Device code for clear input to SN7474 flip-flop
012	166	HLT	7	Halt the microcomputer



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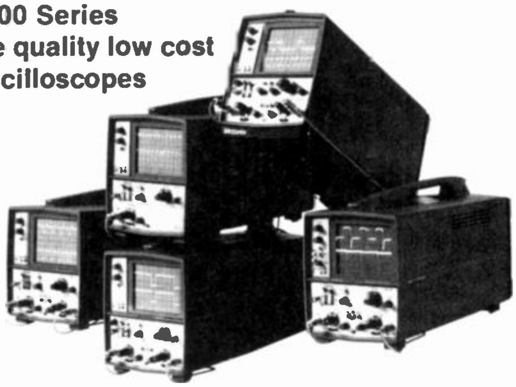

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CIRCLE 29 ON FREE INFORMATION CARD

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The new GR-2001 TV system is the most sophisticated, best performing color TV kit we've ever designed, but it is also much more. It is the heart of a total home viewing system — a Computer TV!

Complete Programming Capability

With its optional Programmer, this Computer TV system allows you to program your set for an entire evening's viewing. The top bank of 8 keys [1] accesses the static NMOS RAM and turns the on-screen clock display into a computer CRT readout which alolws you to see your "program" as you enter it through the bank of 12 keys below the programmer panel. The selected time appears in the first four digits of the clock display, the channel number appears in the last two. First, enter the time at which you want the set to change channels. Next, enter the channel number you want. Then the memory takes over. While you sit back and relax, the Programmer automatically changes to the right channel at the right time. You can program up to 32 channel changes within two 12/24-hour periods!

Those two programming periods add extra versatility. Program the first for your daytime viewing schedule, the second for evening shows. Or, program the first for week nights, the second for weekends. You can even preselect the programs young children can watch — once the programmer is engaged, the manual keyboard is disconnected and can only be reactivated by the remote control or by pressing the correct button on the programming panel.

You can even program the set to return to manual operation at a preselected time, then resume automatic operation at another time. When the last program you want to see is over, the set can be programmed to switch to an empty channel. This will cause the screen to go blank and the on-screen readout to flash on and off indicating that it is time to turn the system off with the front panel pushbutton or optional remote control.

Convenient Remote Control

The optional wireless remote control [2] lets you adjust volume, turn the set on or off, adjust tint, activate the digital readout, scan up or down through the preselected channels, and turn the optional programmer on and off — all at the touch of a button. This wireless remote control has improved circuitry for greater range and reliability and is the best we've ever offered.

Random Access Tuning

The 3 x 4 keyboard [3] lets you instantly choose any of up to 16 preselected stations — up to 24 with the optional eight channel accessory. Switch from VHF to UHF, up or down, in any sequence, and be tuned in instantly without switching through empty channels. Up and down buttons on the keyboard also let you scan all the preselected stations.

Automatic Antenna Rotor Control

A Heathkit exclusive! With the optional antenna rotor control [4], you can program the GR-2001 to automatically rotate your outdoor antenna system as it changes from one channel to another, for optimum reception on every channel. No special knobs to turn, no buttons to push. You can select up to eight separate antenna headings with up to three stations per heading. It's perfect for areas where stations are in widely separated locations.

Superb Color and Sound

The TV set itself contains dozens of circuit refinements and improvements designed to give you the best picture and performance you've ever seen. The Automatic Gain Control circuit, for example, has been significantly improved to better resist airplane flutter. And since you build it yourself, you can be assured of a set that is free of mass production "glitches" that show up all too often in other sets now on the market.

Separate Audio IF Stage

The audio circuitry is probably the finest on any commercial set in the world. The sound signal has its own separate IF stage [5] that contributes to real quality audio. Audio and video muting provide smooth, silent between-channel tuning, too. You can hear the difference — especially if you use the output jack to connect the GR-2001 to your stereo system. The built-in wide-range speaker offers excellent fidelity as well. It's one of the first sets ever to give you real hi-fi sound from a TV!

Phase-Locked-Loop Horizontal and Vertical Hold Circuits

New phase-locked-loop horizontal and vertical oscillators [6] "lock-in" on any channel for a picture that's rock-steady and stable. There are no conventional vertical and horizontal hold controls because you never need them! There are no alignment problems either, so you get consistently excellent pictures year after year.

Black-Matrix Picture Tube

The GR-2001's 25" (diagonal) ultra-rectangular picture tube [7] provides one of the brightest, sharpest pictures in the world. The tube is fully shielded to maintain outstanding color purity by eliminating stray magnetic fields.

Easy To Assemble

Though the GR-2001 is one of our more complex kits, the average person shouldn't have any difficulty in assembling it. A step-by-step illustrated manual will lead you through assembly right up to troubleshooting and testing. A test meter (included) lets you check assembly as you go, and the built-in dot generator aids in setup and service.

GR-2001 Specifications

Antenna Input Impedance: VHF: 300Ω balanced or 75Ω unbalanced. UHF: 300Ω balanced.

Hi-Fi Output: Frequency Response: ±1 dB, 50 Hz to 15 kHz.

Output Voltage: Greater than 1.0 V RMS.

Audio Output: 4Ω or 8Ω, 2 Watts.

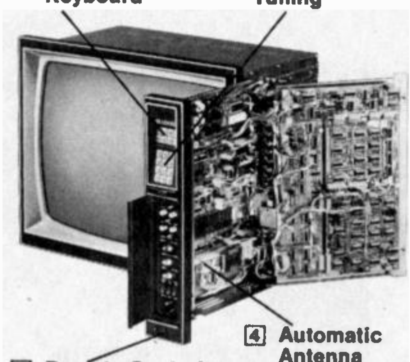
Power Requirement: 110 to 130 Volts AC, 60 Hz, 200 Watts.

Dimensions: 29⅛" W x 20⅛" H x 21¾" D.

GR-2001 TV kit alone (chassis, picture tube and one speaker): 699.95

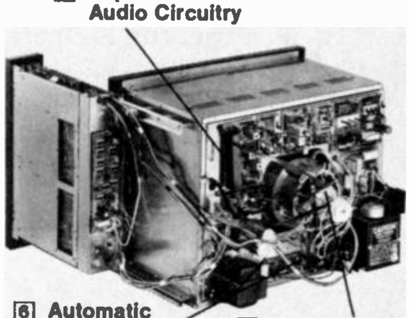
Heath Company, Dept. 20-261
Benton Harbor, Michigan 49022

[1] Programmer Keyboard
[3] Random-Access Tuning



[2] Remote Control
[4] Automatic Antenna Rotor Control

[5] Separate Audio Circuitry



[6] Automatic Horizontal and Vertical Hold Circuits
[7] Black-Matrix Picture Tube

FREE Catalog of nearly 400 fun-to-build electronic kits.

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GX-328A

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CIRCLE 102 ON FREE INFORMATION CARD

the world's only computerized TV system.

Simulated TV Picture

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Send for FREE illustrated career guide

(Simulated TV Reception)

As an NTS student you'll acquire the know-how that comes with first-hand training on NTS professional equipment. **Equipment you'll build and keep.** Our courses include equipment like the **NTS/Heath GR-2001 computerized color TV (25" diagonal)** with varactor diode tuning and digital read-out channel selection; (optional programming capability and digital clock avail.).

Also pictured above are other units — 5" solid state oscilloscope, vector monitor scope, solid-state stereo AM-FM receiver with twin speakers, digital multimeter, and more. It's the kind of better equipment that gets you better equipped for the electronics industry.

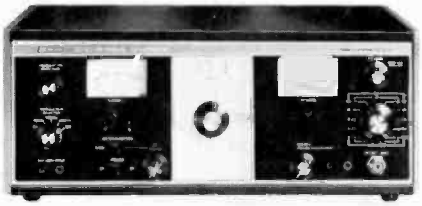
This electronic gear is not only designed for training; it's field-type — like you'll meet on the job, or when you're making service calls. And with NTS easy-to-read, profusely illustrated lessons you learn the theory behind these tools of the trade.

Choose from 12 NTS courses covering a wide range of fields in electronics, each complete with equipment, lessons, and manuals to make your training more practical and interesting.

Compare our training; compare our lower tuition. We employ no salesmen, pay no commissions. You receive all home-study information by mail only. All Kits, lessons, and experiments are described in full color. Most liberal refund policy and cancella-

equipment reports

B & K Model 2040 CB Signal Generator



CIRCLE 82 ON FREE INFORMATION CARD

AS MANY SERVICE SHOPS ARE TOO FREQUENTLY aware, it is almost impossible to convince most CB'ers that a repair or adjustment has restored "like new" performance to their transceiver. The time spent just explaining the in and outs of sensitivity and adjacent channel rejection can eat up a good part of the profit in many CB repair jobs.

But now there's a service instrument that not only lops hours off CB service, it satisfies customers in minutes and lends itself to setting up a traffic-building "lab check-out" station in some unused corner of the shop. For a modest fee, any service shop can now provide a complete laboratory quality check-out of any modern transceiver.

The equipment that does all this is B & K's *model 2040* CB Signal Generator that is specifically designed for the test and adjustment of Class-D AM and SSB transceivers. Just looking at the front panel is almost self-explanatory as to features and service conveniences.

In the center of the front panel is the CHANNEL selector for the digitally synthesized oscillator that provides all 40 channels plus all the frequencies in-between authorized channels. For example, the dial is calibrated for Channels 11 and 12. The frequency between the two is not authorized for Class D, yet the signal generator has a dot and frequency readout for Channel 11½, so adjacent channel rejection for channels 11 and 12 can be measured. The two "channels" between Channels 22 and 23 were similarly unassigned to CB. They are *now* Channels 24 and 25 and are so indicated on the dial.

The CHANNEL selector indicates the frequency and the channel, or a dot if no channel is assigned, for every step of the selector switch.

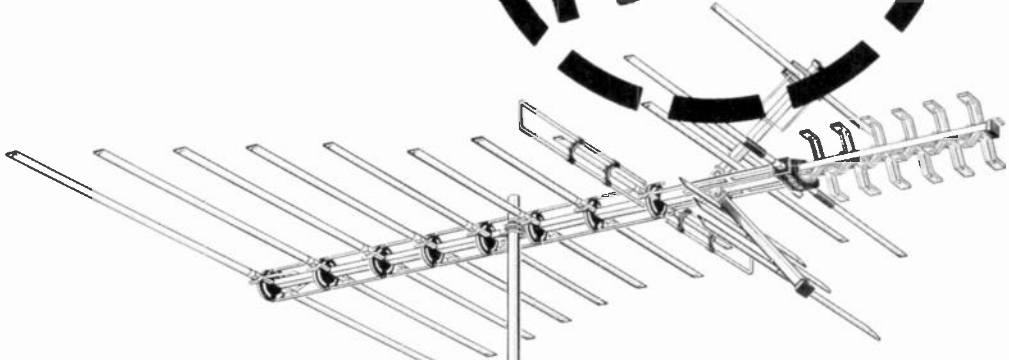
On the right side of the front panel are the RF output controls and an associated meter calibrated in microvolts and dB. A precision shielded attenuator provides a full-scale RF output of 1 to 100,000 microvolts. An RF LEVEL control permits the output to be further reduced to 0.1 μV. For adjacent channel and AGC measurements, the attenuator and meter are calibrated in dB as well as absolute microvolts. The RF output is available at a standard SO-239-type coaxial connector.

For service and troubleshooting there is also a 455-kHz oscillator complete with its own output control and output jacks. This oscillator can be used simultaneously with the RF signal generator.

On the left side of the front panel is a fully metered modulator and incremental frequency control. The modulator provides 400, 1000 and 2500-Hz internal modulation, or external modulation, to full 100%. The modulation amplitude is adjusted by a continuously variable control and the percent modulation is indicated directly on the meter. By "flipping" a meter function switch, the meter is set to indicate the delta frequency (incremental adjustment) of the main oscillator. A control

You get a lot extra with Jerrold's Xtra Rated Antennas.

Xtra Rated



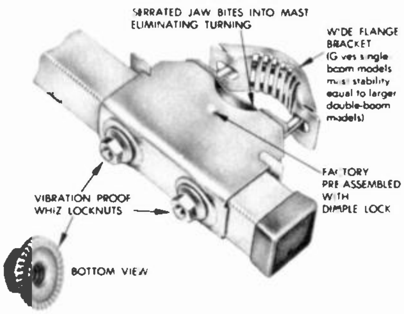
Jerrold
Super VU-Finder
and Paralog Plus
Antennas are now
Xtra rated to give you:

Xtra Ease of Installation
Xtra Mechanical Reliability
Xtra Performance

Jerrold VU-Finder and Paralog Plus Antennas have long been the performance standard of the industry. Yet, we are constantly working to advance the state-of-the-art and have now added a number of important improvements. Our antenna line is significantly better than any antennas we have ever produced. And that goes for competitive antennas too! The Xtra features found in the Super VU-Finder and Paralog Plus Antennas make them *go up faster, perform better* and *stay up longer.*

Here are a few of the features now found in Jerrold Xtra Rated Antennas.

Improved U-Bolt Assembly



Improved Stainless Steel Terminal Screws

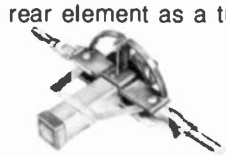
The no-strip stainless steel washers have longer teeth to give a better bite on current foam twin-leads, assuring excellent electrical contact. Terminal screws have also been made longer.

FM Breakaway

FM blocking elements reduce received FM up to 12 dB. To receive FM at full gain, break off the element at score mark.

Stamped Termination Bracket

The stamped termination bracket provides dc continuity and provides higher front-to-back ratio by using the rear element as a tuned reflector.



Dollar for dollar, and dB for dB, no competitive antennas match the VU-Finder and Paralog Series for ease of installation, performance and reliability.

Install a Jerrold Xtra Rated Antenna today and see the difference for yourself or write for complete details.

QDMX

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GENERAL INSTRUMENT CORPORATION

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CIRCLE 60 ON FREE INFORMATION CARD

for this purpose "slides" the RF output frequency ±5 kHz off the frequency indicated by the channel selector. A separate scale on the modulation meter indicates the amount of incremental adjustment. Red and green LED's indicate whether the incremental adjustment is on the high or low side of the center channel. For example, assume the channel selector is set to 27.065 MHz. If the incremental (delta) tuning is adjusted so the meter indicates 2 kHz and the "high" LED is illuminated, the RF output frequency becomes 27.067 MHz. Since modulation is applied with or without delta tuning., it's possible to check in less than one minute's time either adjacent-channel rejection or SSB alternate-sideband suppression (an important parameter as more and more SSB transceivers come into use).

Finally, the *model 2040* has an EIA noise-pulse generator used for checking the effectiveness of noise limiters and noise blankers. (A very easy way to demonstrate to a CB'er the effectiveness of both types of limiters if the transceiver has noise limiter or noise blanker switches.) The noise generator has a pulse width of 1 microsecond, a repetition rate of 100 pulses-per-second, and a risetime and falltime of 10 nanoseconds. This provides a very close approximation of typical electrical interference pulses. The noise generator is applied through a push-pull switch on the RF LEVEL control and can be applied to the signal with or without tone modulation of the carrier.

The obvious advantage of the B & K *model 2040* CB signal generator is that only one single connection need be made to the transceiver under test. All frequencies, modulation, noise pulses, carrier offset (delta), etc., are then available at the flip of a switch and are fully metered. There is no need for external measuring equipment such as a frequency counter or modulation meter to insure measurement accuracy.

Fact is, when the signal generator is combined with B & K's *model 1040* CB service set and a service-grade oscilloscope, a complete checkout of a transceiver's receiver, transmitter and modulator sections can be made in minutes by simply flipping a few switches.

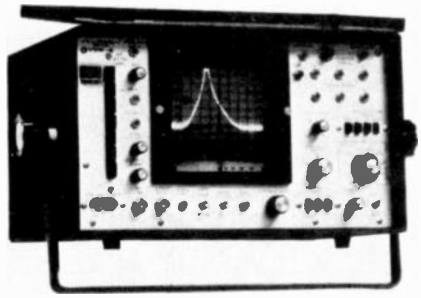
Since the *model 2040's* output frequency is determined through a digitally programmed PLL circuit, the frequency tolerance of all output frequencies is that of the reference oscillator, which is specified by B & K to ±5 parts-per-million (0.0005%) over a temperature range of 0° to 50°C after a 15 minute warmup. Our frequency counter indicated a maximum error of 90 Hz (including the tolerance of the counter), and less than 3 Hz "drift" during the 15 minute warm up. Essentially, there is no change in output frequency during warm up.

The cabinet is RF shielded (circuits are double-shielded) and there is effectively no RF leakage. If the transceiver isn't connected to the generator there is no "reception" from the generator.

The output attenuator circuit has built in protection against accidental application of a transmitter's 4-watt RF output. (The protection is actually rated for 5 watts RF.) Normally, the automatic receive-transmit switching in the companion *model 1040* CB service set would protect the signal generator against accidental application of a CB transmitter's output, but if you haven't yet upgraded your shop with the *model 1040*, you at least don't have to worry about burning out the *2040's* output attenuator.

The suggested retail price of the B & K *model 2040* CB signal generator is $475. All connecting cables are optional. **R-E**

Jerrold/Texscan VSM-5 Spectrum Analyzer



CIRCLE 83 ON FREE INFORMATION CARD

I HAPPEN TO BE A TEST-EQUIPMENT FREAK. I GO all to pieces with test gear that can really do things. So, I was very happy when Jerrold-Texscan sent me their VSM-5 spectrum analyzer to work with. I had seen an audio spectrum analyzer at work, but never had a chance to get my hands on an RF type. To put it briefly, I was amazed at the things this black box with a CRT and knobs on it can do.

The heart of the instrument is a triple-conversion superheterodyne receiver. The 1st oscillator works between 650 and 1,000 MHz, the 2nd oscillator at 586 MHz and the 3rd at 54 MHz. The 1st IF is 650 MHz, the 2nd IF is 64 MHz and the 3rd IF is 10 MHz. The first oscillator can be swept by varactor diodes over a tremendous range; from 4 MHz to 350 MHz. So, the instrument can cover the whole VHF TV band at one time. You can see both sound and picture carriers of every channel.

By adjusting the DISPERSION control, you can change the distance between the channel pips. The horizontal sweep rate can be varied from a very slow sweep (0.3 Hz) to 30 Hz. The center frequency of the display can be moved by a continuously variable control so that any channel desired can be centered on the screen. Fine and coarse tuning controls are also provided. The CRT used is a special type that is similar to those used in radar–the fluorescence is bright bluish-green, and the phosphorescence (a long-persistance phospher that provides "after-glow") is green.

The vertical scale of the graticule is calibrated in dBmV, which is the standard for CATV/MATV systems. The dBmV requires a logarithmic response from the vertical amplifier. This is obtained by means of a special logarithmic-response amplifier in the output of the 3rd IF. Its output feeds a special detector circuit. Two ranges can be used, 30 dBmV or 60 dBmV. So, the actual level of any TV signal or any RF signal can be read instantly. A level of "zero dBmV" means a signal of 1,000 microvolts (1.0 millivolt) which is a standard for CATV systems.

So, the VSM-5 finds its most common use in making fast, accurate tests of CATV systems to verify compliance with the new FCC standards. Among these are such things as the minimum amplitude of the video carrier, which must be 0 dBmV for each

channel; the level of the sound carrier, which must be from 13 to 17 dBmV down to the video carrier, and so on and on. These may be checked with a field-strength meter, of course, but with the VSM-5, the operator can get the "whole picture" at once.

The instrument can be used as a field-strength meter, too, for orienting antennas, measuring their gain, and similar tricks. The height of the pips on the screen is directly proportional to the signal strength. In CATV systems which change channel frequencies, it can be used with an external standard to verify that the new carrier is exactly on-frequency.

With a special "slow-sweep" generator, the whole CATV system can be tested for flat response. This can be done with the system in full operation; the subscribers don't even know it's being done! The sweep-generator is fed in at the head-end, and the VSM-5 is connected to a tap at the end of the line. The slow-sweep generator generatres a continuous-wave that is swept at such a speed that it passes through active channels without causing any disturbance to the picture. The VSM-5 is set to the same sweep frequency and the resulting trace can be photographed to verify flat response of the entire system.

By adjusting the DISPERSION control, each channel can be checked. The sound and video carriers will show up as sharp pips, and the color carrier as a constantly varying smear. Any sign of intermodulation distortion in the system shows up instantly as a pip where there shouldn't be one. At a very wide setting of the DISPERSION control, the harmonics of the horizontal sweep show up. The harmonics are spaced 15.75 kHz apart and any IM shows up between these.

Hum levels in the system can be checked, and signal-to-noise readings taken. If any interfering signals are spotted, the instrument can be set to a lower resolution so that the exact frequency of the interfering signal can be found. The resolution can be set to 200 kHz, 10 kHz or 0.5 kHz (500 Hz) for this. For verification, markers can be switched in at 1, 10 or 50 MHz. These generate a set of zero-beats or birdies for this test. By counting the number of beats, say at 1.0 MHz apart, the signals can be identified.

Beside the variable VHF sweep, three preset bands may be used. These can be tuned to any frequency in the range for tests where the same signal must be checked. For example, we used the markers to check out a set of CB traps by setting up a 27-MHz signal at the left side of the screen, its 2nd harmonic (54 MHz) in the middle, and the 3rd harmonic on the right. By hooking the traps in series with the input and tuning them, their effect could be instantly seen. The same method could be used for setting TV interference traps in a CB (or any) transmitter. All you need is a signal generator that will give you harmonics. I found out, by the way, that my RF signal generator wasn't all that "pure": with the output cranked wide open it developed a very perceptible 2nd harmonic! For checking CB transmitters, all you need is an RF pickoff that will give you about 1.0 watt into the VSM-5 input. The instrument has pushbutton attenuators on the front panel that are capable of providing a total of 62 dBmV in 7 steps. There are two 20-dBmV attenuators, then 1,2,3,6 and 10 dBmV so that you can get whatever attenuation is needed. The actual signal level is then read from the screen and the in-circuit attenuators added to this.

The VSM-5 is powered by an internal 12-volt battery that is rechargeable or from a 117–230-VAC line. It is fully portable and may be used "portable" in the field for up to three hours of continuous operation. This makes it ideal for use as a mobile unit for detecting and measuring cable leakage, antenna testing, gain comparisons and you-name-it.

This instrument will do a lot more things; its usefulness is limited only by the ingenuity of the operator. (This almost got me, at first, but by diligent reading of the instruction manual, I finally made it do everything I wanted it to!) The actual operation is quite simple once you learn how, which really doesn't take all that long. The suggested retail price of the VSM-5 is $3950. **R-E**

Unique full-function 8-digit wrist calculator... available <u>only</u> as a kit.

A wrist calculator is the ultimate in common-sense portable calculating power. Even a pocket calculator goes where your pocket goes—take your jacket off, and you're lost!

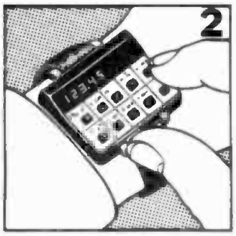
But a wrist-calculator is only worth having if it offers a genuinely comprehensive range of functions, with a full-size 8-digit display.

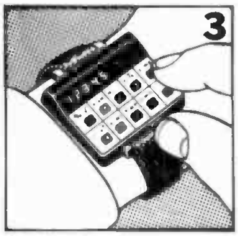
This one does. What's more, because it *is* a kit, supplied *direct* from the manufacturer, it costs only a very reasonable $19.95. And for that, you get not only a high-calibre calculator, but the fascination of building it yourself.

How to make 10 keys do the work of 27

The Sinclair Instrument wrist calculator offers the full range of arithmetic functions. It uses normal algebraic logic ('enter it as you write it'). But in addition, it offers a % key; plus the convenience functions $\sqrt{x}$, $1/x$, x^2; plus a full 5-*function* memory.

All this, from just 10 keys! The secret? An ingenious, simple three-position switch. It works like this.





1. The switch in its normal, central position. With the switch centered, numbers—which make up the vast majority of key-strokes—are tapped in the normal way.
2. Hold the switch to the left to use the functions to the left above the keys . . .
3. and hold it to the right to use the functions to the right above the keys.

The display uses 8 full-size red LED digits, and the calculator runs on readily-available hearing-aid batteries to give weeks of normal use.

Assembling the Sinclair Instrument wrist calculator

The wrist calculator kit comes to you complete and ready for assembly. All you need is a reasonable degree of skill with a fine-point soldering iron. It takes about three hours to assemble. If anything goes wrong, Sinclair Instrument will replace any damaged components free: we want you to enjoy assembling the kit, and to end up with a valuable and useful calculator.

Actual Size

Contents

Case and display window.
Strap.
Printed circuit board.
Switches.
Special direct-drive chip (no interface chip needed).
Display.
Batteries.

Everything is packaged in a neat plastic box, and accompanied by full instructions. The only thing you need is a fine-point soldering iron.

All components are fully guaranteed, and any which are damaged during assembly will be replaced free.

The wrist-calculator kit is available only direct from Sinclair Instrument. Take advantage of this 10 day money-back offer.

Send the coupon today.

KIT ONLY $19.95

Sinclair Instruments Inc.
6 Commercial Street
Hicksville, N.Y. 11801

To: **Sinclair Instruments Inc.** RE-2
6 Commercial Street
Hicksville, NY 11801

Please send me

____ Sinclair wrist calculator kit(s) at $19.95 $____

Sales tax (NY residents) ____

Shipping & handling ($2.50 per unit) ____

Enclosed is check/MO (payable to Sinclair Instruments Inc.) TOTAL $____

Name ____

Address ____

City ____

State ____ Zip ____

I understand that you will refund the purchase price of the kit in full if I return it in saleable condition within 10 days of receipt.

Measure f_T* and a full range of semiconductor parameters for under $300!

with the B&K-PRECISION Model 530

New from B&K-PRECISION, the Model 530 semiconductor tester can actually perform more tests, on more devices, than any other competitively priced semiconductor tester. In the engineering lab, the 530 provides a full range of accurate data including an exclusive bipolar transistor gain-bandwidth product measurement capability to 1500 MHz.

In-circuit tests include:

- Positive good/bad tests for bipolar transistors, FET's, diodes, and SCR's
- Polarity identification of all semiconductor devices, including identification of N or P channel FET's
- Identification of all leads of bipolar transistors
- Gate lead identification of FET's
- Identification of all leads of SCR's

Out-of-circuit tests include:

- Transistor gain-bandwidth product(f_T) up to 1500 MHz
- Transistor beta using two collector current ranges
- Gm of FET's—including high-power devices
- Nondestructive testing of transistor, SCR and diode breakdown voltages up to 100 volts
- Reverse leakage from 0.5μA to 5mA for transistors, SCR's and diodes
- I_{DSS} and gate leakage of FET's
- Identification of device as bipolar transistor, FET or SCR
- Plus all in-circuit tests and many more parameters

The 530 is not only one of the most complete semiconductor testers available, it's one of the easiest and fastest to use. No charts, tables or calculations are required for basic operation, nor is additional equipment required. The 530 is a direct reading stand-alone instrument. Even unskilled assembly line workers can perform quality control tests with minimal training. Both visual and aural test indications are provided.

The B&K-PRECISION Model 530 is priced at only $295. For additional Information or for immediate delivery see your nearest B&K-PRECISION distributor.

*Gain-bandwidth product or unity-gain frequency.

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CIRCLE 80 ON FREE INFORMATION CARD

Radio-Electronics

40-CHANNEL CB SPECTACULAR

SPECIAL 16-PAGE SECTION

IN THIS SECTION

40-Channel

The approval of 40-channel
monium among manufacturers
to abate. Some new type-accepted
shelves and others on the way.

JANUARY 1, 1977, WILL PROBABLY BE RATED AS A GREAT DAY FOR the shipping industry, thanks to the Citizens Band radio industry. That was the word at press-time in mid-December as CB producers lined up type-accepted 40-channel equipment for shipment to retail stores for Jan. 3 selling.

Some companies said they had trucks standing by waiting to head for local or area warehouses and shipping points as soon as the New Year was born. Others said they would wait a few hours and use airliners to convey their new products to dealers anxious to have them for sale the first Monday of 1977.

While the Federal Communications Commission has done a yeoman job of processing hundreds of product submissions, there are more to complete. However, the industry has enough approved product to convince early 40-channel CB shoppers that the new medium is actually here, and there are plenty of goodies from which to make a selection. The feeling is that by March 1 all current prototype submissions will have been processed and the initial product lineup will be complete.

In brief asides to our new product information gathering, we learned that most manufacturers are not expecting consumers to "break down doors to get the new sets," as one put it. Some are expecting a new wave of confusion in the marketplace as potential purchasers evaluate the new offerings at their initial high prices against existing 23-channel product at deeply discounted prices. Said one supplier: "That price differential is really going to tell us what the bottom line actually is." Manufacturers who have been looking forward to January 1, 1977, have been doing so with somewhat lower sales expectations than, say, when they were anticipating January 1, 1976.

Come January the industry as well as the consumer will get

Alpine

Type accepted: *BR640*. No details.

Audiovox

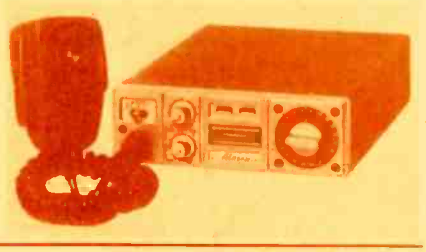
Several units at FCC of a proposed 10-model line for 1977. Marketing expected to begin in March. Line will consist of six in-dash models, some with FM, and four under-dash units. (150 Marcus Blvd., Hauppauge, NY, 11787)

Automatic Radio

Two under-dash models at FCC, prototypes of which had earlier been type-accepted. Expected to be ready for sale on Jan. 3. The sets are: *Model CBL2270*, list priced at $181.95, with built-in slide-in/out theft-proof bracket, RF gain, Delta tune; and *CBH2265*, list priced at $202.50, with theft-proof bracket, RF gain, LED readout. (2 Main Street, Melrose, MA 02176)

B & B

At FCC: Five mobiles, one base unit. Prices expected to be "approximately the same price as equivalent 23-channel models when originally introduced." Two models are expected to be ready for January shipment. (185 Park St., Troy, MI 48064)



B & B's Alaron B-4075

Benjamin

Type accepted: *Model 200*. No details.

Bohsei

At FCC: Two mobiles. Expected to be available in March. (7037 Hayvenhurst Ave., Van Nuys, CA 91406)

Boman

Type accepted: *Model CBR-9950*, not priced, in-dash AM/FM/FM stereo/CB with LED readout, T/R mode indicator light, S/RF meter, ANL, fader control for four speakers.

At FCC: Nine models, consisting of two in-dash, four under-dash, one base station, one modular hideaway (trunk, firewall installation), and one hideaway for attachment to stereo player.

Expects to ship *CBR-9950* Jan. 1. (9300 Hall Road, Downey, CA 90241)

Browning

Five models at FCC—three AM under-dash, one SSB AM under-dash, one single sideband AM base station. No pricing set.

Company is confident all five will be type accepted, with some product ready for shipment to dealers for Jan. 3 selling, more ready within 10 days. (1269 Union Ave., Laconia, NH 03246)

Boman CBH-995 base unit.

Channel Master

Type accepted: Under-dash *Model CB-6835*, featuring PLL, LED readout, Delta tune, ANL, noise blanker. Price not set.

At FCC: One under-dash model. Expects also to submit a base station to

Roundup

CB unleashed a pande-
that is just starting
models are on dealer's
Here's what to look for

FRED PETRAS

a final fix on CB as regards the position of 23-channel versus 40-channel. Several suppliers—some with big, some with small 23-channel inventories—predicted that as the consumer weighs the merits of both types, he will be inclined to lean toward 23's in terms of their initial wide price differential. This, say the producers, *may* cause some dealers to jack up the prices of 23-channel units in their stocks closer to their earlier prices—but not all the way. For example, units that once sold for $140, later discounted to $110, then to $90, and finally on retail shelves at $70, may be hiked back up to, say, $100 or $110. This will preserve a substantial price differential for the cost-conscious consumer. However, we expect to see the supply of 23-channel equipment dry up by the middle of the year. So if you plan to buy 23, you best buy soon.

Other industry members are predicting that the gap will lessen as 40-channel prices move down to "realistic" levels that will be determined in part by consumer acceptance of, or resistance to, the new products.

While we have scoured the industry to come up with a comprehensive roundup of 40-channel product available for January, 1977, selling, that roundup understandably is not complete in the light of: Early press deadlines common to magazine publishing; The unfinished processing of submitted prototype products by the FCC; Incomplete information on the part of CB manufacturers. We beg your indulgence under these circumstances. We hope to add to the information that follows with a second listing in our next issue.

NOTE: Prices indicated are those given when companies were contacted. Some are approximate, and are so indicated. Some prices may change, in line with production/materials cost vagaries.

FCC for late winter/early spring marketing. (Ellenville, NY 12428)

Clarion

Awaiting approval at FCC are: *Model 367*, $329, in-dash AM/FM/FM stereo/CB; *Model 621*, $359, same as *367* plus 8-track player; *Model 672*, $379, same as *367* but with cassette mechanism; *Model RCJ-003*, $199, modular system with separate integrated head containing mike and controls, with electronics mountable on firewall, under dash, under seat, or in trunk.

Expected to be in production in January for marketing the latter part of February. (5500 Rosecrans Ave., Lawndale, CA 90260)

Cobra

At FCC: Nine models, most variations on one basic chassis, consisting of six AM mobiles, two SSB mobiles, one base station. Expects to have some units for shipment Jan. 1. Complete 1977 line will consist of 12 models. (6460 W. Cortland Ave., Chicago, IL 60635)

Cobra 21XLR

Colt

Type accepted: *Model 290*, $200, under-dash, with LED readout, ANL, noise blanker, Delta tune, RF gain, S-meter, PA. Expected to be available at retail mid-January.

At FCC: *450*, $230, under-dash, same features as *290* plus mike gain control, SWR meter; *480*, $320, under-dash, AM/SSB, with same basic features as *450*; *800*, $300, AM base station, LED readout, walnut cabinet, SWR calibration, Delta tune, ANL, noise blanker. (5725 N. Central Ave., Chicago, IL 60646)

Commando

Type accepted: *CC-4040*, under-dash AM radio, LED readout, PLL. No price set. *CC4086*, no details.

At FCC: *CC-4050*, under-dash mini model, LED readout, PLL; *CC-4055*, under-dash full-feature unit with Delta tune, PA, LED readout, PLL; *CC-5010*, in-dash AM/FM/CB combo with LED readout and PLL.

Units at FCC expected to be approved in time for marketing Jan. 1. (P.O. Box 11071, Chattanooga, TN.)

Craig

At FCC: *Model L-101*, under-dash, approximate price $170. Features include Day/Night filament channel readout under all illumination conditions, reversible slide-out bracket, switchable ANL, PA, squelch, large S/RF meter, proprietary Craig mike/control unit.

Model L-131, under-dash SSB, with full complement of SSB controls, noise blanker, Day/Night channel indicator. Approximate price, $360.

Model L-231, SSB base station, approximate price $500. Features include digital clock alarm timer circuitry, dual antenna input.

Model L-600, under-dash, approximately $280. Features include 2-speed up/down channel selector on Craig mike and radio itself, provision for foot-switch channel selection, Day/Night channel indicator, hideaway mike bracket. (921 West Artesia Blvd., Compton, CA 90220)

Fanon/Courier

Fanon division. At FCC: Eight models, consisting of one AM base station, one AM SSB under-dash unit, five under-dash AM units, and one in-dash combination—AM/FM/FM stereo/CB with Channel 9 priority switch and LED readout/selector built into the mike. One of the five under-dash units also has the latter feature.

Six of the above expected to be ready for sale on Jan. 1. (Subsequently type accepted: *Fanfare 100F*, no details.)

Courier division: Type accepted: *Rebel 40*, under-dash, priced at $100.

At FCC: Eleven models, all expected to be type accepted for January 1 selling. (990 South Fair Oaks Ave., Pasadena, CA 91105)

Xtal

At FCC: Six models in the XTAL brand consisting of two under-dash, four modulars for trunk or firewall installation. No price information. (Far Eastern Research Laboratories, 8749 Shirley Ave., Northridge, CA 91324

Fieldmaster

At FCC: *Model TR-40*, $260, under-dash, with noise blanker, ANL, PA, RIT tuning, and separate LED readout unit for above-dash mounting. *Micro-Mini-40*, $240, under-dash compact, LED readout, ANL, noise blanker, PA.

Both expected to be available at retail on Jan. 3. (21212 Vanowen St., Canoga Park, CA 91303)

Arthur Fulmer

At FCC: *Model 15-4035*, under-dash AM/FM/FM stereo/CB with automatic warning light, and full lineup of features including ANL and noise blanker; *Model 16-8400*, in-dash AM/FM/FM stereo/CB with LED readout, monitor override, overload circuitry. Former expected to be available "almost immediately" in January, the latter by Feb. 1. No prices set.

Expected for spring sale, a low-priced unit, *Model 15-4030*, no details. (P.O. Box 117, 260 Monroe, Memphis, TN 38103)

GC

At FCC: *Model 9200*, under-dash, with full complement of features, including PA and noise blanker.

Planning to submit several more for type acceptance. (4000 South Wyman St., Rockford, IL 61101)

Gemtronics

Six models at FCC—five under-dash with "standard" features, plus one base station. Expected to be approved in time for January marketing. (356 South Blvd., Lake City, SC 29560)

General Electric

Type accepted (all under-dash units): *Model 3-5801*, $135, lighted S/RF meter, quick release mounting system, switchable ANL; *Mobel 3-5811*, $160, large meter, PA, switchable ANL; *Model 3-5819*, $220, with 3-way lighted meter, LED readout, antenna warning light, switchable noise blanker and ANL; *Model 3-5821*, $240, with channel priority feature, S/RF meter, PA, LED readout. *Model 3-5812*, $175, with S/RF meter, switchable noise blanker and ANL. *Model 3-5825*, $330, SSB, with AWI light, S/RF meter, LED readout.

At FCC: *Model 3-5871*, $250, AC/DC base station with LED readout, S/RF meter, switchable ANL.

Units expected to be ready for delivery to dealers on Jan. 1. (Audio Electronics Products Dept., Syracuse, NY 13212)

Hallicrafters (Breaker)

At FCC: Five "Hallicrafters" brand under-dash units, as follows: *Model HCM-275*, approximately $200, "high specs"; *HCM-272*, $230, and *HCM-271*, $210, both with LED readout; *HCM-270*, $190; *HCM-261*, $170.

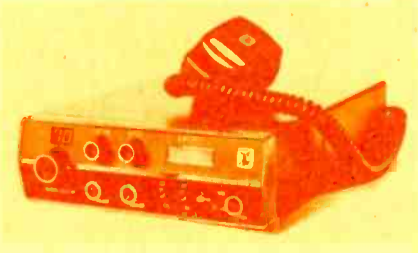
Expected to be type accepted in time for early January sale. (1101 Great Southwest Parkway, Arlington, TX 76011)

Hanabashiya

No products at FCC. Earliest possible 40-channel products in March. (39 West 28th Street, New York, NY 10001)

Handic

Sent 15 models to FCC too late for January selling. They consist of four mobile under-dash units, 1 in-dash AM/FM/FM stereo/CB, 2 base stations, 1 mobile SSB and 1 base SSB, 4 hand-held transceivers, 2 limited-channel (3 and 6) mobiles using crystals. Handic is projecting a starting price of $140, with most full-feature models in the $200 to $250 range. (14560 N.W. 60th Ave., Miami Lakes, FL 33014)


Johnson Viking 4740

Hy-Gain

Type accepted: *Model 2701*, $139.95, under-dash model with ANL, volume/squelch control, remote speaker jack, illuminated channel selector, TVI filter; *Model 2703*, no details. Both expected to be available Jan. 1

At FCC: "About 20" models, consisting of in-dash, under-dash, remote-control and SSB sets, including one AM/FM/FM stereo/CB combo with cartridge playback facilities. (8601 N.E. Highway 6, Lincoln, NE 68505)

I. A. Sales

At FCC: *Models TRX-400* and TRX-500, both under-dash, both with full complement of features. Expected to be retailed in January. (766 Lakefield Road, Westlake Village, CA 91361)

Inland Dynatronics

No information available. (10 Horizon Blvd., South Hackensack, NJ)

J.I.L.

At FCC: *Model 860*, suggested list price $400, in-dash AM/FM/FM stereo/8-track cartridge/CB; *Model 615*, $420, same as *860* but with cassette mechanism instead of cartridge; Model *853-401*, $390, in-dash, AM/FM/ 8-track/CB; *Model 853-201*, $690, 120-channel SSB in-dash with AM/FM/8-track cartridge facilities. *Model 706*, $375, in-dash AM/FM/FM stereo/CB with push-button tuning. SSB version of *706*, $670. (737 West Artesia, Compton, CA 90220)

Ray Jefferson

At FCC: *CB-740*, $150, under-dash; *CB-845*, $200, deluxe under-dash with LED readout, ANL, Delta tune; *CB-7120*, $300, SSB under-dash; *CB-702*, $280 (approximate), LED readout; *CB-712*, $230 (approximate), marine unit.

Expected to be ready for January 1 selling. (Main and Cotton Streets, Philadelphia, PA 19127)

E. F. Johnson

At FCC: Five under-dash units under the *Messenger* brand name, all with LED readouts, as follows: *4120*, suggested list $110; *4140*, $180; *4145*, $180; *4170*, $250; *4175*, $250. *Messenger Model 4230*, $250, AM base station. *Viking Model 4740*, under-dash SSB priced at $360. (299 10th Ave., SW, Waseca, MN 56093)

Kraco

Type accepted: *Model KCB-4003*, under-dash leader model, no price set; *Model KCB-4030*, $220, under-dash with PLL, S/RF meter, squelch, ANL, noise blanker, Delta tune; *Model KCB-4020*, $180, same features as *4030* but no noise blanker; *KCB-4088*, no information.

At FCC: *Model KCB-4010*, $140,


Hy-Gain 2705

under-dash mini model. PLL, squelch, ANL, S/RF meter. (505 East Euclid Ave., Compton, CA 90224)

Kris

Has three under-dash CB radios at FCC. They are: *XL-40*, $160, with ANL, PA, RF meter; *XL-45*, $210, with ANL and noise blanker, PA, LED readout; *XL-50*, $260, deluxe full-feature unit with 3 meters (RF, signal strength, modulation) talk-back feature, ANL and noise blanker, meter dimmer control.

Kris expects to have the units type accepted in time for "early January" sale. The company also plans to submit "at least two other models" for eventual marketing later in 1977. (Pioneer Road, Cedarsburg, WI 53012)

Krypton

One under-dash model at FCC. Sending one under-dash and one-in dash to FCC in January. Markets under *BETA* brand name. (18 Mileed Way, Avenel, NJ 07001)

Lafayette

Type accepted: *HB-940*, $200, LED readout, SWR calibration control, RF gain, squelch, Delta tune, noise blanker, ANL, S-RF meter, PLL; *HB-740*, $160, PLL, Delta tune, ANL, noise blanker; *HB-640*, $120, with PLL, S/RF meter, transmission indicator, squelch, PA.

At FCC: base station and two SSBs.

Type accepted models to be available in all Lafayette company-owned and franchised stores Jan. 3. (111 Jericho Turnpike, Syosset, NY 11791)

Lake

No information available. (1948 E. Lehigh Ave., Glenview, IL 60025)

Maxon

Type accepted: *Maxon 40*. No details.

Meishoh

Type accepted: *ME-402*. No details.

Meriton

Type accepted: *RS-5111*. No details. (35 Oxford Drive, Moonachie, NJ 07074)

Midland

Type accepted: Four under-dash models all with ANL and Delta tuning, squelch, and illuminated rotary dial tuning, among key features. They are: *Models 77-857; 77-882; 77-888; 77-883*. No price or shipping date information available at press time. Also type accepted, *Model 63-240*, and *77-853*, no details. (P. O. Box 1903, Kansas City, MO. 64171)

Motorola

No information available. (1499 E. Algonquin Road, Schaumburg, IL 60196)

Nuvox

No 40-channel products planned at this time. Will enter the market when pricing "becomes practical and reasonable" as opposed to the current heavy discounting prevalent in 23-channel CB, said a spokesman. (150 Fifth Avenue, New York, NY 10011)

Pace

Type accepted: *Model 8041*, $200, under-dash unit featuring Delta tune, PLL, antenna warning light.

At FCC: Eighteen models consisting of 12 mobiles, three base stations, two in-dash AM/FM/CB combos, one scanner. Combos include cartridge or cassette facilities.

Pace expects to ship between 15 and 17 models starting Jan. 1. (24049 S. Frampton Ave., Harbor City, CA 90710)

Palomar

Six units at FCC. Expects three imported models to be approved in time for February selling, three all-American-made in time for sale by end of first quarter.

Import units for possible sale in February are: Palomar *Model 41*, list priced at about $185. Features include LED readout, switchable ANL, squelch, PA; *Model 4100*, approximately $219, whose features include those of *41* plus RF and microphone controls, snappier styling; *Model 49*, approximate price $249, same features as above two units plus noise blanker. All three are 4-watt, under-dash units.

Three all-American-made models consist of one tube-type base station, one mobile AM under-dash, and one deluxe SSB AM base unit. (665 Opper St., Escondido, CA. 92925)

Panasonic

Consumer Electronics Group: Four under-dash units at FCC, as follows: RJ-3250, $200, with quick-release mounting bracket, Channel 9 priority switch, LED readout; RJ-3450, $230, 2-piece modular system for under-seat, trunk, firewall installation, with built-in scanner system, remote control mike; RJ-3150, $170, and RJ-3050, $130, both with LED readout.

Auto Products Dept: Type accepted: Model CR-B4747, in-dash AM/FM/FM stereo/CB radio with push-button tuning; Model CR-B 4700, mini in-dash AM/FM/FM stereo/CB radio with manual tuning. No prices set.

Three models at FCC. No details.

Type accepted models will "absolutely be ready for January 1 shipping." (One Panasonic Way, Secaucus, NJ 07094)

Pearce-Simpson

Type accepted: *Tiger 40*, no price set, under-dash. Delta tune, PA, ANL, noise blanker, S/RF meter, tone, squelch; *Super Cougar 40*, under-dash unit whose features and styling are expected to be revised before marketing, along with a name change.

Submitted "at least 10 pieces to the FCC," in line with plans to have an eight to 10-unit 40-channel line in 1977, made up of mobile and base units, and SSB's. (4701 NW 77th Ave., Miami, FL 33152)

Pace 8155 base unit.

J. C. Penney

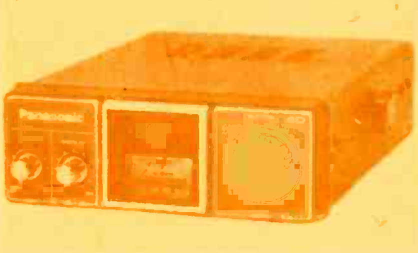
Type accepted: *Model 6203*. No details.

Pioneer

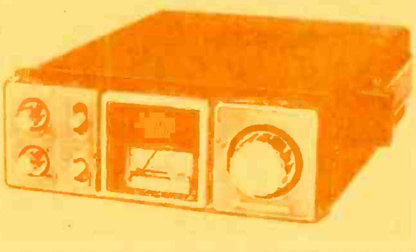
Type accepted: *GT-6600*, no price set, in-dash AM/FM/CB with ANL, squelch, S meter, five pre-set tuning buttons. Expected to be on sale Jan. 1.

At FCC: *Model 1100*, no price, in-dash, AM/FM/CB with ANL, squelch, S meter, manual tuning. (1555 E. Del Amo Blvd., Carson, CA 90746)

more 40-channel CB equipment on next page.



Panasonic RJ-3050



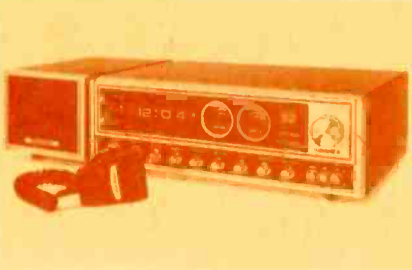
Panasonic RJ-3150

President

Type accepted: *Zachary T.*, $250, AM base station with ANL, PA, RF gain, LED readout, S/RF meter.

At FCC: Six models—also named after presidents of the United States—expected to be type accepted in time for January 1 retailing. They are: *Model John Q.* suggested list price, $170, under-dash AM mobile with ANL, PA, LED readout, S/RF meter; *Honest Abe*, $200, under-dash AM, PA, ANL, Delta tune, S/RF meter, LED readout; *Teddy R.*, $230, under–dash AM, PA, noise blanker, SWR calibration, Delta tune, LED readout, S/RF meter, PA; *Dwight D.*, $330, AM base station, noise blanker, PA, RF gain, tone, SWR calibration, clock, alarm control, Delta tune PA, on-air light, LED readout, with separate speaker; *Grant*, $340, SSB AM under-dash, PA, noise blanker, LED readout, S/RF meter, mike gain; *Washington*, $430, SSB AM base station, PA, noise blanker, mike gain, RF gain, clarifier, PA, LED readout, S/RF meter. (16691 Hale Ave., Irvine, CA 92714)

President Washington



President Dwight D.

Radio Shack

Type accepted: *TRC-455*, AM base station, PLL, LED readout; *TRC-466*, low-priced "very small" under-dash AM with illuminated channel switching; *Mini-40*, compact under-dash AM with illuminated channel switching.

Company expects to have 14-unit line of 40-channel CB's for 1977 selling. (2617 West 7th St., Fort Worth, TX 76107)

RCA

Type accepted: *Model 14T304*, AM mobile unit with LED readout; *14T270*, AM mobile unit, 40-detent channel switch. Both models with ANL. No prices established.

At FCC: Eight models, as follows: one SSB, one base station; five mobiles, one AM/FM in-dash combo. These are expected to be accepted in time for sale in January. (Cherry Hill Offices, Bldg. 206-2 Camden, NJ 08101)

Regency

Type accepted: *Models CR-430, 485, 486*, all foreign-made under-dash units with LED readouts, expected—"Hopefully"—to be available at retail Jan. 3.

At FCC: *Model CB-501*, American-made under-dash unit, first of what will be a completely American-made line.

Price range of the above four models is from $159.95 to $219.95. (7707 Records St., Indianapolis, IN 46226)

Robyn

Eleven models at FCC, with first seven of those in the following list expected to be approved in time for Jan. 1 marketing, the rest shortly thereafter. All units listed feature PLL. All except *T-240-D* are under-dash radios. *Model WV-110*, suggested list price $150. *WV-110P*, same as *110* with antenna and coaxial speaker, $170. *LB-120*, $160. (Above three units feature back-lighted rotary channel indicator.) *DG-130D*, $180, with digital readout. *SX-401*, $190, with rotary back-lit channel indicator. *SX-402D*, $240, with digital readout. *007-140*, $200, with antenna, coaxial speaker. *TR-210D*, $200. *GT-410D*, $260, with digital readout, turn-on/turn-off switch that automatically returns to Channel 9, scanner switch. *GT-440D*, $380, SSB with digital readout. *T-240D*, $300, mobile or base station radio using vacuum tubes, featuring digital readout, PLL. (P. O. Box 478, 10901 Northland Drive, Rockford, MI., 49341)

Royce

At FCC: *Models 1-673; 1-675; 1-678; 1-680; 1-682.* No details. (1746 Levee Road, North Kansas City, MO 64116)

SBE

Ten under-dash radios at FCC. Most feature LED readouts, all use PLL circuitry.

It is expected that the units will be type accepted in time for Jan. 3 retail sale. (220 Airport Blvd., Watsonville, CA 95076)

Sears Roebuck

Type accepted: *Models 28 62674, CM 2378SA, CM 6000LB, TA 4501, 28 62676, CM 6000LA, CM 6100S.* No details available.

Shakespeare

Type accepted: *Model GBS-240*, no details.

At FCC: Two mobiles and one base station. The firm expects these to be accepted by Jan. 1, but their actual retailing time will be determined by Shakespeare's Japanese supplier. (P. O. Box 246, Columbia, SC 29202)

Sharp

Type accepted: *CB-2260*, approximately $140, under-dash, Delta tune, lighted drum channel indicator, flashing Channel 9 indicator, ANL, PA, squelch; *CB-2460*, approximately $150, same as *2260* but with LED readout.

Delivery expected first week of January. (10 Keystone Place, Paramus, NJ 07652)

Siltronix

Late in submitting prototypes to the FCC, this company will not have 40-channel CB's until late February. Awaiting FCC action are three under-dash units, all featuring PLL and LED readouts. (330 Via El Centro Ave., Oceanside, CA 92054)

Sparkomatic

At FCC: Five mobile under-dash and two base stations. Three of the mobiles have touch-bar channel switching. One has "memory" control for automatic tuning of one channel. (Milford, PA 18337)

Standard

Expects to have unit now at FCC approved for sale in January. It is a 40-channel version of the firm's *Horizon 29*, to be called *Horizon 29A*, a mobile model featuring ANL, AN blanking, Delta tune, and squelch, among features. It will carry the same list price as the 23-channel model, $229.95. (P. O. Box 92151, Los Angeles, CA 90009).

Surveyor

At FCC: One AM base station; one SSB base; one in-dash AM/FM/CB combo with LED readout; three under-dash (one with LED readout). (7 Electronics Court, Madison Heights, MI 48071)

Teaberry

Type accepted: *Model 4002*, AM base, dial selector; *4006*, AM mobile, LED readout; *4001*, SSB mobile, dial selector. All three with PLL.

At FCC: One SSB base unit, one SSB mobile; one base, two AM mobiles.

Pricing to be determined at end of December. At least five models expected to be ready for shipment Jan. 1. (6330 Castleplace Drive, Indianapolis, IN 46250)

Tram/Diamond

Five units at FCC: *Model D-42*, with ANL, LED readout, PLL; *D-12*, with PLL (both units under-dash); one SSB

continued on page 50

Antennas for 40-Channels

The addition of 17 new channels requires increased performance from mobile antennas. An understanding of the design and mounting considerations is necessary to select an antenna to meet the new requirements

RICHARD BITNER
*The Antenna Specialists Co.

IT SHOULD COME AS NO SURPRISE THAT CB radio has entered an exciting new stage of growth. The FCC announcement of expanded Class-D service with the addition of seventeen channels was encouraging since it supported the largest of radio services. Unfortunately, the announcement also generated considerable confusion about the status of existing CB products. It also raised the question of just what new products would be made available to fill the needs of the 40-channel market. Now that the dust has settled, what Antenna Specialists has done to meet the need for forty-channel CB antennas should reduce some of the confusion about antenna products and the expansion.

First, it is very important to know that an antenna is not just a piece of cable, a coil, and a steel tip rod. There are many factors that enter into antenna design and affect antenna performance. Since base-station antennas are already "broad band" and will cover the proposed additional channels, they will not be discussed in this article. Mobile antennas provide a whole different set of conditions; however, and those conditions should be understood if proper antennas are to be selected for each application. Some basics of antenna design and history will help to clarify the problem.

Basic antenna design

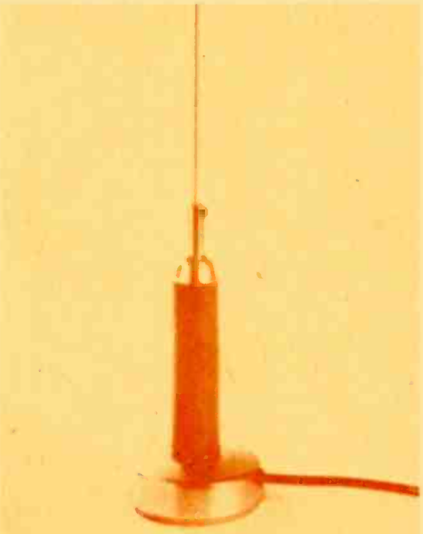
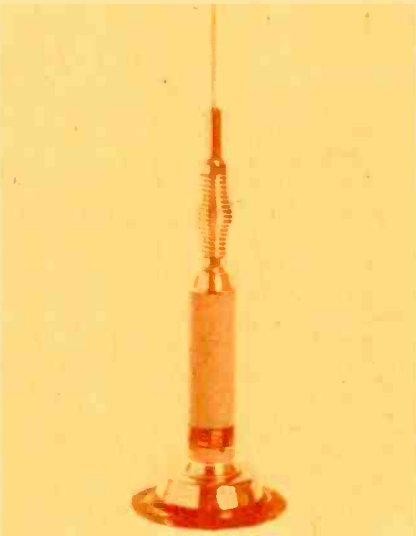
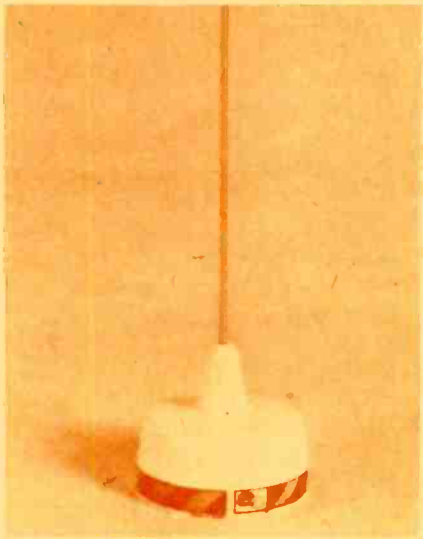
As mentioned above, an antenna is more than a length of cable, a coil, and a rod. Stated in its most simple terms, an antenna is a device that is capable of sending and receiving radio-frequency energy.

That's simple enough, but simple things are often misleading. For example, each antenna must be constructed to operate over a specific range of frequencies. In addition, each antenna must be tuned to operate with a maximum efficiency and it must function equally well both transmitting and receiving. Under most conditions an antenna works best as a half-wavelength radiator.

On CB frequencies, 27-MHz, one-half wavelength is about 18 feet long. A quarter-wavelength radiator and a quarter-wavelength mirror image or ground plane make up the 18-foot system. In the early days of CB, the most common kind of antenna was the 108-inch whip and spring combination. Whip and spring were the active or radiating half of the system and the vehicle body acted as its "mirror image" or ground plane. In effect, this formed the dipole antenna. The long whip system was broad band and offered little problem in terms of matching the antenna to the transmitter.

The quarter-wavelength whip and spring combination did have some problems in terms of aesthetics. In addition the quarter-wave whip & spring combination has some mounting difficulties since most people don't like a 9-foot whip on top of their car. The most common place to mount the antenna, bumper or deck, played games with the antenna's radiation pattern. The quarter-wave whip can also be a problem where areas of low clearance exist.

To meet some of the above shortcomings, a loaded antenna was developed. In this way we make antennas mechanically shorter without significantly changing electrical efficiency. The loading coil changes the antenna's voltage and current components and narrows the bandwidth of operation.

THREE BASE-LOADED WHIPS from Antenna Specialists. The models MS178 (left), M-276 (middle) and M-440 right).

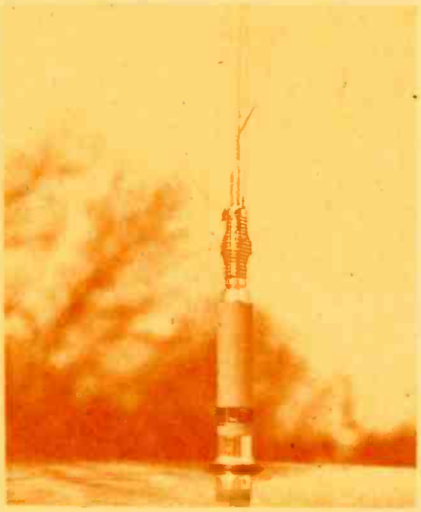
Operation at or near the resonant frequency is excellent. Using a loading coil permits an antenna of almost any length to be developed *but*, the shorter the length the more restricted the design and the bandwidth. This is important in considering 40-channel antenna design.

There are three kinds of loaded mobile antennas; **base loaded**, **center loaded**, and **top loaded**. The top loaded antenna, if it is a true top load, is impractical for mobile service since it requires the use of a large capacitance "hat" to couple it to its mirror image. They were not considered for redesign. The most common type of antenna, the base-load design and the center-load design both have advantages and were redesigned for 40-channel coverage.

Mounting 40-channel antennas

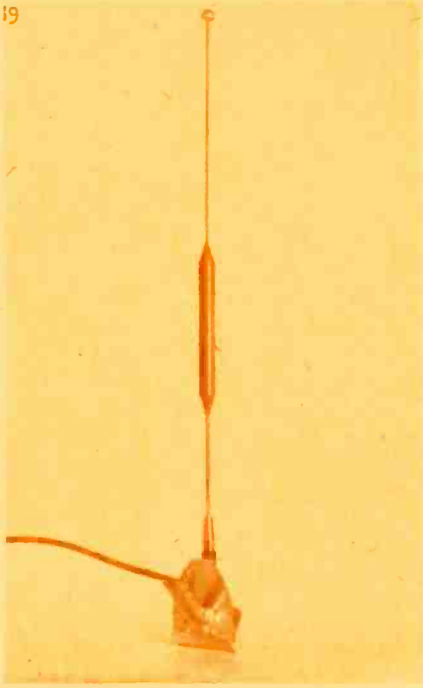
The mounting location of the antenna also has a direct bearing on its performance. The best place to mount any mobile antenna is still the center of the vehicle roof. Trunk or lid mounting with a center location is second best. Other mounting locations tend to distort the pattern, provide restricted mirror image, or reduce effective bandwidth and matching capability. Site election for 40-channel antennas may be somewhat more critical than for 23-channel applications.

With a multiple of variables and design considerations to take into account, design engineers started to develop broadband CB antennas. Keeping antennas as short as possible was still a main criteria.



BASE-LOADED WHIP AND SPRING combination. Antenna Specialists model M-125.

Basically, the base-loaded designs were changed by use of a lower Q coil and a slightly longer tip rod. Q is a measurement of antenna selectivity. In essence, the higher the Q the narrower the bandwidth. Since we are concerned with effective bandwidth, those frequencies on either side of the antenna's resonant frequency, lowering the Q expanded the bandwidth of the antenna. Antennas that are broadband will feature a reworked coil and a longer tip rod. They will physically look the same but have bandwidths that approach 700 kHz at a 2:1 VSWR.



CENTER-LOADED WHIP with gutter mount. Antenna Specialists model M-489

Center-load designs involve the different set of design parameters. Broadbanding was accomplished by using a coaxial matching section in series with the feedline. This has caused expanded bandwidth to approach 300 additional kilohertz and makes it possible to cover the entire band. Short center-load antennas, however, will remain narrowband in configuration.

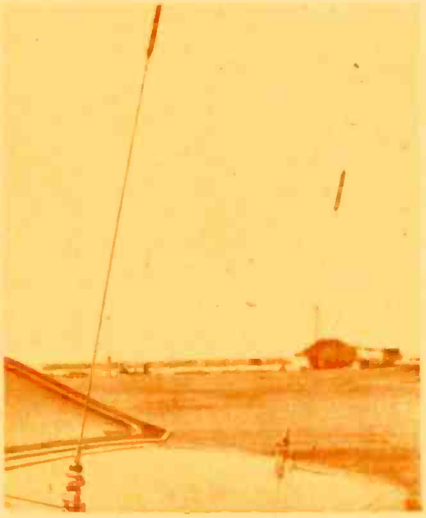
Since effective bandwidth is a function of VSWR perhaps it would be wise to restate some facts about VSWR. Throughout the past several years, the term VSWR, or more simply SWR, has become greatly overused. There seems to be, currently, a feeling that an SWR ratio of 2:1 is unusable. This could not be further from the truth for actual reflected power at a VSWR of 2:1 is only about 11% of the total radiating power.

What this really means is that signal loss with a VSWR of 2:1 is in the neighborhood of ½ of a dB. This is undetectable at either end especially during short-range CB communications. Above 2:1, however, the ratio in its effect changes greatly. No one should be overly concerned with a VSWR in any installation of 2.0:1 since it is a nominal figure and sought by commercial installers.

Any installation variable that changes the design parameters of an antenna can reduce bandwidth and cause an increase in VSWR. Good bonding to the vehicle body, proper antenna site selection, and care in tuning are most important. Since some applications will call for specific types of mounts for antennas, then any limitation imposed by that requirement should be understood by the user. The new 40-channel designs will work very well with 23-channel equipment. Also, remember that any current antenna will work with 40-channel equipment over any given segment of frequencies.

Short antenna designs such as rain-gutter mounts contain built-in compromises which make their inclusion in 40-channel expansion programs unpractical. Again, it is up to the user to determine exactly what his specific needs are in terms of installation requirements and select the antenna which will meet his needs.

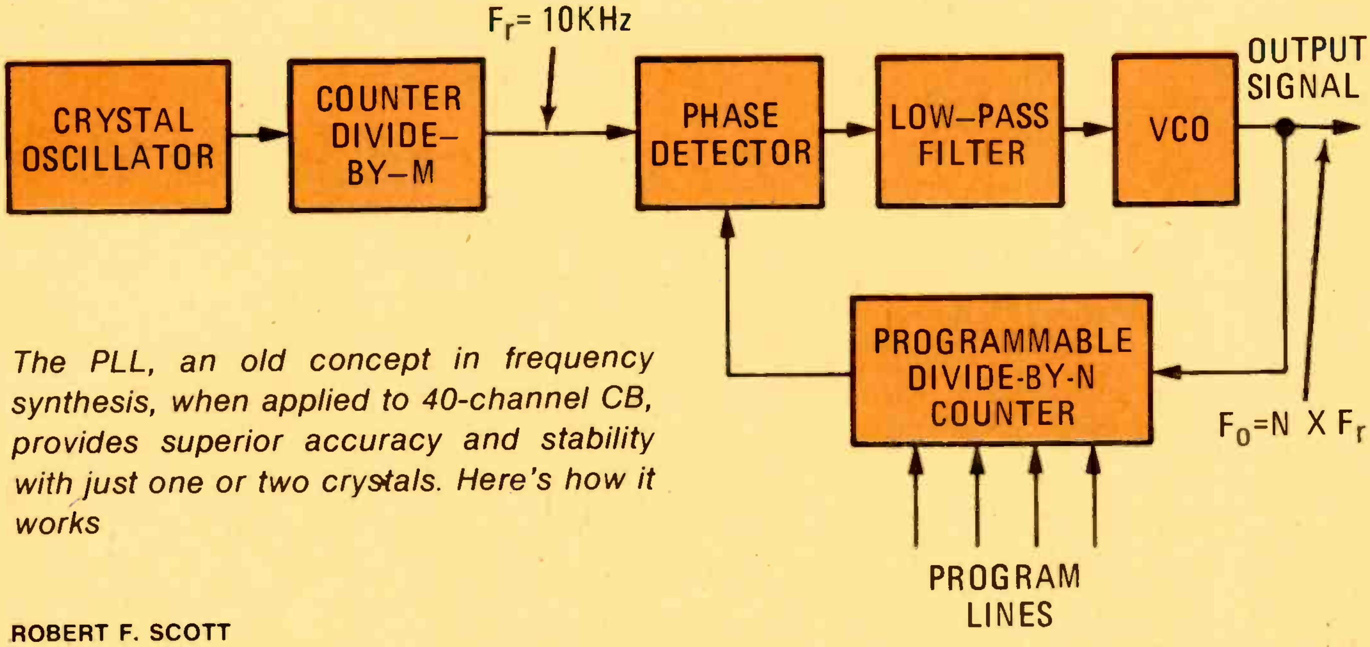
Since there is a wide variety of antenna products manufactured, all application needs should be able to be met without significant difficulty. Such designs as dual antennas, provided they are not overly short, foldover mast designs and 108-inch whip configurations are inherently broad banded and will function well in the 40-channel expansion program.



THREE-QUARTER LOADED. Antenna Specialists model MR312

As we enter this new phase of CB, the product which is currently being manufactured to meet the new expansion requirements will provide those using the service with a means of persuing it with a minimum of fuss. It will be important for the buyer as well as the seller to know what equipment will meet their specific needs. Personal Communications is an ever growing part of the electronics industry and will continue to grow as the need for CB product grows. The additional seventeen channels authorized by the FCC are just the start and as further changes come about, legitimate manufacturers will meet the changing demands. Personal Communications as a means of communicating is here to stay. **R-E**

Using PLL for CB Frequency Synthesizers



The PLL, an old concept in frequency synthesis, when applied to 40-channel CB, provides superior accuracy and stability with just one or two crystals. Here's how it works

ROBERT F. SCOTT
TECHNICAL EDITOR

WHEN FREQUENCY SYNTHESIS WAS FIRST APPLIED TO CB TRANSceiver technology in 1963, it was in the interest of conserving space and providing a higher degree of accuracy and stability in the transmit and receive frequency generating circuits. The twelve or so crystals occupied about one-fourth the space needed for direct frequency control in a 23-channel rig.

When the CB boom hit a couple of years ago, the crystal manufacturers of the world did not have the capacity to make crystals as fast as they were needed for use in CB transceivers. The obvious solution to the problem was to use a frequency synthesis scheme that required a minimum number of crystals. This proved to be the phase-locked loop (PLL) frequency generator that uses from one to three crystals—depending on circuit design.

Just as the PLL frequency synthesizer was gaining a foothold in the top-of-the-line models of some manufacturers, the FCC expanded the Class-D Citizens Radio Service to include seventeen new channels—extending the band up to, and including, 27.405 MHz.

With the crystal shortage still one of the most pressing component procurement problems, the phase-locked loop frequency synthesizer is the only way to go for a manufacturer who wants to remain in the CB transceiver business.

The phase-locked loop

The principle of the phase-locked loop is not new. It was used in some specialized receiver designs developed in the middle 1930's. The most common and most evident application was in the AFC circuits in some of the deluxe AM broadcast receivers of that day. Next came the application of the PLL principle to the synchronization of the vertical and horizontal deflection circuits in TV receivers. Now that we know of two familiar applications of the phase-locked loop, let's see just what it is and how it fits into the CB transceiver design.

Basically, the phase-locked loop is a type of servo-system whose output frequency *locks* onto and follows, or tracks, an input reference signal. The PLL servo system consists of a phase detector, a low-pass loop filter and a voltage-controlled oscillator or VCO. The function of the circuit is to generate an output signal that is an integral multiple of, and in phase with, the input frequency standard.

The input reference signal and the output of the VCO are locked in phase by comparing the phase of the two signals in a detector that converts any phase difference into an error-correcting voltage or current. The error voltage shifts the frequency—and therefore the phase—of the VCO output signal in the direction that causes it to track the input. The basic PLL system is shown in Fig. 1.

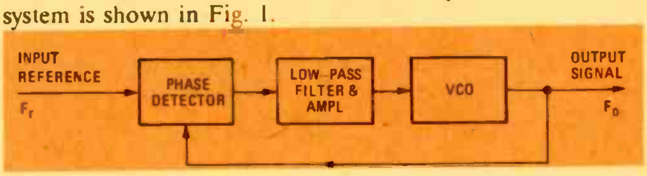


FIG. 1—SIMPLE PLL CIRCUIT produces an output frequency equal to the input reference frequency.

With no reference voltage applied to the phase detector, there is no error voltage at the phase detector output and the VCO runs at its natural free-running frequency as determined by L-C or R-C constants. When a reference signal is fed into the PLL circuit, the phase detector develops two error signal voltages that are proportional to the difference between the reference and VCO signals.

One of the error voltages is the *sum* of the two frequencies—let's call them F_o and F_r, for oscillator frequency and reference frequency, respectively. The other error voltage is determined by the difference between F_o and F_r. The two error signals are passed through the low-pass filter that eliminates $F_o + F_r$, leaving only $F_o - F_r$ as a DC, or near-DC voltage to control the VCO.

The error voltage reduces the phase, and therefore the frequency, difference between F_o and F_r until the frequencies are exactly the same. However, there will be a small but constant *phase* difference required to generate the error voltage that keeps the VCO and reference signals in lock.

If either the reference or VCO output changes phase, the phase detector and filter produce a DC control voltage that is proportional in magnitude and polarity to the phase change. The error voltage thus produced shifts the phase of the VCO signal by altering its frequency until it again locks onto the reference signal.

About now, you're saying, "So what? If all the VCO does is generate a frequency equal to the reference frequency, what good is it? We would need one precise reference frequency for each of the forty CB channels."

Well, what we have been discussing is the basic PLL frequency generator. In practical multi-channel PLL frequency synthesizers, F_r is a very low value and a programmable frequency divider is inserted in the feedback loop as in Fig. 2.

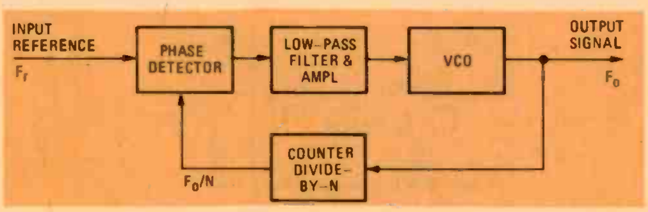


FIG. 2—THE OUTPUT FREQUENCY can be made different from the reference frequency by inserting a divide-by-N counter in the feedback loop. Now the output frequency is equal to N × F_r.

The divider is arranged so it can be made to divide the VCO output frequency by any desired integer N. Phase lock is obtained by comparing the resultant frequency F_o/N with the reference frequency F_r. The phase detector output is now proportional to the difference between F_o/N and F_r.

In most applications, the reference signal is derived from a precision crystal oscillator whose output is fed to a series of frequency dividers. Dividing the crystal frequency by as much as *two thousand* is not uncommon as the resulting reference frequency is usually made equal to the channel spacing—10 kHz except for five 20-kHz gaps. (There are 20-kHz gaps between Channels 3 and 4, 7 and 8, 11 and 12, 15 and 16, and

BOWMAN CB-760 is loaded with features. This 40-channel unit is at the FCC now and should have been approved and available for sale now. Note the use of LED channel readouts.

19 and 20.)

The block diagram of the PLL synthesizer now appears as in Fig. 3. The crystal oscillator frequency is divided by a fixed factor (M) to develop an F_r that equals 10 kHz. The VCO must oscillate at N × F_r to achieve phase lock. A programmable counter is used to select the desired VCO output that is always a multiple of F_r. The divisor N can be derived from BCD switches, keyboard logic or from BCD data from a two-digit 7-segment channel indicator.

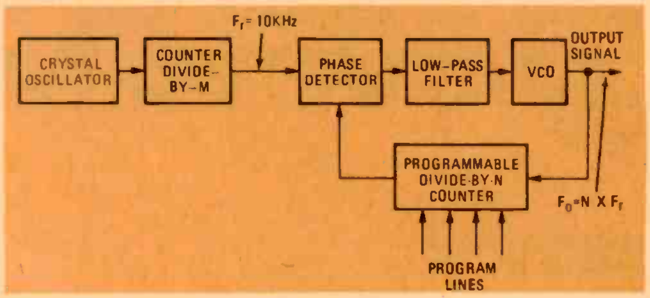


FIG. 3—MULTIPLE OUTPUT FREQUENCIES can be obtained by inserting a programmable divide-by-N counter in the feedback loop. The value of N depends on the data on the program lines.

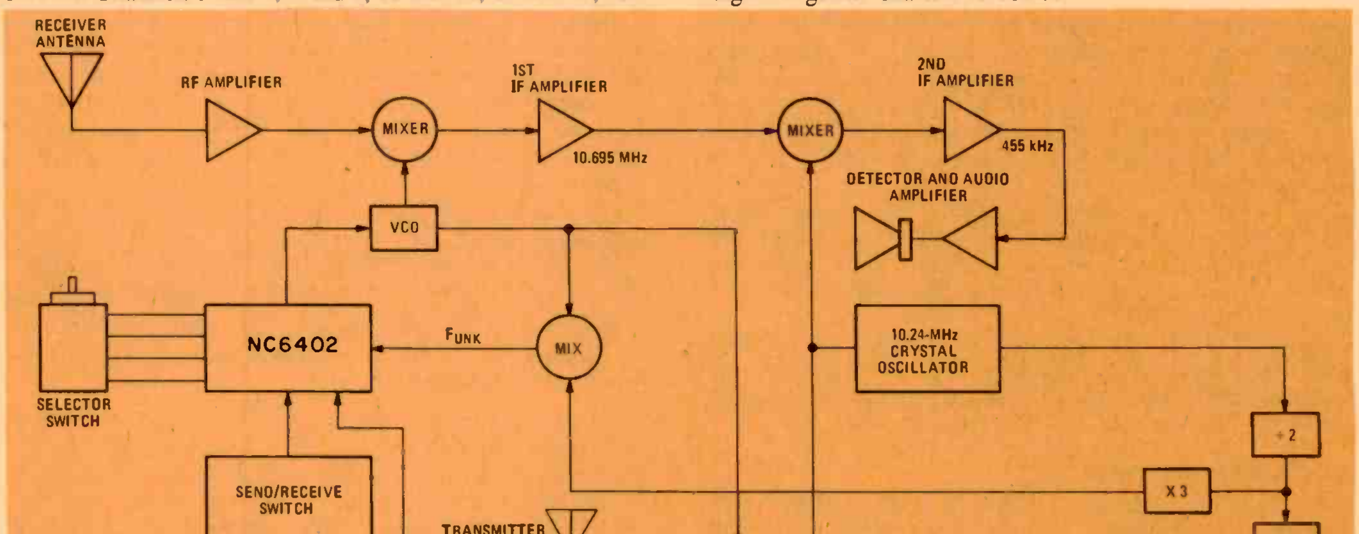


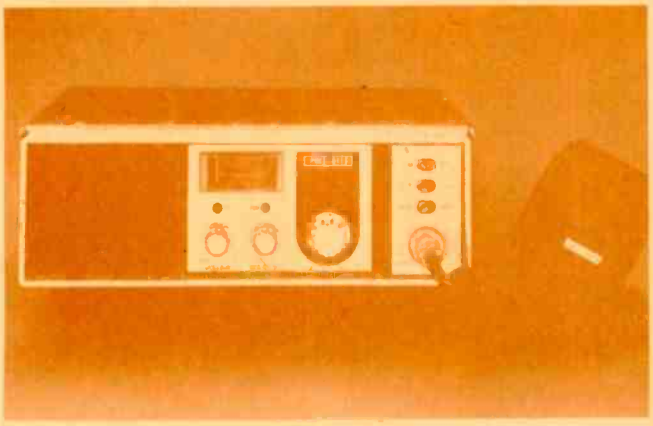
FIG. 4—PLL CIRCUIT of a single-crystal AM CB transceiver.

The CB channel frequencies are not divisible by 10, so various schemes have been used to, in effect, reduce channel spacing and F_r to 5 kHz. In this case (considering circuits that develop the direct signal frequencies for the transmitter) N_{min} equals $F_{o(min)}/F_r$ and F_{max} equals $F_{o(max)}/F_r$. Thus, for Channel 1, N equals 26,965 kHz/5 kHz or 5393. For Channel 40, where N is maximum, N equals 27,405 kHz/5 kHz or 5481.

Most of the earlier PLL frequency synthesizers used in CB transceivers employed large-scale integration and/or discrete semiconductor components along with two or more crystals to generate the precise frequencies needed for the transmitter and receiver circuits. For example, in a transceiver with a single-conversion superhet receiver, one crystal develops the reference voltage. The VCO locks onto F_r and is used to develop the channel frequency for the transmitter circuits.

A second crystal generates a frequency which, when mixed with the VCO output, is used as the injection oscillator frequency to develop the receiver's first IF. A third crystal is used in sets that have dual-conversion receivers. A fourth crystal is needed for sideband selection in SSB transceivers.

Recently, several semiconductor manufacturers developed single-IC frequency synthesizers that require only a single crystal to generate all transmit and receive frequencies. In addition, the devices can be programmed by a simple binary-coded channel selector switch, are compatible with digital display devices, can be used in both single- and double-conversion receivers and can provide positive lockout against operation on frequencies not authorized as CB channels.



PACE 8115 is a 40-channel unit at the FCC for approval. Can be used on AC in the home or DC on the road. LED channel display. Should be on sale now.

Among the devices available—but not necessarily used in CB production at this time—are Motorola's XC3390P and the NC6402 by Nitron, a division of McDonnell Douglas Corp. These devices provide all receive and transmit frequencies while positively locking out all other frequencies.

The Nitron synthesizer

The NC6402 is one of a series of PLL-type frequency synthesizer IC's developed for CB applications. It is a 16-pin dual in-line device using N-channel MOS integrated circuitry. A block diagram of a single-crystal, 40-channel AM CB transceiver is in Fig. 4. All that is needed (in addition to the NC6402) for a complete CB frequency synthesizer is one crystal reference oscillator, a single-wafer rotary switch, a dual D-type flip-flop and an optional two-digit, seven-segment display.

The NC6402 interfaces with a two-digit, seven-segment encoded channel-selector switch. Five of the seven lines of the one's digit and three of the seven lines of the ten's digit are used to generate the address codes for the eight input program lines on the IC. Channels are selected by connecting the appropriate inputs to ground. Figure 5 illustrates switch programming.

The SEND/RECEIVE switch (Fig. 4) develops a logic signal to indicate whether the selected channel is in the transmit or receive mode. A logic "1" for receive and a "0" for transmit. The switch simply makes or breaks a connection to ground.

The VCO output terminal on the device varies between +3 volts and ground during the time that the unknown frequency (F_{unk}) is being locked in. It goes to a high-impedance state when the unknown frequency is locked in. The output is positive when F_{unk} is lower than the reference frequency and negative when F_{unk} is higher than the reference. The output current is sufficient to drive a passive low-pass filter and a varactor-tuned VCO.

GENERAL ELECTRIC 3-5819A has already received FCC approval. It's loaded with features and has an LED channel display. Should be available now.

PRESIDENT'S 40-channel *Grant model* is pending FCC approval. It's a 40-channel AM-SSB transceiver (that means 120 channels to use).

DISPLAY NUMERAL	TENS CODE D	E	F	UNITS CODE A	D	E	F	G
0	0	0	0	0	0	0	0	1
1	1	1	1	1	1	1	1	1
2	0	0	1	0	0	0	1	0
3	0	1	1	0	0	1	1	0
4	1	1	0	1	1	1	0	0
5	·	·	·	0	0	1	0	0
6	·	·	·	1	0	0	0	0
7	·	·	·	0	1	1	1	1
8	·	·	·	0	0	0	0	0
9	·	·	·	0	1	1	0	0

NOTE: 0 = SWITCH CLOSURE TO GROUND

FIG. 5—SWITCH PROGRAMMING of the NC6402 shown in Fig. 4.

While you are absorbing this introduction to PLL frequency synthesis for CB transceivers, we will be preparing to describe the Motorola XC3390P and to take a look at the circuitry used in the General Electric model 3-5800A 23-channel rig. **R-E**

New FCC Rules

ON JULY 27, 1976, THE FEDERAL COMMUNICATIONS Commission *(Charlie)* announced changes in Part 95 of the Rules and Regulations authorizing seventeen additional channels for use on the Class D Citizens band, effective January 1, 1977. In addition, the Commission tightened some of the technical standards for type acceptance and amended some of the sections of the *Rules and Regulations* to clarify the FCC's intent. The sections affected by the changes are *95.3, 95.41, 95.42, 95.49, 95.55* and *95.58*. These amended sections are summarized as follows:

95.3 Definitions (b) A Class-D station is now defined as one operated for radiotelephony in the 26.96 to 27.41-MHz band. (The band has been expanded from 27.255 MHz to 27.410 MHz for a bandwidth of 450 kHz. Fifteen of the added channels are spaced 10 kHz apart over the range of 27.255 to 27.405 MHz.)

95.41 Frequencies available. (2) Formerly listed the seven channels used for communications between units of different stations. Now, this section lists the forty channels ranging from 26.965 to 27.405 MHz that may be used for communications between Class D stations, effective January 1, 1977.

The FCC no longer refers to channel numbers—only frequencies. However, the industry has agreed to continue using channel-number designations with channel indicators and selectors noting Channels 1 through 40 as in the table.

(Note that Channels 24 and 25 have been centered in the 30-kHz gap between Channels 22 and 23)

(3) Deleted. Formerly listed Channel 11 (27.085 MHz) for use solely as the calling channel.

95.42 Special provisions. A new section that states that as of September 10, 1976, authorizations for use of frequencies between 26.96 and 27.41 MHz will be issued only to applicants in the Citizens Radio Service. Any license in a radio service other than the Citizens Radio Service authorizing the use of frequencies between 26.96 and 27.41 MHz shall remain in effect until December 31, 1979.

(Since its inception, the Class D CB service has shared the band—without protection against interference—with medical, industrial, public service and scientific users. No new licenses will be issued in this band except to CB users. Other services sharing the band with CB'ers must vacate the band by December 31, 1979.)

95.49 Emission limitations. (d). This section has been amended to require that the harmonic and other spurious outputs of a CB transmitter type accepted after September 1, 1976 be attenuated at least 60 dB below the fundamental power output in watts.

Frequency	Channel	Frequency	Channel
26.965	1	27.215	21
26.975	2	27.225	22
26.985	3	27.235	24
27.005	4	27.245	25
27.015	5	27.255	23
27.025	6	27.265	26
27.035	7	27.275	27
27.055	8	27.285	28
27.065	9	27.295	29
27.075	10	27.305	30
27.085	11	27.315	31
27.105	12	27.325	32
27.115	13	27.335	33
27.125	14	27.345	34
27.135	15	27.355	35
27.155	16	27.365	36
27.165	17	27.375	37
27.175	18	27.385	38
27.185	19	27.395	39
27.205	20	27.405	40

95.55 Acceptability of transmitters for licensing. (c) (4). New section. A transmitter capable of operating on any frequency other Class-D CB channels may not be installed or used in any Class D station unless a special license authorizing that transmitter is posted in the CB station. In other words, if you have a ham transmitter, transceiver or linear amplifier at the CB location, you had better have a valid license posted for the non-CB gear.

95.58 Additional requirements for type acceptance. (c) (2). Multi-channel transmitters shall be capable of operating only on those channels authorized for Class-D CB service. All frequency-determining circuitry and components (other than the channel selector) must be inside the equipment cabinet and not accessible from outside the cabinet or from the control panel.

Add-on devices—whether internal or external to the original equipment—whose function is to increase the frequency coverage of a Class D transmitter beyond its original coverage range, shall not be sold, manufactured or attached to any transmitter designed for Class-D CB use. (No matter what you may have heard, add-on converters or adapters that give you 40-channel performance from a 23-channel rig are illegal and are not to be used.)

If you purchase a new CB rig—either 23 or 40 channels—you'll find a current copy of *Part 95 of Rules and Regulations*, an application blank for a Class-D CB license (FCC Form 505) and a temporary permit (Form 555-B) packed in the carton.

The serial number of every Class-D CB unit sold after January 1, 1977 will be engraved on the unit's chassis. No more gummed stickers or rubber stampings.

Any CB'er causing interference on television Channels 2, 5 or 6, because of spurious emissions from his rig, will be required to install a low-pass filter between the transmitter output and the transmission line that is feeding the antenna.

(All CB'ers would be wise to take a tip from hams who, for years, have used a low-pass filter on their rigs and high-pass filters on their TV sets.) R-E

40-CHANNEL ROUNDUP
continued on page 44

in-dash with LED readout; *TD-32* under-dash AM with controls in microphone; *TD-52*, single sideband under-dash, controls in the microphone. Latter two are full-featured, including PLL, LED readout.

"Two or three" of the above expected to be available for sale toward the end of January, 1977. (P. O. Box 187 Lower Bay Road, Winnisquam, NH 03289)

Tran Sonic

Type accepted: *MCH-41*. No details.

Toyota Motor

Type accepted: *Model 00860-00001*. No details.

Well

Type accepted: *W-605, W-705*.

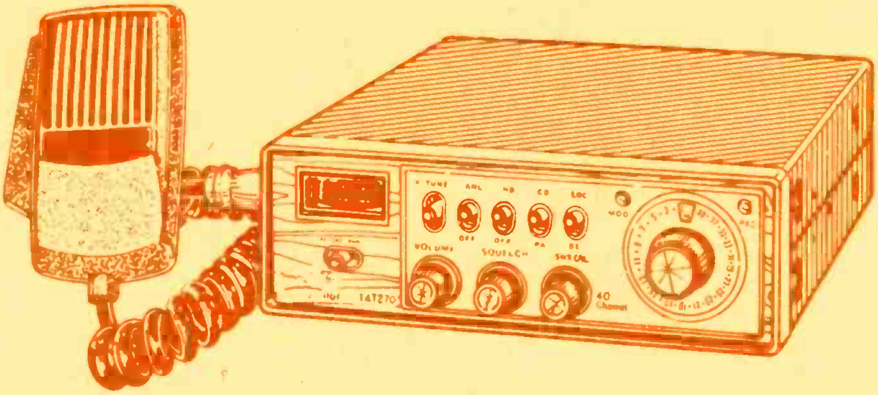
Windsor

At FCC: Four under-dash units, ranging from $90 to $150. (10 Hub Drive, Melville, NY 11746)

Zodiac

"We missed the FCC deadline for January selling. We're not ready yet. We'll let you know when we have 40-channel CBs," said a spokesman. (626 Chrysler Building, New York, NY 10017)

40-Channel Transceiver Directory



THE COMMISSION (FCC) ANNOUNCED AS OF DECEMBER 6, 1976, samples of the following models of Class D, Citizens Radio Service, 40-channel transceivers have been tested by the Commission Laboratory and found to be in compliance with applicable technical requirements for type acceptance and certification.

As stated in earlier releases, grants of certification and type acceptance for these, and for other transceivers yet to be tested which were submitted by November 1, 1976, will be mailed in the latter part of December 1976, and will be effective January 1, 1977. Marketing and importation of these transceivers and others is prohibited prior to the effective dates of the type acceptance and certification grants issued. (See Section 2.803 of the Commission's Rules.)

"Future lists of transceiver models found in compliance with Part 15 and Part 95 rule requirements by the Commission Laboratory tests will be issued in the coming weeks." We are told that there are approximately 300 waiting to be tested.

Alpine Electronics Co., Ltd.
Model: BR-640

Audiovox Corporation
150 Marcus Blvd.
Happauge, NY 11787
Model: MCB-3000

Automatic Radio Mfg. Co.
2 Main Street
Melrose, MA 02176
Models: CBH-2265
CB 2176

B & B Import-Export
185 Park Street
Troy, MI 48064
Model: B-4700

Benjamin Electronic Sound Co.
40 Smith St.
Farmingdale, NY 11735
Model: 200

Boman Industries
9300 Hall Road
Downey, CA 90241
Model: CBR-9950
CB-950

Channel Master
Ellenville, NY 12428
Model: CB6835

Colt Communications, Inc.
5725 North Central Ave.
Chicago, IL 60646
Model: Colt 290

Commando Communications Corp.
P.O. Box 11071
Chattanooga, TN 37401
Models: CC4040
CC4086

Craig Corp.
921 West Artesia Blvd.
Compton, CA 90220
Models: L101
L301

Daiei Electric Co. Ltd.
Model: CTI-90

Dynascan Corp., Cobra Communications Products
6460 W. Cortland Avenue
Chicago, IL 60635
Models: 21XLR
89XLR
138XLR
139XLR

Fanon/Courier Corp.
990 South Fair Oaks Ave.
Pasadena, CA 91105
Models: Fanfare 100F
Rebel 40
Conqueror 40D
Fanfare 880DF

Fukuyama Electronics Co. Ltd.
Model: FKCB001A

Gemtronics
356 South Blvd.
Lake City, SC 29560
Models: GTX-44
GTX-55

General Electric Co.
Electronics Park
Building 5
Syracuse, NY 13201
Models: 3-5801A
3-5811A
3-5811B
3-5812A
3-5819A
3-5821A
3-5825A

General Motors Corp.
Models: GM CBD-10A
GM CBD-20A

Hitachi Sales Corp. of America
401 W. Artesia Blvd.
Compton, CA 90220
Models: CM-2410H
CM-4850H

Hy-Gain Electronics Corp.
8601 Northeast Highway 6
Lincoln, NB 68507
Models: 682A
2700
2702
2703
2705
2679A

Ray Jefferson
Main and Cotton
Philadelphia, PA 19128
Model: CB-740

Kraco Enterprises, Inc.
505 East Euclid Avenue
Compton, CA 90224
Models: KCB-4003
KCB-4005
KCB-4010
KCB-4020
KCB-4030
KCB-4040
KCB-4088
KCB-4075

Kris, Inc.
N144 W5660 Pioneer Rd.
Cedarburg, WI 53012
Models: XL-45
XL-23A

Kyodo Communications & Electronics
Models: Sawtron 770
Sawtron 790

Lafayette Radio Electronics Corp.
111 Jericho Turnpike
Syosset, NY 11791
Models: HB-640
HB-740
HB-940

Mars Radio Corp.
1420 Rodondo Beach Blvd.
Gardena, CA 90274
Models: CON-400
CON-450
M-368
M-374
M-375
M-379

The Panasonic Company
One Panasonic Way
Secaucus, NJ 07094
Models: CR-B4700EU
CR-B4701EU
CR-B4747EU
CR-B4748EU
CR-B4247EU
CR-B4737EU

Maxon Electronics Co., Ltd.
Sunrise Highway
Great River, NY 11739
Model: Maxon 40

Meishoh Electronics Co., Ltd.
Models: ME-400
ME-402
ME-401A

Meriton Electronics, Inc.
35 Oxford Drive
Moonachie, NJ 07074
Models: RS-5111

Midland International Corp.
P.O. Box 1903
Kansas City, MO 64171
Models: 63-240
77-853
77-857
77-882
77-883
77-888
77-955
77-825

Pathcom, Inc.; Pace Communications Division
24049 S. Frampton Avenue
Harbor City, CA 90710
Models: 1000B
8041
2300CA
CB-166
8015A
8010A

Pearce-Simpson, Inc.
4701 N.W. 77th Ave.
Miami, FL 33152
Models: Super Cougar 40
Super Cat 40
Super Tiger 40
Tiger 40

J. C. Penney Co.
Models: 6203
6237

Pioneer Electronics Corp.
1555 East Del Amo Boulevard
Carson, CA 90746
Models: GT-6600
GT-1100

President Electronics, Inc.
16691 Hale Avenue
Irvine, CA 92714
Models: Dwight D
Zachary T
Honest Abe
Teddy R

Radio Shack
2617 West 7th Street
Fort Worth, TX 76107
Models: 21-1520
21-1521
21-1524
21-1526
21-1542
21-1562
21-1580

RCA Corporation
Cherry Hill Offices
Bldg. 206-2
Camden, NJ 08101
Models: 14T270
14T304

Regency Electronics, Inc.
7707 Records Street
Indianapolis, IN 46226
Models: CR-430
CR-485
CR-486

Royce Electronics, Inc.
1746 Levee Rd.
North Kansas City, MO 64116
Models: 1-648
1-675

Sanyo Electric Co. Ltd.
1200 West Artesia Blvd.
Compton, CA 90220
Model: IA-4000

SBE, Inc.
220 Airport Blvd.
Watsonville, CA 95076
Models: Brute 40
SBE-43CB

M.H. Scott Co. Inc.
Model: DAK MARK 3A

Sears, Roebuck & Co.
Models: 2862674
2862676
CM 2378SA
CM 6000LA
CM 6000LB
CM 6100S
CM 6200S
TA 4501
CB-4700S

Shakespeare Company
P.O. Box 246
Columbia, SC 29202
Model: GBS-240

Sharp Electronics Corp.
10 Keystone Place
Paramus, NJ 07652
Models: CB-2260
CB-2460

Sony Corp. of America
9 West 57th Street
New York, NY 10019
Model: ICB-2500

Standard Communications Corp.
P.O. Box 92151
Los Angeles, CA 90009
Model: Horizon 2900

Superscope, Inc.
8150 Vineland Avenue
Sun Valley, CA 91352
Models: CB-340
CB-140

Teaberry Electronics Corp.
6330 Castleplace Drive
Indianapolis, IN 46250
Models: 4001
4002
4006

Toyota Motor Sales USA, Inc.
Models: 00860-00001
00860-00020

Tran Sonic Industries, Inc.
P.O. Box 326
Lexington, MA 02173
Model: MCB-41

Uniden Corporation
Model: 805

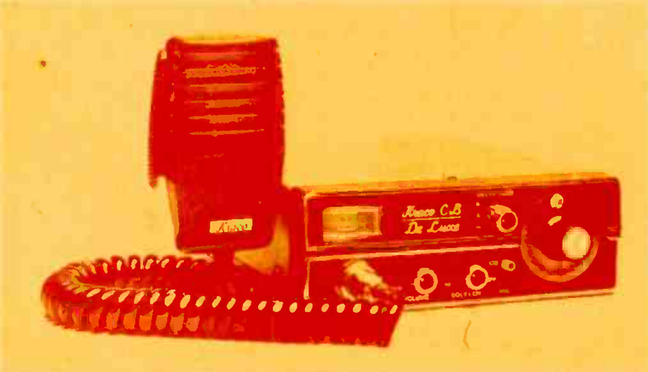
Well, Inc.
Models: W-605
W-705

Western Auto Supply Co.
2107 Grand Avenue
Kansas City, MO 64108
Models: CYJ4832A-87
CYJ4834A-87
CYJ4837A-87
CYJ4862A-87

R-E

TRAM model D62

COURIER Spartan PLL40



RCA model 14T270 (below) KRACO model KCB-4020 (above)

PACE model 8025

New Solderless Coax Connector

FRED SHUNAMAN

IN THE "FIRST SIGNIFICANT IMPROVEMENT IN CB CONNECTORS since the now-standard PL-259 first became available in 1941," Bunker Ramo's RF division has introduced a new, no-solder RG-58 A/U termination that requires no special tools nor training for installation. The new, reusable Amphenol 83-58FCP (field crimp plug) is useful in both base and mobile installations and will be widely used in CB antennas, accessories, and all similar applications that use RG-58 A/U coax.

Not only does the new connector reduce the time and labor required to install connectors—it makes better connections, especially on connectors installed in the field. This cuts down on one of the biggest present causes of radio system failures—faulty interconnections.

STEP 1—SLIDE THE OUTER FERRULE and the coupling nut onto the trimmed cable. Fan the braid out slightly by rotating the insulation. Slide the body assembly over the center conductor of the cable.

STEP 2—PUSH THE BODY ASSEMBLY over the cable so that the barrel goes over the dielectric but under the braid.

STEP 3—POSITION THE BODY so the braid flattens against its rear flange.

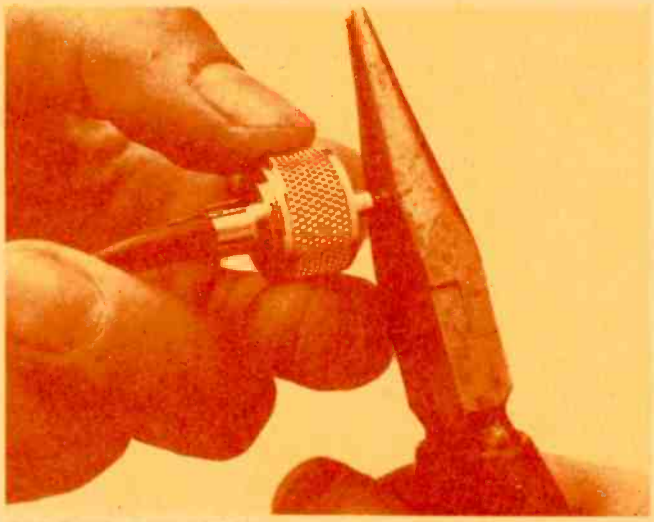
STEP 4—SLIDE THE COUPLING NUT up over the body assembly. Grasp the cable with one hand and push the ferrule forward with the other until it snaps into place.

"Overheating and the damage it causes has been an often-unavoidable consequence of soldering," points out Lee E. Eichenseer, vice president of Bunker Ramo's RF division. "Until now, there has not been a fast, simple means of making reliable connector-to-cable connections. Previously-available solderless connectors required special crimping tools and in many cases their performance was unsatisfactory.

"The new Amphenol 83-58FCP is the first connector to solve all these problems. It offers performance equal to that of standard Amphenol 83-1SP connectors, at the same price."

The specs are indeed equivalent to those of older types. The 83-58FCP has a frequency range of 0-300 MHz and a voltage peak of 500. The thermal limits are −67 to +300 degrees F (149 degrees C). The connectors have standard ⅝-24 threads and mate with regular UHF receptacles and adapters. They are not waterproof.

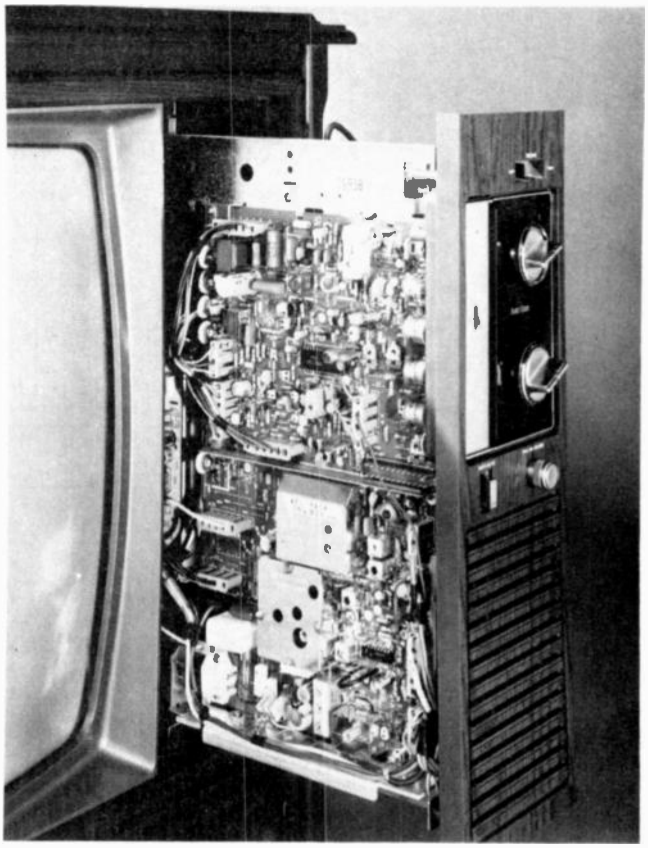
Not only are the new connectors offered for field use, but for manufactured equipment as well. They are being made in OEM (*O*riginal *E*quipment *M*anufacturer) quantities and, according to Mr. Eichenseer, will soon start appearing on CB products offered by various leading accessory, coaxial line and antenna manufacturers. **R-E**



STEP 5—SQUEEZE-CRIMP THE TIP of the center conductor only, with the pliers. If the connector is to be used again, the center contact may be soldered.

STEP 6—TRIM OFF THE TIP of the coax center conductor to flush it with the barrel.

COLOR TV
What'sNew for '77



A look at what the new year has brought us in terms of circuitry, peformance and features.

KARL SAVON
SEMICONDUCTOR EDITOR

CONTINUAL PICTURE TUBE DEVELOPMENT, solid-state techniques and the integrated circuit have matured color TV receivers into truly reliable high-performance instruments. Manufacturers are bringing performance enhancements from the research lab into the latest products.

Progress has been made in such areas as electronic tuning with a system that the customer can install, in flesh tone correction by a system that changes only the flesh tones, and in power management by reduction in power consumption to the 100-watt level.

Though the frequency of servicing over a period has been statistically reduced, new problems have been created by the increasingly complex technology. New product innovations are slanted toward making set repair quicker and more systematic.

Broadcasters and set manufacturers are cooperating by recognizing the amazingly few weaknesses in the color broadcasting standards as originally devised. They have come up with an experimental system that subdues one of the deficiencies.

Quasar

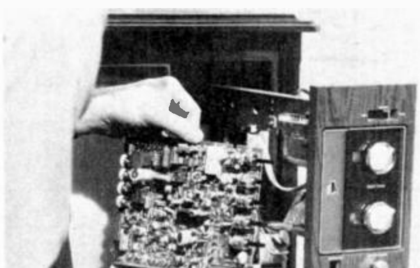
Servicing solid-state receivers can be a very frustrating experience. Very special parts (triacs, integrated circuits) are encountered more and more. Unless you are a service organization specializing in one or two brands, these parts are probably not on your shelves. The trend makes it more difficult for the small service company to stay alive.

Quasar has made a two-front attack on the related problems of serviceability and reliability by the introduction of the "Super Module" and new integrated circuits.

Modular chassis are becoming universal, but Quasar's new Super Module retains the basic concept while making it more practical for a consumer product. The signal package is designed into a single replaceable panel. It performs most of the low-level signal and video processing in designated 1977 models. One module fits all applicable console, table, and varactor and nonvaractor tuned models. As much as 75 percent of the total chassis circuitry is on the module. It plugs into "Works in a Drawer" consoles, continuing the convenience of servicing from the front of the set. To free the panel from the chassis, remove six Phillips head screws and unplug the connectors.

The concept of replacing a large chunk of the receiver in a couple of minutes, with one large module instead of five or six smaller ones, means many fewer plug-and-socket connections. Each pin eliminated is one less spot where corroded or bent pins can cause trouble. Secondary controls mount directly on the module, reducing the number of connections as well as the wiring to the components.

Five integrated circuits in the IF, AFT, sound video, and color sections reduce the component count and the interconnections, again significantly contributing to reliability.



THE QUASAR PLUG-IN SUPER MODULE.

Figure 1 is the block diagram of the TS958/959 receivers. The first two stages of IF amplification and the AGC functions are contained in IC101. Based on sync amplitude, the IC generates automatic gain control signals for the 1st and 2nd IF stages. Both AGC polarities are available for forward-biased mechanical and reverse-biased varactor tuners.

Video processor IC301 accepts the output of the delay line and amplifies the signal. Brightness and sharpness corrections from the viewer controls are performed by IC301 which then feeds video driver transistor Q303. Noise inverter and sync separator stages in IC301 process the video and produce sync outputs for the horizontal AFC and vertical blocking oscillator circuits.

Color processor IC601 takes the video from emitter follower Q301. ACC (Automatic Color Control) helps maintain the chroma level selected by the color intensity control. Demodulated red, green, and blue color difference signals feed the bases of the video output transistors on the picture tube socket (the emitters of the output transistors are driven with the luminance signal from video driver Q303. Relatively few external components surround IC601.

The fifth monolithic device, IC201, takes the 4.5-MHz output from the sound detector and frequency demodulates the audio information. Two audio preamplifier stages increase the detected signal to the necessary level to drive the audio output transistor Q201.

An outstanding accomplishment of the designers of the two Super Module chassis is the low power consumption. The TS958 25-inch models consume 110 watts and the

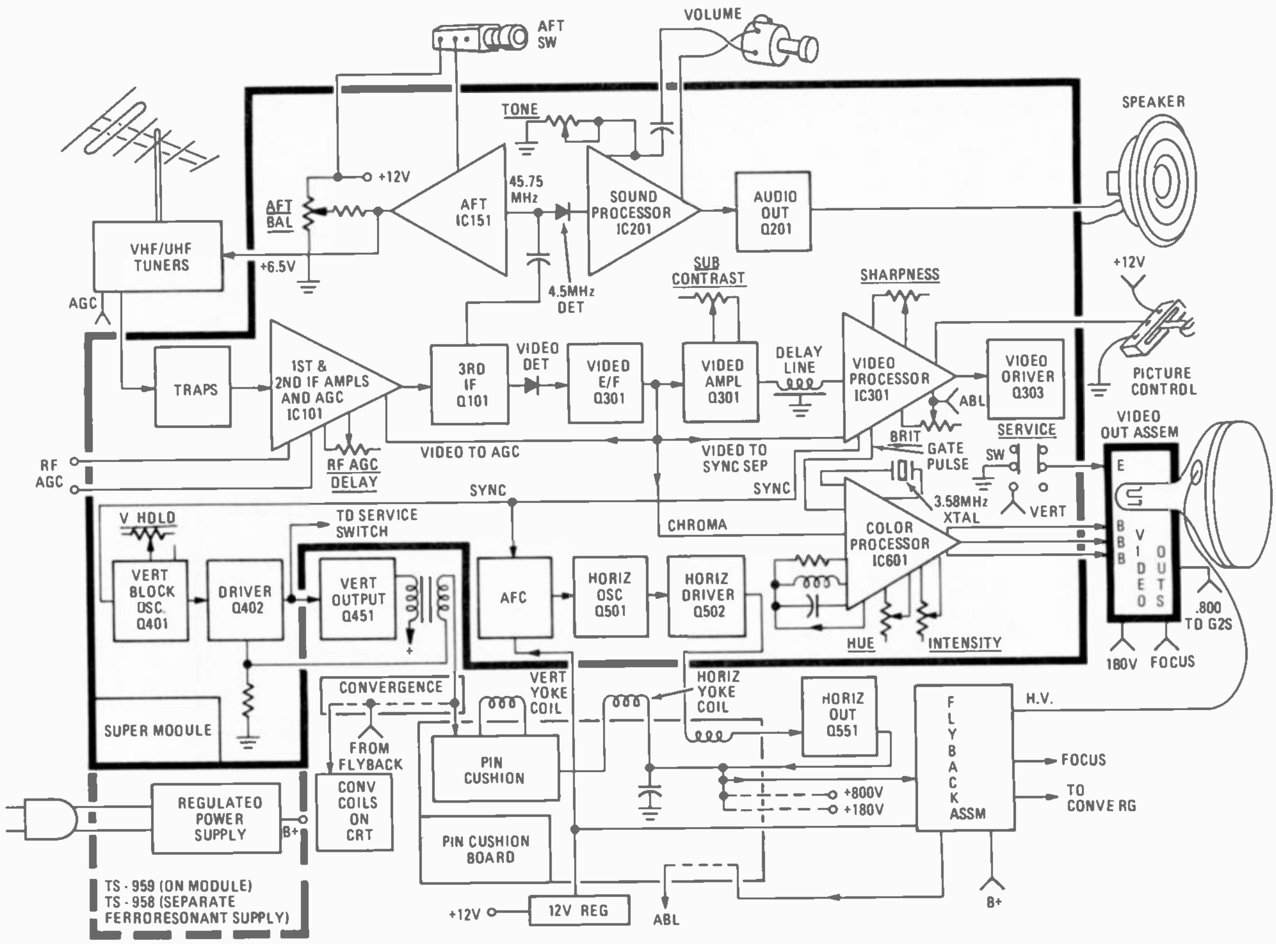


FIG. 1—BLOCK DIAGRAM, QUASAR TS958/959, showing Super Module.

TS959 19-inch sets use only 88 watts! The TS958 has a ferroresonant transformer for voltage regulation. Solid-state electronic regulation is featured in the TS959.

RCA receivers

RCA's new models have a number of innovative features. The top of the line direct-access tuning system with a calculator-type remote control keyboard is continued from last year. A dynamic flesh tone correction circuit has all the advantages of the older breed of color correction circuits but does not introduce the color distortion to colors removed in phase from the range of flesh tones. And a new luminance system optimizes peaking adjustment and produces a sharp picture with improved resolution.

Flesh correction circuits generally distort the color signal. Some colors may be shifted more than others and overall phase corrections inadvertently shift correct colors as well as incorrect hues. RCA's new system restricts the correction to colors closest to the +I

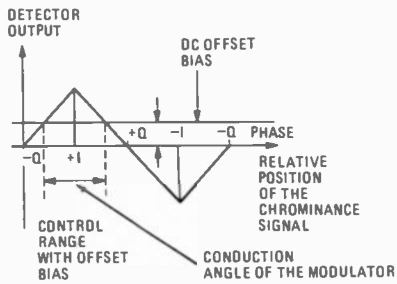


FIG. 2—OFFSET BIAS CONFINES color correction to colors near flesh tones.

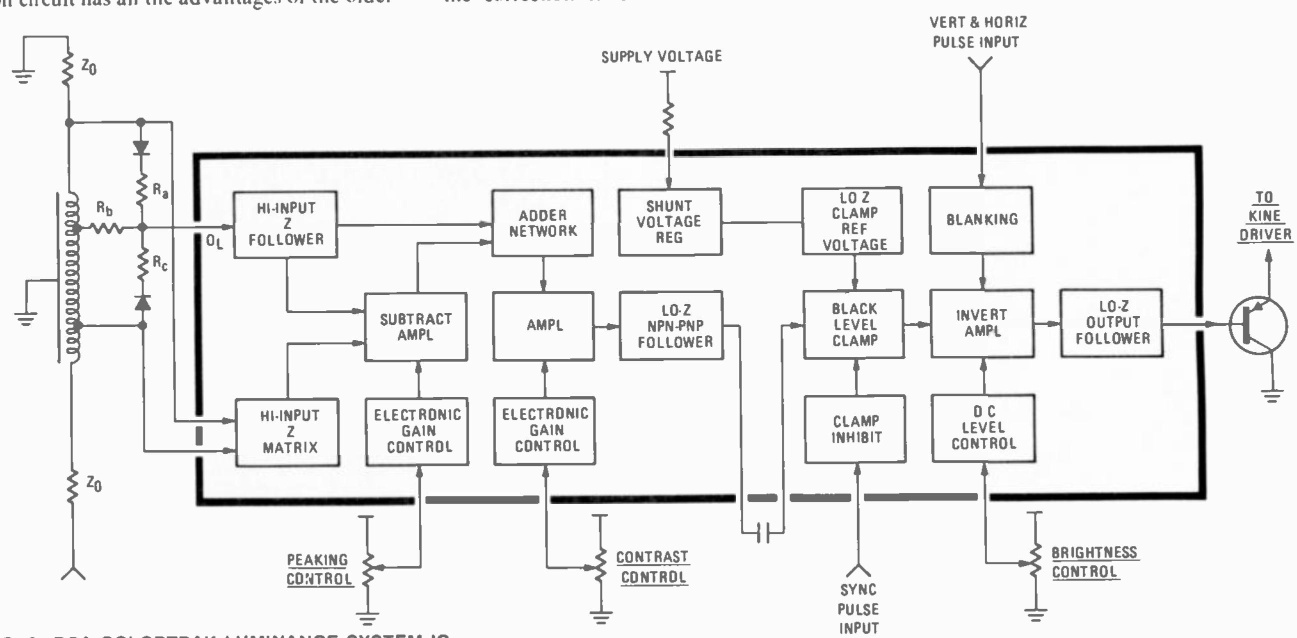


FIG. 3—RCA COLORTRAK LUMINANCE SYSTEM IC.

vector near the flesh tones. Pure reds, blues, greens and normal flesh tones are minimally affected. Magenta and yellow-green color components are the "off flesh tones" that are shifted in phase toward the +I direction.

The dynamic correction system amplitude limits the chroma signal and compares it to the color subcarrier with a phase comparator. At this point the corrections exist for all colors not on the I axis. The phase comparator output is gated in a modulator to produce an output that is added to the color subcarrier before it is used by the Q and I demodulators. Figure 2 shows the action of the modulator. An offset bias applied to the modulator blocks the color corrections for colors outside the portion of the spectrum near flesh colors.

The block diagram of the Colortrak luminance system is shown in Fig. 3. A new integrated circuit produces a unique combination of functions including DC controlled phase corrected peaking, nonlinear transient compression in the white direction, and true black level clamping.

Optimum video transient response has one preshoot and a matching overshoot. Until now, the techniques used in TV receivers have not produced this ideal response. The new RCA sets use a transversal filter system that adds the signals from taps on an otherwise conventional delay line. A high-frequency signal is generated by adding the voltages from the taps closest to the ends of the delay line. By adding or subtracting the high frequency signal from the output of the center tap, a variable peaked signal is formed while maintaining the ideal transient response.

As illustrated in Figure 3, one input to the peaking system is picked off the end of the delay line so only two actual taps are needed.

Zenith

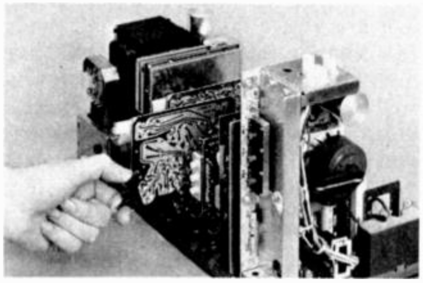
New Zenith engineering advances for 1977 include a 19-inch diagonal Chromacolor 100-degree picture tube with the high-resolution EFL electron gun. The patented EFL gun focuses the electron beam with four instead of two electron lens elements, reducing spot size up to 60% compared with conventional guns. Improved picture sharpness and highlight detail is the result.

Also new is the Color Sentry automatic picture control system that ties together five electronic circuits to adjust the color, level, saturation, tint, color balance, and other parameters automatically. Color Sentry adjusts the picture when changing channels or any other time the program material is altered.

Up to 12 VHF or UHF channels are selected with the touch of a button with Zenith's Touch-Command. Married to the Electronic Video Guard tuning system, light pressure on the selected channel button brings in the viewer's choice without the distraction of passing through other stations. Electronic Video Guard tuning is in 85% of Zenith's color line which is the broadest use of electronic tuning in the industry.

Admiral

The Admiral Group of Rockwell International Corporation has a new line with a 100 percent deluxe solid-state television chassis. The ERA II Limited chassis features the industry's first optional electronic remote control that can be installed by the customer. The suggested retail price of the tuning system is $99.95. A SELECT button on the calculator type keyboard enters the previously keyed-in channel number. Apparently this is Admiral's way of dealing with the problem of differentiating between one and two-digit channel entries.



THE SEVEN MODULES of the Admiral ERA II can be changed in seconds.

Remote control can be added to five sets that have the built-in adapter. The remote transmitter is a duplicate of the tuning panel on the set. Installation consists of simply plugging the unit into the adapter after removing the cover plate on the front of the receiver. A 9-volt battery is inserted in the transmitter and the system is in operation.

The ERA II Limited remote transmitter has a self-checking system that indicates battery condition. If the battery is strong, pressing the SELECT button causes the least significant digit on the receiver's digital display to flash. When the battery is weak, the lower digit stops winking.

The Admiral ERA II Limited chassis is offered in certain 23 and 25-inch consoles. They feature a negative black-matrix picture tube and ambient light sensing. Some 25-inch models are equipped with a digital channel read-out display.

All complex parts, including the power supply and the high-voltage deflection system, have been designed into efficient compact units. Each module is computer tested before installation at the factory.

General Electric

G-E also has an industry first for 1977. It is the 25-inch in-line gun picture tube used in the new YM chassis. One of the main features of the in-line picture tube is the simplified convergence procedure that G-E calls the "4 minute half hour."

The big G-E feature for 1977 is the VIR "Broadcast Controlled" Color system. Details of the experimental Vertical Interval Reference system are described in the November, 1976, issue of **Radio-Electronics.** As explained in the article, General Electric uses tint and color controllers to compare the received luminance and color signals with information extracted from the VIR signal. The VIR reference was carefully designed to allow easy correction for transmission distortions. The signal format is such that it is relatively unaffected by the transmission errors that affect the color burst reference phase and amplitude.

Figure 4 is the schematic of the tint controller and demonstrates the principle of both the phase and amplitude correction mechanisms.

The R–Y color difference signal from the chroma/video module feeds the base circuit of emitter follower Q38. Limiting the bandwidth with R37 and C37 reduces noise. Transistor Q38 drives Q41 and Q42 when the signals are allowed through by the intervening diode gates. The lower switching diode-gate (diode D39) is controlled by the chroma reference interval and the upper gate (D40) by the black reference interval keying-pulses developed in the line recognizer portion of the system. The line-recognizer detects the nineteenth picture line where the VIR signal is located and extracts the chroma and luminance levels from the appropriate signal segments.

When the cathode of either D39 or D40 is at ground potential, the corresponding anode is one V_{be} above ground and the bases of the transistors at ground potential holding them off. One V_{be} is insufficient to forward-bias the two-junction combination of the series diodes D42 or D41 and the base-emitter junction of transistor Q41 or Q42. Positive

continued on page 84

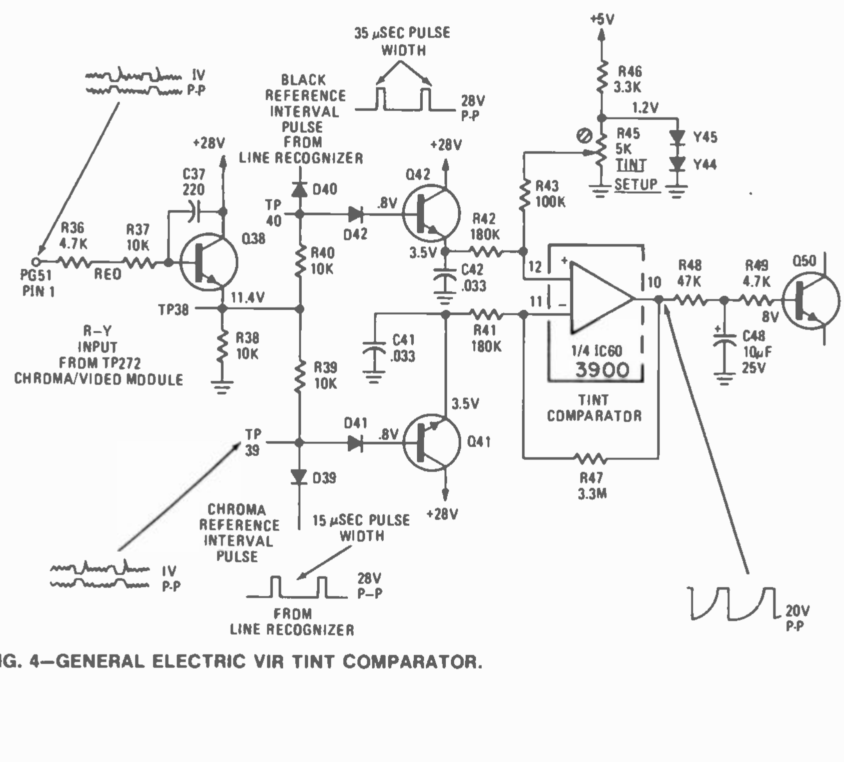


FIG. 4—GENERAL ELECTRIC VIR TINT COMPARATOR.

Build Portable Mini-Organ

JOHN S. SIMONTON, JR.

Part II. *Play music anywhere with this self-contained battery-powered mini-organ. It has its own keyboard, speaker, a unique pitch-bender and covers a five octave range*

LAST MONTH, PART I OF THIS ARTICLE introduced Oz and presented the schematic, foil patterns and began the construction details.

This month, the article concludes with the rest of the construction details and a description of how to connect and use Oz.

Mount the circuit board, keyboard and front panel in the housing that you've built or purchased. (Another tip: build a box, then cut it in halves or quarters or whatever, to make it open; don't cut the pieces first then try to put them together so that they form a closing box.) Then wire the connections between the circuit board and front panel (see Fig. 6). The caveats that I mentioned for PC board to keyboard wiring apply equally here. Leave enough slack so if something breaks, it can be fixed without dismantling the entire thing—but not so long that radiation problems pop up.

That makes twice that I've mentioned "radiation problems." Conceivably some of you are wondering what that means. It means this: as we've already noted, the output of the top-octave IC is a bunch of squarewaves. I might now mention that these squarewaves have very respectable rise and fall times. When we have fast rise and fall times, Mr. Fourier tells us that we will have high-frequency components. Mr. Maxwell tells us that high frequencies have a great ability for launching themselves into space in the form of electromagnetic radiation. The longer the wire that these high frequencies have to pass through, the greater will be their ability to leave the conductor entirely.

Similarly, long wires connected to the input of an amplifier will act as antennas that pick up the radiation and amplify it just as it would any other signal. The net result, in this case, is that notes work their way from the tone-generating circuitry to the amplifier and speaker without bothering to go through the keyboard. It becomes our task, then, either to prevent the radiation to whatever extent possible (short wires): or, failing that, to at least contain the radiation (shielding). Besides short wires there are a couple of other things that you can do to minimize—and probably eliminate entirely—this problem.

Use coax to make the connections indicated to be coax on the schematic and in the illustrations: specifically, the signal path from keyboard to front panel and back to the circuit board.

It is not practical to use coax to make all the connections between the circuit board and keyboard; but fortunately it's not necessary either. Most keyboards have a solder lug attached to their frame somewhere. It's there for a purpose—the purpose being that if you ground it, the whole frame of the keyboard becomes one big shield to prevent radiation spilling out into places it shouldn't. Point "BB" on the PC board is ground and has been provided for just this purpose.

Just a little more, we're almost done. Special note also needs to be given to the pitch-bender panel. If you really want to, you can eliminate it entirely simply by not wiring it in (in which case it would not hurt to parallel an additional 47 pF across C20). But the ability to tremolo and "glide" single notes and chords is to a great extent what OZ is all about, so I will assume you are going to use it. Connect the pitch bender panel to the rest of the circuitry with small diameter coax, like RG-174/U. Coax is important here because we're working with an element that is capacitance sensitive and we want to minimize the effect that grabbing the connecting cord with your hand will have. The most important part of using coax is to make sure that the shield goes to the *driving* terminal of the clock circuit (the output of IC6-b—point "L" on the circuit board). Figure 7 shows the assembly of

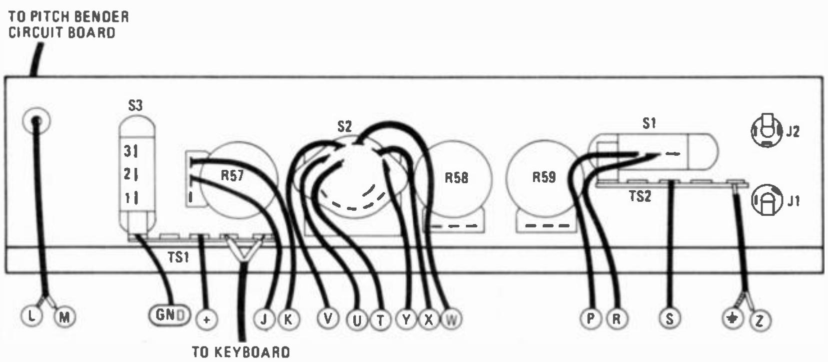
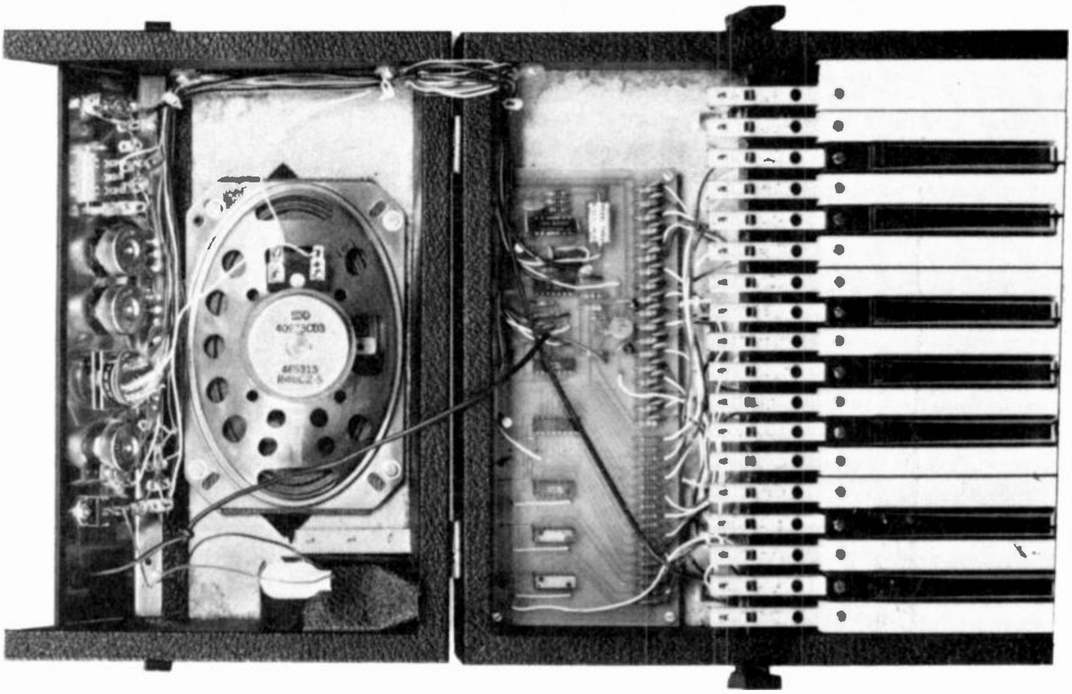


FIG. 6—PANEL-TO-BOARD WIRING.



the pitch bender panel.

You're finished. Now, before you hook up the batteries, why don't you check it through one more time? I always do (well, almost always).

OZ requires a 12-volt power source for proper operation. This can be a line-operated supply if you like, but be aware that a portion of the audio bus is connected to the supply lines, so power supply ripple rejection at the output is low. Make sure the supply is well filtered.

The best bet is batteries. "AA" size cells work well and even taking into account OZ's 60-mA typical current drain, a fresh set of quality batteries should last for a month or more of daily intermittent operation.

Testing

Turn the POWER switch ON and observe that one and only one of the range indicating LED's lights. Change the OCTAVE switch and observe that the LED's follow the action of the switch.

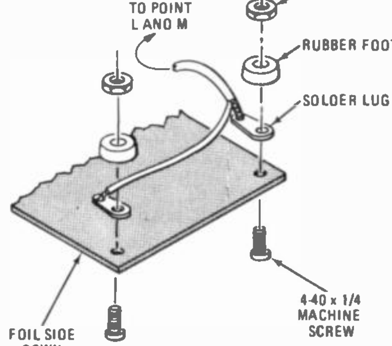


FIG. 7—PITCH-BENDER board assembly.

Depress one of the keys and advance the LEVEL control until a tone is heard from the speaker. Test all the keys to make sure they produce a tone and that the pitch of the tone ascends as you work your way up the keyboard. Confirm that all positions of the OCTAVE switch work and that as the knob is advanced in a clockwise direction the pitch produced changes by octave steps.

While pressing keys, check the operation of the trigger status LED. With the TRIGGER select switch in the STEP position, the LED should come on and stay on as long as any keys are down. In the pulse position of this switch, the LED should wink briefly (very briefly) every time a new key is pressed down.

Try connecting the tone-generation circuitry to an external amplifier by connecting the OUT jack J2 into the input of the outboard amplifier. Under these conditions make sure that signal is being supplied to the external amplifier and that no sound is coming from OZ's speaker.

To test OZ's input jack, you can either run an external program source into J1 (IN) or you can just jumper from OZ's output to its input. If, under these conditions, you still hear sound from the speaker, then the IN jack is working.

Using OZ

There is little to be said about using OZ by itself. You simply turn it on, select the octave that you want to play in, set the LEVEL and TONE controls to your taste and wail!

Interfacing to full synthesizer systems is only slightly more complicated, and more than anything else, requires that you have a firm grasp of exactly what OZ is and what it is supposed to do. Let's pin that down right now: OZ is a combination controller and polytonic pitch source. Nothing more (it doesn't *need* to be anything more). In most synthesizer systems, it will be used in place of—or possibly in conjunction with—a keyboard/voltage controlled oscillator combination.

For example, Fig. 8 shows a "classic" synthesizer configuration. In a patching arrangement like this, there are really two different circuits with which we need to be concerned; the control circuit (triggers, control voltages, etc.) and the audio circuit (outputs of oscillators, inputs and outputs of voltage controlled filters and amplifiers, etc.). In the scheme illustrated, the control circuit can also be broken down into control

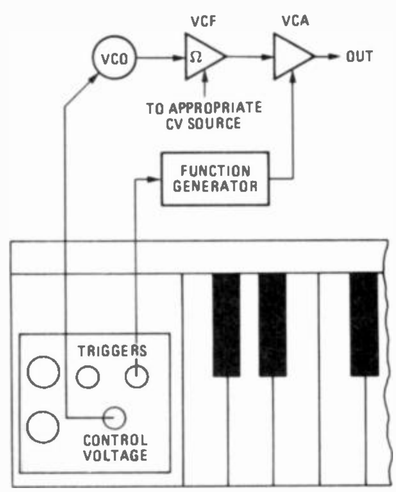


FIG. 8—A SYNTHESIZER PATCH. The initials stand for voltage controlled oscillator, filter, amplifier, and control voltage source.

PARTS LIST

All resistors ½ watt, 10%.
R1-R18—330,000 ohms
R19-R36, R51, R53, R54—22,000 ohms
R37—33,000 ohms
R38—3.9 megohm
R39—150,000 ohms
R40, R41, R56, R60—10,000 ohms
R42—2700 ohms
R43—680,000 ohms
R44—100,000 ohms
R45, R46, R47—10 ohms
R48, R52, R55—2200 ohms
R49—4700 ohms
R50—1000 ohms
R57, R58, R59—5000-ohm potentiometers
C1-C18, C24—.005 μF, ceramic disc
C19, C22, C26, C31—.05 μF
C20—47 pF
C21, C28, C29, C30—.01 μF
C23—100 pF
C25, C32—1 μF, 12-volt electrolytic
C27—250 μF, 12 V
C33—0.22 μF, Mylar
D1—1N914 diode
IC1, IC2, IC3—CD4013
IC4—MK-50240
IC5—CD4024
IC6—CD4001
IC7—LM380
J1—miniature open circuit phone jack
J2—miniature closed circuit phone jack
J3—pin jack
LED's (6)—MSL-7-50 light-emitting diode
Q1, Q2—2N5129 or 2N3904 transistor
S1, S3—SPST slide switch
S2—2P5T rotary switch
Keyboard—18-note DPST switching
Miscellaneous hardware, 4 knobs, front panel, vinyl covered case, 8-ohm speaker, speaker bezel, grille cloth, two 5-lug terminal strips, wire, plastic tubing, coaxial cable, bare wire, cable clamps, wire ties, printed circuit board, LED circuit board, pitch-bender circuit board.

A complete kit of parts to build OZ, including case, PC boards, keyboard, etc, less batteries, is available from;
PAIA Electronics, Inc.
P. O. Box 14359
Oklahoma City, OK 73114
for $84.95 plus shipping and insurance for 12 lbs. Order No. 3760

A set of three circuit boards may be obtained for $10.00 postpaid. Order No. 3760 PC.

The keyboard is available for $39.00 including postage and handling. Order No. AGO-18.

voltages and triggers. When a key is depressed on the keyboard, a voltage that tunes the VCO appears at the control-voltage output of the keyboard while a trigger appears at the trigger outputs. The trigger activates a function generator that produces a precisely preset time-varying voltage which in this case takes care of controlling the VCA to produce varying attack and decay times. The filter is stuck in there for harmonic control and it can be driven by control voltages from a variety of sources that we're not really concerned about.

The audio circuit is from the output of the VCO, through the VCF, through the VCA and finally to some sort of amplifier or recording device.

The part of this circuit that OZ replaces is *only* the keyboard and VCO and the control voltage path between the two. The rest of the patching configuration remains unchanged as shown in Fig. 9. The biggest difference is that by using OZ in place of the keyboard/VCO, you can now play full chords instead of the one-note-at-a-time restriction you previously had. Notice that the processed output can, if you wish, be

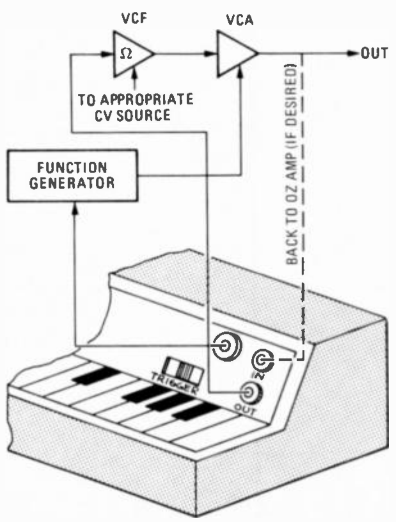


FIG. 9—OZ REPLACES KEYBOARD/VCO.

routed back to OZ's amplifier. You do have one drawback—OZ's output is basically a squarewave rather than the multiplicity of waveforms that you have available from most VCO's; but, with appropriate filtering (at the VCF), that is not really as much of a pain as you would first think.

Many of you will (I hope) be using OZ with the Gnome Micro-Synthesizer (See **Radio-Electronics,** November and December, 1975, and January, 1976, issues.) That's great; that really is what it's designed for. But, you're going to have to make some very light-weight changes to the Gnome before OZ and the Gnome are compatible. Specifically, you're going to have to add an external audio input to the Gnome audio bus.

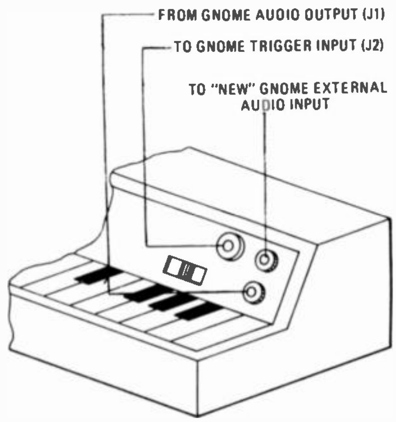


FIG. 11—CONNECTIONS TO GNOME.

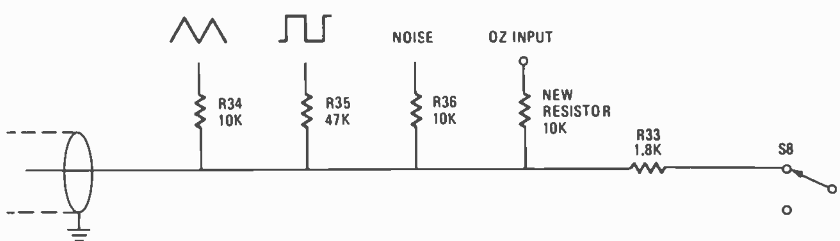


FIG. 10—THE GNOME'S AUDIO BUS, showing the added input and 10K resistor.

Figure 10 shows the audio bus of the Gnome as it was illustrated in the series of articles, and you can see that we have added a new resistor that connects to this bus.

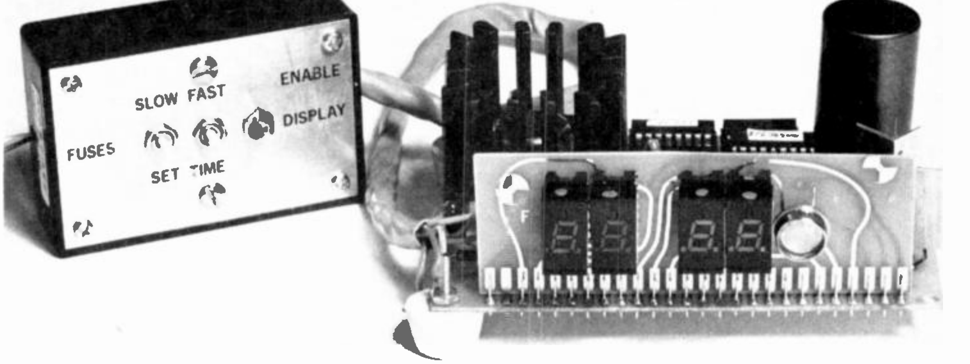
How this new input is made available to OZ is largely a matter of personal preference. In mine, the other end of the new resistor connects direct to a piece of co-ax which then drops out of the seam at the back of the Gnome case and terminates in a miniature phone plug. (In fact, the resistor is inside the plug that terminates the coax—but I'm particularly lazy.) A word of advice—**Do Not** connect both ends of the shield of the coax—there should be one and only one ground connection between OZ and the Gnome and that should be part of the line that runs between the Gnome's output and OZ's input. Multiple grounds in different locations are like an insurance policy guaranteeing hum problems. Ground the shield of the coax mentioned above at the plug that *terminates* the line *only*.

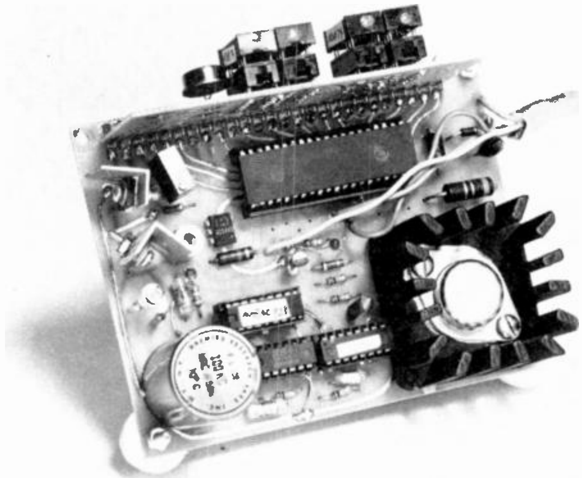
From there, the interconnections are simplicity personified. Your "new" audio input cable connects to OZ's output, OZ's input goes to the Gnome output, and the trigger jacks of both tie together. These connections are shown in Fig. 11.

Playing the Gnome/OZ combination is not very different from playing either one separately—though they are very definitely a synergistic pair. As a matter of fact, only one point need really be brought to your attention. It's this: leave the Gnome's VCA SUSTAIN switch in the sustain position. If you don't, the Gnome's percussion "mute" function will drive you bananas. **R-E**

BUILD

Digital Clock For Your Car





Part II—Construction details on a useful automotive accessory that is rarely available as original equipment. A valuable aid for the trucker and road ralley enthusiast that is simple and easy to build.

ROBERT C. ARP*

AN INTRODUCTION TO THIS USEFUL PROJECT appeared last month along with a detailed description of how the circuit works.

This month, the article concludes with the construction and calibration details, and foil patterns.

Construction

So that either type of display may be used with the clock, foil patterns for two double-sided display boards were prepared, as shown in Fig. 7. The two display boards are directly interchangeable with the main board. However, if incandescent displays are used, the copper trace on the main board that connects the emitter of Q3 to the −5-volt bus must be cut. Then, a jumper wire should be connected from the emitter of Q3 to V_{DD}. The component layout for each display board is shown in Fig. 8.

Because the main board is separated from the display board, a variety of mounting schemes are possible; the display board may be dash mounted and connected to the remotely located main board with an edge connector, a display socket may be used to house the display (such as the Allied Electronics Cat. No. 658-1130) or the display board may be plugged into the main board, using Calectro Digi-Klips (Cat. No. J4-645).

* Product Engineer, National Semiconductor Corp.

Digi-Klips are available at local Calectro dealers and are manufactured by GC Electronics, Div. of Hydrometals Inc., 400 South Wyman St., Rockford, IL 61101.

If you decide to use Digi-Klips, they are available in packages of 24 pins. Although 26 connections are required between the main board and the display board, a package of 24 pins will do the job if two connections are made with wire soldered to each board. The Digi-Klips allow a rigid perpendicular connection between the display board and the main board. They may, however, be placed in the main board with one pin higher than the other to provide a tilted display. If you elect to use the Digi-Klips, a drilling guide is provided in Fig. 9.

Caution: When mounting the Digi-Klips, do not remove them from their plastic carriers; insert the entire row into the holes in the board at the desired angle, and solder each Digi-Klip to its bottom edge-connector pad provided on the board. Then remove the plastic carrier with a small screwdriver and solder each Digi-Klip to its edge connector pad provided on top of the board.

The numeric displays should not be soldered directly to the display board. Mount Calectro Cat. No. J4-635 IC terminal sockets or Molex IC Terminals to the board, in strips of seven or eight, by soldering them both to the top and bottom in-line pads. The two tabs to which the strips of terminals are connected should be closer to the center line of the in-line pads than should be the openings into which the display pins will be inserted. The tabs may be removed by bending them from side to side with long-nose pliers until they snap from the terminals. The displays are inserted into the terminals the same way they are inserted into an IC socket. IC sockets may be used on the main and display boards if the leads are long enough so the sockets can be soldered to all pads on the top of the main board and on the front of the display board that have copper traces running to them. In either case, the terminals or sockets that have copper traces running to them on the top and bottom of the board, must be soldered on both sides of the board.

If the incandescent displays are used, and if a viewing screen is used in front of them, the Radio-Shack Cat. No. 276-116 photoresistor must be used (see parts list). It must be mounted to the display board so that the black chimney is in direct, flush contact with the viewing screen. This will prevent light from the incandescent displays from reaching the photoresistor by reflection from the viewing screen.

If the LED displays are used, mount the photoresistor to the display board so that it stands as far away from the board as do the displays; the ambient light reaching the photoresistor should be equal to the ambient light reaching the displays.

Display bezels may be purchased from Allied Electronics or Tracy Design Corp. The Allied No. 658-1240 bezel assembly has a red circularly polarized viewing screen and two mounting screws that can be used to mount it to the display board. The bezel may be separated from the display board with metal or fiber spacers. The No. 658-1240 bezel is actually made for five LED displays; the extra length is specified so that the bezel will accommodate the four displays plus a Clairex

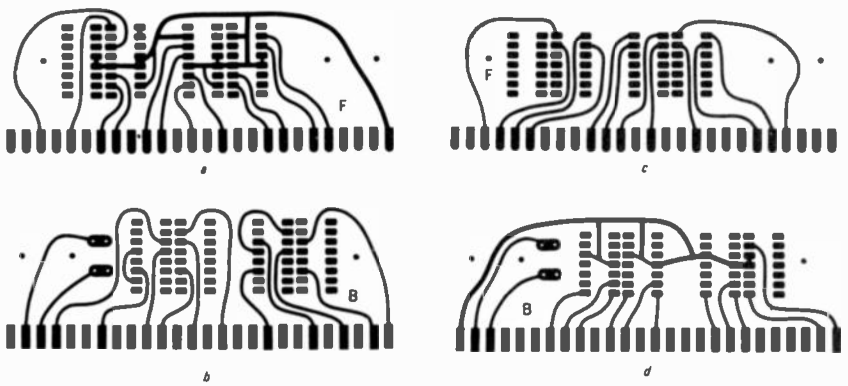


FIG. 7—DISPLAY BOARD foil-patterns shown half-size. *a*—front of incandescent display board; *b*—rear of same board; c—front of LED board; *d*—back of the LED board.

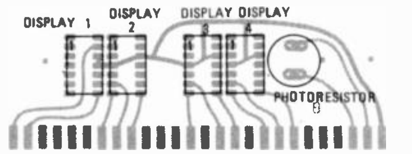


FIG. 8—DISPLAY BOARD COMPONENTS LAYOUT. Front view. Bezel mounting holes are centered by drawing a line across board, through the center of the displays. Inner bezel holes accommodate Allied 658-1240 bezel; outer ones the 658-1260. The photoresistor mounting holes are for Archer 276-116 or Clairex CL704L. Photoresistor solder pads are large enough to accommodate Clairex CLM54L if Allied 658-1260 bezel is used.

FIG. 9—GUIDE FOR DIGI-KLIPS

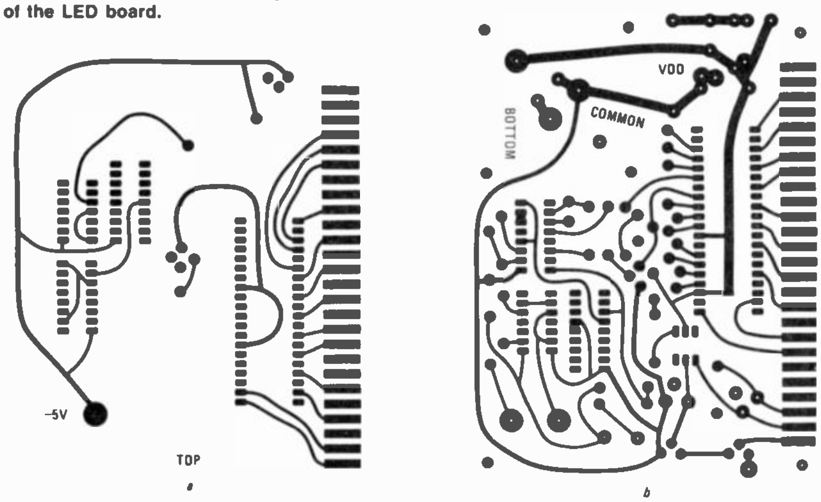


FIG. 10—THE MAIN BOARD foil-patterns shown half-size. *a* shows component side; *b* shows bottom. If board is made a little larger, corner holes may be moved out slightly; they are now positioned for minimum-sized board.

CL704L or a Radio-Shack No. 276-116 photoresistor. The fit is tight; width of the bezel is 3.2 inches.

If a greater bezel width can be tolerated, the Allied No. 658-1260, with a bezel width of 3.7 inches, may be used. This bezel will allow the use of a Clairex CL5M4L photoresistor. All three of the photoresistors mentioned above were used as intensity controls; the Clairex CL5M4L gives the best results.

The foil pattern for the double-sided main board is shown in Fig. 10 and the component layout diagram is shown in Fig. 11. Sockets should be mounted to the main board for the integrated circuits and a socket should be mounted for the opto-isolator/coupler in the same manner as they are installed on the display board. However, a decision must be reached about the MM5385 and MM74C221 installation before the terminals are mounted.

The main printed-circuit board layout demands that these two integrated circuits be mounted from the bottom of the printed-circuit board, or that their pins be bent back 180 degrees before they are mounted from the top of the board. This form of mounting is necessary because of the layout of the MM5385 pins.

There need be no fear of bending back the pins of an integrated circuit as long as the bending is done correctly, with the proper tool. Use a pair of tweezers with sharp, rather than blunt, blades to grasp each pin exactly at the point it enters the package. The pins must be bent precisely at the package exit point and the edge of the tweezers must be held as close to the package as possible during the entire bending operation. This will prevent the pin from bending and breaking at the shoulder.

Bend the pins the full 180 degrees, one at a time, starting with a pin in the upper right hand corner of the IC and proceeding from pin-to-pin in a clockwise direction. You can practice on a bad IC, if one is at hand, or rejected IC's may be purchased at very little expense. Of course, a jig could be set up to bend all the pins on one side of an IC simultaneously.

After all the pins have been bent; check them for alignment before the IC is inserted into the terminals. The pins of all IC's should be carefully observed while the IC's are being inserted to make sure that all pins are actually inserted into the socket.

Next, without removing them from their plastic carriers, insert the first row of Digi-Klips from the top into the holes prepared in the main printed circuit board. Start at the end of the board where the heat sink is mounted. Look through both ends of the carrier and make sure that all center flats are touching the board. If they aren't, press them down with a very small screwdriver or other thin tool inserted into the appropriate end of

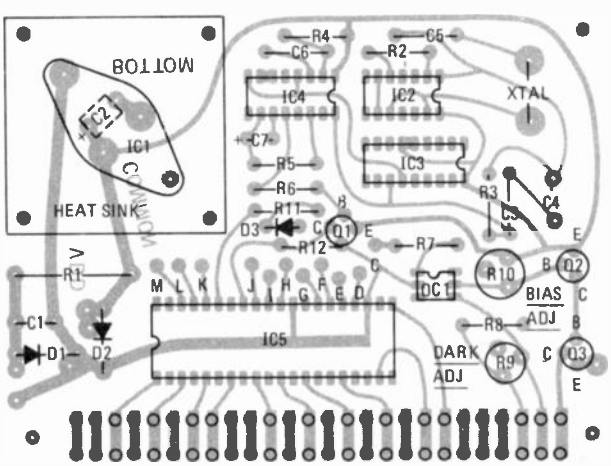


FIG. 11—COMPONENTS LAYOUT, MAIN CIRCUIT BOARD. Top view. Capacitor C2 mounts to bottom of board. Unless pins of MM5385 and 74C221 are bent back 180 degrees (see text) they must also be mounted to bottom of board.

the carrier.

Turn the board over, and, while holding the carrier in place, solder the Klips to the bottom. Remove the carrier with a screwdriver and solder the Klips to the top of the board. Do not allow solder to block the board opening in the center of the Digi-Klips.

Mount another row of Digi-Klips to the main printed circuit board in the same manner, then remove a Digi-Klip from a row in a fresh carrier. After mounting this Digi-Klip there will be an empty Digi-Klip hole at the end of the board on which Q2 and Q3 are to be mounted. (A connection must be made to this Digi-Klip hole, through an ammeter, from the display board power bus during calibration.)

Enough room on the main board has been provided for at least two types of crystals: the cylindrical and flat-type crystals up to 1-inch in diameter.

The heat developed by the LM320K-5 voltage regulator during normal operation of the clock may be dissipated in three ways:

1. Because the input to the LM320K-5 is the negative side of the battery, the voltage regulator may be mounted directly to the metal body of cars with negative ground electrical systems. Choose a level spot, make a good electrical connection, and use any silicone-type of heat sink compound between the regulator and the body of the car.
2. If the clock is to be housed in a metal cabinet, the voltage regulator may be mounted to the cabinet for heat dissipation as long as the total outer metallic surface area of the cabinet is equal to or greater than 42 square inches.
3. A heat sink equivalent to the Wakefield 680-1.25-A (see parts list) may be mounted to the printed circuit board and used to cool the regulator. The size of this heat sink is the minimum that can be used. All heat sink areas and sizes discussed assumes the use of a silicone heat-sink compound between the regulator and the heat sink. Separate the heat sink from the board about .05 inch. The heat sink must also be electrically insulated from the circuit board.

After mounting the LM320K-5 voltage regulator, a jumper must be soldered from the top of the main board at the LM320K-5 pin-2 hole to the bottom of the board at the same hole. This connects the −5-volt bus that runs along the top of the board to the output of the voltage regulator.

A heat sink must also be provided for Q2 and Q3. The Allied Electronics No. 957-2670, or a similar heat sink sold at Radio Shack stores as part of an assortment (Cat. No. 276-003), gives excellent results. The height of the heat sink is sufficient, so that three of the seven fins may be cut from the Radio Shack heat-sink. Use the three-fin sink for Q2 and the four-fin sink for Q3. Many similar heat sinks may be used; the thermal resistance should be about 24° centigrade-per-watt.

Switches for all the desired functions can be mounted in any convenient location. Wires from the power supply and switches must be soldered to the appropriate pads. These pads are labeled A through M (see Fig. 11). Solder the wires necessary to provide the desired functions to their pads, and solder one in-line fuse from the accessory terminal of the ignition switch to pad "C" and an in-line fuse from the battery terminal of the ignition switch to pad "A". A wire must also connect from pad "B" to the negative terminal of the battery. It may be fastened to any part of the car chassis from which paint and/or rust have been removed.

The display board may be mounted to the main board by placing the main board on a sheet of ½-inch styrofoam, then, by pushing the display board into the Digi-Klips. The Digi-Klips should be centered on the connector pads of the display board.

If possible, the main board-display board assembly should be mounted in its permanent location before calibration. (This may not be feasible unless it is to be mounted in a metal cabinet.) Some suggestions for dash mounts have been: in a panel that has been cut to fit an original automotive clock, in seat-belt control cutouts provided in certain models, or in any blank area of the dash.

After calibration, remove the display board by prying it out of the Digi-Klips with a screwdriver so that the last Digi-Klip may be mounted to the main board. This Digi-Klip connects to the display board power bus.

Frequency calibration

The calibration instructions are the same for all supply voltage levels. However, with 6-volt systems the intensity of incandescent displays will be lower than that specified for 12-volt systems. Furthermore, the instructions for calibrating the display current are different for each type of display.

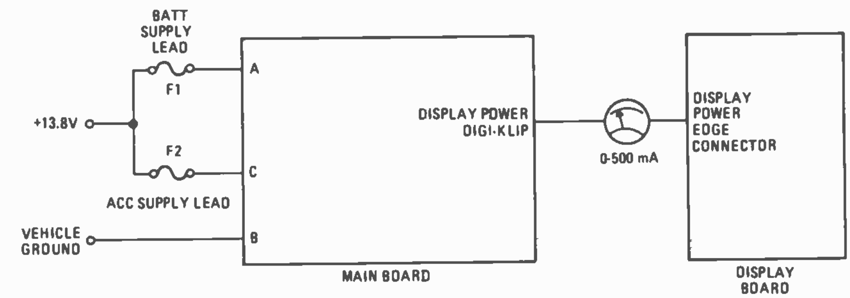


FIG. 12—CALIBRATION SETUP. Install both fuses before turning on power; set both pots to minimum resistance. If displays show an illegal readcut after clock has been reset at initial power turn-on, disconnect power and troubleshoot the display board and displays for shorts or opens. Voltages shown are for a 12-volt system, engine running.

Before applying voltage to the clock, set both the DARK ADJUST potentiometer (R9) and the BIAS potentiometer (R10) for minimum resistance (full counterclockwise). Set R10 for minimum resistance at initial turn-on to prevent the flow of excessive display current that could destroy the displays.

Connect both the battery supply lead and the accessory supply lead to the positive side of the automotive voltage supply (see Fig. 12) with the engine running and the alternator delivering rated voltage to the electrical system. Insert a 0–500-mA meter between the display power Digi-Klip located at the extreme right on the main board and the display power edge connector located at the extreme right on the display board.

Connect the V_{DD} supply lead to the negative side of the automotive voltage supply. During the calibration, a cigarette lighter power plug may be used to interface the clock to the vehicle's electrical system. If the clock is to be mounted in a truck, use the 12-volt supply rather than the 24-volt supply.

If the clock is to be mounted in a truck that does not have a 12-volt supply, change D1 to a 24-volt Zener diode. Also, lower the 24-volt supply to 12 or 15 volts using an LM340K-12 or LM340K-15 and appropriate heat sink. (If a much larger heat sink is used for the LM320K-5, a preregulator may not be necessary.)

Depress the SLOW SET or the FAST SET switch momentarily, to reset the power failure indicator. LED1, on the main circuit board should begin flashing at some rate between 36 and 180 flashes-per-minute. This is because the input to the clock will be between 30 and 150 Hz.

The 50 Hz input to the MM5385 may be adjusted precisely by connecting a digital counter with a resolution of 0.1 Hz between the collector of Q1 and V_{SS}. C4 may then be adjusted with a non-metallic tuning tool until the counter reads 50.0 Hz.

If a counter with at least this much accuracy cannot be used, the 50-Hz input to the clock can be adjusted by tuning C4 while observing the flashing rate of LED1. Because of the oscillator configuration, LED1 will flash only at rates between 36 and 180 per minute. This may be observed by rotating C4 counterclockwise 360 degrees while observing LED1. At some setting of C4, LED1 will be flashing at 180 flashes-per-minute. As the variable plate of C4 is turned counterclockwise past this setting, a point will be reached at which LED1 stops flashing at 180 flashes-per-minute, and, precisely at that point, begins to flash at a 60 flash-per-minute rate. At this point, the input to the MM5385 is 50 Hz. The accuracy of the adjustment may be checked by counting the number of flashes that occur within one minute as observed with a watch.

This method of adjusting the frequency of the oscillator is more accurate than that which can be obtained by using a digital counter with a resolution of 1 Hz, and is, at least, equivalent to the accuracy that can be obtained with a counter with a resolution of 0.1 Hz.

Although there are two points of adjustment that cause LED1 to flash at 60 flashes-per-minute, C4 should be adjusted counterclockwise through settings that cause LED1 to flash at 36 flashes-per-minute, 60 flashes-per-minute, 180 flashes-per-minute and set to the point at which it stops flashing at 180 flashes-per-minute. Whichever setting is used, C4 should be varied so that LED1 flashes at 180 flashes-per-minute just before

continued on page 86

Amplifier/Speaker Interface—a new concept

Until now, matching the performance of an amplifier to a speaker has been a hit or miss affair. A new speaker system handles this problem in a unique way

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

FIG. 1—FORMULA-7 MONITOR SERIES speaker system from British Industries Company.

THE STRINGENT RULES REGARDING AUDIO amplifier power ratings imposed nearly two years ago by the Federal Trade Commission has done much to standardize the way that hi-fi amplifier and receiver manufacturers advertise the power capabilities of their products. This standardization makes it easier to compare power specifications of different competing products. As most readers are aware, the law requires that amplifiers be rated on the basis of their ability to deliver continuous sinewave power into a specified resistive load. The amplifier does this over a specified band of audio frequencies at some specified value of total harmonic distortion.

That's all well and good as far as amplifiers are concerned, but in some ways it has made the problem of interfacing amplifiers with loudspeakers even more difficult than before. For one thing, we do not normally listen to continuous sinewaves and the complex waveforms produced by program sources may be handled quite differently by an amplifier compared to the way that it handles continuous sinewave signals.

Generally, amplifiers can deliver greater short-term power when fed with transient, musical signals than it can when dealing with continuous sinewave signals. Also, since music encompasses a wide dynamic-range of signal amplitudes, it is quite possible to listen to a system at what seems like reasonable loudness levels only to have sudden peaks (that may be greater in amplitude by as much as 10 dB, 20 dB or even more) drive that amplifier well into clipping and audible distortion.

Conversely, a 50 watt-per-channel stereo amplifier, connected to a speaker system that is nominally rated to handle 50 watts, may well be driven to beyond its power handling capability by transient signal peaks. These transient peaks, though instantaneously well in excess of 50 watts, are *not* causing amplifier clipping because they are of such short duration. However, such power levels fed to the speaker, even intermittently, have been known to damage speakers or at least to drive their cones into non-linear operating regions with attendant distortion produced this time from the speakers themselves.

Finally, the so-called nominal power handling rating of the speaker may be based upon the capabilities of the more rugged woofer and not on the lower power-handling capacity of the mid-range or high-frequency drivers in the system. Inordinately high levels of high-frequency energy fed to such speaker systems (either because of super-audible amplifier oscillation, non-typical frequency distribution of musical energy commonly encountered with some forms of electronic music or from amplifier-generated harmonics due to inadvertent amplifier clipping) have been known to "blow" many an expensive mid-range driver or tweeter while the woofer remains intact.

A New Speaker System

A new speaker system, developed by British Industries Company, includes many innovative design features that are intended to alert the user of these dangers and even to protect against their consequences. The B.I.C. Venturi Formula-7 Monitor Series speaker, shown in Fig. 1, is one of two new speakers that the company describes as a "speaker systems that think". It is our purpose here not to evaluate the sound reproducing qualities of the Formula 7 (preferences in speaker sound remain, as always, largely subjective), but rather to discuss the electronic and indicator circuits that have been incorporated in this unusual system.

The upper section of the speaker system contains a control and indicator panel that is shown in Fig. 2. On the front panel to the left of the speaker system is an LED indicator light and just above it, on the sloped section of the front panel, is an AMPLIFIER CLIPPING control. A special test record is supplied with the Formula 7. It contains a continuous signal made up of repeating bursts of 300 Hz, three cycles of which repeats every 100 milliseconds, as shown in Fig. 3. Thus, the duty cycle of this signal is 10%, not unlike the duty cycle of the peak signals in typical music.

In actual use, the listener plays this record through his amplifier and the Formula 7, increasing the volume setting until a distinct change is heard in the character of the pulse-like sound. This point corresponds to amplifier clipping (assuming the amplifier is the limiting factor of the combination). The user then rotates the AMPLIFIER CLIPPING control until the indicator light just flashes. Once the setting is made, the LED will light whenever the amplifier is driven to clipping levels by other musical program sources. The nice thing

FIG. 2—CONTROL PANEL of the Formula-7 speaker system.

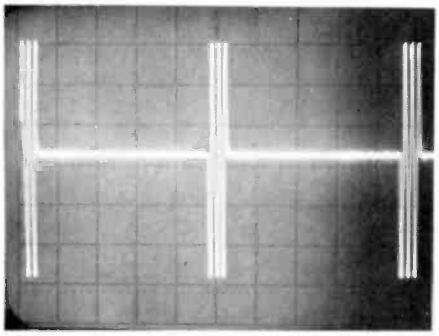


FIG. 3—TEST RECORD supplied with Formula-7 provides three cycles of 300-Hz signal every 100 milliseconds.

about this indicator is that it does not require that the user know or care what the dynamic (or music) power capability of the amplifier in question is in relation to its steady-state or continuous-power rating, since this is really of academic interest and not necessarily directly related to when the amplifier will begin to clip under actual listening conditions.

The clipping indicator feature, as well as two other major indicating and protecting features, will best be understood by referring to the complete schematic diagram of the Formula 7, shown in Fig. 4. Audio signals delivered by the power amplifier to J1-1 and J1-2 are fed to the usual speaker drivers and crossover network components, with which we will deal shortly. In addition, the audio signal is rectified by diode D2 and applied to the positive input of IC3-a. The trigger point of LED9 is determined by picking off a portion of the fixed 5-volts DC from a built-in power supply via R23 and applying it to the negative input of IC3-a. Thus, the trigger point of LED9 can be adjusted by means of R23 (the front panel AMPLIFIER CLIPPING control previously referred to) over a wide range corresponding to amplifier outputs up to around 125 watts-per-channel.

Now, suppose the user owns an amplifier that exceeds the safe power-handling capability of the speaker system. In that case, auditioning of the test record might result in speaker distortion or damage well before the amplifier begins to clip. To prevent overdriving of the speakers in this manner, additional indicator and protection devices have been incorporated.

Referring now to the portion of Fig. 4 that shows the four drivers you will note that there are three circuit breakers (CB1, CB2 and CB3) wired in series

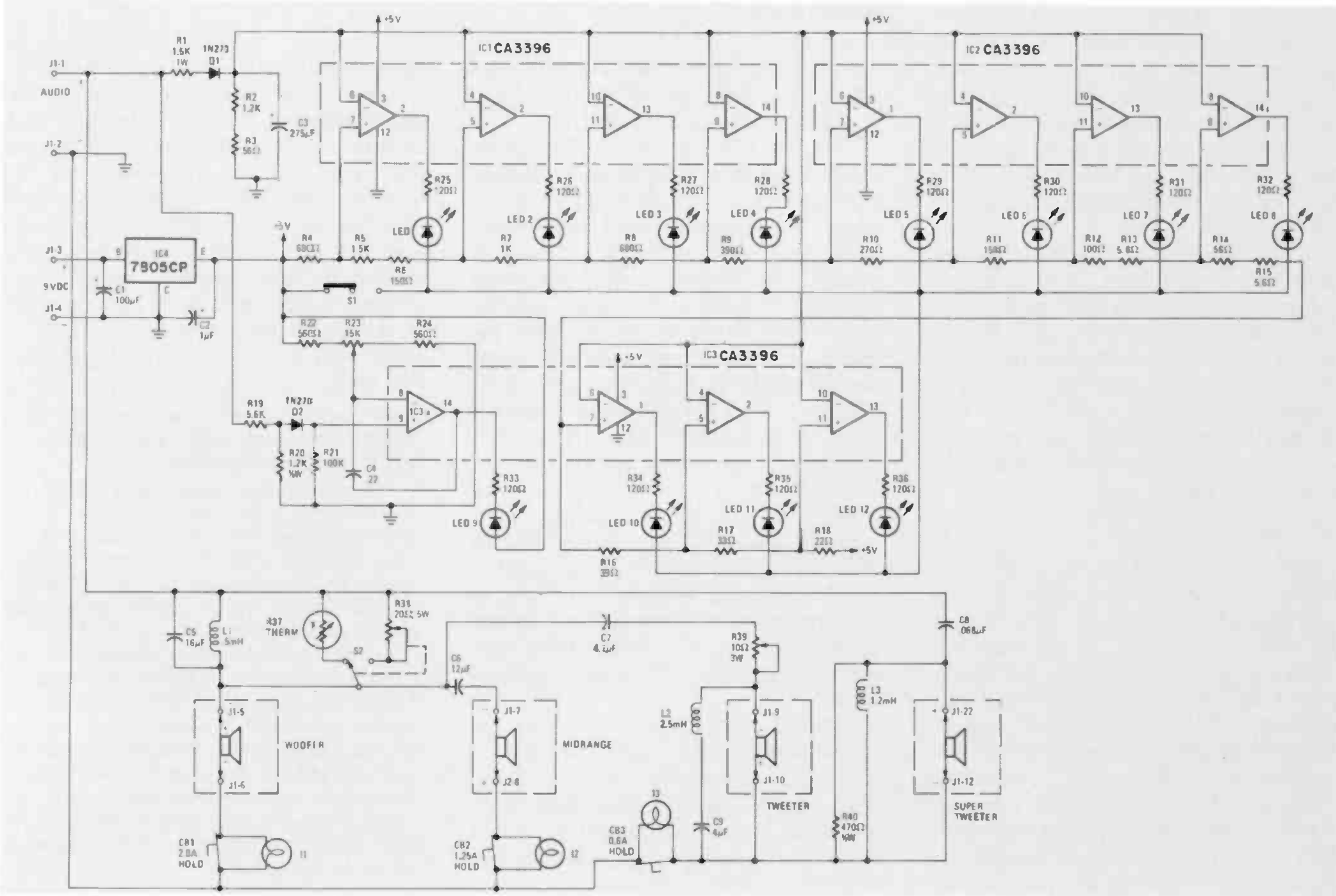


FIG. 4—INTERFACE AND CROSSOVER circuitry of the Formula-7 speaker system.

with each driver. Each circuit breaker is rated at an appropriate value from 2.0 amperes for CB1 to 0.6 amperes for CB3. When the current exceeds the circuit-breaker rating, the appropriate circuit breaker opens and an indicator light wired across that circuit-breaker flashes in accordance to the signal current that then flows through it.

The three circuit breakers are located on the sloped portion of the front panel and are manually resettable. Dividing up this indicating system instead of having a single circuit-breaker permits the user to determine *which* driver elements of the unit are being overdriven and even warns of trouble in the event of super-audible high-frequency oscillation that, while inaudible, might easily destroy the high frequency driver elements.

One other aspect of the Formula 7 is worth mentioning before we leave the speaker-driver section of the schematic. Thermistor R37 is the key component in what B.I.C. calls its "dynamic tonal compensation" system. When front-panel mounted potentiometer R38 (which varies the signal level fed to midrange and tweeter) is rotated fully counterclockwise, switch S2 is thrown to the position shown in Fig. 4. The value of thermistor R37 varies in accordance with the average current flowing through it. R37 is chosen so that when loud levels are reproduced, its resistance is very low (due to the heating effect of the thermistor) while at lower listening levels, its resistance increases and reduces the mid- and upper-mid frequency sound levels. This amounts to the same thing as boosting (relatively) the bass response and is designed to compensate for the well known Fletcher-Munson loudness effect in human hearing. This effect is often compensated for by the so-called loudness controls on amplifiers and receivers. The advantage in this approach is that the resultant response can be directly related to actual sound-pressure levels and not to arbitrary settings of a master volume control that cannot take into account such variables as program source signal levels, speaker efficiency or amplifier gain.

SPL indication

The audio signal from the amplifier is rectified and filtered by capacitor C3 and diode D1. (See Fig. 4.) This varying DC voltage is applied to the negative inputs of eleven comparator circuits (four in IC1, four in IC2 and the three remaining in IC3). The positive inputs of these comparators are supplied with progressively lower and lower DC voltages that are determined by the string of series resistors R4 through R18. Thus, when the lowest-level signals are applied, LED12 will light, while increasingly stronger input signals will trigger LED11, LED10 and so forth up to LED1 which flashes when the greatest audio signal levels are applied to the system.

The row of LED's on the front panel are calibrated in approximately 4-dB increments all the way from 75-dB SPL (*S*ound *P*ressure *L*evel) to 117-dB SPL. A chart inscribed right on the system's front panel (see Fig. 5) permits the user to translate the LED indications into actual sound pressure levels, measured at specific distances on-axis from the speaker system. Alternatively, the user can read the average sound pressure level atained in listening rooms varying in cubic volume from 1000 cubic feet (a

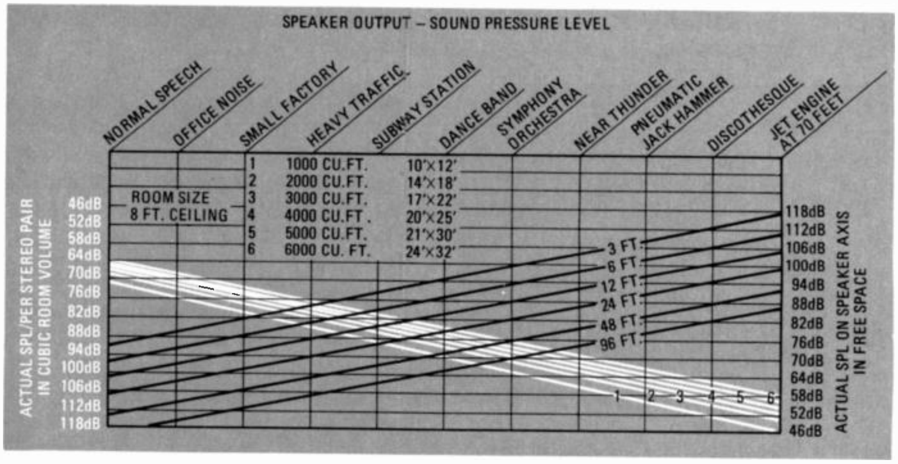


FIG. 5—GRAPH ON FRONT-PANEL enables user to translate power readings into actual sound pressure levels.

room having floor dimensions of around 10 × 12 feet) to 6000 cubic feet (approximately 24 × 32 feet).

The idea of using LED indicators to show audio power levels is, of course, not new and is currently being used on a variety of higher-powered high-priced audio amplifiers available in the hi-fi market. The unique thing about incorporating such indicators on the speaker system itself is that, for the first time, the indicator readings are directly translatable to actual sound pressure levels and not just to wattage levels delivered by an audio amplifier into a fixed resistive load. The manufacturer (in this case B.I.C.), having control of the efficiency of the speaker system and being able to measure actual sound output (in dB SPL) for a given signal voltage input to the loudspeaker system, was able to prepare the chart shown in Fig. 5 so that users can relate the information supplied directly into perceived loudness levels.

From a practical point of view, the system enables the user to balance stereo channels in terms of actual audibility and also permits listeners to judge how loud various programs they listen to really are, as compared with familiar reference levels such as symphony orchestra, dance band, discotheque and several others inscribed over the various LED's below the chart. Observing the flashing lights while listening to music for extended periods may appeal to some hi-fi fans while others may wish to just listen and not look, having established desired levels. For this reason, the Formula 7 has a switch (SW2 in the schematic diagram) that permits you to turn off the sound pressure level indicators at will.

Much of what B.I.C. has built into the Formula 7 is fairly simple in terms of circuit complexity, and the information it provides could be obtained if you owned a good SPL meter and an accurate audio power meter. But few serious audio enthusiasts want to become audio technicians as well. The incorporation of these features in this speaker, as well as in a lower-priced Formula 5 system announced by the company (that one lacks the SPL indicators but has the amplifier clipping indicator as well as the speaker protection indicators and dynamic tonal compensation feature) will, at least, provide a certain amount of peace of mind to users who tend to push their systems to the limit. **R-E**

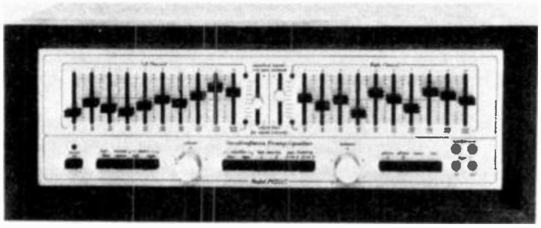
Higher hi-fi recording group goes back to direct-on-disc

A Canadian record company, Nimbus 9 Productions Ltd., has abandoned the tape-recording stage of disc production. The new direct-on-disc albums, bearing the Umbrella trademark, will be sold in the United States by Audio-Technica, the phono cartridge firm.

According to Jon Kelly, general manager of Audio-Technica, bypassing the tape recording stage eliminates problems of distortion, limited dynamic range, and of course, tape noise. Because engineers mix and record the studio performances direct onto a master disc, Kelly points out: "Musicians and engineers must display a high degree of professionalism. There is no room for error.

Records were expected to be available early this winter at $12.95 retail.

Radio-Electronics Tests



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Soundcraftsmen PE2217 Equalizer

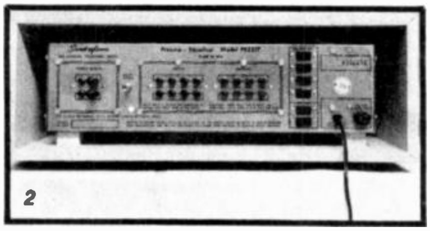
FOR MANUFACTURER'S LITERATURE, CIRCLE 85 ON FREE INFORMATION CARD

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

LAST MONTH WE EXAMINED A RELATIVELY INEXpensive five-band add-on graphic equalizer supplied in kit-form by Heath. The add-on type of graphic equalizer lends itself particularly well to application in hi-fi systems that have already been assembled and which may contain an all-in-one receiver, or an integrated amplifier, or even a separate preamplifier and basic power amplifier. The audio enthusiast who chooses to use completely separate components may find it a bit cumbersome to add yet a fourth major component such as an equalizer to what is already a growing number of individual components. After all, one's shelf or cabinet is only so large. Accordingly, Soundcraftsmen decided that it would be a good idea to combine one of their better graphic equalizer circuits with a highly flexible and well designed preamplifier/control unit, and that is just what their PE2217 adds up to. The front panel, shown in Fig. 1, looks very much like the front panel of that company's model RP2212 equalizer that sells for around $370.00 alone. So, if you are in the market for a preamp and a graphic equalizer you might say that the preamp section of the PE2217 only adds around $160.00 or so above the cost of a 10-band graphic equalizer. Viewed from that point, that's quite a bargain, especially when you consider what the preamp section of the PE2217 can do all by itself.

Preamp related controls are located along the bottom of the front panel and include a POWER on/off pushbutton with an indicator light just above it, a master VOLUME control, a BALANCE control, two stereo HEADPHONE jacks (one disables the line outputs at the rear when a plug is inserted, the other does not) and a TAPE 2 input and output jack pair that provides front-panel connection of a second tape deck and are wired in parallel with similarly labeled phono-tip jacks at the rear. The rightmost bank of pushbuttons take care of program source selection. Six more pushbuttons at the center handle the Tape 1 and Tape 2 monitor circuits, as well as the dubbing options from Tape 1 to Tape 2 or vice versa. The two remaining buttons in this bank permit instant comparison of equalized or unequalized sound and also enable you to apply pre-equalized signals to your tape deck inputs—a very handy feature for adventurous recordists, and one generally not found on preamps or even on separate equalizers.

The upper section of the panel resembles the front of the previously referred to RP2212 equalizer. Two identically calibrated groups of ten slide controls handle octave-by-octave response adjustments for left and right stereo channels. Between these banks of slide controls are two additional gain controls, flanked by upper and lower LED indicator lights for each channel. These controls are active only when the equalization circuits are selected and are used to re-establish identical overall sound levels with those of the unequalized signals, when comparisons are to be made. This is necessary because even if a few of the slide controls are in the "boost" region, overall apparent reproduced levels will be louder than would be the case if all sliders were set to their mid-positions, where the response of the system is flat. The indicator lights flash when program material is channeled through the equalizer, and equal flashing of upper and lower lights indicates correct setting of the gain adjust controls.



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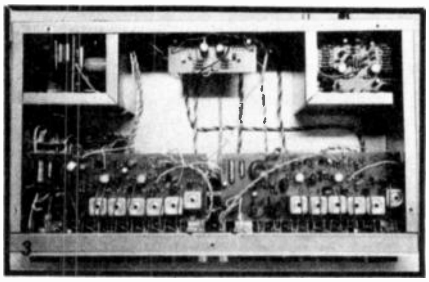
The rear panel of the PE2217 is shown in Fig. 2. The twin pairs of low-level phono inputs at the left are isolated from the high level inputs and tape output at center, a layout detail that permits the most direct and shortest wiring from these inputs to the critical, low-level phono preamp section visible at the rear right of the chassis in Fig. 3. A



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chassis ground terminal is located near the phono input jacks, and, at the extreme right of the rear panel, there are six convenience AC outlets (four switched, two unswitched) for connection of other components. A line fuseholder is located at the lower right, adjacent to the power cord.

Circuit layout

In examining the layout and construction of the PE2217 (Fig. 3), we noted that two identical circuit boards are used for the two channels of equalization. LC filters, using discrete inductances, are employed for each octave filter circuit and, if like us, you can only count six "cans" on each board, rest assured that there are four more per board, resting securely on the surface of the PC boards since they are the ones that handle the lower octaves and are therefore too large in size for standard encapsulation. The power supply at the left-rear is in its own fully shielded compartment, as is the phono preamp section at the right rear. Separate power-supply voltages are provided for the preamplifier circuits and the equalizer circuits in this design. All switches (obscured by the equalizer boards) have gold plated contacts for lowest possible resistance, and the PC boards themselves are of military-grade G-10 glass-epoxy construction. In examining the circuit boards closely, we noted the use of several low-noise carbon-film resistors in critical low-level circuits.

An idea of the flexibility of this combination unit can be gained by examining the

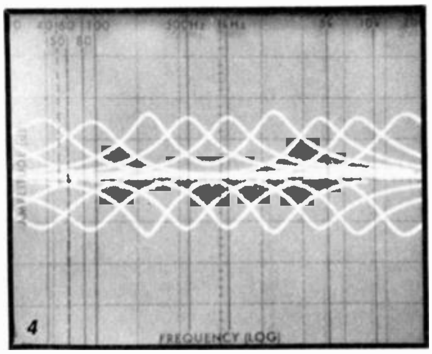
MANUFACTURER'S SPECIFICATIONS:

Frequency Response: High Level Inputs: 5 Hz to 100 kHz, ±0.25 dB; Phono Inputs: RIAA ±0.5 dB. **Harmonic Distortion:** 0.05% at 1 volt. **Signal-to-Noise:** High Level Inputs: 100 dB; Phono Inputs: 84 dB (ref. 10-mV input); Equalizer Section: 90 dB below 1 volt **Overall Maximum Gain:** High Level Inputs: 21 dB; Phono Inputs: 63 dB. **Phono Overload Level:** 105 mV. **Output Impedance:** 600 ohms. **Octave Control Range:** ±12 dB minimum. **Octave Centers:** 30 Hz, 60 Hz, 120 Hz, 240 Hz, 480 Hz, 960 Hz, 1920 Hz, 3840 Hz, 7680 Hz, 15,360 Hz. **Dimensions:** (In supplied wood cabinet): 20 wide by 7¼ high by 11¼ inches deep. **Panel Dimensions:** 5¼ high by 18 inches wide. Also available for rack-mounting, less cabinet at same price. **Suggested Retail Price:** $529.50 (cabinet or rack panel mount).

signal flow. The master VOLUME control is located just ahead of the line amplifier so that best signal-to-noise ratios are maintained. The equalizer section contains those level-matching gain controls that were mentioned earlier and insure against possible overload or distortion within the equalizer section itself. The position of the equalizer section and the switching arrangement permits the user to equalize both the signals at the tape-output jacks and at the line-output jacks, and either of these outputs can be fed with an unequalized signal while the other delivers an equalized signal. Tape dubbing can be accomplished even while listening to another program source such as phono or tuner.

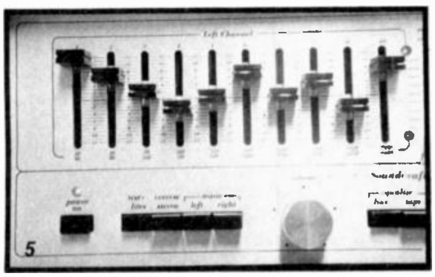
Laboratory measurements

Our measurements of the PE2217 necessarily consisted of two separate groups. First, we checked the action of the equalizer controls themselves. We did this by "plotting" the response obtained at the maximum boost and maximum-cut position of each of the ten octave-controls of a single channel and storing the combined results on the storage-scope of our spectrum analyzer. The spectrum analyzer had been swept from 20 Hz to 20 kHz for each of the twenty-one (including flat response) response curves. The results are shown in the photo of Fig. 4. Maximum boost range to maximum-cut of



each control measured approximately 28 dB, or ±14 dB from the mid-position of each slide control. Peaks are quite evenly spaced which, in this logarithmically plotted sweep means that they were exactly an octave apart, as claimed.

To check the interaction of adjacent



controls, we set up an arbitrary response curve that might typically be required in a less-than-perfect component/acoustic situation. The ten control-knobs were set as shown in the close-up photo of Fig. 5 and a response curve was plotted for these settings. The response obtained is shown in Fig. 6. It corresponds quite closely with the settings of the ten knobs, with the exception of the region of the eighth-octave control that had called for a slight rise in frequency and was

TABLE I

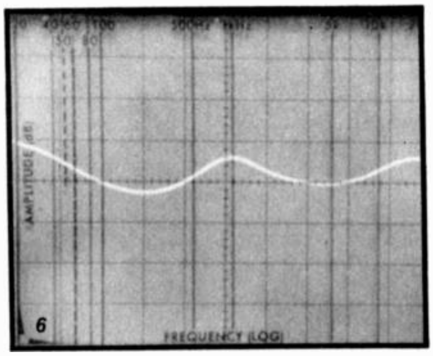
RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Soundcraftsmen** Model: **PE2217**

PREAMPLIFIER PERFORMANCE MEASUREMENTS

INPUT AND OUTPUT REFERENCE LEVELS	R-E Measurement	R-E Evaluation
High level input levels (V)	1.0	
Low (phono) input levels (mV)	10.0	
DISTORTION MEASUREMENTS		
THD at reference input level (%)	0.04	Very good
Input clipping level (V)	3.5	Excellent
Output clipping level (V)	5.0	Good
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency respose (RIAA ± ___ dB)	0.2	Excellent
Maximum input before overload (mV)	100	Good
Hum/noise referred to full output (dB) (10 mV input)	84	Very Good
HIGH-LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± ___ dB)	10-50, 0.5	Excellent
Hum/noise referred to full output (dB)	98	Excellent
Residual hum/noise (min. volume) (dB)	98	Very good
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls		Not applicable
Action of secondary tone controls	See Fig. 5	Excellent
Action of low frequency filter(s)		Not applicable
Action of high frequency filter(s)		Not applicable
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	1.1/1.1	
Input sensitivity, auxiliary input(s) (mV)	100	
Input sensitivity, tape input(s) (mV)	100	
Output level, headphone jack(s) (V or mW)	1.0V (Hi Z only)	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Superb
Adequacy of input facilities		Very good
Arrangement of controls (panel layout)		Excellent
Action of controls and switches		Fair (see text)
Design and construction		Excellent
Ease of servicing		Good
OVERALL PREAMPLIFIER PERFORMANCE RATING		Very good

offset by the dip position of the ninth-octave adjacent control and the flat setting of the adjacent seventh-octave slider. The likelihood of ever needing such a narrow peak in



the response of a real system is very slim.

Measurements related strictly to preamplifier performance of the PE2217 are listed in Table 1 and generally ranged from good to excellent. The sole exception was the action of the slide controls themselves, and our criticism of these will be found in our summary comments following our overall product analysis in Table II.

Use and listening tests

In general, the PE2217 handles well. Program-selection pushbuttons and the six centrally located pushbuttons that handle the tape functions and equalization selection are all interlocked within each grouping to prevent accidental pushing of two buttons at once. The preamplifier's output was at all times adequate for driving even the most insensitive (low gain) of basic power amplifiers.

We found that it is extremely important to be guided by those flashing gain-adjust test lights when the equalizer is "in-circuit", for to ignore their warning is to invite higher levels of overload and distortion. While it is possible to disable the indicator lights at the push of a button (the presumption being that you will tire of watching them flash after proper levels have been set up) we would suggest that they be allowed to do their job at all times, or at least when you switch from one program source to another.

While much of the flexibility of the PE2217 is related to tape recording activities, we feel that even the audio enthusiasts who does not own a tape deck but wants to own a good preamp and an effective graphic equalizer will find that Soundcraftsmen's PE2217 merits consideration on both counts.

Accessories

Although, in theory, one setting of the equalizer controls should suffice for all times (as far as one's system and room acoustics are concerned), there are times when particular program sources may call for different settings of the twenty octave controls. After all, recording engineers apply "equalization" at the studio, too, and you may not always agree with their ideas of tonal balance. For this reason, and because some over-enthusiastic visiting sound-buff friend may not be able to resist the temptation to try his or her own preferred settings. Soundcraftsmen supplies six reference-charts that enable you to permanently record your preferred settings for different program sources and listening situations. The charts may be cut out, so that when you want to return to the settings called for on a given chart, you simply slip it under the ten octave-controls (spacing on the chart between controls is to scale) and position the levers until they intersect the upper edge of the cut-out chart.

Another accessory supplied with the PE2217 is a special test recording that contains octave-band pink-noise signals that can be used to help you "voice" your entire system, including your listening room. Instructions are offered for both those who own no test equipment and for those who own a sound-level meter. In the ears-only method, a mid-band pink noise signal is reproduced over one channel, while individual octave-bands corresponding to the ten controls on the other channel are played for level comparison. As noted in our summary comments, we did not find this by-ear method to be particularly accurate and preferred using an inexpensive sound-level meter with which we were able to do a much better job in our listening room. **R-E**

TABLE II

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Soundcraftsmen** Model: **PE-2217**

OVERALL PRODUCT ANALYSIS

Retail price	**$529.50**
Price category	**High**
Price/performance ratio	**Good**
Styling and appearance	**Excellent**
Sound quality	**Excellent**
Mechanical performance	**Good**

Comments: Combining the functions of a ten-band graphic equalizer and a preamplifier/control unit in a single chassis makes a lot of sense to us, particularly since the increased popularity of graphic equalization, or "room voicing", is primarily one that has arisen from audio enthusiasts who choose to assemble their systems from separate components. Octave-by-octave tone adjustment is, in our opinion, the minimum segmentation needed to do a precise compensating job and, while not as precise as third-octave equalization, it is more effective than what can be done with the lower-cost five-segment units that are available. Although Soundcraftsmen suggests that a good job of equalization of one's system can be done using their supplied test record and one's own ears, we found that a much better job can be done using a sound-level meter—even if it has to be one of the very inexpensive ones that are now available. The ear is too easily deceived, even when pink noise bands are used as the test signal.

As for the preamplifier/control sections of the PE2217, they measured right up there with the best of the separate preamps around. Audible distortion is not likely to be a problem, unless generated by other components in your system, and the flexibility of the switching facilities (especially those related to tape recording, including the pre-equalization possibilities) make the unit a self-contained "patch panel" that will be appreciated by those who own a pair of tape decks and are constantly finding it necessary to plug and unplug cables to achieve required results.

We wish that Soundcraftsmen had supplied detents, or click-stops for the flat settings of each octave control, and that the overload characteristics of the unit (when in the equalization mode) were not so critically dependent upon correct "zero gain" adjustment of those gain controls, but when care is taken, the preamp behaves like a good preamp should, and the equalizer does its expected job much as a separate one would.

Bigston BSD-300 Cassette Deck

WHEN FRONT-LOADING CASSETTE DECKS WERE first introduced for home high-fidelity systems, they were fairly expensive gadgets selling for $300.00 or more if they included Dolby noise reduction circuitry. The public's acceptance of the front-loading cassette deck configuration has prompted a great number of manufacturers to produce lower-cost decks that offer the same advantages of "stackability" with other high-fidelity components. One of the lowest priced of these that we have had an opportunity to test and evaluate is the Bigston *BSD-300*. Bigston Corporation is perhaps not too well known here for its own products but, according to information we obtained from the company's U.S. headquarters, that company has been and continues to be a large supplier of "private label" or custom manufactured tape recording products for retail chains.

As for the *BSD-300* itself, the photo of Fig. 1 shows its front panel layout. Cassettes are inserted, tape forward, into the sloped compartment at the left. This compartment is illuminated for better visibility inside when

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FOR MANUFACTURER'S LITERATURE, CIRCLE 86 ON FREE INFORMATION CARD

power is applied by means of the pushbutton switch at the lower left. A three-digit counter with the usual reset button is also located in the forward part of the cassette compartment. Seven identical metal toggle-levers just below the cassette compartment take care of the EJECT, RECORD, REWIND REVIEW, PLAY, FAST FORWARD CUE, STOP and PAUSE transport functions.

This is one of the few decks we know of that can be placed in the record mode by pressing the single RECORD button. Most others require simultaneous hold-down of both the RECORD and PLAY buttons. The dual-button arrangement is normally a precautionary measure to prevent accidentally erasing a precious recording and is a carry-over from the early days of cassette decks. We have often thought that the bother of having to carefully depress two buttons at once to get into the record mode more than offsets the safety feature and apparently Bigston thought so too.

The REWIND/REVIEW and FAST FORWARD/CUE levers serve a double purpose. Used alone, they perform the normal fast rewind or fast forward functions. Used when the PLAY button is depressed, they permit fast wind in either direction (so long as the button is held down manually) while some sound is heard through your system, thereby enabling rapid location of a specific point in a given cassette tape. The only other units we know of that have this capability (aside from low-fi portable dictating cassette decks) are those offered by Kenwood and sell for quite a bit more than this Bigston model.

The right section of the panel is equipped with a pair of small VU level meters, calibrated from −20 dB to +5 dB and with a Dolby level mark. A RECORD indicator lamp is located between the meters. Below, are three buttons that select tape bias, equalization and Dolby circuitry. The bias and EQ buttons work independently, thereby afford-

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Frequency Response: Standard Tape: 30 Hz to 13,000 Hz; CrO_2 Tape: 30 Hz to 15,000 Hz. **Wow-And-Flutter:** 0.08% WRMS. **S/N Ratio:** Without Dolby: 48 dB; With Dolby: 56 dB. **Output Level:** Line: 0.58 volts; Phones: 0.3 mV/8 ohms. **Power Consumption:** Approx. 10 watts. **Dimensions:** 14 7/16 wide × 5 1/2 high × 10 11/16-inches deep. **Weight:** 11 3/4 lbs. **Suggested Retail Price:** $169.95

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TABLE I		
RADIO-ELECTRONICS PRODUCT TEST REPORT		
Manufacturer: **Bigston**		Model: **BSD-300**
CASSETTE TAPE DECK MEASUREMENTS		
FREQUENCY RESPONSE MEASUREMENTS	**R-E Measurements**	**R-E Evaluation**
Frequency response, standard tape (Hz-kHz ±dB)	35-10, ±3 dB	Poor
Frequency response, CRO_2 tape (Hz-kHz ±dB)	32-8, ±3 dB	Poor
DISTORTION MEASUREMENTS (RECORD/PLAY)	Standard/CRO_2	
Record level for 3% THD (1 kHz) (dB)	+8/+8	Excellent
Harmonic distortion @ −3 VU (1 kHz) (%)	1.0/0.85	Excellent
Harmonic distortion @ 0 VU (1 kHz) (%)	1.0/0.85	Very good
Harmonic distortion @ +3 VU (1 kHz) (%)	1.3/1.0	Very good
SIGNAL-TO-NOISE RATIO MEASUREMENTS	unweighted/weighted "A"	
Standard tape, Dolby off (dB)	56/60	Excellent
Standard tape, Dolby on (dB)	64/67	Excellent
CRO_2 tape, Dolby off (dB)	61/65	Excellent
CRO_2 tape, Dolby on (dB)	68/72	Excellent
MECHANICAL PERFORMANCE MEASUREMENTS		
Wow and flutter (%, WRMS)	0.06 (0.09 RMS)	Excellent
Fast wind and rewind time, C-60 (seconds)	74	Fair
COMPONENT MATCHING CHARACTERISTICS		
Microphone input sensitivity (mV)	0.17	
Line input sensitivity (mV)	120•	
Line output level (mV)	500	
Phone output level (mV)	40 (8-ohm load)	
TRANSPORT MECHANISM EVALUATION		
Action of transport controls		Very good
Absence of mechanical noise		Good
Tape head accessibility		Average
Construction and internal layout		Good
Evaluation of extra features, if any		Very good
CONTROL EVALUATION		
Level indicator(s)		Fair
Level control action		Fair
Adequacy of controls		Fair
Evaluation of extra controls		Good
OVERALL TAPE DECK PERFORMANCE RATING		Good

TABLE II

RADIO-ELECTRONICS PRODUCT TEST REPORT

Manufacturer: **Bigston** Model: **BSD-300**

OVERALL PRODUCT ANALYSIS

Retail price	**$169.95**
Price category	**Low**
Price/performance ratio	**Good**
Styling and appearance	**Excellent**
Sound quality	**Fair**
Mechanical performance	**Excellent**

Comments: If our overall evaluation of this low-cost deck seems particularly negative (considering its low price and the fact that it *does* incorporate Dolby noise reduction at that price) it is because there is so much that is good about this unit that we were particularly disappointed at its very poor record/playback frequency response. If that response could be tweaked up to, say, 14 kHz or 15 kHz when used with top-grade tapes (and we have a feeling that it could be, very easily), the other parameters such as signal-to-noise, headroom, harmonic distortion and wow-and-flutter are all so superior to anything found in this price category that the unit would be a most outstanding buy.

We suspect that in our sample, the cue/review feature was not operating properly for, instead of rewinding when this button was depressed (with play button depressed too), the tape simply came to a standstill. The fast forward cueing feature worked well, however, and is a handy added feature that permits one to reach a desired point in the tape without having to go through the stop mode. Record-level meters are rather on the small side and in our sample, there was a 1.5 dB discrepancy between left and right meters when input levels to both channels were identical and level controls were at maximum. The manner in which the front-loading cassette compartment is arranged makes for fool-proof insertion of cassettes and a ledge up front forestalls cassettes from popping out on to the floor when the eject button is pushed (a failing on some other front-loaders we have seen). In summary, then, the Bigston BSD-300 is in many ways equal to cassette decks costing much more—but that limited frequency response range prevents us from concluding with overall raves for this product.

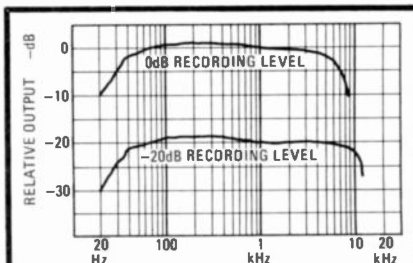
ing four possible combinations. (Figure 1 shows a prototype unit that has a single bias/equalization button. The production model separates the two functions.) Both buttons are in their out position for standard low noise tape and both should be depressed for CrO_2 (or equivalent) tapes.

Large, dual concentric RECORD LEVEL controls are active in the record mode but do not affect the playback output level which is fixed. At the right are a pair of microphone input jacks (that accept standard ¼-inch diameter phone plugs) and a stereo headphone jack for monitoring source signals or for listening to recorded tapes via phones. Inserting microphone plugs in the mic jacks deactivates the rear panel high-level line inputs, so mixing of mics and line inputs is not possible with this deck. Of course, one could use a mic in one channel and a line input in the other. In addition to the line-in jacks, the rear panel of the unit contains the required pair of line-out phono-tip jacks.

Laboratory measurements

Table I summarizes our laboratory test results. In all of our tests, we used TDK-Audua C-60 cassettes as our standard for low-noise, high output and TDK-SA C-60 cassettes as an equivalent for the CrO_2 tape settings. As many readers probably know, TDK-SA tape and the newer Maxell UD-XL-II, while basically ferric particle tapes, are designed so that they require the higher bias normally associated with the CrO_2 tapes that some companies are phasing out of their product lines because of recent improvements in ferric tape formulations.

Most of the results obtained were extremely impressive, especially for a tape deck in this low price category. Our only disappointment came when we measured frequency response using both grades of tape. The frequency response for the TDK-Audua sample is plotted in Fig. 2 and is seen to



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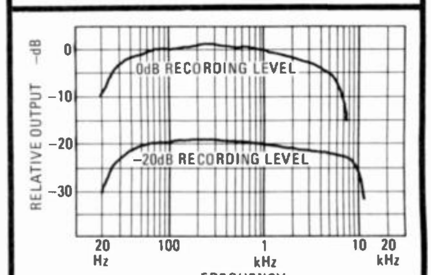

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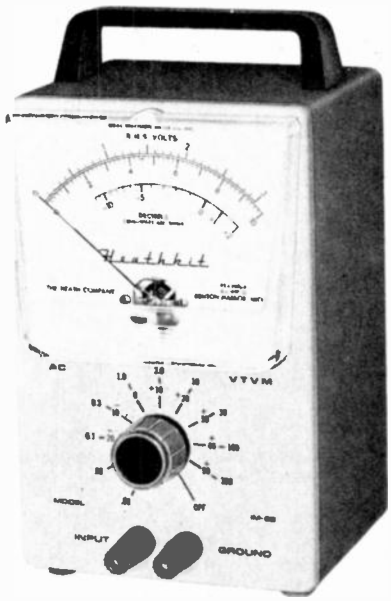
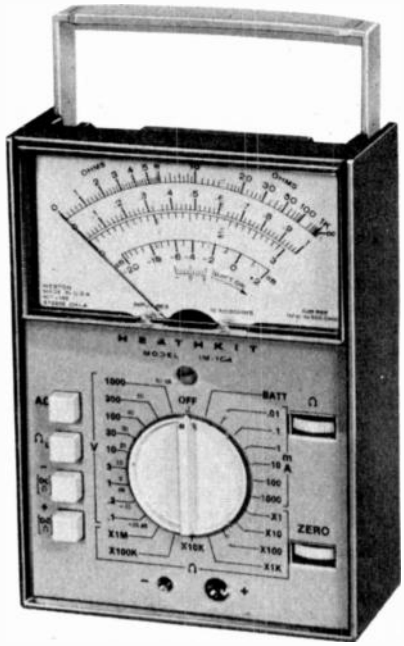
extend only from 35 Hz to 10 kHz ±3 dB at the nominal −20 dB record level used in one of our tests. The frequency response for record/playback of the TDK-SA tape was even poorer, as can be seen in Fig. 3. Normally, we would have expected the response to be somewhat better for this tape, as it has in fact been on almost all other

continued on page 84

Analog Voltmeters





Part II. The analog voltmeter is alive and well. Here's a rundown of the different types currently available—their features, specifications and applications

CHARLES GILMORE*

LAST MONTH, IN PART I OF THIS ARTICLE, we discussed the different types of analog voltmeters that are currently available.

This month we will cover the various features of these voltmeters and the meaning of their specifications.

The ammeter circuit

The most common form of ammeter on TVM's is the simple shunt. The TVM offers the advantage of high gain and low insertion loss. Since the VTVM has an insertion loss of 1 to 1.5 volt for a shunt, ammeters are not normally included in VTVM's. When shunt ammeters are used, the DC and AC ammeters are very similar. The change from AC to DC consist of selecting the correct shunt to be placed across the voltmeter.

Even though the shunt insertion loss can be kept low with a meter having sensitive ranges (0.1 volt, for example), the shunt resistance becomes large for the sensitive current ranges. For example, a meter with 0.1 volt sensitivity has 10,000 ohms insertion resistance for the 10-μA full-scale range. On the same meter, the 1-ampere range has a 0.1-ohm shunt. Due to other series resistances, the 1-ampere range might have an insertion resistance of 0.2 ohms or more.

The TVM ammeters appear in two other, less frequently used forms. First, the scheme shown in Fig. 9-a. In this circuit, an operational amplifier is used as a current-to-voltage converter. The unknown current is introduced to the summing junction of the operational amplifier. This current is nulled by an equal amplitude but opposite polarity current developed by the output voltage of the operational amplifier across the feedback resistor. As this current is flowing through the feedback resistor, the voltage drop across the resistor is directly proportional to the resistance and the unknown current. The output voltage of the operational amplifier (the voltage across the resistor) is then measured with the TVM voltmeter. Since there is no voltage drop at the input to the null amplifier, this technique offers the advantage of essentially zero input impedance.

Figure 9-b shows schematically the technique developed and patented by Weston for current measurement in their model 670 TVM. This TVM features in-circuit current measurements. Measuring the current does not require opening the circuit, a considerable inconvenience with other ammeters. The circuit relies on the inherent resistance in the circuit conductors. The voltage drop across the circuit conductors is reduced to zero by a current equal in amplitude and opposite in polarity to the unknown one. This "bucking current" is maintained at exactly the correct value by the null amplifier.

This technique requires a special pair of two-terminal probes and is especially useful for measuring currents in printed circuit board foils. Both these latter techniques are applicable only where the currents being measured are low enough so the measuring circuit can produce an equal and opposite current, and where DC currents are being measured.

The TVM ohmmeter circuit

The simple and most frequently used ohmmeter circuit for TVM's is identical to the series-resistance type of the VTVM. The newer and more elegant TVMs fea-

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

ture a dual-range ohmmeter circuit which has a choice of two open-circuit voltages. A low-voltage range is provided so semiconductor junctions (both germanium and silicon) are not forward-biased. The maximum open circuit voltage of such ohmmeters is about 0.085. The high-voltage range of these ohmmeters is usually 1.5 volts and can easily forward-bias a semiconductor junction.

These two circuits are constructed in two different ways. First and simplest, the low voltage is obtained by reducing the 1.5-volt ohmmeter battery to the low voltage by a voltage divider circuit. This effectively yields a low-voltage source with a 10-ohm series impedance. Alternatively, the test signal is derived by applying a constant current source to a resistor as shown in Fig. 10. In this circuit, the constant current source is applied to the basic range resistor (say 10 ohms). The value of the current flowing through this resistor determines the maximum open circuit voltage of the ohmmeter. If the 10-ohm resistance is shunted with an unknown resistance, the voltage drop across the resistor is determined by the parallel value of the two resistors. A two-range constant-current source is used for high/low measurements. The constant-current technique permits simple control of the maximum open circuit output voltage of the ohmmeter.

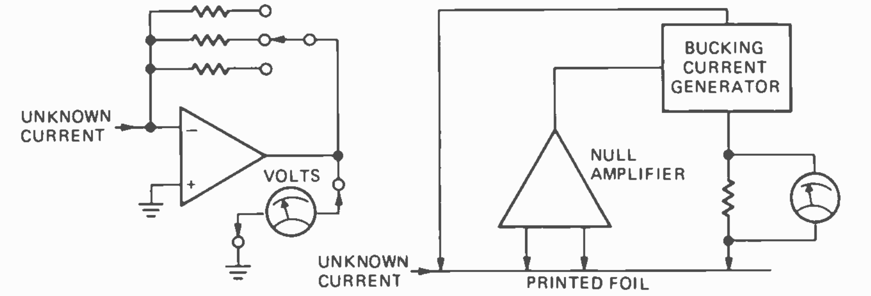


FIG. 9—TWO SPECIAL CIRCUITS for measuring current. Operational amplifier used as current-to-voltage converter is shown in a. Ranges are selected by the feedback resistor. The patented Weston circuit that sets up a bucking current equal to the unknown one and then measures the bucking current is shown in b.

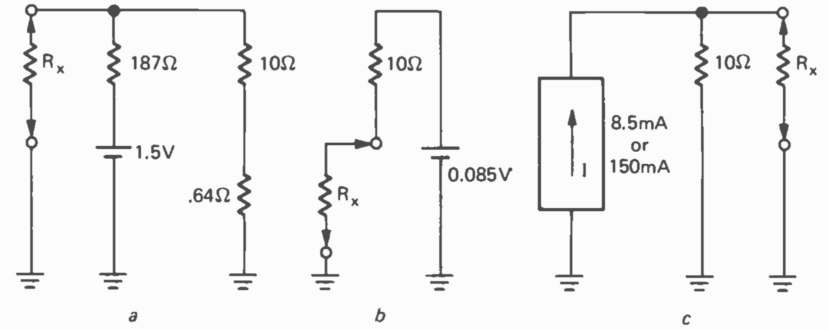


FIG. 10—TWO TYPES OF TEST SIGNAL generators for TVM ohmmeters. Battery and voltage divider combination is shown in a; equivalent circuit is shown in b. Constant-current generator is shown in c.

The AC voltmeter

A specialized form of electronic analog voltmeter amplifies and measures only AC voltages. The AC voltmeter finds special application in laboratory work. It is also part of the standard test equipment used in audio service work. The AC voltmeter is characterized by high sensitivity (compared to the ordinary VTVM or TVM), a voltage-only function, extended frequency response, alternate calibration in dB (usually dBm) and of course AC-only response.

The major difference between the AC voltmeter and the other types discussed lies in the amplifier. As DC voltages are not being measured, they need not be amplified. This allows an amplifier design with considerably more gain but without the worries of DC drift which accompanies a high gain DC amplifier.

The input attenuator of the AC voltmeter is similar to the attenuator described for that AC portion of the TVM. On AC voltmeters with extended frequency response, the input attenuator is often divided into two portions. The first portion is a compensated attenuator providing decade attenuation. Finer attenuation follows an input buffer stage. This is a lower-impedance attenuator and does not need compensation. A specialized form of AC voltmeter offer linear response to logarithmically changing signals. That is, the voltmeter is calibrated linearly in dB and logarithmically in voltage. Such a meter has an additional logarithmic converter placed between the rectifier and the meter circuit. Low-noise amplifier design is required for the amplifiers used for the AC voltmeter.

VTVM AC and DC voltage ranges

The voltage ranges of the VTVM are most common in 1.5—5—15 sequence. This is a modification of the 1—3—10 sequence and is chosen because the steps represent 10 dB voltage *changes*. This is convenient when working with AC signals, and most VTVM's have a dB scale for this purpose. The 0 dB level is 0.774 volts (1 mW on 600 ohms). Figure 11 shows a typical VTVM scale. Occasionally VTVM's are found with a 1—3—10 sequence.

Normally the most sensitive range of the VTVM is 1.5 volts. The 1.5-volt AC range may require special calibration to correct for the nonlinearities of the rectifier when operated at this low input level. The 1.5—5—15 sequence also permits the user to make all measurements in the upper two-thirds of the scale, where the meter is most accurate.

The full scale of 150 volts AC is also handy in countries where a nominal 115 to 120 VAC power-line voltage is used, as measurements of the line voltage are made in the upper third of the meter scale. Needless to say, this advantage disappears when the common line voltage is 200 to 240 VAC. VTVM's have an upper voltage limit of 1,000 to 3,000.

Input impedance

Input impedance for the VTVM is generally specified separately for the AC and DC modes. The general purpose VTVM has an 11-megohm input impedance. Although the 11-megohm input is the most common, other input impedances are used. There is little or no significant difference between the VTVM with 11 megohms and the VTVM with 13-megohms input impedance. There is, however, a significant advantage with the VTVM that offers an input impedance in the *hundreds of megohms*. Such a high input impedance costs money!

If the VTVM is to be used with a high-voltage multiplier probe, then its input impedance, with probes disconnected, must be some standard value. The accuracy of the input impedance is of no consequence unless a multipler probe is being used. Often the accuracy of input impedance is not specified, or a simple note stating the attenuator is composed of 1% tolerance resistors is given. Remember, a VTVM which has 11 megohms input impedance with one megohm in the probe must be calibrated for that series impedance. The direct input to the VTVM without the probe finds the calibration at these points sensitive by an extra 10%.

The VTVM AC mode input impedance is one megohm, except on the expensive VTVM's, which use the same attenuator for the AC and DC modes. The AC input specifications also include the value of shunt capacitance across the input terminals. This figure does not include the probe capacitance, and therefore is simply an indication of the lowest capacitance achievable with special care.

Accuracy

The accuracy specifications of both the AC and the DC modes of the VTVM are given as a percentage of full scale. This is a good reason to keep the measurements as close to full scale as possible. Accuracies of ±1% to ±3% are common for the DC ranges and ±2% to ±5% are common for the AC ranges. The lowest AC range may have a separate error specification due to the nonlinearity of the rectifier at low forward voltages. Accuracy of course depends to a great extent on the price paid for the VTVM. Accuracy also diminishes with time and environmental conditions such as temperature and humidity.

Accuracy specifications of the ohms function are given in one of two ways. On the lower-cost VTVM's, the ohmmeter

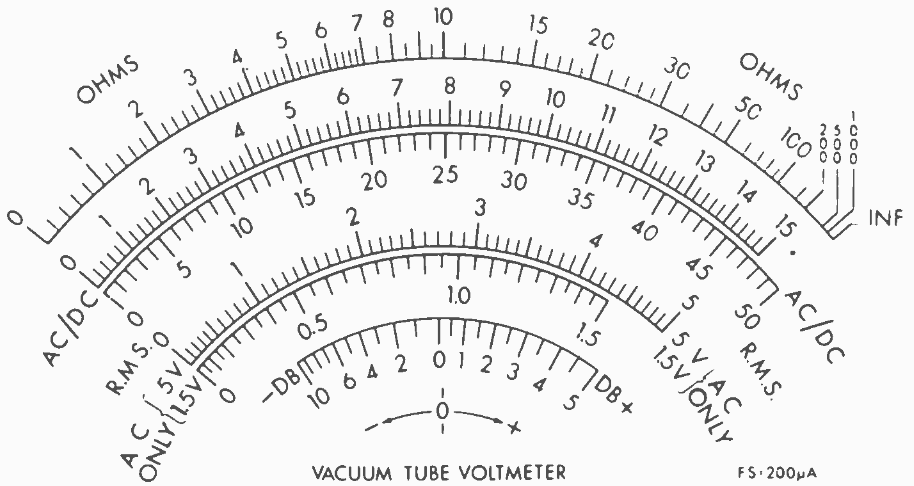


FIG. 11—A TYPICAL VTVM SCALE. Center-scale reading is 10 ohms or a multiple; non-linearity is well shown. Note the special low-voltage scales for AC.

accuracy is indicated by noting the accuracy of the resistors used in the measurement circuits. This indicates an error about the center scale value of the ohmmeter. The error at other points must be calculated. The lowest ohmmeter range does not have the indicated accuracy, due to variations in the battery internal resistance. Accuracy also depends on the preciseness of the ohmmeter scale calibration.

The alternate mode of accuracy specification notes the accuracy as a percentage of the mid-scale reading. VTVMs with such a specification have different specification values for the first range and other ranges of the ohmmeter. A 2 to 5% accuracy figure is common.

Frequency response

Although the accuracy of the AC mode of the VTVM is given as a percentage of full scale, this specification must be further qualified by a *frequency range*. The most common method of specifying frequency response is to indicate the frequency range over which the response will not vary more than ±1 dB when referred to a low-impedance 60 Hz source. The common frequency range for the low-cost VTVM is 25 Hz to 1 MHz. Higher upper frequency limits can be had for additional cost. The Hewlett Packard 410B has a 20 Hz to 700 MHz specification, for example, and costs $275.

Ohmmeter ranges

As noted earlier, ohmmeters conventionally used in the VTVM are specified with a center-scale value, usually 10 ohms. The ohmmeter is ranged in decade steps from this point up, R x 1 megohm being the upper limit. This gives usable measurements in the vicinity of 100 megohms.

Probes

The VTVM is normally supplied with some form of probe. In many cases these probes are either attached to the VTVM or have connectors or characteristics of such a special nature they must be used only with the original model of VTVM. As noted before, the DC probe often has an internal 1-megohm resistance at the tip. If one probe is used for all modes of the VTVM, the probe is switched at the tip. Alternatively, separate leads may be supplied for the DC and AC/OHMS functions. There is always a separate lead for the common or return path. Some specialized VTVM's offer an additional probe for extended high-frequency operation. The mechanical ease and flexibility of the probe are important to consider when purchasing the VTVM.

Controls

The VTVM has two front-panel controls in addition to those for selecting range and function. These are the zero control and the ohmmeter adjustment. The zero control balances the meter electrically when the test leads are shorted together. This control can also move the meter from left zero to center zero, permitting readings of a signal that passes through zero volts. This feature is particularly handy for null detection.

The ohmmeter adjustment sets the full-scale sensitivity of the voltmeter when used in the ohmmeter function. This feature is necessitated by the variations in the battery used for the ohmmeter voltage source.

The function switch selects AC, +DC, −DC, and ohms. The ± selection of the DC mode is useful as it eliminates the need to reverse the test leads. Often reversing the test leads is not practical as it is with the conventional VOM, as the common test lead may be connected to earth ground. If the common lead is not connected direct to earth ground, the impedance to ground (especially the capacitive component) may be quite low. Either situation will cause considerable disturbance to the circuit under test if the voltage source in the circiut is connected to the common lead.

The TVM—voltage ranges

The typical scales for a VTVM are shown in Fig. 11. Decibel, peak-to-peak, and zero-center scales are given for special applications. Often meter scales are color-coded for ease of interpretation.

Three different range sequences are commonly used for the TVM. The 1—3—10 seems the most common at present. These meters start at 0.1, 0.3 or 1 volt and extend to 1,000 or 3,000 volts. A few TVMs use the 1.5—5—15 sequence, and cover approximately the same voltage range. When a very low cost TVM is designed, the scales may run in a 1—10—100 sequence. Such units start with a 1-volt range and go to 1,000 volts. The 1—3—10 sequence is the most practical when working with voltages found in solid-state circuits.

Accuracies

Accuracy for the TVM, like accuracy for the VTVM, is given as a percentage of full scale, and is given separately for the AC and DC voltage modes. DC accuracies are in the ±2% to ±3% area. The accuracy of the DC voltmeter is further limited by environmental factors and possibly the position of the meter.

The AC accuracy lies in the ±2% to ±5% of full scale area, with accuracy being very proportional to price. Accuracy is either specified at a particular frequency or specified over a limited band of frequencies.

Ohmmeter accuracy is much the same as the VTVM ohmmeter accuracy. That is to say, it has a specification indicating a percentage of the mid-scale figure. Accuracies are in the area of 5% for TVM ohmmeters. An alternate method of ohmmeter specification indicates the accuracy in degrees of arc of meter swing. This method of ohmmeter specification is one of the most descriptive. An ohmmeter specification of ±3 degrees of arc is common, on a meter with 100 degrees of swing. Further limitations are given for very low values of resistance.

Frequency response

The frequency response of the AC voltmeter portion of the TVM may be given in a number of ways. The specification may be identical to the AC specification of the VTVM, with AC accuracy specified at a particular frequency (and usually with a low driving impedance) and a frequency response characteristic of plus/minus a number of dB given for a range of frequencies.

Response limits of ±1 dB or ±2 dB are common for TVM specifications; ±1 dB is approximately ±10% error. The specification may be given as error due to the influence of frequency (for example ±5%, 40 Hz to 10 kHz), or the frequency response may be given graphically. The graph plots dB error *vs.* log frequency.

When limited specifications, such as those in a distributors catalog, are given, the actual numerical values of the frequency response may be omitted. In this case, the meter may have only a frequency range specified, or perhaps a simple error specification on the AC ranges. In the latter case, this error figure should not be taken as the error figure including frequency response, but more as an *idea* of the error at some fixed frequency such as 60 Hz. Note that the frequency response of theTVM is much more limited than the response we have come to expect from the VTVM. Where the VTVM is specified to one or two megahertz, the upper limit of all but a few of the TVMs is 10 to 100 kHz. When buying the TVM, pay close attention to this upper specification of frequency response if you need accurate measurements at the upper end of the audio spectrum. A meter that stops at 10 kHz may not suffice. *continued next month*

R-E's Service Clinic

Screen controls

Obscure reactions

JACK DARR
SERVICE EDITOR

COLOR TV SETS ARE FULL OF JOLLY LITTLE surprises for us. Some of them are really obscure and some of them are so obvious that we overlook them. We rely heavily on symptoms and reactions for our diagnoses. The picture-tube section of the set has some really good ones. Here's one of the most popular (??) (This column was prompted by a surprisingly large amount of letters on just these symptoms and reactions!)

In the stock tube circuit, the picture-tube cathode voltages are determined by the plate voltage and current of the video-output tube. If we pull this tube, or if the tube is dead, no plate current can flow. Without a load the plate voltage promptly rises to the supply level, which is usually about +400 volts. (See Fig. 1.) Since this point is directly connected to the picture-tube cathodes, their voltage goes more positive also.

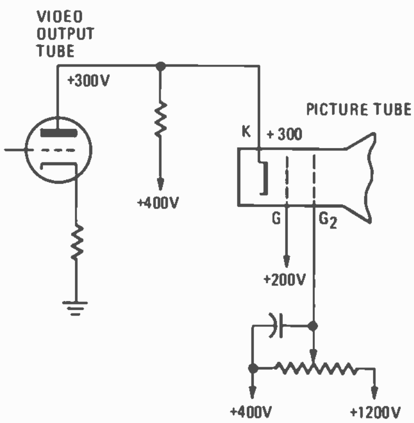


FIG 1

Since the picture-tube grids have presumably been unchanged, the cathode voltage going up makes the grids far more negative. Normal ballpark DC voltages are: +300 volts for the cathodes and +200 volts for the grids. This results in a net bias of -100 volts. If the cathode voltage increases to +400, we now have a bias of -200 volts. The raster promptly blacks out because the picture tube is completely cut off.

Or does it? What if we pull the video-output tube or it goes dead and we still have a raster? This is a *reverse* reaction to what we ought to see; it gives us a very useful clue. If the raster doesn't go out, this is telling us that the picture tube is *not* cut off, and it ought to be. Something has changed the cutoff voltage. (Have you got it yet? What affects the cutoff voltages of the picture tube?)

The answer in almost all cases is a simple one. One other voltage has a great effect on the cutoff point of the picture tube, and this is the *screen grid voltages*. If these are set too high, you will still see a raster. One more good clue here; you will not see any video though you may have sound. If the screen voltages are raised to their maximum level, somewhere around 900-1,000 volts, the cutoff point of the tube will be raised to the point where even the -200-volt bias won't kill the raster.

Why? Very simple. Someone has turned all three of the screen controls wide open! This first happened to me a long time ago. The set came in with the symptoms just described—zero plate current in the video-output tube, no video and a raster. The no-current problem turned out to be a contrast control that was wide open. Since this control is the cathode resistor of the video-output stage, this stopped things dead. Further checking (and some little elapsed time!) showed that all three screen controls had been turned full open.

This can happen when a novice technician can't think of anything else, so he turns the screen controls full on. It can also happen if a child gets behind the set and turns the pretty little red, blue and green controls. (Age anywhere between about 10 and 60 or so.) So: when you get this kind of reaction, don't go looking for complicated things yet. Check the setting of the screen controls. Fix the problem in the video stage, run a grey-scale setup adjustment and you're back in business.

My own pet method of setting these controls is to turn each one till I just see a line. Then back up till it has just gone out. This gives you a little better equalization of the three screens. In the sets that do not have a SERVICE switch, you can use the same method. Turn the brightness to about 25% on and bring each screen control up till you can barely see a raster, then back it off till it

This column is for the service technician's problems—TV, radio, audio or industrial electronics. We answer all questions submitted <u>by service technicians on their letterheads</u> individually, by mail, and the more interesting ones will be printed here.

If you're really stuck, write us. We'll do our best to help you. Don't forget to enclose a stamped, self-addressed envelope. If return postage is not included we cannot process your question. Write: Service Editor, Radio-Electronics, 200 Park Avenue South, New York, NY 10003

disappears. This gives the same results. From here on, setup is the same as before. If dark areas of the picture show color, back off the screen control for that color. If the lighter areas (whites) show color, adjust the drive controls until these are a good white.

Other reactions

Excessively high screen-voltages can cause other problems that are not so obvious. Among these are retrace lines that won't go away as they should with brightness and contrast properly set up. In some cases, excess blooming can be caused by a high screen voltage. Before going through a lot of other and more difficult tests, run a grey-scale setup adjustment and see if this won't solve the problem. This can save a lot of time.

This can work the other way, of course. If none of the screen controls will give you a line or raster on setup and yet you get a dim raster with the SERVICE switch in the NORMAL position, check to see if the screen-grid voltages are up to normal. Read these on the sliders of the screen controls or on the picture-tube socket. In the stock circuit, all three controls will have the boosted-boost (B++) of 1,000–1,200 volts on one end and B+ of about +400 volts on the other. If the B++ rectifier that is almost always (or always, I'm pretty sure) a solid-state diode is down a little, this will reduce the B++ voltage and the screens won't be able to reach the correct voltage. Quick-check: see if B+ and the raw boost are normal. The boost should be about +850 volts. If these are OK but B++ is low, try a new diode unit. This is practically a dry circuit—there is hardly any measurable current flow aside from the bleeder current through the high-resistance screen controls and these go back to B+. Large resistors can be used. If you find one of these that is too hot, look out for leakage somewhere!

Another cute one is the bypass capacitors that are usually connected from the sliders of the screen controls back to the low end. If one of these is leaky or shorted, you won't be able to get that screen up to normal voltage. This is one possible cause for the "two colors make lines on setup but the other one won't" symptom.

Ballpark figures for a typical 21–25-inch picture tube will be +300 volts on the cathodes, +200 volts on the control grids and about +700 volts on the screens. You will find sets with the same tubes using lower DC voltages! So, check the schematic before you start tearing things up!

It's always a good idea to check the bias voltages on the picture tube when you run into unusual reactions involving low high-voltage, dim raster and similar symptoms. The typical maximum beam-current for the picture tube runs somewhere around 1.3–1.4 mA. So, it doesn't take too much of an upset in bias to overload the high-voltage supply and cause problems. R-E

reader questions

SCHEMATIC FOR COLOR BAR

I've a problem of horizontal instability in an Amphenol model 860 color-bar generator. I've checked everything I can with no results. I don't have a schematic. Do you?—P.C., New York, NY.

Sorry to say that I don't. If any of the readers has a schematic of this instrument, it would be appreciated by Peter Campione, 32 Jones St., New York, NY 10014. (Also by Jack Darr, Service Editor, for his files!)

DEAD HORIZONTAL OSCILLATOR

No high-voltage, no bias on horizontal output! This is a Wards GCI-17241A. I know the horizontal oscillator isn't running! I've changed the sinewave coil and the horizontal oscillator coil. No go. Help, help! Customer mad also!—L.H., Detroit, MI.

Don't get mad at it; it's just a machine! Go back over all of the things you've tried and recheck. Also, check for signal on the DC voltage supply. A feedback loop here, due to an open filter, can upset the oscillator. (Feedback: "Better glad than mad! I had replaced C521. Turned out that the one I replaced it with had died on the shelf! Thanks for the help." Note: C521 was not an electrolytic, as I assumed at first. It was the 390-pF *coupling* capacitor in the horizontal oscillator circuit! These can go bad, too.)

HORIZONTAL OSCILLATOR SUPPLY?

I can't see where the plate voltage comes from, for the horizontal oscillator, in circuits like a Motorola TS-921. It is fed from the boost; there isn't any boost until the oscillator starts, is there? So, this is a chicken-and-the-egg question to me. Which comes first and how does it get there?—M.M., Madras, OR.

This causes a lot of confusion among technicians (including me, for far too long). The secret lies in the fact that there *is* DC voltage on the boost line, even though the horizontal oscillator and output are not running.

This voltage comes "through" the *damper tube.* Its plate is tied to B+. As soon as this tube warms up and starts to conduct current, DC appears on the flyback, and also on the plate of the horizontal oscillator. This voltage *must* be present at normal value on the damper cathode or nothing can work. It will be high enough to start the oscillator and let the output tube conduct.

COLOR PROBLEMS

This Philco-Ford 20KT40B chassis has had repeated loss of color problems for quite a while. It seems to be in the 3.58-MHz oscillator IC. The DC voltages on pins 1 and 7 are high. The supply voltage is a little high, too. 23 volts instead of 20.0. What do you think?—D.N., Baton Rouge, LA.

I think two things right at the moment. One, I think this IC is shorted or damaged internally. The DC voltages on pins 1 and 7 come "from inside the IC". Whenever any of these are quite a bit off, as they are here, this indicates internal problems. Second, I think the supply-voltage situation should be checked. This voltage should be brought down to the rated 20.0 volts. Overvoltage operation could be the cause of the repeated failures in this circuit.

(Feedback: reader says "Bingo!" That did it.)

ROLL AND DIM-OUT

The raster shrinks, then the picture starts rolling, then it gets dimmer and goes dark; this is in an RCA CTC-53. At the shop, I had to raise the AC line voltage by 10 volts to make it show up. What could be affecting all of these things at once?—J.M., Evanston, IL.

There is one thing that could affect the vertical size, the sync and the brightness all at once in this chassis. This is the *boost* voltage. It affects the picture-tube screen, and also feeds the input half of the vertical *oscillator.* So, if the boost is dropping, this is the kind of symptom you would see. (Just for luck, check the 31LZ6 horizontal output tube. We have found some of these with gas or grid emission, etc.)

TRANSISTORS OVERHEATING

While testing an RCA Stereo, a YVD-994, on my bench speakers (4-ohm), I noticed that the output transistors got very hot. The emitter-collector voltage across the transistors would drop to less than 0.5 volt at high volume. What is causing this?—S.R., Macogdoches, TX.

This overheating at full volume *under these conditions* is normal. The speaker rating on this model is 8 ohms. If you try to run the amplifier into a 4-ohm load, it will try to develop the same amount of power. This means that the collector current will be *double* the normal amount. You're "bottoming" the power transistors. Output-transformerless (OTL) stages in class B or AB, which these are, draw much more current with a high signal level than they do at rest or no-signal.

You can always use a greater load impedance, but don't go below rated load or short the outputs. This can damage the output transistors.

REPLACEMENT TRANSISTOR TRICK

I'd like to know what transistors will replace these: A634 and C1096. That's all the markings; they were in a little orphan stereo.—C. W., Graham, WA.

There's a little trick you can use with some of these import transistors when seeking replacements in Substitution Guides. If you look under "A634" and get zlich, try adding "2S". Looking under 2SA634, you'll come out with something like a Sylvania ECG-187. These seem to be complementary-symmetry, so the other one would be an ECG-186. In RCA, SK-3083/SK-3054.

HORIZONTAL OUTPUT TUBE GLOWS RED

The horizontal output tube in this G-E G1 chassis glows red, and the fuse blows. I can get high voltage by driving the plate lead to the flyback with an Analyst. Doesn't this clear the flyback and other circuits?—J.M., Nashville, TN.

Yes! From the symptoms, you've lost the grid drive to the horizontal output tube. Check to see if you get the normal -60 volts on the 21LG6 grid. If not, check the horizontal oscillator. We have had some troubles with intermittent-starting oscillators. Try replacing the capacitors across the oscillator coil. Use exact replacements.

(Feedback: .0033- and .0068-μF capacitors replaced and she plays pretty! Thanks.)

NO COLOR

Here's one for you: An Admiral 2K2084 with no color. All color circuits seemed to check out OK. Color very pale at maximum-on color control: some slight barber-pole effect. Finally checked the tint control and found it open. When the slider hit the bad spot, it bridged it and the color came back. New control fixed the whole thing. Have you ever run into this one?—L.S., Brunswick, OH.

Not exactly, but I'm glad to get the data for future use.

REPEATED DAMPER BLOWING

This Magnavox T940 chassis has a bad habit; it blows the damper tubes at assorted intervals. This is getting monotonous. What can I do! I noticed that the last tube that blew had a small blob on the end of the cathode ribbon. Does this tell us anything?— W.M., Phoenix, AZ.

Yes, indeed! The blob on the end of the cathode ribbon means that this was blown out by a sudden heavy pulse of current. This is NOT likely to come from something inside the damper tube itself. Look for something that would indicate an arcover; maybe in the 6JE6 tube, boost, or anywhere in the high-voltage circuitry. Try tapping things.

(Feedback: It worked! I put a ¼-ampere fuse in the damper plate and then started tapping things. At first I got nothing, then after the set had warmed up a little more, I tapped the 6JE6! There was a flash inside it, and the fuse blew. It's been working ever since with a new 6JE6! Thanks.)

BULLSEYE!

You told me to look for an intermittent connection around the horizontal oscillator circuit, when I asked about reasons for the damper tube in this set turning red hot. Bullseye! The oscillator coil had a very intermittent connection due to a crack in the PC board. The customer told me why. He and a friend had the set out on the floor, trying to test tubes, and his 4 year old son dropped a pop bottle in it! What next?—P.T., Chicago, IL.

What next? Goodness only knows!

SERIES-HEATER BREAKDOWN

A Magnavox T931 keeps blowing 12AT7 tubes! This shuts down the whole

thing since it's a series string. I replace it and the thing works for a while, then pow; same 12AT7 out. I found a couple of bad capacitors, but this didn't help.—G.B., Seattle, WA.

This used to be quite a common problem in series-heater string sets. The most likely cause is a heater-cathode short in the *next* tube in the circuit! This will put a much higher AC voltage across the tubes remaining between this point and the input. In this circuit, it would be V1, the 4EH7 1st IF tube.

(Feedback: Right on! That was it.)

VERTICAL RETRACE

I can't get rid of the vertical retrace lines on this Magnavox T908 black-and-white set. The blanking-gate Zener diode had been broken and replaced by someone else. It connects from the collector of the vertical output to the +420-volt boost. All of the DC voltages seem to be a little low, too. The picture tube heater is only 5.1 volts instead of 6.3. Is this significant?—G.R., Pine Bush, NY.

You seem to have two problems! The low voltage isn't significant; probably due to low line-voltage since even the AC voltage to the picture tube heater is down. Not too bad anyway.

The other one is. The vertical blanking gate Zener does NOT connect from the vertical output collector to the +420-volt boost! I'll admit that if you do not examine the schematic very closely, it LOOKS as if it does! The anode of this Zener goes to the vertical output collector, and the cathode goes to the emitter of the video output, through a 15K resistor. Change it; probably blown up.

NO SOUND FROM AMP WITH GUITAR

My son is trying to use an electric guitar he just got on my stereo amplifier. However, we get no sound from the Auxiliary or Tape inputs. The guitar is OK; we checked it on a guitar amplifier. Why can't we get sound from the stereo?—E.P., Philadelphia, PA.

For a ballpark guess, the guitar pickup doesn't have quite enough output to drive the stereo amplifier input. The voltage output of these is very low. You can probably get better results by adding a small preamp stage. Your stereo amplifier has plenty of power output, but may not have enough *voltage gain* in the early stages. Phono pickups and tape decks usually have a fairly high signal output, and these will drive it.

RASTER WITH DEAD DAMPER TUBE?

Here's one for you, Swami! In an old G-E, the raster was about half width and folded over very badly in the middle. Looking around, I found the damper tube completely dead! New damper tube fixed it. Here's the question: How can this happen?—L.C., Mena, AR.

That's a good question and I wish you hadn't asked. The only thing I can think of is that the damper tube had a dead heater, but also had a very good plate-to-cathode *short*! This would be necessary so that you could at least get B+ voltage on to the horizontal-output tube. The loss of any "damping" action would cause the severe foldover, and the loss of boost would reduce the width. (If you want the truth, I have never seen this one at all, but I'll believe anything.)

LOSS OF HIGH CHANNELS

I've a peculiar condition in an Admiral tuner. We get Channels 2, 4, 5 and 6 on the low band, and 7 and 11 on the high band. Low-band stations are pretty good, but the high-band stations are weak; in fact, it won't even get Channel 11. I tried a new 4GS7 mixer tube, but it didn't help. Tried a 5LJ8 which was given as a substitute, same thing. What is?—R.M., Houston, TX.

The most likely thing for this is a load resistor on the oscillator plate which has gone away up in value. A previous mixer tube with a short can cause this. Take a resistance reading from the B+ terminal on the tuner to the oscillator plate pin on the tube socket; you can do this from the top. If this resistor is far higher than it should be, replace it. Hint: you can usually clip the leads and tack the new one in. This is much easier than trying to get the ends out of the switch lugs!

WHAT'S THE CHASSIS NUMBER?

I need a schematic on this Emerson. All of the labels and markings have disappeared.—M.H. Maple Shade, NJ.

Service Ed.: "Send me a tube layout and any part numbers you can find".

M.H.: OK, here. Only part number I can find is 294-6631 on the yoke; also "70841", but I believe it's a patent number or something.

Service Ed.: Nope: that's the part number for the deflection yoke! We're so lucky we stink. Emerson used this yoke in only *one* model, which is a Chassis 120837/839/840, etc., etc., in Sams Photofact Folder 838-2! Tube layout, etc., all agrees with your sketch.

BALLAST TUBE FOR OLD RADIO

I've got an old radio I want to fix. Uses 25L6-6SK7-6SQ7-6J5-25Z6 and a BL42D. What the heck is a BL42D? It is an odd looking thing, all metal.—B.F., Chicago, IL.

A BL42D is a "ballast tube"; it is just a heavy duty wirewound resistor mounted in a can on a tube base. The "42" in the type number stands for the voltage drop across it. Add up the heater voltages of the tubes, and subtract it from 110 (which was the line voltage used at that time) and you'll get 42 volts.

This comes out as something like 140 ohms. Your heater current is 300 mA. Use at least a 10- or 20-watt resistor. 140 ohms is an oddball size so use 150 ohms. You can use a little more resistance since line voltages are higher now.

INTERMITTENT VIDEO

Thanks for your suggestions on my problems with a CTC-25 RCA. The video was intermittent; horizontal lines, flashes, complete picture fade and so on. You said "Check the ground points on the PC board." I looked at all of them and resoldered the ones that didn't look good. No help. So, I got out some solder lugs, nuts and bolts, and I *grounded* those points!

That did it. The problems all went away and haven't come back!

Persistence and perspiration all help. Thanks to Wes Terry, Carlsbad, CA.)

INTERMITTENT WIPEOUT OF 6JE6'S

This RCA CTC-38 chassis has a bad habit of wiping out the 6JE6 horizontal-output tube at odd intervals! Most of the time it comes on and plays perfectly, but every so often it will blow the 6JE6 tube! I've been all over it and I can't find what's doing this. No smoke, no smell, no nothing.—A.S., Gardena, CA.

This evidently is not an intermittent short. The most likely cause would be a horizontal oscillator stage that is intermittent. If the oscillator doesn't start, you *will* lose the 6JE6. Try tapping and bending the PC board around this stage; bad solder joints are a common cause.

(Feedback: That was it! Bad solder joint on the coupling capacitor from horizontal oscillator to horizontal output stage!)

CONVERT TV TO SCOPE?

I've got a curve tracer and I need a scope to work with it. Can I convert a portable TV to do this?—J.M., Bristol, TN.

There is a way of converting old TV's for scopes, but you'd probably be better off to use a regular type! The scope bandwidth has a good deal to do with the curve-tracer patterns! Look for a fairly good "previously-owned" scope, and this might do very well. Check a few known good transistors and you'll get an idea of what the patterns should look like. **R-E**

R-E TESTS BIGSTON
continued from page 74

cassette decks on which we have used it as a reference tape.

Judging from the very low distortion figures obtained with both varieties of tape, we suspect that the people at Bigston have set their bias too high for both standard and CrO_2 tapes. A recording level of +8 dB was reached before 3% total harmonic distortion was recorded during playback measurements and, while we certainly are in favor of good "headroom" in a cassette deck, we suspect that backing off on the bias a bit would improve frequency response. Even if the bias reduction resulted in a reduced 3% THD point for this deck to a record level of say +4 or +5 dB, we would have had much higher praise for the deck. All of which goes to prove once more how inter-related the three important tape specifications of THD, frequency response and signal-to-noise level are. If the settings of bias on this deck are typical of all production units of this model (and they well may not be), we would urge Bigston's engineers to reconsider those settings at once.

Use and listening tests

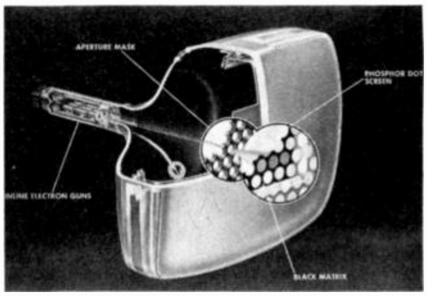
Transport action and control functions were amazingly smooth for a deck priced this low and after a few moments of use we were thoroughly familiar with the control layout. Not mentioned earlier is another innovative feature not found on decks in this class. If both the REWIND REVIEW and PLAY button are depressed simultaneously, a given tape being played will come to its end and then the PLAY button will automatically spring up (thanks to the automatic end-of-play stop feature), at which time the REWIND button takes over and automatically rewinds the tape at high speed to its starting point. With so many fine features going for it, we were distressed at the absence of highs during playback of sample musical material that we recorded. Our product analysis and summary will be found in Table II. **R-E**

COLOR TV '77
continued from page 57

pulses on the diode cathodes back-bias their junctions, allowing their anodes as well as the base and emitter of the corresponding transistor to rise.

Transistors Q41 and Q42 act as peak detectors, since they are emitter followers with high current capability in one direction. Emitter-connected capacitors C42 and C41 are the detector storage elements.

Capacitor C42 charges to a voltage dependent on the amplitude of the chroma



THE GENERAL ELECTRIC 25-inch in-line color picture tube.

signal during the 35-microsecond black reference interval. Capacitor C41 charges during the 15-microsecond chroma reference pulse. One of the four op-amps in IC60, an LM3900, is connected differentially to the two detector outputs. The output of the amplifier is filtered by R48, C48 and R49, and is proportional to the error between the two detected signals.

Selecting the VIR feature with the front-panel control substitutes the filtered output of the op-amp for the DC voltage on the slider of the manual tint control. Variations between the chroma tint and what the VIR signal says it should be is automatically corrected in closed-loop fashion.

GTE Sylvania

The 1977 Sylvania color line includes the carryover GT-Matic II E40 chassis in 21- and 25-inch models, the varactor-tuned E41 and E42 19- and 25-inch sets, and the E20 and E21 17- and 19-inch models. Continuation of the countdown vertical synchronization system remains unique to the GT-Matic receivers.

Seven IC's are used in the high-end GT-Matic II's. They feature an electronically regulated power-supply, low B+ short protection and horizontal shutdown circuits. Three circuit modules plug into the chassis. The IF module contains the power supply minus the transformer, the video IF and detector, the tuner AFC, and the sound IF, audio detector and power amplifier.

The video chroma module contains the chroma processor, the 3.58-MHz CW regenerator and control, video processing and blanking, and the color drive circuits. Vertical and horizontal drive and sweep systems, the pincushion circuitry and the Boost B + power-supply are all on the deflection module. The remaining heavy parts, including the power transformer and filter, horizontal transformer, and tripler, and heat sinking for the B+ regulator and horizontal output transistor, mount on the main chassis.

All IC's and transistors plug in for serviceability. The receiver is loaded with safety features for protection against X-ray radiation and fire. Contributing to fire protection are the power-supply short circuit sensing circuits, the horizontal shutdown system, UL rated self-extinguishing wire, and a mylar insulated and epoxy encapsulated high-voltage transformer. X-ray protection components are the horizontal shutdown device, the high-voltage tripler and the strontium-90 softened CRT glass.

The varactor E41 and E42 receivers use upgraded E11 and E12 chassis. Single-knob control of the varactor tuners make VHF, UHF, and remote control tuning equal. Mechanical memory tuning centers around a 21-pot turret tuner that uses a regulated 33-volt Zener supply as the reference supply. Bandswitching applies power only to the VHF or UHF tuner at any time. The slider on the potentiometers feed a PNP-NPN dual emitter-follower circuit that buffers the tuner from the pots. The voltages of the two oppositely poled base-to-emitter junctions tend to cancel.

These sets use a constant voltage ferroresonant transformer for supply regulation.

A special retrace capacitor design prevents an increase in high voltage due to opens or shorts in the capacitor. Normally either failure would shorten the flyback time and increase the 2nd anode voltage. Figure 5 shows the four-legged arrangement. Each of the two capacitor foils act as jumpers connecting the horizontal output transistor to the output transformer and to ground. If any connection opens, the output transistor is disconnected and the circuit is disabled. Shorts in the capacitor divert the current around the output transistor which shuts everything down.

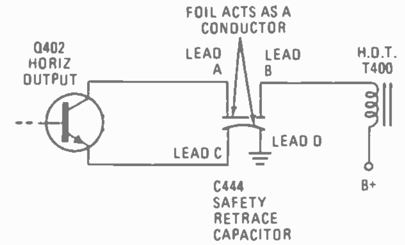


FIG. 5—SAFETY RETRACE CAPACITOR acts as fuse in Sylvania E41, E42 chassis.

The regulated supply in the E20 and E21 chassis uses a current sensing resistor to turn on a current limiter transistor when currents exceed 1.5 A. An SCR shuts off the drive pulses to the horizontal driver and holds the horizontal output transistor off.

Due to differences in the chromaticity coordinates of today's picture tubes and the NTSC chromaticity specifications, color errors result in straight inverse NTSC decoding. Decoding in the E20 and E21 have been modified to minimize these errors. **R-E**

CAR CLOCK

continued from page 63

reaching the setting that causes it to flash at 60 flashes-per-minute.

If C4 is adjusted to provide the 50-Hz input to the clock up from 30 Hz, the oscillator may not begin oscillations at 100 kHz whenever power is initially applied to the clock. This is true even if a counter is used to adjust the frequency.

Display current calibration

During display-current calibration, the time should be set to 10:08 or 10:09 for optimum results. This can be accomplished by manipulating the FAST SET and SLOW SET switches.

The BIAS potentiometer (R10) and the DARK ADJUST potentiometer (R9) must be set to values that allow maximum safe current to flow through the display when maximum ambient light is striking its face. In addition, the display current must fall to a value that will yield the desired display intensity for night-time driving. Therefore, the display current must be monitored with an ammeter between the display power Digi-Klip located on the main board and the display power edge connector located on the display board.

During LED display calibration, the nuts that hold the bezel to the display board should be loose enough to allow easy access to the photoresistor. However, during the incandescent display calibration, the bezel must be secure so that the chimney of the photoresistor is flush against the viewing screen; this will eliminate the problem of light reaching the photoresistor via the display itself.

For this reason the calibration procedures for the two types of displays are different. Calibration for the LED display will be discussed first.

LED display calibration

With R9 and R10 set at minimum resistance, and the viewing screen in place, allow the maximum expected ambient light to strike the display and the photoresistor through the viewing screen.

Increase the resistance of R10 until the display current, as read on the ammeter, is about 210–220 mA. The display should be visible, but not flashing to indicate a power failure.

After a 5-minute warm-up period, adjust R10 for a display current of 300–310 mA. Allow another 2-minute warm-up period; adjust the potentiometer, if necessary, to keep the display current at or below 310 mA. Set the time to 10:08 or 10:09 and reset R10 to 300–310 mA, if necessary.

Remove the viewing screen or bezel, and cover the photoresistor with black electrical tape. With the time set to 10:08 or 10:09, increase the resistance of R9 until the display current is about 20 mA. In bright light, the display will not seem visible, however, it will be about right for nighttime viewing.

Remove the black tape from the photoresistor, replace the viewing screen, and apply maximum expected ambient light to the display. Readjust R10 for a display current of 300-310 mA with the time set to 10:08.

Repeat the dark adjustment and the light adjustment until the display current is about 20 mA when the photoresistor is covered with black tape, and 300–310 mA with the black tape removed, the viewing screen in place, and maximum expected ambient light striking the display.

The 20-mA dark display current is an approximation only; the display should be adjusted for final desired intensity under actual conditions. During all display current adjustments, the time should be set to 10:08, if possible. After adjustments are completed, the display brightness should be sensitive to a hand passed in front of the photoresistor. If absolutely necessary, the maximum permissible display current is 315 mA. However, some allowance should be made for seasonal changes in the weather. With the display disabled, maximum current drawn by the clock will be about 15 mA; with displays enabled, about 325 mA.

Incandescent display calibration

With R9 and R10 set at minimum resistance, the viewing screen in place, and the chimney of the photoresistor flush against the viewing screen, allow the maximum expected ambient light to strike the display and the photoresistor through the viewing screen.

Increase the resistance of R10 until the display current is about 200 mA. Allow a 2-minute warm-up period, then set the time to 10:08 or 10:09.

Readjust R10 for a display current of about 290 mA. Remove the viewing screen and cover the photoresistor with black tape. Then increase the resistance of R9 until the display current is about 100 mA.

Remove the black tape from the photoresistor, replace the viewing screen, and allow maximum expected ambient light to strike the display. The display current should rise to about 290 mA if the time is set for 10:08.

Once again, the viewing screen should be removed and the photoresistor covered with black tape to make sure that the display current will fall to about 100 mA when the photoresistor is fully dark.

If this operation is not correct repeat the above adjustments, but adjust R10 to about 285 mA with the time set at 10:08. Continue in this manner, reducing the initial light current in steps of 5 mA, if necessary, until the maximum display current (not to exceed 290 mA) can be obtained under maximum ambient light. However, the display current should fall to about 100 mA when the photoresistor is covered with black tape.

With the incandescent displays, only one adjustment of the BIAS and DARK ADJUST potentiometers should be necessary; the additional steps are simply given in case they are needed.

With the display disabled, maximum current drawn will be about 15 mA; with displays enabled, about 305 mA. **R-E**

"I hardly think it's proper, to have my alma mater, scavenging upon my clientele."

RESISTOR BURNUP

I've been very confused trying to get this Kenwood amplifier straightened out. There's a 68-ohm resistor in the left channel output that keeps burning up. What can I do to prevent this?—W.Q., Granada Hills, CA.

For one thing, check the *resting* current in both channels. This is the output stage current with no signal at all. It should be the same in both channels and should be fairly small, say about 20 mA ballpark. It will increase as the volume is turned up but should still be about the same in both.

(Feedback: That did it! One channel read about 15 mA, the other read over 100 mA resting current! This was the one that was blowing the 68-ohm resistor. Further checking showed up a couple of resistors in the bias network that had changed in value. I cross-checked against the same resistors in the other channel. Thanks.)

WHY DOESN'T THE RASTER GO OUT?

There is raster and sound on this CTC-39XA RCA but no picture. The plate voltage is high on the 12HG7 video-output tube but the cathode voltage is zero. Screen voltage is high too. In fact, I can pull this tube with no effect. Why does the raster stay on? I thought it should go out!—T.H., Pontiac, MI.

It ought to. In either case (zero cathode voltage indicating no plate current, or tube out), the plate voltage should rise to the supply level. This bias change on the picture tube should cut it off. Now: let us heat up the analyzing iron and see.

One: It sounds to me as if your controls are all honked up! See if all three screen controls on the picture tube aren't turned full on. This will raise the cutoff so that you can get a raster.

Two: Check continuity in the 12HG7 cathode circuit; the contrast control may be open. Also, look to see if this tube is LIT! This booby-trapped me in a case with the same symptoms!

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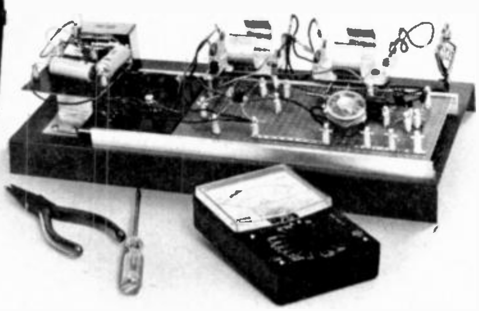

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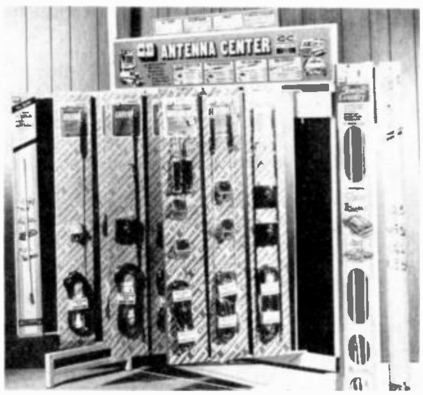

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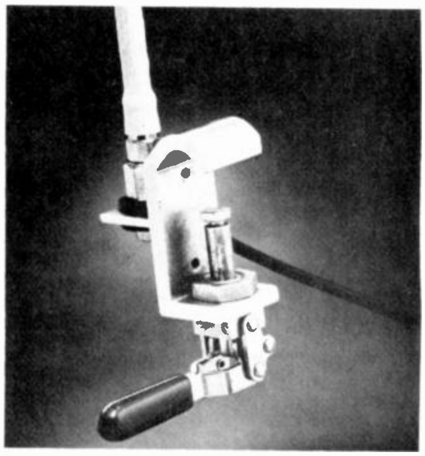

in the locked position, it is adaptable for use on automobile mirrors and luggage racks, or boat rails. It can be adjusted for 1/2 inch to 1 inch tubing—**Midwest Electronics,** 229 Fassett St., Toledo, OH 43605

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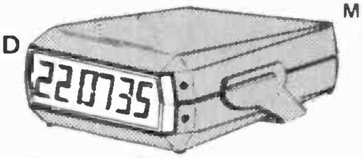

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KIT #2001 COMPLETE KIT (Less 9V. Battery) **29.95 EA** — 3 OR MORE **$27.95 EA.** — 115 VAC Power Pack #AC-1 **$2.50 EA**

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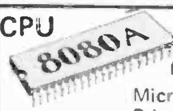
WIRED FOR 12 HR. OP. IF NOT SPECIFIED OTHERWISE

CPU



$19.95 ea.
NS8080AD
Micro Processor Chip
Prime National LSI
40 Pin socket $.50 with each 8080A!

450 ns MEMORY

Fairchild 1K Ram
low, low, low power.

2102L1PC	$1.95ea.
25-99	$1.75 ea.
100-199	$1.60 ea.
200 or more	$1.45 ea.

JUMBO RED LED's 12/$1.00 50/$3.95

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 # 7001B or # 7001C (Set of 2) $7.95

JUMBO DIGIT CLOCK KIT

A complete Kit (less Cabinet) featuring: six .5" digits, MM5314 IC, 12/24 Hr. time, 50/60 HZ., Plug-Transformer, Line Cord, Switches, and all Parts.
[Ideal Fit in Cabinet II]
Kit #5314-5 — **$19.95 ea 2/$38.**

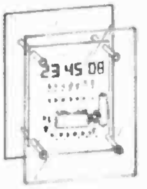
JUMBO DIGIT CONVERSION KIT

Convert small digit LED clock to large .5" displays. Kit includes 6-.5" LED's, Multiplex PC Board & easy hook-up info.
Kit #JD-1CC For common Cathode
Kit #JD-1CA For common Anode
$9.95 ea. 2/$19.

SEE THE WORKS Clock Kit
Clear Plexiglas Stand

- 6 Big .4" digits
- 12 or 24 hr. time
- 3 set switches (back)
- Plug transformer
- all parts included

Plexiglas is Pre-cut & drilled
Size: 6"H, 4⅓"W, 3"D



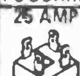
A SUPER LOOKING CLOCK!
Kit #850-4 CP — **$23.50 ea. 2/$45.**

Fairchild Super Digit FND-359

.4" Char. Ht. 7 segment LED RED Com. Cath. Direct pin replacement for popular FND-70.
95¢ ea, 10/$8.50
100/$79.00

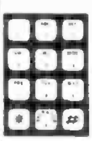
SET OF 6 FND-359 WITH MULTIPLEX PC BOARD $6.95

25 AMP BRIDGE



$1.95 ea.
3/$5.00
100 PIV

TELEPHONE FORMAT KEYBOARD
BY Chomerics



2-1/4"x3" 5/32" thick
$4.95
6/$28.

SCHOTTKY TTL

74S00	$.35
74S01	.40
74S04	.55
74S05	.60
74S09	.55
74S10	.40
74S20	.50
74S22	.45
74S40	.45
74S50	.45
74S51	.55
74S60	.85
74S64	.56
74S73	1.25
74S74	.85
74S75	1.75
74S78	1.50
74S86	.95
74S107	.95
74S112	.95
74S113	1.40
74S114	.95
74S133	.75
74S134	.75
74S138	1.75
74S139	1.50
74S151	1.95
74S153	1.95
74S155	1.95
74S156	1.95
74S157	1.80
74S158	2.50
74S174	2.50
74S175	2.50
74S181	2.35
74S182	1.35
74S251	2.75

DTL

930	$.09
932	.09
937	.09

LED DRIVERS

7447	$.95
7448	.95
75491	.65
75492	.65

VOLTAGE REGULATORS

LM309H	TO-5	$.95
LM309K	TO-3	1.25
7805	TAB	.95
7812	TAB	1.25
7815	TO-3	1.25
7815	TAB	1.25
78L15	TO-5	.75
LM340T-18	TAB	1.25
LM340T-24	TAB	1.25
7824	TO-3	1.25
723	DIP	.75
723	TO-5	.75

DIGITAL CLOCK IC's

MM5312	$4.95
MM5314	3.95
MM5375AB	3.95
CT-7001	7.95
CT-7002	13.95
50380	3.95
MM5369	2.50

XTAL

3.579545 MHZ $1.95

PRESCALE

11C90DC	$15.95
95H90	9.95

DIODES

IN4002	1A, 100 PIV	12/$1.00
IN4005	1A, 600 PIV	11/$1.00
IN4007	1A, 1000 PIV	10/$1.00
RECTIFIER	2.5A, 1000 PIV	4/$1.00
IN914	SIL. SIGNAL	20/$1.00
IN4148	(IN914 Equiv.)	20/$1.00
DIAC	28V.	4/$1.00

PLUG TRANSFORMERS

12VAC at 150 MA	$2.50
12VAC at 500 MA	3.50
7 VAC at 1.75VA	2.50

LINEAR

555	TIMER	2/$1.00
556	DUAL TIMER	.95
565	PLL	.95
566	FUNCTION GEN.	1.75
567	TONE DECODER	1.75

IC SOCKETS

PINS	1-24	25	100
8	$.25	$.22	$.20
14	.25	.22	.20
16	.28	.25	.23
18	.31	.28	.26
24	.50	.45	.40
28	.60	.55	.50
40	.75	.70	.66

COMPUTER

8080A	CPU	19.95
1702	E Prom	8.95
5203	E Prom	8.95
2102L1PC	1K Ram	1.95

EXAR

XR2556	$1.75
XR2567	$1.95

TRANSISTORS

2N2222	TO-18	5/$1.00
2N2554	TO-5	2/$1.00
2N2712	TO-98	5/$1.00
2N3415	TO-92	5/$1.00
2N3704	TO-92	5/$1.00
2N4400	TO-92	5/$1.00
2N4125	TO-92	5/$1.00
2N4249	TO-92	5/$1.00
2N4437	TO-92	5/$1.00
2N6027	PUT	2/$1.00
2N5457	N J-Fet	2/$1.00

SWITCHES

ROCKER SPDT	6/$1.
MINI-SLIDE SPDT	5/$1.
REG. SLIDE DPDT	6/$1.
PUSH BUTTON N.O.	3/$1.
MINI TOGGLE SPDT	$1.30
MINI TOGGLE DPDT	1.50

TRANSISTOR SOCKET

TO-5/18 GOLD PINS 5/$1.00

NYLON WIRE TIES

8" TIE-WRAP	100/$1.95
4" TIE-WRAP	100/$1.75

MOLEX PINS

REEL OF 1000	$8.50
STRIP OF 100	1.25

MISC. PRIME IC's

FAIRCHILD 9316 (74161)	$.95
75234 DUAL CORE SENSE AMP	1.50
MM502H TO-5 SHIFT REG	.95

OP AMPS

3/$1.00

301	TO-5
709	DIP
709	TO-5
741	DIP
741	M-DIP
741	TO-5
747	DIP
748	DIP

DISCRETE LED's

JUMBO RED
12/$1.00
50/$3.95
100/$7.50

PC TRIM POTS

25K 6/$1.00
4.7K 6/$1.00

SPECTROL 10K 10 TURN 95¢ 4/$3.00

7-SEG LED

COMMON CATHODE

	COLOR	HT.	DEC.PT.	PR.EA
FND-359	RED	.4"	RHDP	$.95
FND-503	RED	.5"	RHDP	$1.35
DL-750	RED	.6"	LHDP	$1.95
XAN-654	GREEN	.6"	NDP	$1.95
XAN-664	RED	.6"	NDP	$1.95

COMMON ANODE

DL-747	RED	.6"	LHDP	$1.95
MAN-72	RED	.3"	LHDP	$1.25
XAN-81	YELLOW	.3"	RHDP	$1.75
XAN-351	GREEN	.3"	RHDP	$1.50
XAN-361	RED	.3"	RHDP	$1.50
XAN-362	RED	.3"	LHDP	$1.50
XAN-662	RED	.6"	NDP	$1.95
XAN-692	RED	.6"	NDP	$1.95

Form Inexpensive Sockets — MOLEX PINS
100 for $1.25
Reel of 1000 - $8.50

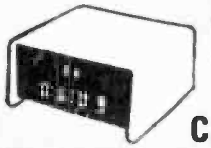
60 HZ.
XTAL TIME BASE KIT

Will enable Digital Clock or Clock-Cal. Kits to operate from 12VDC. Uses MM5369 and 3.58MHZ. XTAL. Req. 5-15VDC/2.5 MA. 1"x2" PC Board. Easy 3 wire hookup. Accuracy: +- 2 PPM

#TB-1 [adjustable]
Complete kit $4.95 ea
Wired & Cal. $9.95 ea

PLEXIGLAS CABINETS
Black, White or Clear Cover

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

$6.50 ea. 2/$12. ANY SIZE/COLOR

3"x6"x1/8" RED OR GREY PLEXIGLAS FOR DIGITAL BEZELS **95¢ ea. 4/$3**

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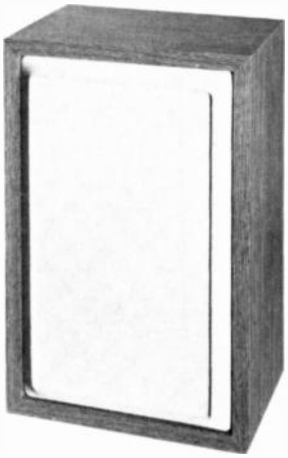
NEW PRODUCTS
continued from page 92

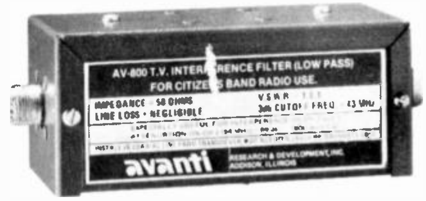
HI-FIDELITY SPEAKER SYSTEMS. The *model SP-325* is a three-way acoustic suspension speaker system featuring an 8-inch woofer with 1¾-pound magnet with a ½-inch rolled suspension cone and a 1¼-inch long-throw voice coil.



The *SP-325* also has a 3-inch mid-range speaker and a 3-inch super tweeter. Crossover frequencies at 6,000 and 9,000 Hz, frequency response is 50 to 20,000 Hz at 8 ohms, power handling capacity is 20 watts RMS with peak power 30 watts. This speaker system also features a cabinet structure, 10⅜ by 16⅜ by 7⅜ inches, of oiled walnut with a laminated finish over ½-inch composition board. The removable grille is contrasting brown grille cloth fabric, stretched over plastic molded perforated base. The model weighs 15 lbs. and retails for $40.00.—**Olson Electronics,** 260 Forge St., Akron, OH 44327.

CIRCLE 87 ON FREE INFORMATION CARD

INTERFERENCE FILTERS, *models AV-800, AV-811* and *AV-820.* If the CB transceiver is radiating harmonics of the same frequency assigned to one or more of the local TV channels, installation of the *model AV-800* low-pass filter (shown) on the transceiver should clear up the problem. If the problem is at the TV receiver



due to front-end overloading, the *model AV-811* filter on the TV lead-in should solve it. The filter lets the TV signals come through unhindered, while choking off the incoming CB signal. A third filter, *model AV-820,* used at the TV set, prevents outside CB signals from entering the TV through the AC power line.—**Avanti Research & Development, Inc.,** 340 Stewart Ave., Addison, IL 60101.

CIRCLE 88 ON FREE INFORMATION CARD

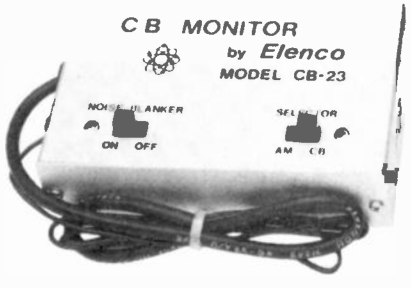
CB METER, *Model 10043,* is a combination power-meter and voltage standing-wave ratio bridge. The new meter measures RF output power up to 10 watts as well as providing VSWR measurements. An important feature of the meter is that it does not require a perfect impedance match to read accurately. It will read ±5% regardless of the input-output impedance match.

The meter is housed in a high-impact black plastic case. The suggested retail price is

$88.00.—**Antenna Incorporated,** 23850 Commerce Park Road, Cleveland, OH 44122.

CIRCLE 89 ON FREE INFORMATION CARD

CB MONITOR, *model CB 23,* converts any AM car radio to a Citizen-band receiver. Includes a



built-in noise suppression circuit using 4 transistors and 3 diodes to minimize ignition noise.

Can be installed in less than 2 minutes with no tools. No special antenna is needed. All 23-channels are tuned by using the regular AM radio dial with Channel-10 corresponding to the 1000 spot on the dial. Price: $34.95.—**Elenco Electronics,** 1940 Raymond Drive, Northbrook, IL 60062.

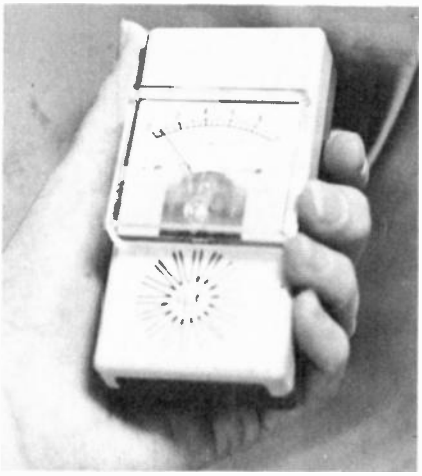
CIRCLE 90 ON FREE INFORMATION CARD

TOOL KIT, *model 39991*, is a 13-piece combination nutdriver and screwdriver set packed in a see-through plastic case that also serves as a bench stand. Included are; a handle, 4" exten-

sion, 3/16" slotted, 1/4" slotted, #1 phillips, #2 phillips, 3/16" nutdriver, 7/32" nutdriver, 1/4" nutdriver, 9/32" nutdriver, 5/16" nutdriver, 11/32" nutdriver, and 3/8" nutdriver.—**Hunter Tools,** 9674 Telstar Ave., El Monte, CA 91731.

CIRCLE 91 ON FREE INFORMATION CARD

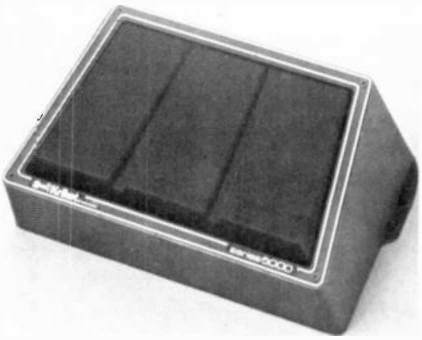
MICROWAVE LEAKAGE MONITOR, *model 245M* is an easy-to-use, hand-held, portable instrument designed for the consumer, industrial engineer, or service technician who wishes



to check for microwave oven leakage. The self-contained instrument operates without batteries, or any external power and is designed to check for 2,450-MHz microwave leakage in the home, industry or commercial establishment. The meter reads from zero to ten milliwatts per square centimeter. The *model 245M* is a direct-reading instrument mounted in an impact-resistant case. It is approximately 2 inches wide by 4 inches high by 1 inch deep. $49.95.—**UCE, Inc.,** 20 North Main, Norwalk, CT 06854.

CIRCLE 92 ON FREE INFORMATION CARD

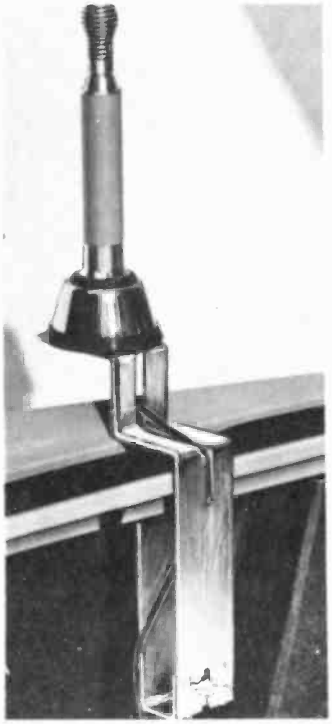
KRIKET AUTO SPEAKER, Series 6000, *model KK-6069*, is an acoustically designed 6 × 9 inch convertible (surface or flush) mount external speaker. It handles up to 30 watts RMS and has 8 ohms impedance. Extended frequency response of 35 Hz to 20,000 Hz is provided through a dual-cone design, while superior sound dispersion is assured by exclusive air suspended front-load speaker mounting technique. The new stereo speaker, made of impact-resistant Dylark in black Duralex, mounts on the rear deck, dashboard or any surface selected, or it snugs under the deck, with or without grille exposure. The unit comes complete with instructions and mounting hardware for either application and an 18 1/2-foot cable. Weighing 6 pounds, each speaker retails for about $44.95.—



Acoustic Fiber Sound Systems, Inc., 7999 Knue Rd., Suite 116, Indianapolis, IN 46250.

CIRCLE 93 ON FREE INFORMATION CARD

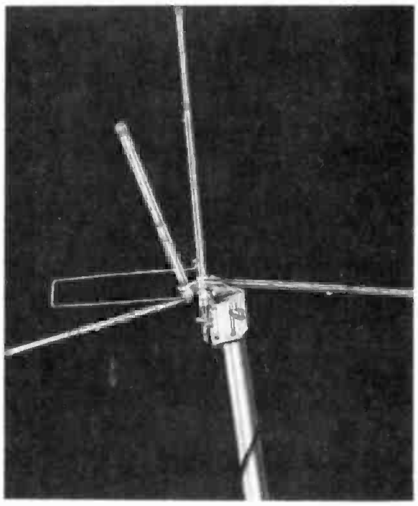
HIDE-IT TRUNK MOUNT. The *model CBTM-20* is a new quick-disconnect trunk mount for CB antennas which can be placed almost anywhere in the trunk of an automobile without the need to unscrew the antenna from the mount. It detaches quickly for storing and does not interfere with the tire, jack, luggage, etc. The *Hide-It* mount and antenna is easily attached into its secure operating position by an adjustable



bracket which fits most cars and accepts most CB antennas. Chrome finished, the mount is complete with self-adhering rubber strip to protect the car's finish and secures the coaxial antenna cable in place, and is self-grounding. $11.95.—**RMS Electronics, Inc.**, 50 Antin Place, Bronx, NY 10462.

CIRCLE 94 ON FREE INFORMATION CARD

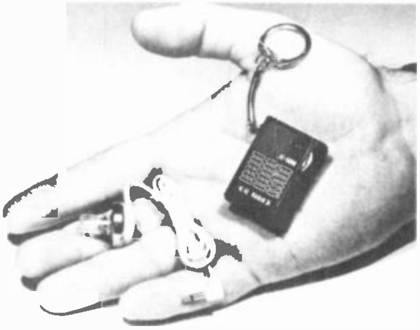
CB BASE-STATION ANTENNA, *model 11-101*, is a 27-MHz quarter-wave, beta-matched,



ground-plane design. It consists of three quarter-wave 108-inch radials to produce the elevated ground-plane, plus a vertical quarter-wave element for signal transmission and reception. All elements include static arrestors, built-in lightning protector and may be fastened to masts up to 1⅝ inches in diameter. The antenna terminates with a 50-ohm impedance to a SO-239 connector that mates with a standard PL-259 plug.—**Breaker Corporation,** 1101 Great Southwest Parkway, Arlington, TX 76011.

CIRCLE 95 ON FREE INFORMATION CARD

ULTRA-MINIATURE AM RADIO, *stock No 1976* is a tiny 1-11/16 × 1-1/16 × 11/16 inches and weighs 1-1/4 ounce Earphone listening only, the radio can be carried easily in your pocket; will



operate for approximately 100 hours on two hearing-aid batteries (included) Priced at $14 95 —**Edmund Scientific Co.**, 380 Edscorp Bldg . Barrington, NJ 08007

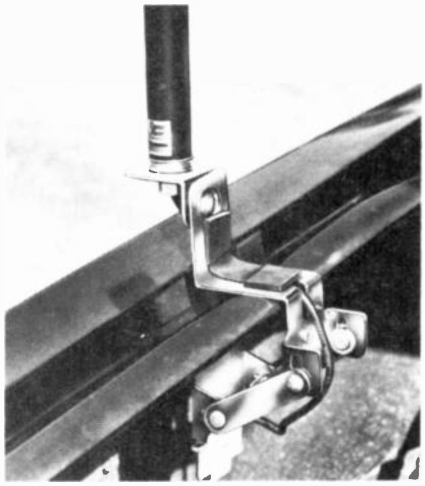
CIRCLE 96 ON FREE INFORMATION CARD

MOBILE SCANNING RECEIVER, Globe 9700 accommodates 16 standard crystals providing eight low-band or eight high-band channels, or

any combination of the two. A convenient band selection switch allows instant and safe band switching while the scanner is in operation. Operates from either AC/DC supply and comes complete with AC/DC power cords. Mounting bracket, antenna and hardware, less crystals—**Globe Electronics**, Div of Hydrometals, Inc , 400 S Wyman, Rockford, IL 61101

CIRCLE 108 ON FREE INFORMATION CARD

FOLD-DOWN CB ANTENNA. A line of full-sized, 40-channel coil-loaded whip antennas that can be conveniently flipped down and hidden in the automobile trunk when not in use Both, base-loaded and center-loaded models are available. Chrome-plated bracket serves as a self-ground-



ing base It is designed to fit most domestic and foreign cars and can be purchased separately for use with an existing antenna—**Channel Master**, Div of Avnet, Inc , Ellenville, NY 12428

CIRCLE 109 ON FREE INFORMATION CARD

CIRCLE 38 ON FREE INFORMATION CARD

CIRCLE 53 ON FREE INFORMATION CARD

new lit

More information on new lit is available from the manufacturers of items identified by a Reader Service number. Use the Free Information Card following page 106.

CASSETTE TAPE AND HOW TO MAKE IT WORK FOR YOU, *No. CB-1-176-25,* is a 28-page booklet containing practical information on the selection and use of cassete recorders/players.

The booklet describes cassette tapes and explains in detail the steps to take before recording. Includes a section on the language of cassette tapes and converting engineering terms into plain English.—Send SASE to **Audio Tape Division Fuji Photo Film U.S.A., Inc.,** Empire State Building, New York, NY 10001.

FLAT CABLE AND CONNECTOR CATALOG, *No. FC-2,* is a 20-page, 2-color catalog. The catalog covers a complete line of flat cable and connectors used for multiple termination in electronic circuits.

The catalog includes complete information on the company's 14- to 50-conductor flat cable, 14- and 16-pin DIP IC connectors, female socket connectors in 20- to 50-pin versions, straight and right-angle terminal headers to mate with the female socket connectors. PC board connectors and assembly tools consisting of a bench press, universal adapter and a low-cost hand tool for DIP connectors.

The new connectors are designed to permit the user to inspect the connections before covering and crimping. Connections can be checked for proper contact and conductors can be examined for proper alignment before final installation. Socket contacts have self-cleaning dual-cantilever construction for lower resistance connections. The connectors also have built-in strain relief so that cables will not pull apart. Assembly of the connectors can be made on a unique bench press with universal adapter that accepts all connectors without additional components or adjustments.

Features of the new Alpha flat-cable include compatibility, excellent tear-down characteristics and high resistance to damage due to repeated folding and bending. The cable is rated at 300 volts and is UL listed.—**Alpha Wire Corp.,** 711 Lidgerwood Avenue, Elizabeth, NJ 07207.

CIRCLE 97 ON FREE INFORMATION CARD

CIRCUIT DESIGN AIDS, 26-page catalog contains electronic circuit design aids from sockets and breadboards to complete educational systems. Described are systems for teaching and experimenting with operational amplifiers, integrated-circuit logic and microprocessors. Complete specifications, technical data and prices are included.—**E & L Instruments, Inc.,** 61 First Street, Derby, CT 06418.

CIRCLE 98 ON FREE INFORMATION CARD

TEST INSTRUMENTS, 40-page illustrated catalog includes oscilloscopes, analog and digital multimeters, frequency counters, signal generators, semiconductor and transistor testers and numerous other test instruments. The catalog lists the features and complete technical specifications for each instrument.—**B&K Precision,** Dynascan Corporation, 6460 W. Cortland, Chicago, IL 60635

CIRCLE 99 ON FREE INFORMATION CARD

next month

MARCH 1977

Hi-Fi Issue

Loaded with special articles on the latest developments in high fidelity sound reproduction.

- **Q-Biphonic.**

  A new way to reproduce recorded sound. Delivers the effects of binaural listening without the headphones. You'll want to know how the system works. It's a 4-channel system.

- **Industry Innovations.**

  Report from Tokyo and New York. Infrared link to headphones. Three new biphonic and binaural systems are highlighted. And more.

- **Audio Rectification.**

  How to eliminate unwanted RF signals picked up by your hi-fi system.

- **Two More Lab Tested Reports.**

  Nakamichi 610 preamp and Garrard GT-55 turntable.

PLUS

Phase-Lock-Loop For CB

Action Football

Another IC Data Sheet

Service Clinic

Analog Multimeters

State SOLID

Featuring a new integrated that simplifies sonar and and anti-collision radar.

KARL SAVON
SEMICONDUCTOR EDITOR

SONAR AND SODAR TECHNIQUES ARE THE BASIS of a variety of fish finder, burglar alarm, and collision avoidance products. A new integrated circuit from National Semiconductor reduces the active circuitry for this useful class of equipment to little more than the single chip and an ultrasonic transducer. The medium-sized 80 × 93-mil chip contains a complete transmitter-receiver.

Choice of two frequencies adapts the equipment to both water-confined Sonar (*S*ound *N*avigation *and R*anging) and air-operative Sodar (*S*ound *D*etection *and R*anging) systems.

Figure 1 is the functional schematic of National's LM1812 ultrasonic transceiver. The single transducer is time-shared by the receiver and transmitter circuits. One-millisecond transmit intervals are interleaved with longer, range-dependent intervals to listen for the reflected echo.

Modulation input pulses at pin 8 proportion the two time periods. Some applications generate the modulation pulse with a permanent magnet attached to an electromechanical display that excites an inductive pickup. Under the control of the pin-8 pulse, Q6 is turned on, enabling the gated oscillator tuned by the L1–C3 tank. The tank is used by both transmitter and receiver, ensuring that they are always at identical frequencies.

The transmitter

Multi-collector transistor Q7 couples the oscillator signal to the 1-μs one-shot. Having been enabled by the modulating pulse on pin 8, the monostable produces a pulse train of 1-μs positive-going pulses with a total 5-μs cycle time defined by the reciprocal of the 200-kHz oscillator frequency. Incidentally, 200 kHz is the water sonar application frequency. Because of the attenuation of the higher frequencies in air, a lower 40-kHz rate is used in sodar.

The 20 percent duty-cycle monostable output feeds the three-transistor transmitter output stage. One-ampere transmitter current pulses multiplied by the 12-volt supply is 12 watts of peak power, yet no special heat-sinking is needed. The power is dealt with by switching the output transistors on fully during the shorter 1-μs positive pulse.

Transistor Q14 is a buffer amplifier that turns on during the 1-μs period. When it is conducting, its collector is pulled low and an inverted modulation pulse appears at pin 7. Transistors Q15 and Q16 are a high-current-

# of STATE

circuit from National Semiconductor sodar circuitry. Useful as depth-finder Also included is RCA microprocessor

gain Darlington output stage. The output voltage on pin 6 is limited to the base-emitter voltage drop of Q16 because as Q15 becomes saturated, the base and collector of Q16 are effectively tied together and Q16 looks like a diode. The base voltage of Q16 is the output voltage on pin 6.

With the output transistors off, no power is dissipated simply because there is no current. Switched on, the power dissipation of the output device is limited to the saturation V_{be} output times the output current. Averaging further limits the power dissipation to ¼ the peak power since the stage is only active for that portion of the total duty-cycle.

Technically, the output operation falls into the Class-C category since the stage conducts for less than half a cycle. The square-wave output is filtered by the low-Q tuned transformer network. Tuned to resonate with the combined cable and transducer capacitance, the transformer coupling tolerates field transducer replacements without retuning.

In some applications such as hydro-acoustic communication systems, either AM, FM, or pulse modulation can be used at reduced power levels.

The ultrasonic receiver

When the input swings negative, capacitor C1 charges more positive at the base of Q1 due to the conduction of D1. Positive input signals then drive Q1 into conduction. Q2 is an emitter-follower that buffers the high-gain first RF stage from the gain control pot. The pot slider is coupled to the second RF stage that is biased by the same diode-capacitor method. Switching off the cascode transistor Q4 disables the second RF stage during the transmit mode.

During the longer receive periods, the base of Q4 is biased at two V_{be}'s above ground by D3 and D4 fed from a current source. The second stage of the receiver is disabled by duty-cycle control transistor Q5 to Q6. Turning on Q5 grounds the base of Q4 directly. When Q6 goes on, the subtractive effect of D5 and D6 also grounds Q4, shutting down the receiver.

L1–C3 acts as a selective filter tuned to either 200 or 40 kHz in the receive portion of the sequence. Transistor Q7 sends the received signal to pulse-train detector Q8. Its purpose is to discriminate against noise. Two or three missing pulses allows C5 to charge sufficiently to dump the charge from integration capacitor C4. Noise reject pot R2 and series resistor R1 in combination with C4 provide an adjustable noise-threshold. After a number of cycles have been received, indicating a valid return echo, display driver Q10 turns on, which in turn drives drives display transistors Q11, Q12, and Q13. Like the transmitter stage, it can deliver ten watts of peak display drive.

The diagram shows an LED display although neon, digital, and CRT readouts can also be used. Neon displays common in depth measuring and fish finding equipment use a voltage step-up transformer. Various methods of chip protection are possible to prevent excessive current buildup in the transformer primary. Returning the transformer winding to an RC filter gives the peak power delivery of the capacitor and the long-

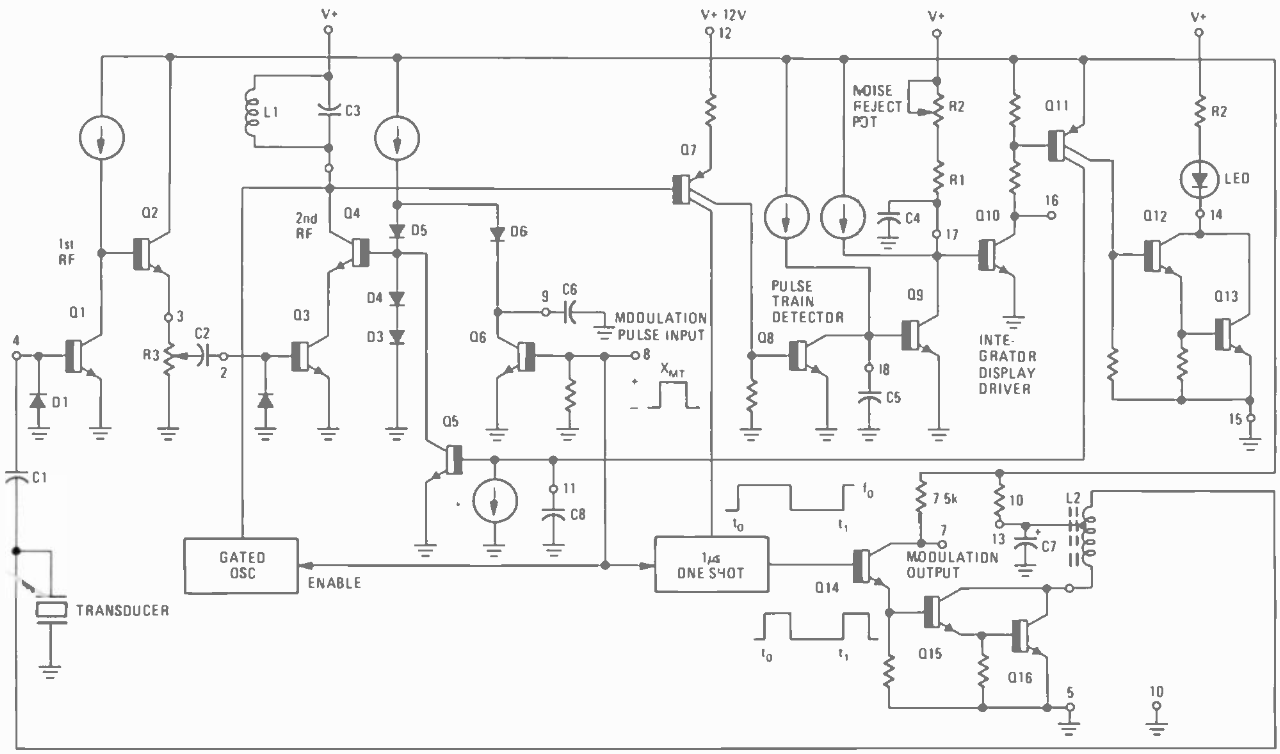


FIG. 1—NATIONAL SEMICONDUCTOR LM1812 ULTRASONIC TRANSCEIVER.

term current limiting of the series resistor. The average output power is thus controlled, but high peak power surges are permitted.

The LM1812 is packaged in an 18-pin DIP and sells for $12 in lots of 100. For additional information, contact National Semiconductor Corporation, 2900 Semiconductor Drive, Santa Clara, CA 95051.

CDP1802 microprocessor

Microprocessors are available in different technologies—PMOS, NMOS, bipolar, and CMOS. CMOS has the distinct advantages of low power dissipation and wide-temperature operation. RCA's 1801 microprocessor was a two-unit deal that was relatively slow and expensive. Started out at $200, the price of the pair dropped into the still unattractive $50 range.

But they haven't been sleeping! Just announced is a single-package CDP1802 COSMAC microprocessor that is a dramatic improvement over the earlier version. New instruction repertoire has been added, cost is competitive, down to under $30 levels, and the execution speed of single-cycle instructions is down to 2.5 microseconds. Standard aluminum gate construction has been supplanted with a self-aligned silicon-gate process that cuts down chip area and increases yield.

RCA's new 230 × 180-mil μP retains the unique architecture of the older 1801 design. Programs written for the earlier circuit will run without change on the new one. It is built with a new C^2L closed-COS/MOS logic. Source connections are common and separate contacts are not needed. Guardbands to prevent parasitic action are not needed, yet the CDP1802D can operate at full supply range of 3–12 volts.

The CDP1802 block diagram in Fig. 2 shows an 8-bit address bus MAO through MA7. The bus is time-multiplexed to 16 bits. Storing the first 8 bits in an external latch gives 65K of memory addressing capability.

Sixteen general-purpose registers distinguish the RCA approach from contemporary processors. Each register is 16 bits long, which adds up to 32 8-bit bytes or a total of 256 read-write scratchpad bits. By loading these registers with frequently used addresses and data, efficient programming code can be written. Single-byte instructions replace multiple-byte main memory addressing operations in other schemes.

Any register can be designated as the program counter or data pointer. One of three 4-bit registers selects the particular one of the 2^4 scratchpad registers.

Many of the memory and register instructions include a 4-bit operand that is stored in the N register. The most significant 4 bits of the instruction is the operation code and is stored in the 4 bit I register. For example, the instruction format 1N is an increment register operation. To increment register 5 by one, the instructions would be 15 in hex or 00010101 in binary. Binary number 0001 would be stored in the I register and 0101 in the N register. The control logic decodes the opcode and sends out signals to direct the N register to select register 5 in the array. The control logic then causes the addressed register to be incremented by one by the incr decr block in Fig. 2.

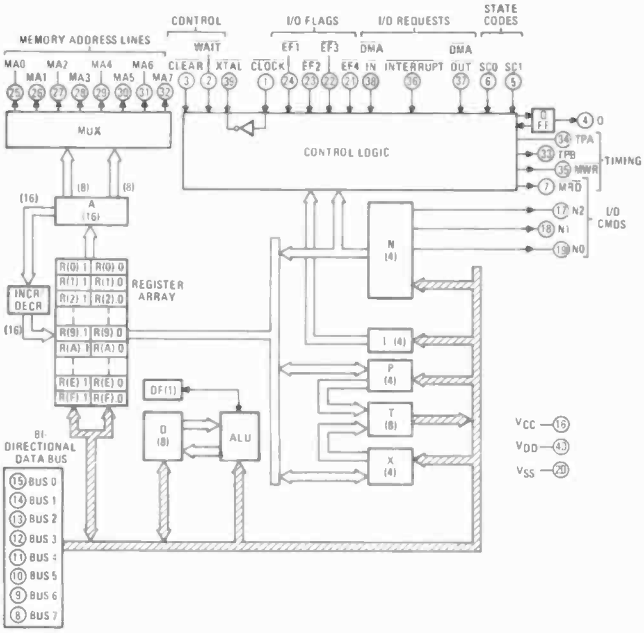


FIG. 2—BLOCK DIAGRAM OF THE RCA CDP1802.

In instructions where register addressing is not used, all 8 bits are interpreted by the control logic and none of the scratchpad registers are selected.

The 4-bit P register decides which of the 16 is to be used as the program counter. The program counter holds the address of the program stored in memory and is incremented sequentially to fetch successive program steps.

(Turn Page)

The 4-bit X register picks the register to be referenced by arithmetic and logic operations.

Interruptions in program executions by peripherals such as terminals and disk memories are standard computer procedures. The 8-bit T register is used to hold the X and P register contents and store them in a single memory-location. After servicing the interrupting device with a special program routine, the T register is used to reset X and P to their original values so the main program can continue from where it left off.

The 8-bit D register is the μP accumulator. Data is transferred in either direction between the D and scratchpad registers. Since the general registers are twice the length of the D register, either the low or high byte can be loaded by separate instructions.

Data transferred to and from memory must pass through the accumulator and is handled by a series of eight memory reference instructions. The instructions use either the X or P registers as operands. These pointers will either stay fixed or will be automatically incremented by the choice of instruction.

Arithmetic and logic operations take place between memory and the D accumulator, governed by an extensive series of instructions. The 1802 has a number of new immediate instructions that are two bytes in length. These load constants or use them as other operands. Immediate means the constant is stored in the second byte of the instruction. This is very useful when setting up indexes or initial memory pointers, which can then be incremented or decremented by the program.

At the heart of many machine-language routines are the branch instructions, and a large assortment will save programming code. The 1802 selection includes two-byte short branches where the second byte is the address that replaces the low program counter byte. Jumps over a 2^8, 256 word total range on the same memory page use these instructions. New to the 1802 are long branches that are three-bytes and allow jumps to any location in memory. The high and low address bytes to be inserted into the program counter are in the second and third instruction words. Except for the unconditional branches, the decision to jump or not is based on the state of the D register, and the DF, Q, and EF flags. DF, the data flag, is a one-bit ALU carry flip-flop. Q is a program controlled flag, and EF1 through EF4 are a group of flags controlled by peripherals.

Short and long skip instructions are similar to the branches in that they are executed in response to the same flag conditions, but their action is limited to the skipping of either one or two steps in the program. They are single-byte instructions that are very efficient in terms of memory space.

The ten control instructions include the stack return and idle operations. The remaining group are the output instructions that route data from the registers pointed to by X to the output data bus or from the input data bus. During input-output operations, the 4-bit N register is set to a value between 1 and 7 and used to select the peripheral device.

The unit price of the 4-6-volt 5-μs CDP1802D is $29.50. The 3-12 volt full speed CDP1802CD is $43.50. Information is available from RCA Solid State Division, Route 202, Somerville, NJ 08876. R-E

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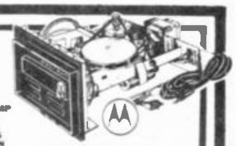

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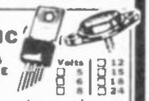

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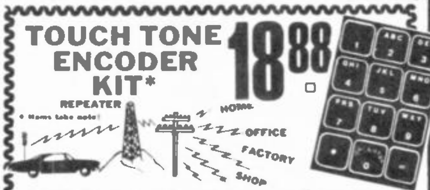

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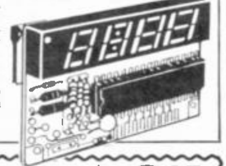

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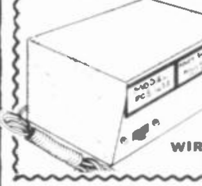

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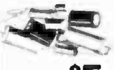

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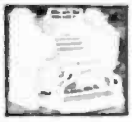

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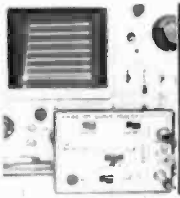

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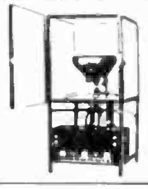

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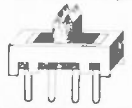

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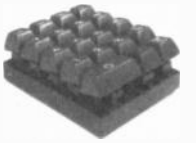

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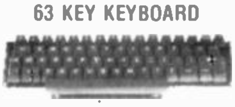
$10.95 each

63 KEY KEYBOARD

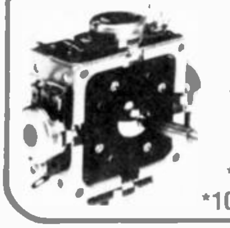


The keyboard features 63 une coded SPST keys unattached to any kind of P C B A ver, solid molded plast 13 base suits most application

$19.95

HD0165 16 LINE TO FOUR BIT PARALLEL KEYBOARD ENCODER $7 95

JOYSTICK



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

*5K Pots $6.95

*100K Pots $7.95

MICROPROCESSOR COMPONENTS

8080A	CPU	$19 95	MC6800L	8 Bit MPU	$35 00
8212	8 Bit Input Output	4 95	MC6820L	Periph Interface Adapter	15 00
8216	Bi-Directional Bus Driver	6 95	MC6810AP1	128 x 8 Static RAM	6.00
8224	Clock Generator Driver	12 95	MC6830L7	1024 x 8 Bit ROM	18 00
8228	System Controller - Bus Driver	12 95			

CPU S			RAM S			
8008	8 BIT CPU	$19 95	1101	256	Stat	$ 2 25
8080	Super 8008	2- 95	1103	1024 x 1	Dynamic	1 00
8080A	Super 8008	19 95	2101	256 x 4	Stat	5 95
SR S			2102	102-	Static	1 75
2504	1024 Dynamic	$ 9 00	2107	4096	Dynamic	9 95
2518	Hex 32 BIT	7 00	21	256	Static	6 95
2519	Hex 40 BIT	4 00	010	10 4	MNOS	29 95
2524	512 Dynamic	2 49	7489		Stat	2 49
2525	1024 Dynam	6 00	8101	256	Static	6 95
2527	Dual 256 BIT	3 95	811	256	Static	6 95
2529	Dual 512 BIT	4 00	8599	16	Static	3 49
2532	Quad 80 BIT	3 95	91L02	102-	Static	2 25
2533	1024 Static	95	4200	256	Static	6 95
3341	Fifo	6 95	93421	256	Static	2 95
74LS670	16 x 4 Reg	3 95	MM5262	2K x 1	Dynamic	99
UART S			**PROMS**			
AY 5 1013	30K Baud	$5 95	1702A	2048	F mos	$12 95
ROM S			5203	2048	F mos	14 95
2513	Cha Ge	$ 9 95	82S 3	32	Ope C	5 00
2516	Cha Ge	10 95	82S123	32 x 8	Tristate	5 00
74S387	1024 Bit Programmable	1 95	4528	1024	Static	95
			3601	256 x 4	Fast	3 95

BIPOLAR PROM SPECIAL

6330 1	256 Bit (32 x 8) Open Collector	2 95	6306 1	2048 Bit (512 x 4) Three State	9 95
6331 1	256 Bit (32 x 8) Three State	2 95	6340 1	2048 Bit (512 x 8) Open Collector	19 95
6300 1	1024 Bit (256 x 4) Open Collector	3 49	6341 1	2048 Bit (512 x 8) Three State	19 95
6301 1	1024 Bit (256 x 4) Three State	3 49	6352 1	4096 Bit (102 x 4) Open Collector	19 95
6305 1	2048 Bit (512 x 4) Open Collector	9 95	6353 1	4096 Bit (1024 x 4) Three State	19 95

Continental Specialties

Proto Board 100 **$19.95** THE MINI-BREADBOARD BUDGET KIT

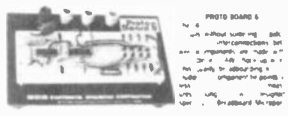
Proto Board 101 29.95

Proto Board 102 39.95

Proto Board 103 59.95

Proto Board 104 79.95

DESIGN MATE 1



Proto Board 6 $15.95

SPECIAL!

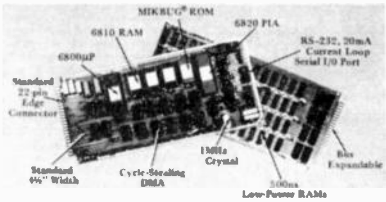
LOGIC MONITOR

Simultaneously displays static and dynamic logic states of DTL TTL HTL or CMOS DIP IC Pocket size $84 95

QT Proto Strips

QT type	# holes	price
QT 59S	590	50
QT 59B	bus strip	2 50
QT 47S	470	10 00
QT 47B	bus strip	25
QT 35S	350	8 50
QT 35B	bus strip	2 00
QT 18S	180	4 75
QT 12S	120	5
QT 8S	80	1 25
QT 7S	70	1 00

GEMINI-68 The Unique Microprocessing System



ALL BOARDS BUS EXPANDABLE

Uses standard size 4½" wide boards, dual 22 pin edge connector

Fully buffered and tristatable address and data buses

STAND ALONE CPU BOARD — Has 384 bytes of RAM on board, serial I O (RS-232 and 20 ma current loop cycle stealing direct memory access (DMA), built in software — selectable echo-back capability Part # SA-CPU Board **$279.95**

CPU BOARD — Same as above but only has 128 bytes of RAM on board-used with 8K RAM board listed below Part # Gemini 68 CPU Board **$259.95**

8K RAM BOARD — Uses low power static RAMS 500ns cycle time, 1 5 Amps Max Part # Gemini 68 RAM Board **$269.95**

8K EPROM BOARD — Uses 5204 EPROMS by AMI or NATIONAL Shipped with all decode and miscellaneous IC s except the 5204 EPROMS Part # Gemini 68 EPROM Board **$ 89.95**

NOT A KIT — ALL BOARDS ARE COMPLETELY ASSEMBLED. BURNED-IN AND TESTED COMES WITH COMPLETE DOCUMENTATION

Allow approximately to week to delivery

$5.00 Minimum Order — U.S. Funds Only California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 24¢ Stamp for 1977 Catalog Dealer Discount Available — Request Pricing

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Timeband

A Trademark of Fairchild Camera and Instrument Corp

DIGITAL ALARM CLOCK $16.95

- 24-Hour Alarm
- DOZE Button
- 100% Solid State
- Large Red Led Display (8 high)
- AM/PM Indicator
- Seconds Display at touch of button
- SPECIFY BLACK OR IVORY

DIGITAL WATCHES

Ladies Watch
- 6 Function
- Bracelet Styling
- 1 Year Guarantee
- Model 900
- Specify Gold or Chrome

$59.95

EXELAR Mens Watch
- 5 Function
- Quartz Crystal
- Black Leather Band
- Manufacturer Guarantee
- Specify Gold or Chrome

$25.00

5 FUNCTION ELECTRONIC CALCULATOR RADOFIN MODEL 8P

$8.95

FEATURES
- 8 Digit Display
- 5 Functions consists of addition subtraction multiplication division percentage with constant on all functions with full floating decimal point
- Power source is 1 piece 9V DC Battery 00GP jack for AC adapter
- Black superfine grained finish plastic cabinet

DIGITAL STOPWATCH

- 8 ight 6 Digit LED Display
- Times to 59 minutes 59 59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One
- Times Single Event — Split & Taylor
- Size 4 5 x 2 15 x 90 4 ounces
- Uses 3 Penlite Cells

Kit — $39.95

Assembled — $49.95

Heavy Duty Carry Case $5.95

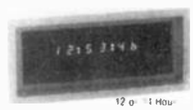
DIGITAL QUARTZ CAR CLOCK

Kit: $29.95

Assembled: $39.95

CASE ONLY (includes hardware mounting bracket and bezel) $5.95

JE700 CLOCK

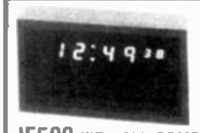


The JE700 a low cost digital clock but a very high quality unit The unit features a simulated walnut case with dimensions of 6 It utilizes a MAN high brightness and the MM5314 clock chip

12 or 24 Hour

115 VAC

$17.95



This large digit clock (6 hours & minutes 3 seconds) features the MM5314 clock chip It operates from 117 VAC and will operate in either a 12 or 24 hour mode The clock is complete with a walnut grain case and has fast set slow set and hold time set features

JE500 KIT - ALL COMPONENTS & CASE $34.95

WIRED & ASSEMBLED $39.95

DIGITAL CLOCK KIT — 3½ INCH DIGITS

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

This clock features big 3½ high digits for viewing in offices auditoriums, etc Each digit is formed by 31 bright 0 2 LED s The clock operates from 117 VAC has either 12 or 24 hr operation The 6 digit version is 27 x 3½ x 1½ and the 4 digit is 18 x 3½ x 1½ Kits come complete with all components, case and transformer

Specify 12 or 24 Hour When Ordering

JE803 PROBE

The Logic Probe is a unit which is to the most part indispensible in trouble shooting logic families TTL DTL RTL CMOS It derives the power it needs to operate directly off of the circuit under test drawing a scant 10 mA max It uses a MAN3 readout to indicate any of the following states by these symbols H HIGH L LOW P PULSE The Probe can detect high frequency pulses to 45 MHz It can't be used at MOS levels or circuit damage will result

$9.95 Per Kit

printed circuit board

T²L 5V 1A Supply

This is a standard TTL power supply using the well known LM309K regulator IC to provide a solid 1 AMP of current at 5 volts We try to make things easy for you by providing everything you need in one package including the hardware for only

$9.95 Per Kit

CIRCLE 4 ON FREE INFORMATION CARD

7400N TTL

SN7400N	16	SN7459A	25	SN74154N	1 00
SN7401N	16	SN7460N	22	SN74155N	99
SN7402N	21	SN7470N	45	SN74156N	99
SN7403N	16	SN7472N	39	SN74157N	99
SN7404N	18	SN7473N	37	SN74160N	1 25
SN7405N	24	SN7474N	32	SN74161N	99
SN7406N	20	SN7475N	50	SN74163N	99
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
SN7411N	30	SN7483N	70	SN74170N	2 10
SN7412N	33	SN7485N	89	SN74172N	8 95
SN7413N	45	SN7486N	39	SN74173N	1 50
SN7414N	70	SN7488N	3 50	SN74174N	1 25
SN7416N	35	SN7489N	2 49	SN74175N	99
SN7417N	35	SN7490N	45	SN74176N	90
SN7420N	21	SN7491N	75	SN74177N	90
SN7421N	33	SN7492N	49	SN74180N	99
SN7422N	49	SN7493N	49	SN74181N	2 49
SN7423N	37	SN7494N	79	SN74182N	95
SN7425N	29	SN7495N	79	SN74184N	1 95
SN7426N	29	SN7496N	89	SN74185N	2 20
SN7427N	37	SN7497N	4 00	SN74186N	15 00
SN7429N	42	SN74100N	1 00	SN74187N	6 00
SN7430N	26	SN74107N	39	SN74188N	3 95
SN7432N	31	SN74121N	39	SN74190N	1 19
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
SN7450N	26	SN74148N	2 00	SN74284N	6 00
SN7451N	27	SN74150N	1 00	SN74285N	6 00
SN7453N	27	SN74151N	79	SN74367N	75
SN7454N	20	SN74153N	89		

MANY OTHERS AVAILABLE ON REQUEST
20% Discount for 100 Combined 7400's

CMOS

CD4000	25			74C04N	75
CD4001	25			74C10N	65
CD4002	25	CD4035	1 85	74C20N	65
CD4006	2 50	CD4040	2 45	74C30N	65
CD4007	25	CD4042	1 90	74C42N	2 15
CD4009	59	CD4044	1 50	74C73N	1 50
CD4010	59	CD4046	2 51	74C74	1 15
CD4011	25	CD4047	2 75	74C90N	3 00
CD4012	25	CD4049	79	74C95N	2 00
CD4013	47	CD4050	79	74C107N	1.25
CD4016	56	CD4051	2.95	74C151	2.90
CD4017	1 35	CD4053	2 95	74C154	4 00
CD4019	55	CD4060	3 25	74C157	2 15
CD4020	1 49	CD4066	1 75	74C160	3 25
CD4022	1 25	CD4069	45	74C161	3 25
CD4023	25	CD4071	45	74C163	3.00
CD4024	1 50	CD4081	45	74C164	3 25
CD4025	25	CD4511	2.50	74C173	2 60
CD4027	69	CD4518	2 50	74C193	2 75
CD4028	1 65	CD4566	3.00	74C195	2 75
CD4029	2 90	74C00N	39	MC4044	4 50
CD4030	65	74C02N	55	MC14016	56

LINEAR

LM300H	80			LM1310N	2 95
LM301H	35			LM1351N	1 65
LM301CN	35			LM1414N	1 75
LM302H	75			LM1458C	65
LM304H	1 00	LM370N	1.15	LM1496N	95
LM305H	95	LM373N	3 25	LM1556V	1 85
LM307CN	.35	LM377N	4 00	LM2111N	1 95
LM308H	1 00	LM380N	1 39	LM2901N	2 95
LM308CN	1 00	[illegible]	1 05	LM3065N	.69
LM309H	1.10	LM381N	1.79	LM3900N	.55
LM309K	.99	LM382N	1.79	LM3905N	60
LM310CN	1 15	NE501K	8 00	LM3909	1 25
LM311H	90	NE510A	6 00	LM5556N	1 85
LM311N	.90	NE531H	3 00	MC5558V	1.00
LM318CN	1 50	NE536T	6.00	LM7525N	90
LM319N	1 30	NE540L	6 00	LM7535N	1 25
LM320K-5	1 35	NE550N	79	8038B	4 95
LM320K-5 2	1 35	NE555V	9	LM75450	.49
LM320K-12	1 35	NE560B	5.00	75451CN	.39
LM320K-15	1.35	NE561B	5 00	75452CN	.39
LM320T-5	1 75	NE562B	5 00	75453CN	.39
LM320T-5 2	1.75	NE565H	1.25	75454CN	39
LM320T-8	1 75	NE565N	1 75	75491CN	79
LM320T-12	1.75	NE566CN	1.25	75492CN	89
LM320T-15	1.75	NE567H	1 95	75494CN	89
LM320T-18	1 75	NE567V	1 50	**RCA LINEAR**	
LM320T-24	1 75	LM703CN	45	CA3013	2 15
LM323K-5	9.95	LM709H	.29	CA3032	2 56
LM324N	1.80	LM709N	.29	CA3035	2.48
LM339N	1 70	LM710N	79	CA3039	1.35
LM340K-5	1 95	LM711N	.39	CA3046	1 30
LM340K-6	1 95	LM723H	55	CA3059	3 25
LM340K-8	1.95	LM723H	55	CA3060	3 25
LM340K-12	1 95	LM733N	1 00	CA3080	85
LM340K-15	1 95	LM739N	1 00	CA3081	2 00
LM340K-18	1.95	LM741CH	.35	CA3082	2 00
LM340K-24	1.95	LM741CN	.35	CA3083	1 60
LM340T-5	1.75	LM741-14N	39	CA3086	.85
LM340T-6	1 75	LM747H	.79	CA3089	3.75
LM340T-8	1 75	LM747N	79	CA3091	10 20
LM340T-12	1 75	LM748H	39	CA3123	2.15
LM340T-15	1 75	LM748N	39	CA3130	1 39
LM340T-18	1 75	LM1303N	90	CA3140	1.25
LM340T-24	1.75	LM1304N	1 19	CA3600	1.75
LM350N	1 00	LM1305N	1 40	RC4194	5 95
LM351CN	65	LM1307N	85	RC4195	3 25

74LS00 TTL

74LS00	29			74LS139	1.95
74LS02	29			74LS151	1 55
74LS03	29	74LS74	49	74LS153	1 89
74LS04	35	74LS75	69	74LS157	1 55
74LS05	35	74LS76	49	74LS162	2 25
74LS08	29	74LS83	1 75	74LS163	2 25
74LS10	29	74LS85	2 49	74LS164	1 95
74LS13	69	74LS86	49	74LS175	1.95
74LS14	1 75	74LS90	1 25	74LS181	3 69
74LS20	29	74LS92	1 25	74LS190	2 85
74LS26	39	74LS93	1 25	74LS191	2 85
74LS27	39	74LS95	1 95	74LS192	2 85
74LS28	39	74LS96	1 89	74LS193	2 85
74LS30	29	74LS107	59	74LS194	1 89
74LS32	39	74LS109	59	74LS195	1 89
74LS40	39	74LS112	59	74LS257	1 75
74LS51	29	74LS132	1 25	74LS260	55
74LS55	29	74LS136	59	74LS279	79
74LS73	49	74LS[illegible]	1 89	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
CT7001	6 Digit, Calendar Alarm 12 or 24 Hour	5 95

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7400	Pin out & Description of 5400/7400 ICS	$2.95
CMOS	Pin-out & Description of 4000 Series ICS	$2.95
Linear	Pin out & Functional Description	$2.95

ALL THREE HANDBOOKS $6.95

FAIRCHILD TECHNOLOGY KITS FAIRCHILD

- Complete Specifications on back of each kit
- Packaged for WALL DISPLAY APPEARANCE
- Dealer's Inquires Invited — Price List Available

DIGITS

FTK0001	0 5" High Common Cathode Digit	$1 00
FTK0002	0 5" High Common Anode Digit	1 00
FTK0003	.357" High Common Cathode Digit	75
FTK0004	0 8" High Common Cathode Digit	2 00
FTK0005	0 8" High Common Anode Digit	2 00

0.8" HIGH DISPLAY ARRAYS

FTK0010	12 Hour 3½ Digit Clock Display	7 00
FTK0011	24 Hour 4 Digit Clock Display	8 00

LED LAMPS

FTK0020	10 Red LED Lamps	1 00
FTK0021	5 Mixed Colored LED Lamps	1 00
FTK0022	10 LED Mounting Clips	1 00
FTK0023	5 Three Piece LED Mounting Adapters	1 00

PHOTO TRANSISTORS

FTK0030	5 Flat Lens Photo Transistors	1 00
FTK0031	5 Round Lens Photo Transistors	1 00
FTK0032	3 Flat Lens Photo Darlingtons	1 00
FTK0033	3 Round Lens Photo Darlingtons	1 00

PHOTO ARRAYS

FTK0040	9-Element Tape Reader Array	16 00
FTK0041	12-Element Card Reader Array	24 00
FTK0042	Reflective Opto Coupler	4 00

COUPLERS

FTK0050	3 General Purpose Opto Couplers	1 00
FTK0051	Darlington Opto Coupler	1 00

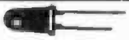
MOS CLOCK CIRCUITS

FTK0400	Digital Clock/Calendar Circuit (FCM7001)	7 00
FTK0401	Digital Clock/Calendar with BCD Outputs (FCM7002)	7 00
FTK0402	Direct Drive Digital Clock Circuit with AC Output (FCM3817A)	5 00
FTK0403	Direct Drive Digital Clock Circuit with DC Output (FCM3817D)	5 00
FTK0405	Direct Drive Digital Clock/Calendar Circuit (FCM7015)	6 00

KITS

FTK0106	Automobile Clock Kit	40 00

DISCRETE LEDS



.125" dia.			.90" dia		
XC209	Red	10/$1	XC111	Red	10/$1
XC209	Green	4/$1	XC111	Green	4/$1
XC209	Orange	4/$1	XC111	Yellow	4/$1
			XC111	Orange	4/$1

.200" dia			.185" dia.			.200" dia			.085" dia.
XC22	Red	10/$1	XC526	Red	10/$1	XC556	Red	10/$1	MV50
XC22	Green	4/$1	XC526	Green	4/$1	XC556	Green	4/$1	.085 dia Micro
XC22	Yellow	4/$1	XC526	Yellow	4/$1	XC556	Yellow	4/$1	red LED
XC22	Orange	4/$1	XC526	Orange	4/$1	XC556	Orange	4/$1	6/$1
SSL-22	RT	4/$1	XC526	Clear	4/$1	XC556	Clear	7/$1	

DISPLAY LEDS

DL707   DL338

TYPE	POLARITY	HT		TYPE	POLARITY	HT	
MAN 1	Common Anode	270	2 95	MAN 3620	Common Anode-orange	300	1 75
MAN 2	5 x 7 Dot Matrix	300	4 95	MAN 3640	Common Cathode-orange	300	1 75
MAN 3	Common Cathode	125	39	MAN 4710	Common Anode-Red	400	1 95
MAN 4	Common Cathode	187	1 95	DL701	Common Anode-red	300	99
MAN 7	Common Anode	300	1 25	DL704	Common Cathode	300	99
MAN 7G	Common Anode-green	300	1 95	DL707	Common Anode	300	99
MAN 7Y	Common Anode-yellow	300	1 95	DL 728	Common Cathode	500	95
MAN 52	Common Anode-green	300	1 75	DL 747	Common Anode	600	2 25
MAN 64	Common Anode-red	400	1 75	DL 750	Common Cathode	600	2 49
MAN 72	Common Anode	300	1 25	DL 338	Common Cathode	110	50
MAN 74	Common Cathode	300	1 50	FND70	Common Cathode	250	75
MAN 82	Common Anode-yellow	300	1 75	FND503	Common Cathode	500	1 00
MAN 84	Common Cathode-yellow	300	1 75	FND507	Common Anode	500	1 00

IC SOLDERTAIL — LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100		1-24	25-49	50-100
8 pin	$.17	16	15	24 pin	$.38	37	36
14 pin	20	19	18	28 pin	45	44	43
16 pin	22	21	20	36 pin	60	59	58
18 pin	29	28	27	40 pin	63	62	61
22 pin	37	36	35				

SOLDERTAIL STANDARD (TIN)

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

SOLDERTAIL STANDARD (GOLD)

8 pin	$.30	27	24	24 pin	$.70	63	57
14 pin	35	32	29	28 pin	1.10	1.00	90
16 pin	38	35	32	36 pin	1.75	1.40	1.26
18 pin	52	47	42	40 pin	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

10 pin	$.45	41	37	24 pin	$1.05	95	85
14 pin	39	38	37	28 pin	1.40	1.25	1.10
16 pin	43	42	41	36 pin	1.59	1.45	1.30
18 pin	75	68	62	40 pin	1.75	1.55	1.40

PUSH BUTTON SWITCH

PB-123 $1.75
Maintained Action Switch
PB-126 $1.75
Momentary Action Switch

SPDT

MINATURE TOGGLE SWITCH

JMT-221	DPDT	on/off/on	$1.95
JMT-223	DPDT	on/none/on	$1.75
JMT-121	SPDT	on/off/on	$1.50
JMT-123	SPDT	on/none/on	$1.25

CLIPLITE NEW LED MOUNTING SYSTEM — to be used with XC556 LEDS — SPECIFY COLORS — RED — GREEN — AMBER — YELLOW **4/$1.00**

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

ASST. 1	5 ea.	10 OHM	12 OHM	15 OHM	18 OHM	22 OHM	1/4 WATT 5%	50 PCS.
		27 OHM	33 OHM	39 OHM	47 OHM	56 OHM		
ASST. 2	5 ea.	68 OHM	82 OHM	100 OHM	120 OHM	150 OHM	1/4 WATT 5%	50 PCS.
		180 OHM	220 OHM	270 OHM	330 OHM	390 OHM		
ASST. 3	5 ea.	470 OHM	560 OHM	680 OHM	820 OHM	1K	1/4 WATT 5%	50 PCS.
		1.2K	1.5K	1.8K	2.2K	2.7K		
ASST. 4	5 ea.	3.3K	3.9K	4.7K	5.6K	6.8K	1/4 WATT 5%	50 PCS.
		8.2K	10K	12K	15K	18K		
ASST. 5	5 ea.	22K	27K	33K	39K	47K	1/4 WATT 5%	50 PCS.
		56K	68K	82K	100K	120K		
ASST. 6	5 ea.	150K	180K	220K	270K	330K	1/4 WATT 5%	50 PCS.
		390K	470K	560K	680K	820K		
ASST. 7	5 ea.	1M	1.2M	1.5M	1.8M	2.2M	1/4 WATT 5%	50 PCS.
		2.7M	3.3M	3.9M	4.7M	5.6M		

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) $10.95 ea.

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- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)
- Complete with built-in bit and sleeve

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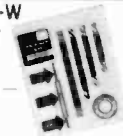
(batteries not included)

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP



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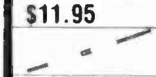
- Roll of 50 ft. White 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped white wire

$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

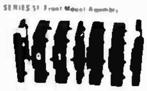
THUMBWHEEL SWITCHES

THUMBWHEEL SWITCH ONLY

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

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

SF Front Mount SR Rear Mount

SERIES SF Front Mount Assembly  SERIES SR Rear Mount Assembly 

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

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These switches feature seven SPST slide switches in a molded dip. They are ideally suited for [illegible] applications.

$1.95

ZENERS — DIODES — RECTIFIERS

TYPE	VOLTS	W	PRICE	TYPE	VOLTS	W	PRICE
1N746	3 3	400mm	4/1 00	1N4005	600 PIV	1 AMP	10/1.00
1N751A	5 1	400m	4/1 00	1N4006	800 PIV	1 AMP	10/1 00
1N752	5 6	400m	4/1 00	1N4007	1000 PIV	1 AMP	10/1 00
1N753	6 2	400m	4/1 00	1N3600	50	200m	6/1 00
1N754	6 8	400m	4/1 00	1N4148	75	10m	15/1 00
1N959	8 2	400m	8/1 00	1N4154	35	10m	12/1 00
1N965B	15	400m	4/1 00	1N4305	75	25m	20/1 00
1N5232	5 6	500m	28	1N4734	5 6	1w	28
1N5234	6 2	500m	28	1N4735	6 2	1w	28
1N5235	6 8	500m	28	1N4736	6 8	1w	28
1N5236	7 5	500m	28	1N4738	8.2	1w	28
1N456	25	40m	6/1 00	1N4742	12	1w	28
1N458	150	7m	6/1 00	1N4744	15	1w	28
1N485A	180	10m	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	1 95
2N2328	1 6A @ 200V	SCR	50
MDA 980-1	12A @ 50V	FW BRIDGE REC	1 95
MDA 980-3	12A @ 200V	FW BRIDGE REC	1 95

TRANSISTORS

MPS A05	5/$1 00			PN4249	4/$1 00
MPS A06	5/$1 00			PN4250	4/$1 00
2N2219A	3/$1 00	PN3567	3/$1 00	2N4400	4/$1 00
2N2221	4/$1 00	PN3568	4/$1 00	2N4401	4/$1 00
2N2222A	5/$1 00	PN3569	4/$1 00	2N4402	4/$1 00
2N2369	5/$1 00	2N3704	5/$1 00	2N4403	4/$1 00
2N2369A	4/$1 00	2N3705	5/$1 00	2N4409	5/$1 00
PN2415	5/$1 00	2N3706	5/$1 00	2N5086	4/$1 00
2N2484	4/$1 00	2N3707	5/$1 00	2N5087	4/$1 00
2N2906A	4/$1 00	2N3711	5/$1 00	2N5088	4/$1 00
2N2907A	5/$1 00	2N3724	$ 65	2N5089	4/$1 00
2N2925	5/$1 00	2N3725	$1 00	2N5129	5/$1 00
2N3053	2/$1 00	2N3903	5/$1 00	2N5138	5/$1 00
2N3055	$ 89	2N3904	4/$1 00	2N5139	5/$1 00
MJE3055	$1 00	2N3905	4/$1 00	2N5209	5/$1 00
MJE2955	$1 25	2N3906	4/$1 00	2N5951	5/$1 00
2N3392	5/$1 00	2N4013	3/$1 00	C106B1SCR	2/$1 00
2N3398	5/$1 00	2N4014	3/$1 00	2N5432	$2 00
		2N4123	10/$1 00		

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50 VOLT CERAMIC DISC CAPACITORS

	1-9	10-49	50-100		1-9	10-49	50-100
10 pf	.05	04	03	.001µF	.05	04	.035
22 pf	05	.04	03	.0047µF	05	04	035
47 pf	.05	.04	.03	.01µF	.05	.04	.035
100 pf	05	04	03	.022µF	.06	.05	.04
220 pf	05	04	.03	.047µF	.06	05	.04
470 pf	.05	04	035	.1µF	12	.09	.075

100 VOLT MYLAR FILM CAPACITORS

.001mf	12	10	07	.022mf	13	11	.08
.0022	12	10	07	.047mf	.21	17	13
.0047mf	12	10	07	.1mf	27	23	17
.01mf	12	10	07	.22mf	33	27	22

+20% DIPPED TANTALUMS (SOLID) CAPACITORS

.1/35V	.28	.23	17	1 5/35V	.30	26	.21
.15/35V	28	23	17	2 2/25V	.31	27	22
.22/35V	28	.23	.17	3.3/25V	.31	.27	22
.33/35V	.28	23	17	4.7/25V	32	28	.23
.47/35V	.28	23	.17	6.8/25V	.36	.31	25
.68/35V	28	23	17	10/25V	40	35	.29
1.0/35V	28	23	17	15/25V	63	.50	.40

MINIATURE ALUMINUM ELECTROLYTIC CAPACITORS

Axial Lead				Radial Lead			
.47/50V	15	13	10	.47/25V	15	13	.10
1.0/50V	.16	14	11	.47/50V	16	14	11
3.3/50V	15	13	10	1.0/16V	15	13	10
4.7/25V	16	14	12	1 0/25V	16	14	11
10/25V	.15	13	.10	1.0/50V	16	14	11
10/50V	.16	14	12	4.7/16V	15	13	10
22/25V	17	.15	.12	4.7/25V	.15	13	10
22/50V	.24	20	18	4.7/50V	16	14	11
47/25V	.19	17	.15	10/16V	.14	12	.09
47/50V	25	.21	19	10/25V	15	13	10
100/25V	24	20	18	10/50V	.16	14	12
100/50V	35	30	28	47/50V	.24	.21	.19
220/25V	.32	.28	25	100/16V	.19	15	14
220/50V	45	41	38	100/25V	.24	20	18
470/25V	33	29	27	100/50V	35	.30	28
1000/16V	55	.50	45	220/16V	23	17	16
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As always, this kit includes all parts, all sockets, and complete instructions for ease of assembly. Because of our past experience with our 4K kit we suggest that you order early. All orders will be shipped on a strict first come basis. Dealers inquiries welcome on this item.

Kit shipped with 2 MHZ crystals for existing 500NS memory. Easily modified for faster RAM chips when the prices come down.

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You requested it! Our first DC operated clock kit. Professionally engineered from scratch to be a DC operated clock. Not a makeshift kluge as sold by others. Features: Bowmar 4 digit .5 inch LED array, Mostek 50252 super clock chip, on board precision time base, 12 or 24 hour real time format, perfect for cars, boats, vans, etc. Kit contains PC Board and all other parts needed (except case). 50,000 satisfied clock kit customers cannot be wrong!

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STICK IT! in your clock in your DVM, etc.!

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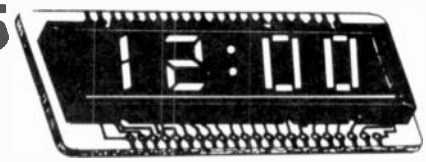

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The Bowmar Opto-Stick. The best readout bargain we have ever offered. Has four common cathode jumbo digits with all segments and cathodes brought out. Increased versatility since any of the digits may be used independently to fit your applications. Perfect for any clock chip, especially direct drive units like 50380 or 7010. Also use in freq. counters, DVM's, etc. For 12 or 24 hour format.

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SN7492N	45
SN7493N	49
SN74100N	90
SN74107N	39
SN74121N	39
SN74145N	89
SN74150N	95
SN74151N	75
SN74154N	1 10
SN74157N	95
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LM323K-5	6 95
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1 60
LM320T-8	1 60
LM320T-12	1 60
LM320T-15	1 60
LM324N	1.10
LM339N	1 55
LM340K-5	1 60
LM340T-5	1.50
LM340T-8	1 70
LM340T-12	1.70
LM340T-15	1 70
LM358N	2.40
LM377	4 50
LM379	5 00
LM380N	1.00
LM703H	.40
LM709H	.28
LM723N	44
LM733N	.89
LM741CH	35
LM741N	25
LM1303N	82
LM2902	1 50
LM3900N	55
LM3909N	69
MC1458V	59
NE540L	3 90
NE550N	65
NE555V	43
NE556A	1.00
NE565A	1 00
NE566V	1 85
NE567V	1 25
SN75451CN	39
SN75452CN	.39
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8700CN	16 00
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CD4002	25
CD4006	1.35
CD4007	25
CD4008	1 50
CD4010	53
CD4011	25
CD4012	25
CD4013	40
CD4014	1 25
CD4015	1 25
CD4016	50
CD4017	1 00
CD4020	1 35
CD4021	1 20
CD4023	25
CD4024	85
CD4025	.25
CD4026	3 85
CD4027	.55
CD4029	1 70
CD4030	.42
CD4040	1 35
CD4042	1.50
CD4043	2 00
CD4044	2 00
CD4049	62
CD4050	55
CD4066	85
CD4068	.25
CD4069	40
CD4071	40
CD4072	.40
CD4073	.40
CD4075	.40
CD4076	1.75
CD4078	.40
CD4081	40
CD4082	.45
CD4508	4 25
CD4510	2 00
CD4511	2 20
CD4515	4.00
CD4520	2.90
CD4527	4 75
CD4528	1.50
CD4583	4 50
CD4585	2 10
CD40192	3 00
74C00	28
74C04	33
74C10	28
74C14	2.10
74C20	28
74C30	.28
74C48	2 95
74C74	.75
74C106	2.10
74C160	2 00
74C192	2.40
74C221	2 75
74C905	3 00
74C906	1 50
74C925	10 50
74C926	10 50
74C927	12 00
INTERFACE	
8095	75
8096	75
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8098	75
8T09	1 25
8T10	4 50
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8T24	3 50
8T25	3 20
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2513B	10 00
21L02-1	2 50
MM5058	2 20
MM5060	3 20
MM5262	.90
MM5330	9 75
CLOCKS	
MM5309	3 90
MM5311	3 60
MM5312	4 80
MM5313	3.60
MM5314	3 90
MM5315	4 00
MM5316	5 00
MM5318	8.95
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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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8080 with data	19 00
8080A with data	23 50
8212	4 50
8224	8 50
8228	8 50

SPECIAL PRODUCTS

LM1812N Ultrasonic Transceiver	7 50
LM3909N LED Flasher/Oscillator	69
LM379S Dual 6W Audio Amplifier	5 00
Data Access Arrangement Kit Instr Incl	10 00

DS0026CN 5 MHz Dual MOS Clock Driver 3.75
Calculator Module 2 95
Encoder HD0165-5 7 50

UART/FIFO

AY5-1013	6 20
3341	8 50
PROM	
1702A	11 50
N82S23	3.25
N82S123	4 00
N82S126	4 85

RESISTORS
¼ watt 5%

10 per type	.05
25 per type	03
100 per type	025
1000 per type	02

MISCELLANEOUS
12 Volt 300 ma transformer 1 25
Keyer 8043 14 50

LEDS

Red TO18	15
Green TO18	20
Orange TO18	20
Yellow TO18	20
Jumbo Red	20
Jumbo Green	25
Jumbo Yellow	25
Jumbo Orange	25

DISPLAY LEDS

MAN1	CA	.270	2 90
MAN3	CC	125	39
MAN6640 Dual	CC	500	3 50
MAN72	CA	300	1 50
MAN74	CC	300	1 50
DL704	CC	300	1 25
DL707	CA	300	1 50
DL727	CA	500	2 55
DL747	CA	600	2 25
FND359	CC	357	95
FND503	CC	500	1 20
FND510	CA	500	1 20
FND800	CC	800	2 75
FND807	CA	800	2 75
5 digit 14 pin display			2 50
NSN33M 3 digit 8 pin			39
7520 Clairex photocells			25
5082-7340 Hex			6.75

CRYSTALS

1 MHz	4 50	6 5536	4 50
2 MHz	4 50	1 8432	4 50
4 MHz	4 25	2 097152	7.75
5 MHz	4 25	2 4576	7 50
10 MHz	4 25	3 2768	7 50
18 MHz	3 90	5 0688	4 50
20 MHz	3 90	5 185	4 50
32 MHz	3 90	5 7143	4 50
32768 Hz	4 00	18 432	4 50
3.5795 MHz	1.50	22 1184	4 50

TV GAME CHIPS
MM57100 6 Games Chip
MM53104 Clock Driver } $29 50
LM1889 Modulator

3 Digit Universal Counter Board Kit Operates 5–18 Volt DC to 5 MHz typ .125" LED display 10 50

VOLUME SPECIALS

		1	100
MM5262	2K RAM	90	50
MM5369	Divider	2 10	1 40
2102-1	500 NS 1K RAM	1 80	1 30
MM5375AA	Alarm Clock	3 75	2 20
FND503	.50" Display	1 20	85
18MHz	Crystal	3 90	2 50
PO411-4	150 NS 4K RAM	8 00	5 75
MA1002E	.5" Alarm Clock Mod	9 95	7 80
MA1013E	.7" Alarm Clock Mod	11 50	8 95
MM5309	Clock	3 90	2 70
MM5314	Clock	3 90	2 70

Other parts also avail

8K Ram Board Kit
- Plug compatible with Altair 8800 and Imsai 8080
- 91L02APC Low power 500 NS RAMS. All parts included with full instructions. $250.00

2K EPROM Board Kit $145.00
I/O Board Kit $47.50

60 Hz Crystal Time Base Kit $4.75
Converts digital clocks from AC line frequency to crystal time base. Outstanding accuracy. Kit includes: PC board, MM5369, crystal, resistors, capacitors and trimmer.

Digital Temperature Meter Kit
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Not a Cheap Clock $17.45
Includes everything except case.
2-PC boards. 6-.50 LED Displays. 5314 clock chip transformer, all components and full instructions.

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Covers audio, ultrasonic and low amateur band to 5 MHz typical Dual channel high sensitivity ±25 millivolts. Crystal controlled clock. Can be prescaled for higher frequency. 6-.50" digits. Full Instructions. Less power supply $40.00

COSMAC 'ELF'
RCA CMOS Microcomputer

CDP1802	$29 50	2101	4 50
CDP1824	9 00	5082-7340	5 50
CDP1852	10 25	Users Manual	7 50

Complete kit of additional parts minus power supply and board $28.00

TERMS: $5.00 min. order U.S. funds Calif. residents add 6% tax.

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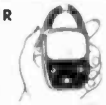
• (ITEM #11-018) - - Charges 12-volt batteries at 2-ampere rate. Turns off when battery reaches full charge, turns on when battery is low, automatically. Can be mounted permanently in engine compartment. 5½" x 3¾" x 2¼".

$12.95 (3½ lbs.)

SNAP-AROUND VOLT-AMMETER



• (ITEM #21-1028) - - "MINIPROBE" clamp type AC ammeter-voltmeter. Small enough to carry in shirt pocket. Will measure 0 to 50-amperes, 0 to 250-volts. Furnished with test leads. Overall size 4-1/2" x 2-3/4" x 1". (1 lb.) List $33.00

$22.95

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$8.79

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• (ITEM #2188) - - Record number of operating hours of electric lights, electrical devices such as refrigerators, furnaces, etc. Records total hours, tenths and hundredths to 9,999.99 hours. For 115-volts, 60-cycles. 4¼" x 3" x 2½". (2 lbs.)

Cost $29.00
$4.39

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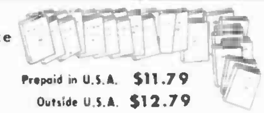

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Outside U.S.A. $12.79

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MM5203 UV PROM	$10.50
1702A UV PROM	$10.75
5204 4K PROM	$18.95

MINIATURE MULTI-TURN TRIM POTS 100, 500, 2K, 10K, 100K, 200K
$.75 each ....3/$2.00

MULTI-TURN TRIM POTS Similar to Bourns 3010 style 3/16"x5/8"x1-1/4"; 50, 100, 1K, 10K, 50K ohms
$1.50 ea. ....3/$4.00

LIGHT ACTIVATED SCR's
TO-18, 200V 1A ....$ 1.75

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2N3585 NPN Si TO-66	$ .95
2N3772 NPN Si TO-3	$ 1.60
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
2N3767 NPN Si TO-66	$ .70
2N2222 NPN Si TO-18	5/$ 1.00
2N3055 NPN Si TO-3	$ .80
2N3904 NPN Si TO-92	5/$ 1.00
2N3906 PNP Si TO-92	5/$ 1.00
2N5296 NPN Si TO-220	$ .50
2N6109 PNP Si TO-220	$ .55
2N3638 PNP Si TO-5	5/$ 1.00
2N6517 NPN TO-92 Si	3/$ 1.00

C/MOS (DIODE CLAMPED)

74C02	.22	4015	.95	4035	1.10
74C10	.22	4016	.40	4042	.78
4001	.22	4017	1.05	4047	2.00
4002	.22	4018	1.00	4049	.40
4006	1.20	4019	.22	4050	.40
4007	.22	4022	.95	4066	.80
4009	.42	4027	.40	4071	.22
4010	.42	4028	.88	4076	.70
4011	.22	4029	1.10	4081	.22
4012	.22	4030	.22	4520	1.15
4013	.40				

LED READOUTS

FND 500-.5" C.C.	$1.75
HP 7740 .3" C.C.	$1.40
MAN-7 .3" C.A.	$1.25
NS 33-3 dig. array	$1.35
DL 747	$2.50

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4-1/2"x6-1/2" SINGLE SIDED EPOXY BOARD 1/16" thick, unetched
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4.5" x 6" SHEET $1.25

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2N 3820 P FET	$ .45
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TIS 43 UJT	$ .35
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2N 6028 PROG. UJT	$ .65

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This board is a 1/16" single sided paper epoxy board, 4½"x6½" 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

MV 5691 YELLOW-GREEN BIPOLAR LED	$1.25
FP 100 PHOTO TRANS	$ .50
RED, YELLOW, GREEN OR AMBER LARGE LED's	ea. $ .20
14 PIN DIP SOCKETS	$ .25
16 PIN DIP SOCKETS	$ .28
MOLEX PINS	100/$1.00
	1000/$7.50
8 PIN MINI DIP SOCKETS	$ .25
10 WATT ZENERS 3.9, 4.7, 5.6, 8.2, 12, 15, 18, 22, 100, 150 or 200V	ea. $ .60
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Silicon Power Rectifiers

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

SILICON SOLAR CELLS
2¼" diameter
.4V at 500 ma. . . . $5.00 ea., 6/$27.50

REGULATED MODULAR POWER SUPPLIES

+- 15 VDC AT 100ma 115VAC INPUT	$27.95
5VDC AT 1A, 115VAC INPUT	$24.95
12 VDC AT .5 AMP	$24.95
IN 4148 (IN914)	15/$1.00

TANTULUM CAPACITORS

.22UF 35V	5/$1.00	4.7UF 35V	4/$1.00
.47UF 35V	5/$1.00	6.8UF 35V	3/$1.00
.68UF 35V	5/$1.00	22UF 35V	$ .40
1UF 35V	5/$1.00	33UF 35V	$ .40
2.2UF 20V	5/$1.00	30UF 6V	5/$1.00
3.3UF 35V	4/$1.00	100UF 35V	$ .50
		150UF 15V	$ .50

M7001 ALARM CLOCK CHIP $6.00

NATIONAL MOS DEVICES

MM1402	1.75	MM5057	2.25
MM1403	1.75	MM5058	2.75
MM1404	1.75	MM5060	2.75
MM5013	2.50	MM5061	2.50
MM5016	2.50	MM5555	4.75
MM5017	2.70	MM5556	4.75
MM5055	2.25	MM5210	1.95
MM5056	2.25	MM5260	1.75

 # 30 WIRE WRAP WIRE SINGLE STRAND 100 FT. $1.40

TTL IC SERIES

7400	.15	7442	.52	74125	.40
7401	.15	7445	.70	74126	.40
7402	.15	7446	.70	74151	.70
7403	.15	7447	.70	74153	.65
7404	.20	7448	.70	74154	1.10
7405	.20	7450	.20	74155	.70
7406	.25	7472	.33	74157	.70
7407	.25	7473	.35	74161	.85
7408	.25	7474	.35	74164	.95
7409	.21	7475	.49	74165	1.05
7410	.15	7476	.35	74173	1.40
7411	.20	7480	.35	74174	.95
7412	.20	7483	.70	74175	.92
7413	.45	7485	.88	74177	.79
7414	.70	7486	.30	74180	.70
7416	.25	7489	1.85	74181	2.10
7417	.25	7490	.45	74190	1.20
7420	.20	7491	.70	74191	1.20
7425	.28	7492	.50	74192	.85
7426	.25	7493	.45	74193	.85
7427	.30	7494	.70	74194	.85
7430	.20	7495	.70	74195	.75
7432	.25	7496	.70	74196	.88
7437	.25	74107	.32	75324	1.75
7438	.25	74121	.38	75491	.65
7440	.16	74123	.65	75492	.65
7441	.85				

MINIATURE DIP SWITCHES
CTS-206-4 Four SPST switches in one minidip package. $1.75
CTS-206-8 Eight SPST switches in a 16 pin DIP package. $2.85

AY 5-1013-A30K ser./par., par./ser., universal UART. $6.95

ALCO MINIATURE TOGGLE SWITCHES
MTA 106 SPDT $1.20
MTA 206 DPDT $1.70

Full Wave Bridges

PRV	2A	6A	25A
200	.95	1.25	2.00
400	1.15	1.50	3.00
600	1.35	1.75	4.00

SANKEN AUDIO POWER AMPS

Si 1010 G 10 WATTS	$ 7.50
Si 1020 G 20 WATTS	$15.95
Si 1050 G 50 WATTS	$27.95

CCD 110 LINEAR 256 X1 BIT SELF SCANNING CHARGED COUPLED DEVICE $99.00
CCD 201 100 x 100 CHARGE COUPLED DEVICE $135.00

LINEAR CIRCUITS

LM307 Op. Amp	$ .30
LM 309K 5V 1A REGULATOR	$ .95
723 — 40 + 40VV REGULATOR	$ .50
301/748-Hi Per. Op. Amp.	$ .31
320T 5,12,15, or 24V NEG REG	$1.25
709C Op. Amp.	$ .31
741A or 741C OP. AMP.	$ .31
710 COMPARATOR	$ .35
CA 3047 Hi Pef. Op. Amp.	$ .95
340T 5, 6, 8, 12, 15, 18, 24V POS REG. TO-220	$1.10
101 OPER. AMP. HI PERFORM.	$ .75
LM 308 Oper. Amp., Low Power	$ .95
747 — DUAL 741	$ .65
556 — DUAL TIMER	$1.00
537 — PRECISION OP. AMP.	$1.70
LM 3900 — QUAD OP. AMP	$ .49
LM 324 — QUAD 741	$1.50
560 — PHASE LOCK LOOP	$2.00
561 — PHASE LOCK LOOP	$2.00
565 — PHASE LOCK LOOP	$1.25
566 FUNCTION GEN.	$1.65
567 — TONE DECODER	$1.50
LM 1310N FM STEREO DEMOD.	$2.75
8038 IC VOLTAGE CONT. OSC.	$3.90
LM 370 — AGC SQUELCH AMP.	$1.15
555 — 2µs — 2 HR. TIMER	$ .45
553 QUAD TIMER	$2.50
FCD 810 OPTO-ISOLATOR	$ .80
1458 DUAL OP AMP	$ .60
LM 380 — 2W AUDIO AMP.	$ .95
LM 377 — 2W Stereo Audio Amp.	$2.50
LM 381 — STEREO PREAMP.	$1.50
LM 382 — DUAL AUDIO PREAMP	$1.50
LM 311 — HI PER. COMPARATOR	$ .90
LM 319 — Dual Hi Speed Comp.	$1.25
LM 339 — QUAD COMPARATOR	$1.50

TRIACS / SCR'S

PRV	1A	10A	25A	1.5A	6A	35A
100	.40	.70	1.30	.40	.50	1.20
200	.70	1.10	1.75	.60	.70	1.60
400	1.10	1.60	2.60	1.00	1.20	2.20
600	1.70	2.30	3.60		1.50	3.00

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TTL

7400	.13	7451	.17	74153	.89
7401	.16	7453	.17	74154	1.20
7402	.15	7454	.17	74155	.97
7403	.15	7460		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	1.40	74LS164	2.20
74LS08	.38	74LS74	.59	74LS193	2.20
74LS10	.36	74LS90	1.30	74LS197	2.20
74LS20	.36	74LS93	1.30		

HIGH SPEED

74H00	.25	74H22	.25	74H61	.25
74H01	.25	74H30	.25	74H62	.25
74H04	.25	74H40	.25	74H74	.39
74H08	.25	74H50	.25	74H101	.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

SCHOTTKY

74S00	.38	74S08	.52	74S22	.38
74S02	.45	74S10	.38	74S32	.52
74S03	.38	74S20	.38	74S74	.38
74S04	.45				

8000 (NATIONAL)

8091	.61	8220	1.49	8811	.65
8092	.61	8230	2.19	8812	1.02
8095	1.25	8288	1.49	8822	2.19
8121	.80	8520	1.16	8830	2.19
8123	1.43	8552	2.19	8831	2.19
8200	2.33	8563	.62	8836	.29
8214	1.49	8810	.70	8880	1.19

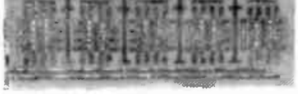
8000 (SIGNETICS)

8263	5.79	8267	2.59

9000

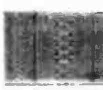
9002	.40	9309	.79	9601	.61
9301	1.03	9312	.79	9602	.79

DVM CHIP 4½ DIGIT
MM5330 — P channel device provides all logic for 4½ digit volt meter. 16 pin DIP with data **$9.95**



IC BREADBOARD
Accommodates 5 16 pin IC's with additional interconnection holes. 1/16" phenolic with silver plated copper circuits. 2 5/16" x 6 9/16" **$1.50 ea.**

UNIVERSAL BREADBOARD
Silver plated copper circuit board 1 1/16" x 5 1/16" 2 rows of 27 holes for DIP IC's — space for transistors, resistors & capacitors. Versatile and simple for breadboarding IC circuits **$1.50 ea.**



SHIFT REGISTERS

MM5013	1024 bit accum. dyn.	1.75
MM5016	500/512 bit dyn.	1.59
SL5-4025	Quad 25 bit	.99
2504	1024 bit multiplexed dyn	3.95

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		

WIRE WRAP - gold plate
14 pin .49

CMOS

4000A	.26	4018A	1.39	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	1.39	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		

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2.2 mfd	35V	.30	22 mfd	16V	.45
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6.8 mfd	50V	.40	150 mfd	15V	.50

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555	Timer	mDIP	.39
565	Phase Locked Loop	DIP	.98
723	V Reg	DIP	.56
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741	Comp Op Amp	mDIP	.26
1458	Dual Comp Op Amp	mDIP	.54
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75491	Quad Seq Driver for LED	DIP	.62

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3046	Transistor Array DIP-14	.73

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**

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**

Mark I
A six digit clock kit with one double sided P.C. board accommodates MM5314 clock chip and 6 FND359 .375" displays. 12-24 hour, 50-60 Hz. Contains all necessary components, 3 switches and complete assembly instructions with schematics. Connections for remote displays.

Mark I **$13.95**

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NSL100	.12
NSL101	.12
NSL102	.15
MV5020	
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AMBER	.15
CLEAR	.15

MULTIPLE DISPLAYS

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HP5082-7405	5 digit .11 red LED	3.49
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MCD2	Opto isolator diode	1.09
MCT2	Opto isolator transistor	.70

LINEAR CIRCUITS

300	Pos V Reg (super 723) TO-5	$ .71
301	Hi Perf Op Amp mDIP TO-5	.29
302	Volt follower TO-5	.53
304	Neg V Reg TO-5	.80
305	Pos V Reg TO-5	.71
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308	Mciro Pwr Op Amp mDIP TO-5	.89
309K	5V 1A regulator TO-3	1.35
310	V Follower Op Amp mDIP	1.07
311	Hi perf V Comp mDIP TO-5	.95
319	Hi Speed Dual Comp DIP	1.13
320T	Neg Reg 5, 12, TO-220	1.39
320K	Neg Reg 5.2, 12 TO-3	1.39
322	Precision Timer DIP	1.70
324	Quad Op Amp DIP	1.52
339	Quad Comparator DIP	1.58
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373	AM/FM/SSB Strip DIP	2.42
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SN74LS47N	1.10	SN74LS221N	1.35
SN74LS48N	1.10	SN74LS240N	2.50
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SN74LS51N	.25	SN74LS242N	2.40
SN74LS54N	.25	SN74LS243N	2.40
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SN74LS73N	.49	SN74LS248N	1.30
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LM741CN		
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2SC495	1.10	2SC774	1.75	2SC1014	1.50	2SC1678	5.50	2SC608	4.85
2SC502	3.75	2SC775	2.75	2SC1017	1.50	2SC1679	4.75	SK3046	2.15
2SC517	4.75	2SC776	3.00	2SC1018	1.50	2SC1728	2.15	SK3047	3.75
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2SC617	4.25	2SC798	3.10	2SC1239	3.50	2SC1957	1.50		
2SC699	4.75	2SC781	3.00	2SC1243	1.50	2SF8	3.00	2SK19	1.75
2SC710	.70	2SC789	1.00	2SC1306	4.75	HEP-S 3001	3.25	2SK30	1.00
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2SC735	.70	2SC799	4.25	2SC1307	5.75	MRF8004	3.00		
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2SA483	1.95	2SB324	1.00	2SC491	2.50	2SC830	1.60	2SD30	.95
2SA489	.80	2SB337	2.10	2SC497	1.60	2SC839	.85	2SD45	2.00
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2SA505	.70	2SB370	.65	2SC535	.75	2SC1010	.80	2SD68	.90
2SA564	.50	2SB405	.85	2SC536	.65	2SC1012	.80	2SD72	1.00
2SA628	.65	2SB407	1.65	2SC537	.70	2SC1051	2.50	2SD88	1.50
2SA643	.85	2SB415	.85	2SC563	2.50	2SC1061	1.65	2SD151	2.25
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2SA705	.55	2SB492	1.25	2SC681	2.50	2SC1172B	4.25	2SD315	.75
2SA815	.85	2SB495	.95	2SC684	2.10	2SC1209	.55	2SD318	.95
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		2N967	.50	2N2221A	.30	2N2916A	3.65	2N3772	1.90	2N4403	.20
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2N334	1.20	2N1305	.30	2N2322	1.00	2N3055	.75	2N3856	.20	2N4441	.85
2N336	.90	2N1377	.75	2N2323	1.00	2N3227	1.00	2N3866	.85	2N4442	.90
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2N443	1.75	2N1543	2.70	2N2327	3.80	2N3393	.20	2N3906	.25	2N5064	.50
2N456	1.10	2N1544	.80	2N2328	4.20	2N3394	.17	2N3925	3.75	2N5130	.20
2N501A	3.00	2N1549	1.25	2N2329	4.75	2N3414	.17	2N3954	3.50	2N5133	.15
2N508A	.45	2N1551	2.50	2N2368	.25	2N3415	.18	2N3954A	3.75	2N5138	.15
2N555	.45	2N1552	3.25	2N2369	.25	2N3416	.19	2N3955	2.45	2N5198	3.75
2N652A	.85	2N1554	1.25	2N2484	.32	2N3417	.20	2N3957	1.25	2N5294	.50
2N677C	6.00	2N1557	1.15	2N2712	.18	2N3442	1.85	2N3958	1.20	2N5296	.50
2N706	.25	2N1560	2.80	2N2894	.40	2N3553	1.50	2N4037	.60	2N5306	.20
2N706B	.40	2N1605	.35	2N2903	3.30	2N3563	.20	2N4093	.85	2N5354	.20
2N711	.50	2N1613	.30	2N2904	.25	2N3565	.20	2N4124	.20	2N5369	.20
2N711B	.60	2N1711	.30	2N2904A	.30	2N3638	.20	2N4126	.20	2N5400	.40
2N718	.25	2N1907	4.10	2N2905	.25	2N3642	.20	2N4141	.20	2N5401	.50
2N718A	.30	2N2060	1.85	2N2905A	.30	2N3643	.15	2N4142	.20	2N5457	.35
2N720A	.50	2N2102	.40	2N2906	.25	2N3645	.15	2N4143	.20	2N5458	.30
2N918	.35	2N2218	.25	2N2906A	.30	2N3646	.14	2N4220A	.45	C103y	.25
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