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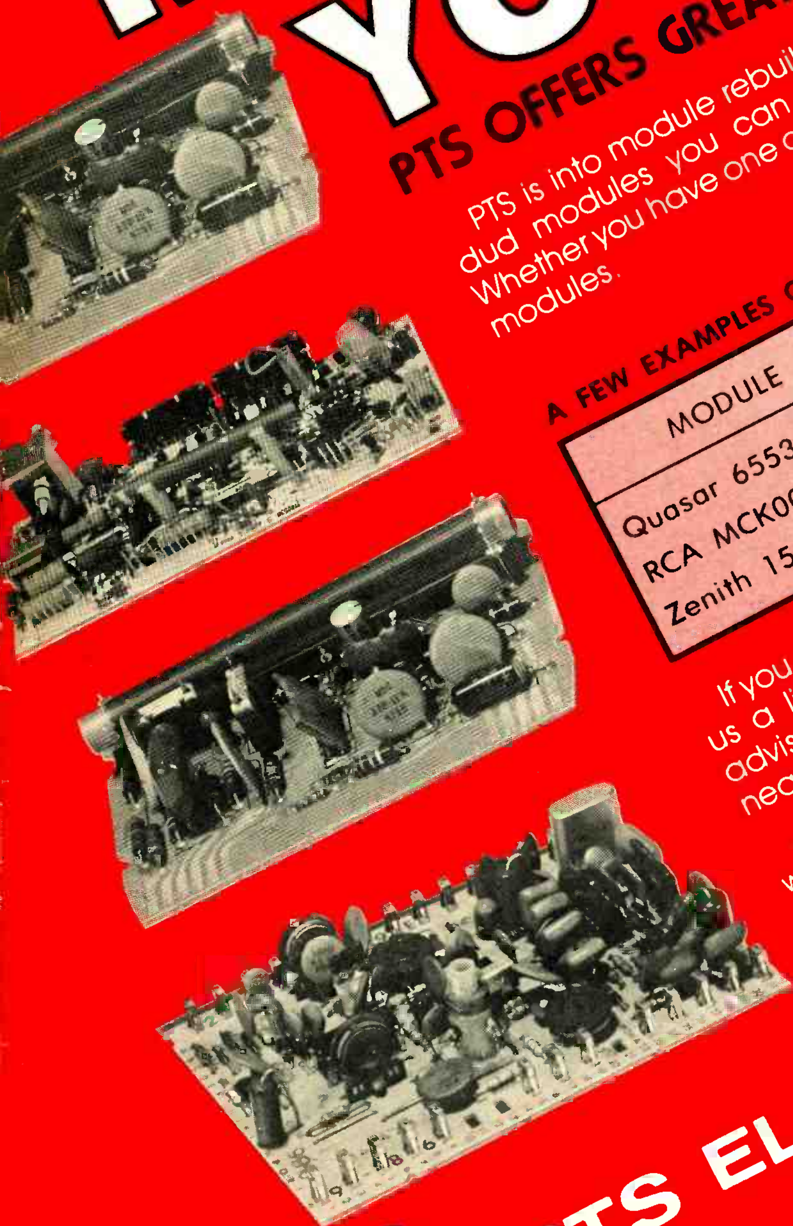

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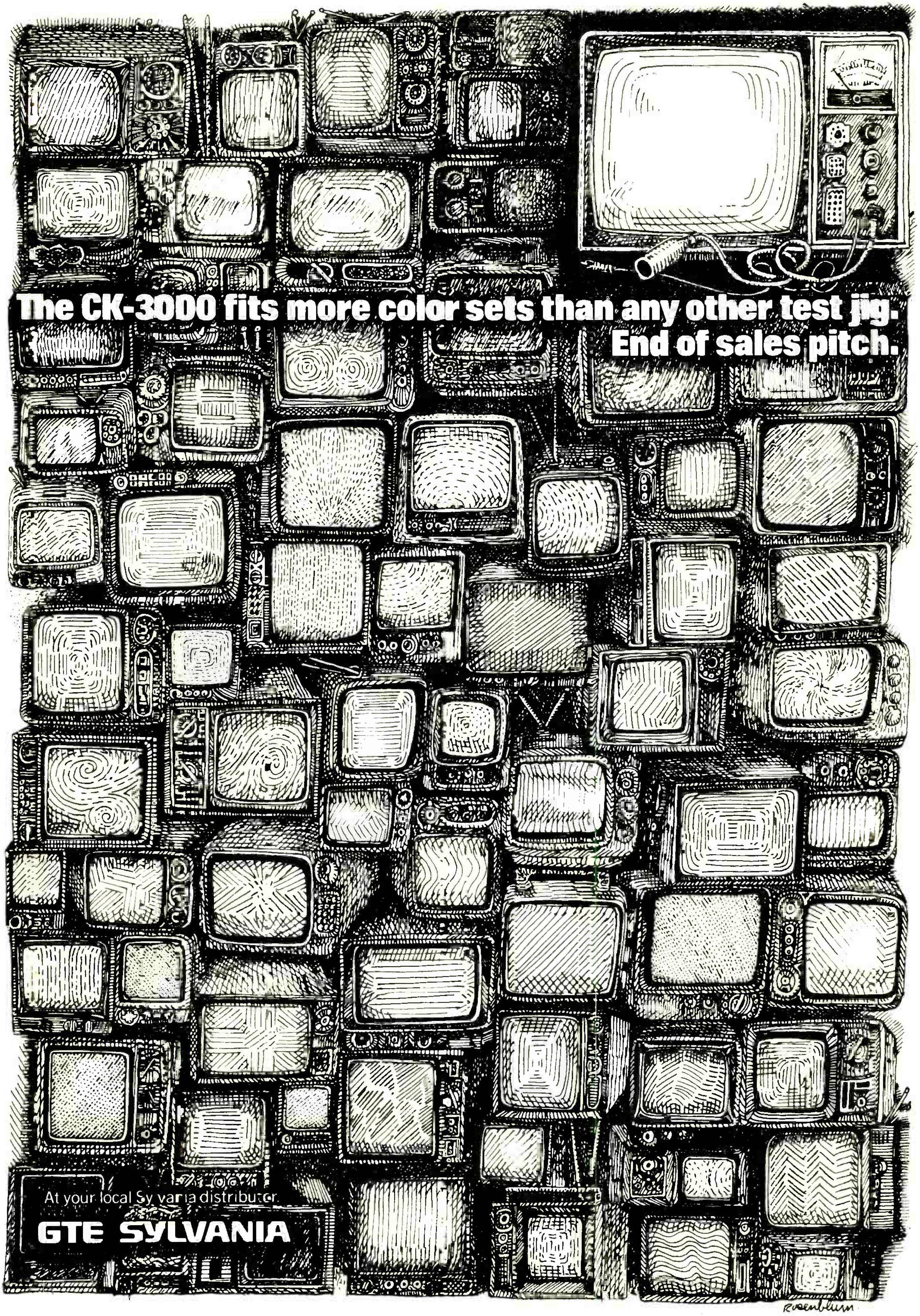
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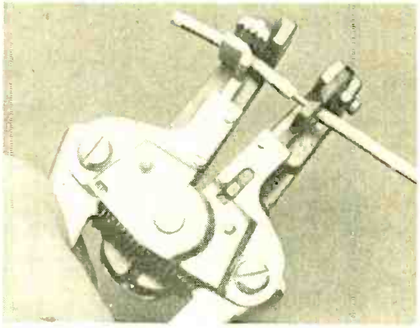
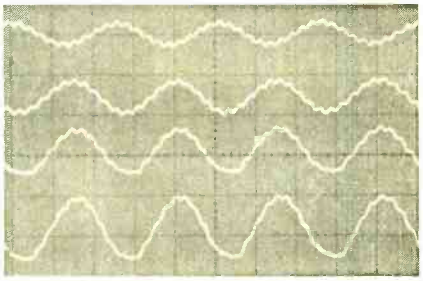
JANUARY 1978 Vol. 49 No. 1

ON THE COVER

Sitting atop the stereo receiver is this month's featured construction project. It provides a digital readout of the frequency that the receiver is tuned to. Works with AM/FM receivers; and, when not displaying frequency, it's a digital clock. For complete details on how to build your own, turn to page 21.



HANDY TOOLS AND GADGETS for the hobbyist, experimenter and service technician that will make life a little easier and will give your work that professional look. Story starts on page 33.



HOW TO TEST PHONO CARTRIDGES yourself by using readily available test records. The waveforms shown are recorded on a test record to test for IM distortion. For the whole story, turn to page 51.

Radio-Electronics, Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Phone: 212-777-6400. Second-class postage paid at New York, NY and additional mailing offices. One-year subscription rate: U.S.A., U.S. possessions and Canada, $8.75. Pan-American countries, $10.25. Other countries, $10.75. Single copies $1.00.

Subscription Service: Mail all subscription orders, changes, correspondence and Postmaster Notices of undelivered copies (Form 3579) to Radio-Electronics Subscription Service, Box 2520, Boulder, CO 80322.

looking ahead

FCC 4-channel tests: In connection with its current investigation of the need for discrete quadriphonic FM broadcasting standards (see **Radio-Electronics,** November, 1977), the FCC recently ran some rather elaborate subjective listening tests with fairly surprising results.

The Commission's laboratories compared the discrete quadriphonic (4-4-4) system using a 4-channel tape deck, RCA's discrete broadcasting system (4-3-4) and three matrix systems (4-2-4) using encoders and decoders. The 4-2-4 systems were CBS's SQ, Sansui's QS and BBC's "H" system.

As might be expected, the 4-4-4 discrete system came out on top—but not by nearly so large a margin as might be expected. In music-listening, 52% preferred discrete and the remaining 48% thought SQ was better. And 58% of the listeners preferred SQ over the H system; 61% thought it was better than 4-3-4 discrete; and 77% liked it better than QS. When asked to pinpoint the direction from which sounds came, SQ and the other matrix systems didn't do nearly so well as 4-4-4 discrete. But the FCC researchers wonder in the report just how important this directionality is, since many of the test panel members preferred that the rear speakers carry "only ambient or reverberated material," presumably because they had been conditioned by concert-hall experiences.

Since matrix 4-channel broadcasting is permitted right now by the FCC and discrete quadriphonics will require elaborate rule-making, the Commission's lab tests appear at first to favor matrix over discrete and to imply that complex legal proceedings on discrete may be a waste of time. But the report on the tests specifically notes that "extreme care must be exercised in choosing the system so that future developments in multi-channel sound will not be stifled."

Zenith's problems: Zenith, America's largest manufacturer of color and monochrome television, also has been the most outspoken in crusading against what it considers to be unfair competition by the Japanese TV makers on the American market. It has emphasized that most of its products are American-made, even though it owns feeder plants in Mexico and Taiwan. It has been called, in fact, the last "American" manufacturer of TV and stereo. While its competitors gradually shifted subassembly and some final-assembly plants to overseas locations, Zenith has resisted the trend.

When the company found it was faced with the possibility of a loss for the third quarter in spite of near-record color TV and stereo sales, it bit the bullet and decided it could hold out no longer. First, it eliminated all basic research projects, continuing only developments which lead directly to products. Then the ax really fell. Zenith announced it would cut its U.S. payroll by about 25%, eliminating 5,000 production jobs and 600 salaried workers, enlarging its Mexico and Taiwan TV operations and moving all stereo out of the U.S.

Slipped disc: Sorry to use the headline so many times, but it continues to be apropos of the videodisc situation. If you recall our exciting episode of last November, you'll remember that RCA decided it was worth postponing the introduction date of its videodisc system in order to extend the playing time to one hour per side, or two hours per disc (**Radio-Electronics,** November, 1977). So RCA has an indefinite introduction date for its system.

Now, along come Philips and MCA, which had been saying for the past year that their optical videodisc system would get its test-market premiere at the end of 1977 or the start of 1978. Suddenly they have decided it's time for a change. They originally had planned to introduce a one-sided disc which played for 30 minutes. Now, like RCA, they have been bitten by the long-play bug and have developed a two-sided disc which will play for at least one hour. Now this will require changes in the new player, and that will take some time. So the first small-scale market introduction of the MCA-Philips optical videodisc system (by Philips' subsidiary Magnavox) is now tentatively scheduled for late '78.

Projection TV: More than 50 manufacturers are currently assembling small-screen TV sets, lenses and screens into simple projection TV systems. You see these most often in bars and taverns, but a good number are finding their way into homes. You can build your own by buying the components from several vendors. If the room is fairly dark, most of these systems work quite well.

These systems came along after Advent set the pace with its three-tube system. The single-tube projector became a relatively low-priced alternative to Advent. Now we're going to start to see a large number of three-tube Advent competitors. First, there is the unit by Projection Systems Inc. (PSI), selling for a little more than some of the Advents ($5,000 and up), but providing an excellent picture. Unique systems using various new ideas, but basically representing three-tube projectors, will be offered soon by Electronic Systems Products and Marv Hodges Instruments. These are not very well-known firms. So who else is in the race? Well, the Japanese are. Mitsubishi very soon will offer a system called "VSS" (for Video Scan System) here in the U.S. at somewhat less than $3,000. Panasonic will have its own three-tube system in a one-piece furniture unit, for sale here probably some time in 1978. Sharp has shown a three-tube projector in Japan and presumably will offer it in the U.S. Sony, which has long had a one-tube projector, is expected to add a multitube unit with higher brightness.

How about major American TV makers? Well, at one time or another, Zenith, Magnavox and Admiral have worked on three-tube systems, but only Admiral seems to be continuing its efforts and nothing is expected to come of them until 1979 at the earliest.

Who else? GE for one. The company has long been a leader in high-priced professional projection TV equipment, and is expected to come into the consumer market with a unique system priced under $2,000, probably in 1978. And at the same time, Henry Kloss, who founded and formerly headed Advent, plans to introduce his own unique home projection design and offer it to other manufacturers to build, rather than make and market it himself.

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

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new & timely

Microprocessor controls tuner-amplifier

Microprocessor technology has now been incorporated in the latest entry in the hi-fi/stereo field—the C3000, a tuner-amplifier produced by Barco Electronic of Belgium.

Pushbuttons operate a scanner system that pinpoints and locks onto desired frequencies with a high degree of accuracy. The tuner uses a crystal oscillator to prevent drift. It scans and locks into the correct radio-channel frequency. There is an up-down mode that is used to automatically scan for optimum signal strength.

The microprocessor also allows up to 16 frequencies to be stored in memory, with instant recall at the touch of a button. The wavelength or frequency of the tuned channel is also shown digitally on the display panel.

Other features of the C3000 include the ability to zero in on stereo transmissions only, a calculator-sized remote control unit that controls 32 of the tuner's 48 functions, pushbutton stereo balance control and a convenient loudspeaker cutout.

General Electric receives Emmy for VIR system

The television industry's highest honor, the Emmy award, was recently awarded to General Electric for its development of the VIR (Vertical Internal Reference) system.

EMMY AWARD for VIR system being presented by TV industry's John Cannon (left) to Fred W. Wellner (right), general manager of GE's Television Department.

John Cannon, president of the National Academy of Television Arts and Sciences, presented the award to Fred Wellner, general manager of GE's Television Department, who noted that VIR was a two-time Emmy winner—the Electronic Industries Association's Broadcast Television Systems Committee, which developed the VIR signal, will also receive the only other engineering award this year.

The system, in essence, is a color-coded reference that allows technicians at each end of the broadcast spectrum—from studio to local station—to determine whether the color being received and rebroadcast is the same as that certified at the broadcast source.

New FCC ruling eases private telephone restrictions

It is not generally known but it has always been possible to own your own phone and not lease it from the telephone company. However, very few individuals or small business concerns have been able to take advantage of this because the phone company has always charged a fee for special "protection devices" that made it uneconomical for widespread usage.

Now, however, as a result of an FCC order, everyone will be able to buy and install his own phone without having to pay a special fee. All that will be necessary is a telephone company-supplied jack to hook the equipment to the telephone network.

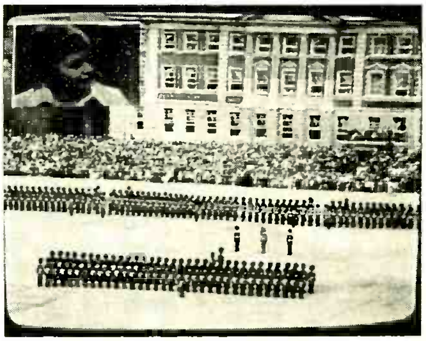
The telephone company is considering a move that will enable them to profit from this decision as well. They are contemplating selling telephones, which they formerly only rented. "We're going to be competitive," asserts Charles Brown, president of AT&T.

Additionally, it is expected that as more customers install their own phones they will find their monthly usage rates will rise. Up until now, the telephone company has been using equipment rental to subsidize basic phone service, which is itself unprofitable. However, in Rochester, NY, the independent Rochester Telephone Company has already been selling company phones to its customers, who then had their bills *reduced* somewhat in return. (So far, of the company's 1800 customers, at least 1200 have taken advantage of the offer.) Officials at the Rochester company feel that, even if customers' monthly bills do go up it won't be by much—they will only need to raise their rates by 1% to offset any loss of revenue from rental equipment.

Picture within a picture—a new look in TV-viewing

Barco Electronic of Belgium has developed a new look in TV viewing that includes three new viewing modes: a picture-within-a-picture mode that allows you to monitor another channel at the same time as your main program, a program timer mode in which you can program the TV to switch channels at programmed times and jump back and forth between channels. All three modes are microprocessor-controlled.

The picture-within-a-picture mode is based on a CCD (*C*harge-*C*oupled-*D*evice) system. The viewer presses the CCD mode pushbutton plus the pushbutton for the monitored channel. The monitored picture appears in miniature form in the upper left-hand corner of the screen, without disturbing the main program. Two parallel electronic circuits are tuned to the viewing channel and the monitored channel, the signals generated by these circuits are then synchronized and the smaller picture is superimposed on the main image.



BARCO TV-VIEWING SYSTEM allows superimposition of second miniaturized picture in upper left part of main picture for simultaneous viewing.

In the program timer system, upcoming program times and channels can be preset to appear in the upper right-hand corner of the screen. A pushbutton selects programs for any time interval up to 9 hours, 59 minutes in advance. The TV set will then switch to the selected channel after the programmed time interval. This technique can be applied to as many as four channels at once.

The program jump mode lets the viewer switch from the main program to another channel every minute or half-minute. Several transmissions can be monitored using this mode.

Direct-to-disc recording provides clear, realistic sound

A novel direct-to-disc recording technique has been introduced by Audio-Technica U.S., Inc., manufacturers of hi-fi components, who have produced two records under the Umbrella label.

The direct-to-disc process bypasses the tape recording stages and many other signal-processing devices that are common in most record-making. The end result is said to be greater clarity, a more realistic "live" sound and less surface noise.

The two Umbrella label recordings are a single, *Father & Son Sonatas*, violin works by Efrem Zimbalist, Sr., and Efrem Zimbalist, Jr.; the other is a two-record set entitled *Big Band Jazz*, performed by Rob McConnell and the Boss Band. The records sell for a suggested resale price of $14.95 and $21.95, respectively.

"10-4 day" is planned to honor CB's good Samaritans

A desperately ill child, a devastating forest fire, a paralyzing snowstorm, an auto-

continued on page 12

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

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 continued from page 6

mobile accident . . . these are just some of the emergency situations in which CB operators have helped when all other communications have failed.

To honor CB's good Samaritans, the Automotive Products Division of Motorola, Inc., has started a campaign to have all 50 states declare the fourth day of the 10th month (i.e., October 4) the official annual "10-4 day." (In CB lingo, 10-4 means "I understand.") 10-4 day is intended to focus the spotlight on the importance of CB radio operators in the nation's communication system.

Motorola plans to contact newspapers, magazines, and TV and radio stations and provide them with information and editorial recommendations to help these media plan their coverage.

U.S. Coast Guard to use CB radio equipment

In an attempt to provide a greater measure of safety to owners of small craft equipped with Citizens band radios, the U.S. Coast Guard will install CB equipment in all its Search and Rescue stations throughout the country.

John Sodolski, vice president of the Electronics Industries Association and head of EIA's communications division, hailed the move as a step in the right direction to provide better emergency communications for thousands of recreational boaters who have been using their CB's as a means of communication.

Although it has not decided yet which channel it will monitor, the Coast Guard plans to have CB service available in time for the 1978 boating season, adding, however, that "the current communication and distress system associated with VHF and 2182 kHz will continue to be the primary system."

Sound synthesizer shows unique talents

Hollywood movie executives were recently given a demonstration of Bell Laboratories' newest star—the telecommunication signal processor, or sound synthesizer. Dr. H.G. Alles, a Bell Labs scientist, put the machine through its paces.

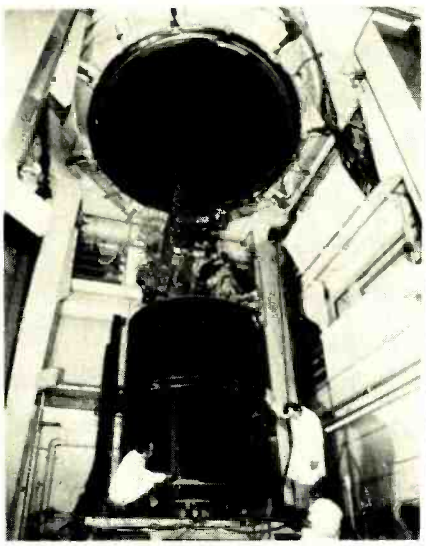
The many-talented synthesizer uses a computer-controlled digital process to compose, orchestrate and perform musical scores almost instantly in real time. It can duplicate the sounds of both familiar musical instruments and some not yet invented! A ordinary keyboard, similar to that of an organ, is pressure-sensitive—each key has 100 different positions that are computer-programmed to recognize all the musical elements and control timbre, vibrato, tempo, etc.

Dr. Alles explained that the device is used in the laboratory "to analyze sound and we will be using it to model transmission systems and to process human speech for the purpose of improving the quality of transmissions." The sound is analyzed by dividing it into frequency and amplitude as it is received—with as many as 200 million operations-per-second. Because in the future, sound transmission will be increasingly in digital form, Bell technicians envision the processor being used as a tone-signal detector. The computer hardware is already compatible with existing phone company switching offices.

New communications satellite handles over 6000 calls

A new Intelsat IV-A communications satellite, developed by Hughes Aircraft of California, was launched by NASA in September, 1977. This latest addition to the ever-growing system of communications satellites will orbit over the Indian Ocean and provide service to more than 40 countries.

It has been estimated that transoceanic phone traffic expands at an annual rate of about 15%; last year the three Intelsat IV-A satellites already operating in the Atlantic Ocean area handled over 50 million calls.



INTELSAT IV-A COMMUNICATIONS SATELLITE being tested prior to launch. Satellite can handle 6000 transoceanic phone calls and two TV programs.

To meet this expanding need, Intelsat IV-A uses beam diversity (essentially the ability to transmit the same frequency band twice) to relay more than 6000 simultaneous calls, in addition to two television transmissions. Beam diversity makes it possible to direct one communications beam to one part of the world and the other beam to another area. Because the two beams are widely separated, they never meet and cause interference, even when the same frequency is used.

After a testing period, the new satellite will take up its post off the east coast of Africa and southwest of India; it will provide service to more than 40 countries in the Far East, Near East and Europe.

National Electronic Service conference looks at the future

One of the highlights of the NESDA conference held August, 1977, in Orlando, Florida, was the Service Conference at which present and future trends were discussed. Here are some of the conclusions drawn from the five separate subject areas covered:

1. Service requirements. Technicians are better trained. With respect to TV, products will be more reliable and use *less* manpower. Other types of products may need *more* manpower in the future. More in-shop repairs, less field service. One crystal-ball prediction—a "throw-away" TV!

2. Types of test equipment needed. Test equipment will be basically the same but more sensitive. Good equipment is presently available but there's a lack of trained technicians. Average equipment investment for TV repair is projected at $1500; for specialized audio service, $5000. New IC's, etc., will make future equipment easier to use. Equipment will last for about five years before obsolescence.

3. Technical training. Industry loses technicians as they become self-employed, promoted or switch fields. Employers should provide better working conditions, fringe benefits, more factory training and other incentives to retain them.

4. Effect of CB on industry. No effect on wages. Not enough qualified or properly licensed businesses. About 50% to 75% of all CB repairs are owner-caused. There are too many brands and unique parts. Equipment investment should be kept low due to low cost of the instruments themselves.

5. Warranty legislation. The federal Magnuson-Moss Law has not improved conditions for servicer, dealer or manufacturer. State legislation lacks impact. Future legislation will probably concentrate on dealer business ethics, business practice and the clarification of warranty terms.

Power lines can cause "biological effects"

In the latest phase of the ongoing controversy surrounding the proposed installation of some upstate power lines by the New York State Power Authority, the state's Public Service Commission recently reported that the 765,000-volt lines may cause "biological effects in humans." Such lines, however, the commission states, could be operated safely if a wide protective zone were established under them.

The proposed protective zone will be 550 feet wide under the lines (more than twice the authorized right-of-way granted the Power Authority). **R-E**

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CIRCLE 100 ON FREE INFORMATION CARD

editorial

Ma Bell . . . fair game

According to the U.S. Supreme Court, you now have the right to buy and hook up your own telephone equipment. This does not give you carte blanche; you still do have a set of FCC rules to contend with: (They'll be out soon.)

The important point is that you will be able to hook up as many phones and accessories as you wish, and not have to pay Ma Bell anything for them. This opens the doors to **Radio-Electronics** readers and writers to come up with some great projects—computer controlled systems, telephone call diverters, automatic memory dialers, picturephones, and whatever else our inventive readers can devise.

We are extremely interested in all those ideas. We want to and will present them to our readers. If you've got a hot telephone add-on, let us know about it. It could end up in the pages of the next issue of **Radio-Electronics**.

A word of caution about the new rules. The phone company must install the jacks. (In certain areas they are already raising the price of installation; so if you want to get ahead, order those extra jacks right away.) In some states (California, for instance, seems to favor Pacific Bell) you may be required to get at least one of your phones from the local phone company. If you do add your own phones, they will have to be units that have been registered with the FCC. However, there are already many companies that have FCC approved phones.

I'd like your comments about this new ruling, suggestions for articles that we should publish and manuscripts for those articles.

Private telephone power. Long may it reign.

Larry Steckler

Larry Steckler
Editor

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Cover photo by Michael Wilson

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

Radio-Electronics magazine is published by Gernsback Publications, Inc.
200 Park Ave. S., New York, NY 10003
(212) 777-6400

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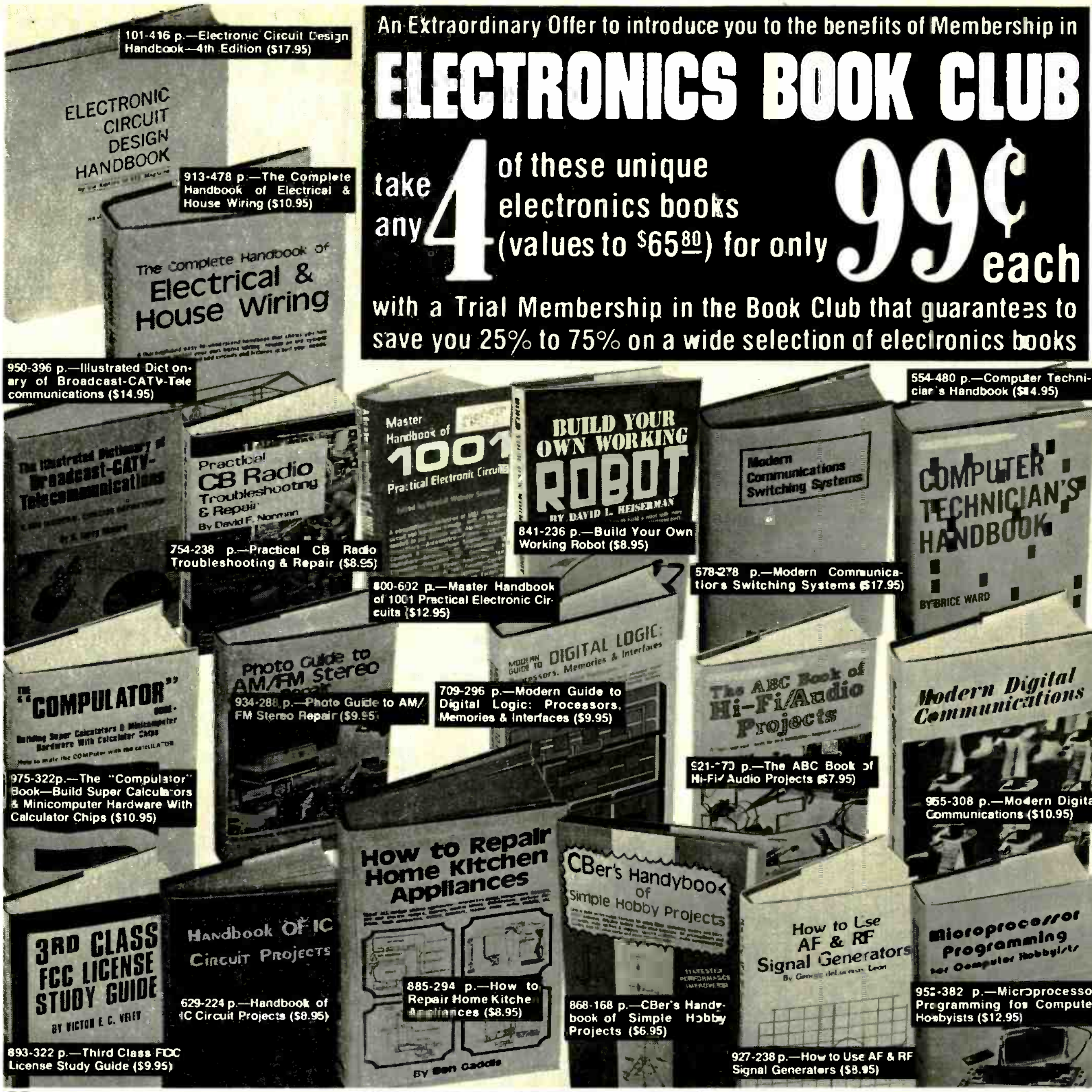

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CIRCLE 14 ON FREE INFORMATION CARD

letters

AMERICAN VS. EUROPEAN TV'S

I would like to have my faith renewed! I've always been told that America has the best equipment in the world. Well, I've been here in West Germany for 3½ years. As a hobby, I've taken up learning about and fixing radios and TV's, both American and European models. There are a few things I noticed that to me, as a novice, did not seem right. Maybe you can tell me why?

1. The entrance to European TV's is simpler—usually only two to four screws or slip catches. American TV's have anywhere from four to eight screws which are sometimes hard to get at, and the back piece itself in some models is difficult to remove.

2. There are no line interlocks on European models—all American models have them. Usually the owner has filed or bent the prong ends to fit the wall receptacle. The cord clips on the inside of the TV are missing because the owner or repairman bent it out of shape getting them off.

3. Just about every European TV has a schematic diagram with voltage checks, waveforms and parts list taped to the inside of the cabinet. I have yet to find one in an American TV. If you need one, you either send to the manufacturer, Howard Sams, or (if you're dumb and rich) to a dealer who will try to get anywhere from $5 to $25 for a schematic.

4. If the TV has been repaired before, there is usually a tag attached showing what was replaced.

5. Every European TV I worked on had a circuit board that was mounted on a fold-out, or fold-down, bracket that gave the service man a very easy access to both sides of the circuit board and all the test points. In an American TV, to get at the test points or to replace defective parts, you have to remove screws, disconnect or cut wires, and sometimes even make jumper cords to test the board out of the cabinet.

6. Both tuners in European models are easily accessible. Not so in American models. Why?

7. Standardization of repair parts: Many different models and makes had the same type tubes, transistors, etc. It seems that every American make and model has its own specific parts, and a repair man would need a large truck or a big store to have any reasonable amount of repair parts on hand.

EDWARD M. KUBILUS
APO, NY

Efforts are being made by National Service Associations here to solve this problem. Unfortunately the American consumer doesn't seem to care. He isn't worried about your problems in fixing his set and he doesn't seem to realize that it results in higher repair costs. We'd like to get some letters from other readers who would like to comment on this problem. Especially from servicers who are involved with organizations that are trying to solve the problem. Tell us what's happening.—Editor

CORE MEMORIES

The article, "Core Memories—How They Work," by Martin A. Sala (**Radio-Electronics,** September, 1977) does not properly explain the operation of a core memory.

1. Once a core is magnetized, it cannot be demagnetized, but its magnetic-field polarity can be reversed. Whichever value

continued on page 18

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7473	74176 (DM8280)
7474	74177 (DM8281)
7475	74192
7476	74193
7485	74367 (DM8097)

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74LS04	74LS86
74LS08	74LS90
74LS10	74LS109
74LS20	74LS123
74LS30	74LS136
74LS32	74LS138
74LS73	74LS151
74LS74	74LS175
74LS75	74LS367

C/MOS

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4001	4044
4010	4046
4011	4049
4013	4050
4016	4051
4017	4069
4020	4071
4023	4081
4024	4511

LINEAR

LM301V	LM340T-15(7815)
LM307V	LM555V
LM309K	LM556N
LM311V	LM567V
LM320K-5(7905)	LM723N
LM320T-5(7905)	LM739N
LM320T-12(7912)	LM741V
LM320T-15(7915)	LM747N
LM339N	LM1458V(5558V)
LM340T-5(7805)	LM1556V
LM340T-12(7812)	LM3900N(CA3401)

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8224	7489
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6810	82S23
6830	2708
AY-5-1013	DM8835N
2513/2140	N8T97

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IN4733	IN4001
IN4734	IN4004
IN4742	IN4007
IN4744	MDA-980-3

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2N2222A	2N3904
2N2907A	2N3906
MJE2955	2N5129
MJE3055	2N5139

RESISTORS

ASST 1	ASST 5
ASST 2	ASST 6
ASST 3	ASST 7
ASST 4	

CAPACITORS

Aluminum Electrolytic

1mfd 50V	100mfd 50V
4.7mfd 50V	220mfd 50V
10mfd 50V	470mfd 50V
22mfd 50V	1000mfd 25V
47mfd 50V	2200mfd 16V

Ceramic Disc

10pf 50V	.001mfd 50V
47pf 50V	.0047mfd 50V
100pf 50V	.01mfd 50V
220pf 50V	.022mfd 50V
330pf 50V	.047mfd 50V
470pf 50V	.1mfd 50V

Dipped Tantalum

.1mfd 35V	2.2mfd 25V
.22mfd 35V	3.3mfd 25V
.33mfd 35V	4.7mfd 25V
.47mfd 35V	6.8mfd 25V
.68mfd 35V	10mfd 25V
1mfd 35V	15mfd 25V
1.5mfd 35V	33mfd 25V

SWITCHES

SPST 4 sta. dip	SPDT push button
SPST 8 sta. dip	SPDT push button
SPDT on-off-on toggle	SPST push button
SPDT on-none-on toggle	SPST push button
DPDT on-off-on toggle	SPST push button
	DPDT slide
	DPDT on-none-on toggle

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8 pin low profile	14 pin wire wrap
14 pin low profile	16 pin wire wrap
16 pin low profile	24 pin wire wrap
24 pin low profile	40 pin wire wrap
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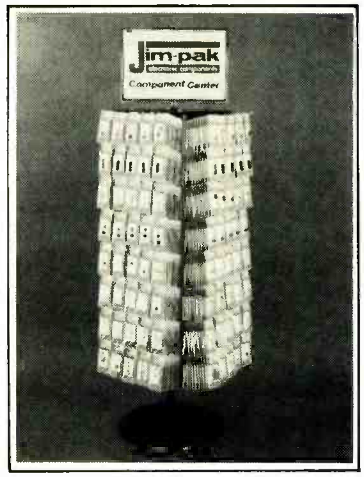

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HAWAII
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IDAHO
Idaho Falls — *Audiotronics*

ILLINOIS
Evanston — *Itty Bitty Machine Co.*
Groveland — *Moyer Electronics*
Mount Prospect — *Tri-State Electronics*
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INDIANA
East Chicago — *Acro Electronics*
Hammond — *Quantum Computer Works*

LOUISIANA
Baton Rouge — *Davis Electronics Supply*

MARYLAND
Baltimore — *Computer Workshop of Baltimore*
Baltimore — *Everything Electronics*
Rockville — *Computer Workshop*
Towson — *Computers, Etc.*

MASSACHUSETTS
Medford — *Tufts Electronics*
North Adams — *Electronics Service Center*
Waltham — *Computer Mart Inc.*

MICHIGAN
Lansing — *Fulton Radio Supply*

MINNESOTA
Duluth — *Northwest Radio of Duluth*
Eagan — *Dacom Amateur Radio Center*

MISSOURI
Parkville — *Computer Workshop of Kansas City*

MONTANA
Billings — *Conley Radio Supply*

NEBRASKA
Lincoln — *Altair Computer Center*
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WEST VIRGINIA
Morgantown — *The Computer Corner*
Morgantown — *Electro Distributing Co.*

CIRCLE 22 ON FREE INFORMATION CARD

LETTERS
continued from page 16

of current it took to initially saturate a core into a magnetized state, it takes at least ¾ of the value of that current in the opposite direction to have the core's magnetic field reverse polarity. It will take at least ¾ of that value in the original direction to switch it back. This procedure is usually represented graphically by the hysteresis loop.

2. Either polarity of a core's magnetic field is arbitrarily chosen to represent a logic 1; the other polarity, a logic 0.

3. Logic 0's are not written. A core is a logic 0, if a 1 has not been written in it.

4. Core memories are fast compared with discs, tapes, etc., but they are slow compared with other solid-state memories.

5. A logic 1, for TTL, is normally 3.3 volts, while a logic 0 is normally 0.2 volts.

DENIS AUBRY
Montreal, Canada

TV-TO-STEREO RECEIVER ADAPTER

I am a college student who is majoring in broadcasting and communications/journalism. I like to dabble in electronics, and have been able to solve and correct some problems with my home studio equipment.

I'd like to suggest that your magazine develop and print the following project, along with circuit illustrated photos showing parts locations as well as easy-to-follow diagrams:

My suggestion is a TV-to-stereo receiver adapter so that home viewers can listen to their favorite TV programs in a pseudo-stereo sound (matrix), and if the particular program audio is worth recording, one could easily do it. One problem I have encountered with a commercial device is hum that is picked up and audible over the receiver speakers, as well as on tape if a recording is made.

I presume this problem is because of the tubes in the TV sets. You can probably figure out a way to avoid this problem, and I think that a lot of people who would like to add a new dimension to their TV viewing would find this a program brightener, especially during reruns and new Fall offerings.

ROBERT E. THOMAS II
Bridgeport, CT

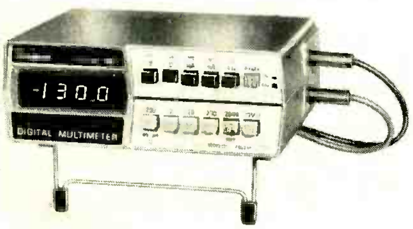
OOOOPS!

There is an error in the parts list for the Biorhythm Clock (Nov., 1977 issue). The ordering information for the parts kit is inaccurate. Kit BC-P ($29.95) is NOT a complete kit of parts. It does not include the PC boards (Kit BC-PCB), the custom-made cabinet (Kit BC-C) or the optional IC sockets (Kit BC-S). For a complete package, you must order Kit BC-P, PLUS Kits BC-PCB, BC-C and, if you desire, BC-S.

The editorial staff of **Radio-Electronics** Magazine sincerely apologizes for any inconvenience you may have experienced as a result of this error.

equipment reports

Simpson model 461 Digital Multimeter



CIRCLE 97 ON FREE INFORMATION CARD

SIMPSON ELECTRIC COMPANY, 853 DUNDEE AVE., Elgin IL 60120 have developed a new, compact 3½-digit digital multimeter, the *model 461*. The readout uses 7-segment 0.3-inches high bright LED's. Despite its small size (it's only 5.5 inches wide, 2 inches high, 4.5 inches deep) it has all the "goodies": A 10-megohm input impedance and a total of 26 ranges. It reads DC volts from 200 mV up to 1.0 kV; AC volts from 200 mV to 600 volts RMS; and reads both AC and DC current, from 200 μA up to 2.0 amperes in five ranges.

There are six resistance ranges, the lowest range is 200 ohms, with only a 200-mV applied voltage. All the other resistance ranges use 2.0 volts.The top range is 20 megohms.

The *model 461* has an accuracy of 0.25% on the DC voltage ranges. The meter also has automatic zeroing and automatic polarity indication. You can take readings down to a resolution of 100 μV, 0.1 ohm, or 100 nA on AC or DC. The resistance readings are accurate to 0.5%, except on the 20-megohm range, which is 1.0%.

The controls are pushbuttons and are spaced widely enough so that there is no problem hitting too many at once. The test leads are recessed and they plug into the right-hand side of the case. The test leads are completely insulated and the test probes are corrugated so that you can hold them more easily; there's also a safety ring to prevent your fingers from sliding too far and getting into trouble. The tips of the probes have sharp points for digging into PC boards, and screw-on insulated alligator clips can be used for hands-off testing.

The DC ranges are overload protected to 1100 volts on all ranges; the AC ranges are protected up to 650 volts RMS. The resistance ranges are protected to 135 volts RMS on the two lowest ranges, and to 250 volts RMS on the higher ranges. A fuse located in the battery compartment protects both AC and DC current ranges to 2.0 amperes.

The *model 461* uses LSI (*L*arge *S*cale *I*ntegration) technology. The A/D converter and most of the circuitry are contained in a single large IC. Only the signal-conditioning circuits (the shunts, multipliers, etc.), are external. Power for the circuitry is provided by four rechargeable NiCad batteries. The charger plugs into a socket on the left side of the case. The Simpson *model 00475* battery charger, 120 V input, comes with the instrument. The *model 00746*, a 230-volt input charger, is also available. Fully charged batteries provide at least 8 hours of continuous operation, and can be recharged overnight.

The readout of the *model 461* is quite stable. It will lock in less than 1 second, and the display is updated three times-per-second. There is no hunting to speak of. The least significant digit (on the right-hand side of the readout) may rock back and forth 1 digit, but

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BUILD AM/FM Frequency Display

Up-date your hi-fi setup with this frequency and time display that can be an add-on accessory or built into a modified AM/FM set. Construction is simple and inexpensive.

GARY MCCLELLAN

THERE'S NO DENYING IT, DIGITAL READouts are definitely a status item these days. And what's more they are practical, offering easy no-squint readings. The home stereo receiver is a natural for a digital readout, but only a few offer this feature. But now you can add a digital readout to your receiver at low cost, and get such advantages as no squinting at a dimly lit dial, or guessing at frequency. Imagine! You listen to a station on 101.3 MHz FM, so you tune to 101.3 on the big ½-inch display and there's your station! And as a bonus, you get a clock function. Wouldn't this project look good on top of your stereo receiver? Or how would you like to build it inside like we did on the Sansui receiver pictured?

This clock/frequency display unit is made possible by a couple of new IC's. You can read the time in hours and minutes, then either the AM or FM radio frequency, depending on what band the radio is set to. And for best accuracy, this project is crystal controlled.

The entire clock/display section is on a single IC! Only a few other IC's are necessary for interfacing. This really simplifies construction. Also, PC artwork and a kit of parts are available. The whole unit is simple, neat and easy to connect to the radio. How about connecting it to one of those manufacturers' close-out AM-FM receivers that are sold without dial or cabinet. They are available from time to time for $30-35 from Poly Pak's, Olson Electronics and other mail-order houses.

There are two state-of-the-art IC's in this project that may not be available to the hobbyist just yet. To make things easier for you, we are offering a kit of parts. If you prefer, you can order just the parts you need and make your own PC boards from the patterns shown in this article.

The time-frequency display can be built into the receiver or made as an add-on accessory with readout and controls in a separate case. In addition to the add-on version, I have built displays inside two commercial receivers—a Sansui *model 331* I bought for $100 and then modified, and a $29.95 "dial-less wonder."

How it works

This project is based on a single IC. This device—the AY3-8112 from General Instruments—is, to my knowledge, the first of its kind. It has inputs to control the time and frequency functions and is easy to work with.

Figure 1 is a block diagram of the digital clock/frequency display. Construction is in two sections. The first is the *radio interface* module (Fig. 2) that processes the radio's local oscillator signals. It must mount inside the radio and as close as possible to the oscillator to minimize detuning and stray radiation that can cause interference in the receiver. The interface accepts the FM local oscillator signal and divides it by 100. To develop the proper signal for the AM radio frequency display, the interface has a Schmitt trigger that simply squares the AM local oscillator signal. A 5-volt regulated supply provides the operating voltage for this board. The FM oscillator signal is divided down by IC1, a VHF prescaler; IC2 is a quad 2-input NAND gate wired as a Schmitt trigger to square the AM oscillator signal and IC3 is the voltage regulator.

The second section or module (Fig. 3) houses the clock/counter IC. Basically, this IC contains three 3½-digit counters, any one of which can be displayed by energizing certain pins. One counter, set to divide by 6, is the clock. It runs as long as power is applied and is independent of the others. The next counter is the AM frequency display. It reads the radio's

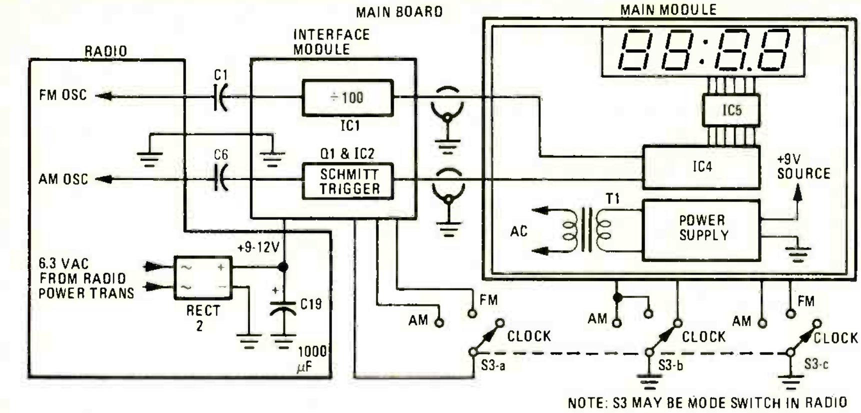


FIG. 1—BLOCK DIAGRAM of the time/frequency display. The interface module processes the oscillator frequencies before they go to counter/clock IC4.

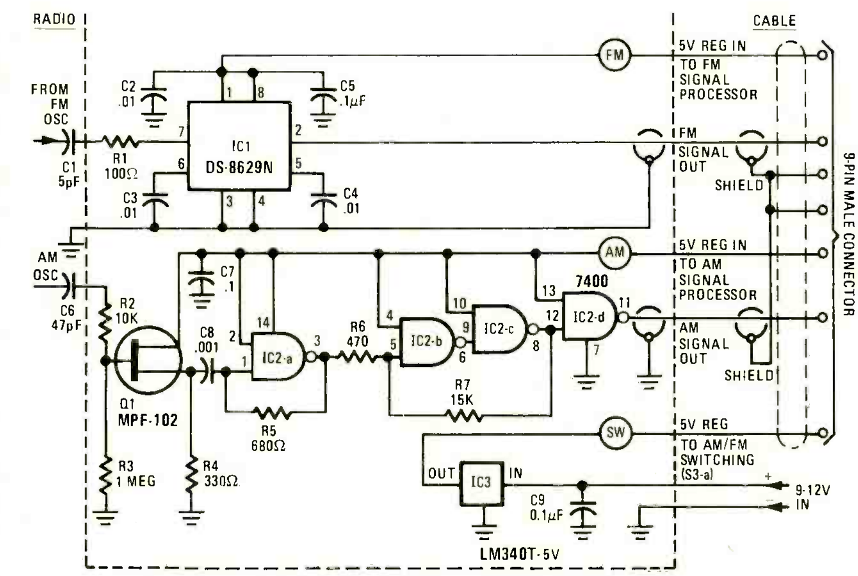


FIG. 2—CIRCUIT OF THE INTERFACE module. FM signal is divided by 100; AM signal is squared by the Schmitt trigger.

local oscillator frequency and subtracts the intermediate frequency (IF) from it. The resultant display is the true radio frequency that the tuner is tuned to.

If this sounds confusing, remember that all superheterodyne receivers mix the incoming signal with the frequency developed by the local oscillator. The difference signal (the intermediate frequency or IF) is amplified and then rectified by the detector to recover the audio signal. The local oscillator frequency must be equal to the signal frequency *plus* the IF. Putting it another way, the frequency that the radio is tuned to equals the oscillator frequency *minus* the IF. This explains why the IF must be subtracted from the oscillator frequency before the resultant is displayed on the digital readout. One of the counters in IC4 is internally programmed to subtract 455 kHz when in the AM mode.

The last counter handles the FM signal. It operates exactly as the AM counter does, but the intermediate frequency that it must subtract is not preprogrammed. The number to be subtracted is programmable externally by diodes D1 and D2. This counter takes the divided-down FM signal from the interface board, counts it and then subtracts the IF. The difference is shown on the LED display. The remaining parts on the main board include the main power supply, a crystal timebase and some display driver components.

Selecting a receiver

The most challenging part of this project is adapting your receiver to the clock/frequency display. Choose a receiver you can work with that has the following features:

PARTS LIST

For interface, display and main boards
All resistors are ¼-watt, 5% film, unless otherwise noted.
R1—100 ohms
R2, R12—10,000 ohms
R3—1 megohm
R4—330 ohms
R5—680 ohms
R6—470 ohms
R8-R10—100,000 ohms
R11—15 megohms
R13-R20—2,200 ohms
R21-R24—3,900 ohms
R25-R32—150 ohms
C1—5 pF mica
C2-C4, C13—.01 µF disc
C5, C7—0.1 µF, 10-volt disc
C6—47 pF mica
C8, C12—.001 µF disc
C9—0.1 µF, 25-volt disc or Mylar
C10—10 pF mica
C11—22 pF mica
C14, C15—.05 µF Mylar
C16—1000 µF, 16-volt PC mount electrolytic
D1, D2—1N4148 diodes
RECT1—50 PIV, 1 A miniature bridge rectifier (Radio Shack 276-1151 or equal)
F1—¼ A fuse and chassis holder
IC1—DS-8629N VHF prescaler (National)
IC2—SN7400N quad 2-input NAND gate
LC3—LM340T-5 5-volt regulator (National)
IC4—AY-3-8112 clock/counter (General Instrument)
IC5—CA-3081 display array (RCA)
Q1—MPF102 FET (Motorola)
Q2—2N2222 silicon NPN or similar
Q3-Q6—2N3905 silicon PNP or similar
DIS1-DIS4—FND-510 common-anode 7-segment display (Fairchild)
LED1-LED3—NSL-5053 lamps (National) or equal
S1-S2—SPST normally open pushbutton switches
T1—6.3 volt, 600 mA filament transformer
XTAL1—2.304 MHz AT-cut crystal, 20 pF parallel capacitance HC6/U, wire leads
Miscellaneous: Interface board (model 80A), display board (model 81B), main board (model 81C) and type 772 LMB box.
All parts listed above are available as the model 81 kit for $44.95 postpaid from Gary McClellan and Co., PO Box 2085, 1001 W. Imperial Highway, La Habra, CA 90631. Also available are the three PC boards, etched and drilled (Kit No. 81-1) for $6.50 postpaid and Kit 81-2, consisting of all IC's, for $34.95 postpaid. California residents add state and local sales tax as applicable.
Additional parts for built-in version
C17-C18—.05 µF Mylar (if needed, see text)
C19—1000 µF, 16 volt PC mount electrolytic
D3, D4—1N4148
D5—1N4002
RECT2—50 PIV, 1 A bridge rectifier (Radio Shack 276-1151 or equal)
RY1—SPDT relay, 12 VDC (Radio Shack 275-003 or equal)
Q7-Q10—2N2222 silicon NPN or similar
R33—10,000 ohms
R34-R36—47,000 ohms
Miscellaneous: Type 007-746 LMB box to house the display, 3-inch square of perforated circuit board.
Additional parts for the add-on version
S3—3-pole, 3-position rotary switch with knob, 463N LMB case for display, 9-pin plug and socket (J1 and PL1)

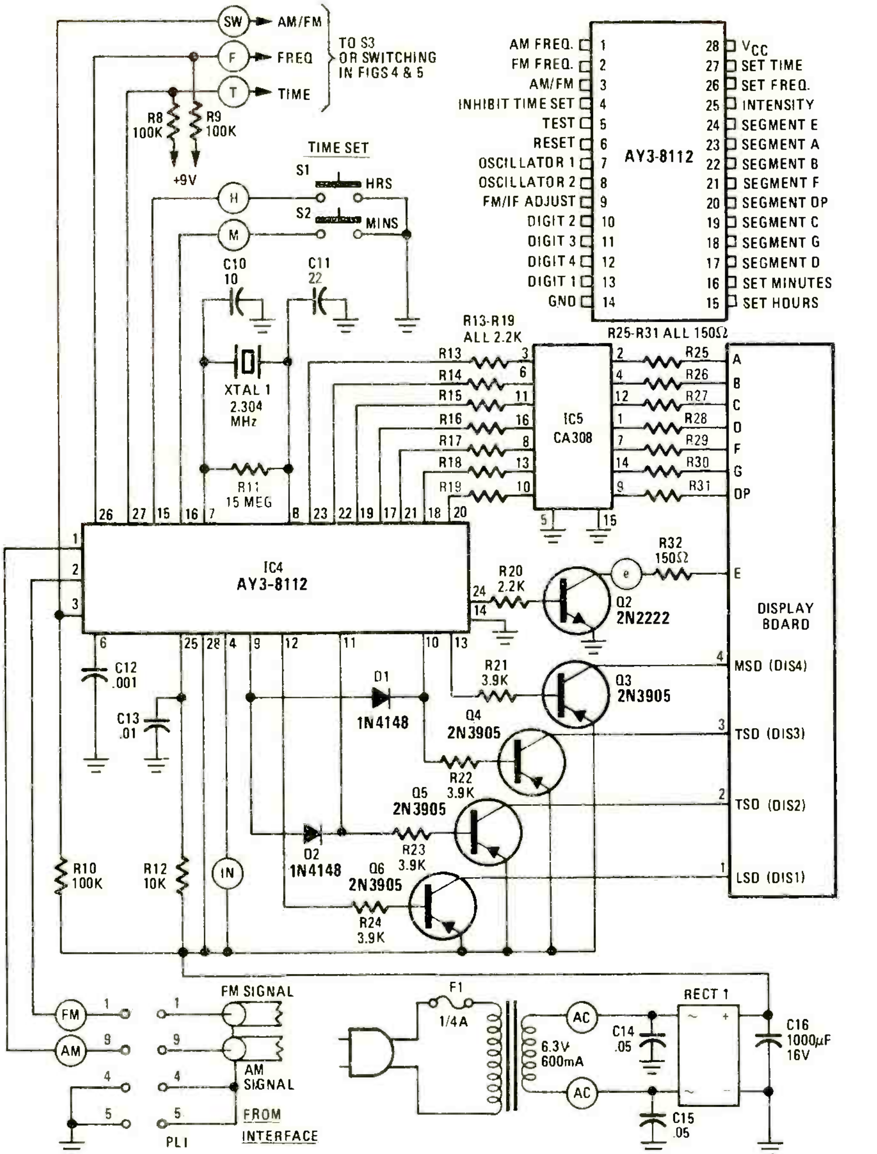


FIG. 3—DISPLAY AND MAIN BOARD WIRING. Most of the parts are on the main board. Display board has three LED's and four seven-segment display devices.

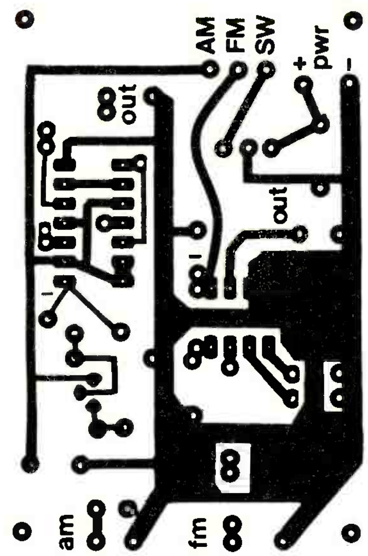


FIG. 4—FOIL PATTERN for the interface board shown full size.

- It must be a solid-state model. Tube-type sets offer a shock hazard and high voltages that can damage the interface board.
- Select a set with ample room around the tuning capacitor. The interface module must be mounted very close to this capacitor and will require the extra room. Avoid compactly built sets. Also, if you want to build everything into the receiver as I did on several models, you'll need room around the existing dial for the display section.
- Know your receiver, or at least know how to locate its AM and FM oscillators. Once you know what to look for, tapping into the oscillators is easy. A schematic of the set will be a great help.
- And finally, your set must have 455-kHz AM and 10.7-MHz FM IF's. This shouldn't be a problem because these IF's are worldwide standards.

Construction

This project is built on three PC boards. You can purchase them or construct your own from the foil patterns presented here. Start construction with the interface board (Fig. 4). (If you buy the boards and the interface board foil is tarnished, polish it with silver cleaner.) This board comes silver plated.

Begin construction by installing the two jumpers as shown in Fig. 5. Note that one is just below IC1 and the other starts at a point under IC2 and extends under R7. Add the resistors. **Keep all leads short!** Install all capacitors except C1 and C6. They connect between the radio and the interface board and will be installed later.

Install the IC's. You may have to enlarge the holes a bit to accommodate the leads of IC3. Install Q1, a MPF102, in the space provided. Attach a small heat sink to the tab of IC3. You can make one from a ¾- by 2½-inch piece of scrap aluminum shaped as shown in the photograph.

Complete this phase of the construction by connecting the leads to the input and output terminals on the board. Use ⅛-inch-diameter shielded cable for the two output leads and regular hookup wire for the rest of the wiring. These leads can be up to 3-feet long. (Be sure that the output leads are shielded; otherwise you'll get radio interference.) I used type RG-174/U coax in my installations.

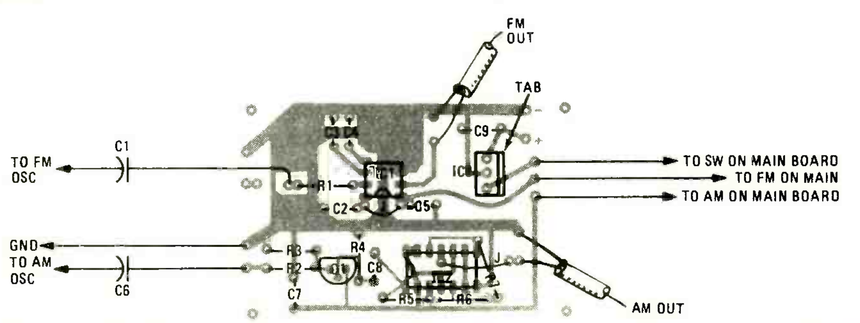


FIG. 5—COMPONENT PLACEMENT layout for the interface board. It is shielded and mounted very close to the radio's local oscillators.

Now, let's tackle the display board (Fig. 6). Install the 13 wire jumpers as in Fig. 7-a. Be sure you get them all and that they are properly installed because the LED's cover most of them. Double-check your work and then install displays DIS1 through DIS4. Note that the ribbed ends point up on the display board—toward the F-segment foil on the reverse side. Install LED1 and LED2 in the center of the display to form the colon. Note how the LED's flat sides are oriented in Fig. 7-b. Finish up by installing the FM decimal point, LED3. A place, marked ST, has been provided for a stereo indicator LED. Use it if you wish to remote the radio's existing stereo indicator for a more professional looking display.

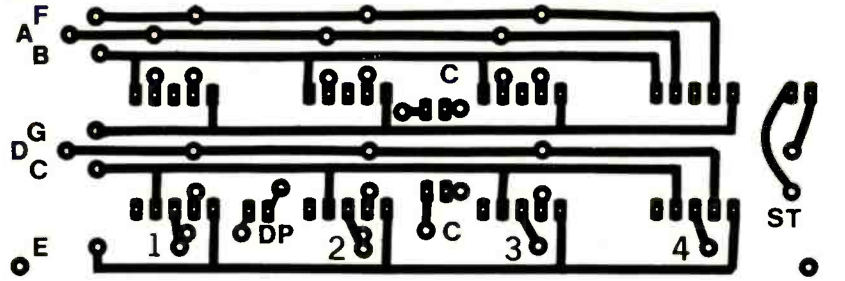


FIG. 6—DISPLAY BOARD FOIL PATTERN. Terminals just above "ST" are for optional LED stereo indicator, shown full size.

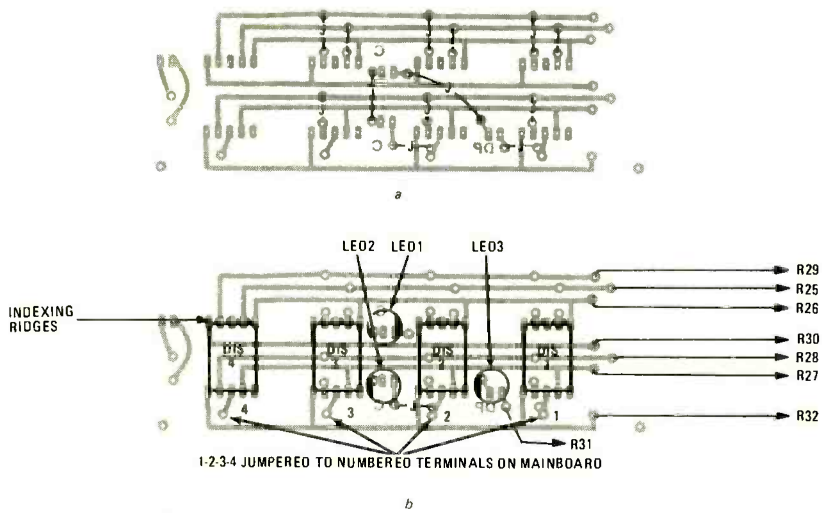


FIG. 7—DISPLAY BOARD component placements. Positions of the thirteen jumpers are shown at *a;* readout components are positioned as at *b.*

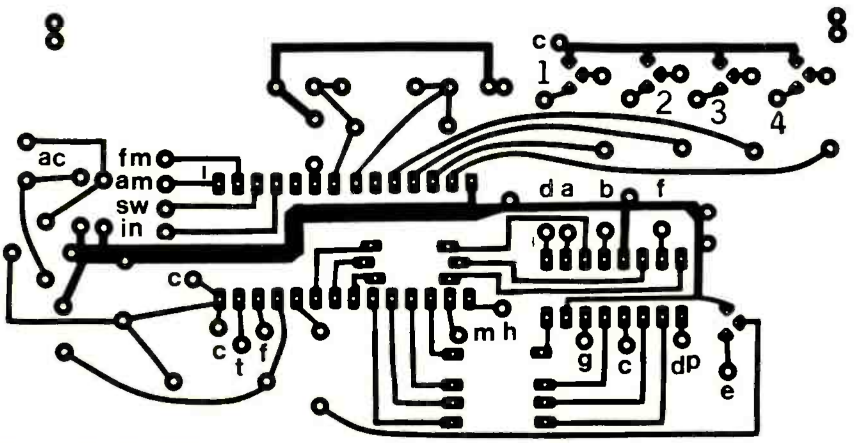


FIG. 8—FOIL PATTERN for the main PC board. The holes in the top right and left corners match similar ones in the display board and are used to join the two boards together, shown full size.

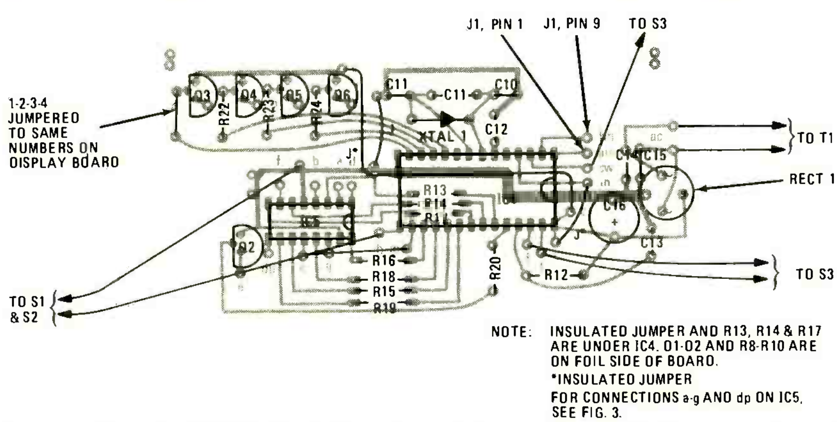
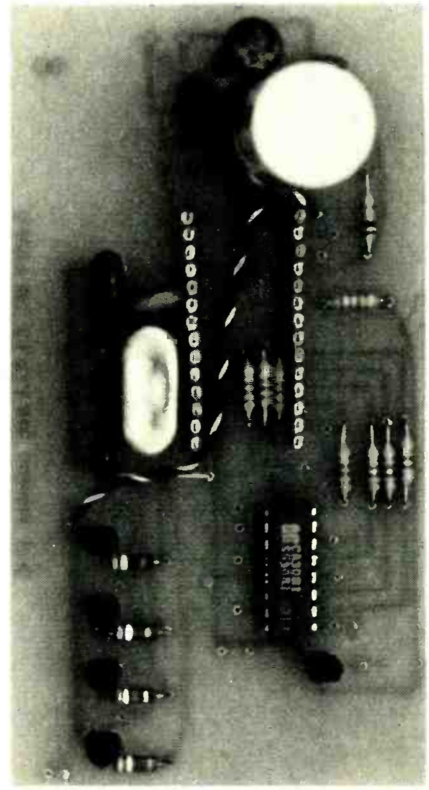
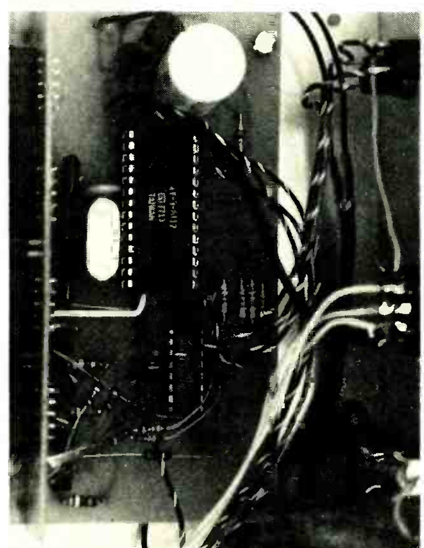


FIG. 9—HOW COMPONENTS ARE PLACED on the main board. Note insulated jumper running under IC4.



VIEW OF A PARTIALLY CONSTRUCTED MAIN BOARD. Note that R13, R14 and R17 are installed between the rows of pins used as the socket for IC4.



CLOSE-UP OF THE COMPLETED BOARD as it appears when installed in the case. Compare this view with that in the photo above.

Build the main board as in Figs. 8 and 9. Install the bare-wire jumper and then the two insulated jumpers. Add two rows of 14 Molex pins to form the socket for IC4. Do not break off the tabs until you are ready to install IC4 as the final step

continued on page 74

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Should your career in electronics go beyond TV repair?

CREI prepares you at home for broader and more advanced opportunities in electronics – plus offers you special arrangements for engineering degrees

There is no doubt television repair can be an interesting and profitable career field. TV repair, however, is only one of the many career areas in the fast growing field of electronics.

As an indication of how career areas compare, the consumer area of electronics (of which TV is a part) makes up less than one-fourth of all electronic equipment manufactured today. Nearly twice as much equipment is manufactured for the communications and industrial fields. Still another area larger than consumer electronics is the government area. That is the uses of electronics in such areas as research and development, the space program, and others.

Just as television is only one part of the consumer field, these other fields of electronics are made up of many career areas. For example, there are computer electronics, microwave and satellite communications, cable television, even the broadcast systems that bring programs to home television sets.

As you may realize, career opportunities in these other areas of electronics are mostly for advanced technical personnel. To qualify for these higher level positions, you need college-level training in electronics. Of course, while it takes extra preparation to qualify for these career areas, the rewards are greater both in the interesting nature of the work and in higher pay. Furthermore, there is a growing demand for personnel in these areas.

Unlike most other home study schools, CREI programs are devoted exclusively to preparing you for careers in advanced electronics. All of CREI programs are college level. And CREI gives you both theory and practical experience in advanced electronics.

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A unique feature of CREI training is its Electronic Design Laboratory Program, which trains you to actually design circuits. It also helps you understand the theories of advanced electronics and gives you extensive practical experience in such areas as tests and measurements, breadboarding, prototype construction, circuit operation and behavior, characteristics of electronic components and how to apply integrated circuits.

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Only CREI offers this unique Lab Program. It is a complete college lab and, we believe, better than you will find in most colleges. The "Lab" is one of the factors that makes CREI training interesting and effective. And the professional equipment in this program becomes yours to keep and use throughout your professional career after you complete the training.

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CREI offers you special arrangements for earning credit for engineering degrees at certain colleges and universities as part of your home study training program. An important advantage in these arrangements is that you can continue your full time job while "going to college" with CREI. This also means you can apply your CREI training in your work and get practical experience to qualify for career advancement.

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EQUIPMENT REPORTS

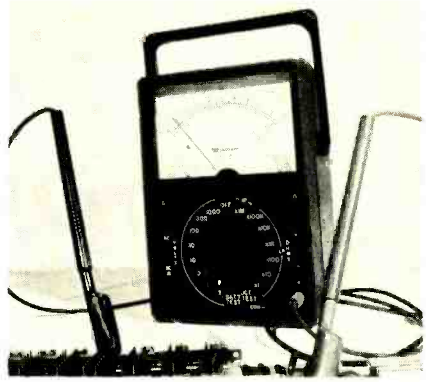
continued from page 20

this rocking usually occurs at 0.1 volt and can be ignored.

Our sample unit came in an impressive leather-like carrying case, *model 00747*. The case has a flap pocket to hold the meter. An adjustable neck-strap is used. The top flap of the case can be turned back and snapped down so that you can carry the instrument around your neck. Holes in the side of the case allow the test leads to be plugged in. A neat pocket on the bottom of the case holds the test leads, and even the battery charger can be carried in its own little pouch, which hangs on the neck strap. A flip-up stand has rubber feet so that you can set the *model 461* at the right viewing angle for bench work. Since there are no connections on the back, the meter can also be set in the vertical position.

The *model 461* is reasonably priced at $142.95, complete with test leads, battery charger and NiCad batteries. The human engineering of the controls, readout, etc., is excellent and makes the *model 461* a useful and highly accurate piece of test equipment. **R-E**

Triplett Model 64 FETVOM



CIRCLE 96 ON FREE INFORMATION CARD

THE THIRD OF THE *60-SERIES* TRIPLETT VOM'S is the *model 64* FETVOM.

Like the others, this, too is contained in a green drop-proof high-impact plastic case. The *model 64* has a high-impedance input of 11.12 megohms in all ranges. It can be used in electrical work, industry and schools; and is particularly applicable in solid-state electronics; radio, TV, CB, and so on. It reads DC voltages up to 1000 volts, with the lowest scale from 0- to 300-mV full scale; eight ranges give flexibility; and the AC voltage ranges are frequency-compensated (except for the 300- and 1000-volt ranges), reading from 20 Hz to 20 kHz. A dB scale is provided on the meter, with a chart showing the range. 0 dB is 1 mW across 600 ohms, or 0.775 VAC.

A single switch selects all voltage and resistance ranges. The function switch on the left side of the panel selects the AC or DC volts. The polarity switch on the right reverses the polarity of DC voltages. This switch also reverses the polarity of test leads in the ohmmeter function for transistor testing. The seven ohms ranges are all (except for the ×1-megohm range) low-power ohms, which apply only 90 mV across the device under test. In the ×1-megohm range, only 0.9 volt is used.

A special junction-test function has its own scale at the bottom of the meter scales. When connected across a good junction of a transistor, diode or IC, the meter shows infinity in one position of the polarity switch; and in the other (forward-biased) position, it reads open, short, germanium or silicon, for both testing and identification. Any significant reading in the infinity direction shows that there is leakage across the junction.

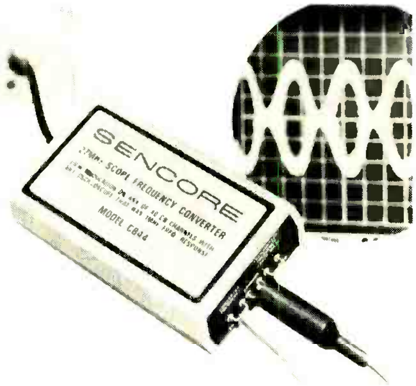
The very first FETVOM's were delicate little things. The *model 64* is specially designed for ruggedness and for electrical safety as well. It has all the regular VOM features, such as recessed test-lead jacks, no exposed metal on the case and so on. It is well-protected electrically, too. Quite a few protective devices are used: a 1-amp fuse in the common lead; protective diodes across the meter itself; a neon lamp shunted across the FET input; an arc gap for good measure; and the same 2-amp 1000-volt fuse to protect the meter against explosive arcs that could not only damage the instrument but also the user. All ranges are guaranteed to withstand up to 1000 volts AC for 30 seconds.

Calibration instructions are given in the manual. Only one is needed for DC, which is set for full scale on a 1.0-volt input on the 0–1-volt range. AC voltages have two, one for calibration on the 3-VAC range, and another for compensation on the 30-V AC range.

A high-voltage probe will raise the upper range of the meter to 30 kV DC. The case handle doubles as a bench rest to hold the instrument at any desired angle.

This nice, useful piece of test equipment is built for long service, and is available from Triplett Corp., Bluffton, OH 45817. The *model 64* sells for $136.00. **R-E**

Sencore model CB44 27-MHz scope frequency converter



CIRCLE 98 ON FREE INFORMATION CARD

IT MAKES IT MUCH EASIER TO FIND PROBLEMS when you can actually look at the modulated RF carrier of a CB transmitter. Under- and over-modulation, clipping, nonlinearity and many other problems can be identified. Until recently, you needed a 30-MHz scope to do this. A circuit has been developed that lets you observe the modulated carrier on any scope with at least a 1.0-MHz bandwidth. Sencore (3200 Sencore Dr., Sioux Falls, SD 57107) has used this circuit in their *model CB42* CB Analyzer.

Now, this company is marketing this circuit as the *model CB44* 27-MHz scope frequency converter.

The *model CB44* has a built-in dummy load rated at 12 watts P-P and at 4 watts average power. A cable and a PL259 plug allow you to connect it to any CB transmitter. The scope is connected to handy terminals on the other end of the unit. What it does is to beat the 27-MHz CB carrier against an oscillator running at 26.865 MHz, resulting in a beat frequency that will be within a 200 to 800-kHz range on CB Channels 1 to 40.

It uses a novel circuit for doing this. The oscillator is a FET with a bipolar buffer. The operating power for the circuit is provided by the CB transmitter's RF carrier. This is rectified, filtered and regulated to run the oscillator on any signal with 1.0 watt of RF power or more. No external power supply at all is necessary.

The output terminals used are unique and very handy. Each one is just a little loop of bare wire on an insulated board. There are three terminals: a scope output, a common and a low-impedance output straight from the RF carrier for use with a frequency counter. Just clip the scope and counter leads to the loops and away you go. Modulation and frequency can be read simultaneously.

A little plastic overlay is included that you attach to the screen of any 3- or 5-inch scope. This is calibrated for an exact reading of the modulation percentage. You set the unmodulated RF carrier level to just fill the space between the two zero marks; and from then on everything is easy. Positive and negative modulation percentage can be read directly. For best results, the test signal should be a good 1-kHz sinewave. Overmodulation, clipping and nonlinearity can be seen. Modulation limiters in the transmitters may be checked out. SSB transmitters can be checked in the same way. You can use either the SSB double-frequency test tone or a single-frequency 1-kHz sinewave. The instruction manual contains typical scope patterns showing correct modulation and several possible faults.

If you happen to like the old original trapezoid pattern for the modulation tests, you can do it. Just feed the scope from the *model CB44* vertical scope output and connect the scope horizontal input (set it to external horizontal sweep) to the collector of the CB modulator. The same graticule can be used for modulation percentage, clipping, etc. Modulation nonlinearity is easy to spot using the trapezoid pattern.

The *model CB44* is a good way to get some more use out of that old but good narrow-band scope. Quite a handy little device and it sells for $75. **R-E**

COMPUTERS

Next month's issue of **Radio-Electronics** will contain a round-up of microcomputer mainframes. It will feature the most popular ones. So, if you're looking to purchase one, or even if you already own one and are interested in knowing what the latest equipment looks like, don't miss the February issue of **Radio-Electronics.**

Forest Belt tells...

What You Need To Know About Tools And Handy Gadgets

WHAT WOULD YOU THINK IF I TOLD YOU THAT TOOLS SERIOUSLY AFFECT YOUR PROFESSIONAL life? They can and they do. Selecting proper tools—and using them wisely—means almost as much to fast, efficient servicing as test equipment. Correct tools often make the difference between a rough, slipshod job and a smooth, professional one, between a repair that takes too long and one that is prompt and quick. Believe me, tools control both your reputation and your profits.

Sometimes it's a matter of choice. For example, suppose you need to make a ⅞-inch hole through a car top. Do you pick a chassis punch or a hole saw? Or do you use a ⅞-inch twist-drill bit? How about a nibbling tool? Do you know what all four of these tools are? Is your choice set by what you have on hand, or do you own them all?

Each tool works in its own special way. To make a hole in flat, blank metal at your workbench, anything but a chassis punch would be unhandy. Even a chassis-nibbler is slow, but it lets you cut holes of almost any shape. However, on a car top, you would find the chassis punch is awkward to manipulate and the nibbler is ineffectual.

For drilling through a wall, only a drill bit makes sense; it's long enough, and there is seldom a danger of rupturing anything on the other side. Yet, for drilling through a metal car roof, a ⅞-inch bit does only a ragged, meandering job. And you'll be astonished how suddenly the drill can gouge the upholstery beneath the roof. On the other hand, a hole saw, with a ¼-inch guide hole centerpunched and drilled with a stubby bit, takes out a ⅞-inch circle of body steel slick and clean. You would have to be very careless to mar the upholstery.

The point is, you choose tools to fit the task. But this presumes that you know about all kinds of tools and gadgets. You should be familiar with them, and you should own the right ones.

The proper tools can save you countless minutes, hours and dollars; and you'll perform better installations and repairs. This will assure you a reputation that draws customers back for other profitable work.

Coping With Wire and Cable

Tools that make your wire and cable connections look and perform as if they were prepared by a factory machine.

CAN YOU, WITHOUT FUMBLING OR BUMBLING, prepare a coaxial cable for a PL-259 connector? Can you strip and tin an 8-conductor rotator cable and crimp the proper-size lugs onto each wire? Do you know how to splice two hookup wires neatly and solidly and completely insulate them without using solder or messy black tape?

If you can, you have most technicians beat. The average technician, given any of the above tasks, begins with a knife or razor blade. Even if the resulting splices or connections are not splattered with blood spots, they seldom appear professional.

However, they could . . . with tools that are now available, you can make your cables and wiring look and perform as if a factory machine had prepared the connections. If you are meticulous, your handiwork performs even better and lasts longer.

Stripping and tinning

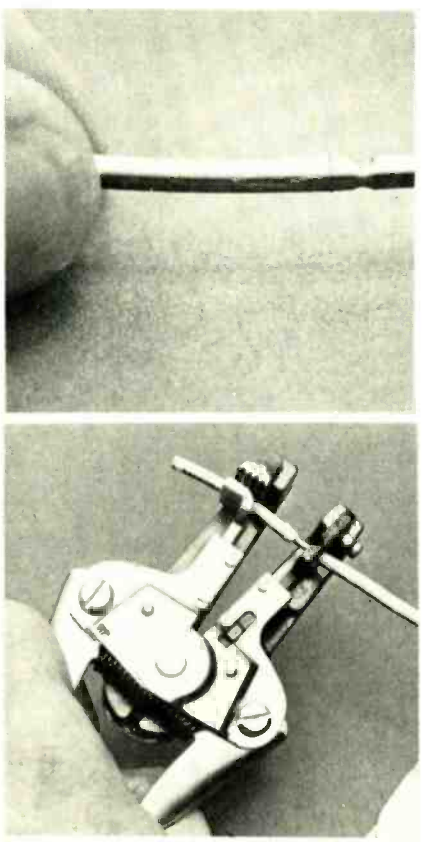
Hacking away at insulation with a razor blade or knife is dangerous. It's easy to slice a finger, and you generally cut off more insulation than you intended. Also, it's difficult to gauge the depth to which you slice until you spot the nicks in the inner insulation, braid or wire. Nicked wires break easily, especially later on when the wire or cable is flexed. And snagged insulation invites short circuits. (Old rule: If a wire *can* short, it *will!*) Straggling strands of wire or braid can also cause shorts, sometimes in the most unexpected places.

The secret to stripping a wire neatly lies in using a wire-stripping tool. If you're adept, you can use the round stripping notch in the jaws of your diagonal cutters. With plenty of practice, adept technicians learn to strip insulation with plain diagonal cutters or side cutters, occasionally nicking or breaking only a few strands. But both methods are makeshift.

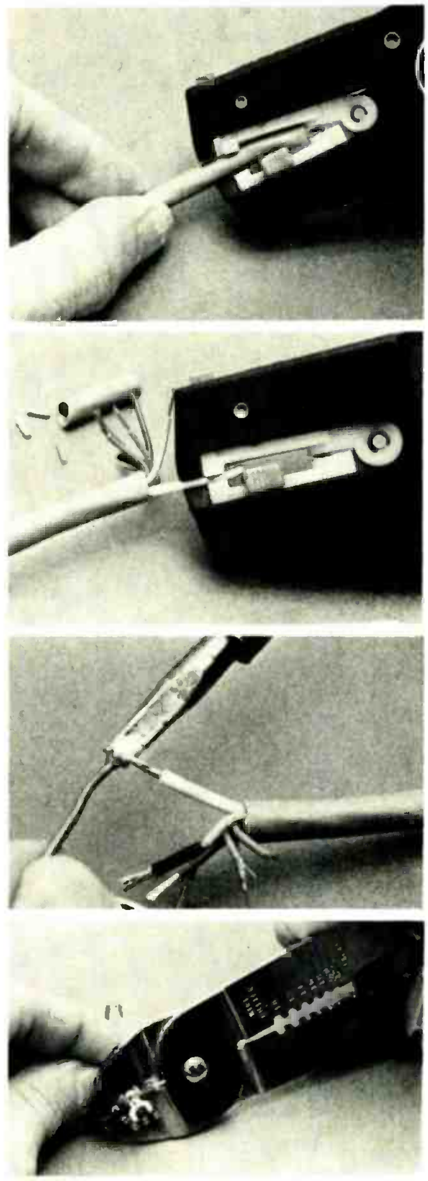
Obtain a good wire-stripper for your toolbox. You can buy inexpensive models that include crimper jaws. For a really professional appearance, combined with true speed and ease, find a stripping tool that holds the wire gently as it strips off the insulation. Of course, an elaborate tool costs more, but by the second or third time you use it, the minutes you save have paid for the tool.

There's an important bonus too: Connectors fit better, can be installed faster and stay in place longer when the wire or cable has been prepared to exactly the right dimensions and has no messy ends. If you choose your wire-stripper wisely, you can use it to cope with several different kinds of wires and cables.

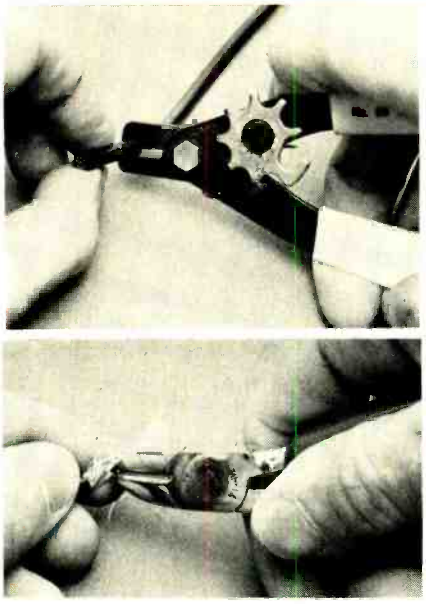
Stripping techniques vary only a bit with cable type. How much you strip depends on the type of connector you plan to attach. For crimped (or soldered)



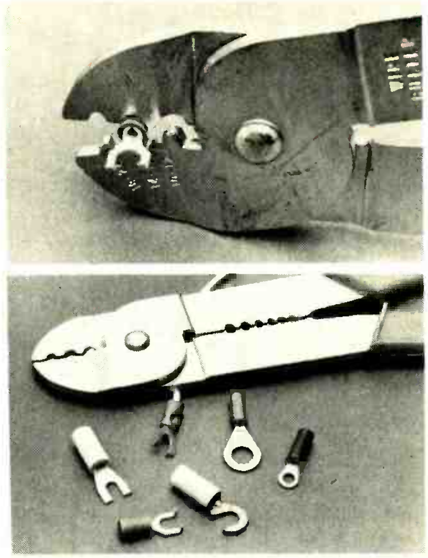
IT'S POOR PRACTICE to try stripping wires with diagonal or side cutters, even with a stripping notch. Nicked wires soon break. A stripping tool does the job smoothly and neatly.



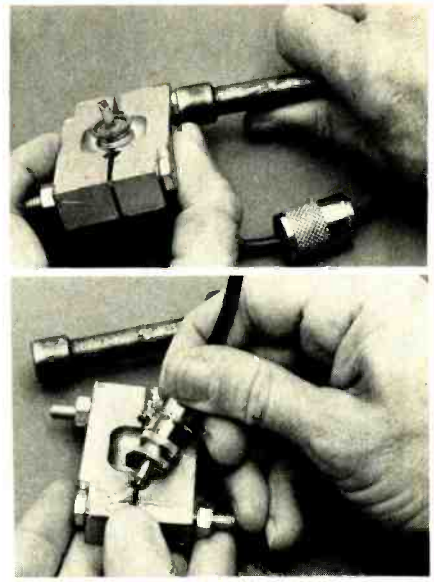
MULTIPLE-WIRE CABLES should be stripped, tinned and fitted with lugs for proper connections. Lazy technicians wrap stranded wires around terminals and eventually wind up with short circuits.



COMPETENT WAY OF STRIPPING COAXIAL CABLE without fancy tool involves stripper for insulation and diagonal cutters to snip braided shield back.



PLACE SEAM OF LUG BARREL in broad saddle of crimper to avoid distortion. Some lugs don't have seams. Tongue styles, left to right: spade, flanged spade, hook and ring.



TIGHTENING BOLTS of this *Model 1100* Gold Line crimper attaches PL-259 connector to coax cable.

lugs, strip no more than 1/4-inch of insulation from the end of the wire.

Tin wire ends after stripping, to prevent strand raveling. Soldering the wire to a lug becomes easier; wrapping it around a terminal screw is smoother; and crimped lugs grip tighter and leave no loose strands.

You can even strip coaxial cable with some multipurpose strippers. Just set the tool for the right diameter at each step.

Here's the procedure:

1. Strip the right amount of vinyl outer covering;

2. Snip (with diagonal cutters) the braid to proper length; and

3. Strip the center insulation.

The illustrations show two kinds of strippers being used. Either one can manage coaxial cable by this technique outlined above. Note in the photos how the stripper is set for step 1—much larger than *in* any of the notches. However, as Table I shows, you can buy strippers meant only for coaxial cable that do a neat job—sometimes in one step.

You seldom have to tin the shielded braid of coaxial cable. On hi-fi cables, however, that are made similarly, you may need to unwind some braid and tin it. To tin any stranded wire, heat the strands (after twisting) until the solder melts and flows among the strands. Before the solder sets (cools), shake off any excess. You don't want any blobs or tips sticking out; they cause trouble.

Making terminations

Where screw terminals are involved, most technicians take the "easy" way out. They twist strands together, wrap the wire end around a screw and then tighten. This results in weak, sloppy, careless and trouble-prone connections.

It's just as easy to attach lugs. Several kinds of lugs are available, and all can be attached to wires by crimping. For a really solid job, take the time to tin the wire ends before you crimp the lugs on. On the other hand, you can make dependable crimped connections by just twisting the strands tight before inserting them into the lug.

Just one word of caution about crimping: Pay attention to how you orient the barrel of the lug in the crimper. Place the barrel seam in the larger *cradle* of the crimping tool so that the smaller crimping tip indents the other side of the barrel and doesn't spread the seam apart.

Choose lugs that fit the wire size; a wide selection is available. You can even buy kits of popular sizes and shapes, with a crimping tool included. It takes just a few minutes to crimp a lug on each wire you plan to connect to a terminal screw. Dependability, neatness and long life of the connections are worth the extra trouble. You are a professional, right?

Terminating coaxial cables, whether for communications or for TV or hi-fi, is a bit more difficult but seldom takes much more time. Once the cable is stripped to fit the connector, tin the stranded center conductors. If the connector is to be soldered on, tin the center wire *even if it's solid;* it will bond easier inside the connector. Tin the shield braid only if the connector does not require that you "fan" it out. If the braid is to be soldered, form it to fit the connector and then tin it. (Soldering is always easier if the wires are tinned in advance.) However, do not tin the connector's hollow center pin. You couldn't run the center conductor as deep as you need to for dependability.

With the right tools, you can crimp connectors onto coaxial cable. An example is the PL-259 connector used in communications and CB radio. Gold Line makes a bolt-operated crimper that lets you squeeze both pin and shell for a tight connection between the cable and the connector. A hand-operated crimper does a similar job. You prepare the cable ends just as you would when soldering on a connector, but instead of soldering, you crimp. You must use a filler for the center pin with small coaxial cables, so the pin grips the center wire tightly.

Some coaxial connectors require only pliers for installation. Ask your distributor to demonstrate the various types of pliers, and select whichever is most convenient, neat *and* dependable for your purposes.

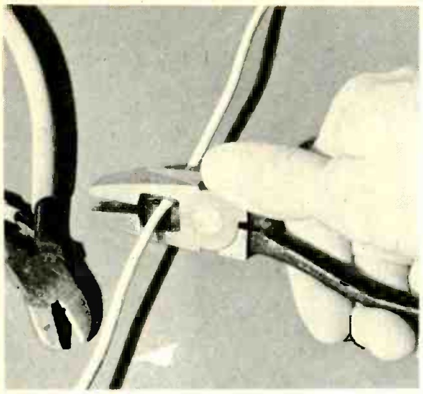
Do not leave any bare wires near a connector or terminal. Bare wires can get crossed and short-out, or touch terminals they should not. If careless soldering melts the insulation near a plug or terminal, clip the ends and remake the connections.

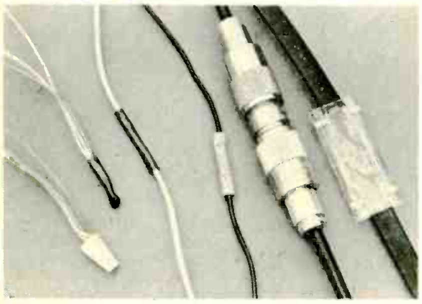
Splicing wires

There are three ways to splice wires without creating a mess.

One method is bulky for electronics wiring, but it makes sense when you have more than two wires to bring together, yet don't have a vacant terminal strip handy. Use a device called a *wire-nut*. Just twist the bare wire ends together, insert them into the wire-nut and wind the wire-nut tight. Threads inside the wire-nut grip the wires tightly, and the outer shell insulates the multiwire splice. Just be careful not to strip the bare ends back too far; the wire-nut skirt must extend well over the insulation on all wires. Small wire-nuts don't take up much space if you keep the wires short.

You can use shrinkable tubing to make a two-wire splice look neat and stay insu-





WIRE SPLICES CAN BE MADE with wire-nuts, shrink tubing, crimped butt splicers. Coax cable and TV twin-lead should be spliced only with connectors that do not upset impedance of cable.

TABLE I
Wire-Stripping Tools & Crimpers

Manufacturer Brand	Model	Strips Wire Sizes (AWG)	Strips Coax Cable	Cuts Cable	Holds Wire As Strips	Connectors Crimped	Remarks
AMP Inc. Box 3608 Harrisburg, PA 17105.	None		•	•	•		
Channellock Meadville, Pa 16355.	908G	10-22	•				
GC Electronics 400 S. Wyman St. Rockford, IL 61101.	8176S	10-22			•	Lugs	
	744-I	8-22		•			
	766-I	8-22		•			
	802	10-22		•			
	760	12-20			•		
	733-I	8-22		•			
Gold Line Van Zant Norwalk, CT 06855.	1111					Coax	Hand tool
	1100					Coax	Bolt-operated
Ideal 1842 Tannery St. Great Bend, PA 18827.	T5-T7	10-30			•		
	T32		•		•		
	T33	TV lead					
	45-164		•	•	•		
	45-090 to 45-098	8-30		•	•		
Radio Shack 2617 West Seventh St. Fort Worth, TX 76107.	64-2268	12-18			•	Lugs	
	64-405	12-18			•	Lugs	
	64-1952	12-24			•		
	64-2129	12-24			•		
	64-1918	8-22		•	•		
Vaco 510 N. Dearborn St. Chicago, IL 60610.	T-1710					Lugs	
	1900	10-22			•	Lugs	Cuts No. 4-No. 10 bolts
Waldom 4641 W. 53d St. Chicago, IL 60632.	H3A,H4A					Lugs	
	CT-4070					Lugs	Cuts No. 4-No. 10 bolts
Xcelite P.O. Box 728 Apex, NC 27502.	100				•		
	103S				•		
	590		•		•		
Utility Tool Corp. 46 Nooks Hill Rd. Cromwell, CT 06416.	UT-5800	RG-58/U					
	UT-8000	RG-8/U					

lated. A butt splice, with wires end-to-end, is best. A twisted end splice done this way can work if you're careful, but it does not look as neat. Strip about ¼-inch of insulation for the end splice, or about ½-inch for a butt splice.

For a butt splice, slip an inch or so of shrinkable tubing onto one wire. Twist the wires together and solder them. Slide the shrinkable tubing down over the bare portion of the wires, making sure it extends well over the insulation. Heat it, so it shrinks. A heat gun is best. If you use a match or torch, you may melt the insulation. Just apply the heat quickly and then remove it.

A crimped butt splice is dependable, neat and easy. Buy a box of butt splicers to use with your crimping tool. Strip each wire about ¼-inch. Insert one wire into each end of the splicer, and crimp both ends. Tug on the splice to make sure you have a solid crimp on both wires.

Splicing coaxial cable, especially communications-type where impedance must be kept constant, is done best by using devices designed especially for the purpose. Do you have a damaged coaxial cable? Just clip out the damaged portion and install a PL-259 connector on each one of the two free ends. Then, attach a PL-258 double female adapter between the two PL-259's. This method is quick and dependable. If the cable is located outdoors, wrap it with tape or—for permanence—shrink some large tubing over the three connectors.

Some technicians splice 300-ohm flat twin-lead any old way. But this is poor practice, creates ghosts and sometimes color problems in TV receivers, and is needless. You can buy male and female extension connectors and attach them to the free ends of the antenna leads (tin the stranded wires), then plug the two connectors together. Outdoors, cover them with tape or shrinkable tubing to keep out moisture. This splicing method works even for shielded 300-ohm cables, if you solder the shield ends together underneath the tape or tubing.

Four wiring criteria

Tools and techniques for handling wires and cables are successful only if they enable you to meet four criteria:

1. Connections and splices must look neat, visibly proving your professionalism.

2. Connections and splices must be electronically sound, and must stay that way. Otherwise, you can expect callbacks. Insulation must also remain intact.

3. Connections and splices must be mechanically solid and secure. Vibration, normal tugging and even mild abuse should not break or loosen your wiring.

4. Connections and splices must be weatherproof. Moisture and corrosion are serious enemies of electronic wiring.

You will never regret owning and using the tools it takes to maintain these standards of quality in your work. **R-E**

Handy Gadgets That Speed Up Service

Tools and gadgets that save time and make your workbench more enjoyable

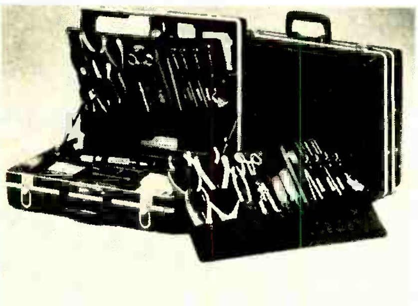
EXPERIENCE INTRODUCES YOU TO A LARGE array of tools and gadgets that other technicians find useful. And, if you browse your distributor's shelves and racks occasionally, you can find a few devices of this nature yourself. You should keep an eye out for them because without spending a great deal you can end up saving money. Anything that makes servicing jobs easier also makes them faster. And saving time puts money in your cash register.

Sometimes you know the item you need but don't know where to find it. Perhaps you saw someone else using it, or it appeared in a magazine ad (an excellent place to find new servicing aids). Maybe you read about it in a catalog, but you can't remember whose.

What follows is a list of handy servicing gadgets you should know about. Probably you already know about some of them since they've been around a long while. They're included in this article for newcomers who may not have spotted them yet. Other items you may have heard of but have not known where to find them. I have listed sources for all these service aids.

You can also ask your electronics distributor (he can't display *all* his inventory). He can order an item if you tell him who makes it.

Some devices are so relatively new that if you don't keep up-to-date with catalogs or magazine ads, you might have missed some. I hope you will find at least a couple of items here that can save you a lot of time and money over the next few months.

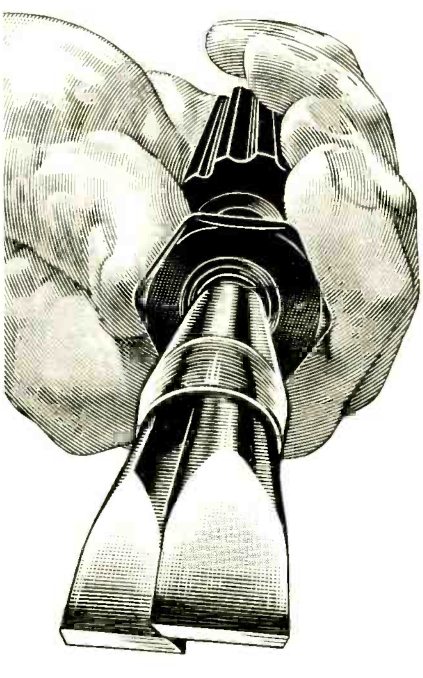


ATTACHE CASES ARE THE "IN" WAY to carry tools on service calls. Platt Luggage *model 600T* holds tools for technicians.

Tool cases and kits

In keeping with modern professionalism, there is a trend toward carrying tools in neat, trim attache-type cases. No more tool pouches slung low on a belt; no more tackle-box-type containers mixing tools among junk; and no more dumping your tube caddy on the customer's floor or even on a dropcloth.

One company that provides cases is Platt Luggage. Their *model 600T* is considered best for electronics technicians. Pallets can be made up to hold whatever tools you want to put on them. Some pallets come ready-made, with a list of tools that fit and plenty of room for larger tools in the bottom of the case.



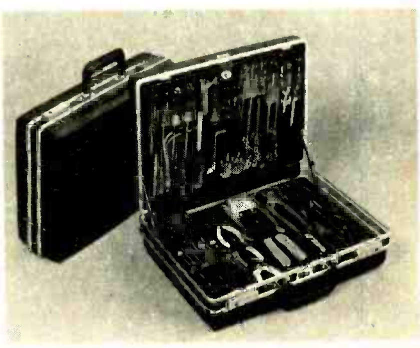
THIS QUICK-WEDGE FROM KEDMAN holds screws while you start them.

Vaco assembles a broad selection of hand tools in a kit for in-home servicers. The *model 70260 Super Case* holds 48 tools for bench work *and* service calls. This careful pallet arrangement insures neatness and cuts down on lost and damaged tools.

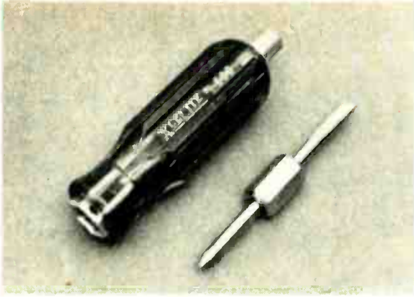
Techni-Tool Inc. offers similar tool kits. Their small tool arrangements are housed in zippered vinyl cases. Larger sets come in attache cases, with pallets that hold the tools in their own specific slots. Heavy outfits, such as for air-conditioning repair or servicing heavy machines, come in steel tool boxes with trays. Techni-Tool has grouped the tools necessary for many specialties: the *model 7609* is suitable for house calls; the *model 7603* contains installation tools.

Carrying all the necessary tools in one pack obviously saves time and effort, and it also saves tools. GC Electronics makes a rollup pack (*model 8283*) full of alignment tools for TV and communications—just about any electronic adjustment job. Another pack, the *model 5050*, carries a comprehensive array of alignment sticks along with numerous small specialty tools—such as a stripper, a crimper, tweezers, soldering aids, a neon tester, a low-volt tester, a fuse puller, a heat sink for soldering, and many more.

Jensen Tools and the Electronic Tool Co. also provide kits of tools for us in roll-up packs or hard cases.



KIT OF TOOLS FROM VACO, neatly arranged in *Super Case*, includes most of what you need for home calls or at the electronics bench.



POCKET-SIZED HANDY-TOOL from Weller Xcelite fits slotted and Phillips screws, plus 1/4-inch and 7/16-inch hex-type screws.

Small handtools

Sometimes situations arise in servicing that can waste minutes—and therefore hours over weeks and months. A number of small tools exist only to rescue you from those embarrassing and generally profitless moments.

For example, how many times have you dropped a small screw or nut down into a crevice just out of reach? At such times, you wish for fingers that are 1/8-inch in diameter and 10-inches long!

What you could do is reach into your toolbox and pull out a GC Electronics flexible pickup tool, *model 5059*. It's 24-inches long, reaches deftly around corners and closes its little gripper "fingers" firmly around the lost object. It also holds tiny screws so you can start them in out-of-the-way places, or in areas such as beside an IF can where your own fingers won't fit. One pickup tool can hold a tiny nut while another one turns a tiny bolt.

Somewhat similar are three types of screwdrivers that hold onto screws: One is typified by the *Quick-Wedge* made by Kedman. It has a split double blade surrounded by a metal tube. Pushing the tube toward the tip thickens the split blade in the screw slot. This wedging action grips the screw as you insert it and start threading it. Vaco uses the same principle in their *K-series* screw-holding drivers. Phillips screws are harder to hold this way, but certain Vaco models manage it. However, you can't drive Phillips screws with these tools; you can only insert them and start threading them.

Another kind of holding screwdriver has a hollow blade, all the way to the tip. A small shaft inside the blade can be rotated; a small bit in the center of the screwdriver bit twists and grips the sides of the screw slot.

POMONA *DIP CLIP* for DIP-type IC's takes the difficulty out of testing IC's with snap-on clip that brings connections up where you can reach them.

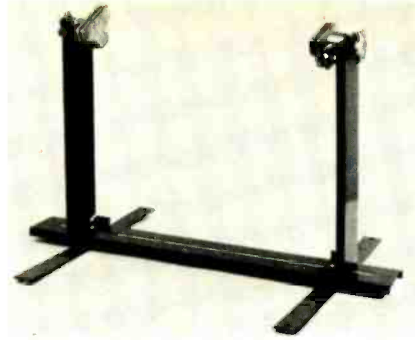
RATCHETING BALL-SHAPED HANDLE of White Products' *Easydriver* offers unique alternative to ordinary screwdrivers and nutdrivers.

A third version has little "fingers" or clips similar to those on the pickup tool mentioned earlier. You slide the finger clips down the blade until they snap onto the screw head. Then you insert the screw and start it. Before you tighten the screw, tug on the screwdriver and a spring pulls the clips free. Slide the clips up out of the way, and you can then tighten the screw. The only one of these we have found is GC *model H3-433*. This principle also works well with Phillips screws. Kedman makes a Phillips-holding screwdriver, the *model CP-24*, that incorporates this idea.

Magnetic screwdrivers and nutdrivers made by Weller-Xcelite accomplish the same purpose. You can start hex-head screws quite handily with magnetic drivers.

Magnetic tools are also handy for retrieving dropped bolts and nuts, for example, the magnetic retriever probe from GC, the *model H3-494*.

MAGNIFIER, SURROUNDED by 8-inch fluorescent lamp, shows parts and connections 1½ times actual size—almost necessary in miniature equipment so prevalent nowadays.



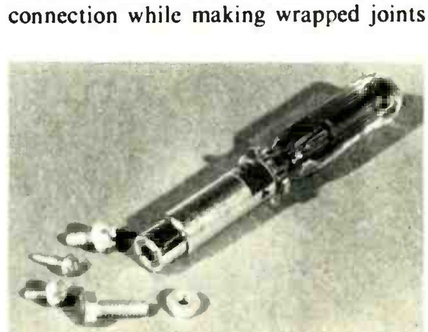
GC CHASSIS CRADLE—indispensable to changer servicing.

Speaking of screwdrivers, ask your distributor for a demonstration of the *Easydriver* made by White Products. This tool has a ball-shaped handle, made of Lexan. The ball-head design allows you to apply the strength of your hand and arm in just the right direction for plenty of torque. But the most unusual thing about the *Easydriver* is that it *ratchets*, in either direction. In many situations, this feature can be a real timesaver. This tool comes with blades for slotted and Phillips screws, plus 1/4- and 3/8-inch nuts; other blades are also available.

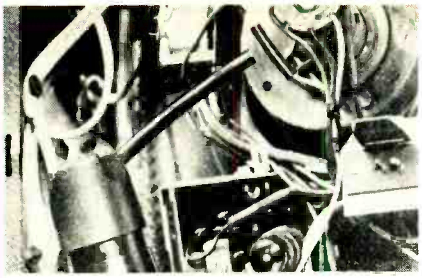
With respect to nutdrivers, an old-standby tool for many technicians is the Xcelite *model 600* four-way pocket tool. The handle is a 1/4-inch and 7/16-inch nutdriver, and the 7/16-inch end accepts a short, reversible slotted-and-Phillips screwdriver bit. Many techs and home-handymen own a half-dozen or more of these versatile multitools—for the kitchen, workshop, toolbox, car, truck, and in the service caddy.

There's also a new self-adjusting nutdriver from Vaco, listed as the *model SA711*. Just push it onto any nut or hex-screw head from 1/4-inch to 7/16-inch; and it fits automatically.

Here are some other tools worth mentioning. OK Machine and Tool Company makes a wire-wrapping tool, the *model WSU-30*, that lets you unwrap this kind of connection and restore it neatly when you're finished. The battery-powered *model BW-630* works faster than the hand tool. Vector also makes a line of manual and powered wire-wrap tools. Their *Slit-N-Wrap* versions even string the insulated wire from connection to connection while making wrapped joints



AUTOMATIC NUTDRIVER FITS SIZES from 1/4-inch to 7/16-inch without changing blade.



DIRECTING TINY JET OF AIR onto specific part or spot on circuit board, Wahl Clipper tool takes power from cordless soldering iron.

where needed. Vaco offers their *model 70007* outfit for removing screws that are stuck and have their head slots stripped. And, for removing and reinstalling snaprings without flipping them all over the shop, try the Vaco *model 70195 Snap-Ring Plier;* it's slip-jointed to fit a broad range of snap-ring sizes. Channellock specializes in pliers with adjustable jaw sizes and also makes a full line of electronics hand tools.

Finally, have you stripped a threaded chass hole lately? Vaco's *model TT31* tapping tool lets you quickly run new threads for 6-32, 8-32, or 10-24 standard bolts.

Time savers at the bench

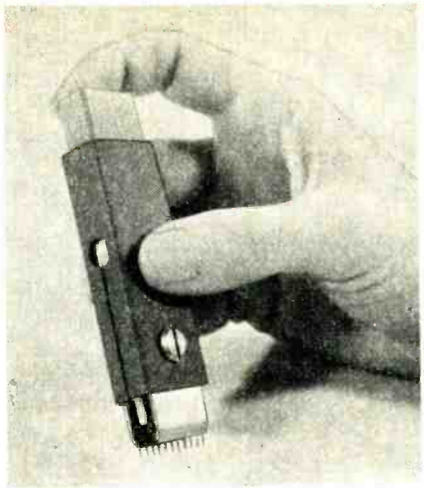
Here's a time-saving device that's been around a long time. It's a tool called a *chassis cradle.* GC Electronics makes one that works well—their *model 5212.* The chassis cradle holds almost any size cassette or tape-machine, record-changer (it's a *must* for them) or stereo chassis, and positions it so you can reach components or adjustments easily. It certainly is an improvement over propping a chassis up with boxes and solder spools.

Panavise makes a full line of small vises that are a must for any bench.

The Lafayette Radio Electronics catalog shows an X-Acto device called *Extra Hands* (Order No. 13R74289). This tool won't carry anything heavy, but it's great for holding plugs and such items for soldering. It treats the objects it holds more gently than a vise.

If you value your eyesight, don't do a lot of work in CB radios or other small PC-board sets without using a bench lamp/magnifier. Lafayette Radio and Allied Electronics both list such lamps in their catalogs. Your distributor probably has the *Luxo* version. These lamps incorporate a circular fluorescent bulb surrounding a 5-inch magnifying glass. Many trouble-shooting jobs may require two such lamps: one for viewing the PC board and components, and one for studying undersized schematics.

Any technician faced with an intermittent knows that it could be a thermal. Troubleshooting takes a special technique: you cool, then you apply heat. Suspect components are cooled with sprays such as GC's *Freeze-Mist;* Chemtronics' *Freez-It*; Tech-Spray, Inc.'s *Mi-*

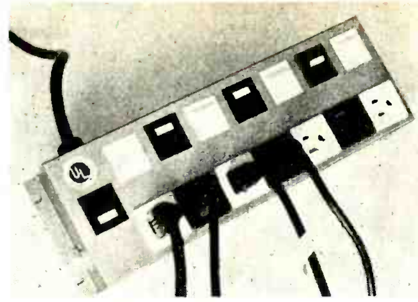


INSERTING DIP-TYPE IC'S into socket or PC board is easier with Techni-Tool gadget that squeezes pins while you plug in the IC.

nus 62 Instant Chiller; or Rawn Company, Inc.'s *Freeze.* (Keep these sprays off hot vacuum tubes.) Then you turn right around and heat the suspected part or board. Since a hair dryer is seldom hot enough, use a heat gun such as the *Master-Mite model 10011,* manufactured by Master Appliance Corporation. It has three heating nozzles and a deflector that narrows the hot air down to a concentrated blast. The gun is hot enough to shrink most heat-shrinkable plastics too. Wahl Clipper also sells a small thermal "tester." It's a handheld blower that directs a 260°F stream of air at a very small spot.

For a quick way to "wire up" your service bench, consider the electric outlet strips offered by SGL Waber Electric. The *model 25PCB-15* contains a master switch, a circuit breaker for the whole panel and seven 3-wire outlets—each with its own pilot-lighted switch. Fasten the panel to your bench with four mounting screws, plug in your instruments and plug in the 15-foot 3-wire (U-ground) cord. If you prefer a "console" type that

CHEMTRONICS C-150 *Freez-It* rapidly localizes intermittent components in circuits.



SGL WABER ELECTRIC PANEL eliminates power-cord "octopi" for test gear on your service bench. Circuit breaker and master switch offer protection and convenience.

fits on top of your bench or desk, consider the 8-outlet *model 97CB-15.*

Help around PC boards

Although PC boards have been around for a long time, they still worry many technicians. Some techs, for example, have not accepted the idea that you can open circuits by slicing the foil. It is easy to bridge the slit later with solder.

But just on the off-chance that you develop a case of the clumsies, keep a bottle of GC's *Copper Print* (Catalog No. 20-2) or *Silver Print* (Catalog No. 21-2) around. If you overheat a foil and it separates from the board, just snip it off. Then, with a fine brush paint a new copper or silver conductor. Dab the paint generously where components join the new conductor. Then spray on a covering of *Silicone Resin Lacquer* (Catalog No. 14-6).

You can't repair many electronic devices today without encountering IC's. Some problems involve testing: How do you reach all those closely spaced and nearly inaccessible pins? You can buy test clips that snap right onto the DIP.

One manufacturer of these gadgets is Continental Specialties Corporation, and another is ITT Pomona Electronics. Pomona calls their clip, appropriately, the *Dip Clip.* It comes in several sizes to fit IC's having 14, 16, 24 or 40 pins.

Rye Industries markets clip-on devices called *Kleps,* made in many sizes. E-Z Hook Test Products also offers a highly versatile variety of clip-on test probe.

In some sets you could get lucky. The IC might be in a socket rather than soldered to the PC board. Either way, however, the DIP could be difficult to plug in. The two rows of holes are not as far apart as the two rows of pins on the DIP. A device, such as the Techni-Tool *model 4990 Inserter,* can squeeze the pin rows slightly inward as you push the DIP into the socket or PC board. Easy if you have this tool; not always so simple if you don't.

Save save save time time time

You should know by now that the way to make more money in electronics servicing is by working faster and smarter. Better tools and a surer knowledge of how to use them are important. **R-E**

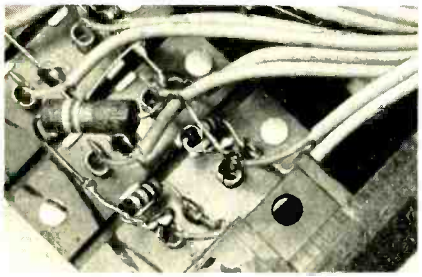
Tricks of Soldering/Desoldering

Constructor, experimenter and service technician all need to know soldering. Here's what it is all about

SOLDERING IS THE MOST BASIC SKILL A service technician must have. Yet, oddly enough, hardly any schools or courses teach soldering techniques.

For example, a young graduate of a two-year program at a private electronics school was hired by the small service department of a music store to repair music amplifiers, auto tape players and low-cost stereo systems. He lasted less than a week! In two returned repairs, his boss saw grossly botched soldering; both callbacks were a result of messy parts replacement.

Another example: A seasoned TV technician won a chance for much higher pay when he switched companies. His new job—with a modern, up-to-date firm—entailed work on auto radios, CB transceivers, video games, some home computer products and the newest TV receivers.



ELECTRONICS-SCHOOL GRADUATE made this kind of mess trying to solder new parts into a chassis.

After four days on the job, he almost lost his new position. He had never learned to replace multipin IC's. After the technician ruined a few new IC's, the service manager assigned him to a young technician who taught him to desolder and remove DIP-type IC's, clean up the board and then install a new IC without bending pins, cracking cases or overheating the IC's.

How could these situations develop? Apparently, soldering ability has come to be taken for granted. Schools assume the student will learn to solder on his own. But just as a thorough knowledge of theory does not assure an ability to troubleshoot electronic gear, neither can a technician necessarily learn how to solder well without some guidance.

Tool manufacturers have developed dozens of aids to proper soldering and desoldering. Yet good tools do not alleviate the need for some understanding of the principles of soldering. Technicians who "learn by doing" often find that, despite years of experience, their parts replacements look messy. Sometimes their soldering masks faults that contribute to callbacks and endless trouble-hunting.

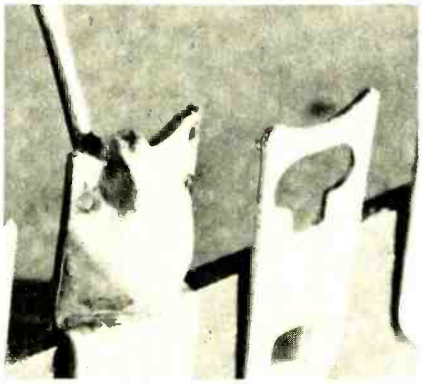
Not too hot, not too cold

Solder consists of tin and lead. Proportions determine the melting point of the solder. For example, 40/60 solder contains 40% tin (always listed first) and 60% lead. Tin melts at a much lower temperature than lead—about 360° F. Hence, 40/60 solder begins to soften (become plastic) at that temperature. Because of the high lead content, 40/60 solder does not become fully molten until its temperature reaches 460°F. The range between these two temperatures is called the solder's *plastic range*.

For electronic soldering, a narrower plastic range must be used. A 50/50 solder begins softening at 360°F, and melts completely at 415°F, which is still too wide a range. Because the solder stays plastic (soft) longer as it cools, *fractures* can occur in the solder joint if a wire or component shifts slightly.

You'll find 60/40 solder is the best for electronic circuit soldering. Its plastic

HEAVY-DUTY HEXACON SOLDERING IRON produces 300 watts to heat large areas for soldering.



SOLDERED JOINTS, GOOD AND BAD, depend on tools, solder, temperature and technique. Left photo shows the dull solder surface of a poor joint. Good joint (right) has a bright silvery surface.

WELLER SOLDERING GUN is still popular for many soldering chores; current heats wire tip.

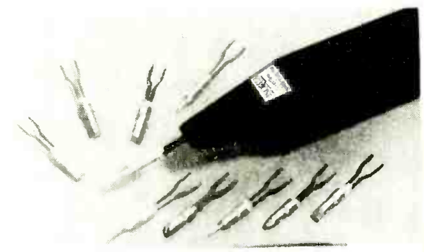
range extends from 360°F to a peak of 375°F. Therefore, it melts quickly once enough heat has been applied, and cools quickly when heat is removed.

One advantage to using this 60/40 tin and lead mixture, with its quick heating-cooling range, is that you are less likely to injure temperature-sensitive components. Solder flows properly only when you heat the entire joint—the component lead *and* the terminal or circuit-board foil—to a temperature that melts the solder. If heating either part of the joint takes too long, the heat conducted by the component leads may damage the component. Therefore, a quick-melting and quick-cooling solder reduces parts damage. (*Note*: For additional protection, place heat-sink clips or forceps on delicate part leads.)

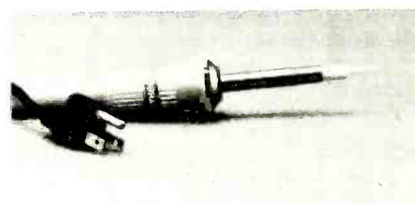
How and where should you apply the heat? Common sense helps only if you understand certain thermodynamic principles. Always apply soldering heat first to the heavier or *least* heat-conductive portion of the joint. As that side heats up, if the joint is solid mechanically, heat spreads to the lighter portion. By the time the heavy side melts the solder, the thinner side is almost ready. Touch solder to the heavy portion, and when the molten solder flows, it finishes heating the thinner or lighter material.

If both surfaces are clean and/or well-tinned (more on this later), solder covers all surfaces quickly and thoroughly—an action called *wetting*. Molten solder penetrates the metal surfaces slightly. As it solidifies, the solder bonds the surfaces. If nothing disturbs either side before the solder drops below 360°F, a solid, electrically sound joint is created.

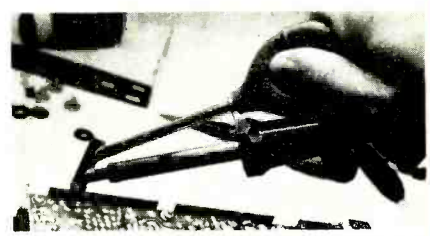
Heavy materials take longer to heat; they also retain heat longer and thus cool more slowly. You must be careful that neither object moves before the solder cools below its solidifying temperature. You soon learn to spot when a solder joint has cooled. Molten solder is shiny; cooled solder acquires a dull appearance. Even then, as long as the joint is still too hot to touch, hold it immobile a few moments longer. That lets the innermost core of the joint cool to below 360°F.



TIPS OF WAHL CLIPPER cordless soldering iron are isolated from handle, concentrate heat at tip.



UNGAR SOLDERING IRONS incorporate "modular" idea—you can select operating conditions to suit the kind of soldering you need to do.



DESOLDERING REQUIRES ONLY that you squeeze the bulb and release it when solder becomes molten. To resolder lead, place solder at joint and let hollow tip melt it into neat, solid connection.

Tools for soldering

Several companies that make soldering guns and irons are listed in Table I. You may find others at your electronics parts distributor.

A good soldering iron must transfer heat *efficiently* to the components of the joint being soldered. This ability stems partly from tip temperature, partly from tip size and shape and partly from how easily you can apply the tip to transfer

TABLE I
SOLDERING IRONS AND GUNS

Brand	Model	Gun	Iron	Wattage	Tip Temp. (F)	3-Wire Cord Avail.	Remarks
Edsyn	ER 140		•	16		•	
15958 Arminta St.	950CL080		•	50			
Van Nuys, CA 91406.							
Endeco	520-3		•	20	700°	•	
5127 E. 65th St.,	525-3		•	25	800°	•	
Indianapolis, IN 46220.	540-3		•	40	970°	•	
	540S-3		•	20/40	700°/970°	•	
GC Electronics	H3-380		•	30			
3225 Exposition Plaza,	H3-384	•		30			Barrel tip
Los Angeles, CA 90018							
Hexacon	21A, 22A, 23A		•	15–60		•	
161 W. Clay Ave.,	24S, 25S, 26S		•	20–60		•	
Roselle Park, NJ 07204.	P24, P25, P26		•	25–60		•	
	P70-P338		•	100–300		•	
	HD85-HD800		•	90–800		•	
Kager International	KL-3000	•		20	570	•	Barrel tips. Variety
1180 S. Beverly Drive		•		30	700	•	to meet all needs
Los Angeles, CA 90035		•		40	770	•	
		•		60	780	•	
Radio Shack (Archer)	64-2066	•		30			Barrel tip
2617 West Seventh St.	64-2190	•		100/140			Wire tip
Fort Worth, TX 76107	64-2073		•	25	640°		
	64-2065		•	30	640°		
	64-2071		•	42	640°		
	64-2080 series		•	27, 42, 50	650°, 800°, 900°		Modular design
Ungar	6900 series		•	10–18	575°–850°	•	Modular design
233 E. Manville,	360 series		•	27–45	650°–950°	•	Modular design
Compton, CA 90220.	6200 series		•	25–55	600°–1150°	•	Modular design
	100 series		•	27–45	650°–1000°	•	Modular design
	200		•				Cordless; quick charge
Wahl Clipper	7900	•					Cordless; solder feed
2902 Locust St.,							
Sterling, IL 61081.	7700		•	50	700°		Cordless; quick charge
	7500, 7800		•	50	700°		Cordless
Weller	8200-3	•		100/140		•	Wire tip
P.O. Box 728, Apex, NC	D550-3	•		240/325		•	Wire tip
27502.	GT7A-3, GT6B-3	•		150, 150	700°, 600°	•	Barrel tip
	WC-100		•		700°		Cordless
	WP25-3, WP40-3		•	25, 40	700°	•	
	W60, W100		•	60, 100	700°	•	
Wen	100	•		100			Wire tip
5810 Northwest Hway,	199	•		130			Wire tip
Chicago, IL 60631.	250	•		250			Wire tip
	288	•		200			Wire tip
	222	•		25–200			Barrel tip
	450	•		25–450			Barrel tip
	75	•		50			Barrel tip

heat quickly and effectively.

Temperatures range widely. Anything under 500°F probably won't work fast enough. Some soldering irons and guns bring tips to as high as 900°F. The average temperature is around 700°F, which is good for soldering or unsoldering most electronic joints.

Do not confuse heat with temperature. *Heat* is what brings the joint and solder to its melting *temperature*. Soldering thin wires and leads to thin foils takes very little heat, yet calls for the usual 360°–370°F to melt the solder. Thicker wires demand more heat to bring them up to melting temperature. Soldering to terminal lugs takes more heat than soldering to PC foils. Soldering to a chassis or other solid metal places heavy heat requirements on a soldering iron or gun.

That's why you see so many sizes of soldering tools. Usually, wattage rating correlates with heating capability. A 30-watt pencil iron heats PC foils without overheating them. A 100-watt iron or gun may, if it touches the foil too long, overheat foil and board enough to bring about foil separation.

However, a 100-watt tool could not solder even a thin wire to a chassis, because the chassis must also reach solder-melting temperature. A 250-watt iron or more would be necessary. Without enough heat to bring chassis-metal temperature high enough (360°), there is no wetting action of the solder on the chassis. Penetration fails to occur, and the result is a cold-solder joint that has poor electrical conductivity (especially for RF), corrodes easily and is mechanically unsound.

Heat requirements break down approximately like this: For soldering transistors and other tiny-wire components to PC boards, use 20 to 40 watts. To solder components with heavier leads, such as ordinary resistors and capacitors, you need 40 to 60 watts. Soldering to terminal boards and tube sockets demands around 100 watts.

You must remember that the heating capability of a soldering iron or gun must suit the *largest* surface or area of the item you heat. Heavy, solid wires of the variety used in electrical wiring need 250 watts or more. Hence, you choose an iron according to purpose. You probably will want to own more than one size. It won't do to apply a heavy-wattage gun or iron to delicate IC's and the like, nor can a small iron do heavy soldering.

Guns and irons

What else do you look for in a soldering tool? You can choose between a gun or an iron. Irons can range from tiny pencil units to 800-watt mammoths that solder sheet metal. Add to these a variety of cordless irons, and you see why you might have difficulty choosing one.

There are even a large number of "third hand" types of soldering tools. The "third hand" feeds solder to the work. One example of such an iron is made by Kager and is shown in the photos. Sure comes in handy when you need one hand to hold the iron and another for the work.

When you work with delicate IC's and FET's, static and leakage electricity can cause problems. For instance, a tiny pulse discharge from your soldering tool can blow a junction. Some irons are rated as "fully grounded."

It's not enough to insist on 3-wire power cords, although a good idea for personal safety. Proper protection against static at the soldering tip goes farther.

You can test for leakage by just plugging the iron in and turning it on. Set your high-impedance digital multimeter for *AC Volts* and touch one probe tip to a known outside ground. Touch the other DMM probe to the iron tip. If the meter reads as little as 1 volt AC, there is leakage to an ungrounded tip.

Weller, Ungar, Edsyn, and Wen are among the best known makers of soldering tools. Almost every technician is familiar with the Weller *model 8200* and its predecessors, with their inexpensive

continued on page 81

THIS SOLDER JOINT HAS just been desoldered. The hot solder has been sucked away leaving a component pin that will easily pull free from the circuit board.

DESOLDERING TOOL FROM EDYSN is a hand-held spring-loaded vacuum device that helps protect FET and MOSFET devices from failure due to static electricity.

TABLE II DESOLDERING TOOLS

Brand	Model or Part No.	Type
Edsyn 15958 Arminta St., Van Nuys, CA 91406.	DE180 AS196	Spring-loaded DIP heater/extractor "Soldapullt" spring-loaded piston-type sucker
Endeco 5127 E. 65th St., Indianapolis, IN 46220.	500-3 510-3	40W bulb-type desoldering iron; many tip sizes 20-to-40W bulb-type desoldering iron
Hexacon 161 W. Clay Ave., Roselle Park, NJ 07204.	R916 898F 882	DIP tip for soldering iron Tunnel tip for soldering iron Rubber-bulb solder sucker
GC Electronics 3225 Exposition Plaza, Los Angeles, CA 90018	684-H-390	Solder Braid
Radio Shack 2617 West Seventh St. Fort Worth, TX 76107	64-2085 64-2086 64-2090	Piston-type spring-loaded sucker Rubber squeeze-bulb sucker "Solder-Up" fluxed braid
Solder Removal Co. 1077 E. Edna Covina, CA 91724.	40-2-5 none	"Removic" DIP desolder/extraction station "Soder Wick" fluxed braid
Tech-Wick Mohawk Equipment Co. Box 4490 Yuma, AR 85364	S-16, R-20	"Tech-Wick" fluxed braid
Ungar 233 E. Manville, Compton, CA 90220.	7800 6943-46 6948 857 858 6982 6983	Bulb-type desoldering iron Circular TO-5 desoldering tip for iron Tunnel DIP desoldering tip for iron Slotted capillary tip for iron Block DIP desoldering tip for iron DIP lifter TO-5 lifter
Weller P.O. Box 728, Apex, NC 27502.	AC303P DS40-3 DS100	Rubber-bulb solder sucker 40W bulb-type desoldering iron Desoldering station

Build Pink Noise Generator

Tests Your HI-FI

Built around a single IC, this device is used to test the response of a hi-fi system and to set up a graphic equilizer

JEFFREY G. MAZUR

A VITAL COMPONENT IN ANY SOPHISTICATED AUDIO SYSTEM IS A graphic equalizer. This device allows you to taper the frequency response of a system to fit a particular need. An equalizer is used most often to match the audio system to room acoustics to achieve an overall flat response. Minor variations can also be made to please individual tastes or to correct for equipment deficiencies.

A typical equalizer can have as few as five or as many as 30 individual controls per channel depending upon the division of the audio frequency spectrum. Each control has a frequency range that follows a regular pattern. The most common pattern is an octave equalizer, in which each control covers the next octave, or doubling of frequency, from the one before it. Some equipment owners consider a graphic equalizer as a "super tone control" unit and often set the controls in an undefined or even random fashion. However, a more consistent, technical approach is needed for the instrument to be used as a room equalizer. One method for checking system response is to use a spectrum analyzer. Since most of us do not own (or cannot borrow) a spectrum analyzer, there is a less expensive alternative: a pink-noise generator that can be built for less than \$10.

The color of sound

Pink noise and white noise are terms that describe a complete mixture of all frequencies in one signal. The difference between the two terms lies in the relative amplitude of each frequency. White noise is characterized by equal energy per bandwidth. This means that there is an equal amount of energy, or loudness, in the frequencies between 20 to 40 Hz as between 40 to 60 hz or 1000 to 1020 Hz.

Pink noise, on the other hand, is characterized by equal energy per octave. Since an octave doubles the frequency, this means that there would be the same volume in the frequencies between 20 to 40 Hz, 40 to 80 Hz, or 640 to 1280 Hz. This is why pink noise is used in setting up an octave equalizer, whose controls follow this doubling pattern—the bandwidth (range of frequencies) of each control also increases by a factor of two.

Incidentally, it is a popular misconception that the noise generated between stations on an FM tuner is pink noise. This is not so. Interstation noise more closely resembles white noise, but not successfully.

Room equalizing

By feeding the pink-noise signal into an audio system through an equalizer, we can measure the overall response (including speaker and room acoustics) at each octave, or whatever bandwidth each control has. If the system is flat, equal loudness is obtained from the bandwidth of each equalizer control. Therefore, if you pass the pink noise through each control band separately and measure the volume from the speakers, you can set the response to be flat (or any other desired curve).

First, selectively isolate each equalizer filter. For a bandpass-type equalizer, as shown in Fig. 1, each filter section passes only those frequencies within its passband and the equalizer control varies the output from each filter. If the controls work to ground as shown in Fig. 1-a, you can isolate one filter section by placing all the other controls to their minimum position. If the controls are located somewhere else in the circuit, you can add switches to turn each individual filter on and off, as shown in Fig. 1-b or Fig. 1-c.

Figure 2 shows a "cut-and-boost" type of equalizer, in which each filter passes all frequencies with the appropriate effect only on the frequencies within its band. Thus, there is no way actually to isolate each filter separately. However, placing all but one control to their minimum position (−12 dB, for example) can effectively single out one audio-frequency band. Whatever effects that "bleed over" from the other filter sections have remain constant and do not affect the relative measurements.

The second requirement for effective room equalization is a means to pick up the sound from the speakers and display its relative amplitude on a meter. Most hi-fi systems have a tape recorder with a microphone input and a record-level meter. However, if this equipment is not available or you want a more accurate indication, you can construct a simple relative-volume indicator, as shown in Fig. 3.

Circuit

The design of a pink-noise generator is greatly simplified by

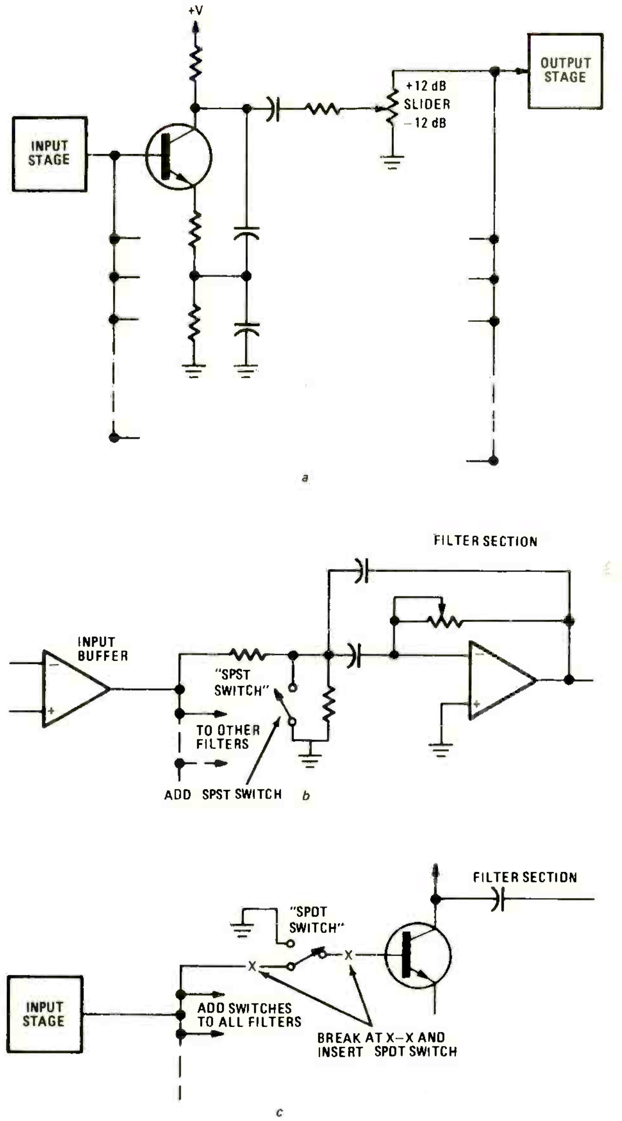
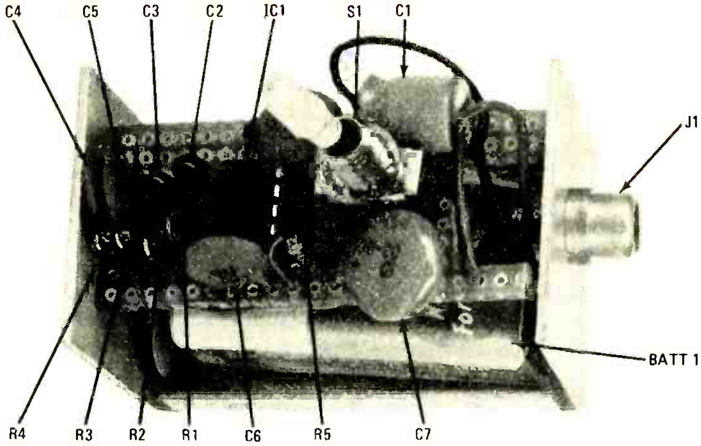


FIG. 1—TYPICAL BANDPASS-TYPE EQUALIZER designs. With the arrangement at *a*, filter circuit is cut out when slider-type level control is at the minimum-gain or ground end. Partial circuits at *b* and *c* show how switches can be added to ground the input to the filter section.



INSIDE THE PINK-NOISE GENERATOR. Its few parts are mounted on a small piece of perforated circuit board and connected by point-to-point wiring. The IC is in a socket.

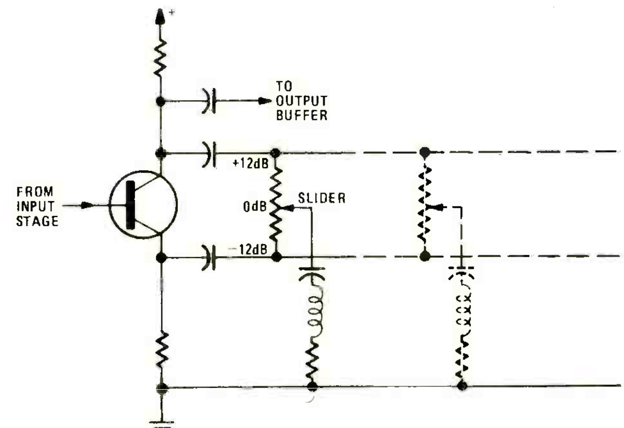


FIG. 2—IN THE CUT-AND-BOOST TYPE equalizer, you can't isolate each filter but you can minimize effects of the unwanted sections by turning them all the way down.

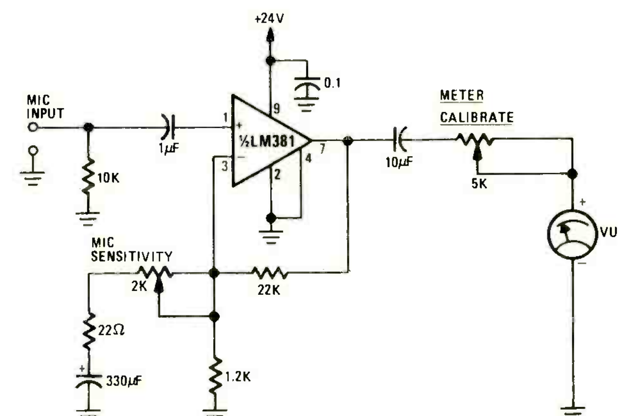


FIG. 3—SIMPLE RELATIVE-VOLUME INDICATOR can be made using one IC and a few parts, including an inexpensive meter.

the availability of a single-IC white-noise source, the MM5837. All this IC needs is power to start generating white noise. To get pink noise, it is necessary to recall the relationship between white and pink noise. Since white noise has equal energy per bandwidth, and since the bandwidth per octave doubles, the use of white noise produces double the energy per octave. Thus, the white noise must be passed through a filter that will reduce the signal amplitude by 3 dB-per-octave. Figure 4 shows how this is done.

Construction

A pink-noise generator is simple to construct. You can assemble the components on perforated board, and the entire unit can be mounted inside the equalizer and connected to its power supply. To prevent spurious signals from leaking into the system, provision should be made to apply power to the generator only when it is in use.

The generator can be housed in a small box with just an on-off switch and a phono jack for the output. Since the MM5837 is a MOS device, handle it with the usual precautions during construction.

Using the generator

Simply turn the generator on and connect it to the input of your system. If the unit has been installed inside the equalizer, connect it to the equalizer input. If the generator is used externally, feed the signal into the AUX, TAPE or other high-level input. In a stereo system each channel is equalized separately. Figure 5 shows for a typical arrangement.

Since all controls are adjusted relative to each other, one control can be arbitrarily set anywhere. For convenience, the middle control is chosen (or the control that affects frequencies of around 1000 Hz), and set to its center or flat position. All other controls are set to their minimum positions or switched off. To get a relative volume reading, place the microphone in a normal listening position and connect it to the tape-recorder input or level meter. Adjust the input level to O VU. Then, turn the middle control down and the first control up. Adjust this control for the same O VU reading. Mark the position of the

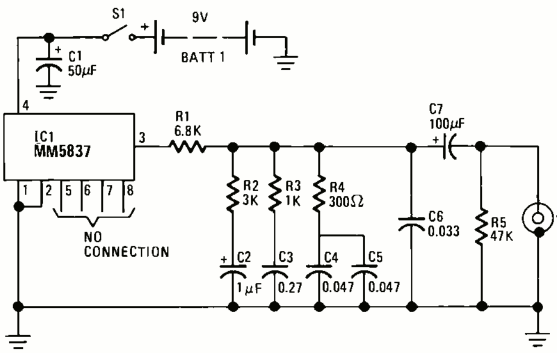


FIG. 4—SCHEMATIC DIAGRAM **of the pink-noise generator. When installed inside the equalizer, its output is fed to the equalizer input. The battery can be replaced by any supply voltage between 7 and 24 volts DC.**

PARTS LIST

All resistors are ¼ watt, 5%, unless noted.
All capacitors 10%, with voltage rating greater than supply voltage.

R1—6800 ohms
R2—3000 ohms
R3—1000 ohms
R4—300 ohms
R5—47,000 ohms
C1—50 μF
C7—100 μF
C2—1 μF
C3—0.27 μF
C4, C5—0.047 μF
C6—0.033 μF
IC1—MM5837 (National) digital noise source (or S2688 from AMI)
J1*—phono jack (optional)
S1*—SPST switch
BATT1*—9-volt battery (optional)
Misc.—battery clip*, 8-pin IC socket, case.*

The following parts are available from West Side Electronics, Box 636, Chatsworth, CA 91311.

Complete kit of parts including perforated circuit board, resistors and capacitors and excluding those marked by an asterisk, No. PNG-C, $9.95, postpaid.

Complete kit of parts, less battery, silk-screened case, No. PNG-K, $13.95, postpaid.

Assembled and tested kit, No. PNG-W, $19.95, postpaid.

California residents add state and local taxes as applicable.

slider with a pencil on the equalizer and return this control to its minimum position. Turn up and adjust each control in this manner. If the microphone frequency response is known, then the equalizer can be adjusted to this curve and the true response

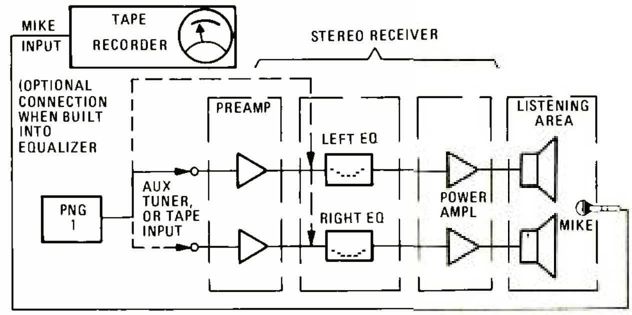


FIG. 5—CHECKING A TYPICAL STEREO SETUP. Mike is in normal listening position. Each channel is equalized separately.

will be flat. Otherwise, the accuracy of the procedure will depend on the response of the microphone.

When all controls have been set properly, disconnect the unit and place all sliders in their marked positions. At this point, the position of the controls marks the flat response setting for the room. You can now make minor alterations to the response to suit personal taste or to compensate for deficiencies such as poor highs from a tape recording.

Some other uses

There are several other uses for pink noise. There have been claims for the soothing and pain-relieving effects of pink noise although the extent of this use is questionable. Music synthesizers and recording artists sometimes use pink-noise generators. By using your pink-noise generator and equalizer, you can create the sounds of wind, rain, surf, etc. In addition, since the MM5837 is a digital noise source, the pink-noise generator can be used as a pseudorandom sequence generator.

Room acoustics

Any changes made to the listening area alters the room acoustics. For example, closing the drapes in a large room could drastically affect system response and necessitate re-equalization. You might consider placing several marks on the equalizer to account for these varying conditions. You must also remember that the response will be slightly different in different places in the room. Thus, it is not necessary to set the controls exactly—± 1 dB is sufficient. Finally, on the odd chance your equalizer controls do not cover equal octave ranges, don't give up. If the bandwidth of each control is known, you can use this measurement to determine at what meter level each control should be set. For example, if the middle control covers one octave but the low-frequency controls cover ½ octave, then set these controls for a reading that is 3-dB below the reference setting. **R-E**

AUDIO-OUTPUT TRANSISTOR SUBSTITUTE

I need a substitute for the audio-output transistor in a Sylvania CX2171W. I got a recommended substitute but the base diagram isn't the same. The base and collector are reversed. Any ideas?—A.C., Baldwinsville, NY.

In many cases you can cross the legs of a substitute transistor, being careful to put spaghetti on at least one, and get by. However, an RCA SK-3103 does have the same basing as the original.

NARROW RASTER

This Zenith 15Y6C15 has a narrow raster—about half an inch on each side. The chassis doesn't agree with either of the schematics I have. In the high-voltage adjust circuit, I see what looks like a VDR. If I shunt the ungrounded side of it to ground with a 100 pF capacitor, I get full width and the grid voltage on the horizontal output tube goes down from −55 to −45 volts. Are there any production changes in this chassis?—A.C., Canadensis, PA.

Yep. This is a late production 15Y6C15 chassis, and the high-voltage-regulator circuit is exactly as you described it. I believe this problem is being caused by that VDR, R110, Zenith part #63-7658. The VDR is used as a shunt rectifier fed by a pulse from the flyback. If the pulse goes up, it causes the grid voltage of the output tube to be driven more negative, thus reducing the output. It's obviously overdoing it; try a new one.

SMALL RASTER

A Zenith 13A16SZ came in with no raster, and the DC voltages in the horizontal section were all wrong. The flyback had too much resistance in one winding, so I replaced it—still no raster. The coupling capacitor between horizontal oscillator and output was leaky. Now I have a raster but it's small on all sides. This is usually low B+, but this time it wasn't. Boost voltage reads only +300 volts. So I'm confused again.—P.N., Houston, TX.

Confused? Welcome to The Club. You've found it; the boost voltage is far too low. Note that the boost also feeds the vertical-input stage; this would account for the raster being small on all sides like low B+.

The boost capacitor C68, 0.15 μF, could be open. Try bridging a new one across it. Since the boost is the *plate voltage* of the horizontal-output stage, it makes the outputs low. **R-E**

ATARI'S VIDEO COMPUTER SYSTEM provides color graphics, joystick controls, variable skill levels and six game cartridges available now. The games available now include *Combat, Indy 500, Space Mission, Video Olympics, Street Racer and Air-Sea Battle.* Each game offers 14 to 50 variations. The *Combat* game, for example, includes 27 variations such as Bi-Plane, Tank, Pong and Jet Fighter.

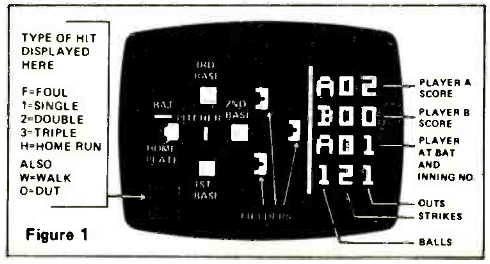
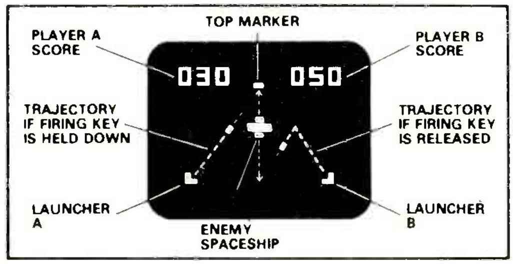
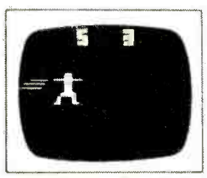


Figure 1

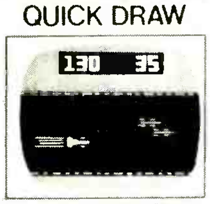


ACTUAL SCREEN PATTERNS of two of the *RCA Studio II* games. Baseball is at the top and one of the two Spacewar games at the bottom. Other games are available and the basic unit has four built-in games.

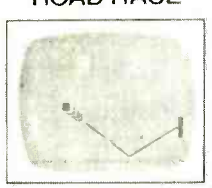
Programmable TV Games



QUICK DRAW



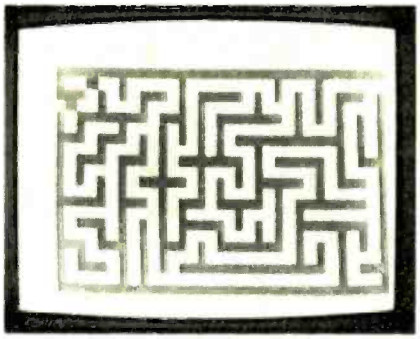
ROAD RACE

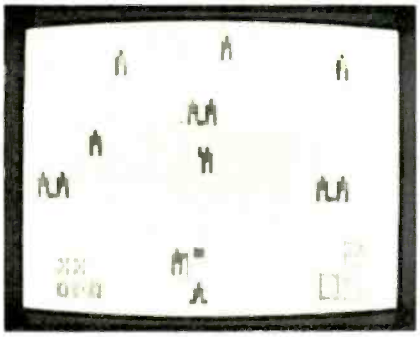


TENNIS

COLECO TELSTAR ARCADE offers three sets of controls and accessories plus plug-in game cartridges. Seventeen different games are provided by the cartridges now available. More will follow. Screen patterns appear in full color on a color TV.

RCA STUDIO II is shown above Calculator-type keyboards are used to play the games. A variety of cartridges are available now.





FAIRCHILD'S VIDEO ENTERTAINMENT SYSTEM was the first programmable unit to appear. It uses *Videocart* cartridges to set up the games. Current games include *Tic-Tac-Toe, Desert Fox, Spitfire, Black Jack, Baseball* and *Space War*. Others are on the way.

Games like the six shown here are competing with TV broadcasting for your viewing time. Not only will you have fun playing the games but they may lead to better TV viewing too

BALLY'S LIBRARY COMPUTER takes the programmable games concept and adds a calculator that prints out on the TV screen making the unit functional as well as entertaining. Also to come is an add-on that turns the unit into a home computer.

APF'S M-1000 MICROPROCESSOR shown at the right includes both keyboard and joystick controls. Cartridges for both games and educational purposes are available.

CB

Uncommon Circuits For Common Problems

An in-depth look at several novel transceiver circuits developed to conquer the problems associated with CB communications.

ROBERT F. SCOTT
TECHNICAL EDITOR

IN THE JULY 1977 ISSUE, WE COVERED three IF noise blanker circuits used in CB transceivers. A noise blanker that does not quite fit into the theoretical mold of most others is used in Radio Shack's Realistic *One-Hander*. As you will recall, the noise blanker works best on impulse-type noise. The basic noise blanker taps off a portion of the incoming signal close to the receiver's input circuits—generally well ahead of the highly selective IF circuits. Noise peaks are extracted from the composite input signal and then shaped and amplified. The shaped noise pulse is fed to a gate that disrupts the signal path for the duration of the noise pulse.

In the *One-Hander* circuit shown in Fig. 1, the noise blanker is connected *after* the ceramic filter and around the second IF amplifier. A portion of the amplified IF signal is taken off at the secondary of the IF output transformer and fed to the noise-blank detector diode. The rectified voltage appearing across the 560K detector load consists of noise pulses and the transmitted audio signal. This signal-plus-noise voltage is amplified and fed through a diode to the base of the noise-blank switching transistor. When the noise-blank switch conducts, it short-circuits the IF signal path to ground, thus preventing much of the noise pulses from reaching the AF detector and the following AF amplifiers.

Squelch and AMC

Squelch is essential to CB radio receiver operation since it can eliminate the annoying background noise that exists in the absence of a signal. Automatic modulation control (AMC) is an equally important adjunct to the CB transmitter. When properly adjusted, it limits the AF modulating signal so that the transmitter by AMC diodes D2 and D3 to develop a DC control voltage across the 10K adjustable trimmer (R1). This voltage is proportional to the level of audio on the modulated V_{cc} line.

Note that the 22K resistor and the

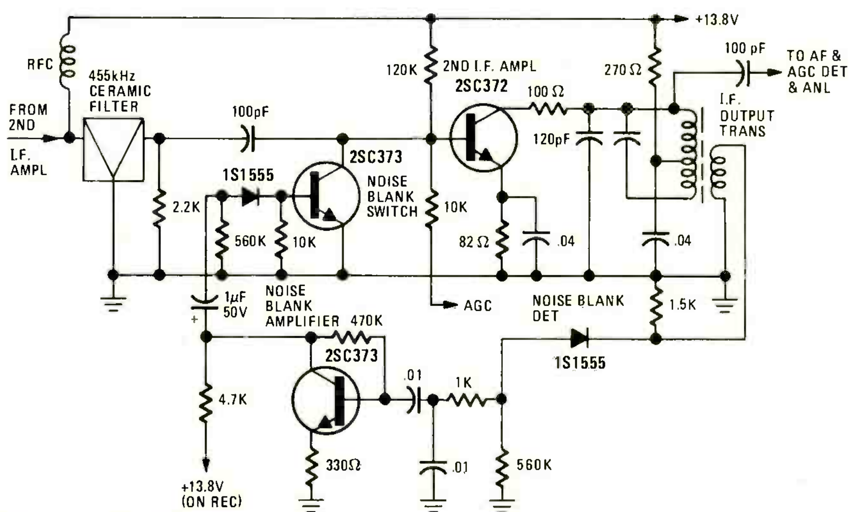


FIG. 1—AUTOMATIC NOISE BLANKER circuit in Radio Shack's *One-Hander* is connected after the 455-kHz IF ceramic filter.

cannot overmodulate and cause splatter-type interference on adjacent channels. Figure 2 shows the essentials of the AMC and squelch circuits in the Radio Shack *One-Hander*.

The signal from the microphone follows a path through the mike amplifier (Q1) and first driver Q4 to the push-pull AF output and modulator stage. A part of the modulated V_{cc} voltage is rectified

collector-base impedance of Q2 form a resistive voltage divider feeding the base circuit of the first AF driver. The AMC transistor collector-emitter impedance acts as the variable element in the voltage divider. Under normal conditions—where the modulating voltage is not high enough to cause overmodulation—Q2 is cut off. Therefore, Q2's internal resistance is very high and the major portion

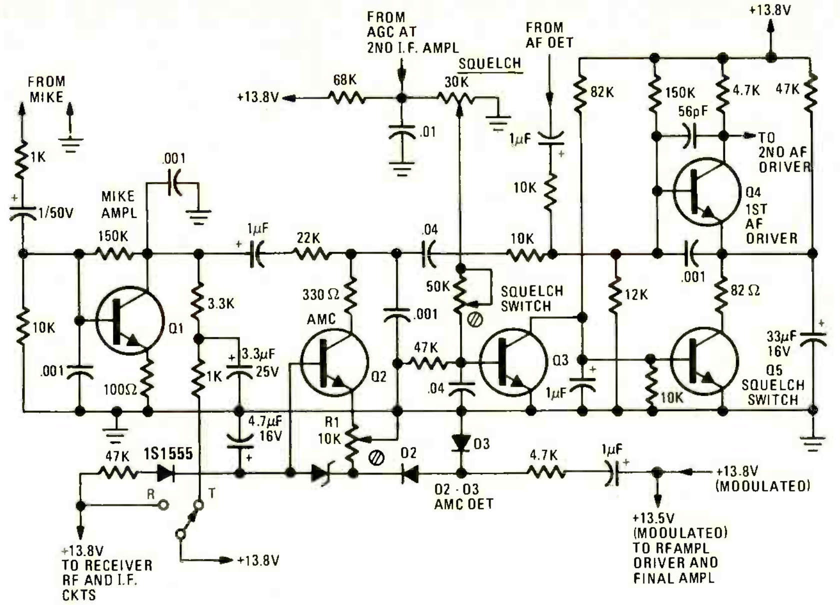


FIG. 2—AUTOMATIC MODULATION CONTROL and squelch circuits in Radio Shack's *One-Hander*.

of the signal voltage from the mike amplifier goes on to driver Q4.

When the modulation level exceeds 90%, the control voltage developed by diodes D2 and D3 is high enough to break down the Zener diode. The AMC transistor Q2 conducts and its internal impedance drops, thus limiting the incoming audio peaks to the point where the modulation does not exceed 90%.

When receiving, V_{cc} voltage (+13.8 V) is switched from collector Q1 to the receiver's RF and IF circuits. The audio from the AM detector output is fed through a 1-µF capacitor and a 10K resistor to the base of Q4.

The squelch circuit consists of switching transistors Q3 and Q5. For a signal to pass from the AM detector to the output, transistor Q3 is cut off while Q5 conducts and appears as a very low resistance in series with the emitter resistor of Q4.

Squelch action is controlled by the AGC voltage level on the second IF amplifier and by the SQUELCH control setting. In the absence of an incoming signal, the SQUELCH control is adjusted just to the point where Q3 conducts, turning off Q5. Squelch switch Q5 now appears as an open circuit in the emitter return of Q4. Audible background noise is eliminated by this action.

When a signal is received, the developed AGC voltage at the SQUELCH control balances out the cutoff bias on Q3. This turns on Q5, which permits Q4 to pass the incoming audio signal. As soon as the incoming RF signal drops out, Q3 turns on and Q5 turns off to squelch or mute the receiver.

LED panel meter

While many transceivers use a moving-coil panel meter both to measure incoming signal strength and as a modulation indicator, E. F. Johnson uses six LED's in place of the meter. One LED, fed by the modulated 12.5-volt line, is the modulation indicator. The other five LED's—connected to the output of a DC amplifier—light progressively as the incoming signal strength increases.

Figure 3 shows how this scheme is used in Superscope's *Aircommand model CB-640*. In this application, there are eight LED's: One, on the extreme left, indicates when power is turned on. The remaining seven LED's check SWR, indicate transmitter output power and modulation level and show the strength of the incoming signal. Figure 4 shows how the LED's react under different operating conditions.

When setting up the LED indicators as an S meter, feed in a 50-µV unmodulated Channel-19 signal and adjust the 4.7K trimmer for 6 volts DC at the emitter of the 2SC1213. The S9 lamp (LED 7) should light up as the generator output is raised to 100 µV. Reduce the generator's

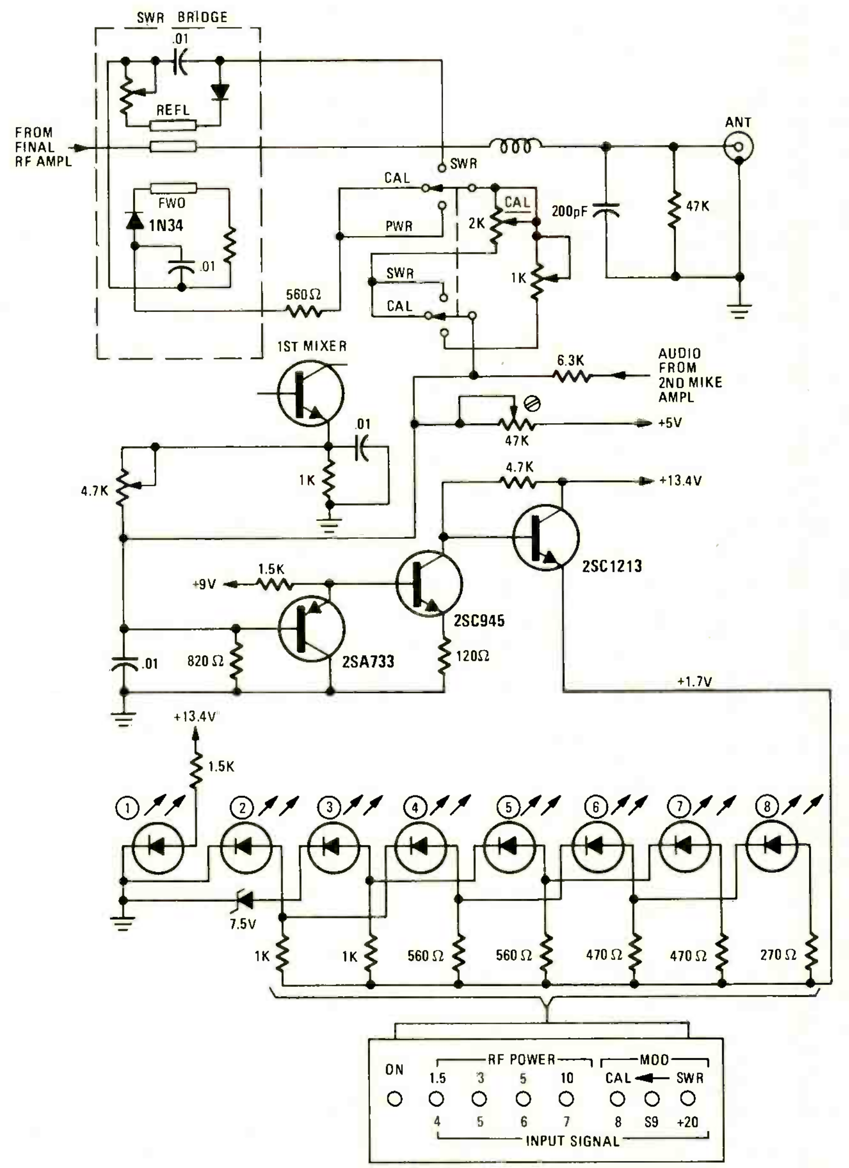


FIG. 3—EIGHT LED's in the Superscope model CB-640 indicate SWR, output power, modulation level and signal strength.

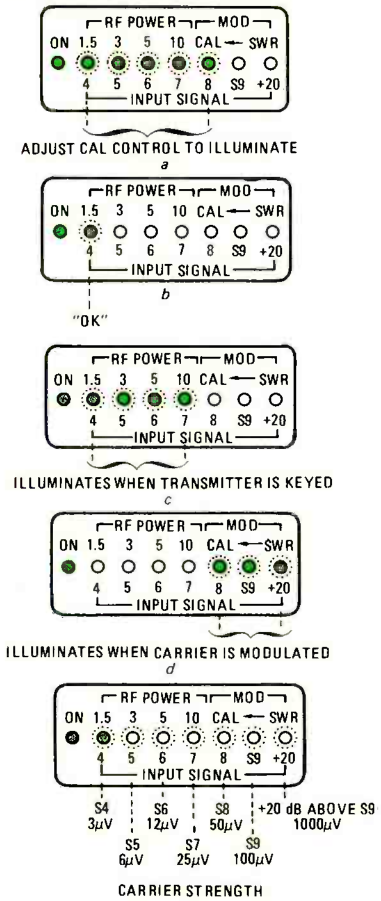


FIG. 4—VARIOUS FUNCTIONS can be displayed on LED indicators of the Superscope transceiver. Correct SWR calibration is shown in *a* and actual SWR is shown in *b*. Other functions include output power (*c*), modulation level (*d*) and signal strength (*e*).

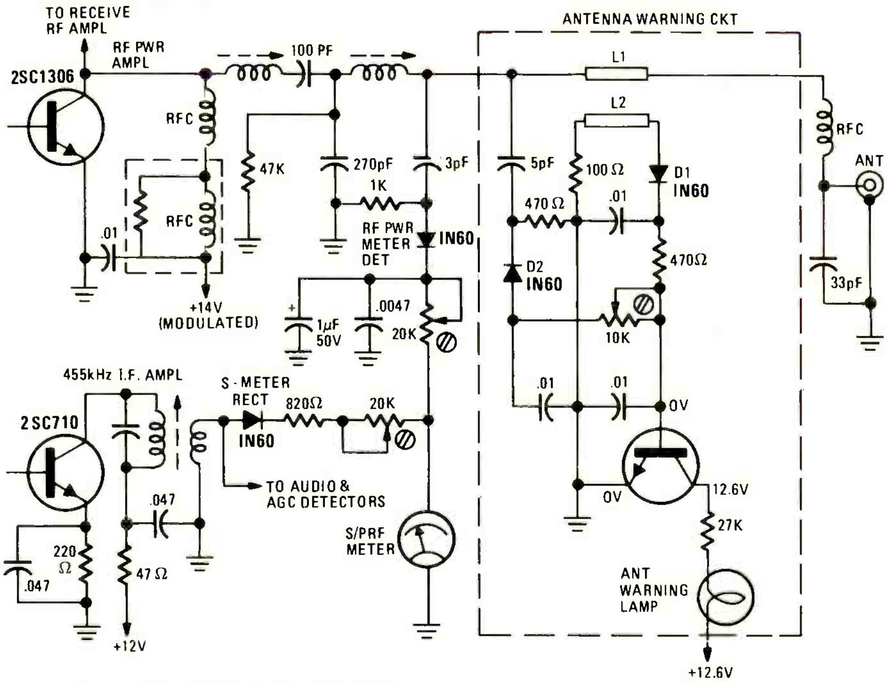


FIG. 5—ANTENNA WARNING circuit in Midland model 13.882C lights indicator lamp at first sign of abnormal SWR.

output to 0 and the S4 lamp (LED 2) goes out.

In setting up for the other meter functions, a 50-ohm dummy load and power output meter are connected to the transmitter output. The 47K potentiometer is adjusted until LED 2 is turned off. The Press-to-Talk switch is pushed, and the external wattmeter should indicate 3.8 watts as specified. With a 3.8-watt unmodulated output, the 1K potentiometer is now adjusted until LED's 2, 3, 4 and 5 are lighted.

Modulate the rig 100% with a 1-kHz note to insure that all LED's, including LED 6 and LED 7, light up.

To check the standing-wave ratio (SWR), set the switch to the CAL position and adjust the 2K CAL potentiometer until all LED's up to the CAL point (LED 6) light up. Throw the switch to the SWR position to make sure that LED's indicating over a 1.5:1 SWR do not light.

Replace the 50-ohm dummy load with a 250-ohm device that will yield an SWR of 5:1. Recalibrate the bridge and then read the SWR. Adjust the 500-ohm potentiometer in the bridge until LED 4 indicates an SWR of 5:1.

Antenna warning indicator

A disconnected antenna or a damaged coaxial cable can cause a very high SWR that can damage transistors in the output stage of the transmitter. Many CB rigs have a built-in SWR meter that is also used to indicate power output, signal strength and modulation level. Thus, the operator may not be aware of trouble in the antenna until the transmitter's output stage has been damaged.

The antenna warning circuit in the Midland *model 13.882C* transceiver lights a 12-volt warning lamp at the first sign of an abnormal SWR. Figure 5 shows the circuits, in which lines L1 and L2 are the familiar transmission-line sections of the SWR bridge.

The transistor in the warning circuit has its base connected to resistive networks that are in turn connected to diodes D1 and D2 that rectify the forward and reflected voltages on the transmission line. The circuit is adjusted so that the transistor is biased on when the SWR is high enough to cause damage.

A panel meter indicates RF power output and incoming-signal strength. When transmitting, the RF power output voltage drives the meter. In the receive mode, the meter gets the rectified output of the IF stage. **R-E**

CB LACKS SENSITIVITY

A new Cobra CB showed very poor sensitivity when installed in the car, but performed perfectly on the bench. I found out what was going on by accident.

On the bench, the speaker was floating (an external speaker was used with it). I left this speaker in the car when testing. After some time, I discovered that one side of the car speaker voice coil was grounded! You guessed it. Whoever had hooked up the external speaker plug had also reversed the wires. Since the hot voice-coil lead went to ground, the receiver apparently had very poor sensitivity.—S. L., Bogalusa, LA.

I used to make quite a bit of money reversing speaker leads in old Ford radios. I haven't run into this problem since about 1948!

FOCUS RECTIFIER CHECK

Is there a good quick test for solid-state TV focus rectifiers? You can't read them with an ohmmeter.—C. H., Port Angeles, WA.

Well, there's one quick check for the focus *circuit* in older TV sets. If the high voltage and boost are normal but the focus voltage is too low, the problem is in the focus voltage supply. Most often, this problem is caused by a bad solid-state rectifier. Normally, the resistors do not have much effect. Substitution is the quickest check. The focus rectifier is driven by the same pulse that drives the high voltage etc. Therefore, if these are normal, the drive pulse is normal. So, the problem must be in the focus circuitry.

TRANSFORMER REPLACEMENT

Help. We can't locate a replacement power transformer for this Sanken amplifier in any electronics catalog.—H. W., Asheville, NC.

You just haven't been looking in the right place! Thordarson's *Transformer Replacement Guide* lists a great many lower-voltage transformers.

A Thordarson 23V428, which is an exact duplicate of the Sanken unit, is 36 volts center-tapped at 2.0 amp. For use with the full-wave rectifier circuit you showed, tape off the center tap.

HI-FI

Easy Way To Test Phono Cartridges

The phono cartridge and its stylus are often the weakest link in the hi-fi system. Test records can help you evaluate your system and keep an eye on its performance.

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

MOST OF THE MUSIC YOU LISTEN TO OVER your hi-fi system begins as a series of modulations or minute wiggles in a record groove. The phono cartridge translates those tiny and often complex modulations into electrical signals that are amplified and applied to your loudspeakers. If your cartridge is not performing properly, no amount of compensation applied to the other stereo components can make things sound right.

While many audio dealers offer audio clinics to test and check amplifiers, preamplifiers and even FM tuners, few shops can actually evaluate phono-cartridge performance. If you own an audio oscillator, an AC VTVM and even the most basic oscilloscope, there are many amplifier tests you can make. Adding a distortion analyzer further enhances your ability to evaluate the purely electronic elements in your hi-fi system. But what can you use (other than your own ears that can often deceive you) to check out the performance of one of your most important components, the phono cartridge?

It would be ideal if you could place the stylus on a piece of test equipment containing a precision transducer. The transducer could then transmit the equivalent of those groove modulations right into the cartridge on a carefully controlled basis. Although some researchers are presently looking into just such a piece of test equipment, no such gadget is yet available for consumer use. The only solution, then, is to use a specially prepared test record. In recent years, several high-quality test records have been marketed containing signals that allow you to check more than just frequency response. For example, CBS Records has seven test records; two are ideally suited for home use and require a minimum of additional equipment to interpret results properly. Even if you don't own a scope, you can hear what's happening as you play the various record bands.

STR-130 test record

CBS test record *No. STR-130* offers three bands of spot-frequency announcements followed by individual frequencies, all recorded using the inverse of the RIAA playback-equalization curve. This means that connecting a meter at the record-output or tape-output terminals of a preamplifier, amplifier or receiver should result in a flat response if the cartridge and preamplifer equalizers are operating correctly. This test record also contains continuous sweep frequencies for use with graphic plotters. However, if you don't own such automated equipment (and how many home hi-fi buffs do?) you can still plot an accurate point-by-point response curve. Twenty-nine separate frequencies are announced and played, ranging from 20,000 Hz down to 20 Hz in approximately third-octave increments.

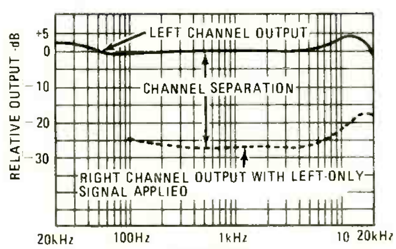


FIG. 1—FREQUENCY RESPONSE of test cartridge (left-channel only) was plotted using the STR-130 test record. Lower plot shows crosstalk.

Figure 1 shows a response curve that was plotted using a high-quality phono cartridge. We set the 1,000-Hz level as an arbitrary 0-dB point (the 1-kHz test tone is presented first) and based the rest of the response curve about that point. Don't be too surprised if you obtain the same kind of resonant peak at the high end as we did with our sample cartridge. Every phono cartridge has some resonant point up near the high end of the audible range. If there is an inordinately high "peak" in the response curve, this could mean that the cartridge is not being loaded properly.

Magnetic cartridges require a fixed-load resistance (usually 47,000 ohms) *and* a fixed capacitance across the output terminals. Most of this capacitance is provided by the shielded audio cables connected between the turntable's output terminals and the phono-input terminals on the amplifier or receiver. Many manufacturers specify the optimum capacitance that should appear across the phono cartridge, but few audiophiles pay much attention to this specification. In the case of most magnetic cartridges, as much as

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

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200 to 400 pF of capacitance may be required to "tame" that upper response peak. Using the *STR-130* test record, you can easily experiment and add fixed capacitance values (small capacitors are best wired across the phono-input jacks) until the high-end response is as smooth as the rest of the curve shown in Fig. 1.

Figure 2 shows what happens to the

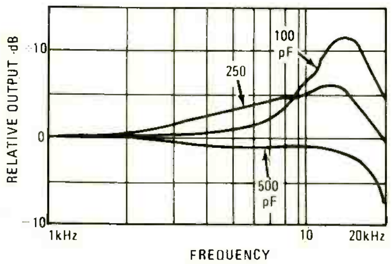


FIG. 2—HIGH-FREQUENCY RESPONSE depends on the amount of capacitance across the output of the cartridge.

high-end response as different capacitance values are added. In checking results of added capacitance, you can save time by stopping the "spot frequency announcements" at around 5,000 Hz (the frequencies begin at 20,000 Hz and decrease gradually).

The *STR-130* record is called the RIAA System Response Test record. The rear panel of the record jacket describes the record contents and use, and contains a table that indicates the exact amount of boost or cut required at different frequencies in the RIAA record or playback curve.

Remember, during the frequency response tests, you will be measuring the combination of the record's output as well as the RIAA playback characteristic built into the preamplifier section of your amplifier or receiver. If you suspect that the RIAA equalization in your amplifier or receiver is not quite right, you can check it by feeding signals from an audio oscillator directly into the phono inputs, plotting the response curve obtained and comparing it with the curve and values presented on the back cover of the *STR-130* test record. Even a 1-dB or 2-dB deviation from the correct RIAA equalization at the frequency extremes can audibly "color" the music.

STR-112 test record

Frequency response is just one of several cartridge characteristics you should be concerned with. Another CBS test record *No. STR-112* provides signals for more sophisticated testing. Among other things, the record contains a series of "tracking" bands with high-level lateral and vertical modulations. Remember, when a phono pickup traces the grooves of a stereo record, the stylus must move both laterally and vertically. The bands on the *STR-112* record contain sinewave modulation levels recorded in increasingly high increments. Both lateral and vertical bands begin at a +6-dB level relative to 11.2 μm, which is equivalent to the 0-dB music level at 300 Hz (the frequency used in these bands). Lateral bands increase to +18 dB, while vertical bands increase to +12 dB, the maximum modulation encountered on music records.

To use these bands, begin with the +6-dB signal and determine if mistracking occurs on this or subsequent higher levels by listening or by observing the waveform on an oscilloscope. In our tests, we used a storage scope to display successively higher modulation levels of the 300-Hz signal in 3-dB steps. The results are

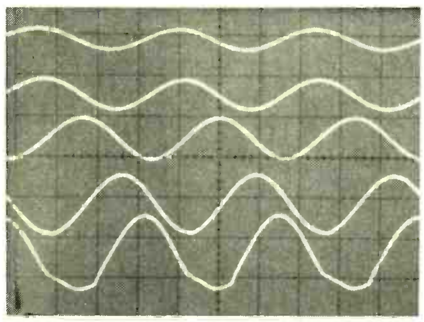


FIG. 3—SINEWAVE SIGNALS are used on the STR-112 test record for the trackability tests. Starting at the top of the scope screen, each successive trace indicates a higher modulation level. Mistracking is evident in the lowest trace.

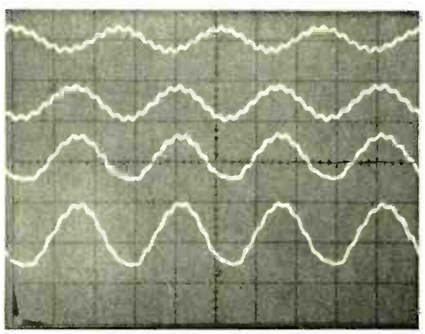


FIG. 4—IM DISTORTION is evaluated using a mixture of high- and low-frequency sinewaves. Starting at the top of the scope screen, each successive trace indicates a higher stylus velocity modulation level. IM distortion is evident in lowest trace.

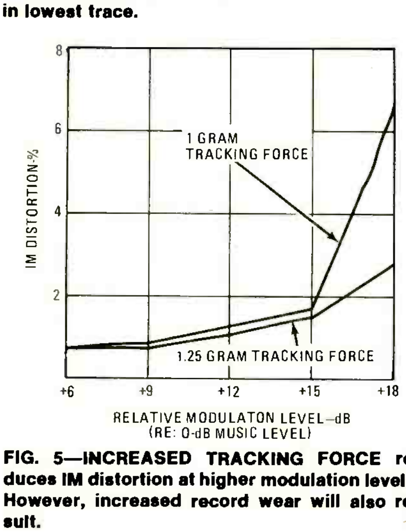


FIG. 5—INCREASED TRACKING FORCE reduces IM distortion at higher modulation levels. However, increased record wear will also result.

shown in Fig. 3; the lower modulation level is shown at the top of the screen and the successively higher levels are displayed below. The test cartridge performed well at +6, +9, and +12 dB, began to show some distortion at +15 dB and exhibited a great deal of distortion at +18 dB (lower trace). Often adjusting the tracking force to a somewhat higher value (all tests were conducted at a 1.0-gram downward force) and readjusting the antiskating force control contained on some better turntable systems allows tracking at higher levels (up to +18 dB with a good cartridge).

Other *STR-112* test bands permit you to evaluate the amount of intermodulation (IM) distortion produced by your cartridge at different modulation levels. First, a 4,000-Hz modulation level is presented for reference. Then, 400 Hz is added to this tone, with increasing amplitude. In another set of bands, 200 Hz is used as the low-frequency component of the combination test signal. The low-frequency component is increased in 3-dB steps until it attains a peak that is 18 dB above a nominal 5 centimeters-per-second stylus velocity. In general, amplitudes of this magnitude are seldom encountered during actual music reproduction. The combination of tones can be applied to the input of an IM distortion meter, observed on an oscilloscope, or even listened to. The increased IM distortion will be apparent even to an untrained listener when it begins to occur in significant amounts.

Figure 4 shows successively higher and higher outputs of this combination test tone. Note that in the bottom trace (and even, to some degree, in the trace just above it), the high-frequency component has been clipped on the negative-going peak of the composite waveform—a clear indication of increased IM distortion. Again, a slightly higher tracking force or more careful antiskating adjustment could have cleaned up the output waveforms. Note that while the IM distortion percentage rises rapidly for this sample cartridge at a 1.0-gram downward tracking force (see Fig. 5), increasing the downward force to 1.25 (still within the recommended tracking force range for this particular cartridge) improves the IM distortion considerably.

TTR-103 test record

Shure Bros., Inc., has done quite a bit of research into cartridge measurement techniques, and have produced test record *No. TTR-103*. The record is designed primarily to be used with a specialized piece of Shure test equipment available only to Shure dealers. However, much can be learned about a cartridge simply by listening to the record or by observing the output of a suitable preamplifier on an oscilloscope.

The *TTR-103* test record checks trackability (the ability of the cartridge and stylus to accurately trace great groove modulations) for three frequency ranges: low, medium and high. For the high-frequency tests, a 10.8-kHz burst signal with a 270-Hz repetition rate is used. Maximum peak velocity that the stylus will have to trace begins at 15 centimeters-per-second and increases first to 19 centimeters-per-second, then 24 centimeters-per-second and finally 30 centimeters-per-second. Figure 6 shows the outputs observed during this high-frequency trackability test, with the lower velocities at the top, and higher velocities in succeeding lower sweeps. The tests showed little or no distortion at velocities of 15 and 19 centimeters-per-second; some distortion appeared at the 24 centimeters-per-second velocity and, finally, considerable distortion appeared as the velocity was increased to 30 centimeters-per-second.

The medium-frequency trackability test signal contained in the Shure *TTR-103* test record bands consists of a mixture of equal-amplitude 1,000-Hz and 1,500-Hz signals. As the cartridge begins to mistrack, sum and difference components (500 Hz and 2,500 Hz) will appear if a spectrum analyzer or wave analyzer is used. However, even if the results are observed on an oscilloscope or listened to carefully, it is easy to know when midfrequency mistracking occurs. Maximum velocities of stylus travel required by these test bands begin at 20 centimeters-per-second and increase to 25 centimeters-per-second, 31.5 centimeters-per-second and, finally, to 40 centimeters-per-second. Figure 7 shows that the sample cartridge did pretty well for the 20 and 25 centimeters-per-second velocities, began to have problems at a peak velocity of 31.5 centimeters-per-second and really "fell apart" when at a peak velocity of 40 centimeters-per-second.

The low-frequency trackability tests provided by the *TTR-103* test record are almost identical to the IM distortion tests supplied in the CBS *STR-112* test record, in that 400-Hz and 4,000-Hz combined signals are used to test the cartridge. In the case of the Shure test record, however, stylus peak velocities are defined in centimeters-per-second and range from peak velocities of 15 centimeters-per-second to 30 centimeters-per-second. Figure 8 shows trackability problems at a peak velocity of 24 centimeters-per-second (the third trace from the top of the scope face), and when the stylus tried to trace this composite signal at a peak velocity of 30 centimeters-per-second, trackability problems became pronounced.

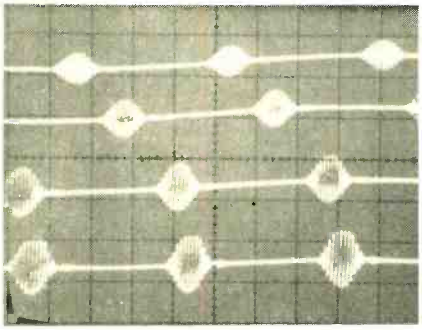


FIG. 6—HIGH-FREQUENCY TRACKABILITY TEST on TTR-103 test record consists of burst signals. Starting at the top of the scope screen, each successive trace indicates a higher stylus velocity. Lowest trace (stylus velocity of 30 cm-per-second) shows mistracking in the form of waveform clipping.

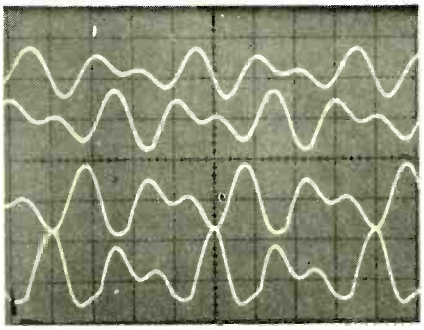


FIG. 7—MIDFREQUENCY TRACKABILITY TEST on TTR-103 test record consists of a mixture of high- and low-frequency sinewaves. Mistracking is evident in lowest trace in the form of waveform distortion. Lowest trace corresponds to highest stylus velocity (30 cm-per-second).

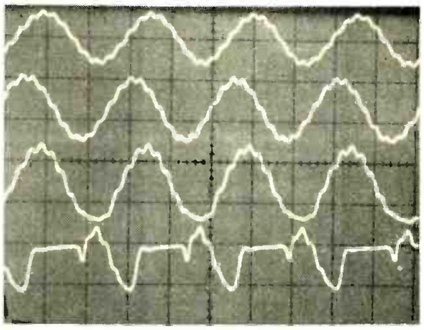


FIG. 8—LOW-FREQUENCY TRACKABILITY TEST on TTR-103 test record. Mistracking is evident in lowest trace. Lowest trace corresponds to highest stylus velocity (30 cm-per-second).

The few test records discussed in this article (as well as others) are very useful in evaluating phono-cartridge performance and, more important, can guide you in your attempts to adjust your turntable for best possible performance. However, if a cartridge is very old and does not represent the state-of-the-art, no amount of adjustment or tracking force increase may clean up the distorted waveforms. It is also possible that a cartridge can be good, but mounted in a tone arm that is not compatible with it. In that case, there is only one possible solution: shop for a new cartridge, a new turntable system, or both. **R-E**

RCA home videotape recorder records up to four hours

A suggested retail price of $1000 has been set by RCA for its new four-hour, home videotape recorder. This figure is about $300 less than the suggested retail prices of the Sony and Zenith two-hour cassette systems.

Matsushita of Japan, which makes the videotape recorder for RCA, has its own VHS system it plans to market in the U.S. under its Panasonic label later this year, but declined comment on price and date of entry into the videotape market. Sony and Zenith, at this writing, were not planning any price change.

At least 15 U.S. and Japanese companies have gone on record stating they plan to make videotape recorders using either the Betamax (Sony) or VHS formats; the problem now is whether Sony or Matsushita can supply them with enough units to keep up with the demand. Sony expects to produce about 30,000 units per month (half for the U.S. market), and although Matsushita has yet to get into full swing, RCA division marketing vice president Jack Sauter predicts that his industry's sales of recorders would reach 250,000 at the end of 1977 and 750,000 by 1978.

In comparing the VHS system with the Sony Betamax system, RCA stressed the former's smaller size, lighter weight and more energy-efficient mode of operation. To make a four-hour recording, the RCA tape drive unit spins at 1.67 centimeters-per-second, or half the speed provided by the two-hour recording capability also contained in the system. The reason for providing two speeds, explains David E. Daly, RCA division vice president, is to afford compatibility between VHS recorders. In other words, any two-hour cassette recorded on your neighbor's machine can be played on your VHS unit. Such flexibility is not true for a four-hour recording which must be played back on the same machine.

You can attach the RCA unit to the antenna leads of any TV set to make color recordings off the air or with a camera. The machine can play prerecorded tapes; record one program while you watch another; and when used with a timer, can even record without anyone having to be in the room.

"With coffee so high it's seldom I'm offered any . . . even though a cup or two makes me work much faster & more efficiently!"

Radio-Electronics Tests Dual C-939 Cassette Deck

1

LEN FELDMAN
CONTRIBUTING HI-FI EDITOR

IF YOU BELIEVE THAT THE CASSETTE DECK HAS been perfected to its ultimate state, you will be surprised to learn that Dual, known for their precision line of record players, has managed to come up with a few operating features and performance capabilities in their new *model C-939* cassette deck that raises the level of that once lowly recording format yet another notch. Bidirectional playback, the ability to record in either direction and even continuous cassette play are not unique to this machine, having been featured in Dual's earlier auto-reverse deck and in other competitive cassette models over the past few years. But Dual's execution of these intricate capabilities, plus some other new features of the *model C-939*, put it into a class by itself.

Figure 1 shows the front panel with both its conventional and unusual controls. A three-digit counter and reset pushbutton are accompanied by a rewind-MEMORY pushbutton to the left of the cassette compartment. The cassette door is smoothly and slowly opened by depressing the EJECT button that also turns off the machine. Cassettes are easily inserted in guides on the cassette door itself, for error-free positioning. Keyboard pushbuttons along the lower edge of the front panel handle STOP, CONTinuous, RECORD, fast rewind, reverse play/record, forward play/record, fast forward and PAUSE functions. The normal speed (forward or reverse) pushbuttons do not remain depressed when selected, so that the automatic reversing action that takes place at the end of play (if selected) does not pop up either of these keys. The PAUSE pushbutton can be used to preset all level controls before the recording begins.

Three round pushbuttons along the lower right of the panel select either Fe, Cr or FeCr while simultaneously applying the correct bias and equalization for the tape used. Three pushbuttons to the right of the tape selectors activate the Dolby circuitry, select Dolby FM (for recording or decoding Dolby FM broadcasts, including compensation for the required 25-ms de-emphasis), and a LIMITER circuit. Microphone input jacks and a phone jack are also located along the lower right-hand portion of the front panel. Separate slide-type level controls for the left- and right-channel line inputs and microphone inputs are located at the center right of the panel. To the left of these controls are two pairs of output-level and Dolby-calibration controls; all four controls are recessed almost to panel-surface level, since they are considered to be one-time or seldom-used adjustments that should not be accidentally miscalibrated.

Heaphone output-level controls are slightly more elevated from the front panel (what a convenience having separate level controls for main and headphone outputs). Two small rotary controls handle Dual's unique fade-edit feature—the left control is a spring-retained knob which, when rotated against the force of the retaining spring, can be pressed downward into the panel. This releases an erase head that can then be used to selectively fade out or eliminate specific portions of a recorded program. The level of fade or erasure is determined by the second rotary knob to the right.

Perhaps the most unique section of the control panel is the tiltable platform at the upper right. Since the *model C-939* can be operated horizontally, vertically (even mounted on a wall with hardware supplied), or at a tilt-up angle (with brackets supplied), this platform (which contains the record indicators) can also be tilted for best viewing. Instead of conventional VU meters (or even VU meters augmented by a single peak-indicating LED), the entire metering system consists of tiny LED's (seven green and five red LED's per channel). The LED's are calibrated from −20 dB to +5 dB. Furthermore, the LED banks can be switched to either peak or VU (average) indications by means of a slide switch located below the indicator rows.

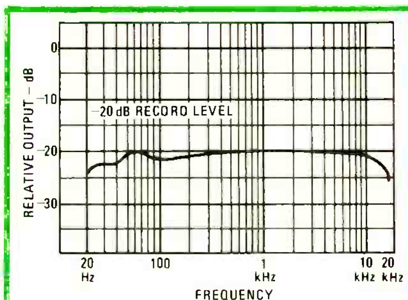
CIRCLE 109 ON FREE INFORMATION CARD

The tiltable platform also contains lights that show which direction the tape is traveling (necessary in a two-direction deck), a Dolby indicator light and a light that indicates the record mode. All these valuable indicating devices are contained in a surface area no larger than 6 × 2 inches. This LED arrangement solves the problem of adequate dynamic range in cassette recordings, and a user need no longer be concerned with the so-called "ballistics" of this or that meter, the nature of the music being recorded and so forth. In fact, with this sort of level-indicating device, Dual could easily have omitted the limiter circuit that is intended only be used in live recording situations in which an operator might not be able to control overly high instantaneous levels produced by poor mike technique.

Construction and circuit details

The two capstans of the *model C-939* are driven by a synchronous continuous-pole motor that is elastically suspended and independent of voltage, temperature and load variations. A precision flat belt drives the capstans while the tape take-up reel is driven by a second belt directly from the motor. Fast wind uses a different, gear-drive system.

Electronic amplifiers and other circuits are constructed on plug-in modules for easy servicing. A hard Permalloy 4-track record/



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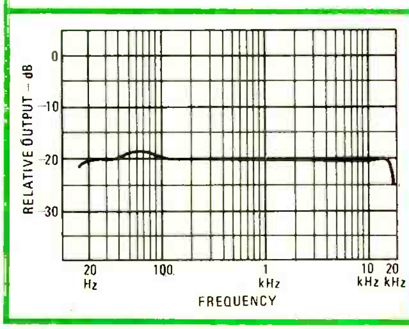

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MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Frequency Response: Ferric, 20 Hz to 16 kHz; CrO_2, 20 Hz to 17 kHz; FeCr, 20 Hz to 17 kHz (no tolerances given). **Wow-and-Flutter:** 0.05% WRMS. **Signal-to-Noise Ratio:** Ferric, 63 dB with Dolby; CrO_2, 63 dB with Dolby; FeCr, 65 dB with Dolby. **Total Harmonic Distortion:** Less than 1.0% at 0 VU record level. **Erasure:** 70 dB. **Fast Wind Time:** 60 seconds for C-60 cassette. **Bias Frequency:** 80 kHz. **Input Sensitivity:** Mike, 0.3 mV; line, 70 mV. **Output Level:** 0 to 700 mV (variable). **Dimensions:** 17.3 W × 5.9 H × 11.8-inches D. **Suggested Retail Price:** $550.

TABLE I

Manufacturer: **Dual (United Audio)** Model: **C-939**

CASSETTE TAPE DECK MEASUREMENTS

	R-E MEASUREMENTS	R-E EVALUATION
FREQUENCY RESPONSE MEASUREMENTS		
Frequency response, standard tape (Hz-kHz ± dB)	30-15, 3.0	**Very good**
Frequency response, CRO_2 tape (Hz-kHz ± dB)	20-14.5, 3.0	**Good**
Frequency response, other (see text) Hz-kHz ± dB	See Figs. 2,3	
DISTORTION MEASUREMENTS (RECORD/PLAY)	**UD-XL-I UD-XL-II**	
Harmonic distortion at −3 VU (1 kHz) (%)	1.0 0.75	**Excellent**
Harmonic distortion at 0 VU (1 kHz) (%)	1.0 0.85	**Excellent**
Harmonic distortion at +3 VU (1 kHz) (%)	1.1 1.1	**Superb**
Record level for 3% THD (dB)	+10 +7.0	**Superb**
SIGNAL-TO-NOISE RATIO MEASUREMENTS		
Standard tape, Dolby off (dB)	58	**Excellent**
Standard tape, Dolby on (dB)	67	**Excellent**
CrO_2 tape, Dolby off (dB)	60	**Superb**
CrO_2 tape, Dolby on (dB)	69	**Superb**
MECHANICAL PERFORMANCE MEASUREMENTS		
Wow-and-flutter (%, WRMS)	0.04	**Superb**
Fast wind and rewind time, C-60 (seconds)	45	**Very good**
COMPONENT MATCHING CHARACTERISTICS		
Microphone input sensitivity (mV)	0.3	
Line input sensitivity (mV)	73.0	
Line output level (mV)	650	
Phone output level (mV)	1350	
Bias frequency (kHz)	80	
TRANSPORT MECHANISM EVALUATION		
Action of transport controls		**Superb**
Absence of mechanical noise		**Excellent**
Tape head accessibility		**Very good**
Construction and internal layout		**Excellent**
Evaluation of extra features, if any		**Superb**
CONTROL EVALUATION		
Level indicator(s)		**Superb**
Level control action		**Good**
Adequacy of controls		**Excellent**
Evaluation of extra controls		**Excellent**
OVERALL TAPE DECK PERFORMANCE RATING		**Excellent**

TABLE II

Manufacturer: **Dual (United Audio)** Model: **C-939**

OVERALL PRODUCT ANALYSIS

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

Comments: Perhaps the most impressive feature of the Dual *model C-939* cassette deck is the multiple LED arrangement used to indicate record and playback levels. Much more precise than even some of the better record level meters used on high-priced cassette decks, the calibrated LED arrangement really insures against over recording, and yet allows the user to take fullest advantage of the dynamic range available on cassette tapes. The auto-reverse feature (ability to play in both directions without turning over the cassette and the ability to record in either direction) has a smooth action and a totally reliable tape azimuth alignment. The dual-capstan drive is positive and consistent, making the system less subject to variations. The fade-edit feature enables you to erase preselected portions of a recording *after* the recording has been made and permits professional fading effects to be added later—without the user having to act as a real-time recording engineer. While the frequency-response capability is not as great as higher-priced decks, it is adequate, and, more important, the low wow-and-flutter specs permit a recording that approximates that possible with 7½-inch-per-second open-reel decks.

Dual has created a logical and thoughtful balance between frequency response, distortion and signal-to-noise capability. Not too long ago, a signal-to-noise ratio of 60 dB (*without* Dolby) would have been considered a dream when it comes to cassette performance. Yet, that figure was actually measured using Maxell UD-XL-II tape (for which the machine seems ideally calibrated, when the CrO_2 tape switch is activated). This new entry from Dual must be seen and tried to truly appreciate it.

playback head is used along with *two* erase heads (necessary because of the bidirectional tape handling facilities).

Laboratory measurements

Results of our lab measurements are listed in Table I and can be compared with the manufacturer's published specifications listed in this report. Frequency response, using a sample of Maxell UD-XL-I tape, is shown in Fig. 2, and Fig. 3 shows similar measurements for a sample of Maxell UD-XL-II tape. The latter tape sample requires the CrO_2 tape-selection setting, while the UD-XL-I tape was tested by pressing the Fe tape pushbutton. It is difficult to compare Dual's frequency-response claims with our results because the manufacturer's specification fails to indicate a tolerance (±dB value). Although the results may not be as impressive as those claimed (and achieved) by higher-priced competitive units, frequency response is only one performance criterion. Our summary comments together with overall product evaluation are shown in more detail in Table II.

The double-capstan and motor/belt drive arrangement is successful in terms of tape transport uniformity as evidenced by the extremely low wow-and-flutter figure (0.04% WRMS) obtained in our lab measurements. Even unweighted, the wow-and-flutter was only 0.08%. Note that the various signal-to-noise ratios shown in Table I are all *unweighted* figures.

Use tests

The full flexibility of the *model C-939* can only be appreciated through a hands-on session with the machine. For example, when we made our frequency-response checks at the usual −20 dB record level, it was gratifying to observe that the green LED level indicator labeled "−20 dB" lights up (with no others illuminated), which attests to the extreme accuracy of the LED level indicators. Transition from forward play to reverse play is smooth and noise-free, and it is possible to reverse the direction of play without first depressing the STOP button. At end of tape travel (in either direction), the transport not only comes to a stop (and the capstans are disengaged), but power to the entire deck is automatically shut off—a real boon to the forgetful operator. In short, Dual seems to have thought of everything that many other manufacturers have overlooked. Superlatively low distortion, high signal-to-noise ratios, smooth tape transport action and adequate bandwidth all contribute to a cassette deck that would fit in nicely with the very best high-fidelity component systems. **R-E**

Sansui AU-717 Amplifier

CIRCLE 110 ON FREE INFORMATION CARD

THE INTEGRATED AMPLIFIER HAS BEEN CHARacterized as being "midway between a receiver and separates." This category seems to imply that an integrated amplifier is not quite as flexible or as high in performance capability as a separate basic amplifier preceded by a preamplifier-control unit. In the past this was generally true, but now there is a group of integrated amplifiers that offer as much circuitry sophistication and control flexibility as any two-piece amplifying system. Typical of this new breed is Sansui's impressive *model AU-717*, a moderately priced, relatively high-powered unit.

At the lower left of the black front panel (see Fig. 1) is a POWER on-off lever switch and, directly above it, an indicator light that flashes for a few seconds immediately after turn-on, until circuits have stabilized and the audio outputs have been connected to the speaker terminals. The light also flashes a warning whenever the built-in protection circuits are activated. The SPEAKER switch selects either or both sets of speakers connected to the unit. Step-type BASS and TREBLE controls, mounted one above the other, are augmented by pushbuttons that determine crossover points—400 Hz or 200 Hz for bass, 6 kHz or 3 kHz for treble. Four switches at the lower center of the panel come next. These switches handle tone defeat, subsonic- and high-cut filter switching and loudness.

A large dB-calibrated step-type VOLUME control dominates the panel and is located above a much smaller channel-balance control knob. To the right of this control knob is an audio MUTING switch that lowers the listening level by a fixed 20 dB. Three vertically arranged interlocking pushbuttons select SOURCE, TAPE 1 or TAPE 2; a rotary tape COPY switch used with the tape pushbuttons can select dubbing from either tape deck to the other, tuner dubbing, source, or an off position that disconnects both tape-output jacks when taping is not desired. At the upper right-hand side of the panel is a program SELECTOR switch with two PHONO positions and settings for TUNER or AUX.

The rear panel of the *model AU-717* contains the usual banks of speaker terminals. These terminals are spring-loaded for the easy insertion of stripped speaker wires. One switched and two unswitched AC convenience receptacles are located near the speaker terminals. To the left are the preamplifier-output/main amplifier-input jacks that are interconnected (or separated) by a slide switch that is locked in the connected mode to prevent the inadvertent disconnection between the preamplifier and amplifier unless done so deliberately for bi-amplification or to interpose some accessory device between these two circuit points. The usual array of tape-input and tape-output jacks plus a chassis ground terminal and a line fuseholder complete the rear-panel layout. The rear panel is shown in Fig. 2.

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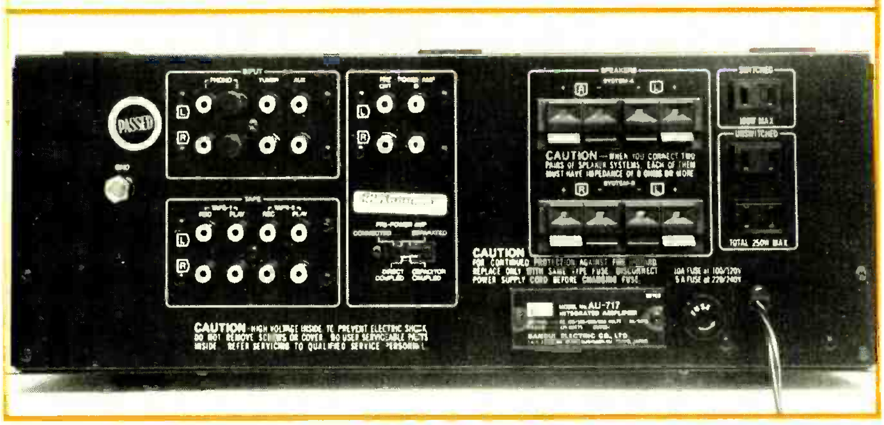

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Power measurements

Table I shows our measured results for the power-amplifier section. One clear advantage of DC design is apparent. Even at the low 20-Hz extreme, the amplifier delivers a full 92 watts—the same value obtained for midfrequency power—compared with its 85-watt rating into 8 ohms. In this amplifier, the high-frequency power capability proves to be the limiting factor and that determines the FTC power rating of the unit, since 86 watts was obtained at a 0.025% rated distortion for this frequency—just a bit higher than the 85 watts claimed. Although Sansui does not provide a power rating for 4-ohm loads, we measured the amplifier's power capability with 4-ohm loads connected, and again the power-output limitation was observed at the high-frequency extremes, with readings of 94 watts for 0.025% rated distortion. The THD reading at a nominal 1-watt output really consisted of noise rather than distortion. Since 1-watt levels are around 19 dB lower than the rated 85-watt level, and since the noise reading was 0.02% of the 1-watt output, this translates to around 74 dB of noise at a 1-watt level, or 93 dB of noise at full output—precisely the reading that was obtained when subsequent noise measurements were made.

Preamplifier measurements

The equalization characteristic of the preamplifier was one of the most precise we have ever measured, with the deviation from the standard RIAA playback curve never exceeding more than 0.1 dB. In Table I, the phono hum and noise is referred to the unit's own 2.5-mV input sensitivity—and not to a higher, irrelevant 10-mV sensitivity, as is often the case. The 380-mV overload figure for phono is far greater than would ever be required using even the highest output magnetic cartridges available.

MANUFACTURER'S PUBLISHED SPECIFICATIONS:

Power Output: 85 watts-per-channel continuous power 8 ohm loads, 20 Hz to 20 kHz. **Rated Harmonic Distortion:** 0.025%. **Rated IM Distortion:** 0.025%. **Damping Factor:** approximately 60 at 8 ohms. **Frequency Response (Power Amp In):** 0 to 200,000 Hz, −3 dB. **Input Sensitivity:** phono 1 & 2, 2.5 mV; high level, 150 mV. **Phono Response:** RIAA ±0.2 dB. **Phono Overload:** 350 mV. **Signal-to-Noise Ratio (A Weighted):** phono, 78 dB; high level, 100 dB. **Bass Range:** ±10 dB at 50 Hz. **Treble Range:** ±10 dB at 15 kHz. **Subsonic Filter Cutoff:** 16 Hz, 6 dB-per-octave. **High Filter Cutoff:** 10 kHz, 6 dB-per-octave. **Audio Muting:** −20 dB. **Power Requirements:** 110-130 V, 60 Hz, 735 watts (maximum). **Dimensions:** 16 15/16 W × 6 5/8 H × 15 3/4 inches D. **Weight:** 39.2 lbs. **Suggested Retail Price:** $450.

TABLE I

Manufacturer: **Sansui** Model: **AU-717**

AMPLIFIER PERFORMANCE MEASUREMENTS

	R-E Measurement	R-E Evaluation
POWER OUTPUT CAPABILITY		
RMS power/channel, 8-ohms, 1 kHz (watts)	92.0	Very good
RMS power/channel, 8-ohms, 20 Hz (watts)	92.0	Excellent
RMS power/channel, 8-ohms, 20 kHz (watts)	86.0	Good
RMS power/channel, 4-ohms, 1 kHz (watts)	118.0	Not rated
RMS power/channel, 4-ohms, 20 Hz (watts)	115.0	Not rated
RMS power/channel, 4-ohms, 20 kHz (watts)	94	Not rated
Frequency limits for rated output (Hz-kHz)	Below 10-22	Excellent
DISTORTION MEASUREMENTS		
Harmonic distortion at rated output, 1 kHz (%)	0.0085	Superb
Intermodulation distortion, rated output (%)	0.025	Good
Harmonic distortion at 1-watt output, 1 kHz (%)	0.02	Good
Intermodulation distortion at 1-watt output (%)	0.012	Very good
DAMPING FACTOR, AT 8 OHMS	55	Excellent
PHONO PREAMPLIFIER MEASUREMENTS		
Frequency response (RIAA ± dB)	0.1	Superb
Maximum input before overload (mV)	380	Superb
Hum/noise referred to full output (dB) (at rated input sensitivity)	82 "A"	Excellent
HIGH LEVEL INPUT MEASUREMENTS		
Frequency response (Hz-kHz, ± dB)	2.8-68, 3	Excellent
Hum/noise referred to full output (dB)	93 "A"	Very good
Residual hum/noise (minimum volume) (dB)	93 "A"	Good
TONAL COMPENSATION MEASUREMENTS		
Action of bass and treble controls	See Fig. 5	Excellent
Action of secondary tone controls		
Action of low frequency filter(s)	See Fig. 6	Excellent
Action of high frequency filter(s)	See Fig. 6	Fair
COMPONENT MATCHING MEASUREMENTS		
Input sensitivity, phono 1/phono 2 (mV)	2.5/2.5	
Input sensitivity, auxiliary input(s) (mV)	150	
Input sensitivity, tape input(s) (mV)	150	
Output level, tape output(s) (mV)	150	
Output level, headphone jack(s) (V or mW)	138 mW	
EVALUATION OF CONTROLS, CONSTRUCTION AND DESIGN		
Adequacy of program source and monitor switching		Excellent
Adequacy of input facilities		Excellent
Arrangement of controls (panel layout)		Very good
Action of controls and switches		Excellent
Design and construction		Superb
Ease of servicing		Good
OVERALL AMPLIFIER PERFORMANCE RATING		Excellent

TABLE II

Manufacturer: **Sansui** Model: **AU-717**

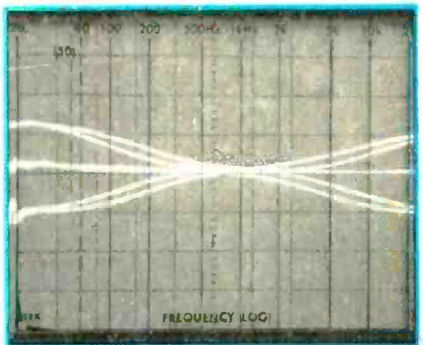
OVERALL PRODUCT ANALYSIS

Retail price	**$450**
Price category	**Medium**
Price/performance ratio	**Excellent**
Styling and appearance	**Excellent**
Sound quality	**Superb**
Mechanical performance	**Very good**

Comments: While the emphasis placed on the DC power-amplifier design is certainly justified, we were even more impressed by the control precision built into the Sansui *model AU-717*, and by its moderate price. Sansui claims that this unit has reduced transient intermodulation distortion—a direct result of the DC design, and, indeed, the *model AU-717* delivered sound as transparent and clean as any we have heard from an integrated amplifier (and equal to that produced by some of the better basic power amplifiers). It should be pointed out, however, that only the power-amplifier section is DC-coupled from input to output, so that the claimed bandwidth (from 0 to 200,000 Hz) is somewhat meaningless when all program-source inputs must first travel through the non-DC preamplifier and control sections. The filters are a mixed bag. While the high-cut filter has too gradual a slope and begins to cut at too high a frequency (affording no more noise suppression than is possible with the TREBLE control), the subsonic filter cuts off at around 16 Hz and effectively reduces subsonic rumble without affecting the musical bass content at all. The combination of the tape COPY switch plus the separate TAPE PLAY button arrangement allows you to record FM programs from a connected tuner even while listening to other programs. The off position of the tape COPY switch prevents the tape decks from interacting with the rest of the system, which is important if the input impedance of your connected tape machines is less than optimum.

Figure 3 shows the tone-control range. In this variable-turnover design, the maximum amount of bass or treble boost and cut remains virtually the same at the frequency extremes, regardless of the turnover point selected.

Figure 4 shows that the high-cut filter action is extremely gentle, and, while Sansui maintains that this was done in order not to introduce phase shifts, we found that the high-cut filter, in its practical applications, was of little use; the same degree of cut was obtain-



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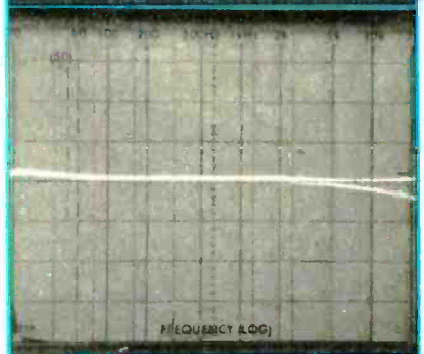

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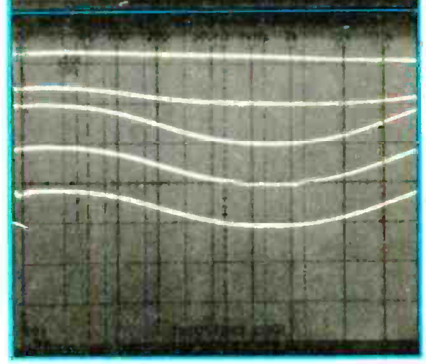
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able using the regular TREBLE control. Although Fig. 4 does not show the subsonic-filter action, the subsonic filter in the *model AU-717* effectively removes this unwanted range of frequencies without affecting musical reproduction.

Figure 5 shows the loudness-control action at various volume settings, and, in addition, confirms the extreme accuracy of the calibration marks on the master volume control. Each vertical division on the scope face represents a 10-dB amplitude change, and, using only the front-panel calibrations of 0, −10, −20, −30 and −40 dB, one can see how closely the 1-kHz center-frequency points on each curve correspond to the desired loudness levels.

summary

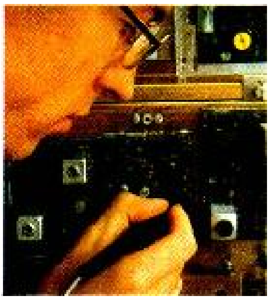
A summary of our reactions to the *model AU-717*, together with overall comments regarding its quality, is shown in Table II. The price, power output and performance features of this new Sansui entry make it worth serious consideration—even by those who prefer separate amplifiers and preamplifiers. **R-E**

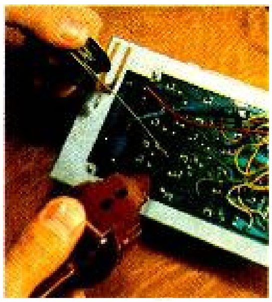
The whole team wondered what Ron Brown was up to in his basement.

Word has it he was up to something mighty special. And when he didn't show up for bowling practice one Wednesday night, the Lucky Strikers (that was the name of his neighborhood team) began to wonder, too.

So it was that a bunch of the boys decided to pay their "star" a visit, and talk him out of his secret project and back into action. It didn't happen that way, though.

Matter of fact, it was Ron Brown who talked the Lucky Strikers out of their bowling night and down into his workshop. What was it ...what could be exciting enough to keep a bunch of ten-pin tigers from their favorite pastime? One of the most fascinating learn-at-home programs in the world, that's what!





Actually build and experiment with a new big-screen color TV in ASI's fascinating learn-at-home program. It will help you develop new skills as an electronics troubleshooter.

You'll set up your own electronics laboratory to discover first-hand the technology behind the most exciting innovations in the world of home entertainment electronics.

In fact, as part of the program, you'll actually build and experiment with a beautiful, integrated circuit 100% solid state color TV.

But most important of all will be the new skills you'll develop all along the way...the kind of skills that could lead you in exciting new directions. For example, like many of ASI's 140,000 graduates, once you complete the program you could use your training:

1. To provide part-time income
2. To start a business of your own
3. To seek out a job in the electronics industry
4. To upgrade your current job
5. As a foundation for advanced programs in electronics

Go exploring at home, in your spare time. No traveling to class. No lectures. No one breathing down your neck.

ASI wants to make it easy for you to get to know the exciting world of home entertainment electronics. You'll be able to develop new skills in your own home on whatever days and hours you choose. So you don't have to give up your present job or paycheck just because you want to prepare yourself for some future opportunities.

What's more, we believe that when you're exploring a field as fascinating as home entertainment electronics, reading about it is just not enough. That's why you'll get lots of "hands on" training experience with some of the most impressive electronic training tools you've ever seen!

No Electronics Background Necessary

That's one of the advantages of this program. We start you off with the basics and help you work your way up, one step at a time. You'll start right off using your hands as well as your head. That's because ASI firmly believes that one of the best ways to develop skills is the exciting "hands on" way.

Each time you receive new materials you will assemble and experiment with the kind of fascinating electronic equipment that will guide you with tests and experiments and will help you become familiar with operations and applications. With ASI you BUILD, EXPERIMENT, and KEEP:

- Signal Generator—This important tool helps you explore AM alignment and signal injection. This is a source of modulated or unmodulated signals. It provides a wide range of frequencies for use in AM, FM, TV, LW and SW broadcast bands.
- Transistorized Radio Receiver—Build your radio in a spread out format directly on a large schematic diagram. You will learn how transistors, capacitors, resistors and other parts work together to receive radio signals and convert them into sound.
- VTVM (Vacuum Tube Voltmeter)—Build and troubleshoot measurements of DC+, DC−, AC rms and peak-to-peak voltages.
- Solid State Triggered Sweep Oscilloscope—See the heartbeats of tiny integrated circuits with one of the most universal of all testers. You'll experiment with displays of voltage waveforms found in audio devices, television receivers, transmitters and other electronic equipment.
- Vectorscope—Patterns for converging, adjusting and troubleshooting color television receivers. Solid state circuitry and integrated circuits are used for accuracy, stability and reliability since this will be a key instrument for troubleshooting and servicing color television receivers.
- Color Television Set—As you build, you explore automatic fine tuning, plug-in circuit boards, the cathode ray tube and all the components and circuitry used in the late model color receivers.

Besides these, you will also receive a pre-wired and assembled multi-tester plus a professional quality set of electronic hand tools and tool box.

And Only ASI Offers Audio/Visual Aids Too!

You will receive a filmstrip projector, filmstrips and records that SHOW and TELL you the proper way to perform some of the fascinating tests and experiments you'll do in the program. Only ASI offers this exciting way to combine theory with practice...and our graduates tell us that these aids are some of the most helpful and interesting parts of the program.

We try to give more personal attention than other learn-at-home programs.

1. Toll-free phone-in assistance. Should you ever run into a rough spot, we'll be there to help. While many schools make you mail in your questions, we have a toll-free line for questions that can't wait.

2. Every student is assigned a Personal Technical Advisor. He'll follow your progress and be available whenever you want to "talk shop" or bounce around an idea or two.

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101

hobby corner

Helpful hints, including magnetizing and demagnetizing tools, tuning a mobile antenna, a simple field strength meter and more.

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

I'VE BEEN SAVING SEVERAL SHORT, BUT helpful, items for use in this column when space permits. Well, the pile is growing taller, so I thought I'd put together an entire column based on these short items. Sort of a helpful hints column. You should find at least one useful item in the group. So, on to the first one.

Magnetism and your tools

Sometimes when you need a magnetized screwdriver or other tool (or one that is *not* magnetized) it can be very frustrating when the tool is in the wrong magnetic state. For example, have you ever tried to sort out small nuts and bolts with magnetized tweezers, or adjust a meter to zero with a magnetized screwdriver?

The other day I took a file from the pegboard to reshape the end of a pin punch. After a couple of light passes, I noticed the file was cutting very unevenly. To my surprise, the file had become magnetized and the filings were clogging it up. Thirty seconds later it was working fine. You, too, can demagnetize (and magnetize) any steel tool very quickly.

Demagnetizing: To quickly and completely demagnetize any tool you must use an electromagnet powered by *alternating* current (AC). Although you can make your own electromagnet, two different sizes made for the tape recording fan are readily available. One is a head demagnetizer that works well with small tools, and the other is a bulk eraser that can be used with both small and large objects.

The demagnetizing process is quite simple. Turn the eraser on and hold the tool in the alternating electromagnetic field. Then, *keeping the eraser on,* slowly withdraw the tool until it is a foot or two away. If this is done properly, the screwdriver or tool will be completely demagnetized.

Magnetizing: Of course, a tool can be magnetized by stroking it *in one direction* with a permanent magnet. However, an electromagnet is much more effective. A DC electromagnet would be best but it is just as easy to use your AC demagnetizer.

Just place the tool in the magnetic field and turn the magnet off. The tool is magnetized when the field collapses around it. However, there is one little catch to this procedure.

As the AC current constantly changes from maximum to minimum and back, the electromagnetic field also changes. You may find that you cut the electromagnet off when it was at minimum so that nothing collapsed around the tool! In this case, the tool will not be magnetized, which you can check by putting it into a box of bolts or paper clips.

If the tool wasn't magnetized the first time around, it only takes a few seconds to try again. In several tries at most, you will hit maximum and have a strong magnet.

Caution: When using a strong electromagnet such as a bulk tape eraser, keep it away from your VOM and other meters. It's also a good idea to remove your wristwatch.

Insertion tool

Now and then a device comes along that you have always needed. The OK Machine and Tool Company has developed an IC insertion tool that is different—it has a pin straightener built into the handle.

All told, I must have spent days straightening IC pins with my long-nose pliers. If each pin isn't just right, the IC won't go into a socket or board. Now, I simply pop them into the straightener and they are ready to go. (However, don't throw your pliers away—you'll still need them if the pins are badly mangled.)

Holders updated

A few months ago, we had an article about homebrew breadboards and part holders. Since then I have used two different holders made by PanaVise.

As is true with almost everything, a ready-made item costs more than a home-made one. The PanaVise devices are no exception, but their convenience and adaptability are excellent. When a board, panel or part is inserted, it stays in place. When you angle the vise in any direction, it holds that position while you pull, push and solder.

The PanaVise devices are really handy since they can hold things lightly or they can really bear down. So, they can be used for metal, wood, plastic, glass and other materials.

Mobile antenna tuning

Most advice on installing and tuning a mobile antenna—ham or CB—stresses the use of an SWR (*S*tanding-*W*ave *R*atio) meter. Certainly it can be done this way but the process can get a little tricky.

It is far more satisfactory to do the tuning with an FSM (*F*ield *S*trength *M*eter). First, an FSM is much simpler to construct, and less costly to buy. Second, you can get the desired results much easier and quicker with an FSM; it shows you *power radiated from the antenna,* which is what you are interested in.

Figure 1 shows a simple FSM. Construction is straightforward and not at all critical in terms of part values or placement. Substituting a less sensitive meter (such as a 0-to-1 mA meter) will mean that you must attach a longer antenna wire to the FSM or place the instrument closer to the transmitter antenna, or both. The FSM can be built inside a metal, wood or plastic box, or even on a breadboard.

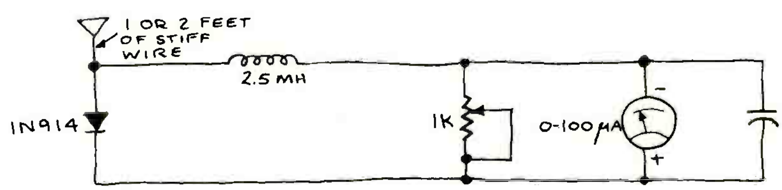

FIG. 1

When tuning the antenna using an FSM, use the following procedure.

1. Simulate on-the-road conditions; i.e., close the doors, get the car away from trees, roofs, etc.
2. Place the FSM on the outside of the car so that the meter face is visible (for instance, on the hood). If you want to go to the trouble, you can also place the meter

inside the car and connect the AM radio antenna in place of the FSM antenna wire.

3. Switch to your favorite channel and key the transmitter briefly while you note the meter reading.
4. Adjust the FSM sensitivity control and/or its antenna-wire length (*not* the CB antenna) to give a reading of about three-fourths of full scale.
5. Adjust the CB antenna until the FSM gives the highest reading. Just change the antenna length by loosening the set screw, sliding the movable section in or out, then retightening the screw. If lengthening the antenna gives a lower reading, shorten it and vice versa. Keep adjusting the antenna until you *pass* the maximum reading, then return to it. Make the adjustments in small steps—with most short loaded antennas, a small change in length creates a big change in output.

If you follow the above procedure, your antenna will be tuned for maximum effectiveness on the channel you have chosen. Unfortunately, it cannot do equally well on all channels. If you frequently operate on two widely separated channels, say Channels 11 and 37,

continued to page 76

computer corner

Z-80 *The Z-80 instruction set and how it compares to the 8080 instruction set.*

WILLIAM BARDEN, JR.

LAST MONTH'S COLUMN DISCUSSED THE pin-out of the Z-80 IC and the Z-80's timing. Now let's take a look at the Z-80's instruction set.

One of the most confusing things to a novice microcomputer user is the use of the instruction set. A simple computer may be constructed with a set of ten instructions or so. This basic computer can perform any operation that a computer with an instruction set of 200 instructions is capable of performing. Naturally, the program, or set of instructions to perform the function, will be much longer for the simple computer than for the 200-instruction computer.

The 200-instruction computer offers a versatile set of instructions from which a programmer can choose. If the programmer is very familiar with the instruction set of a computer, he may choose instructions that optimize the program for size (number of instructions) and speed (number of instructions to be executed for a given function).

The Z-80 offers a set of 158 instructions from which the Z-80 programmer may choose. Many of the instructions are very powerful. However, many instructions simply are included to achieve compatibility with the 8080 and 8008. Since some of 8008/8080 types of instructions do not follow classical instruction lines, they prove confusing to both novice and experienced programmer alike.

Z-80 instruction set

The Z-80 instruction set may be divided into 8 major groups:

1. Load and Exchange
2. Block Transfer and Search
3. Arithmetic and Logical
4. Rotate and Shift
5. Bit Manipulation
6. Jump, Call and Return
7. Input/Output
8. CPU Control

The Load and Exchange instructions move data 8 or 16 bits at a time between CPU registers or between CPU registers and external memory including stack. Many of these types are provided in the 8080. Moving data from memory to CPU registers is necessary to load the CPU A register in preparation for arithmetic or logical operations such as adding two 8-bit operands or performing a logical AND or shift operation. When the operation has been performed, or after a series of operations, the CPU register results may be moved back to memory by the same type of instruction. Transfers between CPU registers and memory are also required in preparation for a "programmed" I/O (*I*nput/*O*utput) operation where an 8-bit operand is transferred to or from an I/O device via a CPU register. Eight- or 16-bit data may also be moved from one CPU register to another CPU register, or the contents of two CPU register pairs may be exchanged. In all load operations, the *source data* is *copied* to a *destination* register or memory location. The original data *remains unchanged.* All computers have instructions of this type.

Load and Exchange example:

LD A, 1000H   Loads the A register with the contents of location 1000_{16}. Location 1000 remains unchanged. (H stands for hexadecimal, or base 16.)

The Block Transfer and Search instructions are very powerful instructions that few computers and no other current microprocessors have. With one instruction, the Z-80 can transfer a block of memory data from one set of locations in memory to another, or search a block of memory for a given character. In other microprocessors, the block transfer or search would take perhaps six to ten instructions to implement, with subsequent longer transfer and search times. The following instruction transfers 100 bytes of data from location 1000_{10} to location 2000_{10} in the Z-80. The source location (1000_{10}) and the destination location (2000_{10}) were previously loaded into the H,L and D,E register pairs by two move type instructions. The number of bytes to be moved (100_{10}) was also preloaded into the B,C register pair.

An example of Block Transfer is shown in Fig. 1.

Arithmetic and Logical instructions are found in all computers and microprocessors. In the Z-80, all 8-bit arithmetic and logical operations use the current A register (A or A^{1}). A second 8-bit operand from another CPU register or external memory is used in an addition, subtraction, AND, OR, or similar operation with register A. The results of the operation are transferred to register A and appropriate flags are set. Certain types of 16-bit arithmetic operations are also permitted, notably additions between CPU register pairs and the H,L register pair (destination). Binary-coded-decimal (BCD) addition and subtraction can be performed by using the standard addition and subtraction instructions and executing a special DAA or *Decimal Adjust Instruction* that adjusts the results of the addition or subtraction to BCD format.

Addition example:

If register A contains $00001010_2(10_{10})$ and register B contains $01000111_2(71_{10})$, executing ADD B produces:
(A) = $01010001_2 = 81_{10}$ (Sum)
(B) = $01000111_2 = 71_{10}$ (Contents of B unchanged)

Rotate and Shift type instructions expand greatly upon the 8080 capabilities. The 8080 can only *rotate* the contents of the A register, or the contents of the A register and carry bit together, one bit left or right. The Z-80, however, not only can perform a rotate shift right or left, but can also perform *arithmetic* and *logical* shifts. In addition, not only can register A be shifted, but *any* CPU register, or *any* memory location. Finally, two BCD

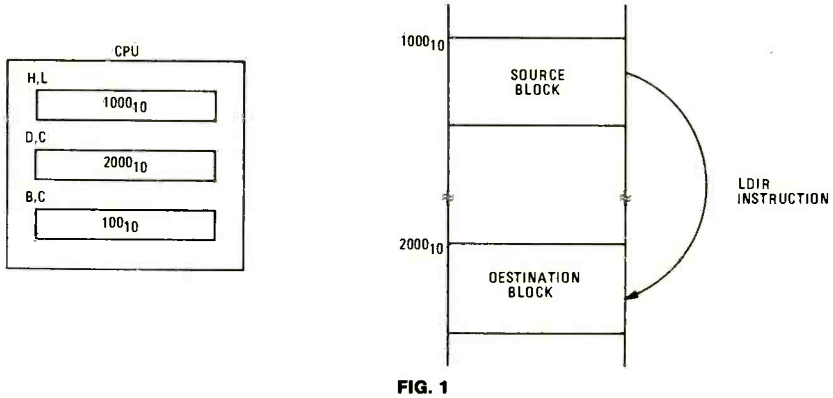

FIG. 1

digit rotate instructions perform a rotate of an accumulator BCD digit and two BCD digits in a memory location.

The Z-80 Bit Manipulation instructions enable the programmer to test, reset, or set any bit of a CPU register or any memory location. None of this group is provided in the 8080. Testing, resetting and setting bits are common operations that would take several instructions in other microprocessors.

Bit Manipulation example:

SET 3,B Sets bit 3 of CPU register B

The Jump, Call and Return instructions include the 8080 unconditional and conditional jumps, calls and returns. A jump instruction reroutes program execution to a specified address either unconditionally or conditionally based on one of the flag bits (carry, no carry, zero, etc.). A call performs the same jump, but pushes the return address into the memory stack so that a return may be made by a return instruction, which pops the return address from the stack and causes the program to return to the next instruction following the call. Calls and returns are used for subroutine operation. A subroutine is any set of instructions that perform a certain function (square root, search a table, etc.). In addition to the 8080 instructions in this group, the Z-80 includes jump "relative" instructions, jump "indexed" and several other types.

The Input/Output group of instructions include the 8080 IN and OUT instructions. The IN and OUT instructions enable one byte of data to be transferred between the A register and an I/O device. In the Z-80, however, one byte may be transferred between any CPU register and an I/O device. Also included are block input or output instructions that effect the transfer of up to 256 bytes of data between any CPU register and the I/O device.

Input/Output example:

H,L Holds the address of the block of data to be output (1000_{10})
B Holds the number of bytes to be transferred (250_{10})
C Holds the address of the I/O device (5)
OUTD Outputs 250_{10} bytes of data to I/O device 5, starting at location 1000_{10}

The last group of instructions include miscellaneous CPU control instructions to halt the microprocessor, enable and disable interrupt, perform a "no-operation" instruction and three instructions (not in the 8080) to set several types of interrupt modes.

In next month's column, we will examine the different ways in which the Z-80 can address memory locations. **R-E**

service clinic

Help wanted: A good power transformer!

How to find a replacement transformer without a schematic.

JACK DARR
SERVICE EDITOR

A COMMON QUESTION IN THE CLINIC MAIL-bag concerns an "orphan," a small- to medium-sized tuner, stereo, tape player, etc. The unit name is meaningless, and, of course, no service data or parts source are listed. The power transformer will be bad. For the most part, the primary winding will be open, probably because the wire was used that was too small for the load. At any rate, the question is, "Where can I get a replacement?"

Fortunately, there is a test you can use. Check the DC voltage and the current drawn. Look at the voltage rating of the electrolytic filter capacitors. It is easy to identify the capacitors, the rectifier diodes and the power transformer in a unit. By noting the filter-capacitor rating *and* polarity, you can get a good idea of the voltage. With 16-volt filters, the voltage is probably 12. In fact, most of these little monsters do use 12-volt DC power supplies especially if a tape deck is included; the decks tend to use 12-volt DC motors, the same as in automotive-type units. A unit may have a solid-state regulator or speed control, with the motor actually running on less than 12 volts, but the supply voltage is what you have to determine.

In the last letter we received, the malfunctioning unit was a "Cariole"; there was no listing anywhere, of course. The transformer apparently had two secondaries, each with a diode rectifier. Since the unit was a tuner/tape combo, one supply probably fed the amplifier and the other the tape-drive motor. You can verify it with an ohmmeter. To find the amplifier power supply, trace from the output transistors back to the filter capacitors. The output transistors are also fairly easy to pin down with the *Mark I Calibrated Eyeball* by following the leads back from the speaker.

Now, for the test: Unhook the amplifier DC power supply from the transformer, and connect it to a bench DC power supply with a variable output voltage. Use a current meter, such as the *TeleMatic Polaris TPS-225*, or the *Heathkit IP-2718*. Set the voltage output to 0, and unit switch to AM or FM. Adjust the volume control very low. If the unit has a common supply, unhook the tape motor.

Bring the DC voltage up slowly, watching the current meter. Most meters will start working at about 8 to 9 volts. If the current isn't more than about 25 to 30 mA, keep on until you get to 12 volts. If the current is still fairly low, turn the volume up just a little and see if the unit works. The current should run no more than about 75 to 100 mA at a pretty fair volume. You can check even fairly high-powered amplifiers by keeping the volume down. Resting current should not exceed 20 to 25 mA (for a ballpark figure) and increase with volume.

If you want to know the maximum power output, look at the output transistors. If they are small, say TO-5's, etc., the power will be low. If you see TO-66's or even TO-3's, it's a high-powered unit. You can check AM, FM and even tape by feeding an audio signal into the tape audio input.

Now, connect the DC power supply to the motor-circuit input through the speed control circuitry, if used. Bring the voltage up slowly while watching the current; check the speed by running a test tape. The motor current and voltage can be read out on the meters.

If both amplifier and motor are fed from a single source, just add the currents to find out what your full load will be. Now add about 1.0 amp for a safety factor and you're ready to start looking. Use 2.0 amps as a starting figure. There are a lot of 12-volt filament transformers, rated at 1 to 3 amps and more, which should be adequate. Be sure to check the physical size of the replacement against the original. Many of them are mounted in pretty tight places.

If you need a dual 12-volt supply you can always use a 24-volt transformer with a center-tapped secondary. Ground the center tap and use each end of the winding for one of the 12-volt sources. You can get any polarity needed (even ± 12 volts) by hooking up the diodes correctly. Triad, Thordarson, Signal and others have catalogs showing suitable transformers, their electrical ratings and physical sizes.

Hint: If you have a transformer with a drain greater than your bench power supply can handle, check it out one channel at a time by lifting the collector supply from one channel. Check it again at lower volume and get a ballpark idea of what the maximum full-load current should be by verifying what type of output transistor is used. For example, if the transistor has 2.0-amp maximum current rating, that's all you need to know. Don't be afraid to overrate the transformer a little. It's better to have it running cool and happy! **R-E**

service questions

HORIZONTAL-HOLD PROBLEMS

I've got two sets on the bench with similar problems. A Sears 529.71921 has very touchy horizontal hold. If the hold control is not adjusted exactly, it blanks out the left half of the screen and the color is lost. A Magnavox T904 shows a similar symptom—the color is lost before the picture goes out of horizontal sync. How can horizontal sync affect color in these sets?—G. K., Goleta, CA.

Easily! In quite a few sets, the horizontal-hold range is much greater than the color-hold range. You can lose color before horizontal sync. The reason: the *phase shift* that takes place when you move the horizontal-hold control too far in either direction. If the *keying pulse* from the flyback moves too far, it is so far out-of-phase with the color burst that the burst doesn't get through, and the color-killer turns the sync off. The Sears model could have a badly unbalanced AFC diode unit. The symptoms are similar.

SPEAKER SUBSTITUTION

I have a color TV with a miserable little 4-inch speaker that barely fans the air from about 200 to 4000 Hz! The trouble is that this unit uses an OTL circuit and a 32-ohm speaker. Everyone, including you, tells me not to use an 8-ohm speaker! Can you tell me what I could do?—C. P., San Clemente, CA.

You can make a 32-ohm speaker out of a combination of units. For example, connect two 16-ohm speakers in series or four 8-ohm units in series. You can connect these in a row to approximate a sound column. To check that the units are all in phase, hook them up and then touch the terminals of a 1.5-volt battery to the output leads. Make sure that all the cones go in or out at the same time. If one cone does not, reverse its voice-coil leads.

FOCUS PROBLEM CONFIRMED

I've just read the Service Clinic on focus problems (**Radio-Electronics**, July, 1977) and liked it! I've spent many hours on dogs having this symptom. Here's a trick I have used successfully on many of them. Pull the CRT socket off (high voltage is hooked up) and check for any voltage on the focus pin. If so, ground the focus pin and apply power. This will often loosen the particle that is causing the short. Gently tapping the tube neck helps sometimes. Now recheck, and the short may be gone.

(Thanks very much to Don Davis TV, Warner Robins, GA 31093.)

TUBE SUBSTITUTE NEEDED

I need a replacement for a 35D5 tube in an old stereo amplifier. I can't even find a listing on this one in the manuals. Do you know of one?—J. G., Madison, WI.

This is an old tube that's new to me. (I've only been in the business 50 years; some day I'll learn.) Finally located it in a 1955 Sylvania *Tube Manual*. This is an oddball 9-pin miniature-base, type 9FU tube.

Your best bet is to replace the 9-pin socket with a 7-pin miniature tube and use a 35C5 unit, which is electrically identical to the 35D5. The 35C5 has another advantage—it's available!

HUE PROBLEM

I use a 20Y1C38 Zenith at home for a monitor. The set has an oddball color problem. When I turn the hue control to minimum, the color disappears. The hue is off slightly, although there is plenty of chroma. Anything in your files on this?—B. W., New York, NY.

I see two things that could be causing your problem: first, if the metallized cardboard sleeve over the yellow lead from the cathode of the second color IF (bandpass) amplifier tube is not properly grounded, it will cause hue problems. Second, if capacitor C156 (.01μf) in series with the hue control leaks, here we go again. Clue—the grid voltage of the first color amplifier varies up to 3 volts as the hue control is turned.

SYNC PROBLEM

This Sylvania D-12 chassis has very poor sync. I checked and replaced everything I could think of (a detailed list was enclosed), and nothing happens. Any ideas would be welcome!—C. K., Portland, OR.

(I sent him my best ideas. His feedback letter read: "Thanks for the waveforms and data. I found the cause of the problem. It was a bad *socket* on sync separator Q12. Evidently, the very small capacitance of the terminals and base pins had caused enough sync to leak through so that it would almost work. Replacing the socket cleared up the problem."

Rechecking the detailed list of voltages showed that the sync separator collector did read a bit too high. After repair, all was normal.)

SCREEN WIDTH LOSS

This Zenith 4B25C19 doesn't have enough width on either side of the screen. The horizontal output tube, the damper, etc., all were replaced, and the B+ voltage is good. The bias on 20LF6 is off a little. What's causing this?—W. C., Punxsutawney, PA.

I suggest checking all resistors around the horizontal output tube, etc. (Feedback: "All of them checked OK, and I was about to look elsewhere when I noticed a hairline crack on R334, which is the little 100-ohm resistor on the 20LF6 control grid. I moved it with a stick and it came apart! The resistor did *not* look burned, either. Close observation pays off!")

PICTURE REVERSAL

I want to experiment with projection TV, using a small Sears or a Sharp color set. How can I reverse the picture so that the lettering will read correctly, from right to left?—D. N., Ravenna, OH.

I invented this a long time ago! All you do is reverse the leads to the vertical yoke. This turns the picture upside down, but also turns it inside out so that the lettering is a mirror image. This method is simpler than reversing the horizontal yoke winding, which, of course, will also turn the picture inside out.

WEAK TV AUDIO

I've been working a long time on this Bradford TV, which has weak audio. There are some unusual DC voltages on the 6DT6, including +585 volts on pin 5, and 0 volts on pins 1 and 6. The manual shows only +62 volts on pin 5 (the plate). Where's all that voltage coming from?—D. S., Kearny, NJ.

Well, there's no schematic on this Bradford model, so we need a tube manual and a clean rag to wipe the crystal ball with.

In addition to the high voltage on the plate, there are a couple of other things that should be checked. Pin 6 is zero. This is the 6DT6 screen grid, which should have about +100 volts on it. With no screen voltage, the tube probably doesn't conduct, which would cause high plate voltage. In many circuits, the sound-detector plate is fed from the *boost* through a high-value resistor. This keeps the sound from coming on until the set has warmed up, and gets rid of "warm-up buzz."

CHASSIS "EATS" TUBES

I've got a dandy problem: This CTC-31 RCA chassis eats a 6JE6 tube and a damper tube about every six months. When you change the tubes, the set works perfectly. All the voltages around the flyback are normal. Any suggestions?—G. C., Birmingham, AL.

Yes. The most likely answer is that there is a loss of the horizontal grid drive, due to horizontal-oscillator signal dropout. Since an intermittent *short* in or around the flyback literally "leaves tracks," there's probably a bad solder joint, or something similar, in the circuit between the oscillator and the output grid. Also, look for a possible crack in the 100-ohm resistor in the 6JE6 grid.

RESISTORS BURN OUT

When I first looked at this RCA chassis CTC-17XAB, the vertical blanking amplifier transistor and resistors R60 (56,000 ohms) and R138 (1000 ohms) were burnt out. When I replaced them, they promptly blew up again. The DC voltages on the transistor don't seem OK. The voltage on pin 8 of the horizontal output tube is high, almost double what it should be. What's happening?—L. McK., Mansfield, OH.

Resistors burn up because there's too much current flowing. In this case, the key clue is burnup of resistor R138 (1000 ohms), which goes only to the 6JE6 suppressor grid. So, the overload current must come from that point. Check the 6JE6 tube by replacing it. Perhaps it has a suppressor grid-to-screen short, which is applying too much high voltage to the blanker transistor and the resistors.

PICTURE OFF-CENTER

I've just repaired a CTC-22 RCA chassis. It works, but the picture is off-center to the right, with a ¾-in. black space on the left side. This chassis has no horizontal centering control. I even put a milliammeter in series with the horizontal yoke winding; the reading showed less than 1.0 mA DC through the winding. I'm in the camera end of the TV, and don't get much set experience.—A. K., Patrick AFB, FL.

Oh, I wouldn't say that, you're getting some now! Let's rub the crystal ball. Try this: Take the signal off and see if the blank raster is centered. Something might be upsetting the horizontal blanking, making it too wide.

(Feedback: Bingo! You got me on the right track. Grid circuit R762 of the second video had opened up. The blanking pulse at this point was very wide, high in amplitude and integrated into a broad pulse. A new resistor fixed it. Thanks.")

AGC PROBLEM

When I had an AGC problem in a D-12 Sylvania chassis, you suggested heating up the AGC transistor. Even though I had replaced this transistor, I tried out your suggestion. There was the answer! Warm the transistor up and it goes out. I substituted a better-grade transistor and the problem cleared up. Thanks.—J. G., Brooklyn, NY.

Even a blind pig gets an acorn now and then!

SERVICE DATA FOR CANDLE TV

Do you know of anyone who has service data for a Candle MT-510A TV?—Al's TV, 41 Anndale Drive, Willowdale, Ont., M2N 2W9

No, I don't. Normally, we're not supposed to do this, but I must have had at least a hundred requests for this make. There are two addresses, "Candle, Los Angeles, CA," and "Hatzlachi, New York"; neither of these answer. If anyone has this data, send it to the Canadian technician.

CB THROUGH STEREO

I've got a CB radio, and I'd like to feed the sound through my Sears stereo amplifier system. I hooked it to the TAPE jack, but got nothing.—W.F., Marysville, KS

Unfortunately, your TAPE jacks are not inputs, but *outputs* for feeding a tape recorder. Feed the CB sound from the EXT. SPEAKER jack of the CB into the PHONO input. If you get distortion, reduce the CB volume so that you won't overdrive the stereo input. **R-E**

TUNER FREQUENCY DISPLAY

continued from page 32

on this board. Next, install 2.2K resistors R13 through R20. Be careful when installing these parts. Some of the pads are pretty close together and solder bridges can occur if you are not very careful. Next, install R21 through R24, the crystal and capacitors C10, C11 and C12. Check for shorts and solder bridges and then install R11.

Mount transistors Q3 through Q6 next to resistors R21–R24. Note that the flats on the transistor cases are next to the associated resistors. Transistor Q2 goes in next. Install IC5 so the index notch and the pin-1 dot face the socket for IC4. Install R12 and C16. Watch the polarity of C16. Rectifier RECT1 goes in so the plus sign faces the closest edge of the board. Complete the component installation with the addition of capacitors C13, C14 and C15.

Cut seven short lengths of hookup wire and strip the ends. Stick an end in the FM, AM, SW, T, F, M and H pads and solder. Cut two more pieces of hookup wire. There are two unmarked pads near IC5 and Q2. These are on the "ground" strip that runs lengthwise across the board. Connect the wires to these pads. Connect switches S1 and S2 to the wires from the M and H pads. Then connect a ground lead to one of the switches and bus it to the other switch with a piece of hookup wire. The other ground lead goes to the ground point on the interface board.

Turn the board over and install 100K resistors R8, R9 and R10, soldering them directly on the Molex pins. Install D1 and D2. Be sure that the anodes of both connect to pin 9 of the IC.

Flip the board back over and break off the Molex tabs. Carefully install IC4 with pin 1 closest to filter capacitor C16.

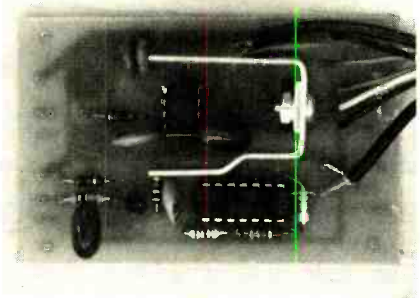

FIG. 10—TOP VIEW OF THE INTERFACE BOARD. Note the home-made heat sink on regulator IC.

Take the display board and pick up two pieces of wire previously clipped off resistor leads. Insert a wire (from the foil side) through the pads in the lower corners of the display board and solder in place with the ends flush with the front surface. Bend each wire down and flat against the board's surface. Stick these wires into matching holes in the main board, straighten up the display and solder the wires to the pads on the main board. Tack the two boards together with household cement or a similar adhesive.

Complete construction by connecting up the display. Use small pieces of hookup wire to connect the anode leads. These are numbered 1 through 4 and you simply connect 1 to 1, 4 to 4 and so on. Next attach resistors R25 through R32. They go between A on the main board to A on the display board, DP on the main board to DP on the display, and so on.

Well, that's it for now. By the time that you reach this point in the project, you'll have next month's issue telling you how to select one of two types of installations and how to go about it. **R-E**

HOBBY CORNER
continued from page 67

tune up for maximum output on a mid-range channel (in this case, Channel 23) then check to see if you have about equal power on Channels 11 and 37.

Use your FSM to check your antenna tuning occasionally. (Writing this reminded me that I had not checked mine for a while. I just checked it and found it at a maximum 8-channels from where it was originally tuned to. Now my coverage should improve a bit.) Since garage roofs, tree limbs and even normal traveling vibration can cause detuning over a period of time, you should check to be sure that your antenna is at peak efficiency for maximum range.

CB to ham to CB

At one time, ham operators and CB'ers did not see eye to eye. Now, however, in spite of a few die-hards, there is a lot of cooperation.

Many hams have since discovered the value of having a CB rig in the car, particularly when traveling away from home. What better way to obtain information on road conditions, locations of restaurants and motels or to summon emergency road service. Such help is available on isolated highways, in villages and towns as well as in the big cities.

Similarly, many CB'ers have decided to expand their horizons and talk with ease to others across the state, the country or the world. Some have studied for the FCC examinations entirely on their own. Others have been helped by a neighboring ham or a local ham club class. If you're a CB'er who would like to but has not taken the plunge, you can obtain helpful information by writing to the American Radio Relay League, Newington, CT 06111. **R-E**

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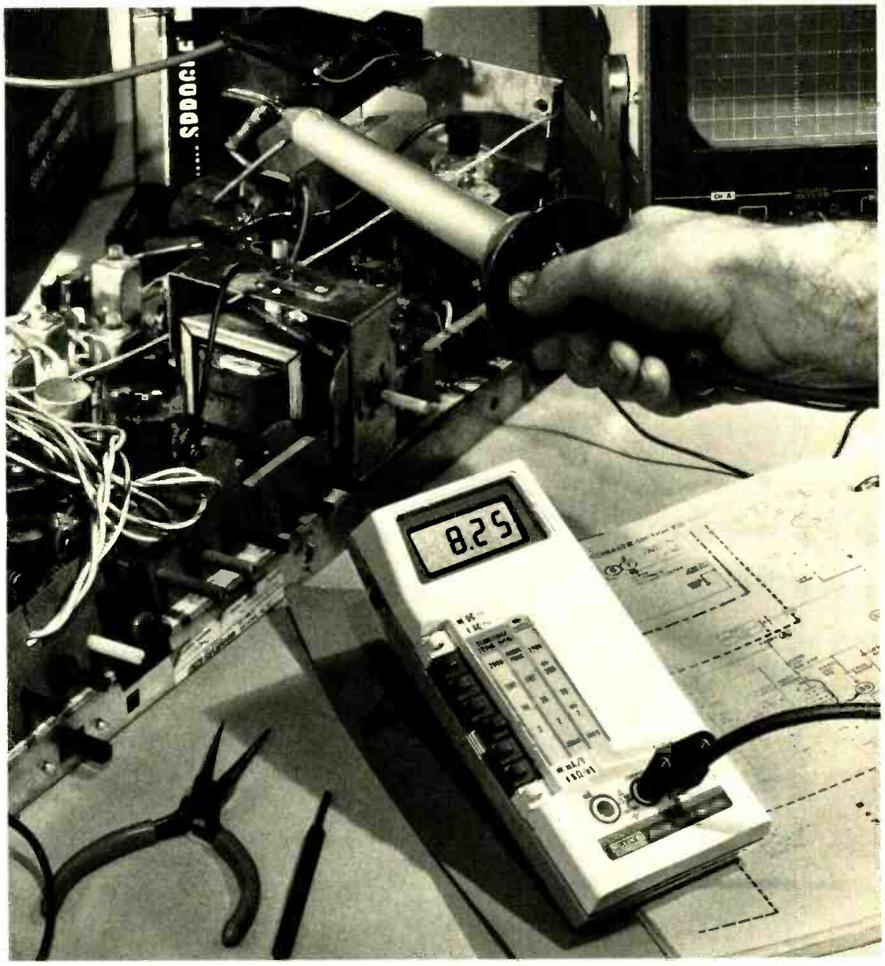
CIRCLE 78 ON FREE INFORMATION CARD

How do you really use a multimeter?



Usually at your bench, in the shop, shared with others. And, if it's a Fluke multimeter, you use it with confidence.

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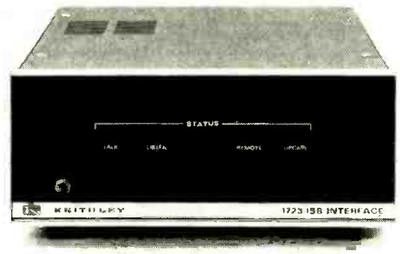
CIRCLE 25 ON FREE INFORMATION CARD

new products

More information on new products is available from manufacturers of items identified by a Free Information number. Free Information Card follows page 96.

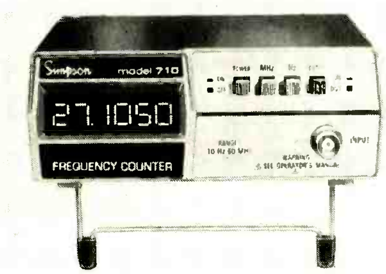
MICROPROCESSOR-BASED INTERFACE, *model 1723,* when combined with manufacturer's digital multimeters, *model 172* and *model 173,* can be used in any bus-based system. The DMM's can be operated in talk, listen or talk-only modes. In systems using a controller such as a programmable calculator or minicomputer, data can be transmitted via the controller to the DMM in the listen mode.



The *model 1723* provides 10^9 ohms, 100-pF isolation from analog low to digital low, minimizing ground-loop problems. Optional accessories include dual-rack mounting kit (*model 1018*) and cable assembly (*model 7008*). The *model 1723:* \$795; *model 172/1723* combination: \$1320.—**Keithly Instruments, Inc.,** 28775 Aurora Road, Cleveland, OH 44139.

CIRCLE 99 ON FREE INFORMATION CARD

FREQUENCY COUNTER, *model 710,* offers 6-digit LED display and LSI circuitry to provide full operation to 60 MHz with 1-Hz resolution. Sampling is 5 times-per-second on MHz and 0.5 times-per-second on Hz, with ±1 count accuracy and 10-ppm timebase. Switchable low-pass filter eliminates input noise.



Counter comes with folding bench stand, push-button control and BNC connector input. Optional accessories include connecting cables, 50-ohm dummy load, 12 VDC auto light adapter, probes and carrying case. Unit measures 2 × 5.6 × 4.6-inches and sells for \$150.—**Simpson Electric Co.,** 853 Dundee Ave., Elgin, IL 60120.

CIRCLE 101 ON FREE INFORMATION CARD

TORCH/SOLDERING IRON, *model 5001 Versa Torch*™, is a self-contained portable instrument that uses a special adapter to fit Ungar's ¼-inch thread-on soldering tips. Companion pinpoint burner tip performs a variety of home and shop jobs, such as thawing pipes, welding and bending plastics, etc. Detachable stand locks *Versa Torch*

into two positions for burner use or preheating purposes. Weighing only 11 ounces, the *Versa Torch* is fueled from standard propane or *MAPP*® gas cylinders to provide up to 30 hours continuous heating. Price: \$24.95.—**Ungar,** Div. of Eldon Industries, Inc., 233 E. Manville, Compton, CA 90220.

CIRCLE 102 ON FREE INFORMATION CARD

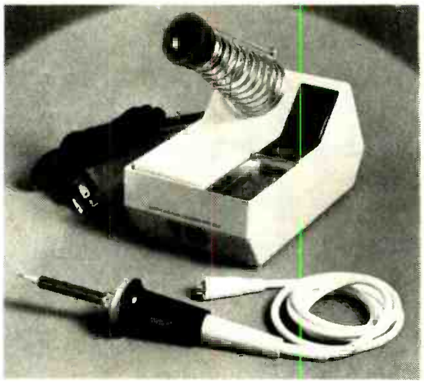
IN-LINE FUSEHOLDER *(Part No. FHA1)* is made of high-temperature PVC with two 4-inch 16-gauge wire leads. Designed for use with manufac-

turer's ATO series *Autofuse* (20 amp or less), fuseholder comes bubble-packed or mounted 12 to a board.

The *Autofuse* is a two-part-construction, blade-type unit for use in low-voltage electronic applications. Suggested retail prices: for fuseholder, 51¢ (100-500 lots, 43¢); *Autofuse*, 30¢ (100-500 lots, 26¢).—**Littelfuse, Inc.**, 800 E. Northwest Highway, Des Plaines, IL 60016.

CIRCLE 103 ON FREE INFORMATION CARD

SOLDERING STATION, *model WTCPN*, contains low-voltage temperature-controlled soldering pencil with heat shield. "Closed-loop" system controls maximum tip temperature while



grounded tip protects voltage and current-sensitive parts. Uses an assortment of 17 iron-plated replacement tips, each available in 600°, 700° and 800° F. Suggested retail price: $45.85.—**Weller-Xcelite Electronics Div.**, The Cooper Group, Apex, NC 27502.

CIRCLE 104 ON FREE INFORMATION CARD

COMMUNICATIONS RECEIVER, *Mark II* version of earlier *Mark I model FRG-7*, has a fine-tune control to simplify single-sideband tuning. The receiver can be tuned from 500 kHz to 29.7 MHz and operates off an AC line, or by using either

eight internal D-cells or a 12-volt battery. *Mark I* owners can purchase a fine-tune control kit and instructions for $7.25 postpaid.—**Yaesu Electronics Corp.**, Box 498, 15954 Downey Ave., Paramount, CA 90723.

CIRCLE 105 ON FREE INFORMATION CARD

ACOUSTIC COUPLER, *Pennywhistle 103*, is the first modem in kit form. It can be used either as an acoustic coupler (with phone handset) or wired directly into the phone itself. Unit operates in both unidirectional and bidirectional modes. A

three-stage active filter eliminates noise and harmonics.

CIRCLE 13 ON FREE INFORMATION CARD

CIRCLE 47 ON FREE INFORMATION CARD

Components mount on a 5 × 9-inch PC board; chassis parts, speakers, speaker grilles, muffs and line cord are included. Highly detailed manual contains full assembly, test and adjustment instructions as well as hook-up directions for several applications. The *Pennywhistle 103* can be used with tape recorder to enter data via the phone into computer memory. Price: $129.95.—**M&R Enterprises, Inc.**, Box 61011, Sunnyvale, CA 94088.

CIRCLE 106 ON FREE INFORMATION CARD

40-CHANNEL CB TRANSCEIVER, *Sidebander V*, is an SSB/AM mobile unit using phase-locked loop circuitry. Unit also contains Channel 9 priority switch, 40-channel scanning switch, "Speech Spander," automatic modulation-level control, rapid-turn channel selector, large LED readout, clarifier and switchable noise blanker and limiter. Included with the *Sidebander V* are a PA provision and mike. Price: $419.95.—**SBE, Inc.**, Dept. P, 220 Airport Blvd., Watsonville, CA 95076.

CIRCLE 107 ON FREE INFORMATION CARD

TV PROJECTION LENS, *model MKII*, is an f/2.6, 13.5-inch focal-length design using top-quality high-index glasses that are anti-reflection coated for maximum picture contrast, light transmission and durability. Recommended for 9-inch to 17-inch diagonal TV screen. The barrel is made of anodized aluminum; dimensions are 5⅛-inches

long, 5⅞-inches diameter. Price per unit is $180.—**TeleVue Optics,** 15 Green Hill Lane, Spring Valley, NY 10977.

CIRCLE 108 ON FREE INFORMATION CARD

CIRCLE 72 ON FREE INFORMATION CARD

CIRCLE 9 ON FREE INFORMATION CARD

SOLDERING/DESOLDERING

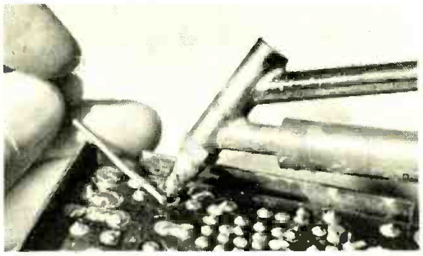
continued from page 42

wire tips. Low-cost tip replacements, and their wide availability, are distinct advantages. However, one characteristic of such guns should concern you—the wire tip heats when heavy alternating current flows through it. **The resulting AC field can be dangerous to semiconductors, meters and other sensitive components.**

Also, the low-voltage transformer secondary that supplies the high current is isolated from the power line *and* ground, which makes it susceptible to static buildup. You can avoid this by clipping a shorting jumper from tip to ground, but that's unhandy. Both Weller and Wen make barrel-tip guns to circumvent static buildup.

Used properly, the safest soldering tool is a cordless iron because it is not connected to the AC line during soldering. Hence, no AC leakage is possible. Rechargeable internal batteries supply current to heat the soldering tip. Between actual soldering times, the iron rests in a charging cradle that restores the battery charge.

A simple procedure will avoid the static-electricity complication that exists even with a cordless iron. After turning on the iron or gun, and just before touching it to the connection(s) to be soldered, first touch your hand and then the soldering tip to the chassis ground *AND the ground bus* of the equipment you're working on. That may seem a bit of trouble, but it can become a habit. This precaution discharges any static buildup so that there is none left.



EXTENSIVE USE OF IC's calls for new soldering and desoldering techniques.

If you buy a cord to run a battery-operated iron directly from the power line, and expect to use the iron around FET's and IC's, make the leakage test with the AC cord plugged in. Continue the static-grounding procedures described above whenever you use the iron. Wahl Clipper even offers a cigarette-lighter plug and cord that lets you recharge the soldering iron's NiCad batteries while you're on the road.

Finally, as you consider soldering tools, you have to look at tips. Most common are the pyramid tip and the chisel tip. Table II shows a number of variations on

turn page

the chisel tip: screwdriver, spade, and various chisel shapes, sizes and tapers. In addition to the pyramid tip, there are conical or "pencil" shaped tips—some needle-pointed, some with blunted ends. Two main varieties: the regular type, in low- and high-wattage sizes, and a special, plated long-life version with a rounded tip.

Choosing a tip depends primarily on one consideration: whatever shape transmits the most heat to the surfaces you plan to solder. When you begin heating a joint, your chief concern is to place as much heated soldering-tip surface in contact with the joint as you can. Thus, chisel tips work well when you solder wires to flat terminals. To solder thin wires to holes in PC boards, fine-pointed tips are preferable. A broad chisel tip heats best for soldering to a chassis.

Cleaning and tinning

Given the right iron size, the right tip and the right temperature, you still have some other concerns if you want dependable soldered connections.

First, all surfaces to be joined by solder must be clean. Chassis, terminals, wires, foils, whatever—the surfaces must be clear, not only of dirt or grime or accumulated oils (like fingermarks), but of oxidation too. Sanding or wire-brushing gets rid of most surface foreign matter. Scrape the surfaces of component wires

CORDLESS SOLDERING STATION BY UNGAR consists of a rechargeable iron and recharger. The charging holder comes with a tip cleaning sponge.

bright before you insert them in PC boards or terminals. Burnish the pins of DIP integrated circuits before you plug them into the board for soldering. Wire-brush (or use clean steel wool) the surfaces of printed foils before you insert new or replacement parts. Clean off resin residue and old solder.

Make sure the solder you use has rosin flux in it. It cleans and deoxidizes surfaces just ahead of the solder flow. However, do not depend on flux to do the whole cleaning job because it does get past oxidation, but not much else.

Parts removal made easy

Any technician can figure out how to untangle component leads from terminals in a hand-wired chassis. Unfortunately, not many radios, TV sets or other electronic equipment nowadays are hand-wired. Practically everything uses PC boards.

This would present no problem if all you had to remove and resolder were capacitors or resistors. Even transistors usually have wires that you can grab with long-nose pliers and pull out of their PC board holes while you melt the solder on the underside of the board.

What can really throw you is trying to remove a 16-pin DIP integrated circuit from a PC board. You can melt the solder at one or two pins, but the other pins still hold the IC solidly. However, there's a shiny side to this coin: Techniques for removing IC's work just as efficiently for other PC-board-mounted components. Using correct procedures insures neat workmanship in all parts replacements.

Naturally, with so much of this kind of work to be done, tool makers have come up with plenty of gadgets to aid in the task. Firms that responded to our requests for information are listed in Desoldering Tool Chart II.

Simplest are squeeze-bulb solder suckers. They look like an ear-syringe, but have *Teflon* tips to withstand the heat of molten solder. You heat the joint, squeeze the bulb and hold its end near the

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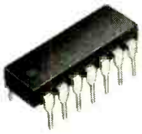

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7402	276-1811	39¢
7404	276-1802	35¢
7406	276-1821	49¢
7410	276-1807	39¢
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7427	276-1823	49¢
7432	276-1824	49¢
7441	276-1804	99¢
7447	276-1805	99¢
7448	276-1816	99¢
7451	276-1825	39¢
7473	276-1803	49¢
7474	276-1818	49¢
7475	276-1806	79¢
7476	276-1813	59¢
7485	276-1826	1.19
7486	276-1827	49¢
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7492	276-1819	69¢
74123	276-1817	99¢
74145	276-1828	1.19
74150	276-1829	1.39
74154	276-1834	1.29
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74194	276-1832	1.19
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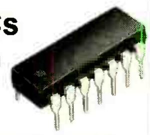

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74C02	276-2302	49¢
74C04	276-2303	49¢
74C08	276-2305	49¢
74C74	276-2310	89¢
74C76	276-2312	89¢
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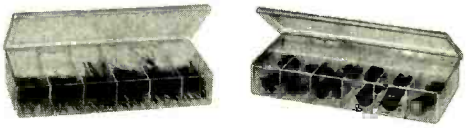
4013	276-2413	89¢
4017	276-2417	1.49
4020	276-2420	1.49
4027	276-2427	89¢
4049	276-2449	69¢
4050	276-2450	69¢
4511	276-2447	1.69
4518	276-2490	1.49

Linear ICs

By National Semiconductor and Motorola — first quality

Type	Cat. No.	ONLY
301CN	276-017	49¢
324N	276-1711	1.49
339N	276-1712	1.49
386CN	276-1731	99¢
555CN	276-1723	79¢
556CN	276-1728	1.39
566CN	276-1724	1.69
567CN	276-1721	1.99
723CN	276-1740	69¢
741CN	276-007	49¢
741H	276-010	49¢
3900N	276-1713	99¢
3909N	276-1705	99¢
3911N	276-1706	1.99
4558CN	276-038	79¢
75491	276-1701	99¢
75492	276-1702	99¢
7805	276-1770	1.29
7812	276-1771	1.29
7815	276-1772	1.29

Resistor and Capacitor Packs



Resistor and capacitor kits in handy plastic storage boxes you can use over and over again. Stock up!

½ Watt, 10% Tolerance Resistors. 271-601 .... **Pkg. of 350/9.95**
¼ Watt, 5% Tolerance Resistors. 271-602 .... **Pkg. of 350/9.95**
50WVDC Ceramic Disc Capacitors. 272-601 .... **Pkg. of 175/9.95**
35WVDC Radial Lead Capacitors. 272-602 .... **Pkg. of 35/9.95**
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Tantalum Capacitors

Maximum capacity in smallest size. Low ESR, highly stable electrical characteristics and low leakage. Radial leads.

Cat. No.	μF	Each	Cat. No.	μF	Each
272-1401	0.1	39¢	272-1407	2.2	45¢
272-1402	0.22	39¢	272-1408	3.3	45¢
272-1403	0.33	39¢	272-1409	4.7	49¢
272-1404	0.47	39¢	272-1410	6.8	49¢
272-1405	0.68	39¢	272-1411	10.0	49¢
272-1406	1.0	39¢	....	...	...

Nos. 1401-1408, 35WVDC; 1409-1411, 16WVDC.

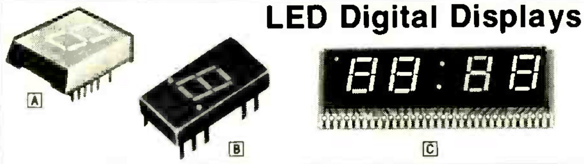
PC Board Accessories

8-piece photographic PC board processing kit — fastest, easiest way to produce perfect printed circuit projects.
276-1560 .... **12.95**
Etch-Resist Marking Pen. 276-1530 .... **1.19**
Etchant Solution. 276-1535 .... **1.89**
PC Board Assortment. 276-1573 .... **1.98**

Build an LED Digital Clock

12-HR LED Clock Module. Just add a transformer and switches for a complete clock with 0.5" LED display. **277-1001** **14.95**
Transformer for above. 120VAC 60 Hz. **273-1520** **3.99**
SPST Miniature Pushbutton Switch. 275-1547 .... **5/1.99**
Display Case. 1$^{13}/_{16}$x3$^{7}/_{8}$x4$^{7}/_{16}$". **270-285** **3.95**

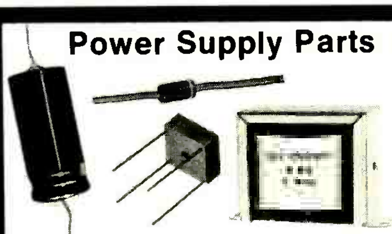
LED Digital Displays



Digits	Size	Drive	Cat. No.	ONLY
A 1	0.6"	Anod.	276-056	2.99
A 1	0.6"	Cath.	276-066	2.99
B 1	0.3"	Anod.	276-053	1.99
B 1	0.3"	Cath	276-062	1.99

Digits	Size	Drive	Cat. No.	ONLY
B 1	0.3"	Anod.	276-1210	4/6.99
B 1	0.3"	Cath.	276-1211	4/6.99
C 4	0.5"	Anod.	276-1201	6.95
C 4	0.5"	Cath.	276-1202	6.95

Power Supply Parts



6-Amp Full-Wave Bridge Rectifier. 50 PIV.
276-1180 .... **1.99**
50V 3-Amp Power Rectifier. 300-A surge.
276-1141 .... **Pkg. 2/69¢**

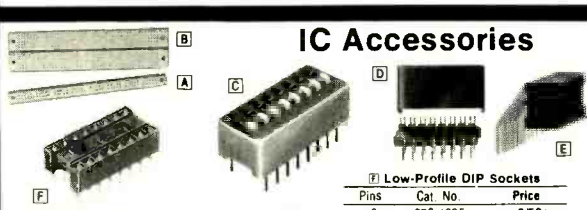
Electrolytic Capacitors

3300 μF at 35V. 272-1021 .... **2.99**
5000 μF at 35V. 272-1022 .... **3.49**

Heavy-Duty Transformers. All for 120VAC, 60 Hz.

Cat. No.	Volts	Current	Size	Each
273-1512	25.2 CT	2A	2¾x2¼x2"	4.99
273-1513	12	5A	4x2x2½"	8.95
273-1514	18 CT	4A	4x2x2½"	8.95

IC Accessories

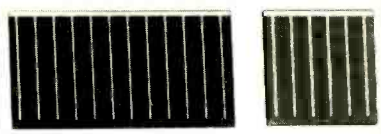


A **Bus Strip. 276-173** **1.99**
B **Experimenter Socket. 276-172** **9.95**
C **DIP Switch. 275-1301** **1.99**
D **DIP Header. 276-1980** **1.29**
E **Right Angle 16-Pin Socket. 276-1985** **1.49**

F Low-Profile DIP Sockets

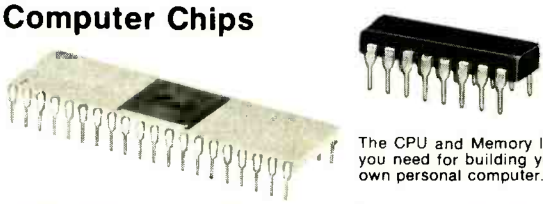
Pins	Cat. No.	Price
8	276-1995	2/59¢
14	276-1999	2/89¢
16	276-1998	2/89¢
28	276-1997	Ea. 89¢
40	276-1996	Ea. 99¢

Silicon Solar Cells



Produce Power from Light!
2cmx4cm. 0.5V at 100mA. **276-120** **2.99**
2cmx2cm. 0.5V at 60mA. **276-128** **1.99**

Computer Chips



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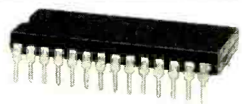
2102 Static RAM. 1024-word by one bit read/write memory. Under 600 nS access time.
276-2501 .... **2.49 Ea. or 8/14.95**

Clock Chips



50252. 12-hour clock, 24-hour alarm chip. With full specifications. **276-1751** **6.99**
7001. 12-hour calendar alarm clock IC. With all data. **276-1756** **10.95**

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7402	.21	7450	.26	74122	.49
7404	.21	7451	.27	74123	1.05
7405	.24	7453	.27	74125	.60
7407	.45	7454	.41	74126	.81
7408	.25	7460	.22	74132	3.00
7409	.25	7472	.39	74141	1.15
7410	.20	7473	.45	74150	1.10
7411	.30	7474	.45	74151	1.25
7413	.85	7475	.80	74153	1.35
7416	.43	7482	1.75	74154	1.54
7417	.43	7483	1.15	74157	1.30
7420	.21	7485	1.12	74161	1.45
7422	1.50	7486	.45	74164	1.65
7425	.43	7489	2.49	74165	1.65
7427	.37	7490	.69	74166	1.70
7428	.35	7491	1.20	74174	1.95
7430	.26	7492	.82	74175	1.95
7432	.31	7493	.82	74180	1.05
7437	.47	7494	.91	74181	3.55
7438	.40	7495	.91	74191	1.50
7440	.21	7496	.91	74195	1.00
7441	1.10	74100	1.25	74197	1.00

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74L86	.69	74LS74	.65	74S153	2.25
74LS00	.39	74LS112	.65	74S387	1.95

74H00 TTL

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74H01	.33	74H20	.33	74H55	.39
74H04	.33	74H21	.33	74H73	.59
74H05	.35	74H30	.33	74H74	.59
74H10	.33	74H40	.33	74H76	.65

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MC844	1.25	MC1810P	1.25
MC853P	2.25	MC3004L	2.25
MC876P	2.25	MC3007P	2.25
MC1004L	1.25	MC3021L	2.15
MC1010L	1.25	MC3060L	2.65
MC1305	1.95	MC3062L	3.00
MC1352P	1.55	MC4024P	2.20
MC1357	1.70	MC4044P	4.80
MC1371	1.85	MC14507CP	1.25
MC1439	2.65	MC14511CP	2.76
MC1458P	.50	MC14512CP	1.70

C MOS

4001AE	.29	4023AE	.29
4002AE	.29	4024AE	1.50
4007AE	.29	4025AE	.35
4010AE	.58	4028AE	1.60
4011AE	.29	4029AE	2.90
4012AE	.29	4030AE	.65
4015AE	1.25	4037AE	4.50
4016AE	.65	4040AE	2.40
4018AE	1.10	4044AE	1.50
4019AE	.65	4049AE	.75
4020AE	1.75	4050AE	.75
4021AE	1.50		

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75453BP	.39	LM311H	.90	LM1458N	.80
75454BP	.39	LM318N	1.50	N5556V	1.50
75491BP	.79	LM339N	1.85	NE5558	1.00
75492BP	.85	LM351AN	.65	NE555V	.60
CA3005	1.60	LM370N	1.25	NE556	1.50
CA3006	3.50	LM380N	1.45	UA702	.80
CA3018	1.10	LM566	2.25	UA703CH	.45
CA3018A	1.60	LM711CH	.60	UA709CH	.30
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LM340T0-6	1.75
LM340T0-8	1.75
LM340T0-12	1.75
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2SA484	3.00	2SC374	.70	2SC777	4.00	2SC1307	5.75	2SD187	.80		
2SA489	.80	2SC375	.65	2SC778	4.00	2SC1308	4.75	2SD188	.95		
2SA495	1.65	2SC380	.70	2SC781	3.00	2SC1317	.60	2SD201	1.95		
2SA496	1.15	2SC381	.70	2SC784	.70	2SC1318	.70	2SD213	3.75		
2SA497	1.00	2SC382	.70	2SC785	1.00	2SC1327	.70	2SD218	4.75		
2SA562	.70	2SC387	.70	2SC788	2.15	2SC1342	.50	2SD223	4.50		
2SA564	.50	2SC394	.70	2SC789	1.00	2SC1347	.80	2SD234	1.00		
2SA606	4.25	2SC403	.65	2SC790	1.75	2SC1359	.65	2SD235	1.00		
2SA628	.65	2SC454	.65	2SC793	2.50	2SC1377	5.50	2SD257	2.00		
2SA634	1.25	2SC458	.70	2SC798	3.10	2SC1382	1.00	2SD261	.80		
2SA636	1.25	2SC460	.70	2SC799	3.50	2SC1383	.75	2SD287	4.00		
2SA643	.85	2SC478	.80	2SC815	.75	2SC1384	.85	2SD288	1.00		
2SA673	.85	2SC481	1.85	2SC821	4.00	2SC1447	1.25	2SD291	.85		
2SA678	.75	2SC482	1.75	2SC828	.75	2SC1448	1.25	2SD300	2.50		
2SA679	3.75	2SC484	3.75	2SC829	.75	2SC1449	1.30	2SD313	1.10		
2SA680	3.75	2SC485	3.25	2SC830	1.60	2SC1475	1.50	2SD314	1.10		
2SA682	.85	2SC493	2.75	2SC838	.70	2SC1507	1.25	2SD315	.75		
2SA683	.90	2SC494	3.50	2SC839	.85	2SC1569	1.25	2SD318	.95		
2SA684	.95	2SC495	1.10	2SC853	1.00	2SC1675	1.75	2SD325	1.25		
2SA699	1.30	2SC496	1.15	2SC866	5.85	2SC1678	5.50	2SD330	1.50		
2SA699A	1.45	2SC497	1.60	2SC871	.70	2SC1679	4.75	2SD331	.90		
2SA706	.55	2SC502	1.50	2SC900	.70	2SC1728	2.15	2SD350	3.25		
2SA733	.65	2SC509	1.25	2SC922	.55	2SC1730	.60	2SD360	1.50		
2SA777	.90	2SC515	.80	2SC929	.70	2SC1756	1.25	2SCF8	3.50		
2SB22	.65	2SC517	4.25	2SC930	.65	2SC1760	2.15	2SCF6	1.25		
2SB54	.70	2SC535	.75	2SC938	.65	2SC1816	4.50	2SF8	3.00		
2SB56	.70	2SC536	.65	2SC945	.65	2SC1908	.70	HEPS3001	3.25		
2SB77	.70	2SC537	.70	2SC1000	.65	2SC1909	4.75	JSP7001	.75		
2SB175	.55	2SC608	4.90	2SC1013	1.50	2SC1957	1.50	MRF8004	3.00		
2SB186	.60	2SC609	4.90	2SC1014	1.50	2SC1964	4.75	MPS8000	1.25		
2SB187	.60	2SC614	3.80	2SC1017	1.50	2SC1973	1.50	MPS8001	1.25		
2SB324	1.00	2SC619	.70	2SC1018	1.50	2SC1974	4.90	MPSU02	.50		
2SB337	1.75	2SC620	.80	2SC1034	3.50	2SC1975	4.90	MPSU31	4.00		
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2SB370	.65	2SC634A	.65	2SC1061	1.65	2SC2027	6.00	SD1076	28.95		
2SB405	.85	2SC644	.70	2SC1079	3.75	2SC2028	1.10	SK3047	3.75		
2SB407	1.65	2SC674	.60	2SC1080	3.75	2SC2029	4.75	SK3048	3.25		
2SB415	.85	2SC708	3.00	2SC1096	1.20	2SC2034	3.00	SK3049	4.75		
2SB435	.75	2SC710	.70	2SC1098	1.15	2SC2074	3.00	SK3054	1.25		
2SB461	1.25	2SC711	.70	2SC1115	2.75	2SC2075	5.50	2SK19	1.75		
2SB463	1.65	2SC712	.70	2SC1116	4.00	2SC2091	1.10	2SK30A	1.00		
2SB474	1.50	2SC715	.70	2SC1124	1.25	2SC2092	4.75	2SK33	1.20		
2SB481	2.10	2SC730	.65	2SC1166	.70	2SC2166	4.75	2SK41	1.75		
2SB492	1.25	2SC731	3.00	2SC1170	4.00	2SD45	2.00	3SK22Y	2.75		
2SB495	.95	2SC732	.70	2SC1172	4.00	2SD68	.90	3SK40	2.75		
2SB507	.90	2SC733	.70	2SC1172B	4.25	2SD72	1.00	3SK45	2.75		
2SB511	.70	2SC734	.70	2SC1173	.95	2SD77	1.00	3SK49	2.75		
2SC116	3.00	2SC735	.70	2SC1209	.75	2SD81	3.25	4004	3.00		
2SC183	1.00	2SC738	.70	2SC1211	.75	2SD88	1.50	4005	3.00		
2SC184	1.00	2SC756	3.00	2SC1213	1.00	2SD92	1.50	40080	1.25		
2SC281	.65	2SC763	.70	2SC1226A	1.25	2SD118	3.25	40081	1.50		
2SC371	.70	2SC774	1.75	2SC1237	4.50	2SD130	1.25	40082	3.00		
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AN208	4.75	LA4051P	4.65	TA7061P	2.25	UPC20C	5.00
AN210	3.10	LA4400FS	3.80	TA7063P	2.25	UPC41C	3.95
AN211	3.30	LA4400FR	3.80	TA7074P	4.90	UPC48C	3.95
AN214	4.90	LD3080	4.00	TA7075P	4.90	UPC554C	3.90
AN217	3.30	LD3120	3.10	TA7076P	4.55	UPC555H	3.00
AN227	5.80	M5112	5.40	TA7089P	2.90	UPC563H2	8.00
AN239	6.50	M5115PR	4.80	TA7120P	2.20	UPC566H	2.25
AN241	3.20	PLL01A	13.50	TA7120P-C	2.20	UPC575C	4.10
AN274	3.95	PLL02A	12.00	TA7122AP	2.30	UPC576	4.10
AN315	3.50	PLL02A-G	12.00	TA7124P	1.85	UPC592H2	3.00
BA511	3.50	SG613	5.40	TA7150P	4.55	UPC595C	3.60
BA521	3.95	STK011	10.50	TA7153P	6.90	UPC596C	3.50
HA1202	3.10	STK015	6.50	TA7201P	6.40	UPC1001H2	5.15
HA1306W	5.20	STK032	14.20	TA7202P	4.50	UPC1008C	6.00
HA1308	4.50	STK050	24.50	TA7203P	7.00	UPC1020H	5.50
HA1312	4.05	STK056	11.35	TA7204P	6.50	UPC1025H	5.50
HA1322	5.20	STK415	8.50	TA7205P	6.50	UPC1156H	6.50
LA1201	4.25	TA7028M	3.50	TC4011P	.55	UPD277C	4.50
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LA4000	5.50	TA7051P	3.50	TC5082P	12.00	UPD858C	13.00
LA4030	4.85	TA7054P	3.05	TC9100P	12.00	UPD861C	22.00

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2.2MF50	Axial Leads	.15	30MF25	Axial Leads	.18
3.3MF10	Axial Leads	.15	47MF25	Radial Leads	.19
3.3MF10	No Polarity	.15	47MF50	Radial Leads	.24
10MF25	Axial Leads	.15	100MF16	Radial Leads	.19
10MF50	Axial Leads	.16	100MF25	Radial Leads	.24
10MF150	Axial Leads	.20	500MF50	Axial Leads	.60
25MF35	Axial Leads	.18	1000MF35	Axial Leads	.65

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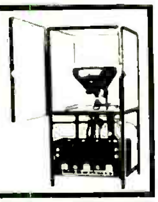

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4. LOCATION OF KNOWN OFFICE OF PUBLICATION *(Street, City, County, State and ZIP Code) (Not printers)*: 200 Park Avenue South, New York, New York 10003
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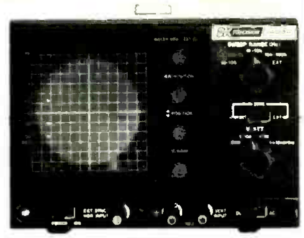

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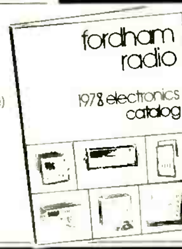

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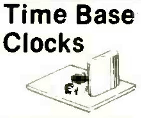

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9601	One Shot	3/$1
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9932	Quad 2 Input NAND Buffer	8/$1
9945	RS F/F	8/$1
9946	Quad 2 Input NAND	8/$1
9949	Quad 2 Input NAND	8/$1
9951	Monostable Multivibrator	8/$1
9962	Triple 3 Input NAND	8/$1

HOUSE # TTL IC's

7400	10/1.00	Please specify	7437	6/1.00
7404	10/1.00	that you	7438	6/1.00
7408	10/1.00	are ordering	74141	3/1.00
7420	10/1.00	House Number TTL.	74153	3/1.00

CRYSTALS

300 KHz	$1.50
3.57945	1.25

COUNTER AND CLOCK CHIPS

MK50252	Clock Chip	$4.99
MM5316	Clock Chip	3.75
MK50250	Alarm Clock	3.75
MK50380	Alarm Chip	2.95
FCM7010	Direct Drive Clock Chip	4.95
MK5005	4 Digit Counter w/Latch	8.50
MK5002	4 Digit Counter	8.95
MK50395	6 Digit UP/Down Counter	12.95
MK50397	6 Digit Elapsed Timer	8.95
CT5005	Calculator Chip w/Specs	1.25
MK5021	Cal. Chip w/sq. rt.	2.50

SOCKET SPECIAL! 28 PIN 1C SOCKET 3 FOR $1 WHEN PURCHASED W/CLOCK 1C

SOCKETS

- 8 Pin Low Profile .20
- 14 Pin Low Profile .22
- 16 Pin Low Profile .25
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- 28 Pin Low Profile .69
- 40 Pin Low profile .89

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Originally Cost $3. each
Similar to 2N913
2 Per Pack 2/$1

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2N 3904 NPN	8/$1
2N 3906 PNP	8/$1
2N 3392 Pre-Amp	25/$1
2N 4400 NPN	10/$1
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POWER TRAN.

115 W 200V	NPN	.95
TIP 29 (EP967)	NPN	4/$1
TIP 30 (EP929)	PNP	4/$1
TIP 31 P.C. Leads	NPN	5/$1
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TN 2021 By RCA		.95
FET TIS 75 HOUSE #		**5/$1**

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AXIAL TYPE

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35 MFD	25V	15/$1
200 MFD	25V	5/$1
470 MFD	35V	4/$1
470 MFD	16V	4/$1
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47 MFD	35V PC Leads	10/$1
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330 MFD	50V PC Leads	5/$1
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1,900 MFD 35WVDC (Mini)	3/$2
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68 PFd	50V	680 PFd	50V
100 PFd	100V	.001 Fd	
150 PFd	50V	.002 MFd	50V
220 PFd	50V	.01 MFd	200V
330 PFd	50V	.02 MFd	200V
.001 UFd	500V	3.3 PF	500V
.0015 UFd	500V	4.7 PF	500V
.005 UFd	500V	8.2 PF	500V
		100 PF	500V

PC Leads 25/89 cents No Mix
Long Leads 25/89 cents No Mix

TANTALUM

1 MFD20 WVDCPC Leads	15/$1
3.3 MFD35 WVDC PC Leads	8/$1
4.7 MFD10 WVDC PC Leads	5/$1
10 MFD20 WVDC PC Leads	8/$1
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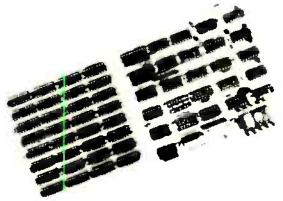

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Control, data and address inputs utilizes low power Schottky devices.

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on board regulation is provided. On board (invisible) refresh is provided with no wait states or cycle stealing required.

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4. On board regulation provided.
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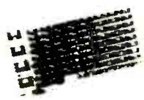
Fully assembled and tested. Not a kit. Imsai — Altair — S-100 Buss compatible, uses low power static 21L02-500ns fully buffered on board regulated, quality plated through PC board, including solder mask. 8 pos. dip switches for address select.



4K LOW POWER RAM KIT

Fully Buffered — on board regulated — reduced power consumption utilizing low power 21L02 — 1 500ns RAMS — Sockets provided for all IC's. Quality plated through PC board. *Add $10. for 250ns RAM operation.

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FEATURES:
A. Bowmar Jumbo .5 inch LED array.
B. MOSTEK — 50250 — Super clock chip.
C. On board precision crystal time base.
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E. Perfect for cars, boats, vans, etc.
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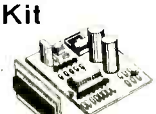

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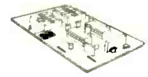
DIGITAL LED READOUT THERMOMETER — $29.95

Features: Litronix dual 1/2'' displays. Uses Silicoaix LD131 single chip CMOS A/D converter. Kit includes all necessary parts (except case): AC line cord and power supply included. 0-149° F.



6 DIGIT ALARM CLOCK KIT

Features: Litronix dual 1/2'' displays, Mostek 50250 super clock chip, single I.C. segment driver, SCR digit drivers. Kit includes all necessary parts (except case). Xfmr optional. Eliminate the hassle.
AC XFMR — **$1.50 Case $3.50**

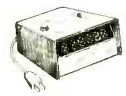
5 Digit Countdown Utility Darkroom Timer Kit

Features: Large LED 1/2'' displays oper. from 0.1 sec. to 59 min. 59.99 sec. 5A-115V. Relay included to control appliances. Operates on 115V AC. Displays can be turned off for total darkness while counting. All necessary parts included.
Special design case $3.75.

$44.95

6 Digit General Purpose or Computer Timer Kit — $29.95

Features: Large LED 1/2'' displays, Mostek 50397 counter display/driver, counts up to 59 minutes, 59.99 seconds with crystal controlled 1/100 second accuracy, operates on 115V AC or 12V DC supply. All necessary parts included. Special design case $3.75.



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4 JUMBO .50'' DIGITS ON ONE STICK! WITH COLONS & AM/PM INDICATOR
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DL 721 8 C.A. · DL 727 - C.A.
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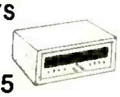

$79.95 Complete Kit

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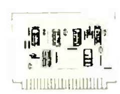

Features: K.C. standard 2400/1200 Hz. 300 Baud, TTL, I/O compatible, phase lock loop, 22 pin connector. Feeds serial data via microprocessors I/O ports and from cassette tape recorder. **$14.95**

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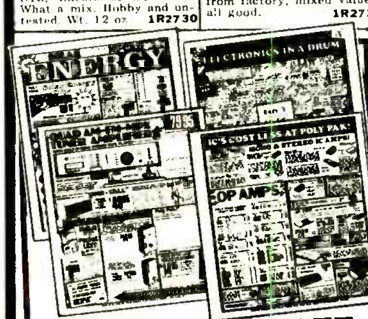

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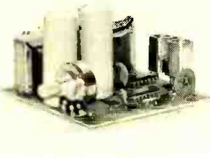

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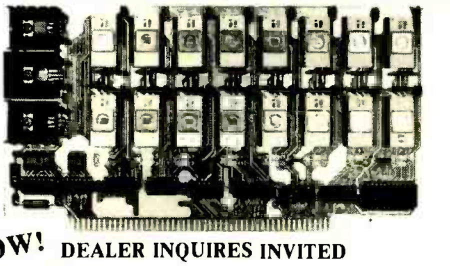

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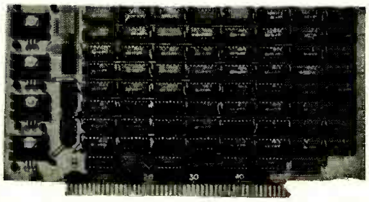

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MAN 3640	Common Cathode-orange	.300	1 75
MAN 4610	Common Anode-orange	.300	1.00
MAN 4640	Common Cathode orange	400	1 00
MAN 4710	Common Anode-red ±1	400	1 00
MAN 4730	Common Anode-red	400	1.00
MAN 4740	Common Cathode-red	400	1 00
MAN 4810	Common Anode-yellow	400	1 00
MAN 6610	Common Anode-orange-D.D	.560	1.25
MAN 6630	Common Anode-orange	.560	1.25
MAN 6640	Common Cathode-orange-D.D.	.560	1.25
MAN 6650	Common Cathode-orange ±1	.560	1.25
MAN 6660	Common Anode-orange	.560	1.25
MAN 6680	Common Cathode-orange	.560	1.25
MAN 6710	Common Anode-red-D.D.	560	1.25
MAN 6730	Common Anode-red ±1	.560	1.25
MAN 6740	Common Cathode-red-D.D.	560	1 25
MAN 6750	Common Cathode-red ±1	.560	1.25
MAN 6760	Common Anode-red	.560	1.25
MAN 6780	Common Cathode-red	560	1 25
DL701	Common Anode-red ±1	.300	1.00
DL702	Common Cathode-red	.300	1.25
DL704	Common Cathode-red	.300	1 50
DL707	Common Anode-red	300	1.50
DL741	Common Anode-red	600	1 95
DL746	Common Anode-red ±1	.630	1 95
DL747	Common Anode-red	600	2 25
DL749	Common Cathode-red ±1	630	1 95
DL750	Common Cathode-red	600	2 49
DL33B	Common Cathode-red	110	.69
FND70	Common Cathode (FND359)	.250	.75
FND503	Common Cathode (FND500)	.500	1.29
FND507	Common Anode (FND510)	500	1 29
5082-7300	4 x 7 Sgl Digit-RHDP	.600	19.95
5082-7302	4 x 7 Sgl Digit-LHDP	600	19 95
5082-7304	Overrange character (±1)	600	15 00
5082-7340	4 x 7 Sgl Digit-Hexadecimal	.600	22 50

CA3013	2.15	CA3082	2.00
CA3023	2.56	CA3083	1.60
CA3035	2.48	CA3086	.85
CA3039	1.35	CA3089	3.75
CA3046	1 30	CA3091	3.50
CA3053	1.50	CA3102	2.95
CA3059	3.25	CA3123	2.15
CA3060	3.25	CA3130	1.39
CA3080	85	CA3140	1 25
CA3081	2.00	CA3401	.49
		CA3600	1 75

EXAR

XR-2206KB Kit $19.95 — **XR-2206KA Kit $14.95**

WAVEFORM GENERATORS		MISCELLANEOUS		TIMERS	
XR-205	$8 40	XR-2211CP	$6 70	XR-555CP	$ .49
XR-2206CP	5.50	XR-4136	2.00	XR-320P	1 55
XR-2207CP	3 85	XR 1468	3 85	XR-556CP	1 85
STEREO DECODERS		XR-1488	5 80	XR-2556CP	3 20
XR-1310CP	$3.20	XR-1489	4 80	XR-2240CP	4.80
XR 1310EP	3 20	XR-2208	5 20	**PHASE LOCKED LOOPS**	
XR-1800P	3 20			XR-210	5 20
XR-2567	2 99			XR-215	6 60
				XR-567CP	1 95
				XR-567CT	1 70

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	43	40 pin	1 75	1 59	1 45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

8 pin	$.40	.38	.35	22 pin	.95	.85	.75
10 pin	45	41	37	24 pin	$1 05	95	85
14 pin	39	38	37	28 pin	1 40	1 25	1 10
16 pin	43	42	41	36 pin	1 59	1 45	1.30
18 pin	75	68	62	40 pin	1 75	1 55	1.40

50 PCS. RESISTOR ASSORTMENTS $1.75 PER ASST.

		10 OHM	12 OHM	15 OHM	18 OHM	22 OHM		
ASST. 1	5 ea.	27 OHM	33 OHM	39 OHM	47 OHM	56 OHM	1/4 WATT 5%	50 PCS.
		68 OHM	82 OHM	100 OHM	120 OHM	150 OHM		
ASST. 2	5 ea.	180 OHM	220 OHM	270 OHM	330 OHM	390 OHM	1/4 WATT 5%	50 PCS.
		470 OHM	560 OHM	680 OHM	820 OHM	1K		
ASST. 3	5 ea.	1 2K	1 5K	1 8K	2 2K	2 7K	1/4 WATT 5%	50 PCS.
		3 3K	3 9K	4 7K	5 6K	6 8K		
ASST. 4	5 ea.	8 2K	10K	12K	15K	18K	1/4 WATT 5%	50 PCS.
		22K	27K	33K	39K	47K		
ASST. 5	5 ea.	56K	68K	82K	100K	120K	1/4 WATT 5%	50 PCS.
		150K	180K	220K	270K	330K		
ASST. 6	5 ea.	390K	470K	560K	680K	820K	1/4 WATT 5%	50 PCS.
		1M	1 2M	1 5M	1 8M	2 2M		
ASST. 7	5 ea.	2.7M	3 3M	3 9M	4 7M	5 6M	1/4 WATT 5%	50 PCS.

ASST. 8R Includes Resistor Assortments 1-7 (350 PCS.) **$9.95 ea.**

$5.00 Minimum Order — U.S. Funds Only
California Residents — Add 6% Sales Tax

Spec Sheets - 25¢ — Send 35¢ Stamp for 1978 Catalog
Dealer Information Available

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All Advertised Prices Good Thru January

HOBBY-WRAP TOOL-BW-630

$34.95
(batteries not included)

- Battery Operated (Size C)
- Weighs ONLY 11 Ounces
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025 inch)
- Complete with built-in bit and sleeve

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft. White or Blue 30 AWG Wire
- 50 pcs. each 1", 2", 3" & 4" lengths — pre-stripped wire.

$11.95

WIRE WRAP TOOL WSU-30

WRAP • STRIP • UNWRAP - $5.95

WIRE WRAP WIRE — 30 AWG

25 ft. min. $1.25 50 ft. $1.95 100 ft. $2.95 1000 ft. $15.00
SPECIFY COLOR — White - Yellow - Red - Green - Blue - Black

WIRE DISPENSER — WD-30

- 50 ft. roll 30 AWG KYNAR wire wrap wire **$3.45 ea.**
- Cuts wire to desired length
- Strips 1" of insulation **Specify** — Blue-Yellow-White-Red

REPLACEMENT DISPENSER SPOOLS FOR WD 30
Specify blue, yellow, white or red **$1.98/spool**

DIP/IC INSERTION TOOL WITH PIN STRAIGHTEN
Inserts both 14 and 16 pin packages. Pin Straightener built into Handle.
Model INS-1416 **$3.49/ea.**

HP 5082-7400 SERIES — MULTI-DIGIT

			10 or more
• ⅛" ht. • Common Cathode Red	2 Digit	$ .79	.69
• 3-5 volts @ 5 mils/second	3 Digit	.89	.79
• 7 segment Monolithic	4 Digit	.99	.89
• Dip Package	5 Digit	1.19	.99

TV GAME CHIP SET — $9.95

Includes AY-3-8500-1 Chip and 2.010 mhz crystal
(2.010 crystal — $1.95 ea/AY-3-8500-1 Chip — $8.95 ea.)

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			PN4250	4/$1.00
MPS A06	5/$1.00			2N4400	4/$1.00
2N918	4/$1 00			2N4401	4/$1 00
2N2219A	3/$1 00	2N3638	5/$1 00	2N4402	4/$1 00
2N2221	4/$1 00	2N3702	5/$1 00	2N4403	4/$1 00
2N2222A	5/$1 00	2N3704	5/$1 00	2N4409	5/$1 00
2N2369	5/$1 00	2N3705	5/$1.00	2N5086	4/$1 00
2N2369A	4/$1 00	2N3706	5/$1 00	2N5087	4/$1 00
2N2484	4/$1 00	2N3707	5/$1 00	2N5088	4/$1 00
2N2906A	4/$1 00	2N3711	5/$1 00	2N5089	4/$1 00
2N2907A	5/$1 00	2N3724	$ .65	2N5129	5/$1.00
2N2925	5/$1 00	2N3725	$1 00	2N5138	5/$1 00
2N3035	2/$1 00	2N3772	$2 25	2N5139	5/$1 00
2N3055	$ .89	2N3903	5/$1.00	2N5209	5/$1 00
MJE2955	$1 25	2N3904	4/$1.00	2N5210	5/$1 00
MJE3055	$1 00	2N3905	4/$1 00	2N5432	$2 00
2N3392	5/$1 00	2N3906	4/$1 00	2N5449	3/$1.00
2N3398	5/$1 00	2N4013	3/$1 00	2N5951	5/$1 00
PN3567	3/$1 00	2N4014	3/$1 00	C106B1SCR	2/$1 00
PN3568	4/$1 00	2N4123	6/$1.00	40409	$1.75
PN3569	4/$1 00	PN4249	4/$1 00	40410	$1.75

CAPACITOR CORNER

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
2200/16V	.70	.62	.55	470/25V	.31	.28	.26

CIRCLE 20 ON FREE INFORMATION CARD

BREAD BOARD JUMPER WIRE KIT

Each kit contains 350 wires cut to 14 different lengths from 0.1" to 5.0". Each wire is stripped and the leads are bent 90° for easy insertion. Wire length is classified by color coding. All wire is solid tinned 22 gauge with PVC insulation. The wires come packed in a convenient plastic box.

JK1 . . . . $10.00 / kit

SOCKET JUMPERS

Mates with two rows of .025" sq. or dia. posts on patterns of .100" centers and shielded receptacles. Probe access holes in back. Choice of 6" or 18" length.

Part No.	No. of Contacts	Length	Price
924003-18R	26	18"	$ 5.38 ea
924003-06R	26	6"	4.78 ea.
924005-18R	40	18"	8.27 ea.
924005-06R	40	6"	7.33 ea.
924006-18R	50	18"	10.31 ea.
924006-06R	50	6"	9.15 ea.

JUMPER HEADERS

Solder to PC boards for instant plug-in access via socket-connector jumpers. .025" sq. posts. Choice of straight or right angle.

Part No.	No. of Posts	Angle	Price
923863-R	26	straight	$1.28 ea
923873-R	26	right angle	1.52 ea.
923865-R	40	straight	1.94 ea.
923875-R	40	right angle	2.30 ea.
923866-R	50	straight	2.36 ea.
923876-R	50	right angle	2.82 ea.

INTRA-CONNECTOR

Provides both straight and right angle functions. Mates with standard .10" x .10" dual row connectors (i.e. 3m, Ainsley, etc.) Permits quick testing of inaccessible lines.

Part No.: 922576-26 **No. of contacts:** 26 **Price** $6.90 ea

INTRA-SWITCH

Permits instant line-by-line switching for diagnostic or QA testing. Switches actuated with pencil or probe tip. Mates with standard .10" x .10" dual-row connectors. Low profile design. Switch buttons recessed to eliminate accidental switching.

Part No.: IS-26 **No. of contacts:** 26 **Price** $13.80 ea.

CRYSTALS

THESE FREQUENCIES ONLY

Part #	Frequency	Case/Style	Price
CY1A	1.000 MHz	HC33 U	$5.95
CY2A	2.000 MHz	HC33 U	$5.95
CY2 01	2.010 MHz	HC33/U	$1.95
CY3A	4.000 MHz	HC18 U	$4.95
CY7A	5.000 MHz	HC18 U	$4.95
CY12A	10.000 MHz	HC18 U	$4.95
CY14A	14.31818 MHz	HC18U	$4.95
CY19A	18.000 MHz	HC18 U	$4.95
CY22A	20.000 MHz	HC18 U	$4.95
CY30B	32.000 MHz	HC18 U	$4.95

CONNECTORS

PRINTED CIRCUIT EDGE-CARD

156 Spacing-Tin-Double Read-Out

Bifurcated Contacts — Fits .054 to .070 P.C. Cards

15/30	PINS (Solder Eyelet)	$1.95
18/36	PINS (Solder Eyelet)	$2.49
22/44	PINS (Solder Eyelet)	$2.95
50/100	PINS (Wire Wrap)	$6.95
50/100A (.100 Spacing)	PINS (Wire Wrap)	$6.95

25 PIN-D SUBMINATURE (RS232)

DB25P	PLUG	$3.25
DB25S	SOCKET	$4.95

205-CB HEAT SINKS 680-.75A

205-CB	Beryllium Copper w-black finish for T0-5	$ .25
291-.36H	Aluminum for T0-220 Transistors & Regulators	$ .25
680-.75A	Black Anodized Aluminum for T0-3	$1.60
Dude 4	Black Anodized Aluminum — predrilled mounting holes for T0-3 — 4¾ x 1¼ x 2"	$1.75

Etching Kits (cannot be shipped via air)

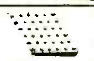
32 X A-1	P.C. Etch Materials Kit enough for 5 circuit boards	$29.95 ea.
27 X A-1	Etched Circuit Kit Complete kit — only add water	$ 9.95 ea.

Plugboards

3662	6.5 X 4.5 X 1/16 Epoxy glass P-Pattern 44 P.C. Tabs-Spaced .156	$ 6.95 ea.
22/44	Mating connector for plugboard — 22 pin double readout	$ 2.95 ea.
8800V	Universal Microcomputer/Processor plugboard — Epoxy Glass — complete with heatsink and mounting hardware 5.313 X 10 X 1/16 copper clad	$19.95 ea.

Vector

1/16 VECTOR BOARD



	0.1" Hole Spacing Part No	P-Pattern L	W	Price 1-9	10 up
PHENOLIC	64P44 062XXXP	4.50	6.50	1.72	1.54
	169P44 062XXXP	4.50	17.00	3.69	3.32
EPOXY GLASS	64P44 062WE	4.50	6.50	2.07	1.86
	84P44 062WE	4.50	8.50	2.56	2.31
	169P44 062WE	4.50	17.00	5.04	4.53
	169P84 062WE	8.50	17.00	9.23	8.26
EPOXY GLASS COPPER CLAD	169P44 062WEC1	4.50	17.00	6.80	6.12

63 KEY KEYBOARD $29.95

This keyboard features 63 unencoded SPST keys unattached to any kind of P.C.B. A very solid molded plastic 13 x 4 base suits most applications.

HD0165	Encoder Chip (encodes 16 Keys)	$7.95 ea.
AY-5-2376	Encoder Chip (encodes 88 Keys)	$14.95 ea.

MICROPROCESSOR COMPONENTS

8080A	CPU	$16.00	CDP1802	CPU	$19.95
8212	8 Bit Input/Output	4.95	MC6800	8 Bit MPU	24.95
8214	Priority Interrupt Control	15.95	MC6820	Periph. Interface Adapter	15.00
8216	Bi-Directional Bus Driver	6.95	MC6810AP1	128 x 8 Static RAM	6.00
8224	Clock Generator/Driver	9.95	MC6830L8	1024 x 8 Bit ROM	15.00
8228	System Controller Bus Driver	10.95	Z80	CPU	29.95

CPU'S

8080A	Super 8008	16.00
2650	8 BIT MPU	26.50
P8085	CPU	29.95

SR'S

2504	1024 Dynamic	$ 3.95
2518	Hex 32 BIT	7.00
2519	Hex 40 BIT	4.00
2522	Dual 132 Bit SSR	2.95
2524	512 Dynamic	1.95
2525	1024 Dynamic	3.00
2527	Dual 256 BIT	3.95
2529	Dual 512 BIT	4.00
2532	Quad 80 BIT	3.95
2533	1024 Static	5.95
3341	Fifo	6.95
74LS670	16 x 4 Reg	3.95

UART'S

AY 5-1013	30K Baud	$5.95

ROM'S

2513(2140)	Char. Gen.-upper case	$ 9.95
2513(3021)	Char. Gen.-lower case	9.95
2516	Char. Gen.	10.95
MM5230	2048 BIT (512 x 4 on 256 x 8)	1.95

RAM'S

1101	256 x 1	Static	$ 1.49
2101	256 x 4	Static	5.95
2102	1024 x 1	Static	1.75
2107/5280	4096 x 1	Dynamic	4.95
2111	256 x 4	Static	6.95
7489	16 x 4	Static	2.49
8101	256 x 4	Static	5.95
8111	256 x 4	Static	6.95
8599	16 x 4	Static	3.49
21L02/91L02	1024 x 1	Static	2.25
74200	256 x 1	Static	6.95
93421	256 x 1	Static	2.95
MM5262	2K x 1	Dynamic	2 for 1.00
UPD414(2104)	4K	Dynamic 16 Pin	5.95

PROMS

1702A	2048	Famos	$ 9.95
5203	2048	Famos	14.95
82S23	32 x 8	Open C	5.00
82S123	32 x 8	Tristate	5.00
74S287	1024	Static	7.95
3601	256 x 4	Fast	3.95
2708	8K	Eprom	19.95
2716	16K	Eprom	34.95
6301-1	1024	Tri-State Bipolar	3.49
6330-1	256	Open Collector Bipolar	2.95

SPECIAL REQUESTED ITEMS

FCM3817	$5.00	11C90	19.95	7205	19.95	9368	3.95
AY-3-8500-1	8.95	4N33	3.95	ICM7045	24.95	LD110/111	25.00/set
AY-5-9100	17.50	8T20	7.50	ICM7207	7.50	95H90	11.95
AY-5-9200	14.95	8T97	2.00	ICM7208	22.00	MC3061P	3.50
AY-5-9500	4.95	HD0165	7.95	ICM7209	7.50	MC4016 (74416)	7.50
AY-5-2376	14.95	MCM6571	13.50	MK50240	17.50	MC1408L7	8.95
9374	1.95	MCM6574	13.50	DS0026CH	3.75	MC1408L8	9.95
82S115	25.00	MCM6575	13.50	TIL308	10.50		

CLOCK CHIPS

MM5309	$9.95
MM5311	4.95
MM5312	4.95
MM5314	4.95
MM5316	6.95
MM5318	9.95
MM5369	2.95
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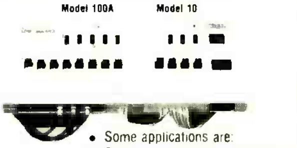
CT7001	5.95

PARATRONICS

Featured on February's Front Cover of Popular Electronics

Logic Analyzer Kit
Model 100A
$229.00/kit

Model 100A assembled $295.00



- Analyzes any type of digital system
- Checks data rates in excess of 8 million words per second
- Trouble shoot TTL, CMOS, DTL, RTL, Schottky and MOS families
- Displays 16 logic states up to 8 digits wide
- See ones and zeros displayed on your CRT, octal or hexadecimal format
- Tests circuits under actual operating conditions
- Easy to assemble — comes with step-by-step construction manual which includes 80 pages on logic analyzer operation.

(Model 100A Manual - $4.95)

- Some applications are:
  - — Troubleshooting microprocessor address, instruction, and data flow
  - — Examine contents of ROMS
  - — Tracing operation of control logic
  - — Checking counter and shift register operation
  - — Monitoring I/O sequences
  - — Verifying proper system operations during testing

PARATRONICS TRIGGER EXPANDER - Model 10

Adds 16 additional bits. Provides digital delay and qualification of input clock and 24-bit trigger word. — Connects direct to Model 100A for integrated unit).

Model 10 Kit — $229.00
Model 10 Assembled — $295.00
Baseplate — $9.95
Model 10 Manual — $4.95

B&K PRECISION 3½-Digit Portable DMM

- Overload Protected
- .3" high LED Display
- Battery or AC operation
- Auto Zeroing
- 1mv, 1Va, 0.1 ohm resolution
- Overange reading
- 10 meg input impendence
- DC Accuracy 1% typical

Ranges: DC Voltage - 0-1000V/ AC Voltage 0-1000V
Freq. Response 50-400 HZ
DC/AC Current: 0-100mA
Resistance 0-10 meg ohm
Size 6.4" x 4.4" x 2"

Model 2800
$99.95

Comes with test leads, operating manual and spare fuse

Accessories:

AC Adapter BC-28	$9.00
Rechargeable Batteries BP-26	20.00
Carrying Case LC-28	7.50

CSC 100 MHz 8-Digit Counter

- 20 Hz-100 MHz Range
- .6" LED Display
- Crystal-controlled timebase
- Fully Automatic
- Portable — completely self-contained
- Size — 1.75" x 7.38" x 5.63"
- Four power souces, i.e. batteries, 110 or 220V with charger, 12V with auto lighter adapter and external 7.2-10V power supply

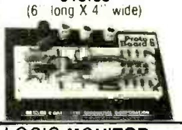
MAX-100 $134.95

ACCESSORIES FOR MAX 100:

Mobile Charger Eliminator use power from car battery — Model 100 — CLA $3.95
Charger/Eliminator use 110 V AC — Model 100 — CAI $9.95

CONTINENTAL SPECIALTIES

PROTO BOARD 6
$15.95
(6" long X 4" wide)



Other CS Proto Boards

PB100 - 4.5" x 6"	$ 19.95
PB101 - 5.8" x 4.5"	29.95
PB102 - 7" x 4.5"	39.95
PB103 - 9" x 6"	59.95
PB104 - 9.5" x 8"	79.95
PB203 - 9.75 x 6½ x 2¾	80.00
PB203A - 9.75 x 6½ x 2¾ (includes power supply)	129.95

PROTO CLIPS

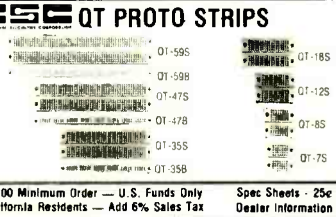
14 PIN	$4.50
16 PIN	4.75
24 PIN	8.50
40 PIN	13.75

DESIGN MATES

DM1 - Circuit Designer $69.95
DM2 - Function Generator $74.95
DM3 - RC Bridge $74.95

LOGIC MONITOR for DTL, HTL, TTL or CMOS Devices **$84.95**

CSC QT PROTO STRIPS



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

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The Incredible "Pennywhistle 103"

$129.95 Kit Only

The Pennywhistle 103 is capable of recording data to and from audio tape without critical speed requirements for the recorder and it is able to communicate directly with another modem and terminal for telephone "hamming" and communications for the deaf. In addition, it is free of critical adjustments and is built with non-precision, readily available parts.

Data Transmission Method	Frequency-Shift Keying, full-duplex (half-duplex selectable).
Maximum Data Rate	300 Baud
Data Format	Asynchronous Serial (return to mark level required between each character)
Receive Channel Frequencies	2025 Hz for space, 2225 Hz for mark
Transmit Channel Frequencies	Switch selectable. Low (normal) — 1070 space, 1270 mark. High — 025 space, 2225 mark
Receive Sensitivity	46 dbm accoustically coupled
Transmit Level	15 dbm nominal. Adjustable from -6 dbm to -20 dbm
Receive Frequency Tolerance	Frequency reference automatically adjusts to allow for operation between 1800 Hz and 2400 Hz
Digital Data Interface	EIA RS-232C or 20 mA current loop (receiver is optoisolated and non-polar)
Power Requirements	120 VAC, single phase, 10 Watts
Physical	All components mount on a single 5" by 9" printed circuit board. All components included.

Requires a VOM, Audio Oscillator, Frequency Counter and/or Oscilloscope to align.

ERC AM/FM 8-Track Stereo Receiver With BSR Changer

- PLL System
- BSR Record Changer
- Slide Controls
- Automatic AFC Control
- 4 Speaker Output
- Walnut finish vinyl covered wood veneer with smoke dust cover

Size: 20"W x 9⅜"H x 15¼"D

Model 8365 $149.95

DIGITAL STOPWATCH

- Bright 6 Digit LED Display
- Times to 59 minutes 59.59 seconds
- Crystal Controlled Time Base
- Three Stopwatches in One: Times Single Event — Split & Taylor
- Size 4.5 x 2.15 x .90 (4½ ounces)
- Uses 3 Penlite Cells

Kit — $39.95
Assembled — $49.95
Heavy Duty Carry Case $5.95

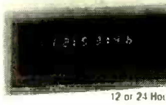
Stop Watch Chip Only (7205) $19.95

IMC 3½ DIGIT DPM KIT

- New Bipolar Unit
- Auto Zeroing
- .5" LED
- Auto Polarity
- Low Power
- Single IC Unit

Model KB500 DPM Kit $49.00
Model 311D-5C-5V Power Kit $17.50

JE700 CLOCK



The JE700 is a low cost digital clock, but is a very high quality unit. The unit features a simulated walnut case with dimensions of 6 x 2½ x 1. It utilizes 3 MAN72 high brightness readout, and the MM5314 clock chip.

12 or 24 Hour

115 VAC *KIT ONLY* **$16.95**

HEXADECIMAL ENCODER 19-KEY PAD

- 1 - 0
- ABCOEF
- Shift Key
- 2 Optional Keys

$10.95 each

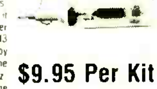
INSTRUMENT/CLOCK CASE

Injection molded unit. Complete with red bezel. 4½" x 4" x 1-9/16".

$3.95 ea.

JE803 PROBE

The Logic Probe is a unit which is for the most part indespensible in trouble shooting logic families TTL, DTL, RTL, CMOS. It derives the power it needs to operate directly off of the circuit under test, drawing a scant 10 mA max. It uses a MAN3 readout to indicate any of the following states by these symbols (HI) 1 (LOW) 0 (PULSE) P. The Probe can detect high frequency pulses to 45 MHz. It can't be used at MOS levels or circuit damage will result.



$9.95 Per Kit

printed circuit board

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**

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2N6101 (S5004)	NPN SI TAB	80	10	75		.65	5.00
D41D1	PNP SI TAB	30	1	6		.25	2.00
MPS5172(HEP56)	NPN S TO-92	25	.1	.2		.12	1.00
C106D1	SCR TAB	4A-400V	.2MA GATE			.65	5.00

-SUPER SPECIALS-

2708 1024 X 8,450NS, EPROM	$20.95
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360MFD. 600VDC PHOTO FLASH CAP.	.90
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SP425 SPERRY 9 digit ¼" HV multiplexed 7 seg.	1.25
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T.V. crystal for above.....	1.75
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93410 256 x 1 45NS RAM . . .	.85
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7430 TTL nand gate	.14
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UA715 60MHz. op-amp	1.20
74S206 256 x 1 45NS RAM . . .	.90
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78L05 5.0V " " "	.29
78L6.2 6.2V " " "	.29
78L12 12V " " "	.29
78L15 15V " " "	.29
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78MG 4 term. adj. .5A + reg.	1.29
79MG " " " " - reg.	1.39
7805T tab 1A 5v regul	.89
7812 to-3 1A +12V regul.	.59

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Ideal module for home built counter projects. Includes 7490 decade counter 7475 latch, 7447 driver, and RCA .6" NUMITRON display. PCB with plated thru hole and instructions supplied...... KITS SUPPLIED FROM ONE TO TEN DIGITS PER BOARD (all interconnects plated)..

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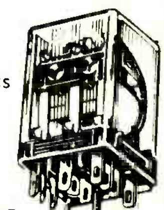

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24VDC COIL
650 ohms
120VAC
10.5MA

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150/170MHz KIT **$12.95**
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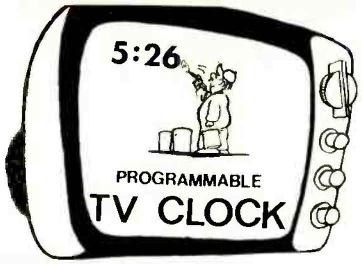

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2SA 353	.70	2SA 908	11.00	2SC 482	1.50	2SC 959	1.50	2SC 1624	1.30	2SD 526	1.10
2SA 377	2.00	2SB 54	.59	2SC 485	1.60	2SC 971	1.00	2SC 1626	1.10	2SD 555A	6.60
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2SA 483	3.00	2SB 75	.59	2SC 495	1.00	2SC 984	.90	2SC 1647	.59	**FET**	
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2SA 485	2.00	2SB 186	.59	2SC 509	.90	2SC 1014	1.20	2SC 1674	.59	2SK 30	.90
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2SA 496	1.10	2SB 220	.70	2SC 536	.59	2SC 1030C	2.80	2SC 1682	.45	2SK 40	.70
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2SA 509	.70	2SB 324	.70	2SC 538A	.70	2SC 1060	2.25	2SC 1708	.59	2SK 55	1.30
2SA 525	2.50	2SB 337	1.60	2SC 562	2.15	2SC 1061	1.40	2SC 1728	2.00	2SK 68	1.30
2SA 537	2.25	2SB 367	1.50	2SC 563	1.10	2SC 1080	4.40	2SC 1730	.59	3SK 22	2.55
2SA 539	.70	2SB 368B	2.15	2SC 619	.59	2SC 1096	1.00	2SC 1760	2.00	3SK 35	2.25
2SA 561	.59	2SB 379	1.10	2SC 620	.59	2SC 1111	3.40	2SC 1775	.45	3SK 39	2.25
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2SA 564A	.59	2SB 405	.70	2SC 644	.59	2SC 1116	4.40	2SC 1885	.70	3SK 41	2.50
2SA 565	1.10	2SB 407	1.40	2SC 645	.70	2SC 1116A	4.90	2SC 1908	.59	3SK 45	2.50
2SA 566	3.40	2SB 415	.70	2SC 650	1.30	2SC 1124	1.30	2SC 1909	4.40	MK 10	2.00
2SA 606	1.90	2SB 434	1.20	2SC 668	.59	2SC 1162	1.10	2SC 1951	1.10	**IC**	
2SA 624	1.10	2SB 440	.70	2SC 680	2.80	2SC 1168	.59	2SC 1957	1.20	AN 214Q	3.40
2SA 627	3.60	2SB 463	1.50	2SC 684	1.40	2SC 1173	.90	2SC 1969	4.90	AN 315	3.70
2SA 628	.59	2SB 471	1.60	2SC 693B	.59	2SC 1175	.90	2SC 1973	1.10	BA 511	3.40
2SA 634	.90	2SB 472	2.80	2SC 696	1.95	2SC 1177	14.00	2SC 1975	4.40	BA 521	3.70
2SA 640	.59	2SB 474	1.20	2SC 706A	1.90	2SC 1189	1.40	2SC 2028	.90	HA 1151	3.70
2SA 643	.70	2SB 492	1.00	2SC 710	.59	2SC 1211D	.70	2SC 2029	3.90	LA 4400	3.70
2SA 659	.59	2SB 507	1.60	2SC 711	.59	2SC 1213	.70	2SC 2091	3.60	TA 7045M	3.00
2SA 663	4.90	2SB 509	1.90	2SC 712	.59	2SC 1222	.45	2SC 2092	3.90	SN 7400	.19
2SA 666	.70	2SB 514	1.90	2SC 717	.59	2SC 1226	1.00	2SC 2098	3.90	SN 7490	.60
2SA 672	.70	2SB 526C	1.30	2SC 730	4.40	2SC 1237	4.25	2SD 28	2.80	TA 7055P	3.00
2SA 673	.70	2SB 527	1.90	2SC 732	.59	2SC 1239	3.50	2SD 75	1.10	TA 7060P	1.60
2SA 676	.70	2SB 528D	1.60	2SC 733	.59	2SC 1279	.70	2SD 90	1.60	TA 7061AP	1.90
2SA 683	.70	2SB 536	1.60	2SC 734	.59	2SC 1306	4.40	2SD 91	1.60	TA 7062	1.90
2SA 684	.70	2SB 539	4.90	2SC 735	.59	2SC 1307	4.90	2SD 92	1.50	TA 7205P	3.90
2SA 695	.70	2SB 541	4.40	2SC 738	.59	2SC 1312	.59	2SD 118	3.00	TA 7310P	3.95
2SA 697	.70	2SB 554	10.00	2SC 756	2.80	2SC 1313G	.59	2SD 130	1.20	UPC 592H2	1.60
2SA 706	1.60	2SB 561B	.70	2SC 763	.59	2SC 1317	.59	2SD 142	2.00	PLL 02A	8.80
2SA 715	1.40	2SB 564	.90	2SC 773	.70	2SC 1318	.59	2SD 143	2.80	**DIODES**	
2SA 719	.70	2SB 595	1.90	2SC 774	1.60	2SC 1327	.59	2SD 178	1.40	1S 84	1.00
2SA 720	.70	2SB 600A	7.00	2SC 776	2.65	2SC 1330	1.50	2SD 180	2.50	1S 188	.45
2SA 721	.70	2SC 183	.59	2SC 778	3.60	2SC 1342	.59	2SD 187	.59	1S 332	.45
2SA 725	.59	2SC 184	.59	2SC 781	2.65	2SC 1344	.59	2SD 188	3.00	1S 953	.45
2SA 726	.59	2SC 281	.59	2SC 783R	3.60	2SC 1345D	.59	2SD 205	1.40	1S 1007	.45
2SA 733	.59	2SC 284	1.40	2SC 784	.59	2SC 1359	1.40	2SD 217	4.40	1S 1209	.45
2SA 740	2.65	2SC 367	.90	2SC 785	.70	2SC 1360	1.00	2SD 223	1.90	1S 1211	.45
2SA 744	3.70	2SC 369	.70	2SC 789	1.00	2SC 1362	.59	2SD 224	1.90	1S 1555	.32
2SA 745R	4.40	2SC 371	.59	2SC 793	2.80	2SC 1364	1.40	2SD 227	.59	1S 1588	.32
2SA 747	5.80	2SC 372	.59	2SC 799	3.60	2SC 1377	4.90	2SD 234	1.00	1S 1885	.45
2SA 750	.59	2SC 373	.59	2SC 815	.59	2SC 1383	.59	2SD 235	1.00	1S 2076	.45
2SA 756	3.40	2SC 374	.59	2SC 828	.59	2SC 1400	.59	2SD 287	3.70	1S 2093	.45
2SA 758	5.80	2SC 380	.59	2SC 829	.59	2SC 1402	3.70	2SD 313	1.10	1S 2473	.45
2SA 774	.59	2SC 381	.59	2SC 838	.59	2SC 1403	3.70	2SD 315	1.20	1N 34	.25
2SA 777	1.10	2SC 382	.59	2SC 839	.59	2SC 1419	1.10	2SD 325	1.10	1N 60	.25
2SA 798	.70	2SC 387	.59	2SC 870	.59	2SC 1444	2.80	2SD 356D	1.10		
2SA 814	1.90	2SC 394	.59	2SC 871	.59	2SC 1448	1.10	2SD 357D	1.00		

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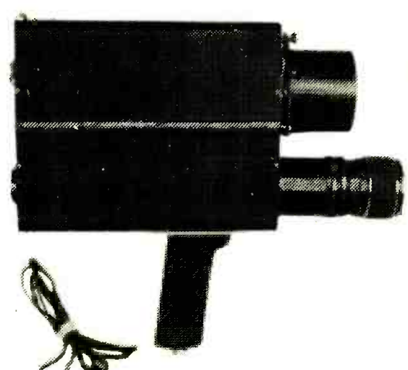

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Memory is 512X5 produces 64 five by seven ASCII characters. New by National, w/specs $6.00

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12 VDC w/5 inch loud bell, w/instructions.
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REED RELAY
High quality, ultra-sensitive 5VDC SPDT reed relay. Use in a variety of applications where transistors or SCR's are not quite suitable. May be driven directly from TTL. RRY-510 $1.50

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.3" orange and yellow readouts by Monsanto. Factory prime. Common anode.
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Orange (DRO-730) $1.38

FAN MOTOR
117VAC fan motor for use in cooling insides of test equipment, operating models, cooling yourself off, etc. A fantastic buy at this price ! MOT-115 $2.95

LOGI-CASE
Universal instrument enclosure with a wide variety of applications. Unique interior plexiglass rack assembly will hold up to 6—1.5" by 4" PC boards. Great for packing a lot of components into a very small space. Adds a very professional touch to any project. Made from 1/8" thick anodized, extruded aluminum. So tough that you can run over it without damaging it !!!! The Logi-Case comes with a reversible front filter allowing you to choose between transparent red or smoke grey. Now available in two popular sizes:
Small: 4½L x 3¼D x 1¾H.
Large: 6L x 4½D x 2H.
SMALL (LCS-100) $7.95
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TYPE	PART NO.	PRICE
470 ohm, vertical	PCV-471	.25
1K ohm, vertical	PCV-102	.20
2.5K ohm, vertical	PCV-252	.20
5K ohm, vertical	PCV-502	.20
10K ohm, vertical	PCV-103	.25
22K ohm, horizontal	PCV-223	.25
50K ohm, vertical	PCV-503	.20
470K ohm, horizontal	PCV-473	.25

12V RELAY
Brand new 12VDC relay by Cornell Dubilier. Has N.O. and N.C. contacts. Measures appx. 1 x 1¼". CRY-012 $1.50

PANEL LAMP
110VAC panel lamp. Neon lamp inside with white plastic outer lens assembly. Includes dropping resistor & mtng clip. NEL-110 29¢

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NPN phototransistor & PN infrared light emitting diode. 1500 volt isolation. 3ma coll output current. Excellent frequency response to 300 khz. Brand new Motorola 6 pin DIP with full specs & data. POI-427 $1.00 10 for $9

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The famous Motorola HEP170 universal replacement diode. Rated 1000 PIV @ 2.5 Amps. HEP-170 ...... 20 cents ea. 100 for only $14.50

STROBE TUBE
Experimenter's delight ! New xenon strobe tube & trigger transformer. Tube op. from 150-300V FFT-100 1.75

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Includes magnet and magnetic reed switch. Design your own alarm system and save $$$. BAS-100 .... $1.95

TRANSFORMER
Mini transformers for clocks, etc. Outputs 8V @ 500ma or 12V @ 190ma. With specs. CMX-812 $1.50

HEAT SHRINK
Much easier to use than electrical tape. Slip over solder joint & heat. Tube will shrink to form tight seal. 12—6" peices, assorted sizes. HST-120 $1.45

1-3pf TRIM CAP
Mini trim cap. Great for crystal circuits, hand probes, etc. Measures 3/16" diameter. PCT-130 95¢

V.O.X.
Solid state Voice Operated switch. Complete w/ all parts and completely assembled. SCR output W/ schematic. VOX-900 .... $1.50

100K MINI-POT
New by IRC, PC mount trimpot. ¼" H by ½" diameter. PCT-104 50¢

.1uf, 6000V CAP
New by Sprague. Great for experimenting w/ high voltage. AXC-160 .... .70¢

2N3055
The king of audio power transistors now at an unbeleivable price !!! Brand new BNC 055 .... .50¢

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Heavy duty, SPST high quality. Rated 15A @ 125 VDC. TSW-111 95¢

POWER RELAY
Potter & Brumfeild 120V. SPDT, 25 Amp. CRY-012 $4.00

SNAP SWITCH
Mini SPDT snap switch by Cherry. Rated 5 amps, 125—250 VAC. MSW-523 65¢

RIBBON CABLE

Cond	Part No.	1'	10'
6	RIB-006	.25	2.00
12	RIB-012	.45	3.95
24	RIB-024	.85	7.95

WIERD SWITCH
Strange, but useful reverse-action snap switch w/ lever. NC & NO connection LSW-100 .... .75¢

WIRE SPECIAL
22 ga magnet wire. Unique solder-thru insulation. Buy by the pound and save! (Appx. 500 feet). LBW-220 $3.95

RUBBER FEET
Molded, adhesive back rubber feet in peel-off sheets from 3M.
Round: (RRF-120) 12 for 75¢
Square: (SRF-120) 12 for 55¢

POT w/ SWITCH
New by Allen-Bradley. 100K mini 1/8" shaft, ¼" mount. with SPST switch. QVR-104 65¢

MICRO SWITCH
Miniature SPDT momentary contact pushbutton. Rated 5 amps @ 125VAC MSP 111 95¢

TTL DATA BOOK
TDB-254 $4.95
The newest edition of the TTL data book for design engineers. Detailed specs on over 900 TTL devices including standard and high-technology Schottky Clamped TTL. Pin assignment drawings of all TTL types. The most complete book ever written on TTL. —By Texas Instruments.

VACUUM SWITCH
SPST pneumatic switch. Enclosed diaphram activates with vacuum or pressure. Extremely sensitive. Brand new. VPS-195 .... $1.95

TRIMMER BOARDS
Made for test probes, these boards contain 2—5-30 pf trimmer capacitors, 1—500 ohm and 1 1K ohm miniature trimmer pots. PAT-018 90¢

5 MEG H.V. POTS
High voltage pots w/ insulated shaft for protection against high voltage.
1/8" shaft—Small (QVR-505) $1.45
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1.5V DC MOTOR
Great for toys, experimenting, etc. 6" leads, 1/16" shaft.
MOT-015 .... .50¢
10 for only $4.00

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Super high quality. Input 117VAC, outputs: 5.5V @ 200ma 10.5V @ 250ma or 12V @ 300 ma. With specifications. PCX-120 $1.50

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Brand new Rubycon. 600 uf at 360 volt. Use with our flash tube & trigger transformer to make a very high quality strobe light !!! PFC-360 $1.95

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75¢
Black molded bezel for digital displays. Snaps into square hole. 2¼" long by 7/8" high. Adds a professional touch !!! NBZ-001

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Quality computer grade caps.
12000mf @ 25VDC CGC-122 .... 3.95
5900mf @ 60VDC CGC-596 .... 2.50
5000mf @ 30VDC CGC-503 .... 1.95
2700mf @ 25VDC CGC-272 .... 1.75

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High quality dual concentric pot. 1/8 and 1/4 inch shafts. New by Allen Bradley. Measures 5/8" square. Front pot is 25K linear rear pot is 50K log. MVR-255 $1.75

CLOCK CHIP
Most popular clock chip on the market. National MM5314. 12/24 hour, 50 or 60 hz, 6 digit. MME-314 $4.95

JUMBO L.E.D.
Jumbo red LED for experimenters. Factory prime units. .200" diameter. LED-188 5 for $1.

SLIDE SWITCH
Standard DPDT Long shaft for deep panel mounting. 3A @ 125VDC SSW-221 25¢

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Standard size pot hex nuts. 2 sizes:
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your choice, 25 for 1.00

FELT FEET
3/8" diameter. Comes in peel-off strips of 15 felt feet per strip. FFT-015 25¢ strip

.01uf DISC
.01 uf disc ceramic capacitor. We have thousands !!! Buy while they last DCP-010 5¢

10K POT
Brand new Clarostat, 1/4" shaft standard pot. TVR-103 90¢

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.02 uf disc ceramic capacitor. We have thousands !!! Buy while they last DCP-020 5¢

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We somehow managed to get ahold of hundreds of these. Very popular number for replacement in radios, TV's, etc. New and unused. AUT-127 50¢

STAND-OFF
Insulated stand off terminal, ¼" dia., 5/8" long. With ¼" mounting screw. SOT-210 10/$1.49

CONNECTOR
Female UHF to BNC male connector. Plated, new. ADP-239 $1.95

COMPONENT CARRIER
Molded plastic with hole drilled in center. 7/16" I.D. CLP-050 5/25¢

.1/50V CAP
TRW dipped mylar capacitor. .1 uf at 50 VDC. DCP-150 15¢

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Black molded bakelite barrier block, 5 position. BTS-250 25¢

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New by STM. 5200 uf at 25 VDC, PC leads PCL-522 75¢

1800uf CAP
1800 uf at 40VDC. Brand new. PCL-184 55¢

8200uf CAP
8200 uf at 15 VDC. Brand new by Mallory. AXC-821 75¢

5uf, 150V
5 uf, 150VDC cap. Great for audio crossover networks. Non-polarized. NPC-515 60¢

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Single solder terminal strip. Bakelite mount. STS-010 4 for .... 25¢

.01uf MINI CAP
Ultra-miniature .01 uf ceramic chip capacitor, axial lead. Appx. ¼" long. High quality. DCP-015 15¢

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Ultra-miniature ceramic capacitor for crystal circuits, etc. UMC-047 10¢

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7401	.16	7453	.17	74154	1.20
7402	.15	7454	.17	74155	.97
7403	.15	7460	.17	74156	.97
7404	.16	7464	.35	74157	.99
7405	.19	7465	.35	74158	1.79
7406	.20	7470	.30	74160	1.23
7407	.28	7472	.30	74161	.97
7408	.18	7473	.35	74162	1.39
7409	.19	7474	.28	74163	1.09
7410	.16	7475	.49	74164	.99
7411	.25	7476	.30	74165	.99
7413	.43	7483	.68	74166	1.25
7414	.65	7485	.88	74170	2.10
7416	.35	7486	.40	74173	1.49
7417	.35	7489	2.25	74174	1.23
7420	.16	7490	.43	74175	.97
7422	.30	7491	.75	74176	.89
7423	.29	7492	.48	74177	.84
7425	.27	7493	.48	74180	.90
7426	.26	7494	.78	74181	2.45
7427	.29	7495	.79	74182	.79
7430	.20	7496	.79	74184	1.90
7432	.23	74100	.98	74185	2.20
7437	.25	74105	.44	74187	5.75
7438	.25	74107	.37	74190	1.15
7440	.15	74121	.38	74191	1.25
7441	.89	74122	.38	74192	.95
7442	.59	74123	.65	74193	.85
7443	.73	74125	.54	74194	1.25
7444	.73	74126	.58	74195	.74
7445	.73	74132	.89	74916	1.25
7446	.81	74141	1.04	74197	.73
7447	.79	74145	1.04	74198	1.73
7448	.79	74150	.97	74199	1.69
7450	.17	74151	.79	74200	5.45

LOW POWER

74L00	.29	74L51	.29	74L90	1.40
74L02	.29	74L55	.29	74L91	1.20
74L03	.23	74L71	.29	74L93	1.50
74L04	.29	74L72	.45	74L95	1.50
74L06	.29	74L73	.56	74L98	2.25
74L10	.29	74L74	.56	74L164	2.25
74L20	.29	74L78	.75	74L165	2.30
74L30	.29	74L85	1.09		
74L42	1.39	74L86	.65		

LOW POWER SCHOTTKY

74LS00	.36	74LS32	.38	74LS95	2.09
74LS02	.36	74LS40	.45	74LS107	.59
74LS04	.36	74LS42	1.40	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

CMOS

4000A	.26	4018A	1.19	4066A	.84
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	.49	4049A	.59		
4017A	1.01	4050A	.59		

CAPACITORS
CERAMIC DISC

1pf 50V	82pf 50V	820pf 50V
5pf 50V	100pf 50V	.001uf 50V
7pf 50V	120pf 50V	.0047uf 50V
10pf 50V	150pf 50V	.01uf 50V
22pf 50V	180pf 50V	.01uf 1000V
27pf 50V	220pf 50V	.022uf 50V
33pf 50V	270pf 50V	.030uf 50V
47pf 50V	390pf 50V	.050uf 50V
56pf 50V	470pf 50V	.1uf 50
68pf 50V	600pf 50V	

QTY.	PRICE (each)	PRICE (Minimum 10 per value)
0-10	$.10 ea	
10-100	$.10 ea	$.05 ea
100-		$.04 ea

LINEAR CIRCUITS

LM300H	$.71
LM301CN	.29
LM302H	.65
LM304H	.80
LM307CN	.26
LM307H	.30
LM308H	.89
LM309H	1.05
LM309K	.99
LM310CN	1.07
LM311CN	.89
LM311H	.89
LM311N	.89
LM319N	1.13
LM320K	
5, 5.2, 12, 15	1.29
LM320T	
5, 12, 15	1.19
LM322N	1.59
LM324N	
(LM2902N)	1.52
LM339N	1.58
LM340K	
5, 6, 8, 12,	
15, 18, 24	1.29
LM340T	
5, 6, 8, 12,	
15, 18, 24	
(78 — — Equiv.)	1.19
LM372N	2.93
LM376CN	.59
LM380N	1.29
LM380-8CN	.95
LM381N	1.75
LM382N	1.75
LM385K	.45
NE531V	2.90
NE540L	2.90
NE546A	1.09
NE550A	.75
LM555CN	.39
NE556A	.85
LM560N	2.95

LM561N	2.95
LM565N	1.19
LM565H	1.39
LM566H	1.39
LM566CN	1.19
LM567CN	1.29
LM567H	1.49
LM703H	.59
LM703CN	.39
LM709N	.25
LM709H	.29
LM710N	.59
LM711N	.39
LM723H	.55
LM723N	.52
LM733H	.79
LM739N	.99
LM741CN(8)	.32
LM741CN(14)	.32
LM741CH	.35
LM747H	.79
LM747N	.71
LM748CN	.35
LM1310N	2.80
LM1414N	1.59
LM1456CN	1.29
LM1458CN	.59
LM1496N	.89
LM1800N	2.48
ULN2208	.89
ULN2209	.89
CA3046	1.19
CA3081	1.49
LM3900N	.49
LM7524	.79
LM7525	.79
8038B	4.59
75451CN	.35
75452CN	.35
75453CN	.35
75454CN	.35
75491N	.71
75492N	.85

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- PROGRAMMED MATHEMATICALLY TO PLAY IN PERFECT PITCH PERMANENTLY.
- ATTRACTIVE CASE, CONVENIENT WALL MOUNT.

$39.50 SHIPPING $1.00

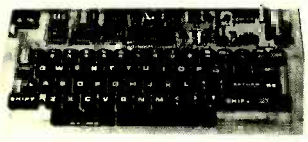
DISCRETE LED's

		EACH
ME4	INFRARED CLEAR DOME .170"	.29
MV10B	CLEAR DOME .170"	.25
MV50	CLEAR AXIAL .09"	.12
MV50	RED AXIAL .09"	.12
NSL100	RED .19"	.12
RL209	RED DIFF SUBMINIATURE .12"	.12
RLT-T1-03	WHITE DIFF SUBMINIATURE NO FLANGE .124"	.15
RLC-200	RED DIFF CURRENT REG. .190" CONST BRIGHTNESS 4.5-12.5V	.25
RLC-201	RED DIFF. CURRENT REG. CONST. BRIGHTNESS 4.5- .190"	.25
RL-4403	RED DIFF. FULL FLOOD .190"	.15
GREEN	SPOT .190"	.18
CLEAR	POINT .190"	.15

LED s

		EA.
DL10A	RED CA .27" LHD	$1.89
DL 707	RED CA .30" RHD	1.49
DL 507	RED CA .50" RHD	1.49
FND 359	RED CC .375" RHD	.89
DL 702	RED CC .30" LHD	1.39
NSN 74R	RED CC .30" RHD	1.49
DL 500	RED CC .50" RHD	1.49
MAN5	GREEN CA .27" LHD	1.39
MAN8	YELLOW CA .27" LHD	1.39
MAN82	YELLOW CA .3" LHD	1.89
MAN66	RED CA .6" LHD	2.19
DL747	RED CA .6" LHD	2.39

Stand Alone ASCII Keyboard



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2. BUFFERED 8 BIT (TRI STATE LATCH) PARALLEL OUTPUT WITH VALID DATA SYNC PULSE AND LEVEL
3. 20 MA OPTO ISOLATED CURRENT LOOP, POLARITY INDEPENDENT
4. EIA RS232C

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ANSI — COMPATIBLE KEY SET, FOR SLIM LINE "HIDEAWAY" PACKAGING
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REPEAT KEY REPEATS AT CHARACTER RATE
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LOW PROFILE CASE (OPTIONAL) *Available Mid December*

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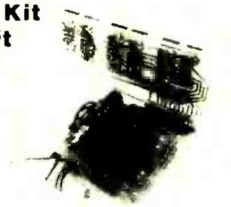
Clock Kit 6 Digit



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**

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Solder Tail - low profile

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14 pin	.20	28 pin	.59
16 pin	.22	40 pin	.69
18 pin	.29		

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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" **$1.80 ea.**

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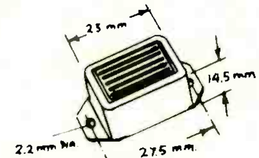

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100 - 1000		.10	$.09
1000 -		.10	.08

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2.2 mfd	35V	.30	22 mfd	16V	.45
3.3 mfd	35V	.30	33 mfd	10V	.40
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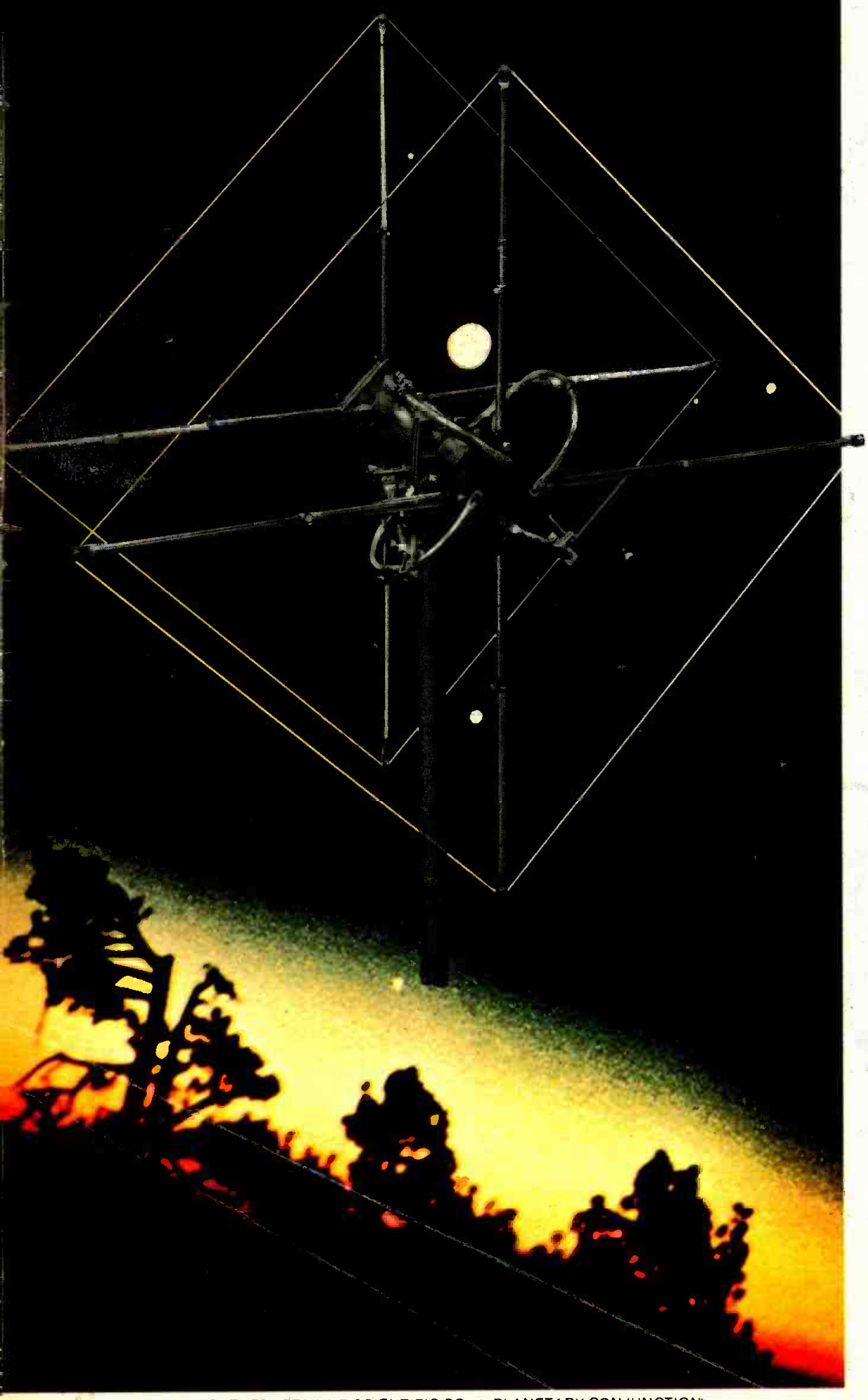

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Compact construction. *New* cast aluminum rear hub. *New* fiberglass filled high impact ABS front hub. *New* swaged joints on orbital gamma match plus cadmium plated parts and bolts, stainless steel clamps, aircraft quality heavy duty tubing for strong, low weight, long lasting construction.

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Band Width	Full 40 Channels
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Polarity Isolation	23 db Vertical to Horizontal
VSWR	1.2:1
Switch Box Included	Low VSWR co-axial change-over to effect switching horizontal to vertical.
Impedance	50-52 ohms
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Lightning Protection	D.C. Ground
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