YOUR ONE-STOP SOURCE OF ELECTRONICS INFORMATION

ICD 08559

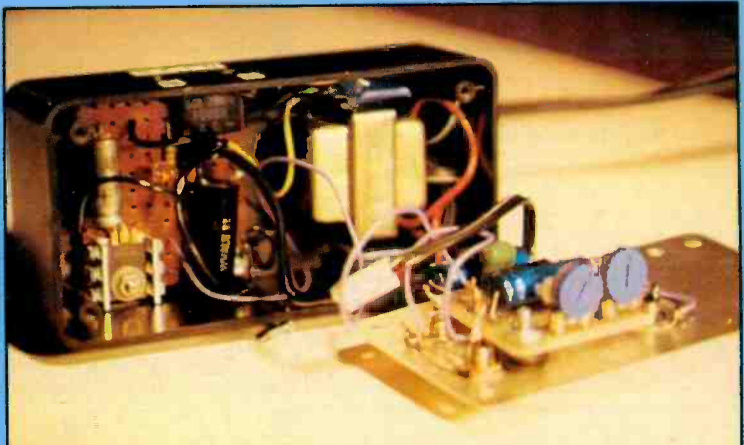
MODERN ELECTRONICS

AUGUST 1986 $1.95
CANADA $2.50

TM

THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

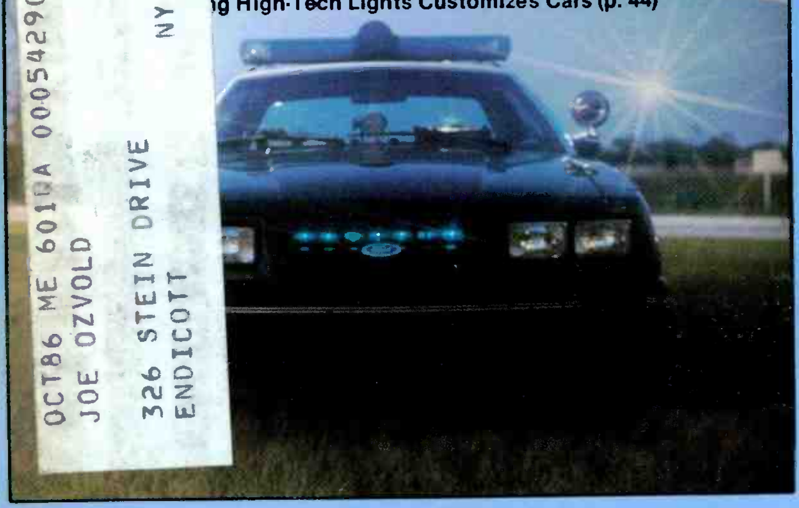
- LINKING COMPUTERS BY RADIO
- COMPACT DISC & PLAYER EMPHASIS-DEEMPHASIS METHODS

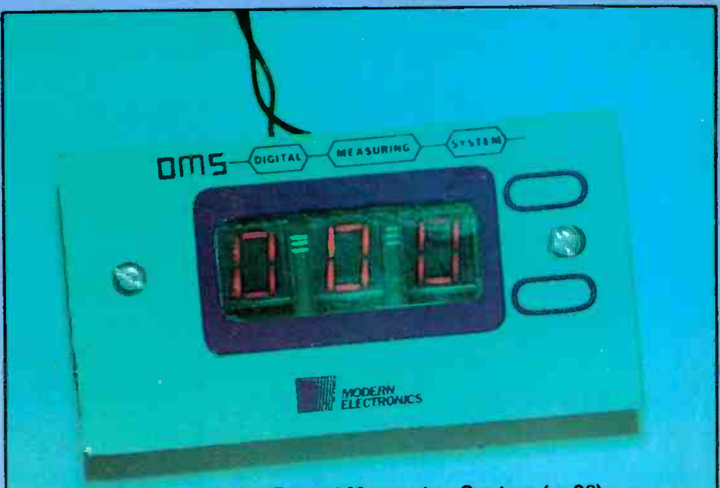

A Dual Video Amplifier (p. 36)

Complete Construction Plans:

- Expandable Digital Measuring System
- Video Amplifier Simplifies ...e-VCR Applications
- ...cing Lights for Cars
- Solar Cell Power Supply
- Experimenter's FM Transmitter
- RS-232 Breakout Box

...g High-Tech Lights Customizes Cars (p. 44)





An Expandable Digital Measuring System (p. 22)

Bulk Rate
Permit No. 79
U.S. Postage Paid
Gordonsville, VA 22942

Plus: Forrest Mims Experiments with Power MOSFETs • Reports on Alpha Software's Keyworks "Key Redefiner" and Microsoft's Latest "Word" Version • Don Lancaster Discusses Creating Your Own Custom ICs • Scanner Communications • Electronics & Computer News . . . and more.

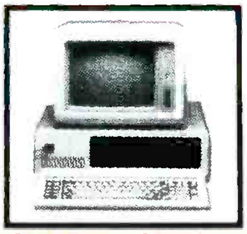
COMPUTERS AT WHOLESALE

SMARTEAM MODEM

103/212A-Operates at 300 BAUD and 1200 BAUD •BELL 103 and 212A compatible •HAYES compatible •Auto answer, dial and redial •External speaker for monitoring calls • AC adapter supplied
Uses RS 232-C Connector.

No. 91990 ....

BUILD YOUR OWN COMPUTER COMPONENTS



IBM® PC/XT-COMPATIBLE COMPUTER COMPONENTS

IBM® PC/XT-Type Case: No. 90180	$33.00
150 Watt Power Supply: No. 90155	$65.00
IBM® -Type 5150 Keyboard: No. 90130	$45.00
Mother Board expandable to 640K with 256K included— Board: No. SPCL03	$135.00
Monochrome Graphic Printer Board: No. 99010	$75.00
Floppy Drive Controller Board No. 92260	$29.00
2 Floppy Disk Drives No. 93140 at $95.00 ea.	$190.00
12" TTL High resolution Magnavox monitor No. 96710	$87.00

YOUR COST $659.00

Get components from such famous & reliable manufactures as TEAC, Panasonic, Seagate, Magnavox, QUME, NEC, Hitachi, ITT, Mitsubishi & more! warranty-2 years on Magnavox monitors.

ASSEMBLY REQUIRED

CIRCLE 52 ON FREE INFORMATION CARD

KEYBOARDS

K150M—AT-look-alike keyboard, made exclusively for XT's, with enlarged return key, cap lock & num lock.

No. 99020 .... $59.00

K-133 — features separate numerical & cursor pads/ function keys along top, LED cap lock & num lock.

No. 51515 .... $76.00

COLOR GRAPHICS BOARD

RGB and Composite Port, Light Pen interface, Graphics 320 x 200 (color), 640 x 200 (BW), Text 25 x 80. FCC Approved.

No. 92280 .... $65.00

MAGNAVOX COLOR MONITOR

•RGB High resolution •14" diagonal •640 dots/H-240 lines/V-200 characters •Built-in tilt stand.

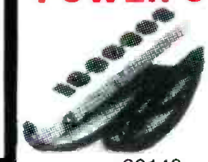
No. 97890 .... $298.00

MULTI I/O CARD

Built-in Floppy Controller that can drive 2 floppy drives. Two RS 232 ser adapters, Timer Port, Parallel printer port, joystick adapter. FCC Approved.

No. 96770 .... $84.00

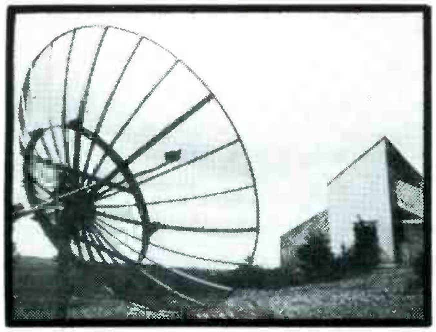
POWER OUTLET STRIP



6 outlets with 15 amp surge protector & 6' cord. UL rated.

90140 .... $9.95

SATELLITE T.V.



SYSTEM "AA"

PORTABLE SATELLITE SYSTEM

ONLY 15 MINUTES SET-UP TIME!

INCLUDES:

- 5 ft. Aztec spun aluminum antenna w/patio mount
- Brand-name receiver
- 100° LNA
- Feedhorn
- 100 ft. hook-up cable

Antenna can be hung on wall for storage!

COMPLETE SYSTEM

SPCL09 .... ONLY $377

SAVE OVER $600

IMPORT SPECIALS

MULTI-NAIL DRIVER

4-in-1 nail driver includes 4 sockets — nail driver, screwdriver, socket wrench and nail puller

92180 .... $1.25

"AS SEEN ON TV"

TRAVEL ALARM

LCD travel alarm clock mounted in a snap-up wallet for use on the road!

Suggested Retail $12.99

94020 .... $2.30

STROSEM 6"x9" CAR SPEAKERS

Hi-energy 3-way speaker pair with 40-oz. magnet for rear deck mounting.

Suggested Retail $50.00/pr.

23010 .... $7.75 pair

AMERICANA

Slim-design car stereo equalizers with built-in power booster, LED power indicators, fader, and 100-200 watts maximum power output.

Suggested Retail $70.00

22330 .... 7 band ... $9.85

22350 .... 10 band ... $12.25

Telko EXPENSE TABULATOR

Calculates and records expenses while you travel! Features 16 expense categories, detachable thermal printer, full-function memory, and expense error correction key.

Suggested Retail $129.95

96910 .... $66.50

SANYO SOLAR CALCULATOR

Solar-powered wallet-type calculator never needs batteries, features LCD display, independent memory, and includes wallet.

Suggested Retail $16.95

11230S $3.25

THE WHOLESALE OUTLET

1 INTERSTATE AVENUE, DEPT. ME, ALBANY NEW YORK 12205

CALL TOLL FREE: 1-800-344-4387 (NON-NYS) ALL OTHER CALLS AND NYS 518-459-7883. CALL FOR CATALOG WITH HUNDREDS OF PRODUCTS! ALL ORDERS SHIPPED FOB ALBANY. CUSTOMER PAYS FREIGHT AND HANDLING. CHECKS ACCEPTED (ON MAIL-IN ORDERS ONLY) AND YOUR ORDER IS SHIPPED WITHOUT DELAY! ALL OTHER ORDERS SHIPPED UPS COD (CASH, MONEY-ORDERS OR CASHIER'S CHECK ONLY.) MINIMUM ORDER $25. PRICES SUBJECT TO CHANGE WITHOUT NOTICE. WE ARE NOT RESPONSIBLE FOR TYPOGRAPHICAL ERRORS. SOME ITEMS NOT AS PICTURED.

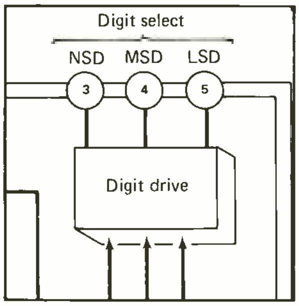
MasterCard VISA TeleCheck

CIRCLE 53 ON FREE INFORMATION CARD

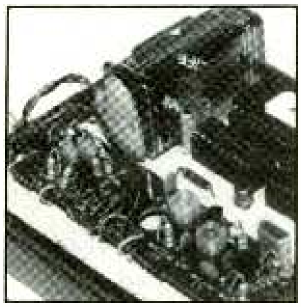
MODERN ELECTRONICS

THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

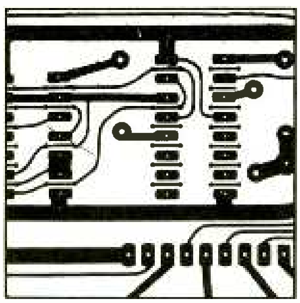
AUGUST 1986 **VOLUME 3, NUMBER 8**



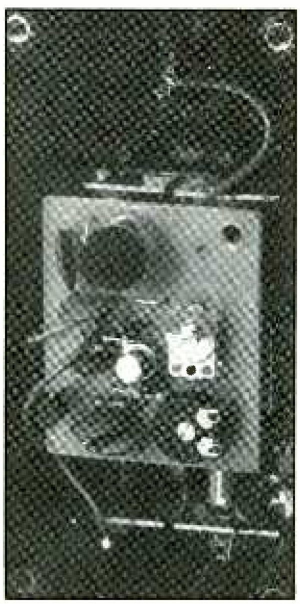
22



30



44



48

FEATURES

COLUMNS

DEPARTMENTS

Offices: 76 North Broadway, Hicksville, NY 11801. Telephone: (516) 681-2922. Modern Electronics (ISSN 0748-9889) is published monthly by Modern Electronics, Inc. Application to mail at second class rates pending at Hicksville, NY and other points. Subscription prices (payable in US Dollars only): Domestic - one year $16.97, two years $31.00, three years $45.00; Canada/Mexico -one year $19.00, two years $35.00, three years $51.00; Foreign - one year $21.00, two years $39.00, three years $57.00. Foreign Air Mail - one year $74.00, two years $145.00, three years $216.00.

Radio Shack Parts Place™

THE BUILDER'S STORE! OVER 1000 COMPONENTS IN STOCK

Top-Quality Capacitors

Tantalums. IC pin spacing. 20% tolerance.

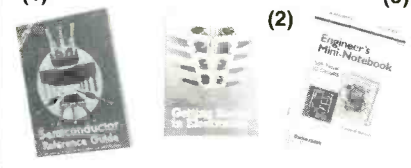
µF	WVDC	Cat. No.	Each
0.1	35	272-1432	.49
0.47	35	272-1433	.49
1.0	35	272-1434	.49
2.2	35	272-1435	.59
10	16	272-1436	.69
22	16	272-1437	.89

High-"Q" Ceramics. Moistureproof coating.

pF	WVDC	Cat. No.	Pkg. of 2
4.7	50	272-120	.39
47	50	272-121	.39
100	50	272-123	.39
220	50	272-124	.39
470	50	272-125	.39
µF	**WVDC**	**Cat. No.**	**Pkg. of 2**
.001	500	272-126	.49
.005	500	272-130	.49
.01	500	272-131	.49
.05	50	272-134	.49
.1	50	272-135	.49

Electronics Books

(1) (2) (3)



(1) Semiconductor Reference Guide. "Sub" listing plus data on Radio Shack devices. Illustrated. 254 pages. #276-4009 .... **3.99**
(2) Getting Started in Electronics. By Forrest Mims III. Easy-to-understand "hands on" intro! Learn as you build! 128 pages. #276-5003, 2.49
(3) Timer IC Mini-Notebook. By Mims. Learn to use 555/556 timer ICs. 32 pages. #276-5010, **99¢**
Op Amp Mini-Notebook. By Mims. Over 40 clever circuits using popular op amp ICs such as 741. #276-5011 .... **1.49**

NEW! REPLACE-A-CELLS™

Rechargeable Nickel-Cadmiums

The fast way to replace defective cells in cordless tools, appliances and telephones

Now you don't have to pay sky-high prices and wait for "exact replacement" battery packs! These new Radio Shack ENERCELLS let you replace only the bad cells and use the good ones. They're available in two popular sizes and have solder tabs for easy connection. Also great for making your own rechargeable battery packs!

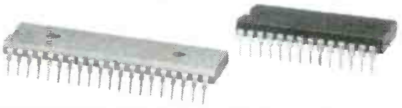
Type	Volts	Amp. Hour	Cat. No.	Pkg. of 2
Sub C	1.25	1.1	23-190	5.99
AA	1.25	0.45	23-191	3.99

4000-Series CMOS ICs

With Pin-Out, Specs

Description	Type	Cat. No.	Each
Quad 2-Input NOR Gate	4001	276-2401	.79
Quad 2-Input NAND Gate	4011	276-2411	.79
Dual Type-D Flip Flop	4013	276-2413	1.19
Decade Counter/Divider	4017	276-2417	1.49
Inverting Hex Buffer	4049	276-2449	.99
Quad Bilateral Switch	4066	276-2466	1.19

Speech Synthesis Chips



CTS256-AL2 Text-to-Speech IC. 40-pin device translates standard ASCII into control data for synthesizer below. With data. #276-1786, **16.95**
SPO256-AL2 Speech Synthesis IC. 28-pin MOS LSI device uses a stored program to produce natural speech. With detailed data. #276-1784 .... **12.95**

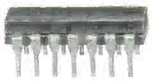
You Rang, Sir?

(4) (5)

(4) 12 VDC Electronic Chime. Melody-synthesizing IC and mini-speaker combo produce a distinctive "ding-dong" output at 75 dB. #273-071 .... **6.95**
(5) Pulsing/Continuous Piezo Buzzer. Great for alarms, vehicle backup alerts. Screwdriver terms. 90 dB output at 12 VDC, only 10 mA. Operates 4 to 28 VDC. With panel-mounting ring. #273-068 **6.95**

7400-Series TTL ICs

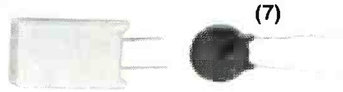
All Include Pin-Out, Specs



Description	Type	Cat. No.	Each
Quad 2-Input NAND Gafe	7400	276-1801	.89
Hex Inverter	7404	276-1802	.99
Quad 2-Input AND Gate	7408	276-1822	1.29
BCD to 7-Seg. Decoder/Driver	7447	276-1805	1.69
Div. by 2/5 BCD Counter	7490	276-1808	1.19

Transient Protectors

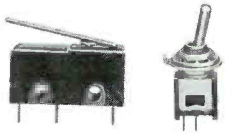
(6) (7)



(6) Gas Discharge Tube. Fast-response 120 VAC line-spike protector. For use when repetitive surges are expected. #270-811 .... **2.49**
(7) Heavy-Duty MOV. Diverts AC-line voltage "spikes" before they can damage computers, other sensitive equipment. Easy to install. #276-568 .... **1.69**

Subminiature Switches

Low As 1^19



SPDT With 3/4" Lever Actuator. Requires 45 grams to operate. Rated 5 amps at 250 VAC. 3/4 × 1/4 × 3/8". #275-016 .... **1.19**
SPST PC-Mount Toggle. Rated 0.3 amp at 125 VAC. Body: 3/8 × 3/8 × 1/4". #275-645 .... **1.49**

Power Supply Diodes

Micromini 1-Amp. 30-amp surge.

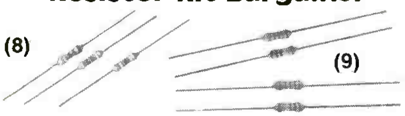
Type	PIV	Cat. No.	Pkg. of 2
1N4001	50	276-1101	.49
1N4003	200	276-1102	.59
1N4004	400	276-1103	.69
1N4005	600	276-1104	.79

3-Amp "Barrel". 200-amp surge.

Type	PIV	Cat. No.	Pkg. of 2
1N5400	50	276-1141	.79
1N5402	200	276-1143	.89
1N5404	400	276-1144	.99

Resistor Kit Bargains!

(8) (9)



(8) 1/4-Watt. 5% tolerance. 100-piece set includes 13 popular standard values ranging from 10 ohms to one megohm. #271-308 ..... **2.79**
(9) Precision Metal-Film. 1/4-watt, 1% tolerance. 50 pieces with 12 popular standard values ranging from 10 ohms to one megohm. #271-309 .... **2.49**

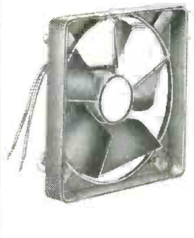
Mini Printed Circuit Pots

Only 49¢ Each **1/8-Watt**

Sealed against noise-causing contaminants.

Ohms	Cat. No.	Each
1k	271-333	.49
10k	271-335	.49
25k	271-336	.49
100k	271-338	.49

120 VAC Cooling Fan



Cools Equipment For Longer Life and Better Performance

This whisper quiet fan delivers up to 65 cubic feet per minute. Features diecast venturi, leads for easy hookup. 11 watts. 4 11/16 × 4 11/16 × 2 1/2". UL recognized. #273-241 .... **14.95**

Handy Test Probe Adapters

Fit Over Test Probe Tip

(10) (11) (12)

(10) Mini-Hook Clip Adapters. Adapt probes for testing on crowded boards. Spring-loaded for positive connection. #270-334 ...... **Pair/1.99**
(11) IC Probe Adapter. Recessed design so you of touch only one IC pin at a time. #270-335, **99¢**
(12) Insulated 'Gator Clips. Free hands. 2 1/2" long. One red, one black. #270-354, **Pair/1.49**

Panel Switch Values

(13) SPST Momentary. Rated 0.5 amp at 125 VAC. 3/8" button. 1/4" mtg. hole.

Contacts Normally	Cat. No.	Pkg. of 5
Open	275-1547	2.49
Closed	275-1548	2.69

(13) (14)

(14) "Jumbo" Illuminated SPST. Versatile! Can be wired normally open, or normally closed. Rated 5 at 250 VAC. Lamp requires 12 volts. 5/8" mtg. hole. #275-678 .... **5.95**

Over 1000 items in stock: Binding posts, Books, Breadboards, Buzzers, Capacitors, Chokes, Clips, Connectors, Fuses, Hardware, ICs, Jacks, Knobs, Lamps, Multitesters, PC Boards, Plugs, Rectifiers, Relays, Resistors, Switches, Tools, Transformers, Transistors, Wire, Zener Diodes, more!

Radio Shack®
A DIVISION OF TANDY CORPORATION
Prices apply at participating Radio Shack stores and dealers

CIRCLE 50 ON FREE INFORMATION CARD

EDITORIAL

Shooting 'Em Down

Many people, in many businesses and industries, have had their ideas shot down. Sometimes this happens at the idea's inception, while at other times it occurs when a concept is already advanced to a completed stage, just waiting for the final button to be pressed. Later, perhaps many years later, the same basic concept often comes to life. How depressing!

I've had more than my share of this. For example, in the mid-Seventies, I had a $250 construction project on my desk that allowed me to telephone another similarly equipped party and observe him on a video monitor. It worked! In response to the author's expressed need for money to allow him to complete the writeup and order kit parts, we advanced him payment. Would you believe that he disappeared, along with the loot? (He surfaced in another state ten years later and I sent him a note to which he never responded.) So we were shot down by someone's irresponsible action.

Now I see modestly priced assembled video/telephony equipment showing up. Luma Telecom recently introduced a visual telephone that sells for $1,450. It's a freeze-frame system that transmits still pictures every few seconds. (Ours was a slow-scan system.)

In another instance, in 1983, I planned to publish a cover story on how to build an IBM PC clone for ¼ of the computer's selling price at that time. I was forced to withdraw it when top management at *Computers & Electronics* demanded I do so because they were fearful that it might affect Big Blue's advertising. Just take a look at the look-a-likes available today, though . . . three years later.

Following this, I got a promise that our work on another major article would not be in vain before assigning a staff member to the editorial project. Receiving assurances that the IBM-clone problem was a rare exception to "sales" stepping into the editorial arena, we proceeded to work up the article, which revealed the inner workings of how hardware and software products being sold can unlock protected programs, as well as illustrating how various protection schemes work. At the last moment, the article was again killed. Reason? Software advertisers in another in-house magazine might be upset. So much for editorial independence and working in a fiefdom ruled by fiat.

Fortunately, my decision to publish plans to build the MITS' Altair computer was a *fait accompli.* My boss was very unhappy about the whole thing, though.

I remember, too, a little microprocessor produced by RCA—the COSMAC 1802 chip. It was turned into the heart of a little microcomputer by one of RCA's developers after RCA wanted no part of using it for this purpose. We published plans to build, expand and apply it, called it the "Elf," and it gave many people a great learning and using experience for a nice couple of years. RCA, to its credit, acknowledged the application in one of its journals. (Author Joe Weisbecker got a David Sarnoff award for his work with this CPU, by the way.)

Then there was a bar-code reader project for about $30 that was killed, a scheduled assembly-language course series that was stolen for use in another magazine without ever telling me (I found out through the author, Mitch Waite, who was told that I approved all this), and on and on.

How have you readers fared in this area? Do you have any "I was shot down" stories?

Art Salsberg

LETTERS

Re-Entering SWL

•I am re-entering the hobby of SW listening. Way back I was a member of the Canadian International DX Club, CIDX. Would you happen to have the address to this club or any other SW listening club? Any help would be greatly appreciated.

Brian J. Penney
Wappingers Falls, NY

CIDX, 6815 12th Ave., Edmonton, Alberta T6X 3J6. Also, you can contact the umbrella organization, ANARC, for information about North American DX clubs at 1500 Bunbury Dr., Whittier, CA 90601.—Ed.

Errata Catch Up

• I enjoyed the "CoCo Testlab" (Feb. & Mar. 1986). After building the Testlab and typing in the software, I noted that the IC Tester Program contains several errors that causes it to fail. The errors appear to be in lines 40, 620 and 650. In line 660, second section, I believe MS$ should be MSG$. Also, line 330 in the Capacitor Test Program should read "GOSUB 700" —not GOTO 700.

Donald R. Schmitz
Milwaukee, WI

The author replies: In the second part of line 40, there should be an up-arrow (∧) instead of the > shown in the "INT(2 ∧I)" statement. At the end of the second part of line 620, insert ")" between 48 and +. Insert "13" between < > and THEN in the third part of line 650. MSG$ wasn't used because Color BASIC recognizes only the first two letters of the variable, so MS$ = MSG$. Finally, you're correct about the Capacitor Test Program.—Jim Barbarello.

• The "Automatic Phone Disconnector" (Feb. 1986) is an interesting and unusual concept. However, the circuit as shown cannot work. The "phone box" should connect to a jack like "P3," but with a closed-circuit contact, instead of the J3 diode as shown. Jack P3 should be replaced by a plug labeled P3.

There is a serious problem in driving the relay from the output of the gate. The relay shown has normal operating current of 72 mA, but it will actually operate at somewhat lower current. The gate's output is about 3.5 volts, which would allow use of a nominal 50-mA relay. However, the gate also has internal resistance to limit current. My tests on two gates showed I could get only 21 mA into a 70-ohm load. So either a transistor driver should be used or a more sensitive relay should be substituted.

Kenneth E. Stone
Cherryvale, KS

The author replies: Symbols for the plugs and jacks are wrong (my error), particularly since J3 looks like a diode rather than the closed-circuit jack it really is. The builder can also eliminate R6 and R7, with PC1 and PC2 completing the gate input circuits to ground. Mr. Stone's point about using a driver transistor between IC1 and the relay or substituting a more sensitive relay is a good precautionary idea. (To install a driver stage, disconnect K1 from LED3 and pin 3 of IC1. Then connect the base of a 2N2222 transistor to this point, ground the base, and reconnect K1's coil to the collector.) However, both of the Disconnectors I've built are operating flawlessly without the driver stage.—Victoria Di Zerega

(Continued on page 70)

MODERN ELECTRONICS NEWS

SURFACE-MOUNT TRAINING KIT. Surface mount technology promises to bring major changes to electronics production. To familiarize electronic technicians and design engineers with working with surface mount devices, Vector Electronic Co. has introduced its SMT Training Kit. It's a hands-on system for becoming involved with use of SMD breadboarding on prototype printed-circuit boards. The kit contains more than 575 surface-mount components as model SMT2000, including five different double-sided epoxy-glass pc boards with tinned footprint patterns and a sixth single-sided board, conductive adhesive, a comprehensive manual, etc. A less expensive version, minus SMDs, is also available as SMT1000. Prices are $348 and $250.50, respectively.

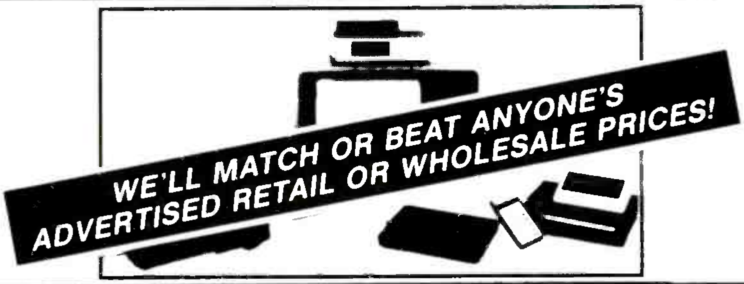
NEW-GENERATION BUSINESS CALCULATORS. Hewlett-Packard is now marketing a new line of calculators that can solve user-defined equations with out requiring programming. Called "The Business Consultant," it features menus displayed in a 4-line x 23 character LCD display that allows users to enter equations in words using alphabetic keys. $175.

VCR CHANGES. More and more foreign manufacturing facilities are being installed in the U.S. Hitachi, for example, is the first one to produce VCRs here with production running in an Anaheim, CA plant that will produce 100,000 units per year initially. 200,000 TV sets are currently coming off the line per year at the same plant....Toshiba, which started out with Beta-format VCRs, had added VHS models to its line not long ago, and has now announced it will sell only VHS models. ...A VCR study by EIA/Consumer Electronics Group reveals that 56% of VCR's are used in the living room 29% in the family room and 11% in the bedroom; more males than females use VCRs (49% vs. 37%); the VHS share increased to 90% in 1985; VCR owners report using the machine an average of 9.3 hours a week for playback and 6.1 hours for recording....With the Yen strengthening, the price of blank videocassettes is expected to rise in the near future.

HOME PHONE TECHNOLOGY ADVANCES. Digital voice chips may start to shove audio cassettes out of telephone answering machines. Colonial Data Technologies (New Milford, CT), for example, has introduced an all-solid-state compact one, the VP-700 "Voice Messenger," that digitizes a voice message for message-leaving purposes. The $54.95 device adds this auto-answer feature to existing phones. The company also offers an automatic dialer that can handle up to 130 phone numbers along with names they relate to for automatic dialing initiated by simply typing the name or initials of the person or business you wish to reach. An LCD displays the duration of the phone call and time of day....According to Packaged Facts, Inc, a NY research company, sales of home telephone equipment and accessories will reach $4.22 billion by 1990 from an annual growth rate of 8% starting in 1985. According to the study, growth due to the AT&T breakup rose 127% in 1983 and 45% in 1984. AT&T is still the leader in market share, at least in 1984, the year upon which the sales data was gathered, with 20% of the home telephone market. Tandy was next with 13%, followed by Dynascan/Cobra, 11%; Uniden, 10%; Panasonic and ITT, 8% each. Panasonic (Matsushita) led in the Telephone Answering Devices area with an 18% share in 1984, while Tandy led in Accessories with 15%, beating out AT&T's 12%.

SOFTWARE COPY PROTECTION LOSING. More and more software companies have dropped copy protection from their wares. Major player Microsoft Corp. (Microsoft Word, Multiplan, etc.) and Software Publishing (PFS and Harvard) are among them. Lotus Development, with "Numero Uno" Lotus 1-2-3 hasn't, though. But as a result, it lost Air Force and Navy microcomputer contracts to Sorcim's SuperCalc. The double-edge sword has many software makers, especially creators of complex programs that require rather high selling prices, in a quandry.

CABLE-TV



BONANZA!

ITEM	SINGLE UNIT PRICE	DEALER 10-UNIT PRICE
RCA 36 CHANNEL CONVERTER (CH. 3 OUTPUT ONLY)	29.95	18.00 ea.
PIONEER WIRELESS CONVERTER (OUR BEST BUY)	88.95	72.00 ea.
LCC-58 WIRELESS CONVERTER	92.95	76.00 ea.
JERROLD 450 WIRELESS CONVERTER (CH. 3 OUTPUT ONLY)	105.95	90.00 ea.
SB ADD-ON UNIT	109.95	58.00 ea.
BRAND NEW — UNITS FOR SCIENTIFIC ATLANTA	*Call for specifics*	
MINICODE (N-12)	109.95	58.00 ea.
MINICODE (N-12) VARISYNC	119.95	62.00 ea.
MINICODE VARISYNC W/AUTO ON-OFF	179.95	115.00 ea.
M-35 B (CH. 3 OUTPUT ONLY)	139.95	70.00 ea.
M-35 B W/AUTO ON-OFF (CALL FOR AVAILABILITY)	199.95	125.00 ea.
MLD-1200-3 (CALL IF CH. 2 OUTPUT)	109.95	58.00 ea.
INTERFERENCE FILTERS — CH. 3	24.95	14.00 ea.
JERROLD 400 OR 450 REMOTE CONTROLLER	29.95	18.00 ea.
ZENITH SSAVI CABLE READY (DEALER PRICE BASED ON 5 UNITS)	225.00	185.00 ea.
SPECIFY CHANNEL 2 or 3 OUTPUT	***Other products available — Please Call***	

Quantity	Item	Output Channel	Price Each	TOTAL PRICE
			SUBTOTAL	
			Shipping Add $3.00 per unit	
			COD & Credit Cards — Add 5%	
			TOTAL	

California Penal Code #593-D forbids us from shipping any cable descrambling unit to anyone residing in the state of California.

Prices subject to change without notice.

PLEASE PRINT

Name ______

Address ______ City ______

State ______ Zip ______ Phone Number ( ) ______

☐ Cashier's Check ☐ Money Order ☐ COD ☐ Visa ☐ Mastercard

Acct # ______ Exp. Date ______

Signature ______

FOR OUR RECORDS:

DECLARATION OF AUTHORIZED USE — I, the undersigned, do hereby declare under penalty of perjury that all products purchased, now and in the future, will only be used on cable TV systems with proper authorization from local officials or cable company officials in accordance with all applicable federal and state laws.

Dated: ______ Signed: ______

Pacific Cable Company, Inc.

7325½ RESEDA BLVD., DEPT. # 20 • RESEDA, CA 91335

(818) 716-5914 • *No Collect Calls* • (818) 716-5140

IMPORTANT: WHEN CALLING FOR INFORMATION
Please have the make and model # of the equipment used in your area. *Thank You*

Only NRI Gives You System for Total

You get it all . . . training for America's fastest growing career opportunity . . . training to service all computers . . . training on a total computer system. And only NRI training gives you all the skills and confidence to become a complete computer service technician.

Today, you can't successfully repair a computer with confidence unless you know that the peripheral equipment is operating properly. Only NRI can give you the well-rounded training you need because only NRI gives you a complete computer system . . . computer, monitor, disk drive, printer, software, even test instruments like a digital multimeter and logic probe. It all adds up to training that builds the knowledge, competence and ability you need to succeed as a computer service specialist.

Get inside the IBM PC compatible Sanyo

As an NRI student, you'll get total hands-on training as you actually build your own Sanyo 550 Series computer from the keyboard up. As you assemble it, you'll perform demonstrations and experiments that will give you a total mastery of computer operations and servicing techniques. You'll do programming in BASIC language—even run and interpret essential diagnostic software. You'll prepare interfaces for peripherals such as printers and joysticks. Using utility programs, you'll check out the operation of the 8088 microprocessor. Step-by-step, NRI will guide you right into a high paying career in one of America's fastest growing fields.

New! Course now includes high performance printer

Only NRI includes an advanced dot matrix printer as part of your hands-on training. Working with it, you'll get practical experience in adding peripherals, perform experiments bringing to life operating principles, and then go on to learn critical maintenance and servicing techniques, including changing the print head.

A Total Computer Systems Training

Understanding you can get only through experience

You need no previous knowledge to succeed with NRI. You start with the basics, rapidly building on the fundamentals of electronics with bite-size lessons to master advanced concepts like digital logic, microprocessors, and computer memories.

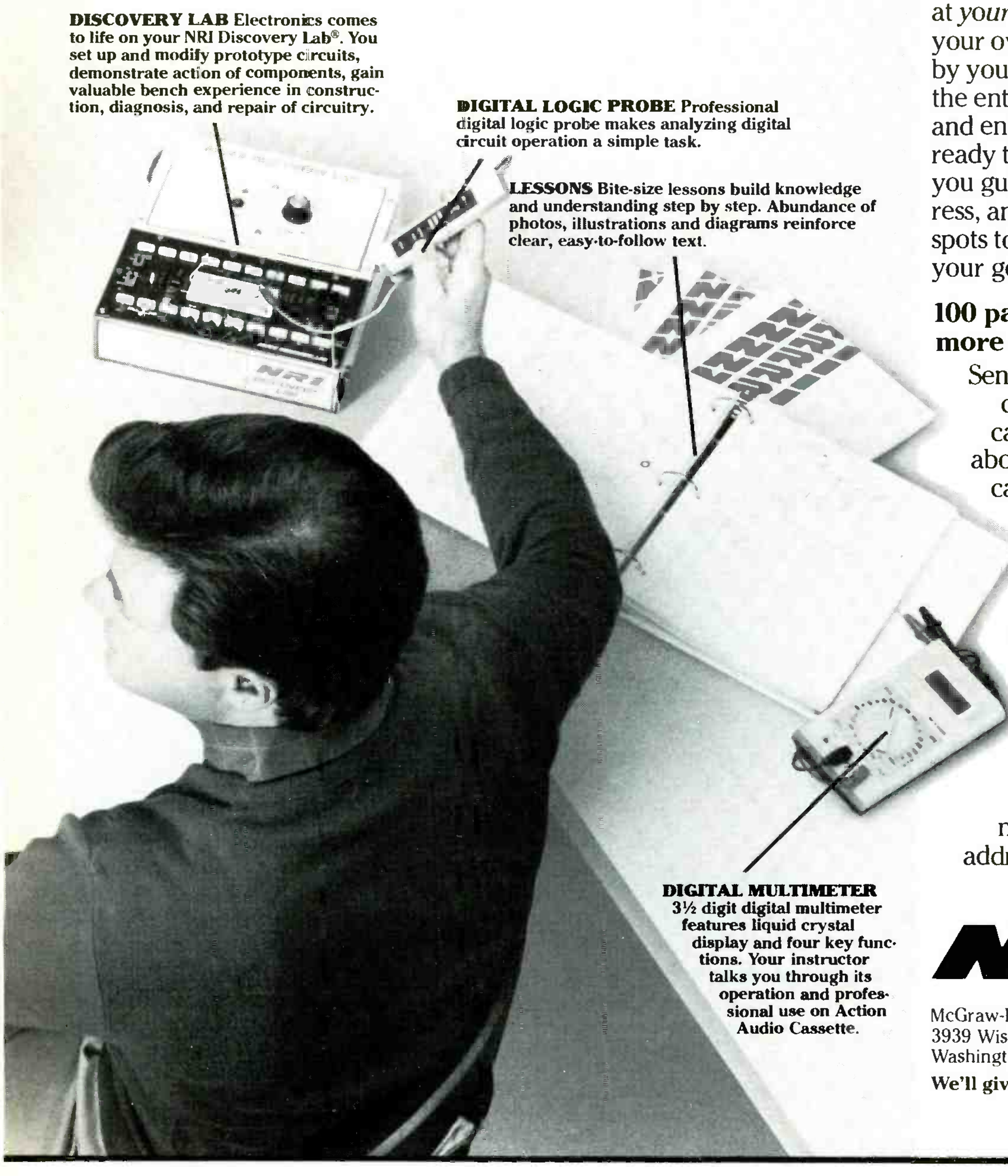
You'll reinforce this new understanding with hands-on practical demonstrations and experiments that give you real world experience. You'll use the exclusive NRI Discovery Lab to see what makes transistors tick . . . build and test working electronic circuits that duplicate key computer circuitry . . . and construct digital logic circuits that demonstrate computer performance.

Do it at home in your spare time

NRI trains you in your own home at *your* convenience. You learn at your own pace, backed at all times by your own NRI instructor and the entire NRI staff of educators and engineers. They're always ready to answer questions, give you guidance, follow your progress, and help you over the rough spots to keep you moving toward your goal.

100 page free catalog tells more . . . send today

Send the postage-paid reply card today for NRI's 100 page catalog that gives all the facts about computer training plus career training in robotics, data communications, TV/audio/video servicing, and many other fields. You'll see how NRI can give you the skills and confidence you need for advancement, a new career—even a service business of your own in the existing world of electronics. If the card is missing, write to NRI at the address below.



NRI SCHOOLS

McGraw-Hill Continuing Education Center
3939 Wisconsin Avenue
Washington, DC 20016

We'll give you tomorrow

For more information on products described, please circle the appropriate number on the Free Information Card bound into this issue or write to the manufacturer.

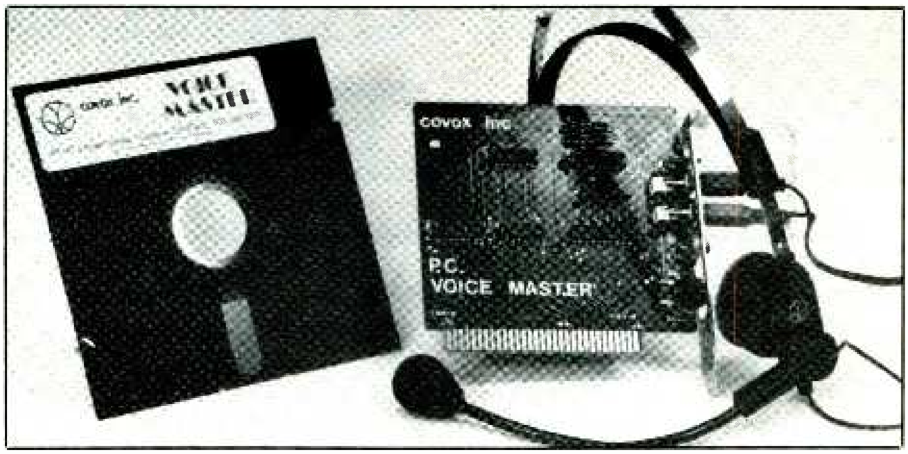
100-MHz 4-Channel Portable Oscilloscopes

The Models 2245 and 2246 oscilloscopes in Tektronix's new General Purpose Scope (GPS) series offer 100-MHz bandwidth in two 4-channel portables. Ratings for the series include 2-mV sensitivity, 2% horizontal and vertical accuracy, 2-ns/div. sweep speed and 1:20,000 delay jitter. Two of the four channels are optimized for logic signals. Autolevel triggering provides automatic triggering of any signal, with sensi-

tivity to 0.25 division at 50 MHz and 0.5 division at 100 MHz. A 10:1 holdoff range provides triggering on complex waveforms. Separate A and B readout intensity controls provide optimum contrast, and a low-noise vertical system ensures a crisp, clear display.

The Model 2246 adds the following: pop-up menus that allow measurements to be made with a single pushbutton; CRT display of voltage and time functions on top of the basic vertical and horizontal scale factors; gated measurements for short-duration waveforms (the selected portion of the waveform is highlighted and the screen displays "gated" and the numeric voltage level); ground- and trigger-level indicators that simplify interpretation and reduce setup time. $1,800 Model 2245; $2500 Model 2246.

CIRCLE 31 ON FREE INFORMATION CARD



Voice-Recognition System

A low-cost multi-feature Voice Master voice-recognition system for the IBM PC, XT and AT and compatible computers has been announced by Covox Inc. The half-card expansion board with resident program recognizes hundreds of words and works with most existing software. Other software is supplied on a 5.25-in. floppy disk. Voice Master serves as a foundation for a complete voice development system. The company also announced that high-quality digital speech will also be supported through optional software. The package consists of the half-card, software on disk and a headset. $129.95.

CIRCLE 32 ON FREE INFORMATION CARD

Temperature Controller For Soldering Irons

An adjustable temperature controller that operates with any standard soldering iron rated at 15 to 1600 watts has been introduced by M.M. New-

man (Marblehead, MA). Called the Dial-Temp Soldering Iron Controller, it lets the user select, the best soldering temperature for a given job. Soldering iron temperature can be adjusted from 300 degrees to full heat by adjusting the control knob on the top of the Controller. The Controller plugs between the soldering iron and any three-wire 117-volt ac outlet. $27.50.

CIRCLE 33 ON FREE INFORMATION CARD

Visual Telephone

Luma Telecom Inc. (Santa Clara, CA) has announced availability of "Luma," a visual telephone for everyday use. The 8-lb. picture-transmitting telephone is designed to sit on a desk. It uses regular telephone con-

nectors and lines to send and receive black-and-white, freeze-frame video "snapshots" in 1 to 5 seconds.

In use, a caller selects the "live" full-motion image he wants to send and then presses a button to freeze the image and transmit it. Built in is a speakerphone feature that permits hands-free calling and a screen-display directory that can hold up to 100 names and telephone numbers. In addition, the Luma phone has a six-button module that is compatible with most multi-line telephone systems and works on PBX and Centrex office phone systems. $1450.

CIRCLE 34 ON FREE INFORMATION CARD

AT-Compatible Computer

Built around the 80286 microprocessor operating at 6 MHz, Heath's new Model HS-241 Advanced PC offers IBM PC-AT compatibility with up to 30% advantage in operating speed. An improved video system is said to

make the Advanced PC 20 to 400 times faster than the IBM PC-AT in screen scrolling operations. AT compatibility allows use of virtually all 16-bit IBM software currently available and the MS-DOS and Microsoft's Xenix operating systems.

Standard features include: a serial and a parallel port; a 5.25-in, 1.2-Mbyte floppy-disk drive; an IBM-compatible detached keyboard with enlarged L-shaped RETURN and double-width SHIFT keys in the standard typewriter locations; 512K RAM (expandable to 15M); and Microsoft MS-DOS, Windows and GW-BASIC (kit version only). Options include floppy and 10- and 20-MB hard-disk drives, color and monochrome graphics boards, memory expansion and an 80287 coprocessor. The keyboard connects to the system unit via a coiled cord that extends to 6 ft. The system unit measures 21"W × 16.5"D × 6.5"H and weighs 38 lbs. $2899.

CIRCLE 35 ON FREE INFORMATION CARD

"Wireless" Monitor System

A system that monitors all types of equipment by transmitting coded signals through a building's ac wiring is available from Precision Control Inc. (Haskell, NJ). The "wireless" Sentry system is available in two models: the Model 100 system consists of one Central Receiver and up to 99 Remote Transmitters, while the Model 10 can accommodate up to 10 Remote Transmitters.

The transmitters can detect the closure of virtually any kind of sensor switch. Upon receipt of this information, the Central Receiver flashes the number of the tripped switch's transmitter to pinpoint the trouble location and energizes the user's choice of audible warning device or automatic telephone dialer.

Random-phase digital circuitry, which is not affected by electrical noise on the power lines, is used in the system to assure accuracy and reliability. Additionally, the company claims that signal transmission does not interfere with computers and other electrical devices in the building in which the system is installed.

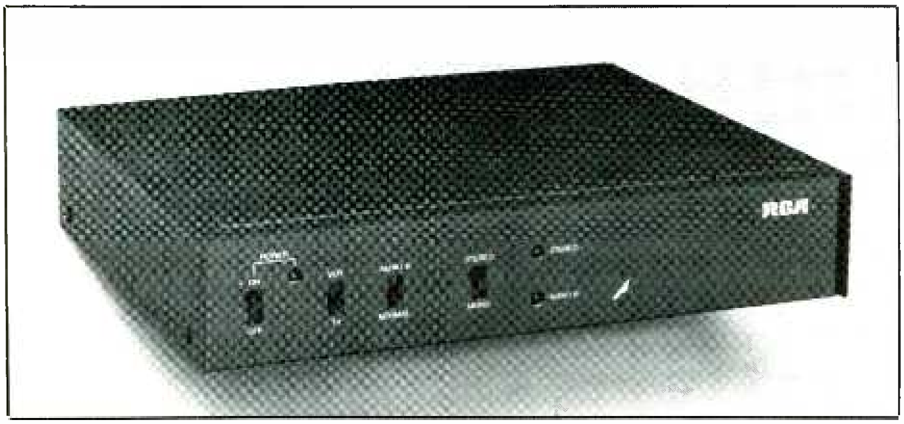
CIRCLE 36 ON FREE INFORMATION CARD

Microprocessor-Controlled Dual Cassette Decks

Technics' Model RS-T20 double cassette deck is microprocessor-controlled to simplify editing, and a synchro-start function that simultaneously starts the editing and play transports. Series playback of both transports enables the deck to automatically play two different cassettes, one after the other.

An automatic space control adds a 4-second silent gap between passages during editing. If stop is pressed on Tape 1 (play only) during editing, both decks automatically stop and a 4-second rec mute is inserted before shifting into the rec pause mode. Transport controls are microprocessor controlled and are all soft-touch. Other features include one-touch recording, cue, review, automatic tape bias/equalization selection, LEDs that light for settings on the Tape 2 transport, two-color LED "meters," input level controls, metal-compatible MX heads, a three-digit tape counter for Tape 2 and a headphone jack. Also featured are twice normal speed operation during editing and Dolby B/C noise reduction. $200.

CIRCLE 37 ON FREE INFORMATION CARD

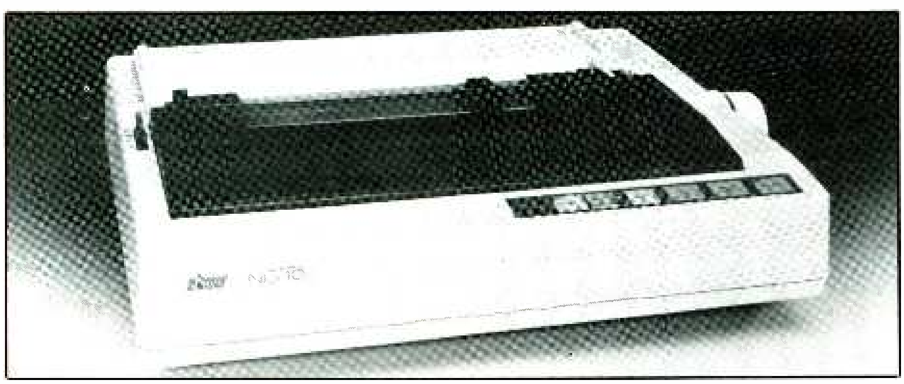


Broadcast Stereo Adapters

Two stereo adapters that let consumers take advantage of TV stereo broadcasts have been announced by RCA. The Model BSA010 is for receiving and recording TV broadcast audio on VCRs equipped with a stereo TV adapter jack and is usable with RCA's Models VKP950, VKT700, VLP950HF, VLT600 series and VLT700HF VCRs. $79.95.

The Model BSA020 (shown) is for use with RCA ColorTrak "L" line of TV receivers with stereo adapter jacks and RCA Models VLP650HF and VLP950HF VCRs. This model has switches for selecting bilingual or stereo decoding and TV/VCR selection and has LEDs that light to indicate mode of operation. $149.95.

CIRCLE 38 ON FREE INFORMATION CARD



Dot-Matrix Printer

Star Micronics' new Model NL-10 dot-matrix computer printer has a 9-wire printhead that offers high-speed draft-quality copy at 120 cps and near-letter-quality copy at 30 cps. The printer features plug-in cartridges that interface it to IBM PC series and compatibles, Commodore 64 and 128, and standard parallel-output computers. (Availability of interfaces for Apple and serial-output computers is expected soon.)

Pushbutton switches on the front panel control 11 format and print functions, including three print pitches, type style, print mode, margin settings and forward and reverse micro paper feed. Ease-of-use features include a rear tractor feed that eliminates wastage of the first sheet and saves time in realigning paper between jobs; automatic single-sheet feeder; bidirectional tractor feed for improved graphics quality; and snap-in ribbon cartridges. Automatic single- and dual-bin cut-sheet feeders are available as options. $379 basic printer; $60 each interface cartridge.

CIRCLE 39 ON FREE INFORMATION CARD

Portable Power Supply

SideKick™ is a new high-power 12-volt portable standby power pack and recharging system from Gates Energy Products. It is built around the company's own sealed lead-acid battery that is resistant to overcharging and excessive discharging and

easily recovers from deep discharges. Nominal capacity is 5.0 AH, which yields 11, 5, 2 and 0.75 hours of power at drains of 5, 10, 25 and 100 watts, respectively.

Recharging is via a built-in 117-volt ac charging unit. Nominal recharge time is 24 hours, though SideKick accepts a top-up charge if needed and can still receive a full charge

overnight. No degradation of the power curve results if the battery is only partially charged/discharged. The battery can be recharged up to 2000 times, depending on usage. The circuit is protected by a resettable thermal breaker.

Power from SideKick is delivered through a standard auto lighter socket. Battery, charger and plug-in unit store in a nylon shoulder pack with adjustable straps. SideKick measures 10" × 6" × 2.75" and weighs 6 lbs. $89.95.

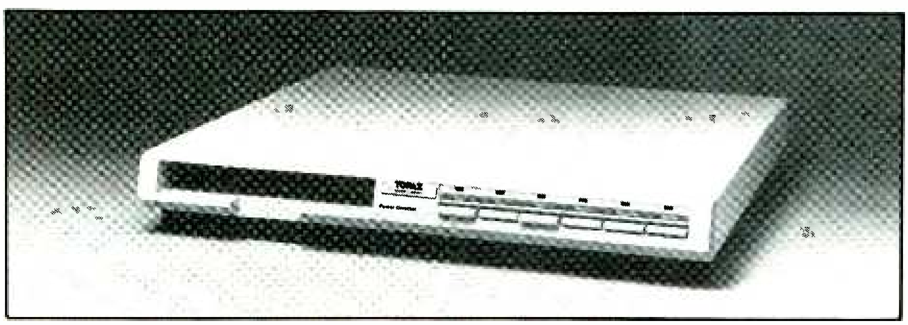
CIRCLE 40 ON FREE INFORMATION CARD

Satellite TV Receiver

The Model ESR924i is R.L. Drake's first satellite component to incorporate both an earth station TV receiver and an antenna positioning system in a single unit. The microprocessor-controlled, Ku-band-compatible has its own power supply and comes with a full-function infrared remote controller. Priority View allows the user to preprogram up to nine channels into memory. The receiver simultaneously selects the correct satellite, channel, polarization and audio format for each selection.

Parental lockout on the remote controller gives parents discretionary powers over the channels children can view. Block conversion features dual input switching that eliminates the need for external relays or switching splitters. Among the receiver's other features are enhanced stereo sound, antenna positioning programmability for up to 21 satellites, LED indicators for channel and satellite name on the front panel, and concealed seldom-used controls. The remote controller allows the user to adjust fine tuning, select a satellite, set polarity and adjust volume from the viewing position. $980.

CIRCLE 41 ON FREE INFORMATION CARD



Computer Power Directors

Power Director from Topaz, Inc. (San Diego, CA) is a multiple-outlet power control center that protects personal computers against voltage spikes and power surges. Five ac outlets on its rear panel accommodate a computer and all its peripherals so that only one wall outlet is needed for the system. Each Power Director outlet is controlled by its own separate switch, and a master switch allows the entire system to be powered up and down in one operation.

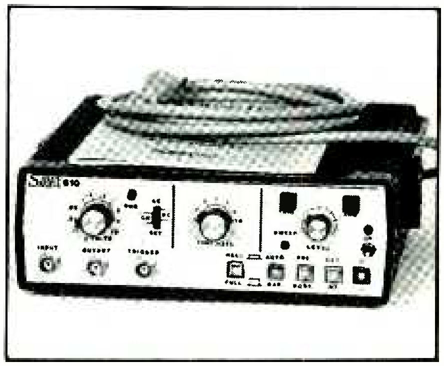
Power Director reduces power-line spikes of up to 6000 volts to a harmless 330 volts and also suppresses inter-outlet spikes. Additionally, the unit prevents surges from entering a modem through telecommunication lines and provides attenuation of emi and rfi.

Either of two options can be installed in the unit's media storage slot: a Data Director that allows two computers to share one peripheral or two peripherals to be accessed from one computer, or a Print Saver buffer that permits simultaneous operation of a computer and a printer.

CIRCLE 43 ON FREE INFORMATION CARD

Digital Scope Memory

New from Sibex is the Model 610 Scope Memory, which converts an analog oscilloscope into a digital storage scope. It has a 10-MHz maximum sample rate and can store up to 1-MHz sine-wave signals in its 2K × 8



static RAM. A variety of triggering options are available, including external triggering. A special "setup" feature permits normal oscilloscope operation without having to disconnect the Scope Memory from the oscilloscope with with it is used.

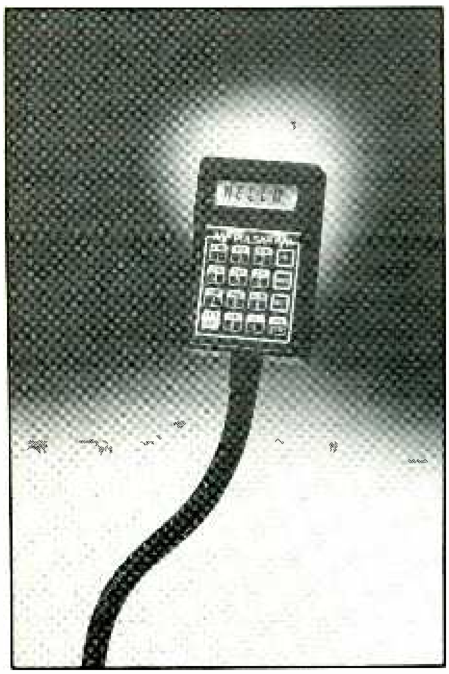
Pre- and post-triggering are built in. You can also select a 1/2 pre-, 1/2 post-data combination mode that allows the trigger point to be conveniently displayed midway across the screen. Delayed sweep allows you to examine the entire memory and expand any portion of the waveform for detailed analysis.

Sampling rate is selectable in seven steps from 0.1 to 10 μs in a 1-2-5 sequence. Input sensitivity range is selectable in 10 steps from 10 mV to 10 V/division, also in a 1-2-5 sequence. Input impedance is 1 megohm/20 pF. Maximum input is $\pm$45 V with a 1:1 probe. A LED turns on to indicate an overload condition. $985.

CIRCLE 44 ON FREE INFORMATION CARD

Vehicle Security System

The flagship Intercept 1000 automobile security system from Pulsar Mfg. (Burlingame, CA) offers an exclusive built-in installation analyzer, an illuminated numeric and limited alpha LCD display and an alarm time memory that records times of tampering. Features include: an il-



luminated keypad; low-power CMOS circuitry; user programmability; ignition and starter disable; electronic hood lock; battery back-up; a pager output; and a remote arming option.

A car owner can use the keypad to program: any exit time from 3 to 99 seconds and entry time from 0 to 99 seconds; his own personal disarming code from among 100,000 possible combinations; and any siren cut-off time from 0 to 9 minutes. The keypad also permits the user to display a countdown of time remaining after entry/exit; sound the siren on command; set the alarm to manual for valet parking; release the hood lock; recall from memory the times of tampering; reset exit/entry delays to instant; and call up a stopwatch function.

CIRCLE 45 ON FREE INFORMATION CARD

Cleaner & Lubricator

Cramolin is a fast-acting antioxidizing solution designed by Craig Laboratories (Escondido, CA) to clean, preserve and lubricate all metal surfaces, including gold. Unlike cleaners that contain Freon FT that cleans by pushing away settled dirt particles without preventing further exposure to airborne contaminants, Cramolin actually removes resistive oxides. It then forms a protective molecular layer that adheres to the metal surfaces to maintain maximum electrical

conductivity and prevent further contamination.

Cramolin is available in standard 2% Red and added-preservative Blue formulations. It is supplied in both an aerosol spray can that comes with an extension nozzle for reaching into tight places and in liquid form. The Tech Kit contains a 6-ounce can of aerosol Cramolin Red, swabs, lint-free cloths and brushes. The Electronic Maintenance Kit contains 2 drams each of Cramolin Red and Blue in liquid form, lint-free cloths, brushes and swabs.

CIRCLE 46 ON FREE INFORMATION CARD

VHS Camcorder

Panasonic's new Model PV-300 OmniMovie camcorder employs a 7-lux charge-coupled device (CCD) optical pickup and High Quality (HQ) recording and playback in a portable VHS package. "High Quality VHS" increases the white clip level of the video signal and allows the recording of higher frequencies to enhance image reproduction than is possible with VHS units that lack HQ.

An infrared auto-focus lensing system lets the user just aim and shoot. The power-driven 8:1 f/1.2 zoom lens automatically adjusts color balance to ensure that recorded colors are true to life. An automatic iris automatically adjusts to almost any lighting condition. Operation of the zoom in/out functions is via a single control, and one can choose between manual zooming and macro closeup shooting.

Instant playback is via the camcorder's built-in electronic viewfinder. The system allows still frame, field advance, slow play and search to be displayed on the viewfinder's screen. The camcorder weighs 5.6 lbs. without battery (6.9 lbs. with battery). It comes with an ac adapter/charger, battery pack, remote controller, earphone and shoulder strap. $2000.

CIRCLE 47 ON FREE INFORMATION CARD

Emphasis and Deemphasis For Compact Discs

A detailed look at what appears to be an anachronistic adoption of an old technique to state-of-art recordings

By Bob Lochner & Tisi Yamada

Few users are aware that compact digital disc players and recordings frequently utilize emphasis during recording and deemphasis during playback. Although emphasis is an option on the part of the recording companies that make compact discs, the majority of CD players include deemphasizing circuits. For those CD recordings that do employ emphasis (the great majority do, of course), deemphasis is required to assure proper program reproduction.

In this article, we will explore what emphasis and deemphasis are and what this technique contributes to recording and playback of musical programs through the compact disc medium. We will also discuss why some companies elect to forego emphasizing programs. But first a little history to set the stage.

Why Emphasize/ Deemphasize?

To better understand why that might appear to be an unnecessary and outdated technique to state-of-the-art recording equipment, it is necessary to understand why emphasis and deemphasis were used in the first place. The original reason why the recording industry adopted this technique dates back to the early post-War World II days, when high-fidelity recording and reproduction were just beginning to emerge on the scene.

In the early days, reproduction of high frequencies was relatively easy to accomplish. Unfortunately, the ease with which high frequencies could be reproduced resulted in a noise problem as well. Noise resulting from pops, dust, scratches, static discharges on the disc during play and the white noise inherent in the recording and playback electronics was a major problem.

While high frequencies were easy to record and play back, the limitations of the vacuum-tube amplifiers of the time made successful recording and playback of lower-frequency material more difficult to achieve. Because the recording of loud low-frequency passages required considerable stylus excursion, excessive "real estate" was required for each spiral groove on the disc. This resulted in a lower density of grooves cut during recording, seriously limiting the maximum recording time possible on a given disc.

Although amplification of higher frequencies was easier to accomplish, noise of all kinds, naturally rich in high-frequency content, was very noticeable during playback of a disc. What was needed was a way to record a program in such a manner that all of the high-frequency content remained while the noise level was reduced to inaudibility.

Extensive research revealed that rather than recording linearly, emphasizing the amplitude (loudness) of the material being recorded with a rising characteristic as the frequency increased helped significantly in overriding the various forms of noise in the middle- and high-frequency ranges. The higher the frequency, the greater the emphasis.

Of course, on playback, controlled deemphasis with a characteristic that was a mirror image of the emphasis characteristic more or less restored the fidelity of the program while leaving the various noises at a much lower and more tolerable level. Since emphasizing during recording and deemphasizing during playback provided a considerable improvement in the apparent quality of the reproduced program, this technique soon became a standard tool used by all recording companies in combatting noise.

By reducing the white noise that the playback system dealt with, emphasis and deemphasis also reduced the need for wide mechanical excursions of the stylus during the cutting stage. This eventually gave rise to the long-play (LP) disc with which we have all become familiar.

Emphasis and deemphasis may have become a standard tool of the recording industry, but it was (and still is) far from standardized. A number of standards for emphasis/deemphasis were proposed—among them those from CBS, RCA and RIAA—each vying for economic advantage in the marketplace. Though the RIAA standard has since become the virtual *de facto* standard, the tumultuous early days of high fidelity made the common "tone" control a necessity on consumer equipment.

The Current Situation

Recording and playback problems are greatly reduced today in all recording media. However limitations continue to exist in even the latest technologies—including the that of the

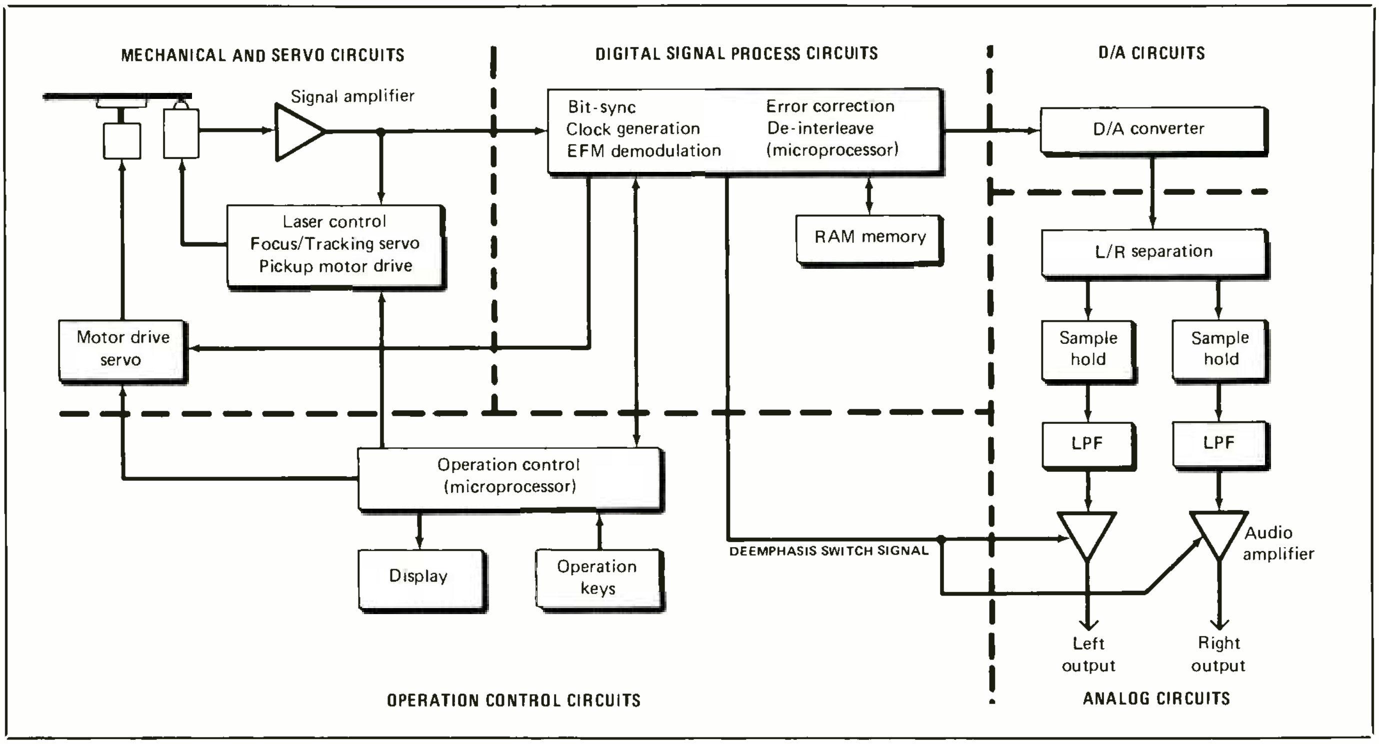


Fig. 1. Block diagram of a Compact Disc player.

Compact Disc. White noise is the one universal bugaboo in all technolgies.

White noise is an inescapable fact of life in any equipment in which amplification is used. By definition, white noise contains all frequencies across the audio spectrum at equal amplitude. But what may appear on an oscilloscope screen as equal amplitudes is not necessarily how the human ear discerns the distribution.

We hear audio frequencies in a more or less natural octave manner; one might say we have a natural logarithmic response. For example, if asked to differentiate between low, medium and high notes in a musical selection, a typical listener might consider the notes from 40 to 300 Hz to be low, from 300 Hz to 2.5 kHz to be medium and from 2.5 to 16 kHz (or the upper range of his hearing) to be high. He is also likely to consider the distribution within each range to be equal.

Simple arithmetic, based on the above example, reveals that the white noise in the "low," "medium" and "high" notes is spread across 260 Hz, 2.2 kHz and perhaps 13.6 kHz, respectively. However, since the white noise is evenly distributed in terms of amplitude, it follows that the combined white-noise energy in the high-note range is on the order of 50 times greater than the combined energy in the low-note range. With this great a variation, white noise in the higher frequencies will always be more noticeable, even in systems that use the latest digital techniques.

White noise also has a major effect on signal-to-noise ratio (S/N) and, hence, dynamic range, both areas in which CD technology has brought significant benefits. The *maximum* dynamic range in decibels (dB) at the output of a Compact Disc player, based on the Sony/Phillips 16-bit CD specification, is determined by the expression: $6A + 1.8$, where A is the number of bits. With the 16-bit spec, maximum dynamic range is $(6 \times 16) + 1.8 = 97.8$ dB for a sine wave.

It is important to understand that the maximum dynamic range spec is met only at the output of the digital-to-analog (D/A) converter and then only when all conditions are ideal. It is not the spec taken at the CD player's audio output jacks. This being the case, dynamic range—and S/N—can only deteriorate as the output from the D/A converter passes through each amplifier stage on its way to the player's output jacks. By the time the signal arrives at the output jacks, it is also to be expected that overally dynamic range will be reduced by a modest factor.

Even the best amplifier stage generates white noise. The white noise component of each successive stage adds to the total and raises the noise floor of the signal, thus reducing dynamic range. Although the D/A converter output in a CD player can, under ideal design conditions, produce a dynamic range of 97.8 dB, a more realistic figure would be more on the order of 90 dB measured at the speaker output. This is still a healthy dynamic range and is virtually unattainable with analog equipment.

Since you will be more aware of white noise at the higher frequencies, due to the ear's combining effect, using emphasis in recording and deemphasis in playback reduces the energy-sum of white noise. In turn, this increases both the S/N and dynamic range of your system's output. And this is the main reason why emphasis and deemphasis is still regarded as a valued ally in modern CD technology.

The Sony/Phillips Spec

The Sony/Phillips design specification for Compact Disc players includes a defined emphasis/deemphasis characteristic. It also includes a provision for encoding discs so that the player can recognize whether or not a specific disc has been emphasized during the recording process.

Not every CD recording is emphasized, and no recording company presently tells the user whether or not a particular disc has been emphasized. Indeed, in many cases, a single company offers titles that are emphasized and others that are not, probably depending on the relative state of the master recording to be reproduced. This was anticipated by the original designers of the CD system. Provision for automatic switching in and out of a deemphasizing circuit was a design element of the CD player right along with the standardization of the emphasis specification. Therefore, virtually all CD players include automatic deemphasis switching.

As shown in Fig. 1, three sections are required in all deemphasis circuits used in CD players. The first is the CPU (central processing unit, commonly called a microprocessor). This device reads the disc's directory and determines from the program information whether or not the recording has been emphasized. If it is, the CPU switches in deemphasis.

The second section is a switching arrangement that switches in and out the deemphasis network upon command from the CPU. There are actually two switches in a CD player, one for each audio output channel. Since switching speeds are not an important consideration in CD players, both FET (field-effect transistor) and relay switches have been noted in representative players we have examined.

FET and relay switches each have their own advantages. FET switches, for example, have no moving parts, isolation is better than 1 megohm in the off mode, and on resistance is on the order of 100 ohms. The last can be partially compensated for by the deemphasis network's circuitry. On the other hand, relay switches offer virtually infinite resistance when off and 8 to 10 milliohms (thousandths of an ohm) when on, which obviates the need for making allowances for switching resistance.

You can easily determine whether or not a recorded program has been emphasized, if this information is not

Emphasized Compact Discs

Manufacturer	Disc. No.	Title
American Gramaphone	AGCD-359	Fresh Aire II
CBS	MK37204	Mendelssohn V-Concerto
	MK37273	Mahler Symphony #1
	CD 36711	Beethoven #5, Schubert #8
Denon	38C37-7069	Concert Royal
	38C37-7062	Tchaikovsky Symphony #6
	38C37-7068	Organ Concert
	38C37-7021	Beethoven Symphony #9
Polydor	3113-6	Screen Music of Love and Prime
Real Time	RT 3009	Darn That Dream
Toshiba-EMI	CC38-3006	The Ring of the Niebelung
	CC38-3022	Ravel Bolero
	CC38-3007	Beethoven V-Concert
	CC35-3015	Vivaldi The Four Seasons

Linear Compact Discs

Manufacturer	Disc. No	Title
American Gramaphone	AGCD-366	Sampler III
Arista	ARCD 8268	Arista's Perfect 10
CBS/Sony	35DP82	Herbie Hancock Future Shock
Delos	CD 3007	Vivaldi The Four Seasons
	CD 3010	F. Handel The Water Music
	CD 3015	Tchaikovsky Symphony #5
Deutch Grammaphon	410 895-2	Berlioz Symphony Fantastique
	410 025-2	Gershwin Rhapsody In Blue
	400 039-2	R. Straus Eine Alpensinfonie
L'Oiseau-Lyre	410 553-2	Pachelbel Canon
London	411 959-2	Luciano Pavarotti Mamma
	410 137-2	Wagner Der Ring Des Niebelungen
	410 552-2	Faure Pavane
	400 047-2	Dvorak Symphony #9
Nonesuch	79033-2	Janacek Idyla/Mladi
Philips	411 420-2	Mozart Raquiem
	411 036-2	Wagner Tristan Und Isolde
Polydor	800 020-2	Vangelis Chariots of Fire
Polygram	816 054-2	Hear the Light I
	814 981-2 M-1	Scorpions Love at First Sting
	816 055-2	Hear the Light II
	814 981-2 M-1	Scorpions Love at First Sting
Toshiba-EMI	CC38-3042	Faure Requiem
	CC38-3030	Wagner Der Ritt Der Walkuren
Warner Brothers	23696-2	Donald Fagen The Nightfly

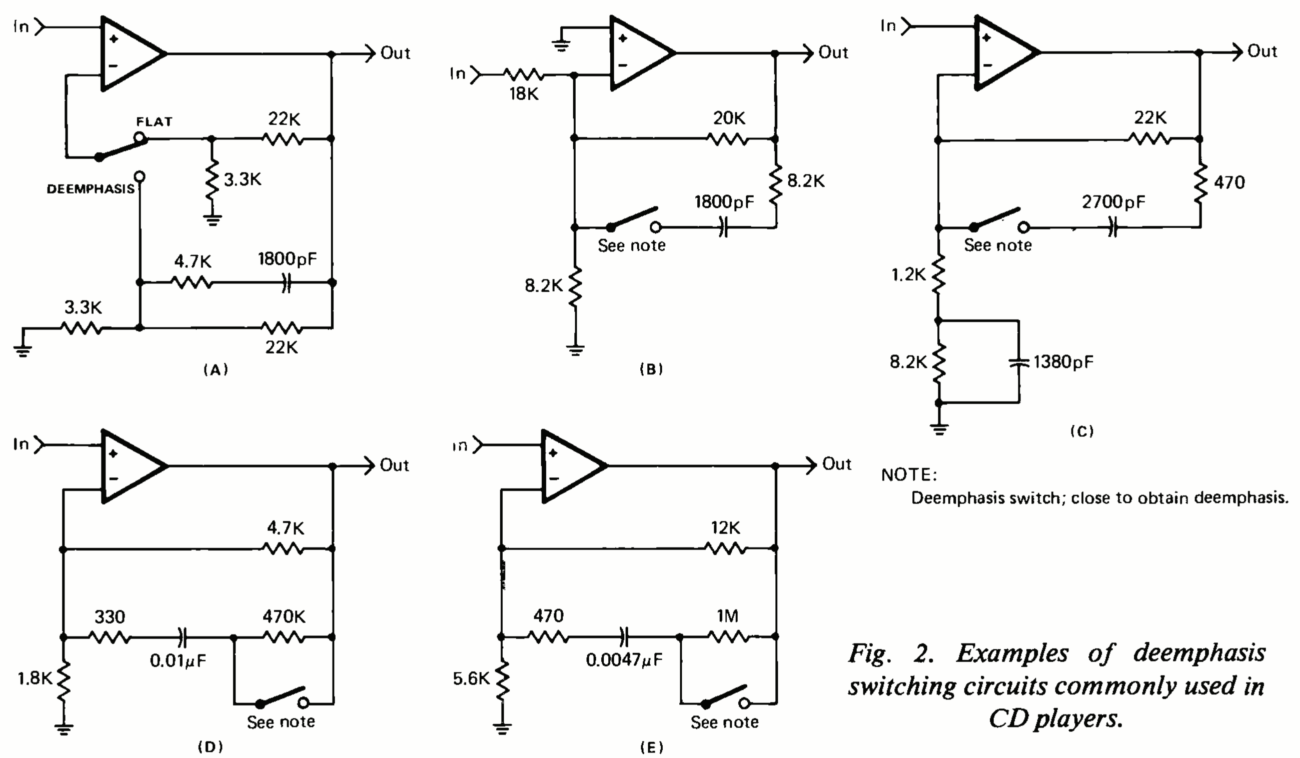


Fig. 2. Examples of deemphasis switching circuits commonly used in CD players.

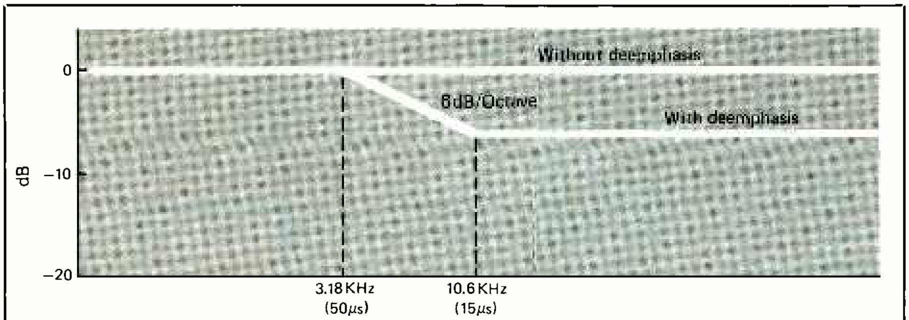


Fig. 3. Ideal deemphasis characteristics for CD players.

given on the disc or the package it came in. Simply monitor the state of the switch used to apply deemphasis.

The third section of the deemphasis circuit is the deemphasis network itself. Different design approaches for this circuit are used by different manufacturers of CD players. Five possible variations are shown schematically in Fig. 2, all of which can be found in current CD players. The circuits shown in Fig. 2 have been simplified for clarity.

Sony/Phillips' licensing agreement specifies a flat deemphasis response to 3.18 kHz, a 6-dB/ocatve rolloff between 3.18 and 10.6 kHz and then a flat response with no further attenuation beyond 10.6 kHz (see Fig. 3). These are ideal figures. In the real world, filter transition points are not sharp, rolloff stages never have straight-line characteristics until at best well past the transition frequency, and the complex reactances of filter components guarantee departures from the ideal.

Although a perfectly responsive deemphasis network to match the Sony/Phillips specification is impossible to build, complex bandpass filter designs are capable of providing a good approximation. However, practical filters will differ from one design to another and even from one set of "identical" components to another in the same design in a production run unless extremely close tolerance, high-quality components are used.

Undoubtedly, one of the major reasons why some CD recordings purposely lack emphasis is the impossibility of designing perfect deemphasis networks. This is especially so when the master recording is already a state-of-the art example made under carefully controlled circumstances, with very low noise and excellent accuracy to begin with. Characteristics of the various deemphasis network designs invariably affect CD program reproduction fidelity in an imperfect way.

(Continued on page 85)

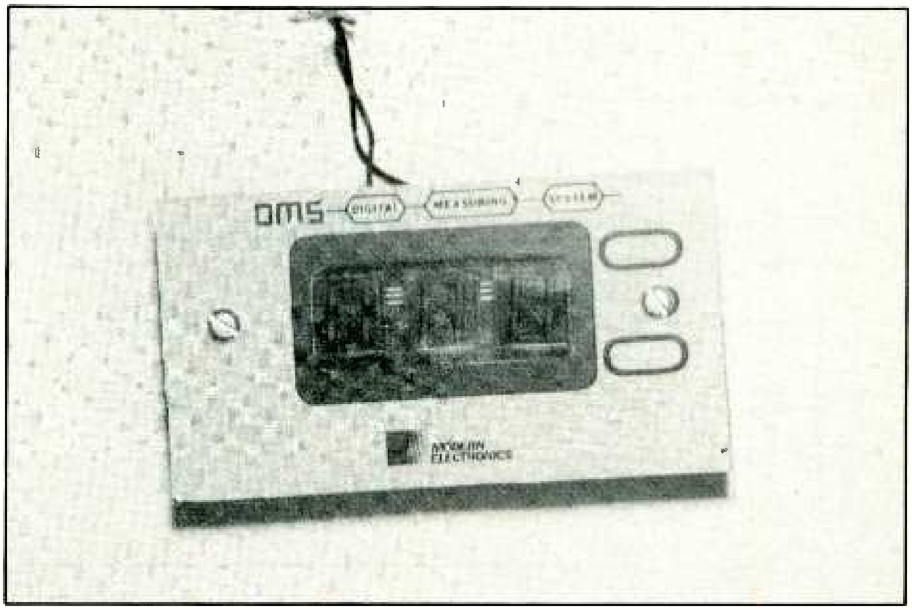
A Digital Measuring System

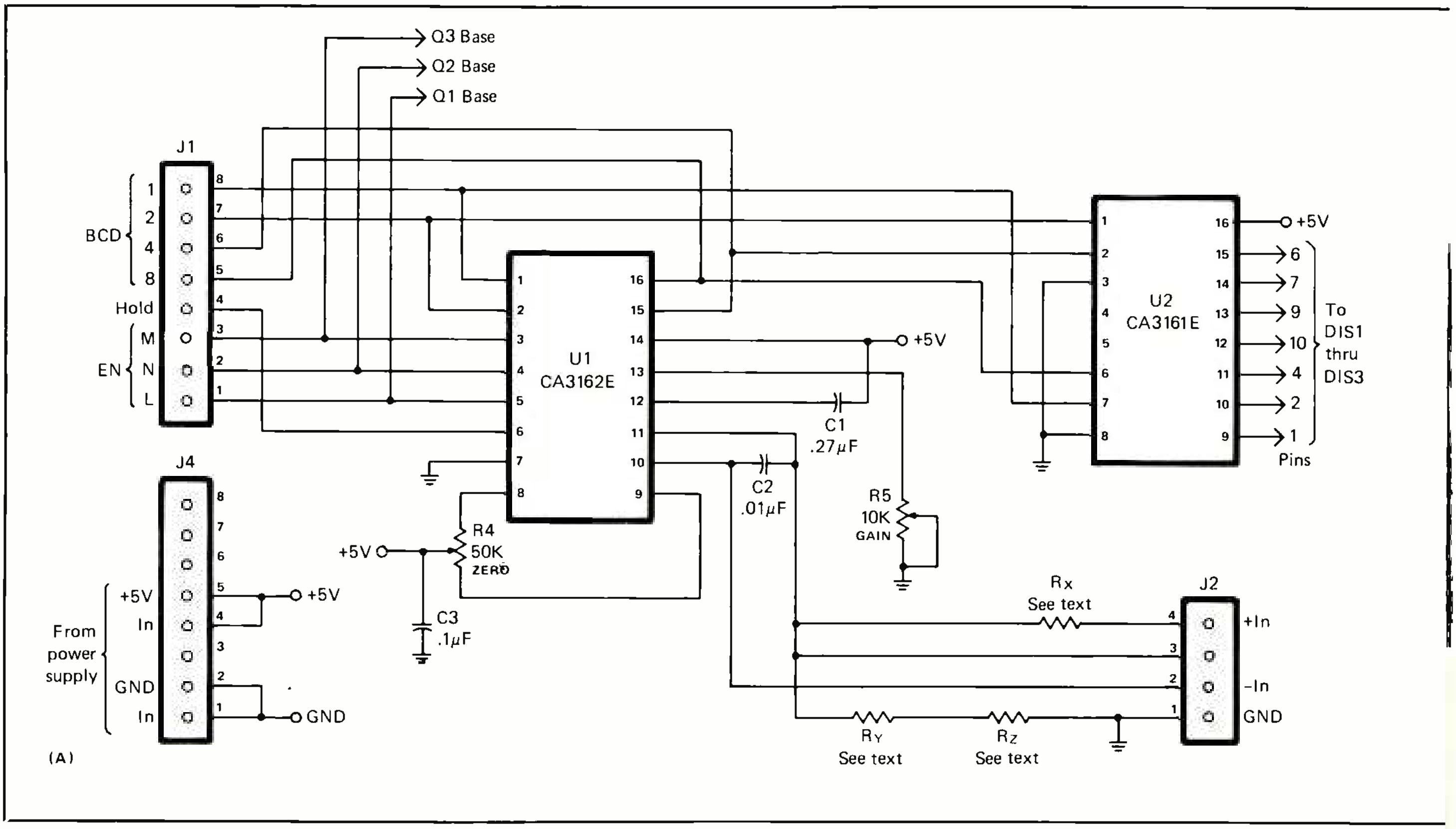
This compact element serves as the basic building block for a wide variety of add-on measuring modules

By Charles R. Ball

Most modern electronic instruments have gone "digital." You see this in multimeters, frequency counters, tachometers, weight scales, thermometers, and just about every other instrument designed to measure the magnitude of a particular physical parameter.

Common to all digital instruments are the numeric display and its decoding and driving circuitry. With commercial measuring instruments, every time you purchase a particular one, you are duplicating the display/decoder/driver systems—for which you pay a hefty premium, usually more than half the purchase price. In this





article, we describe how to build a highly accurate, low-cost 3-digit panel meter that serves as the basic building block for a wide range of specialty add-on function modules like a DMM, tachometer thermometer, etc.

The Digital Measuring System features single-polarity supply operation, 999-mV full-scale sensitivity, 0.1% accuracy, and a multiplexed BCD (binary-coded-decimal) output. It also has variable update, display hold, over/under-range indicators, a floating input, and negative readings to −99 mV. (See the Table for a complete list of Technical Specifications.)

This is an ideal building block for a variety of digital measuring systems that can be used in the shop, home, car, boat or industry. Add-on modules can later be used to allow the system to measure voltage/current/resistance, temperature, pressure, revolutions per minute and more.

This month, we tell you how to build the DMS and the power supply that goes with it and the add-on modules. Next month, we will tell you how to build a tachometer module for measuring rotational speed, and in the future other useful modules will be described as they are developed.

About the Circuit

At the heart of the DMS is an analog-to-digital (A/D) converter, shown as *U1* in Fig. 1. This integrated circuit is an ultrastable differential-input, dual-slope A/D converter designed specifically for digital numeric systems. Internal details of the complex A/D converter chip are given in Fig. 2.

A voltage applied to the input of the

PANEL METER PARTS LIST

Semiconductors
DIS1,DIS2,DIS3—FND507 LED numeric display
Q1,Q2,Q3—2N2222 transistor
U1—CA3162E A/D converter
U2—CA3161E BCD-to-7-segment decoder/driver

Capacitors
C1—0.27-μF, 100-volt metallized Mylar or polystyrene
C2—0.01-μF, 12-volt disc
C3—0.1-μF, 12-volt disc

Resistors (all ¼-watt, 10% tolerance)
R1,R2,R3—56 ohms
Rx,Ry,Rz—See text
R4—50,000-ohm trimmer potentiometer (Bourne No. 3352H-1-503 or similar—see text)
R5—10,000-ohm trimmer potentiometer (Bourne No. 3352H-1-103 or similar—see text)

Miscellaneous
Printed circuit board; headers (AP Products No. 929974-36; cut to lengths needed); IC sockets (2); Molex Soldercons; spacers; machine hardware; hookup wire; solder; etc.

Note: The following items are available from BALL, P.O. Box 1022, Snellville, GA 30278-1022; Double-sided pc board No. DPMR-PC for $9.95; CA3162E and CA3161E, No. DPMR-IC, for $11.00; complete kit of parts (less headers) for decoder/driver/display, No. DPMR-K, for $27.95; power supply pc board, No. DPMRPS-PC, for $6.95. Headers and terminal board are available from Digi-Key, P.O. Box 677 Thief River Falls, MN 56701.

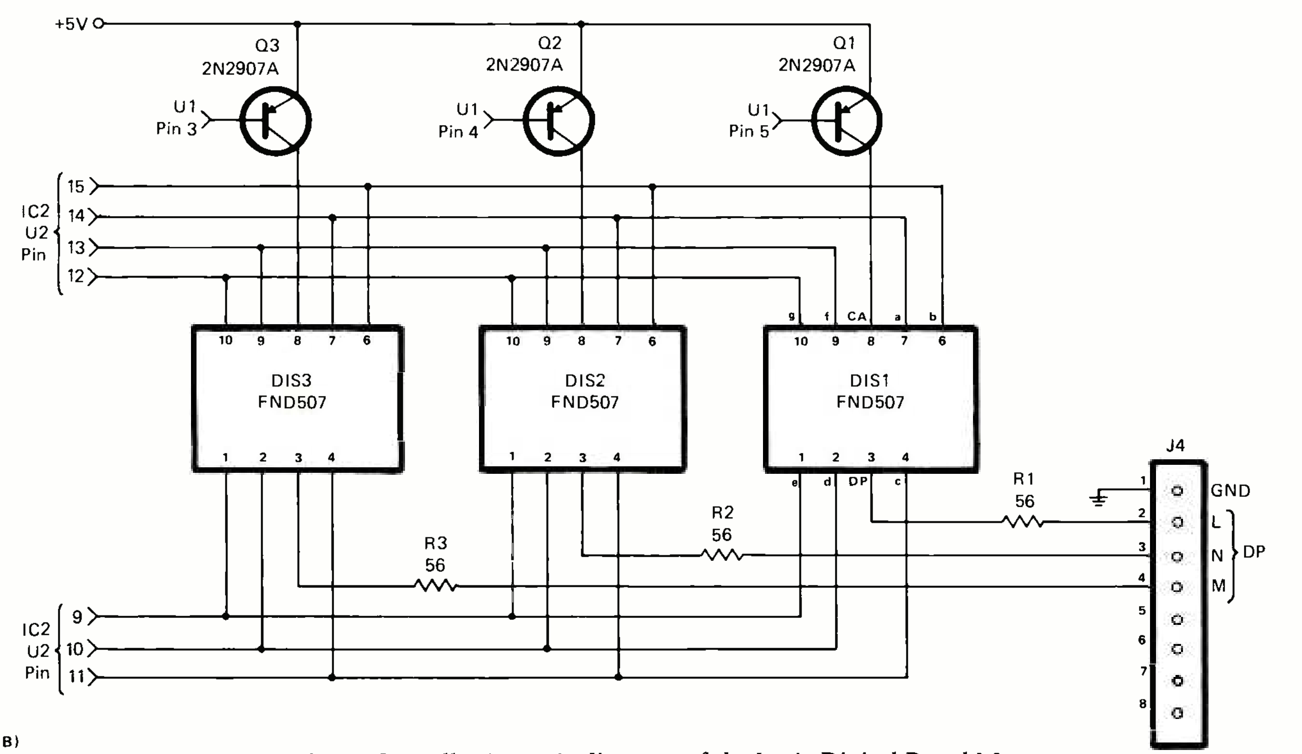


Fig. 1. Overall schematic diagram of the basic Digital Panel Meter.

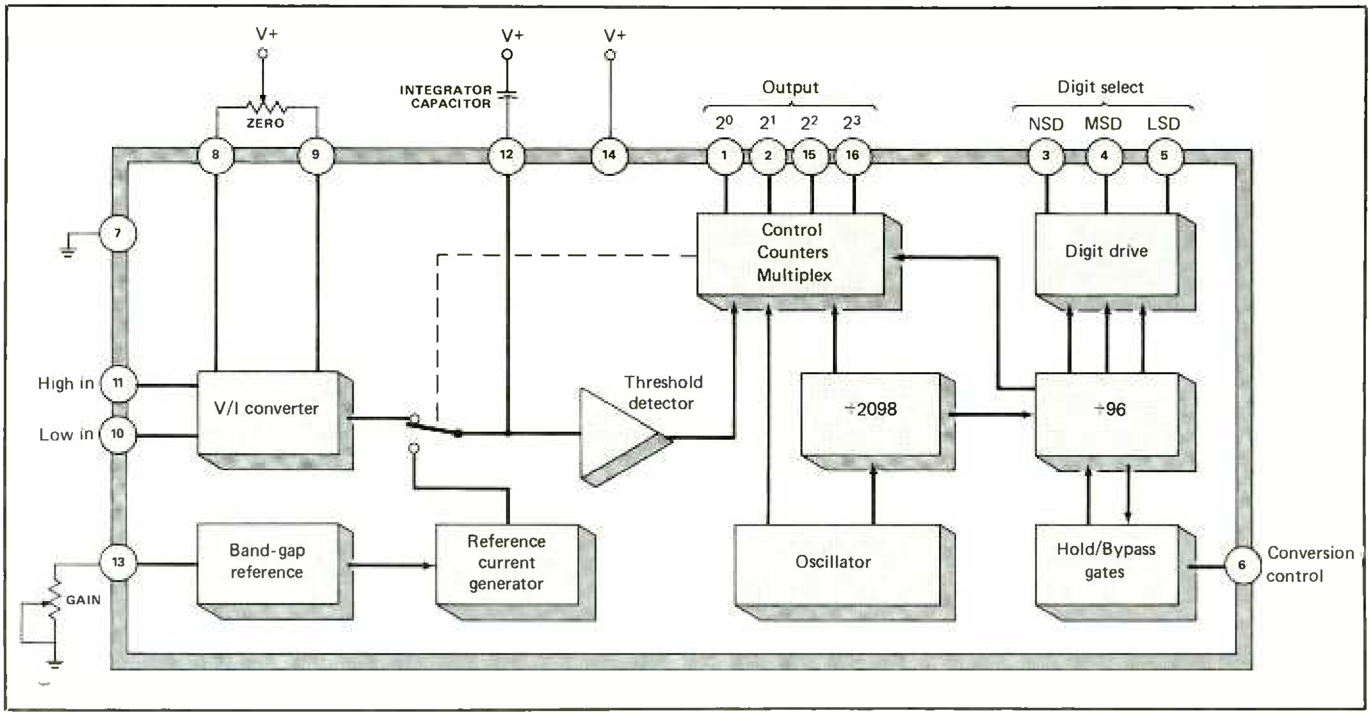


Fig. 2. Block diagram of internal circuit details of the A/D converter chip used in this project.

D/A converter is converted to a current that charges the integrator capacitor (*C1* in Fig. 1) over a predetermined number of clock periods. The integrator capacitor is then connected to a different and opposite polarity current source.

The number of clock periods required to restore the integrator capacitor to the original charge is a direct function of the applied voltage. When the comparator (threshold detector) senses restoration, the number of clock periods is latched into the counter and multiplexed into the display decoder/driver chip via Output pins 1, 2, 15 and 16. The Digit Drive block sequences the three digits on one at a time at a fast enough rate that the eye sees all digits on simultaneously, via pins 3, 4 and 5.

Timing and the multiplex rate inside the A/D converter are derived from a 786-kHz ring oscillator. The multiplex rate is 384 Hz. Two conversion rates —4 and 96 Hz—and display hold are available with the A/D converter's pin 6 option. A/D conversion time is approximately 5 milliseconds.

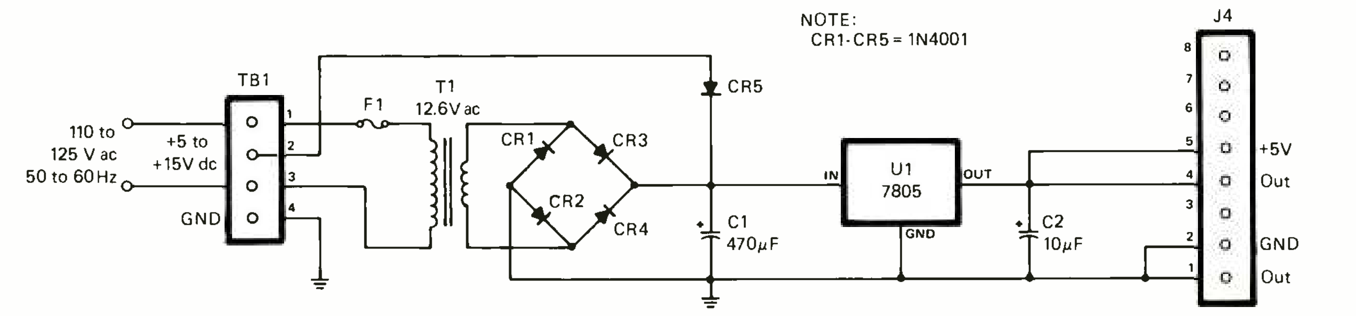
Returning to Fig. 1, we see that dc voltages are scaled to the proper level by resistive networks and are applied to the input of *U1*. The A/D converter then determines the value of the applied signal, scales it and multiplexes the information in BCD format. This information is then processed by BCD-to-7-segment decoder/driver *U2* to provide segment signals for the displays. Digit-enable is provided by transistors *Q1, Q2* and *Q3* that turn on LED numeric displays *DIS1, DIS2* and *DIS3*, respectively.

Although only a single-polarity power supply is required for proper operation, the DMS can still measure negative potentials down to −99 mV. Any potential more negative that −99 mV will cause the display numerals to disappear and be replaced by the three horizontal dashes (---) that indicate an underrange condition. Likewise, any potential greater than +999 mV causes EEE to appear in the display, this time indicating an overrange condition.

Shown in Fig. 3 is the power supply for the DMS system. When this power supply is plugged into the DMS (all header blocks, identified by "J" numbers in all circuits and modules, in this series directly mate with each other to eliminate as much point-to-

Technical Specifications Table

Input voltage level	
Normal	−99 to +999 mV
Maximum	+15 V
Input impedance	80 to 100 megohms
Accuracy at 25 C	±1%, ±1 count
Temperature coefficient	
Zero	10 μV/°C
Gain	0.005 °C to 125 °C
Power supply output	+5 V dc, 200 mA



POWER SUPPLY PARTS LIST

C1—470-µF, 25-volt electrolytic capacitor
C2—10-µF, 10-volt tantalum capacitor
CR1 thru CR5—1N4001 rectifier diode
T1—12-volt, 300-mA transformer
TB1—4-position terminal board (OK Industries No. TS-4)
U1—7805 +5-volt regulator
Misc—Printed-circuit board; machine hardware; hookup wire; solder; etc.
Note: See Panel Meter Parts List for sources of parts.

Fig. 3. Schematic diagram of project's regulated 5-volt power supply.

point wiring as possible), +5V and GND are automatically connected through *J4*. Ac power-line voltage or +12 volts can serve as the source for this supply.

Construction

If you wish to obtain a very compact project and make it possible for the DMS and power-supply modules (as well as any future modules that might be forthcoming) to mesh together, the only practical way to assemble the circuitry is on printed-circuit boards.

Shown in Fig. 4 are the actual-size etching-and-drilling guides for the DMS board. Note that two guides are required for each board—one for the top and the other for the bottom. The actual-size etching-and-drilling guide for the single-sided power supply board is shown in Fig. 5.

You can fabricate your own pc boards from Figs. 4 and 5 if you wish. Unless you are very experienced in fabricating pc boards, especially the difficult double-sided DMS board that requires careful attention to registering the two sides, you might wish to purchase ready-to-wire boards from the source given in the Note at the end of the Parts List.

When wiring the DMS board, refer to the components placement/orientation diagram in Fig. 6. Except for the ICs and displays, install the components on the DMS board exactly as shown, paying particular attention to the basing of the transistors. Then install the headers in the *J1* through *J5* locations on the noncomponent side of the board.

Next, install sockets in the *U1* and *U2* locations and Molex Soldercons in

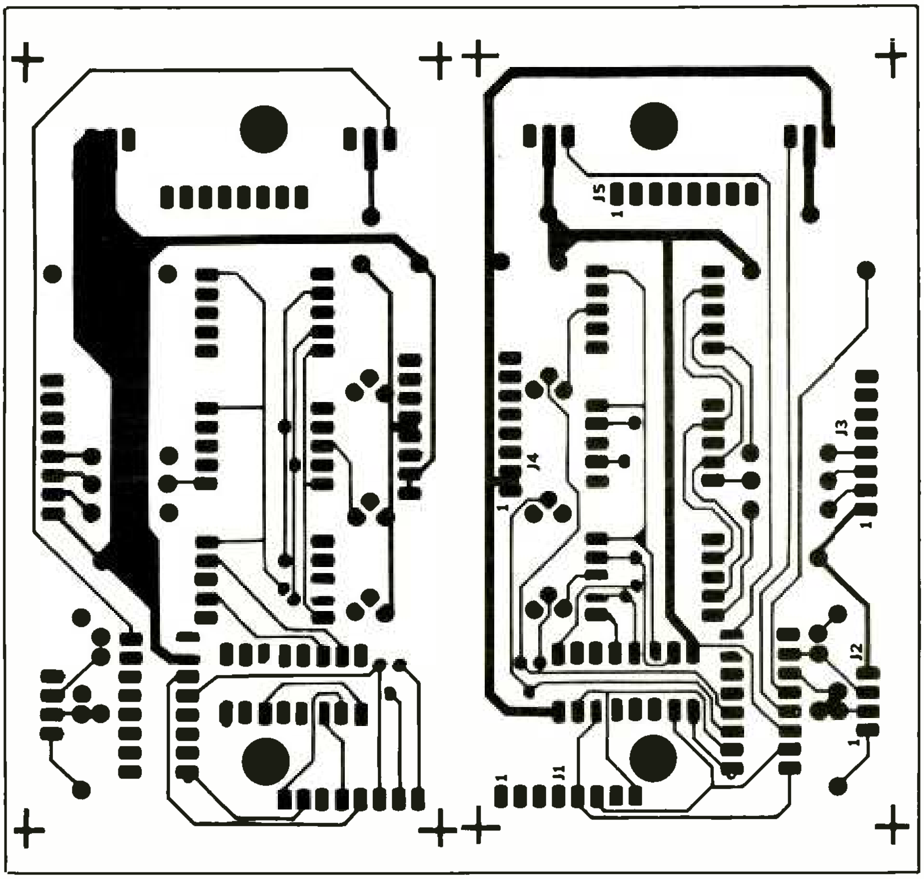


Fig. 4. Actual size etching-and-drilling guides for the top and bottom of the DMS printed-circuit board.

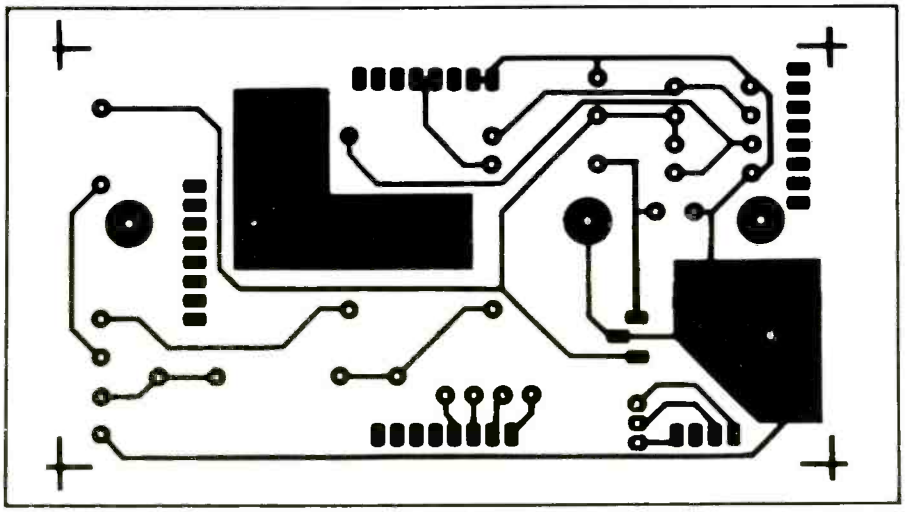


Fig. 5. Actual-size etching-and-drilling guide for the 5-volt power supply.

the *DIS1, DIS2* and *DIS3* locations. Do *not* install the ICs in their respective sockets just yet.

You can install trimmer controls *R4* and *R5* on either side of the board, depending on your preferences and needs. Decide which is better for your needs before installation. Note that several mounting holes are provided for the trimmer controls. This allows you to select from a wide variety of trimmer potentiometers. For easy adjustment and greater stability, you might want to consider replacing the pc-type trimmers specified in the Parts List with multi-turn precision wirewound trimmers.

For fixed decimal point operation, you need install only one 56-ohm dropping resistor in the appropriate location (*R1, R2* or *R3*) and ground the associated DP lead on the display.

Note at this time that there are no resistors in the R_x, R_y and R_z locations. These locations will be used later under calibration and use.

After soldering is completed, carefully clean away any rosin flux from the board with alcohol or flux solvent. This is necessary because the DMS's 80- to 100-megohm input impedance is easily affected by stray high-resistance paths.

When the board assembly is clean, use standard handling procedures for MOS devices and install *U1* and *U2* in their respective sockets. Then install the displays in their Molex Soldercon socket pins. Pay careful attention to orientation.

Wiring of the power supply board, as per the components placement/orientation guide in Fig. 7, is simple and straightforward, and no special precautions are necessary. Just keep in mind that the *J1* through *J5* headers are to be mounted on the component side of the board with the long pins protruding through the solder side. For safety, place piece of plastic IC carrier (not the conductive type) over the fuse and fuse clips to prevent accidental electrical shocks. If operation is required from only a +12-volt source, you can eliminate *T1, CR1* through *CR4* and *F1*.

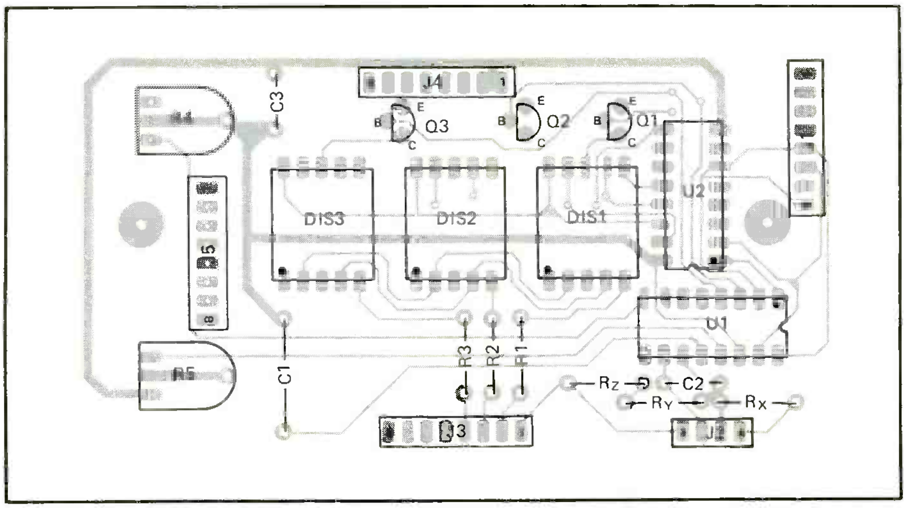


Fig. 6. Components placement/orientation guide for the DMS board.

Calibration

You need the regulated a 5-volt dc power supply shown in Fig. 3 and either a millivolt reference source or two 100,000-ohm, 1% tolerance resistors and a 1.35-volt mercury cell to calibrate the DMS. If you have the millivolt reference, set if for an output of 650 mV. However, if a millivolt reference is not available, breadboard the circuit shown in Fig. 8 to obtain the required 650-mV reference voltage across R_b.

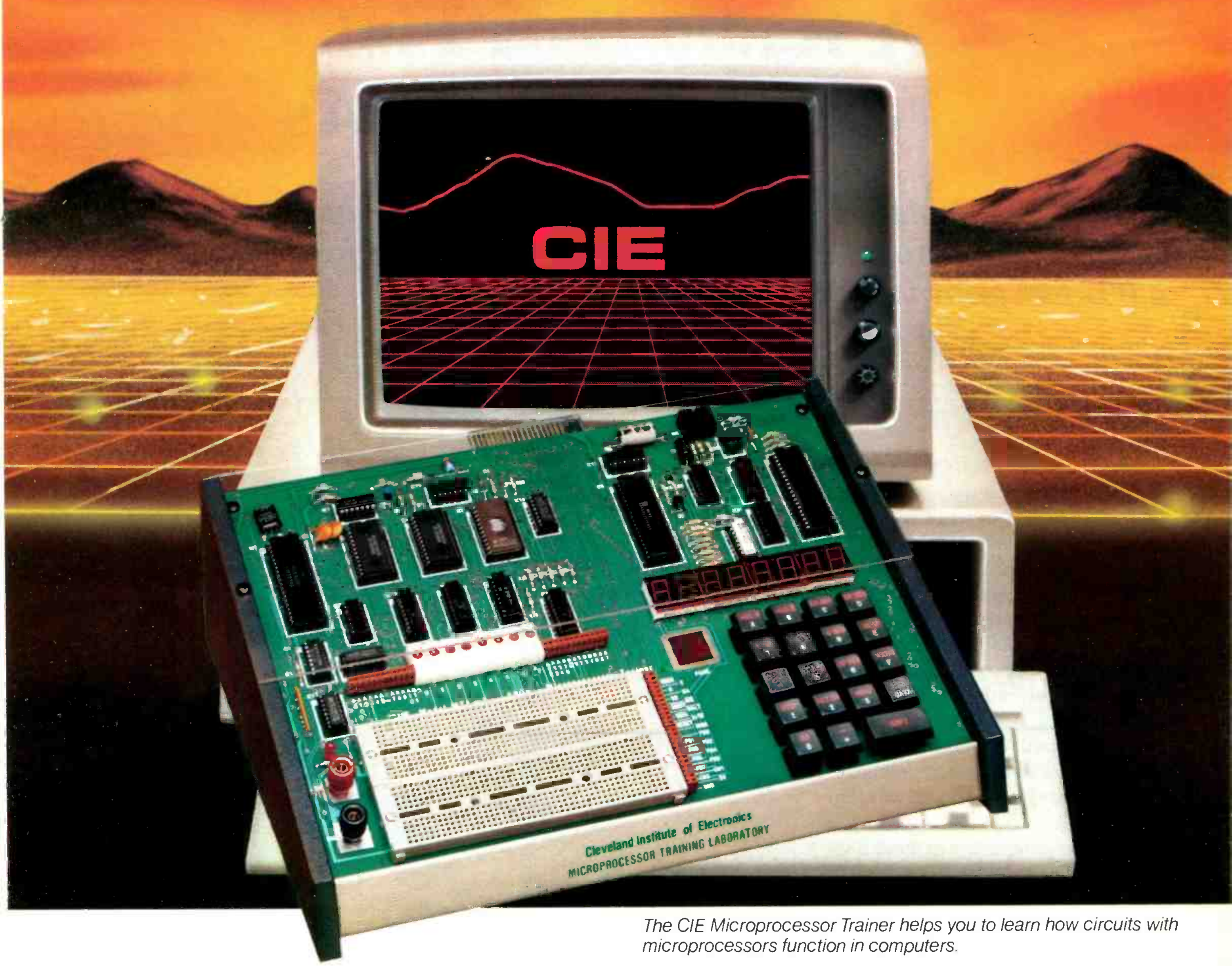
Before starting calibration, temporarily solder a 100,000-ohm, ¼-watt resistor in the R_z location on the board. Leave this resistor standing about ½" above the board's surface, since it may have to be removed later.

Using the header arrangement, plug together the 5-volt power supply and DMS boards. Secure the two boards together and/or to a panel with spacers and machine hardware via the mounting holes provided, as shown in the lead photo. Turn on the power and observe that a random number, "---" or "EEE" appears in the display.

Carefully adjust the ZERO trimmer control to obtain a reading of exactly 000. Connect the negative side of the millivolt reference source or the Fig. 8 circuit to − IN and the positive side to + IN on the DMS board. Now careful-

(Continued on page 91)

EXPAND YOUR CAREER HORIZONS...



The CIE Microprocessor Trainer helps you to learn how circuits with microprocessors function in computers.

START WITH CIE.

Microprocessor Technology. Satellite Communications. Robotics. Wherever you want to go in electronics... start first with CIE.

Why CIE? Because we're the leader in teaching electronics through independent study. Consider this. We teach over 25,000 students from all over the United States and in over 70 foreign countries. And we've been doing it for over 50 years, helping thousands of men and women get started in electronics careers.

We offer flexible training to meet your needs. You can start at the beginner level or, if you already know something about electronics, you may want to start at a higher level. But wherever you start, you can go as far as you like. You can even earn your Associate in Applied Science Degree in Electronics.

Let us get you started today. Just call toll-free **1-800-321-2155** (in Ohio, 1-800-362-2105) or mail in the handy reply coupon or card below to: Cleveland Institute of Electronics, 1776 East 17th Street, Cleveland, Ohio 44114.

CIRCLE NO. 171 ON FREE INFORMATION CARD

CIE World Headquarters — MO-62

Cleveland Institute of Electronics, Inc.
1776 East 17th Street • Cleveland, Ohio 44114

☐ Please send your independent study catalog.
For your convenience, CIE will try to have a representative contact you — there is no obligation.

Print Name ______________________

Address ______________________ Apt. ________

City ______________ State ________ Zip ________

Age ________ Area Code/Phone No. ______________

Check box for G.I. Bill bulletin on Educational Benefits
☐ Veteran ☐ Active Duty **MAIL TODAY!**

Just call toll-free **1-800-321-2155** (in Ohio, 1-800-362-2105)

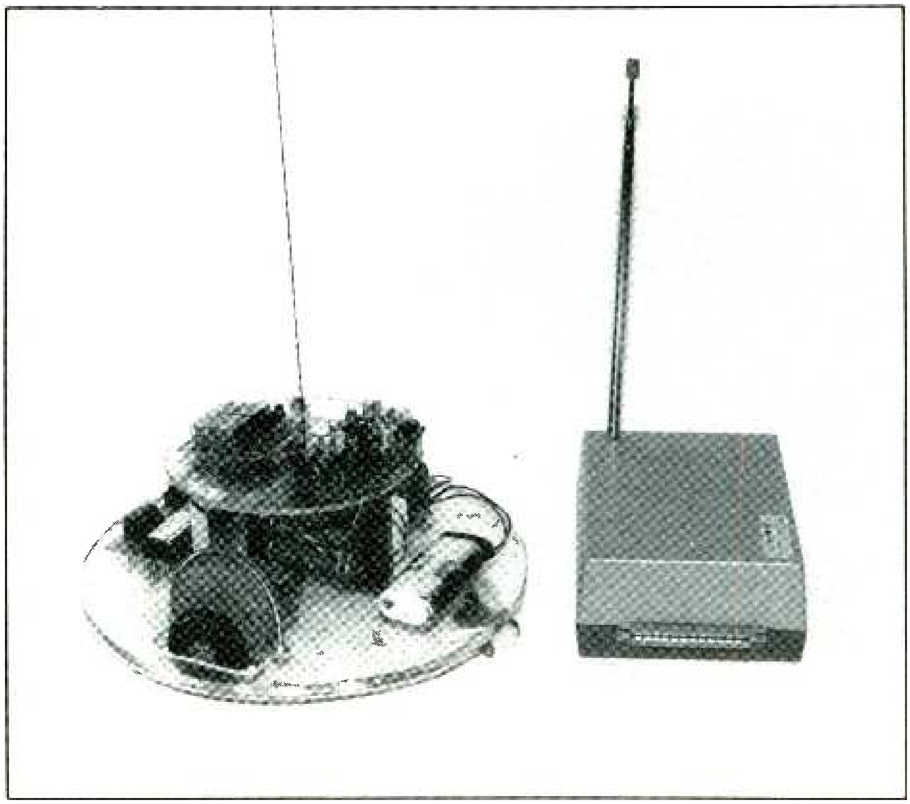
A Radio Data Link For Commodore 64's

R-f link eliminates parallel cable between computer and parallel peripheral to extend data transmission to as far as 1,000 feet away instead of an 8-foot maximum

By Jim Stephens

As my latest robotic crawler crept slowly across the room, I watched with frustration as it came to the end of its 8-foot-long umbilical and tried to drag my Commodore 64 computer onto the floor. Lengthening the cable would not solve my problem because the parallel interface to my C-64 was already at its recommended maximum length. What I really needed was a way to get the data and commands to my robot *without* a wired umbilical. And that meant some sort of radio data link.

With the general idea in mind, I set out to design a system that would fill my needs. The Radio Data Link for the Commodore 64 computer described in this article was the result. It provides a simple and inexpensive way to transmit data to and from almost any parallel-fed device, including another computer, a robot, data-gathering equipment, printers and others. In fact just about any parallel device a computer can "talk" to is a good candidate for the Radio Data Link. Now, instead of my robot crawler's mobility being limited to just 8 feet, it can roam around at distances up to 1,000 feet away.



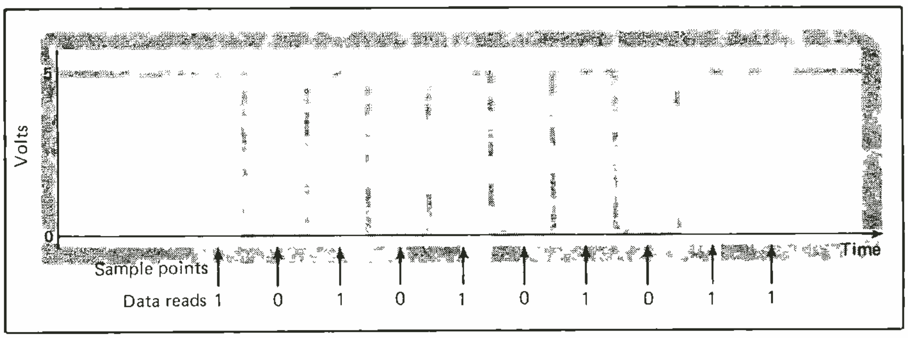


Fig. 1. Diagram of transmitted data in serial format. Note that 10 bits are transmitted for each word.

System Design

Most computers, including the C-64, have a parallel port that places an 8-bit

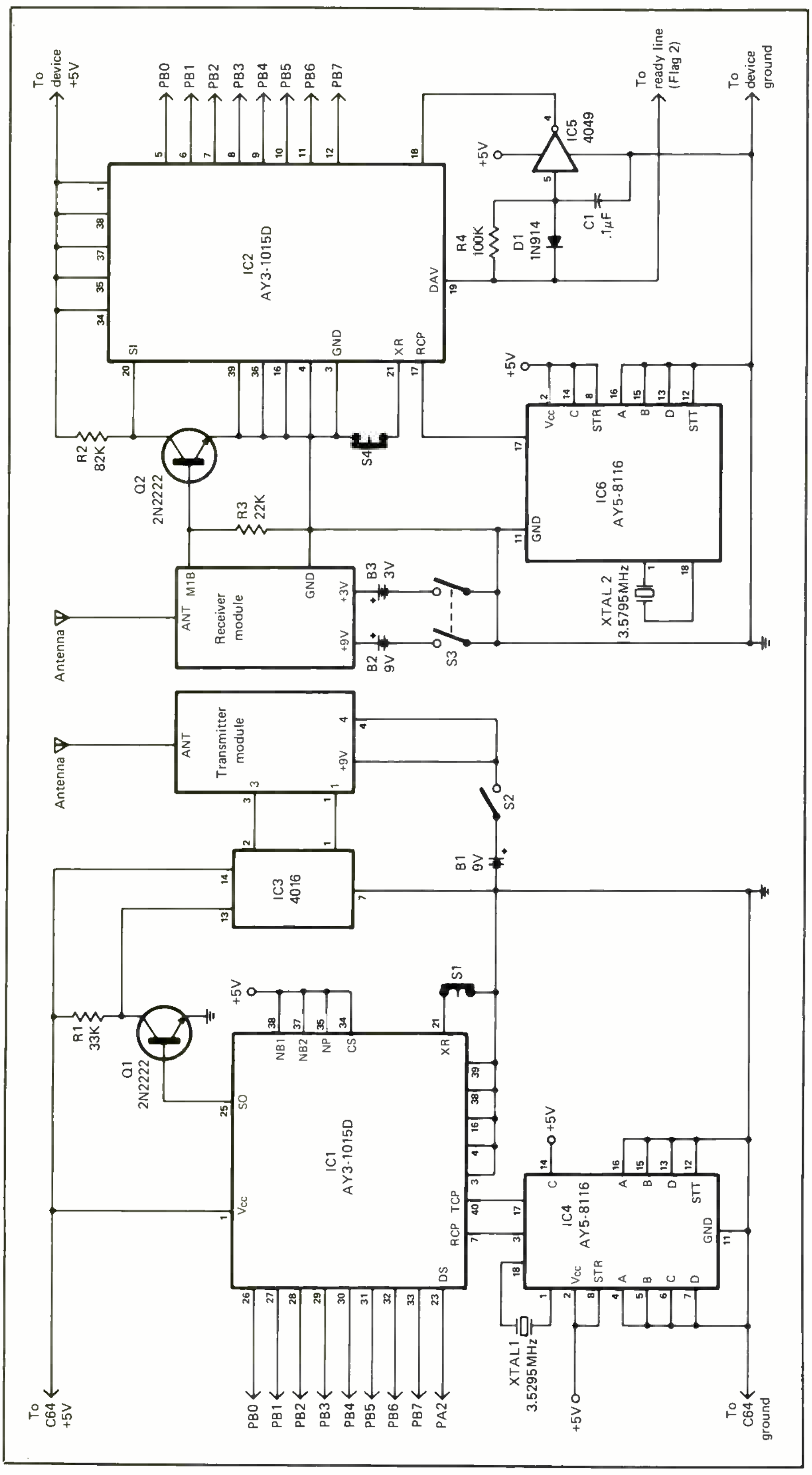


Fig. 2. The complete schematic diagram of the transmitting and receiving sections. The output of the receiver is shown going to a second C-64, but it could go to almost any other device that needs data transmitted to it.

word on the eight data lines. Each of the eight lines represents one bit in the data word. Because the full eight bits of the word go out simultaneously, the parallel method is fast and effective for transferring data *inside* a computer. But if a device is more than a few feet away from the computer, parallel communication can become slow and cumbersome.

Serial transmission, in which the individual bits that make up a data word are sent one bit at a time in "serial" fashion, may be slower internally, but it has the advantage of providing transmission of data over relatively

PARTS LIST

Semiconductors
D1—IN914 diode
IC1,IC2—AY3-1015D UART
IC3—4016 CMOS quad bilateral switch
IC4,IC6—AY5-8116 dual baud-rate generator (Radio Shack Cat. No. 276-1795 or similar)
IC5—4049 quad inverting buffer
Q1,Q2—2N2222 transistor
Capacitors
C1—0.1-µF ceramic
Resistors (¼-watt, 10% tolerance)
R1—33,000 ohms
R2—82,000 ohms
R3—22,000 ohms
R4—100,000 ohms
Miscellaneous
B1,B2—9-volt transistor battery
B3—Two 1.5-volt AA cells in series
S1,S4—Spst normally closed pushbutton switch
S2—Spst normally off lever switch (Radio Shack Cat. No. 275-612)
S3—Dpdt lever switch
XTAL1,XTAL2—3.5795-MHz color-burst signal crystal (Radio Shack Cat. No. 272-1310)
Assembled and tested transmitter and receiver modules (Radio Shack Cat. No. 277-1012, $16.95); circuit boards (see text); 44-pin edge connectors (2); sockets for all ICs (see text); snap-on connectors for B1 and B2; two-cell AA connector for B3; antennas (see text); suitable plastic enclosures; machine hardware; wire; solder; etc.

lines in the C-64's and receiving device's User Ports by adding filtering and regulation. Alternatively, you can replace the batteries with permanent ac-operated supplies, but be sure to well filter and regulate the voltages.

Although the circuit shown in Fig. 2 sends data in only one direction, a few more components could easily convert it to handle two-way transmission/reception. Such a system is quite useful if you plan on using the project to communicate between two C-64's. For this type of use, two transmitter/receiver pairs are needed, though you would not have to duplicate the existing UARTs (and clocks), since each UART contains separate receiver and transmitter sections.

A 26-page manual from Syntronics Inc., 2310 Sweetwood Rd., Nashville, TN 37214, available for $5, contains more circuits and diagrams that include modifications for dual transmission. One section shows how small walkie-talkies can be modified in lieu of using the specified Radio Shack receiver/transmitter modules.

The Syntronics manual includes schematics for permanent power supplies, robotics, analog-to-digital (A/D) converters and other applications. Also included are numerous programs for use with all of the various devices.

Construction

Since the circuit does not use high-

and soldering hardware, etc.—to wire the transmitting and receiving sections. The prototype worked well with Wire Wrap, using two 44-pin Wire Wrap boards and Wire Wrap sockets for all ICs. Therefore, for the remainder of this section, we will step you through Wire Wrap construction.

The transistors, capacitors and resistors can be mounted in an IC Wire Wrap socket, which is then used as a carrier. This type of discrete component mounting simplifies wiring and makes later troubleshooting easier. The receiver and transmitter modules are small enough to be mounted on the Wire Wrap boards along with the other components.

There is no advantage to making your wiring extra neat. In fact, crisscrossing the wiring helps cancel out some of the noise in the circuit. Make sure that each Wire Wrap connection is tight and consists of at least five turns. This is especially important if you plan to mount the circuit in or on an object subjected to vibration.

To avoid confusion and to aid in troubleshooting should it become necessary, number the pins of each IC socket on the wrap side of the boards. This will lessen the possibility of wiring errors. As you Wire Wrap the circuits, keep the wiring as short as possible to prevent stray radiation from the radio sections and to keep down induced hum.

Connection of the transmitter and

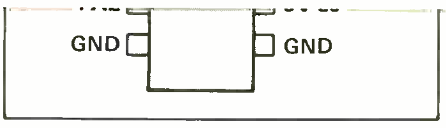


Fig. 4. The pinout diagram of the Commodore 64's User Port.

receiver boards to C-64 computers and parallel peripherals and devices are usually made with standard—and expensive—24-pin connectors. A less expensive 44-pin connector, available from Radio Shack (Cat. No. 276-1551) and other suppliers, can be modified to suit the same purpose. Simply cut down the connector with a hacksaw, as shown in Fig. 3, and smooth the edges with a file. Then solder the connector tabs directly to the fingers on the Wire Wrap boards.

Figure 4 shows the pinout of the C-64's User Port. Data pins PB0 through PB7 and data strobe PA2 are located on the bottom of the connector. The DAV ready line of receiving UART *IC2* goes to Flag 2 pin B. This line alerts the receiving device or computer when incoming data must be read. Although UARTs can transmit and receive simultaneously, the computer must send and read data as separate operations. In the Fig. 2 circuit, this is no problem because communication is in only one direction.

House the transmitter and receiver sections in separate plastic or metal boxes that are large enough to accommodate the circuit boards, batteries long distances. The pulse waveform of an 8-bit serial word is illustrated in Fig. 1. It starts and ends with long pulses that bracket three separate short pulses. Voltage measurements made where the arrows point show that this waveform represents 1010101011 in binary (a +5-volt level is a binary 1, a 0-volt level a 0).

In the serial bit stream, a wide pulse at the left defines the beginning of each word, and another wide pulse at the right tells the receiving device that a complete word has been sent. Without these synchronizing start and stop bits, only garbage would appear at the output of the device.

Though serial data transmission is preferred for long distances, sometimes it is necessary to have long-distance communication with a parallel device. For this, a means must be found to convert 8-bit parallel data into serial pulses at the transmitting end and reconvert the serial pulses back into the parallel format at the receiving end. The AY3-1015D Universal Asynchronous Receiver/Transmitter, or UART, accomplishes this easily and inexpensively. Its logic levels are fully compatible with the C-64's User Port.

Because radio does not work too well in transmitting computer data made up of high and low pulses, it is necessary to convert the binary 1s and 0s into tones that radio can handle. At the receiving end, these tones must be

Range of the system is up to 1,000 feet, which is more than would be needed for computer applications.

There are three separate tone decoders inside the receiver. By changing tone combination, four separate functions or voltage outputs can be obtained from the system. It is possible to select just one clear tone combination and transmit it in an on/off fashion. The voltage at one of the outputs on the receiver module will then rise and fall in unison with the tone. The result is a serial transmission that can be "read" by a receiving device.

About the Circuit

The complete circuit for the Radio Data Link for the C-64 is shown in Fig. 2. Parallel data from the computer's User Port is converted into serial form by UART *IC1*, which then passes the 8-bit words as serial pulses to the transmitter module. Quad bilateral switch *IC3* turns the tone on and off in relation to the serial pulses from transmitting UART *IC1*. Receiving UART *IC2* detects the pulses from the receiver's M1A output and converts them back into parallel form.

Data Available (DAV) line at pin 18 of *IC2* goes high when a complete 8-bit word has been received. This line is continuously read by the receiving device (or computer) to determine if data should be read from the data bus.

the pulses that operate the UART shift registers. The pulses shift the data bits, count them and latch the outputs for use. For reliable operation, the clocks must be stable and the pulses must be exact and clean. Since there are two separate clocks, their frequencies must be very close to each other.

The clocks are built around AY5-8116 dual baud-rate generators, which are much more stable than ordinary RC circuits. Also, their output frequencies can be changed by selecting various connections at the devices' control pins.

Both clock circuits operate at the same frequency and are extremely stable over a wide range of voltages and temperatures. Basic clock frequency in both cases is set by inexpensive color-burst crystals *XTAL1* and *XTAL2*.

Clock output frequencies are controlled by selectively connecting pins 4 through 7 and 13 through 17 to either ground or +5 volts. If all four connections for each frequency-select pin are grounded, output frequency will be approximately 80 kHz, providing a transmission rate of about 50 words per minute.

Connecting pin 14 to +5 volts, as shown in Fig. 2, increases the transmission rate to 150 wpm, which seems to be a good compromise in this system. Faster rates made the transmitter lock up, since it cannot switch fast

(or power supplies) and switches. Mount them so that the connectors are at the same heights as the User Ports on the devices into which they are to plug, as shown in Fig. 5.

Any 20" length of stiff wire can be used for each antenna. You could double the length of the transmitting antenna to obtain greater communicating range if needed. Some experimenting might be needed here, depending on operating conditions. An alternative to the stiff wire are a pair of telescoping whip antennas whose lengths can be adjusted until you obtain satisfactory performance under different operating conditions.

Before you complete final assembly, double-check all your wiring, paying particular attention to hookups to the various pins of the ICs, transmitter and receiving modules and the batteries. Make sure that the 9 volts from the batteries does not appear at the User Port connectors; if it does, you are likely to destroy the 5-volt output chips in the ports.

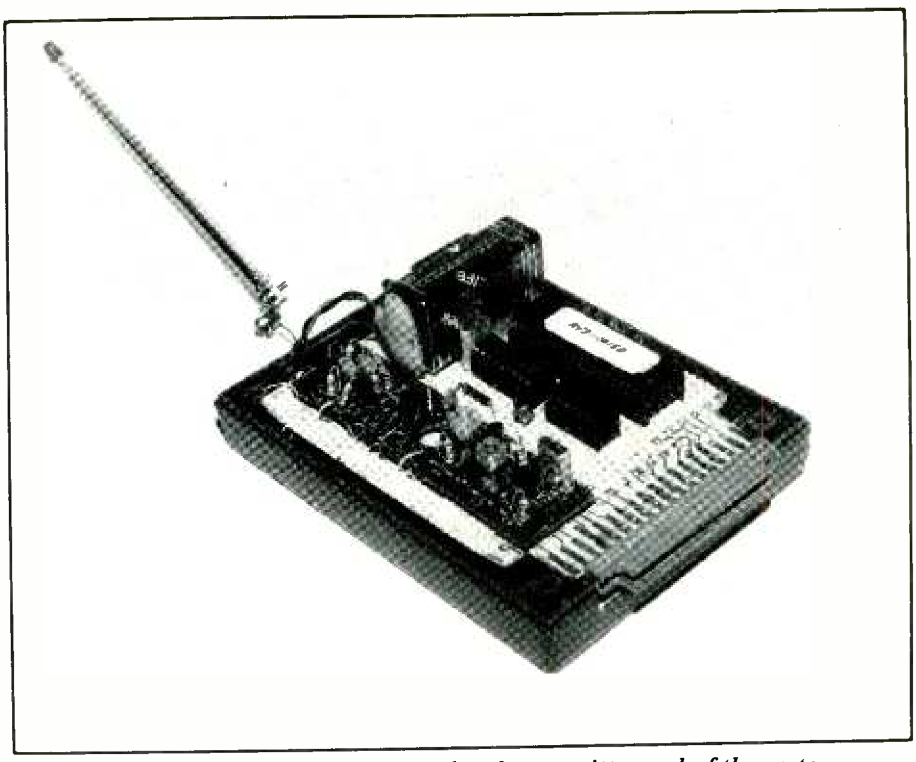


Fig. 5. Interior view of the completed transmitter end of the system.

Programming the System

When you are certain that all your wiring is correct and the batteries are installed properly, plug the transmitting and receiving units into two C-64 computers. Turn on power to the computers and transmitting and receiving units. Then key Program 1 into the transmitting computer and Program 2 into the receiving computer. These programs allow the system to transmit and receive data between the two computers. (The project can be used between two Commodore VIC-20 computers or between a C-64 and a VIC-20 with the proper changes to the PEEK and POKE locations that control the ports).

Program 1 sets up *IC1* for transmitting. Line 100 sets the PA2 line output, and line 200 pulses the PA2 line with a positive pulse by placing a 1 here as an output bit. Since PA2 is connected to the data strobe (DS) pin of *IC1*, a positive voltage on DS enters User Port data into the UART's transmitter buffer. The UART then sends the required number of bits to the transmitter module when the PA2 line is restored to low in line 420.

All bits on the User Port are outputted by line 300. Line 350 reads the keyboard, and line 380 changes the string character from the keyboard to an ASCII number. To keep up with what has been typed into the console, line 385 prints the transmitted character on the console's screen. The program continuously loops back and reads the next character.

Program 2 for the receiving console reads the incoming data from the output port of *IC2* and converts the ASCII numbers back to the characters that were typed into the transmitting keyboard. Line 10 sets all eight bits of the receiver's User Port to input. Line 110 sets the Flag 2 pin to input, and line 120 places a 1 or 0 status on Flag 2 in variable *Y*. Line 120 also masks out the other bits at memory location 56589 to prevent a fouled display. The display routine continuously reads several of the other bits at this location for screen display information.

Since the Flag 2 line is connected to *IC2*'s DAV pin, the program checks to see if this line is high. If not, it loops back to check it again in line 200. Once the DAV lines goes high, signaling what a data word is waiting at *IC2*'s output, the program places the ASCII number in the variable *X* and converts it to a character. The character is then printed on the receiver screen by line 250. Once done, the program loops back to check the status of Flag 2.

Transmission of control characters to the receiving console is also possible. Pressing the cursor keys on the transmitting console will make the printing on the receiving screen start on another line. Even the HOME key works, sending the cursor to the first line on the receiving screen. Graphics and the CONTROL and F keys can also be transmitted. With more programming, each F key can be told to perform various functions.

The receiving screen will not print control characters or BACK SPACE but

(Continued on page 92)

ELECTRONIC SURPLUS COMPONENTS & GOOD STUFF

MACHINE PIN SOCKET
22 PIN GOLD PLATED SOCKET
5 Pcs. $1.00
Stk. #ICS-22M

$.75
ROCKER SWITCH
16 Amp On/Off
Used in Xerox 820 Computers

Full Wave Bridge
6AMP 300V
2/$1.00

RIGHT ANGLE TOGGLE
SPDT 10/$3.00

SNAP ACTION SWITCH
MICRO SWITCH ASS'T OF 10
$2.50
Stk. #500-10M

COMPUTER POWER CORDS
$1.75 EA
– 10/$12.50

CIRCUIT BOARD BONANZA

Sound generator boards removed from electronic pin-ball games. Contains oscillators, control circuits & 2 watt audio amp. Experimenter's dream!!!
$2 ea – 10/$12.50
w/schematics

5V & 12V REGULATOR BOARD
Regulator board containing 5V & 12V to-220 regulators, fuses, bridges, caps & I/O connectors. Size 2"x4" w/heatsinks.
REG-512 .... $3.50

RECTIFIER BOARD
Contains (4) 10 Amp bridges, (3) large filter caps, & I/O conn. Size 4.5" & 8".
BRDG-4 .... $2.50ea or 10/$12.50

LINEAR & CMOS BONANZA
Circuit board removed from SINGER electronic calculators, has 20 linear & cmos IC's & a wealth of other parts.
BD-20 .... $2.50 ea or 10/$12.50

12 VDC TOY MOTOR
Stk. #MO-12 .. 2/$1.00

GIANT CAPACITOR ASSORTMENT
500 PCS. $9.95

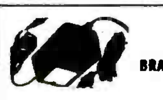
SURPLUS LASERS
$79.00
LASER-80

CRYSTALS

Frequency	Case	Price
40 MHZ	HC18	$1.25
6 0MHZ	HC18	$1.25
8 0MHZ	HC18	$1.25
10 7MHZ	HC18	$.75
14 318MHZ	HC18	$1.25

IC BARGAINS

LS00 ... $.15	LS123 .. $.42	LS240 .. $.60
LS01 ... $.15	LS124 . $1.40	LS241 .. $.60
LS02 ... $.15	LS125 .. $.30	LS242 .. $.90
LS03 ... $.15	LS126 .. $.40	LS243 .. $.80
LS04 ... $.15	LS132 .. $.40	LS244 .. $.50
LS05 ... $.15	LS133 .. $.25	LS245 .. $.50
LS08 ... $.15	LS138 .. $.35	LS251 .. $.45
LS09 ... $.15	LS139 .. $.30	LS253 .. $.40
LS10 ... $.15	LS145 .. $.55	LS257 .. $.45
LS11 ... $.15	LS151 .. $.40	LS258 .. $.50
LS12 ... $.25	LS153 .. $.30	LS259 . $1.00
LS13 ... $.30	LS154 .. $.75	LS260 .. $.40
LS14 ... $.25	LS155 .. $.40	LS266 .. $.30
LS15 ... $.30	LS156 .. $.40	LS273 .. $.75
LS20 ... $.15	LS157 .. $.30	LS279 .. $.30
LS21 ... $.18	LS158 .. $.40	LS280 .. $.80
LS27 ... $.21	LS160 .. $.50	LS283 .. $.35
LS30 ... $.15	LS161 .. $.40	LS290 .. $.65
LS32 ... $.20	LS162 .. $.60	LS293 .. $.75
LS33 ... $.25	LS163 .. $.35	LS298 .. $.85
LS37 ... $.30	LS164 .. $.50	LS299 . $1.50
LS38 ... $.25	LS165 .. $.80	LS322 . $2.50
LS42 ... $.30	LS166 .. $.75	LS323 . $2.25
LS51 ... $.20	LS169 . $1.00	LS364 .. $.90
LS54 ... $.25	LS174 .. $.35	LS366 .. $.40
LS55 ... $.20	LS175 .. $.35	LS367 .. $.40
LS73 ... $.30	LS181 . $1.25	LS368 .. $.30
LS74 ... $.23	LS191 .. $.80	LS373 .. $.50
LS85 ... $.45	LS192 .. $.70	LS374 .. $.75
LS86 ... $.19	LS193 .. $.74	LS375 .. $.35
LS93 ... $.50	LS194 .. $.60	LS377 .. $.90
LS107 .. $.28	LS195 .. $.50	LS378 .. $.80
LS109 .. $.28	LS196 .. $.70	LS390 .. $.80
LS112 .. $.30	LS197 .. $.75	LS393 .. $.75
LS122 .. $.35	LS221 .. $.50	LS399 . $1.00
		LS670 . $1.24



NEW! MILTON BRADLEY XFMR.
Input: 120VAC
Output: 12VAC CT @ 1.7AMP
UL Approved
Stk. #TM4243-33 $4.95

VOLTAGE REGULATORS
7805 5V 1.5amp
7812 12v 1.5amp
7824 24v 1.5amp
7905 5v 1.5amp
7905 5v 1.5 amp
7912 12v 1.5 amp
$.43 EACH

8237 .. $4.95
8237-5 $5.49
8250 .. $6.95
8251 .. $1.69
8251-A $1.89
8253 .. $1.89
8263-5 $1.95
8255 .. $1.69
8255-5 $1.89
8259 .. $1.95
8259-5 $2.29
8272 .. $4.95
8279 .. $2.49
8279-5 $2.95
8282 .. $3.95
8284 .. $2.95
8286 .. $3.95
8288 .. $4.95

6845 VIDEO CHIP
$4.50

EPROM
2716 ..... $2.00
2532 ..... $2.75
2732 ..... $2.25
2764 ..... $2.75
27128 .... $4.50

VOLKES MODEM
300 BAUD
$24.95

AT CRYSTAL
18 MEG
$3.50

HEAT-SHRINK TUBING
100'
5/8" = $15.00
3/8" = $10.00

COMPUTER RUBBER FEET
4/$2.00

NEC 3500
40 CPS SERIAL PRINTER "REBUILT" PRINTER
$550

COMPUTER GRADE CAPACITORS
Ass't of 10
Stk. #CCG-10 .. $2.50

ELECTRONIC PIEZO BEEP BUZZER
Special – 2/$1.00
7/8" Diameter element on plastic mounting. Originally used in Radio Shack telephone as the ringer.
Stk. #PZO-78 .... $.75

ULTRAVIOLET TUBES GOOD FOR EPROM ERASERS
110 VAC
$2.25 ea. – 10/$15.00

POWER SUPPLY
General purpose compact power supply. 3 outputs: +5V @ 1 Amp, +12V @ 1 Amp, & +24V @ 1 Amp. Power Transistors mounted on a heat sink. 2"x4" w/transformer. Stk. #PS-3P $4.49

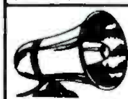
RIBBON CABLE
9 conductor Spectrastrip with red marker strip. 250' per roll. 28ga. stranded wire. WRIB-9 .... $10/roll
20 conductor spectrastrip with red marker stripe. 100' per roll. 28ga. stranded wire. WRIB-20 $.30/ft. or $25/roll

CPM DISK
For V20 CHIP
$3.75

COMMODORE PRINTER/ PLOTTER FITS ALL MODELS
$49.95

WTEK CABLE CONVERTER
Model No. TC-1M Converter. Both Mid-Band & VHF frequencies. Has built in power supply. Units are new & in working cond.
Stk. #TC-1M $9.95

1000 PIECE RESISTOR ASS'T
ALL SIZES & VALUES
Stk. #RES-1000 . $3.00



$6.95
OUTDOOR SPEAKER - HORN Stk. #Spkr-60

XEROX 1810 CPM BOOT DISK $3.75

BUILD YOUR OWN EPROM ERASER
115VAC BLACK LIGHT (ULTRA VIOLET)
115 volt ultra violet light, with lamp, ballast and in-line cord switch. Just build enclosure to finish.
Stk. #EPR-125 .... $12.50

TI COMPUTER FLOPPY DRIVE CABLES
SINGLE FLOPPY DRIVE CABLE
Cable is 15" long with 34 pin card edge & 34 pin header conn.
CFS-15 .... $2.00 ea or 10/$14
DUAL FLOPPY CABLE
Cable is 34" long w/3 34 pin edge connectors.
CFS-30 .... $4.00 ea or 10/$25

POWER SUPPLY
MFG. BY GENERAL INSTR.
Input: 110VAC
Output: +5VDC @ 5Amps
+12VDC @ 2.5Amps
–12VDC @ 3Amps
PS-120 .... $19.95
Used in some Commodore comp.

WALL PLUG ADAPTERS
6VDC @ 300ma
$1.75 or 10/$12.50

ISOLATION TRANSFORMER
117VAC
117VAC @ 125VAC
Mfg. by Signal Trans
$3.00 each – 10/$20.00

RIGHT ANGLE HEADERS
40 pin .... $.40
34 pin .... $.50
10 pin .... $.25

COMPUTER CHESS GAME

(NEW)
MILTON BRADLEY CHESS GAME
Electronic circuit board removed from famous toy maker's game. Board has 6502 processor, 74LS series IC's, buzzer & many other useful components. Boards are complete and un-damaged. MB part #7924243001.
BD-792 .... $3.95 ea. 10/$24

DISKETTE LOOSE LEAF HOLDER
Vinyl Diskette Holder
Holds 2-5¼" diskettes. Has 3 hole punch to mount in standard loose leaf folder. Stk. #1 VIN-5 .... 10/$2.50
For standard 8½x11

$1.75
PLASTIC ENCLOSURE
2"x3"x4"

STANDARD 6' 3 PRONG LINE CORD
$.40 #CRD 6

DIABLO TYPE 30 POWER SUPPLIES
115VE 8amps
$15.00

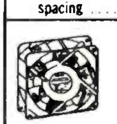
ALTOS 8000 COMP.
$250

TRANSFORMERS

STK.#	PRI (VAC)	Secondary (VAC)	Price
TN-6.3	117	6.3 @ 300ma	$.125
TN-12	117	12 @ 400ma	$.135
TN-24A	117	24 @ 200ma	$.125
TN-24B	117	24ct. @ 3.6 Amp	$3.50

SPECIAL TRANSISTOR SALE STK. #T-500
500 PC 2N2222
Un-Marked – $3.50

EDGE CONNECTORS
ALL ARE 1.56" SPACING.
22/44 EDGE CONNECTOR
$2.00
31/62 Connector for IBM PC Board. .1" spacing $2.50



4" COOLING FAN
120 VAC
NEW
Stk. # FN-4 – $6.50

8-PIN HEADER STRIP
Stk.#HDR-8
$.15 EACH

HOOK-UP WIRE ASS'T
6 SPOOLS OF
50' – $3.00
#WIR-30H

100 PC ASSORTMENT RF COILS
$3.50

COILED CORD BONANZA
4 conductor coiled cord. Black vinyl jacket. Extends to 6 ft. No connectors on either end.
Stk. #CC-000 .... 3/$1.00
4 Conductor coiled cord. Black vinyl jacket. Extends to 6 ft. Phone connector on one end and no connector on the other.
Stk. #CC-020 .... 2/$1.00
4 Conductor coiled cord. Grey vinyl jacket. Extends to 6 ft. Used as keyboard cable. Phone jack to 5 pin din connector.
Stk. #CC-100 ...... $4.00

HEAT SINK
TO-3
$.25

LOAD RESISTOR FOR IBM POWER SUP.
5 Ohm @ 25 Watts
$1.79
Stk.#RIBM-5

12 VAC @ 250ma TRANSFORMER
TN12A
2/$1.50

ELECTRONIC COMPONENT BONANZA

STOCK#	DESCRIPTION	PRICE
Res20	Power res. ass't. 20pcs	$2.29
Res100	Precision res. assort. 1% & 2% types. 100 pcs.	$2.59
Res1000	Res. assort. 1000pcs. All sizes & values	$3.25
Re100p	100 miniature trimpots, pc mount	$4.79
Re25p	25 tv and radio pots. Good selection	$2.79
Re25g	25 ganged pots. Hard to find types	$3.25
Ch35	Miniature choke coils. 35pcs. many values	$2.79
Ch15	Slug tuned if coils. 15 pcs.	$2.29
Ch20	Open wound tuning coils. 20pcs.	$2.29
Ch10	Transfmr style choke. 60mh. 10 pcs.	$2.29
Cp100	100pc. electrolytic assort. Great values	$3.37
Cp100d	Ceramic disc caps. 100pcs., great values	$2.59
Cp25hv	High voltage disc caps. 1Kv min. 25 pcs.	$2.79
Cp25p	25pcs. polystyrene caps. high stability	$1.79
Cp685	Nichicon 6800mf @50v. 12 pcs.	$2.75
*Cp316	Mepco 3000mf @16v. low est. 12 pcs.	$3.75
Cp12s	Mallory low esr switching caps. 10pcs.	$3.75
Cp100ma	100 mylar bypass & coupling caps. Axial	$3.75
Cp100mr	100 mylar bypass & coupling caps. Radial	$4.25
Cp25t	Tantalum assortment. 25pcs.	$3.55
Cp25dm	25pc. dipped mica cap. assortment	$2.79
Cp13cg	Mallory computer grade caps. 13pcs.	$4.79
Di100g	100 germanium diodes. in34 etc.	$2.25
Di100s	100 silicon diodes. in4148 types, etc.	$2.25
Di15p	15pcs. power diodes. 2 amps & above	$2.75
Q50m	50 Magnavox tv replacement transistors	$3.79
Q100a	100 small signal transistors. Pnp & npn	$4.79
Q150r	150 rf transistors. Metal can, unmarked	$1.79
Q10p	TO-220 power transistors. 10pcs. pnp & npn	$2.29
F3	6' inline fuse holder w/3amp fuse. 3 pcs.	$.99
Cb10	10 airpax circuit breakers. 3 to 25amps	$4.49
Cn30m	30pc molex connector & socket assortment	$3.49
Bs25	25pc. barrier strip assort. 2 to 20 connects	$2.55
Wr100	100' connecting & hook-up wire. All guages	$2.25
Xo3	3 pcs. speaker crossover networks	$1.59
Sp2	Pair of 6x9 car speakers	$4.79
Rel10	10pc. relay assortment. Ac & dc types	$3.79
Jk25	25pc. audio jack & connector assort.	$2.59
Sw25	Slide switch assortment, many sizes, 25 pcs.	$2.59
Sk16	100pcs. 16 pin IC sock. Staggered pins	$2.25
Sk14	100 pcs. 14 pin IC sock. Staggered pins	$2.25

MAGNETS
2" Bar Magnet with Tape On One Side
2/$1.00

POWER SUPPLY
5V@35 AMP
$45.00

SMALL COMPUTER QUALITY CAPS
CERAMIC MONOLYTHIC CAPS. FOR ALL TYPES OF COMPUTER APPLICATIONS. ULTRA STABLE.

PART #	MFD.	VOLTS	COST
CMO-103	.01	50	.10
CMO-473	.047	50	.11
CMO-104	.1	50	.12

6VAC CT @1.7 AMPS
TN-1500
$4.95

12 VOLT MINIATURE PC BOARD RELAY
SPDT
#REL-12Y
$1.25

10/$2.00
Stk.#HK-10
Heat sink ass't
All Types Incl.

RADIO SHACK BROKEN BOARDS
TRS-80
MOD III
5/$10.00

WIRE TEST PROBE WIRE
18 Guarage rubber coated. Red, black, white or blue ...... 100'/$13

HOOK-UP WIRE
24 Guage standard cond.
22 guage solid conductor, your choice 100'/$2
WIRE WRAP WIRE
30 Guage solid cond. Choice of colors. Wir-30 .... 100'/$2.50

TV-GAME SWITCH
$.65 EACH
OR 10/$4.25

TOCOM 55 PLUS CABLE TV CONVERTER
55 CHANNEL CONVERTER
Mainboard – $7.50
Power supp. – $4.50

LOLIR LECTRONICS
13933 NO. CENTRAL #212
DALLAS, TX 75243

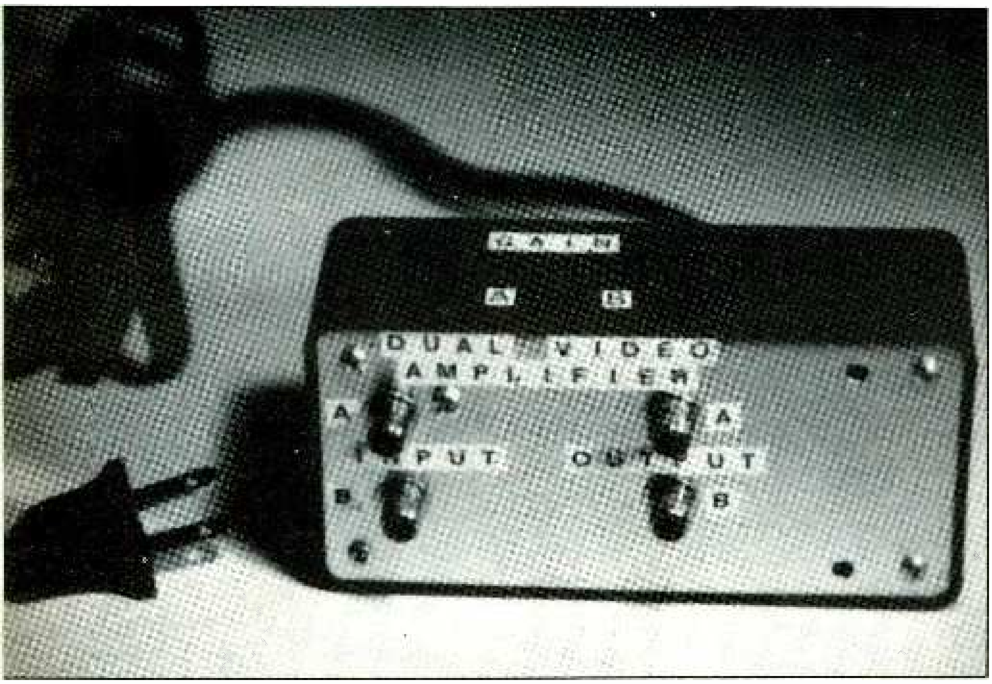
214-234-8032
214-234-8091
214-234-8105

TERMS: Check or Money Order. COD's Add $1.90. TX Res. add 6% Tax. Please add $3.50 shipping. All out of stock items will be refunded.

CIRCLE 65 ON FREE INFORMATION CARD

A Dual Video Amplifier

Allows you to use two VCRs with one TV receiver/monitor and dub from one VCR to the other without swapping cables or slipping switches



By Michael J. Keryan

According to a recent survey, 25 percent of new VCR sales in 1986 are expected to be to second-time VCR buyers. Furthermore, two-VCR users are more likely to buy a new top-of-the-line TV receiver/monitor combination with direct audio and video inputs. This can lead to a common problem —connecting two VCRs to a TV receiver/monitor while retaining the ability to dub high-quality pictures from VCR to VCR, all without having to swap cables or flip switches.

There are, of course, several commercial products that will solve the problem, though most are rather expensive. An alternate route is to build and use the Dual Video Amplifier accessory described here. Cost of the project is about $25. Although the amplifier circuit to be described is very simple and low in cost, it is of very high quality. In operation, it doesn't degrade the color or sharpness of the picture.

Some Background

A starter system usually contains a single VCR and an ordinary color TV receiver. With this arrangement, there's hardly ever any problem with hookup, since there isn't much you can do other than record and play back tapes. Changing to a TV receiver/monitor is a step up. Using the direct video and audio inputs in this arrangement (Fig. 1) results in better sound and picture quality.

Adding a second VCR to an existing VCR-TV receiver/monitor system may sound like an extravagance if you still haven't bought your first VCR. Many VCR owners are installing a second unit, mainly to be able to copy tapes. Recording of two programs being aired at the same time when you can't view either at air time, may be a compelling second reason for installing that second VCR. Yet another reason is to back up a different-format machine. For example, you might have a Beta-format machine but are finding it more and more difficult to find Beta tapes for rent locally. The solution is to back up the Beta VCR with a much more popular VHS VCR. This way, you get the best of both worlds without sacrificing the investment you made for your original machine.

At first glance, it might appear that everything should plug together with no problems, since the TV receiver/monitor has two sets of video and audio inputs. Indeed, initial hookup *is* simple, as shown in Fig. 2. With this arrangement, you can direct the output of either VCR into the TV receiver/monitor. The rub is that this arrangement doesn't permit direct dubbing between VCRs. To be able to dub, you must juggle cables, unplugging the source VCR's cables from the TV receiver/monitor and

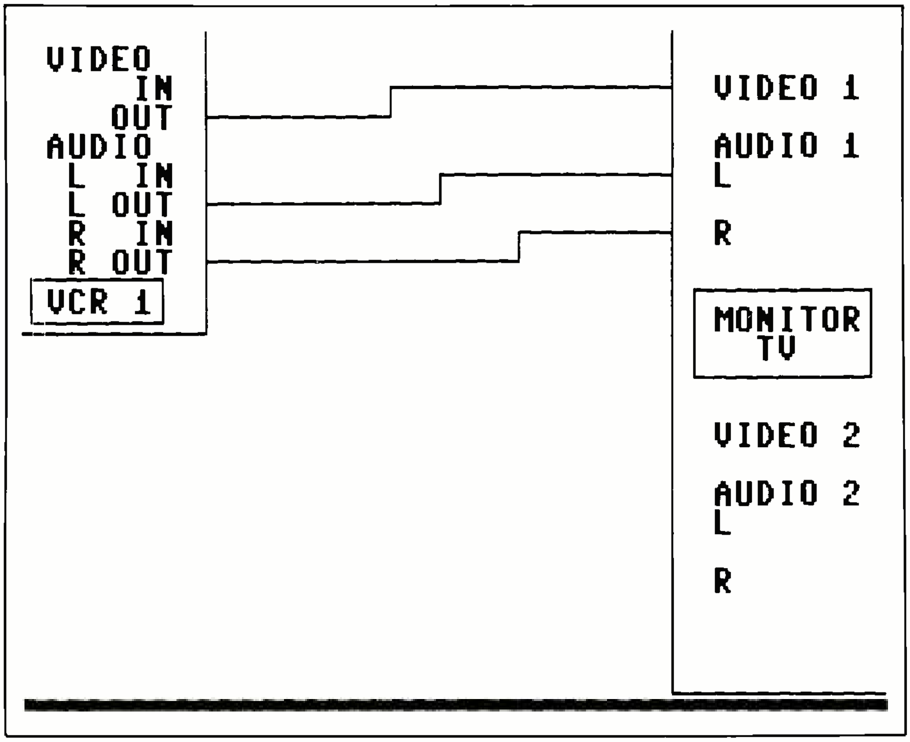


Fig. 1. Hookups for a single VCR and TV receiver/monitor.

plugging them into the other VCR's input jacks. Try doing that a number of times in the usually cramped quarters while trying to read black-on-black jack identification labels under the usual poor lighting!

An alert electronics enthusiast might see a possible solution at his local Radio Shack store—Y-type phono-plug adapters that split the signal from a single cable so that it can feed two inputs. This arrangement is shown in Fig. 3. It's a solution of sorts, but hardly practical. While the audio might be fine, the video will be much less than perfect. In fact, it's likely to be terrible if you're used to getting good pictures from your video system.

Using the Fig. 3 arrangement, the picture from either VCR will be only about half as bright as it was before installing the Y adapters, both directly on-screen and when copying a tape. The reason for this should be obvious. A video signal from a VCR is designed to drive only one 75-ohm video input. Feeding this signal to two 75-ohm inputs in parallel halves the impedance so that the VCR is now looking at 37.5 ohms. The result is a substantially reduced signal level going into both the TV receiver/monitor and the second VCR.

Why not use switches to send the video signals to only one input at a time? This is another impractical solution if the objective is to keep things as simple as possible. Considering the complexity of the typical two-VCR system, this switching could very well make the entire system incredibly difficult to use.

The perfect solution is one you never have to bother keeping track of once you've installed it. All you really need is to isolate the video inputs with buffer amplifiers. This is what you'll find in commercial video enhancer/stabilizer accessories sold as commercial products for $100 or more. If you want and need the extra functions provided by the enhancer/stabilizer and are willing to spend the money for the separate accessories you need for each VCR, you've found your solution. However, if you really don't need the extra features and would like to save a bundle of money, the Dual Video Amplifier

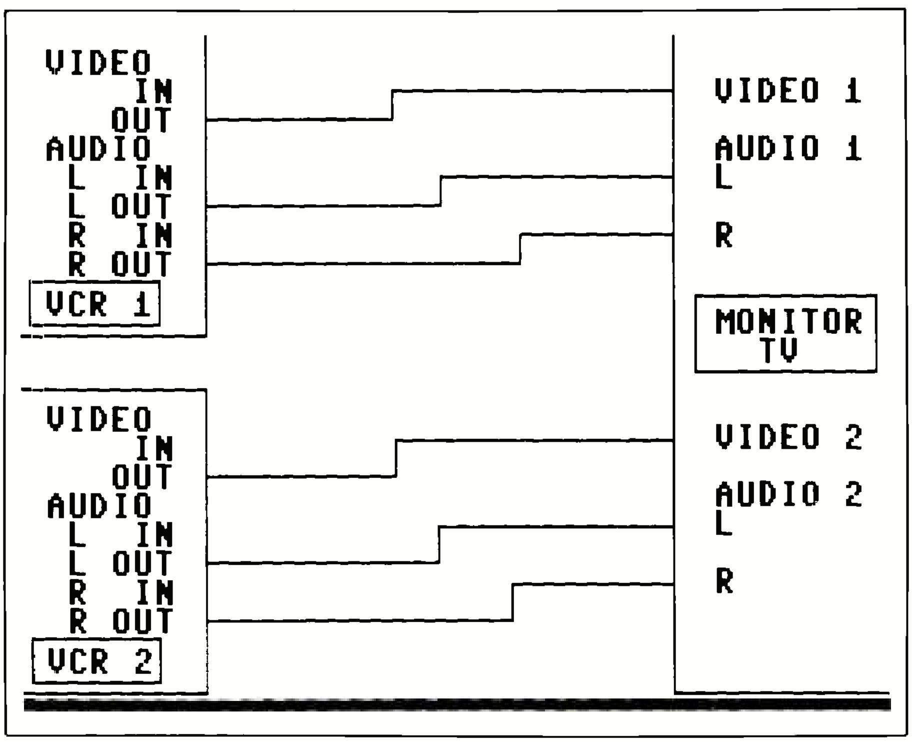


Fig. 2. Feeding two VCRs to a TV receiver/monitor; copying from one VCR to the other can not be done.

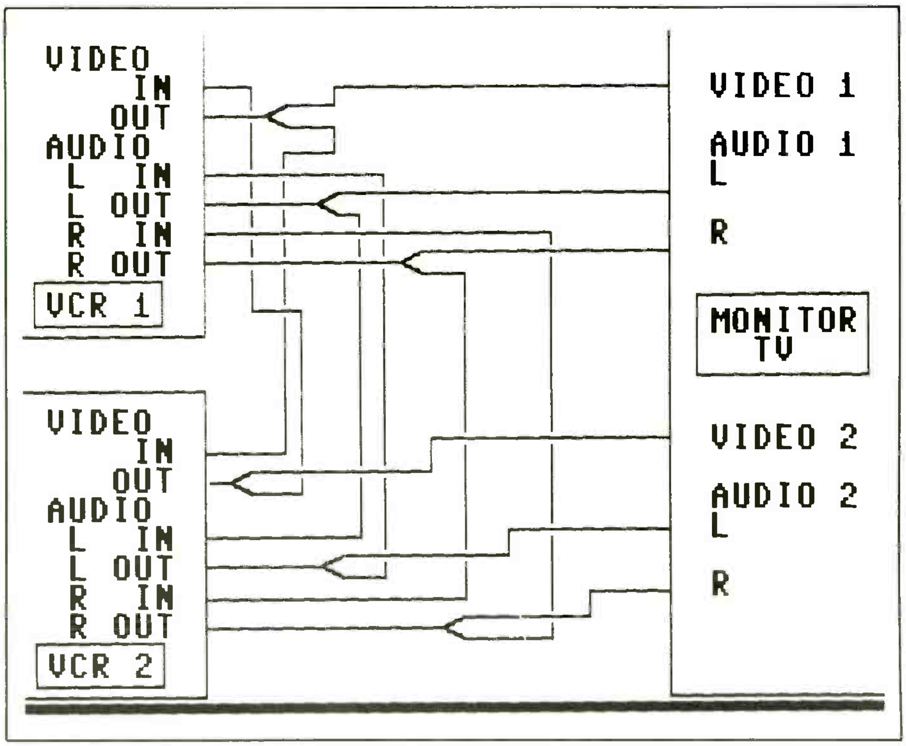


Fig. 3. Feeding two VCRs to a TV receiver/monitor; copying from one VCR to the other can be done.

accessory to be described is by far the best solution in terms of performance, ease of use and cost.

About the Circuit

As shown in Fig. 5, the dual video amplifier consists of two distinctly separate sections—the dual amplifiers themselves, built around *IC1*, and the power supply whose output is regulated by *IC2*. Because each video amplifier channel has its own separate gain control, the project allows you to adjust signal levels from all video sources (tuner, VCR 1 and VCR 2) so that the pictures from all are the same brightness.

Input impedance for each video amplifier channel is approximately 5,000 ohms. This is high enough to assure that no significant reduction in picture signal results when the amplifiers are paralleled with the 75-ohm input of a VCR.

Video signals from VCRs or other sources are fed through *C1* and *C2* to the respective op-amp inputs. The values of these coupling capacitors are large to assure good low-frequency picture quality. With capacitors lower in value than the 250 microfarads specified, you may detect brightness variations from top to bottom of the screen.

An LM359 is a good choice for *IC1*. It was selected for its excellent high-frequency response and high crosstalk rejection. While most other op amps begin to attenuate the signal by the time the frequency reaches the higher audio range and are virtually worthless at 1 MHz, the LM359 delivers useable performance out to 20 MHz or more. Don't substitute a different op amp for the LM359.

Gain controls *R5* and *R6* permit you to vary the gain of the op amps from 0 to about 2 in the respective video amplifier channels. Operating these controls permits you to adjust the picture as desired. As you adjust *R5* and *R6*, you'll notice that they affect both brightness and contrast.

Resistors *R8* and *R9* serve as a voltage divider that provides a bias voltage for the op amps. If you wish, you can replace these two resistors with a single 500-ohm potentiometer that will allow you to experiment with the picture/sync ratio.

My project has no power switch for the simple reason that I'm using my TV receiver/monitor's switched ac accessory outlet to turn on and off the power whenever I turn on and off the receiver/monitor. Since I need the video amplifiers only when viewing a VCR program, this works out fine for me. If your TV receiver/monitor doesn't have a switched outlet or you have another application in mind, you may wish to add *S1* to allow you to switch on and off power to your video amplifier.

Any power supply that can deliver between 5 and 22 volts dc can be used with the project. This allows you to use a different power supply from that shown in Fig. 5. If you do use a different supply, however, make sure the output from the power transformer is at least 3 volts greater than the potential you want at the output of the regulator.

You might think that a power supply with an output of 15 volts or more is preferable to one with a lower-voltage output, but it isn't. A low-voltage power supply is preferred for two reasons. Firstly, it keeps heat losses to a minimum. Secondly, it calls for lower-voltage components that are less expensive than their higher-voltage counterparts.

Light-emitting diode *LED1* is an optional power-on indicator. If you prefer, you can omit the LED and current-limiting resistor *R10*.

Construction

Owing to the project's very simple design and low component count, construction is also very simple. Aside from having to keep all wiring as short as possible, there's nothing particularly difficult about building the project.

You can point-to-point wire the

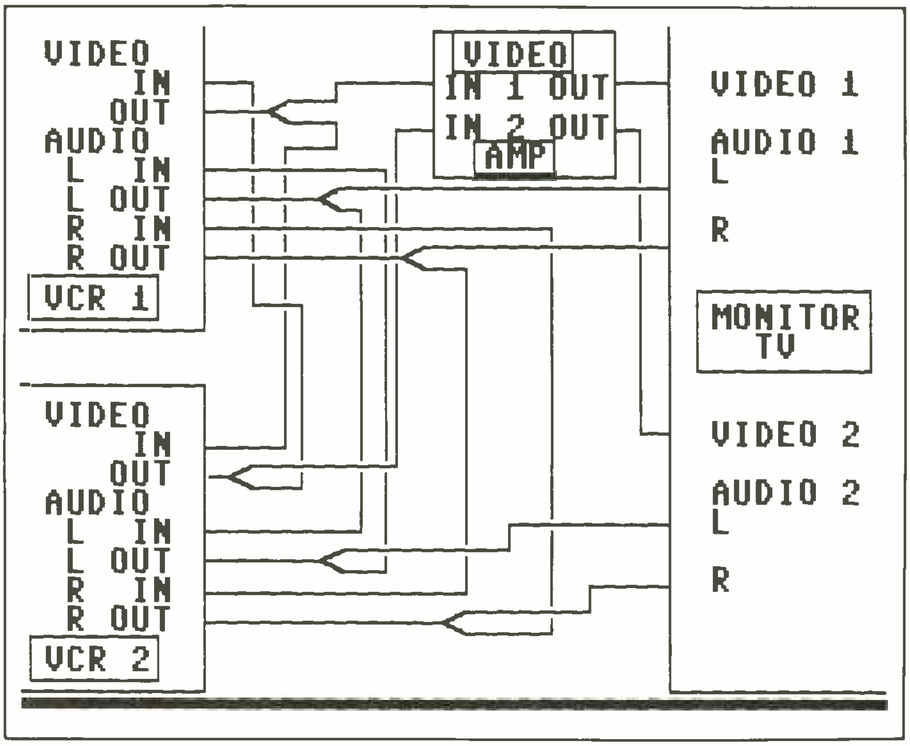


Fig. 4. Feeding two VCRs to a TV receiver/monitor; copying can be done and video amplification assures that no loss in picture quality occurs.

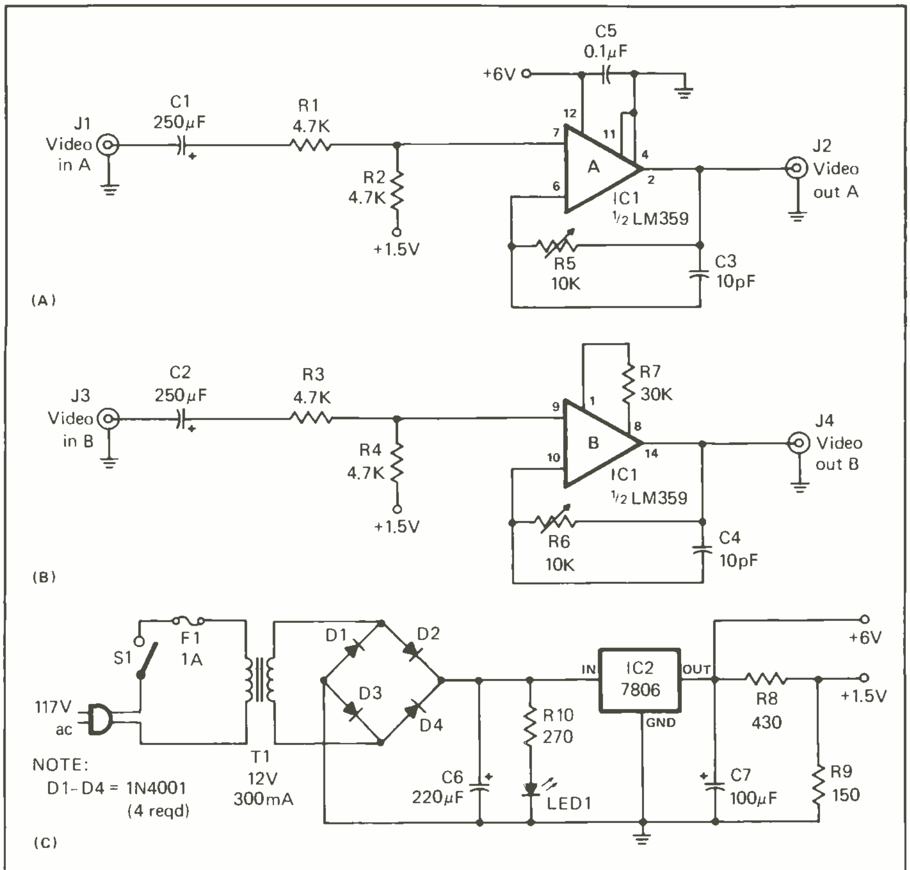


Fig. 5. Overall schematic diagram of Dual Video Amplifier.

circuit on two separate pieces of perforated board, one for the video amplifiers and the other for the power supply, using appropriate soldering hardware. Alternatively, you can design and fabricate a printed-circuit board to take the place of point-to-point wiring. In either case, it's a good idea to use a socket for *IC1*. When wiring the circuit, make sure you install the components with the proper orientation and polarities, as shown in Fig. 5, and use a heat sink with *IC2* to dissipate excessive heat.

Gain controls *R5* and *R6* can be ei-

PARTS LIST

Semiconductors

IC1—LM385 dual high-speed operational amplifier (do not substitute)
IC2—7805 +6-volt regulator
D1 thru D4—1N4001 rectifier diode or equivalent bridge rectifier assembly
LED1—Light-emitting diode

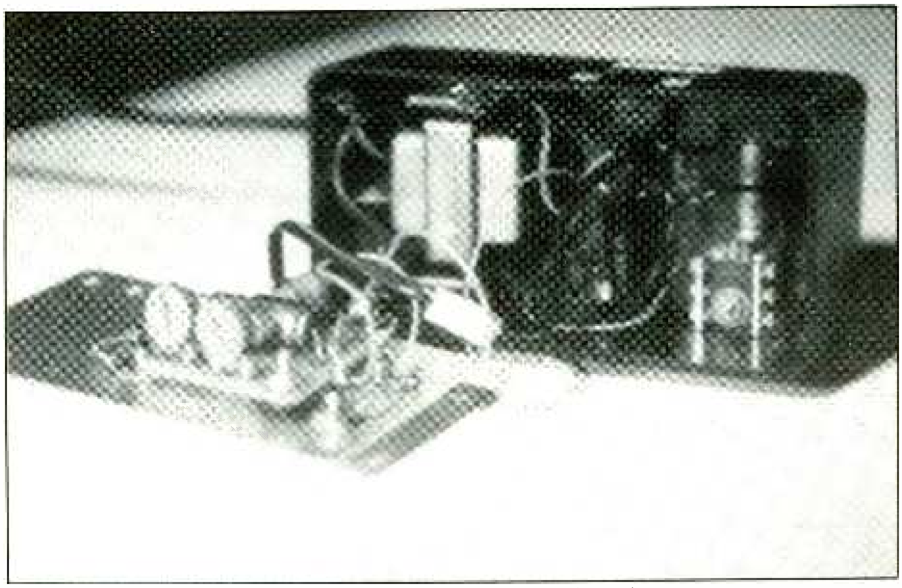
Capacitors

C1,C2—250-μF, 12-volt electrolytic
C3,C4—10- to 13-pF, 50-volt ceramic
C5—0.1-μF, 50-volt disc
C6—220-μF, 16-volt electrolytic
C7—100-μF, 16-volt electrolytic

Resistors (¼-watt, 10% tolerance)
R1 thru R4—4,700 ohms
R7—30,000 ohms
R8—430 ohms
R9—150 ohms
R10—270 ohms
R5,R6—10,000-ohm pc or panel-mount potentiometer (see text)

Miscellaneous

F1—1-ampere fuse
J1 thru J4—Phono jack
S1—Spst slide or toggle switch (optional; see text)
T1—12.6-volt, 300-mA transformer
Suitable metal or plastic box; fuse holder for F1; small heat sink for IC2; printed-circuit board or perforated board and soldering hardware; socket for IC1; control knobs for panel-mount potentiometers; rubber grommets; plastic strain relief (optional; see text); rubber feet or Velcro strips (see text); video cables; lettering kit; machine hardware; hookup wire; solder; etc.



Interior view of assembled project.

ther pc-type trimmer potentiometers or standard or miniature panel-mount pots (as can be the 500-ohm potentiometer, if this is used in place of *R8* and *R9*). Panel-mount pots are more convenient if you anticipate having to frequently adjust the controls, though they do add to the cost of the project.

Use a plastic or metal box in which to house the project. Drill holes for mounting the jacks through one end and for mounting the circuit board(s) through the floor of the box. If you're using panel-mount potentiometers for *R5* and *R6* and/or have decided to replace *R8* and *R9* with a 500-ohm pot, drill the mounting holes for these components in locations where they won't interfere with the rest of the circuitry. Otherwise, drill access holes to these pots directly in line with their adjustment slots when the circuit board is in place.

Then drill a mounting hole for a toggle-type power switch or cut a rectangular slot and drill mounting holes for a slide-type switch, locating it where it won't interfere with the rest of the circuitry. Drill holes for the LED (if you're using it) and ac line cord, and a few extra holes to allow heat to escape.

Label the various jacks, controls, positions of the switch and the LED. If you use dry-transfer lettering, give it two or three *light* coats of clear acrylic spray to protect it.

Mount the circuit board(s) on the floor (using spacers) and the other components in their respective locations on the walls of the box. Line the LED and line cord holes with rubber grommets. Plug *LED1* into its grommet and pass the free end of the ac line cord through its rubber grommet. Tie a knot in the ac line cord about 4" from the free end inside the box or use a plastic strain relief.

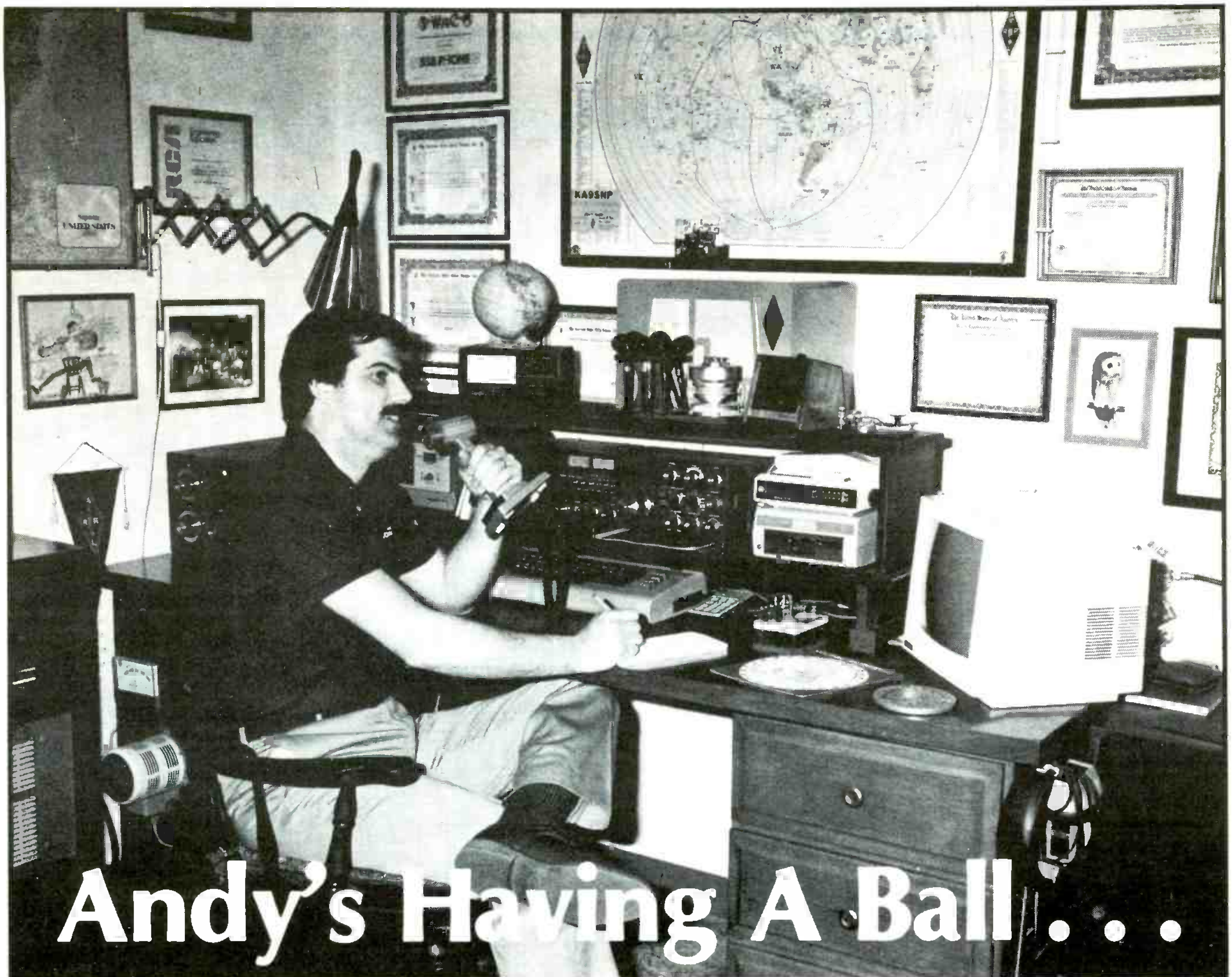
When everything is mounted in its respective location (use spacers between the circuit board and floor of the box), refer to Fig. 5 and interconnect all off-the-board components to their respective points in the circuit.

Normally, the video amplifier would be mounted on the rear panel of the TV receiver/monitor with which it is to be used. If this is your intent, you can secure it in place with a couple of strips of Velcro epoxied to the back of the box and to the receiver/monitor's rear panel to hold it in place. Alternatively, you can simply place the box near your TV receiver/monitor or VCRs. In this case, place four self-stick rubber feet on the bottom of the box.

In Closing

Connecting your Dual Video Amplifier into your system is simple, as shown in Fig. 4. Use video-quality cables for all interconnects. Keep the cables as short as possible. Don't use audio cables! Long cables and audio cables will attenuate high frequencies, resulting in reduced picture sharpness.

The Dual Video Amplifier may have been designed to provide isolation when feeding a composite signal from each of two VCRs to a TV receiver/monitor and a VCR, but this isn't its only use. You can use it to isolate or amplify composite-video signals in other applications using VCRs, video cameras, computers, etc. The gain controls allow widely varying signal sources to be adjusted for optimum signal levels. ME



and you can too!

Andy is a Ham Radio operator and he's having the time of his life talking to new and old friends in this country and around the world.

You can do it too! Join Andy as he communicates with the world. Enjoy the many unique and exclusive amateur bands . . . the millions of frequencies that Hams are allowed to use. Choose the frequency and time of day that are just right to talk to anywhere you wish. Only Amateur Radio operators get this kind of freedom of choice. And if it's friends you're looking to meet and talk with, Amateur Radio is the hobby for you. The world is waiting for you.

If you'd like to be part of the fun . . . if you'd like to feel the excitement . . . we can help you. We've got all the information you'll need to get your Ham license. Let us help you join more than a million other Hams around the world and here at home. Who are we? We're the American Radio Relay League, a non-profit representative organization of Amateur Radio operators.

For information on becoming a Ham operator
circle number 110 on the reader service card or write to:

AMERICAN RADIO RELAY LEAGUE Dept CQ, 225 Main Street
Newington, Conn. 06111.

This space donated by this publication in cooperation with the American Radio Relay League.

High-Tech Sequencing Lights for Vehicles

Customize your car with these eye-catching lights

By Bill Owen and Robert Fernandez

Would you like to "jazz" up your car with lights that scan back and forth, like those on NBC's *Knight Rider* super-car, K.I.T.T.? Here's you chance. The sequencing lights in the project to be described will give any car the high-tech K.I.T.T. look. Not only that, the moving lights also serve as a safety device that gets the attention of other motorists and pedestrians alike—much better than any stationary light can.

This project can be installed in any car with a 12-volt, negative-ground electrical system. It is relatively easy to build and install and even easier to operate. Built in is a control that allows the sequence scan rate to be adjusted as desired. You also have a choice of red or blue lights.

(Note: Before you install or use the sequencing light project described here, check local ordinances to make sure they're not prohibited).

About the Circuit

Refer to the schematic diagram shown in Fig. 1. Action begins with 14-stage ripple counter *U1*. This IC has a built-in oscillator that enables it to count its own self-generated signal. The internal gate oscillator's frequency is governed by the RC value of resistors *R1* and *R3*, potentiometer *R2* and capacitor *C1*. Making *R2* variable allows the scan frequency to be adjusted as desired.

Inside *U1*, the oscillator output is connected to the input of the serial counter stages. The binary-coded output at pins 7, 5, 4 and 6 continuously counts in binary between 0000 and 1111. Feeding these four binary outputs to quad 2-input exclusive-OR (XOR) gate *U2* causes the binary count at output pins 3, 4, 10 and 11 to reverse when it reaches 111 and cause a countdown back to 000.

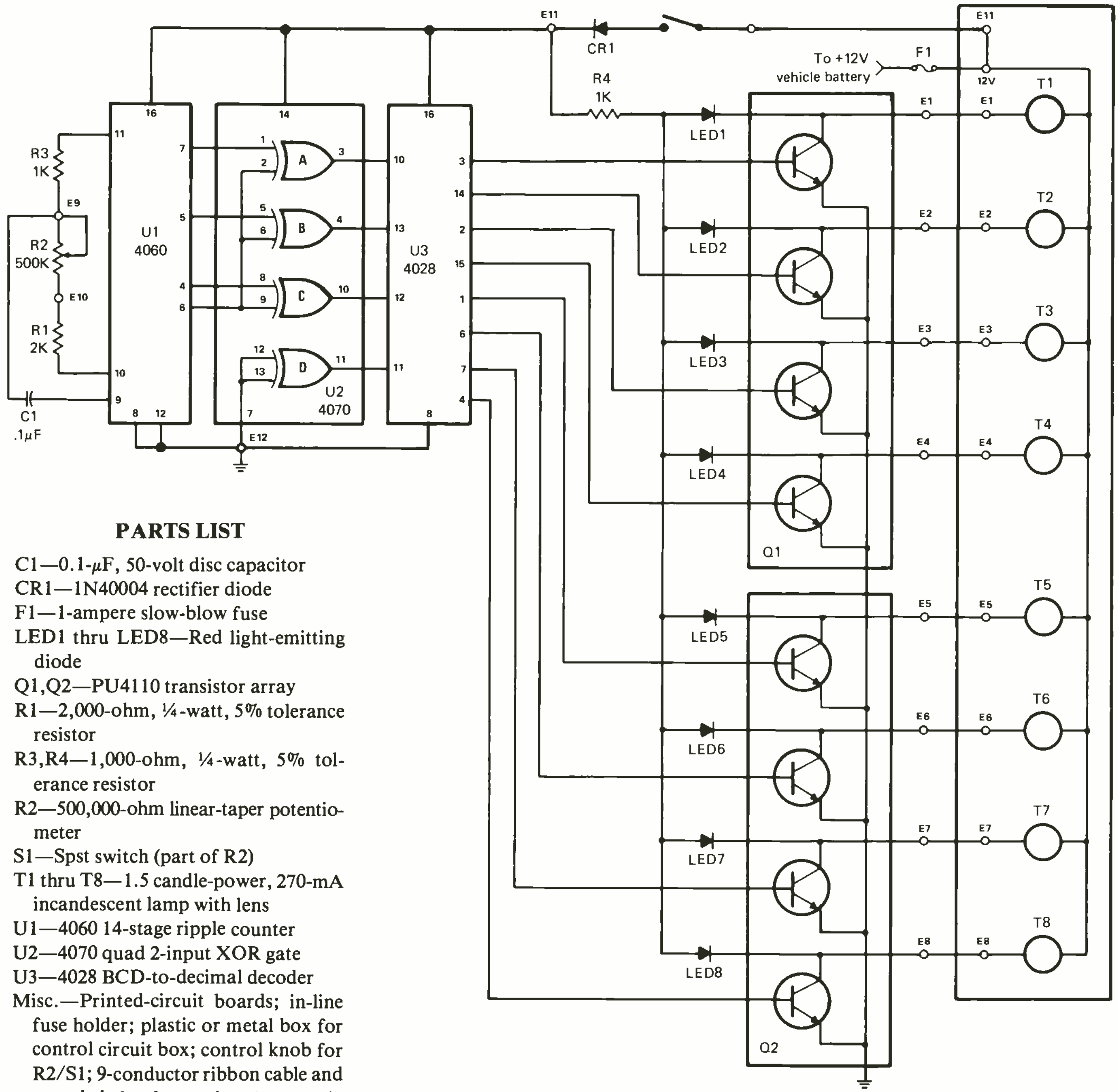
Shown in the Table is the binary count sequence fed into *U3*. When the binary count sequences up to 111 and back down to 000, BCD-to-decimal decoder *U3* counts up to 7 and back down to 0, with an octal output where one of eight output pins is high at any given point in time.

Quad Darlington driver transistor packages *Q1* and *Q2* are directly driven by the eight CMOS outputs from *U3*. Both the lamps on the remote lamp assembly (shown in the dashed-line box) and the indicator LEDs in the control circuit are easily driven by the power transistor arrays made up of *Q1* and *Q2*. In fact, this control circuit is fully capable of driving several lamp arrays in parallel.

As the circuit's count up/down cycles repeat, the lamps, identified as *T1* through *T8* in Fig. 1, "sweep" up and down. If the lamp assembly is oriented horizontally, as would normally be the case, the lamps would sweep back and forth. The LEDs serve as a "local" indicator of circuit operation. Viewed from inside your car, they cycle in the same manner as the lamps do.

Construction

As with most projects in which integrated circuits are used, printed-cir-



PARTS LIST

C1—0.1-µF, 50-volt disc capacitor
CR1—1N40004 rectifier diode
F1—1-ampere slow-blow fuse
LED1 thru LED8—Red light-emitting diode
Q1,Q2—PU4110 transistor array
R1—2,000-ohm, ¼-watt, 5% tolerance resistor
R3,R4—1,000-ohm, ¼-watt, 5% tolerance resistor
R2—500,000-ohm linear-taper potentiometer
S1—Spst switch (part of R2)
T1 thru T8—1.5 candle-power, 270-mA incandescent lamp with lens
U1—4060 14-stage ripple counter
U2—4070 quad 2-input XOR gate
U3—4028 BCD-to-decimal decoder
Misc.—Printed-circuit boards; in-line fuse holder; plastic or metal box for control circuit box; control knob for R2/S1; 9-conductor ribbon cable and stranded hookup wire (see text); mounting materials for display board and control circuit box (see text); spade lug; hot-melt glue or silicone adhesive; machine hardware; solder; etc.

Fig. 1. The schematic diagram of the project.

Note: The following items are availabe from NRG Electronics, P.O. Box 24138, Ft. Lauderdale, FL 33307: Both ready-to-wire pc boards for $19.95; complete kit of parts except cabinet and glue or adhesive, for $59.95; cabinet with hardware for $9.95. Add $4.50 for P&H; Florida residents, add state sales tax.

cuit wiring is recommended for this one. In this project, pc wiring obviates any problems that could arise as a result of mechanical vibrations caused by the automotive environment. There are two pc boards in the project. One is for the control circuitry, the other for the lamp display assembly.

You can buy ready-to-wire control-circuit and display pc boards from the source given in the Parts List or fabricate your own using the actual-size etching-and-drilling guides in Figs. 2 and 3. Note that the control board is shown in full, while the 24″-long

Clock	4060 Pin:				4070 Pin:			4028 Pin:							
Pulse	6	4	5	7	10	4	3	3	14	2	15	1	6	7	4
1	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0
2	0	0	0	1	0	0	1	0	1	0	0	0	0	0	0
3	0	0	1	0	0	1	0	0	0	1	0	0	0	0	0
4	0	0	1	1	0	1	1	0	0	0	1	0	0	0	0
5	0	1	0	0	1	0	0	0	0	0	0	1	0	0	0
6	0	1	0	1	1	0	1	0	0	0	0	0	1	0	0
7	0	1	1	0	1	1	0	0	0	0	0	0	0	1	0
8	0	1	1	1	1	1	1	0	0	0	0	0	0	0	1
9	1	0	0	0	1	1	1	0	0	0	0	0	0	0	1
10	1	0	0	1	1	1	0	0	0	0	0	0	0	1	0
11	1	0	1	0	1	0	1	0	0	0	0	0	1	0	0
12	1	0	1	1	1	0	0	0	0	0	0	1	0	0	0
13	1	1	0	0	0	1	1	0	0	0	1	0	0	0	0
14	1	1	0	1	0	1	0	0	0	1	0	0	0	0	0
15	1	1	1	0	0	0	1	0	1	0	0	0	0	0	0
16	1	1	1	1	0	0	0	1	0	0	0	0	0	0	0

This Table illustrates the logic states of the outputs of each IC used in the project. Note that the sequence repeats at the ninth clock pulse and that a "1" or high in the output of the 4028 turns on the associated lamp-driver transistor. The pattern of 1s shows the scan sequence of the lights.

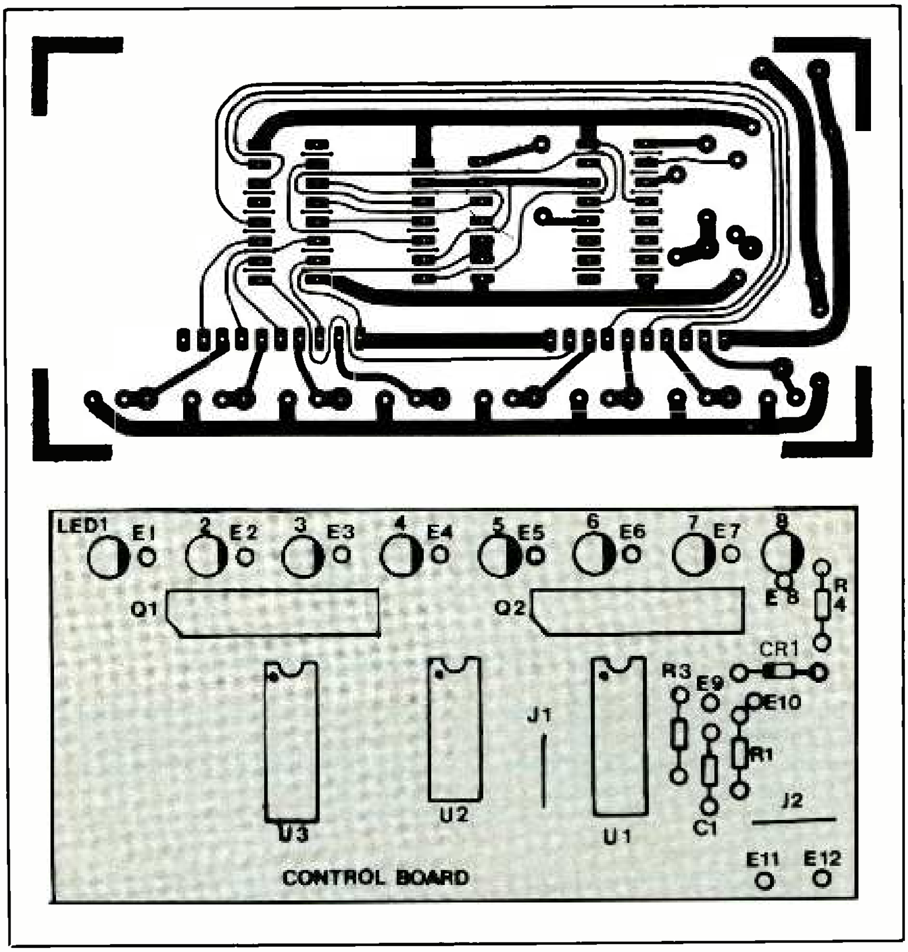


Fig. 2. The actual-size etching-and-drilling guide and components-placement diagram for the control-circuit board.

display board is shown actual-size but not full length. To make the display-board guide fit on the page, ¾" from the top-left portion and 2½" from the bottom-right have been removed. When using the guide, butt the three sections together end to end, top to bottom. Then add ¾" of blank board at the left and 2½" at the right.

Wire the boards exactly as shown in the components-placement guides in Figs. 2 and 3. The ICs in Fig. 2 are best installed with their pins directly soldered to the copper pads on the control board without benefit of sockets. Make sure when you wire the control board that you install each component in its proper place and that you properly orient the diode, LEDs, integrated circuits and transistor arrays. Don't forget to install the two jumper wires as indicated. Practice safe-handling procedures when handling the CMOS ICs to prevent destroying these sensitive devices with static electricity.

Prepare a nominal 5"-long by 2-½"-wide by 1-½"-deep metal or plastic box by cutting a slot, or individual holes for the LED display, drilling a mounting hole for *R2/S1* and drilling a hole or cutting a slot for routing the cable that connects the control circuit to the lamp display board.

Cut the LED display window slot (if used) to 4" × ⅜" across the top of the front panel, in line with the LEDs when the circuit board is installed. For the interconnect cable, drill a hole through the rear wall of the box or trim a slot wide enough for the ribbon cable between the two box halves. Then drill a hole for *R2/S1*. Finally, drill holes for brackets, cement a Velcro pad or fasten a layer of double-sided foam tape to the bottom or top of the box, depending on whether you plan to mount the box on or under your car's dashboard.

Cement a red plastic lens over the

(Continued on page 86)

NEW! Lower Price Scanners

Communications Electronics,™ the world's largest distributor of radio scanners, introduces new lower prices to celebrate our 15th anniversary.

Regency† MX7000-GP

List price $699.95/**CE price $469.95**
10-Band, 20 Channel • Crystalless • AC/DC
Frequency range: 25-550 MHz. continuous coverage and 800 MHz. to 1.3 GHz. continuous coverage.
The *Regency* MX7000 scanner lets you monitor Military, Space Satellites, Government, Railroad, Justice Department, State Department, Fish & Game, Immigration, Marine, Police and Fire Departments, Broadcast Studio Transmitter Links, Aeronautical AM band, Aero Navigation, Paramedics, Amateur Radio, plus thousands of other radio frequencies most scanners can't pick up. The *Regency* MX7000 is the perfect scanner to receive the exciting 1.2 GHz. amateur radio band.

Regency® Z60-GP

List price $299.95/**CE price $179.95/SPECIAL**
8-Band, 60 Channel • No-crystal scanner
Bands: 30-50, 88-108, 118-136, 144-174, 440-512 MHz.
The *Regency* Z60 covers all the public service bands plus aircraft and FM music for a total of eight bands. The Z60 also features an alarm clock and priority control as well as AC/DC operation. Order today.

Regency® Z45-GP

List price $259.95/**CE price $159.95/SPECIAL**
7-Band, 45 Channel • No-crystal scanner
Bands: 30-50, 118-136, 144-174, 440-512 MHz.
The *Regency* Z45 is very similar to the Z60 model listed above however it does not have the commercial FM broadcast band. The Z45, now at a special price from Communications Electronics.

Regency® RH250B-GP

List price $659.00/**CE price $329.95/SPECIAL**
10 Channel • 25 Watt Transceiver • Priority
The *Regency* RH250B is a ten-channel VHF land mobile transceiver designed to cover any frequency between 150 to 162 MHz. Since this radio is synthesized, no expensive crystals are needed to store up to ten frequencies without battery backup. All radios come with CTCSS tone and scanning capabilities. A monitor and night/day switch is also standard. This transceiver even has a priority function. The RH250 makes an ideal radio for any police or fire department volunteer because of its low cost and high performance. A *60 Watt* VHF 150-162 MHz. version called the **RH600B** is available for $454.95. A UHF 15 watt version of this radio called the **RU150B** is also available and covers 450-482 MHz. but the cost is $449.95.

NEW! Bearcat® 50XL-GP

List price $199.95/**CE price $114.95/SPECIAL**
10-Band, 10 Channel • Handheld scanner
Bands: 29.7-54, 136-174, 406-512 MHz.
The Uniden Bearcat 50XL is an economical, hand-held scanner with 10 channels covering ten frequency bands. It features a keyboard lock switch to prevent accidental entry and more. Also order part # **BP50** which is a rechargeable battery pack for $14.95, a plug-in wall charger, part # **AD100** for $14.95, a carrying case part # **VC001** for $14.95 and also order optional cigarette lighter cable part # **PS001** for $14.95.

NEW! Scanner Frequency Listings

The new Fox scanner frequency directories will help you find all the action your scanner can listen to. These new listings include police, fire, ambulances & rescue squads, local government, private police agencies, hospitals, emergency medical channels, news media, forestry radio service, railroads, weather stations, radio common carriers, AT&T mobile telephone, utility companies, general mobile radio service, marine radio service, taxi cab companies, tow truck companies, trucking companies, business repeaters, business radio (simplex) federal government, funeral directors, veterinarians, buses, aircraft, space satellites, amateur radio, broadcasters and more. Fox frequency listings feature call letter cross reference as well as alphabetical listing by licensee name, police codes and signals. All Fox directories are $14.95 each plus $3.00 shipping. State of Alaska–**RL019-1**; State of Arizona–**RL025-1**; Baltimore, MD/Washington, DC–**RL024-1**; Buffalo, NY/Erie, PA–**RL009-2**; Chicago, IL–**RL014-1**; Cincinnati/Dayton, OH–**RL006-2**; Cleveland, OH–**RL017-1**; Columbus, OH–**RL003-2**; Dallas/Ft. Worth, TX–**RL013-1**; Denver/Colorado Springs, CO–**RL027-1**; Detroit, MI/Windsor, ON–**RL008-3**; Fort Wayne, IN/Lima, OH–**RL001-1**; Hawaii/Guam–**RL015-1**; Houston, TX–**RL023-1**; Indianapolis, IN–**RL022-1**; Kansas City, MO/KS–**RL011-2**; Long Island, NY–**RL026-1**; Los Angeles, CA–**RL016-1**; Louisville/Lexington, KY–**RL007-1**; Milwaukee, WI/Waukegan, IL–**RL021-1**; Minneapolis/St. Paul, MN–**RL010-2**; Nevada/E. Central CA–**RL028-1**; Oklahoma City/Lawton, OK–**RL005-2**; Orlando/Daytona Beach, FL–**RL012-1**; Pittsburgh, PA/Wheeling, WV–**RL029-1**; Rochester/Syracuse, NY–**RL020-1**; San Diego, CA–**RL018-1**; Tampa/St. Petersburg, FL–**RL004-2**; Toledo, OH–**RL002-3**. New editions are being added monthly. For an area not shown above call Fox at 800-543-7892. In Ohio call 800-621-2513.

NEW! Regency® HX1500-GP

List price $369.95/**CE price $239.95**
11-Band, 55 Channel • Handheld/Portable
Search • Lockout • Priority • Bank Select
Sidelit liquid crystal display • EAROM Memory
Direct Channel Access Feature • Scan delay
Bands: 29-54, 118-136, 144-174, 406-420, 440-512 MHz.
The new handheld *Regency* HX1500 scanner is fully keyboard programmable for the ultimate in versatility. You can scan up to 55 channels at the same time including the AM aircraft band. The LCD display is even sidelit for night use. Includes belt clip, flexible antenna and earphone. Operates on 8 1.2 Volt rechargeable Ni-cad batteries (not included). Be sure to order batteries and battery charger from accessory list in this ad.

Bearcat® 100XL-GP

List price $349.95/**CE price $203.95/SPECIAL**
9-Band, 16 Channel • Priority • Scan Delay
Search • Limit • Hold • Lockout • AC/DC
Frequency range: 30-50, 118-174, 406-512 MHz.
The world's first no-crystal handheld scanner now has a LCD channel display with backlight for low light use and aircraft band coverage at the same low price. Size is 1⅜" x 7½" x 2⅞." The *Bearcat* 100XL has wide frequency coverage that includes all public service bands (Low, High, UHF and "T" bands), the AM aircraft band, the 2-meter and 70 cm. amateur bands, *plus* military and federal government frequencies. Wow...what a scanner!
Included in our low CE price is a sturdy carrying case, earphone, battery charger/AC adapter, six AA *ni-cad* batteries and flexible antenna. Order your scanner now.

Bearcat® 210XW-GP

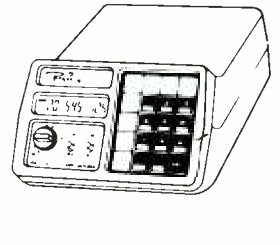
List price $339.95/**CE price $209.95/SPECIAL**
8-Band, 20 Channel • No-crystal scanner
Automatic Weather • Search/Scan • AC/DC
Frequency range: 30-50, 136-174, 406-512 MHz.
The new BearCat 210XW is an advanced third generation scanner with great performance at a low CE price.

NEW! Bearcat® 145XL-GP

List price $179.95/**CE price $102.95/SPECIAL**
10 Band, 16 channel • AC/DC • Instant Weather
Frequency range: 29-54, 136-174, 420-512 MHz.
The *Bearcat* 145XL makes a great first scanner. Its low cost and high performance lets you hear all the action with the touch of a key. Order your scanner from CE today.

TEST ANY SCANNER

Test any scanner purchased from **Communications Electronics**™ for 31 days before you decide to keep it. If for any reason you are not completely satisfied, return it in original condition with all parts in 31 days, for a prompt refund (less shipping/handling charges and rebate credits).



NEW! Bearcat® 800XLT-GP

List price $499.95/**CE price $317.95**
12-Band, 40 Channel • No-crystal scanner
Priority control • Search/Scan • AC/DC
Bands: 29-54, 118-174, 406-512, 806-912 MHz.
The Uniden 800XLT receives 40 channels in two banks. Scans 15 channels per second. Size 9¼" x 4½" x 12½."

OTHER RADIOS AND ACCESSORIES

Panasonic RF-2600-GP Shortwave receiver..... $179.95
RD95-GP *Uniden* Remote mount Radar Detector... $128.95
RD55-GP *Uniden* Visor mount Radar Detector..... $98.95
RD9-GP *Uniden* "Passport" size Radar Detector... $199.95
BC-WA-GP *Bearcat* Weather Alert™ $49.95
DX1000-GP *Bearcat* shortwave receiver **SALE**... $349.95
PC22-GP *Uniden* remote mount CB transceiver ... $99.95
PC55-GP *Uniden* mobile mount CB transceiver.... $59.95
R1060-GP *Regency* 10 channel scanner **SALE**.... $92.95
MX3000-GP *Regency* 30 channel scanner $229.95
XL156-GP *Regency* 10 channel scanner $139.95
UC102-GP *Regency* VHF 2 ch. 1 Watt transceiver ... $124.95
P1405-GP *Regency* 5 amp regulated power supply... $69.95
P1412-GP *Regency* 12 amp reg. power supply... $164.95
MA256-GP Drop-in charger for HX1200 & HX1500 ... $84.95
MA518-GP Wall charger for HX1500 scanner $14.95
MA516-GP Carrying case for HX1500 scanner.... $14.95
MA257-GP Cigarette lighter cord for HX12/1500 ... $19.95
MA917-GP Ni-Cad battery pack for HX1200....... $34.95
SMMX7000-GP Svc. man. for MX7000 & MX5000 ... $19.95
SMMX3000-GP Service man. for *Regency* MX3000 ... $19.95
B-4-GP 1.2 V AAA Ni-Cad batteries (set of four) $9.95
B-8-GP 1.2 V AA Ni-Cad batteries (set of eight) $17.95
FB-E-GP Frequency Directory for Eastern U.S.A..... $14.95
FB-W-GP Frequency Directory for Western U.S.A.... $14.95
ASD-GP Air Scan Directory $14.95
SRF-GP Survival Radio Frequency Directory....... $14.95
TSG-GP "Top Secret" Registry of U.S. Govt. Freq. ... $14.95
TIC-GP Techniques for Intercepting Comm. $14.95
RRF-GP Railroad frequency directory............. $14.95
CIE-GP Covert Intelligenct, Elect. Eavesdropping ... $14.95
A60-GP Magnet mount mobile scanner antenna... $35.95
A70-GP Base station scanner antenna $35.95
USAMM-GP Mag mount VHF/UHF ant. w/ 12' cable... $39.95
USAK-GP ¾" hole mount VHF/UHF ant. w/ 17' cable ... $35.95
USATLM-GP Trunk lip mount VHF/UHF antenna $35.95
Add $3.00 shipping for all *accessories* ordered at the same time.
Add $12.00 shipping per shortwave receiver.
Add $7.00 shipping per scanner and $3.00 per antenna.

BUY WITH CONFIDENCE

To ***get the fastest delivery from CE*** of any scanner, send or phone your order directly to our Scanner Distribution Center.™ Michigan residents please add 4% sales tax or supply your tax I.D. number. Written purchase orders are accepted from approved government agencies and most well rated firms at a 10% surcharge for net 10 billing. All sales are subject to availability, acceptance and verification. All sales on accessories are final. Prices, terms and specifications are subject to change without notice. All prices are in U.S. dollars. Out of stock items will be placed on backorder automatically unless CE is instructed differently. A $5.00 additional handling fee will be charged for all orders with a merchandise total under $50.00. Shipments are F.O.B. Ann Arbor, Michigan. No COD's. Most products that we sell have a manufacturer's warranty. Free copies of warranties on these products are available prior to purchase by writing to CE. Non-certified checks require bank clearance. Not responsible for typographical errors.

Mail orders to: Communications Electronics,™ Box 1045, Ann Arbor, Michigan 48106 U.S.A. Add $7.00 per scanner for R.P.S./U.P.S. *ground* shipping and handling in the continental U.S.A. For Canada, Puerto Rico, Hawaii, Alaska, or APO/FPO delivery, shipping charges are three times continental U.S. rates. If you have a Discover, Visa or Master Card, you may call and place a credit card order. Order toll-free in the U.S. Dial 800-USA-SCAN. In Canada, order toll-free by calling 800-221-3475. WUI Telex anytime, dial 671-0155. If you are outside the U.S. or in Michigan dial 313-973-8888. Order today.

Scanner Distribution Center™ and CE logos are trademarks of Communications Electronics Inc.
‡ *Bearcat* is a registered trademark of Uniden Corporation.
† *Regency* is a registered trademark of Regency Electronics Inc.
AD #070286-GP

For credit card orders call 1-800-USA-SCAN

COMMUNICATIONS ELECTRONICS INC.

Consumer Products Division
P.O. Box 1045 □ Ann Arbor, Michigan 48106-1045 U.S.A.
Call 800-USA-SCAN or outside U.S.A. 313-973-8888

CIRCLE 82 ON FREE INFORMATION CARD

An Experimenter's FM Transmitter

This tiny transmitter gets experimenters on the air license-free and offers many practical wireless uses

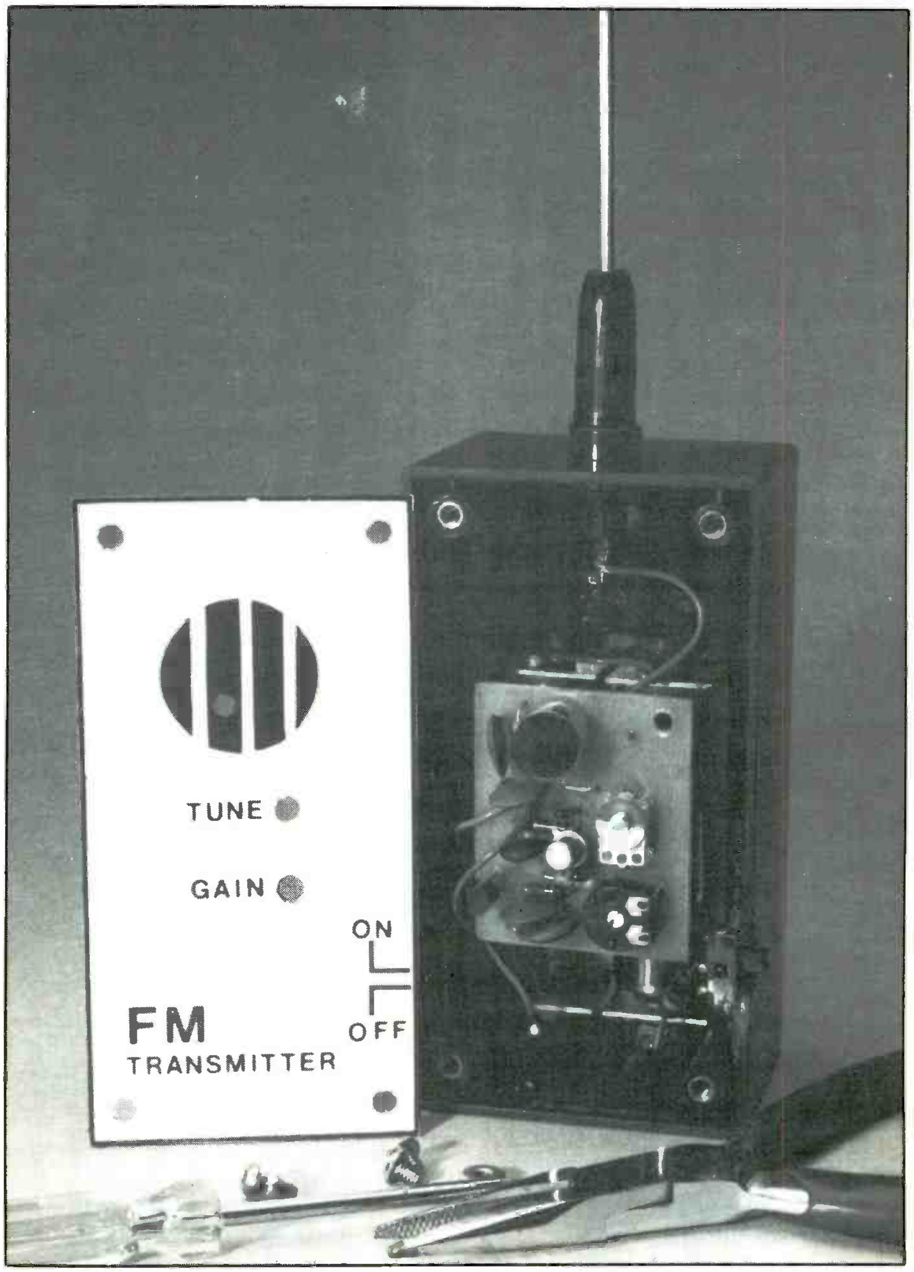
By Luther M. Stroud

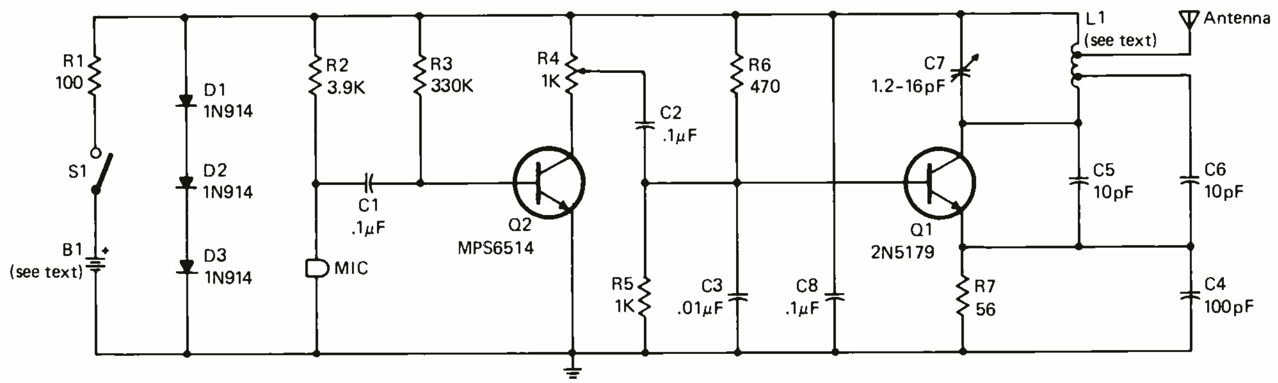
Need a one-way intercom or a device to listen for the ring of your telephone or the cry of an infant when you're outdoors or in a different room? Perhaps you could use another input to a public-address system without having to run more cables, or you'd like to listen to the news on TV or your hi-fi system without disturbing others in the same room. The Experimenter's FM Transmitter described here is designed to do all this and much more.

This license-free radio transmitter has a myriad of practical uses, yet it's short on cost and long on performance. It's also easy to build. The Experimenter's FM Transmitter can easily broadcast a clear signal 50 feet or more to an FM receiver.

About the Circuit

Referring to Fig. 1, sound enters the project through electret microphone *MIC*. Sound energy is converted to a varying dc voltage by a field-effect transistor inside the microphone. Resistor *R2* provides bias current, while capacitor *C1* couples the varying audio-frequency voltage from the microphone to *Q2*'s base. Current in *Q2*'s collector circuit is limited to 2 mA by *R4*, which sets the proper FM modulation level. The amplified signal from *Q2* is coupled to the base of *Q1* through *C2*.





PARTS LIST

B1—See text
C1,C2,C8—0.1-µF disc capacitor
C3—0.01-µF disc capacitor
C4—100-pF disc capacitor
C5,C6—10-pF disc capacitor
C7—1.2-to-16-pF trimmer capacitor
D1,D2,D3—1N914 diode
MIC—Electret microphone
Q1—2N5179 or MPS5179 transistor
Q2—MPS6514 transistor
(All resistors ¼-watt, 10% tolerance)
R1—100 ohms
R2—3,900 ohms
R3—330,000 ohms
R5—1,000 ohms
R6—470 ohms
R7—56 ohms
R4—1,000-ohm flat-mount pc trimmer potentiometer
S1—Miniature spst slide switch

Misc.—Printed-circuit board; suitable enclosure (all-metal or Radio Shack Cat. No. 270-230 plastic with metal panel or similar); stiff wire, banana jack and banana plug for antenna; dry-transfer lettering kit and clear spray acrylic for front panel (see text); miniature transfer jack (optional—see text); machine hardware; hookup wire; solder; etc.

Note: The following items are available from Pershing Technical Service, P.O. Box 1951, Ft. Worth, TX 76101: Etched and drilled pc board for $7.00; kit of all parts for pc assembly (does not include hardware, case, battery, antenna or front panel) for $15.00. Add $1.00 P&H per order. Texas residents, add 5% sales tax.

Fig. 1. Overall schematic diagram.

The *Q1* circuit is a Hartley oscillator in which *R5* and *R6* set up bias voltage and *C3* and *C8* bypass r-f to circuit ground. Feedback for oscillation is via *C6*. The oscillator's operating frequency is determined by the setting of *C7*, the inductance of coil *L1* and the base bias voltage of *Q1*.

FM modulation occurs when the audio signal from *Q2* is delivered to the base of *Q1*, which changes the internal base-to-emitter capacitance. The small amount of AM modulation also present presents no problem because the FM receiver with which the Transmitter is used normally rejects it.

All components for the transmitter were selected to provide the best performance with a very low supply voltage. Usable operation can be obtained with as little as 1 volt dc for battery *B1*. Use only the components specified in the Parts List to build this project. If you substitute components, poor performance or a project that fails to operate altogether may result.

For the more technically oriented reader, here are some particulars with regard to the transistors. The transistor specified for *Q1* easily oscillates as a result of its 1,000-MHz cutoff frequency and nearly 100 H_{fe} with 3 mA of collector current. The *Q2* transistor's H_{fe} is nearly 300 with only 2 mA of collector current.

Power for the transmitter can be as simple as a single 1.5-volt carbon-zinc AA cell. However, since operating frequency is determined partially by the supply voltage, it might be better to use a more expensive mercury cell for *B1*. A good compromise

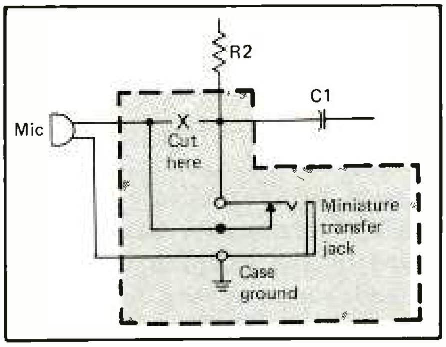


Fig. 2. An optional direct-signal cable-fed input circuit modification is shown in boxed area. When a cable is plugged into the transfer jack, the circuit to the microphone is broken.

in terms of cost, performance and operating stability would be to use a regulated supply. Two AA cells, with *R1* in place to limit current and the three forward-biased diodes (*D1*

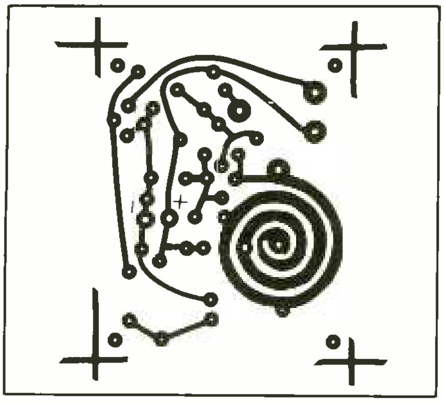


Fig. 3. Actual-size etching-and-drilling guide. Spiral pattern is a printed-circuit r-f inductor.

through *D3*) form a 1.8-volt regulated power source.

An option you might consider adding to the Experimenter's FM Transmitter is an external audio input jack in series with the microphone, as shown in Fig. 2. Use a transfer jack that disconnects the internal microphone when a direct-feed shielded cable is plugged in. If you use this modification, the project *must* be housed inside a metal box to provide shielding and a chassis ground for the cable. When using this modification, keep the input signal level down to a few millivolts to prevent overloads.

Construction

Though this is a very easy project to build, two cautions are in order, dictated by the high frequencies involved: you *must* use a high-quality G-10 epoxy-fiberglass printed-circuit board, and you must keep all component leads and wire lengths as short as possible.

You can fabricate the pc board from the actual-size etching-and-drilling guide shown in Fig. 3 or obtain a ready-to-wire board from the sources given in the Note at the bottom of the Parts List. In Fig. 3, note the spiral conductor pattern that obviates the need to wind a coil.

Wiring of the board, as shown in Fig. 4, starts with installation of the resistors, proceeds to the capacitors and finishes with the transistors. Leave 3/16″ of lead length between the bottoms of the transistor cases and the top of the board. Identify the transistor leads as follows: With the flats on the cases of the MPS5179 and MPS6514 facing upward and the leads pointing toward you, the emitter, base and collector are from left to right. With the tab on the metal case of the 2N5179 at the lower left and the leads pointing toward you, the base, collector and emitter are clockwise from the top. If you use a 2N5179, clip the "case" lead close to the bottom of the transistor's case prior to installation.

The "ground" terminal on the electret microphone connected to the metal case goes into the hole nearer the center of the board. Install short red, black and green insulated stranded wires in the B1+, B1– and ANTENNA holes, respectively, as shown in Fig. 4.

Connect and solder together *D1* through *D3* in a series chain. Keep the leads as short as possible at the joints. Carefully bend the array into an open-ended triangle. Trim the leads at opposite ends of the diode array to ½″ in length, and bend the remaining stubs in the same direction at a right angle to the bodies of the diodes 3/8″ from the ends. Plug the banded cathode lead into the – and the anode lead into the + holes on the *bottom* of the board. Solder both leads to their respective copper pads on the board. Clean away all solder flux from the board with alcohol or a flux solvent.

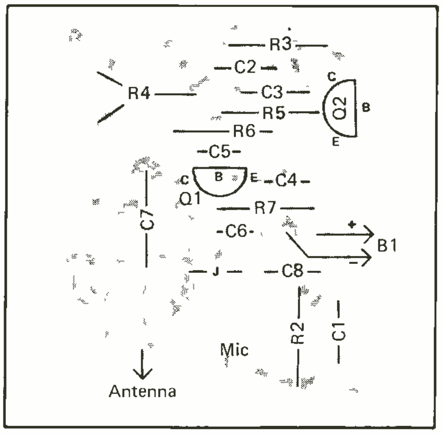


Fig. 4. Components-placement/orientation diagram. Note that the diodes mount on the bottom of the board and power switch S1 *mounts off the board.*

Use either an all-metal box (best choice) to house the Transmitter or one that has at least one metal panel (like the Radio Shack one specified in the Parts List.) Metal is necessary to offset most or all of the body capacitance that could affect frequency stability of the Transmitter when it is held in your hand.

Mark off and drill three 1/8″ or 3/16″ holes in the front panel to provide access to TUNE capacitor *C1* and GAIN potentiometer *R4* and to allow sound to enter the microphone before you mount the board. Make sure you accurately locate these holes. Then use a lettering kit (if you're using the Radio Shack box specified in the Parts List, cement a photocopy of Fig. 5) to label the front panel of the project. Protect the panel with two or more light coats of clear acrylic spray. Mount the board in place, using a 4-40 × ¾″ flathead machine screw, a nut and a ½″ spacer and sandwiching a ½″-square piece of acoustically transparent foam plastic between the panel and the front of the microphone.

Machine the box to accommodate the battery holder on the rear wall, the banana jack for the antenna on the top and the ON/OFF power switch on the right side. Also, if you've decided to use the optional external audio signal input feature, drill a hole for the transfer jack where installation won't interfere with any other part of the circuit. Mount these items in their respective locations. Then refer to Figs. 1, 2 and 3 and wire together the various elements. The ends of *R1* connect to one lug of *S1* and to the + lug of the battery holder. The red wire from the B1+ hole of the board goes to *S1*'s other lug.

Fabricate the antenna by soldering one end of a 6" to 10" length of stiff heavy-duty solid wire to a banana plug. With the power switch set to OFF, install the cell or cells in the battery holder, assemble the case and plug in the antenna.

Checkout and Use

Set the GAIN control to center of rotation and the TUNE capacitor to half-mesh. (Note that rotating GAIN control *R4* clockwise *reduces* gain, which is just the opposite action of most such controls.) Turn on your FM receiver and tune it to a quiet spot at the low end of the dial. Use the mono mode and no muting.

Turn on the FM Transmitter and slowly adjust its TUNE trimmer with a nonmetallic alignment tool until you hear feedback howl coming from the speakers. This tells you that the FM Transmitter's carrier frequency is close to that to which the FM receiver is tuned.

You may notice when tuning the Transmitter that local FM broadcast stations are heard when adjusting the TUNE capacitor. This is caused by the Transmitter's carrier overloading the receiver's local oscillator and mixing with the incoming broadcast station signals. If this occurs, either move the Transmitter farther away from your FM receiver or shorten the project's antenna. (I've used this effect as an FM sweep generator by feeding a sweep ramp voltage into the audio input and using the TUNE capacitor to adjust the center frequency. The sawtooth amplitude determines sweep width.)

As you tune the Transmitter, you may pick up the audio at more than one place on the FM dial. If this occurs, use the strongest signal location for operating the system. Built with the parts specified in the Parts List, the tuning range of the Experimenter's FM Transmitter should be between 88 and 95 MHz. Transmitting

Fig. 5. Actual-size front panel for specified Radio Shack chassis box.

range depends mostly on the quality of the receiver with which the project is used. Obviously, the better the quality, the greater the range.

Don't make the antenna longer than 10". If you do, the project may radiate more signal than the FCC legally permits. Also, the longer the antenna, the more loading on the oscillator, which causes shifts in frequency as body capacitance and other objects come near the antenna. A shorter antenna offers less range but more stability.

As mentioned earlier, an audio program can be broadcast by the Experimenter's FM Transmitter to a personal headphone receiver for private listening without disturbing others. Sound quality from an inexpensive portable tape recorder or TV receiver is very good when broadcast by the Transmitter and listened to through a good receiver. Just use the direct-feed cable and metal enclosure, and keep the input level down to a few millivolts. **ME**

A Solar Cell Converter

Steps up a low-voltage photovoltaic cell's output to power circuits from a single 1.2-volt Ni-Cd battery

By Dan Becker

Many circuits that use low-power ICs and transistors operate on 5 to 15 volts dc. A convenient way to power many such circuits is to use a single 1.2-volt nickel-cadmium cell that can be kept charged by a low-cost solar-cell arrangement. The dc-to-dc converter described here can do just that.

Elegantly simple, the converter provides the voltage step-up for applications where 6 to 12 volts or more, at low current drain, is required. Though circuit efficiency is only about 30 percent, the step-up feature, using a minimum of components, is all that is needed. Our converter is designed to power circuits that require up to 18 volts with a maximum current drain of only a few milliamperes.

Using a 1.2-volt, 400-milliampere source, the converter can provide 9 volts at 17 mA. It can also supply outputs of 12 volts at 12 mA and 18 volts at 1 mA. It can operate from as little as a 1- to as much as a 2.4-volt input. Since output voltage is proportional to input voltage, you can adjust as necessary for the demands of the load with which you use the converter project.

About the Circuit

Note in Fig. 1 that the circuit utilizes two high-beta transistors for *Q1* and *Q2*. Due to the low collector supply voltage and high emitter current required, there is no need for biasing resistors in this circuit. Transistor *Q1* and transformer *T1* are arranged to form an audio-frequency power oscillator whose frequency is about 8 kHz. The primary and secondary windings of *T1* establish the 180-degree phase reversal and open-loop gain necessary to maintain oscillation. Resistor *R1* sets collector current to a linear value.

Transistor *Q2* is operated as a class-B amplifier and, with transistor *Q1*, forms a Darlington circuit. During each cycle of oscillation, when *Q1*'s emitter current reaches peak, it drives *Q2* into saturation. This generates a large current spike in the primary of *T2*. Step-up action within *T2* causes a much higher voltage to appear across *T2*'s secondary. With no

PARTS LIST

B1—Nickel-cadmium cells (see text)
C1—100-μF, 35-volt electrolytic capacitor
D1—1N4001 rectifier diode
D2—5082-2800 hot-carrier diode (Hewlett Packard)
PC1 thru PCn—Photovoltaic cells (see text)
Q1,Q2—2N5089 transistor
T1,T2—Transformer (hand-wound with 36-gauge magnet wire and installed inside Amidon No. PC1107-77 or similar pot core; see text)
Misc.—Printed-circuit board or perforated board and soldering hardware; hookup wire; solder, etc.

Note: The following is available from Dan Becker, 101 Highland Dr., Chapel Hill, NC 27514: kit of all parts, including pc board, components and magnet and hookup wire for $15.95 plus $2.50 P&H.

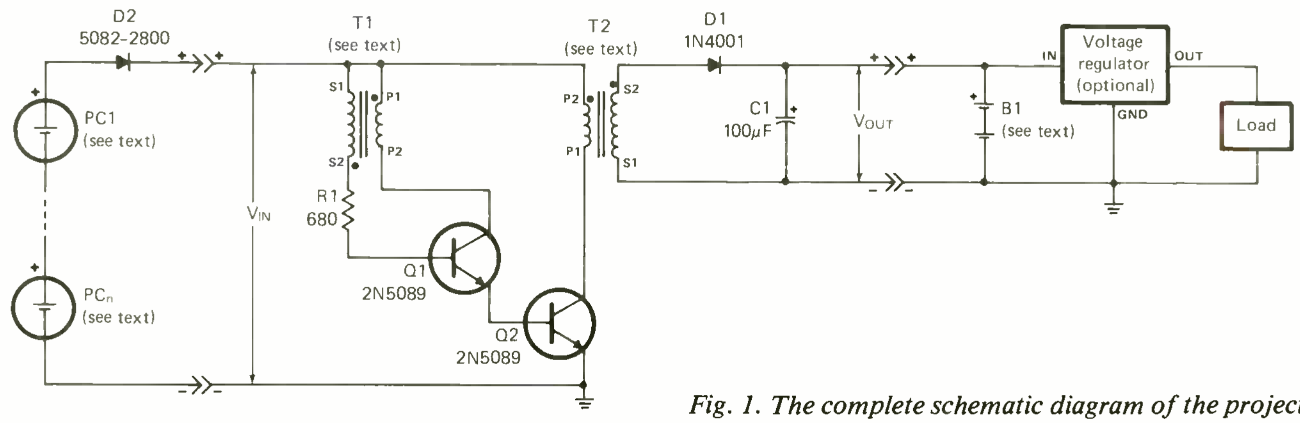


Fig. 1. The complete schematic diagram of the project.

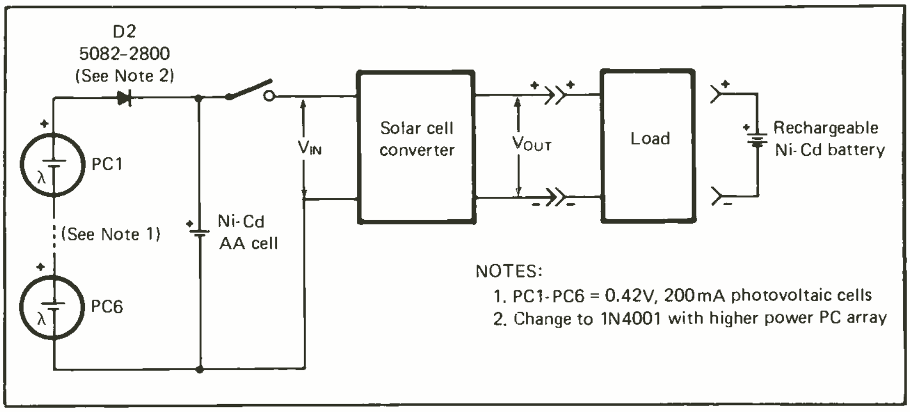


Fig. 2. A minimum of six 0.42-volt photovoltaic solar cells are required to recharge a single 1.2-volt nickel-cadmium cell.

load connected across the circuit's V_{out} terminals, *C1* will charge to about 20 volts. Diode *D1* and capacitor *C1* rectify and filter the high-voltage pulses coming from the secondary winding of *T2*.

Figure 2 illustrates the minimum number of 0.42-volt photovoltaic cells required to charge a single 1.2-volt Ni-Cd AA cell. The Hewlett Packard 5082-2800 diode specified for *D2* is a hot carrier type. This type of diode has a much lower forward-voltage drop, typically on the order of 0.34 volt, than the common silicon 1N4001 type rectifier that drops about 1 volt. Maximum forward current for the 5082-2800 should not exceed about 350 mA.

Aside from supplying power directly to the load, the converter can also be used to charge a higher-voltage Ni-Cd battery connected across its output as illustrated by the battery at the right in the drawing. Used in this manner, the circuit and battery both contribute power to the load.

How a solar-cell source, indicated by the circled V, can be used to power a load, optionally with a rechargeable battery, is illustrated in Fig. 3. Three 0.42-volt, 200-mA photovoltaic cells in series will recharge a 7.2-volt Ni-Cd battery in 16 to 20 hours of full sun. Used in this manner, a 1N4001 blocking diode is required in series with the rechargeable battery to prevent the battery's voltage from feeding back into the converter and damaging the solar cells.

Accompanying Fig. 3 is a table that lists the various output voltages and currents that can be expected from the converter with different V inputs. As you can see, the device used to supply input power to the converter can be either photovoltaic cells or a chemical cell. The latter can be an Ni-Cd cell, a mercury cell or any other type of chemical cell.

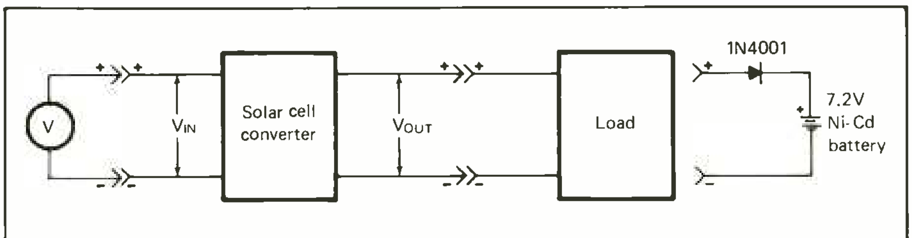
Construction

The circuit is small enough to be hard wired on a 2″-square piece of perforated board, using appropriate soldering hardware. For a more professional appearance, you might want to use a printed-circuit board. You can fabricate a pc board using the actual-size etching-and-drilling guide shown in Fig. 4, or you can purchase a pc board ready for wiring from the source given in the Parts List Note.

Whichever method of wiring you decide upon, install the capacitor, diode, resistor and two transistors on the board exactly as shown in Fig. 5. Make sure that you orient *D1, Q1* and *Q2* as shown and that the polarity of *C1* is correct before soldering the leads of these components to the pads on the bottom of the board.

Next, wind identical transformers *T1* and *T2*. To make *T1*, remove the plastic bobbin from the pot core and place it on a pencil or thin wooden dowel. Using No. 36 magnet wire, wind 16 turns for the primary and 230 turns to for the secondary, leaving 4″ extra wire at each end of each winding. Wind the secondary and primary in the *same* direction. Attach labels with the legends S1 and S2 to the beginning and ending, respectively, of the secondary winding and P1 and P2, to the beginning and ending, respectively, of the primary.

Place the wound bobbin in the pot core and sandwich the two halves of the core together. Make sure that each of the four wires exits freely through the openings in the pot core. Temporarily insert the nylon screw



Source (V)	Typical Output
Three 0.42-volt, 200-mA solar cells in series	18 volts at no load 12 volts at 5 mA 6 volts at 8 mA
One 1.2-volt Ni-Cd cell	18 volts at 1 mA 12 volts are 12 mA
Two 1.2-volt Ni-Cd cells in series	22 volts at 22 mA
Two size N 1.5-volt alkaline in series	20 volts at 20 mA

Fig. 3. The voltage and current available at the output of the converter is determined by the voltage applied to the input and type of device used.

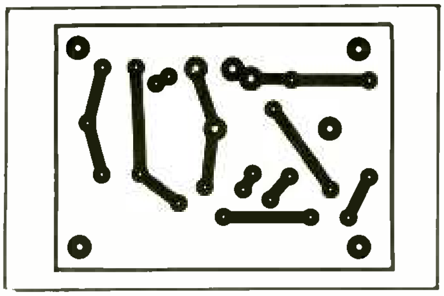


Fig. 4. Actual-size etching-and-drilling guide to use to fabricate a printed-circuit board for the project.

through the hole in the core and fasten with the nut.

Repeat the above for *T2*.

Position each transformer over its respective mounting location on the board, measure the lead lengths needed to wire them into place and trim the leads to length. (Make sure you do not cut off the identifying labels, and identify the transformers as *T1* and *T2* according to how the leads have been trimmed.) Scrape away ¼" of insulation from all four lead lengths on both transformers and tin the exposed metal with solder.

Holding the pot core to prevent it from coming apart, remove the nut from *T2* and physically mount this transformer in the proper location on the board. Use the nut to anchor it into place. Route the leads to the appropriate holes and solder them to the copper pads. Repeat the procedure for *T1*.

Figure 6 illustrates a simple, reliable means for mounting the photovoltaic cells.

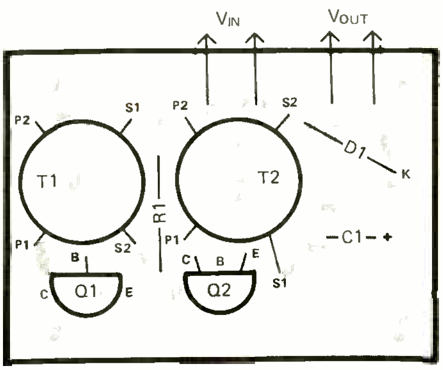


Fig. 5. Installation details for the components on the board. Take care to properly polarize and/or orient the capacitor, diode and transistors. Use color-coded wires for connections to the solar cells and rechargeable Ni-Cd cell(s).

It is important that you minimize unnecessary voltage (IR) drops between the circuit and the Ni-Cd cell. Because the peak current is high, the two wires that interconnect the Ni-Cd cell and the circuit board should be short lengths of No. 22 or 20 hookup wire.

Checkout and Use

Temporarily connect a 1,000-ohm resistor to the output terminals of the Converter and a dc voltmeter set to measure 15 to 20 volts across the resistor. Now connect a 1.2- or 1.5-volt cell to the input terminals of the Converter and note that the meter immediately registers about 12 volts. (If a regulated output is required, a low-power voltage regulator, such as the Intersil ICL7663, can be used.)

When solar power is desired, the Converter provides considerable versatility. For example, six 0.4-volt photovoltaic cells connected in series with a blocking diode, as in Fig. 3, can be used to maintain the charge on a single 1.2-volt Ni-Cd cell. The converter output is then connected to recharge a small 9- or 12-volt battery. This system will then provide periodic operation at a higher voltage. Alternatively, low-voltage solar array can directly power the Converter, providing continuous daytime operation of a higher-voltage circuit.

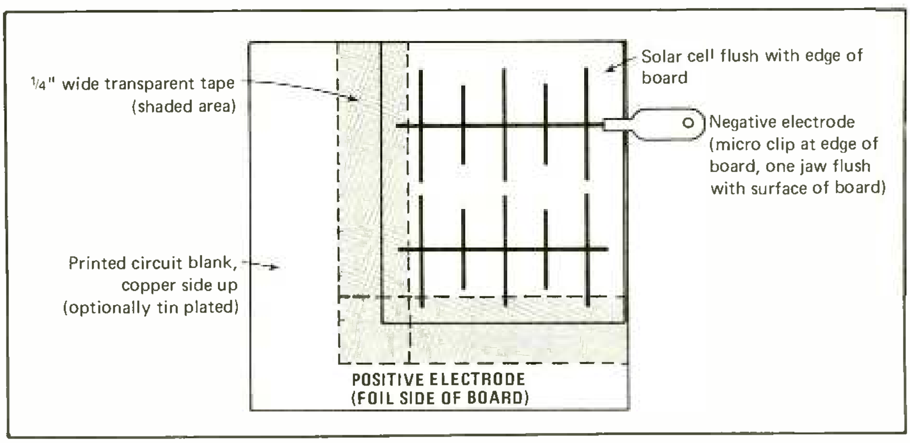


Fig. 6. Mounting details for the photovoltaic solar cells on a printed-circuit board blank.

NEW **NEW** **NEW**

$395.00 128K Apple $395.00 Compatible Computer

The moment you buy it the Laser 128 computer is compatible with virtually all software for the Apple® II, Apple® IIe, and Apple® IIc. All the equipment is here. Plus the Laser 128 gives you the features Apple® forgot.

• 5¼" Disk Drive • Additional Disk Drive Interface • Serial Printer Interface • Parallel Printer Interface • Modem Interface • RGB 80 Column Color Interface • Mouse Interface • Hi-Res Graphics • 32K Rom • 128K RAM • Expansion Slot for Apple® Peripheral cards • Battery Pack Interface • Numeric Keypad • Programable Function keys • Carrying Handle

Limited time only

*Free Magic Window IIe Professional Word processor ($149.95 Value)

*with Laser 128 Purchase

$395.00 **$395.00**

Comparably priced Apple® IIe system **$1500.00**

Comparably priced Commodore® 128 system **$850.00**

•Home

•Business

•Students

•90 Day Warranty

•15 Day Free Trial

This is the best computer buy in the U.S.A. You get the complete Laser 128 computer with all the features shown, Plus for a limited time only, you get the Professional Magic Window IIe Wordprocessor all for only $395.00. We have tested this machine with over 500 software titles from our comprehensive catalog and the Laser 128 runs them all perfectly. (it even runs Appleworks®) This is a must buy for new and old computer buyers. List $648.95. **Sale $395.00.**

	List	Sale
Centronics cable (for Centronics Printer)	$ 29.95	$ 19.95
Serial Cable (for Modem hookup)	$ 34.95	$ 19.95
9" 80 Column Hi-Res Green Monitor	$199.00	$ 59.95

Accessories	List	Sale
2nd Disk Drive	$299.95	$129.95
Professional Analog Joystick	$ 39.95	$ 19.95
RGB cable (RGB Monitor hookup)	$ 24.95	$ 19.95

Apple and Commodore are registered trademarks of Apple Computer Inc. and Commodore Business Machines Inc. respectively

Add $10.00 for shipping, handling, and insurance. Illinois residents please add 6¼ % sales tax. Add 20.00 for CANADA, PUERTO RICO, HAWAII, ALASKA, APO-FPO orders. All orders must be in U.S. Dollars. WE DO NOT EXPORT TO OTHER COUNTRIES EXCEPT CANADA. Enclose Cashier Check, Money Order or Personal Check. Allow 14 days for delivery, 2 to 7 days for phone orders, 1 day express mail. Prices & Availability subject to change without notice.
VISA — MASTER CARD — C.O.D. C.O.D. on phone orders only.

Computer Direct

We Love Our Customers
22292 N. Pepper Rd., Barrington, Illinois 60010
312/382-5244 to order

An RS-232C Breakout Box

Use this device to isolate and solve serial interface problems

By Cass Lewart

Most problems that occur when you try to establish a serial interface are due to incorrect polarities, incorrect baud rates, broken leads or incorrectly configured equipment. Part of the difficulty has to do with the so-called RS-232C serial interface "standard" that leaves equipment manufacturers free to design their interfaces according to their own standard (see "The Ambiguous Standard" box), which many frequently do. For these occasions, an excellent and simple diagnostic tool that will help you find what is wrong with a serial connection that fails to achieve communication and correct the problem is a device known as a breakout box.

The breakout box is equipped with a male DB-25 connector at one end and a female DB-25 connector at the other end. This arrangement allows it to plug in series directly between the computer and any serial device, such as a printer, a modem, a mouse, etc. It then provides a simple means for checking voltages on each line in the interface cable and for swapping pin connections where necessary.

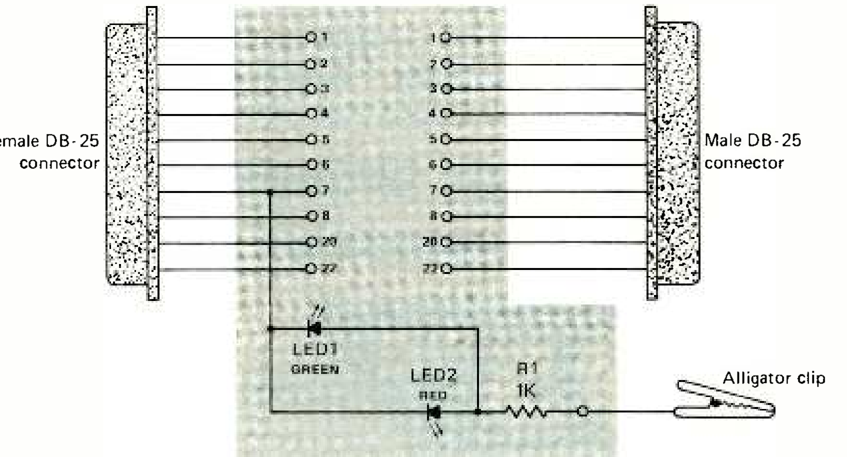
Though commercial breakout boxes can cost $100 or more, you can build a simple version, like the one described here for $20 or so, depending on how fancy you want to get with the packaging.

About the Circuit

Shown in Fig. 1 is the circuit for the breakout box. This simple circuit itself consists basically of a number of connection points, two short lengths of ribbon cable terminated in DB-25 connectors and a pair of LEDs with a current-limiting resistor (*R1*). Each line between the DB-25 connectors is completed with a jumper wire as needed by a given application.

As shown, this simple breakout box uses only pins 1 through 8, 20 and 22. Most devices—such as modems, printers and power controllers—use only a subset of these 10 pins. However, if your specific device requires other pins as well, you can easily expand the box to include up to the full 25 contacts possible with the DB-25 interface connector.

Green and red light-emitting diodes *LED1* and *LED2* provide a convenient means for checking the polarities of the voltages on the various pins. With the breakout box connected between two computers or between a computer and a serial peripheral or device, you simply touch the alligator clip connected to the LEDs to the contacts and observe which color LED lights. Resistor *R1* serves as a current limiter to prevent



PARTS LIST

LED1—Green light-emitting diode
LED2—Red light-emitting diode
R1—1,000-ohm, ¼-watt, 10% tolerance resistor
Misc.*—Perforated G-10 unclad epoxy-fiberglass board; spring-loaded standoffs; ribbon cable and male and female solder-type DB-25 connectors (or prepared cable terminated with male or female DB-25 connectors at opposite ends—see text); miniature alligator clip; solder post; hot-melt glue or silicone adhesive; machine screws (4); threaded 1" spacers (4); rubber feet (4); stranded and solid hookup wire; solder; etc.

*Because of the flexibility in construction, items mentioned here are for the most basic version of the project. The text gives details on substitutions and additions you can use to make the project more suitable to your needs.

Fig. 1. Overall schematic diagram of basic project. Jumper wires interconnect numbered points to complete circuit between the two DB-25 connectors.

the LEDs from being damaged by voltages higher than their designed 1.5 volts.

Any line on which there is a positive voltage (on condition) causes *LED1* to light. Conversely, any line on which there is a negative voltage (off condition) causes *LED2* to light. Touching the alligator clip to Transmitted Data contact line 2 or Received Data contact 3 causes both LEDs to light. (See the Table for the standard functions of each line.) With a little practice, you should be able to judge the approximate baud rate—300, 600 or 1200—by observing the LEDs.

Figure 2 shows the most basic arrangement for a breakout box. One way you can relatively inexpensively improve on the breakout box's versatility is to give it a gender changing capability. To do this, you simply add a male DB-25 connector in parallel with the female connector and a female DB-25 in parallel with the male connector. Doing this gives you every possible combination of connections you are likely to encounter.

The breakout box allows you to "rewire" the interface cable to allow you to make incompatible devices communicate with each other. One common use is for you to configure a "null modem," as shown in Fig. 2. The null modem is required if you wish to reconfigure a DCE to a DTE device or vice-versa. You need a null modem to connect one computer to another to exchange files.

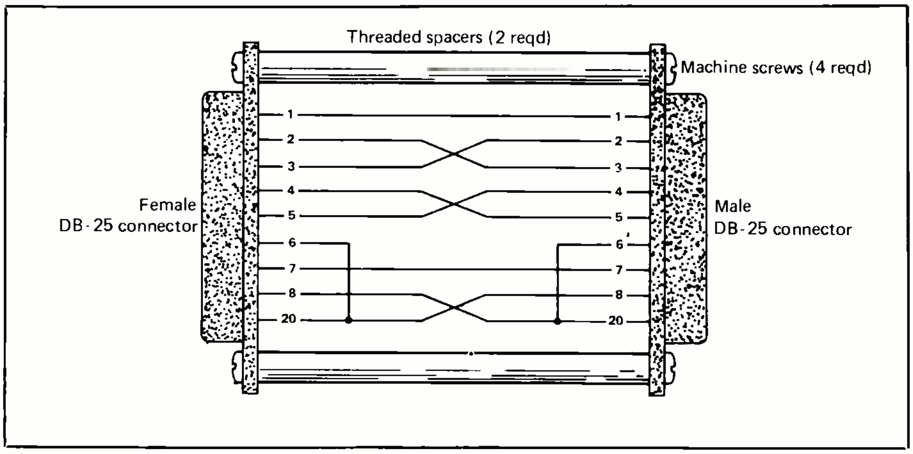


Fig. 2. Typical example of what the breakout box can be used to do. This is the "null modem" configuration required to interconnect two computers.

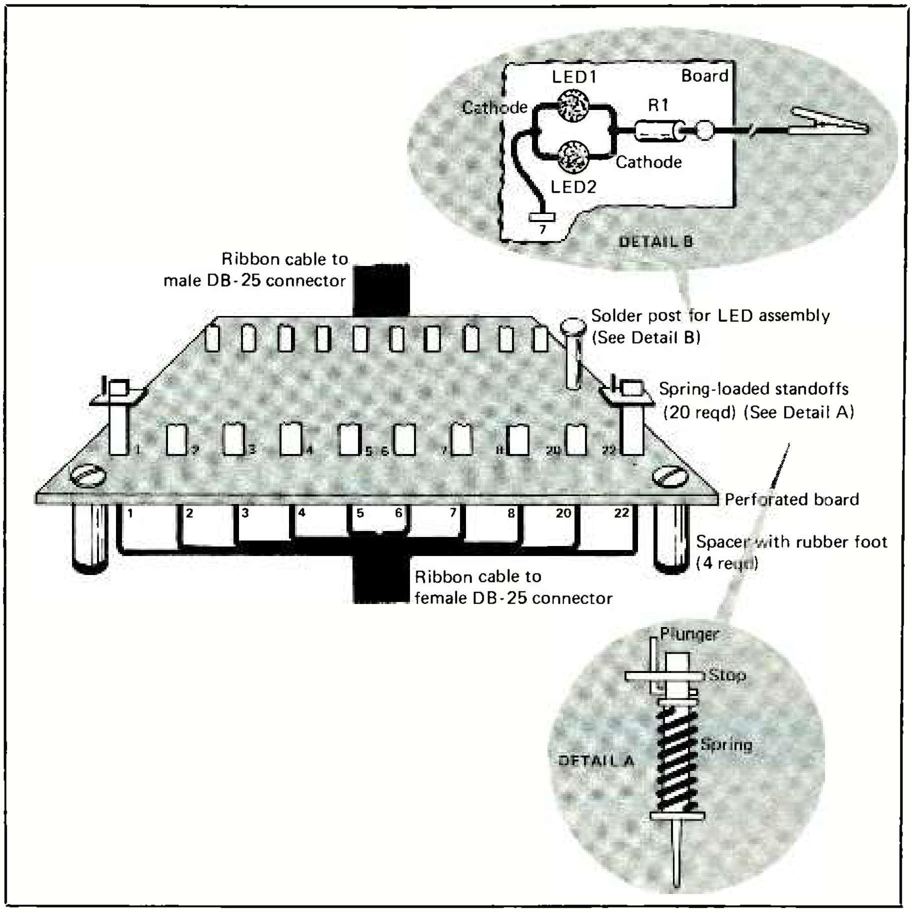


Fig. 3. Assembly details for the most basic version of project. Other parts can be substituted to suit particular applications as needed.

Construction

There are no hard and fast rules for building the breakout box. In fact, depending on your needs and/or desires, you have a number of options open. The simplest and least expensive approach would be to use the arrangement shown in Fig. 3.

To make this version, you need a piece of unclad G-10 epoxy-fiberglass perforated board. Do not use paper-phenolic board, which easily cracks and splits when pressure is applied to it. Plug into the holes in the board as many spring-loaded standoffs (pictured in Detail A) as needed and connect and solder the ribbon cables to the solder tails on the standoffs on the bottom of the board.

At the other ends of the cables

The Ambiguous Standard

The serial interface is a common means of connecting personal computers to each other and to modems, printers, power controllers and other devices. As a standard, however, it leaves a lot to be desired. When it was first developed, by the Electronics Industries Association (EIA) back in 1969, the so-called RS-232 serial interface "standard" filled the needs of the then current state of affairs in computing. In light of today's needs, however, the RS-232C standard is ambiguous.

Though most—but not all—serial devices use 25-pin male or female DB-25-type connectors, the actual type of connector is not specified in the standard. And while the standard calls for a 25-pin connector to be used, it assigns specific functions to only 22 pins, leaving three pins for the designer to use as he sees fit. To add further to the confusion, the standard refers to Data Terminal Equipment (DTE) and Data Communication Equipment (DCE). This designation is fine if a terminal (DTE) is always connected to a modem (DCE), but how should a terminal connected to a computer and a modem be designated? Here, it can be considered as a DCE or a DTE device.

The RS-232C standard is not totally ambiguous, however. It adequately describes a few things, namely the electrical characteristics of the data and control signals. According to the standard, data signals must be −3 to −15 volts for the "mark" and +3 to +15 volts for the "space." On control lines, then, positive voltages mean "on" and negative voltages mean "off." However, anything between −3 and +3 volts is not defined.

From the foregoing, you are probably wondering how any serial device could properly communicate with a computer. Sometimes they do and sometimes they do not. When they do not, perhaps the best troubleshooting aid you can have is a breakout box. This handy device gives access to each of the lines in the serial cable without requiring the cable to be cut into.

There are many different configurations of expensive breakout boxes available commercially. However, the one described in the main article is simple, inexpensive to build and does the job a breakout box should do—without fanfare or the special functions that add to the cost of the commercial units.

Pin Designation on the Break-out Box

Pin No.	Designation	Abbrev.	Signal Direction
1	Protected Ground	PG	
2	Transmitted Data	TD	DTE to DCE
3	Received Data	RD	DCE to DTE
4	Request to Send	RTS	DTE to DCE
5	Clear to Send	CTS	DCE to DTE
6	Data Set Ready	DSR	DCE to DTE
7	Signal Ground	SG	
8	Received Line Signal Detector	RLSD	DCE to DTE
20	Data Terminal Ready	DTR	DTE to DCE
22	Ring Indicator	RI	DCE to DTE

solder the individual conductors to the appropriate DB-25 connector pins. Be careful to avoid creating solder bridges between the closely spaced pins, and use soldering heat judiciously to prevent charring the insulation.

Connect and solder together the LEDs as shown in Detail B. Then connect and solder one lead of *R1* to the indicated LED junction and connect the other lead of the resistor to the pin-type solder post. Remove ¼″ of insulation from both ends of a 5″ length of stranded hookup wire. Tightly twist together the fine wires at each end and lightly tin with solder. Connect and solder a miniature alligator clip to one end of this wire. Then connect and solder the other end to the pin-type solder post, making sure you also solder the resistor lead to the post.

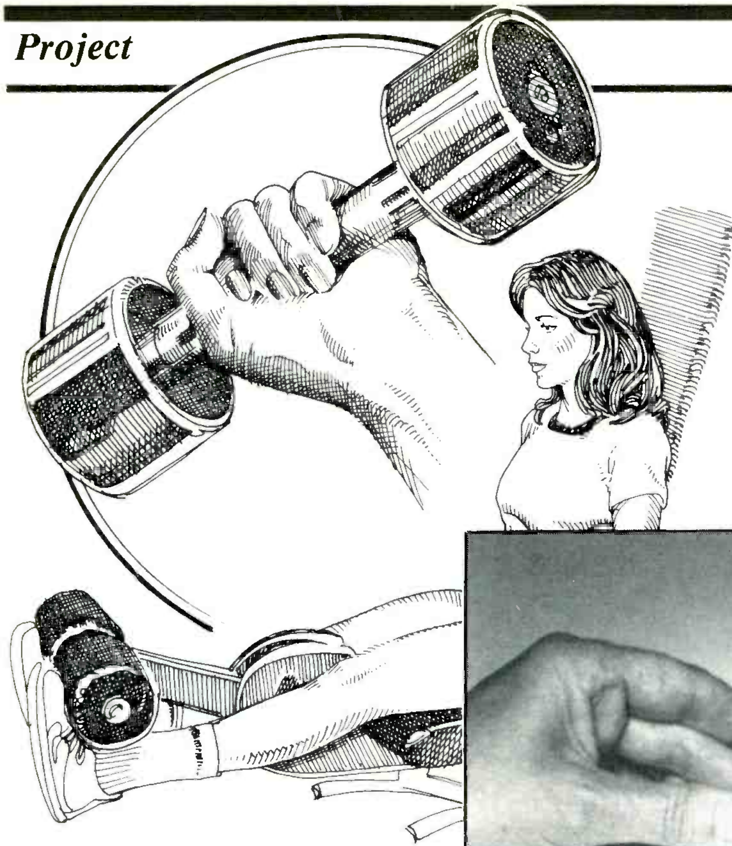
Remove ¼″ of insulation from both ends of a 2″ length of hookup wire and connect and solder this between the other junction of *LED1* and *LED2* and the standoff to which line 7 of the cable is connected.

It is a good idea to label each of the standoffs with its appropriate connector pin line number. Also, you might want to secure the cables to the bottom of the board with hot-melt glue or silicone adhesive. This will prevent the conductor wires from breaking loose as you handle the project. Finish up by attaching threaded spacers with rubber feet to each of the four corners of the board with machine screws.

Here is a neat construction hint. To save on soldering effort, you can use an inexpensive serial cable (available for about $10 at computer fairs). Simply cut the cable in half and connect the wires corresponding to pins 1 through 8, 20 and 22 (and any of the rest you might want to add to your project) to the standoffs. This way, you will not have to laboriously solder individual ribbon cable conductors to the closely spaced solder cups on the DB-25 connectors and run the risk of shorting out adjacent pins with solder bridges or charring insulation.

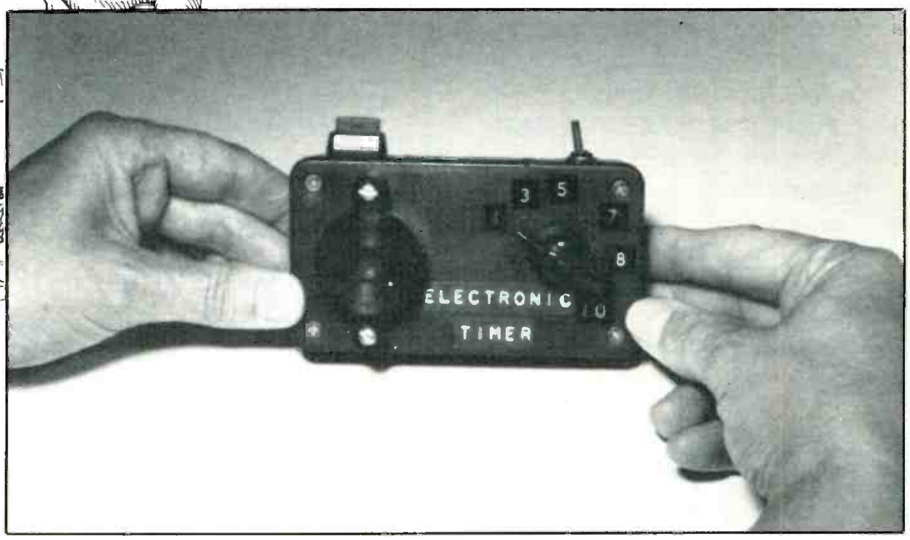
Finally, prepare as many 3″ lengths of stranded hookup wires as you need for the jumpers as follows. Strip ¼″ of insulation from both ends of each wire. Tightly twist together the fine wires at each end of each wire and lightly tin with solder. Then connect a wire from standoff 1 on the female side to standoff 1 on the male side of the project. To do this, gently press down on the standoffs, insert the wire in the gap between the underside of the stop and plunger arm, and release the standoff. The wire will be held firmly in place. Repeat for all standoff pairs.

The project is now ready to be put into service. However, if you wish, you can get a bit fancy by placing the board inside a plastic box. Make sure the box has a flip top that gives you complete access to all standoffs and the wire with the alligator clip, however. If you go this route, you can even use a solderless breadboarding socket in place of the perforated board and standoffs—as long as you solidly anchor the ribbon cables to the box so that they can not pull loose from the socket. A 2-lug terminal strip can then be used for the LED, current-limiting resistor and alligator-clip/cable arrangement. ME



Electronic Exercise Timer

Useful circuit uses omnipresent 555 timer IC



By Homer L. Davidson

If you're into physical fitness or must perform therapeutic exercises, the Electronic Exercise Timer described here is just what the doctor ordered. With it, you can time each of the exercises in your fitness or therapy program for the required length of time without having to watch a clock or to count silently. Using the timer, you just dial in the period of time you need, from 1 to 10 minutes, turn on the power and tap another switch to get things started. From then on, you perform your exercise until a high-pitched beep alerts you to the end of the time period you chose.

How It Works

Shown in Fig. 1 is the schematic diagram of the Electronic Exercise Timer. Countdown timing is accomplished with 555 timer *IC1*, whose period is determined by the RC time constant of *R2, R3* and *C1*. Because *R3* is a potentiometer, different timing periods can be selected. Once a timing cycle is initiated, *IC1* automatically counts down. A timing cycle can be stopped and restarted at any time during the countdown cycle by pressing and releasing START switch *S2*.

At the end of the timing cycle, a piercing sound is emitted by piezoelectric buzzer *P1*. The buzzer continues to sound until power from the battery is interrupted by opening *S1*. Also, each time *S1* is closed, *P1* sounds until a timing cycle is started by pressing and releasing *S2*.

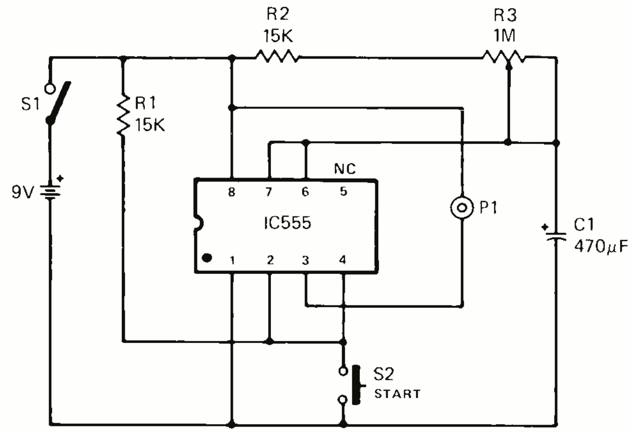
Power for the project is provided by a 9-volt battery. The timer draws only 2.7 mA during the countdown cycle and only about 9.7 mA at full load when *P1* is on. Hence, the battery should last a long time, even if the project is used every day.

Construction

Owing to the simplicity of the circuitry, you can easily wire the project's electronics on a small piece of perforated board whose holes are on 0.1″ centers. The only soldering hardware needed is a socket for *IC1*. If you wish, you can design and fabricate a small printed-circuit board that you can use in place of perforated board.

Components that mount on the board are *C1, IC1* (in a socket), *R1* and *R2*. Mount these components and interconnect them according to Fig. 1. Make certain you properly wire to the pins of *IC1, C1* is properly polarized, and that the battery connector leads go to the correct points in the circuit.

Select a suitable size plastic or metal box in which to house the Exercise Timer (see Parts List). The box should be large enough for convenient handling and to accommodate the delay control and switches



PARTS LIST

C1—470-µF, 16-volt electrolytic capacitor
IC1—555 timer
P1—4.7-kHz piezoelectric buzzer (Radio Shack Cat. No. 272-957 or similar)
R1,R2—15,000-ohm, 1-watt resistor
R3—1-megohm, linear-taper potentiometer
S1—Spst miniature toggle switch
S2—Spst normally-open, momentary-action, soft-touch pushbutton switch

Misc.—Suitable enclosure (such as Radio Shack Cat. No. 270-221 4.4″ × 2.44″ × 1.06″ project case); 9-volt battery and snap connector; 8-pin DIP IC socket; pointer-type control knob; machine hardware; lettering kit; hookup wire; solder; etc.

Fig. 1. Schematic diagram of project.

without interfering with each other or the internal circuitry. Locate the potentiometer and piezoelectric buzzer on the front panel and the switches on the top of the box.

Calibration and Use

All you need for calibration is a timing device that reads out accurately in minutes and seconds. A stopwatch or a digital watch with stopwatch/timer function will do fine.

Begin calibration by setting potentiometer *R3* to its fully counterclockwise postion. Then rotate *R3*'s control knob clockwise a quarter-turn and set *S1* to on. Observing the timing device you are using for calibration, press and release START switch *S2* to begin the timing cycle. If the buzzer sounds before 60 seconds are up, slightly adjust *R3*'s control knob clockwise and initiate the timing cycle once more while again observing the timing device. Continue trimming *R3*'s setting and reinitiating the timing cycle until the buzzer sounds at the end of 60 seconds. Mark the position of the knob's pointer on the project's panel.

To calibrate for a 3-minute interval, start by turning off the project and waiting a couple of minutes. then rotate *R3*'s knob another quarter-turn clockwise (a half-turn from the fully counterclockwise position) and repeat the calibration procedure detailed above.

Continue calibrating for other timing periods, finishing up with a 10-minute position at or near full-clockwise rotation of *R3*'s control knob. If you do not obtain a full 10-minute countdown cycle at full-clockwise rotation, it may be necessary to replace *R3* with a higher-value potentiometer, in which case you will have to redo calibration from the start.

Keep in mind that the last few timing periods may not be as accurate as the first five minutes. Actual timing accuracy may depend on a number of factors, including choice of components and room temperature. However, the accuracy of this handy Exercise Timer is more than adequate for exercises and game timing.

After you've marked the pointer location for each timing period on the project's panel, use a lettering kit to label the positions and the functions of the switches. A tape labeler (see lead photo) is one way to go. Its adhesive-backed lettering is very durable. Alternatively, you can use dry-transfer lettering, protecting it with three or four *light* coats of clear acrylic spray. **ME**

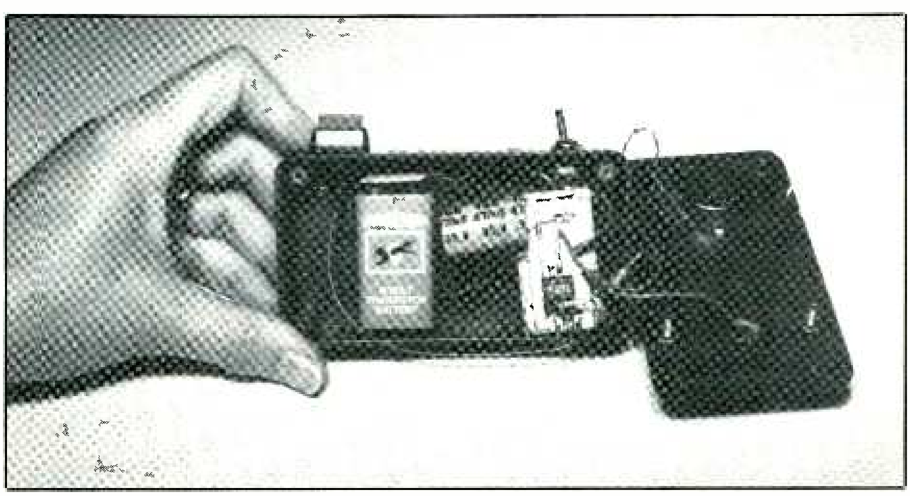


Fig. 2. Prototype of project was assembled on a printed-circuit board.

ELECTRONICS NOTEBOOK

Experimenting With the Power MOSFET

By Forrest M. Mims III

Ten years ago, a new kind of power transistor slowly began to invade the traditional territory of the bipolar power transistor. Though the invader was known by many names, circuit builders experienced in the use of MOS field-effect transistors (MOSFETs) immediately recognized the new power transistors as a new kind of MOSFET.

A good deal of time has been required for the power MOSFET to become fully accepted as the highly versatile component it is. Early devices were unreliable, and several years were required for competing semiconductor companies to develop new and better varieties of power MOSFETs. Today, the power MOSFET is fully accepted into the family of semiconductor components.

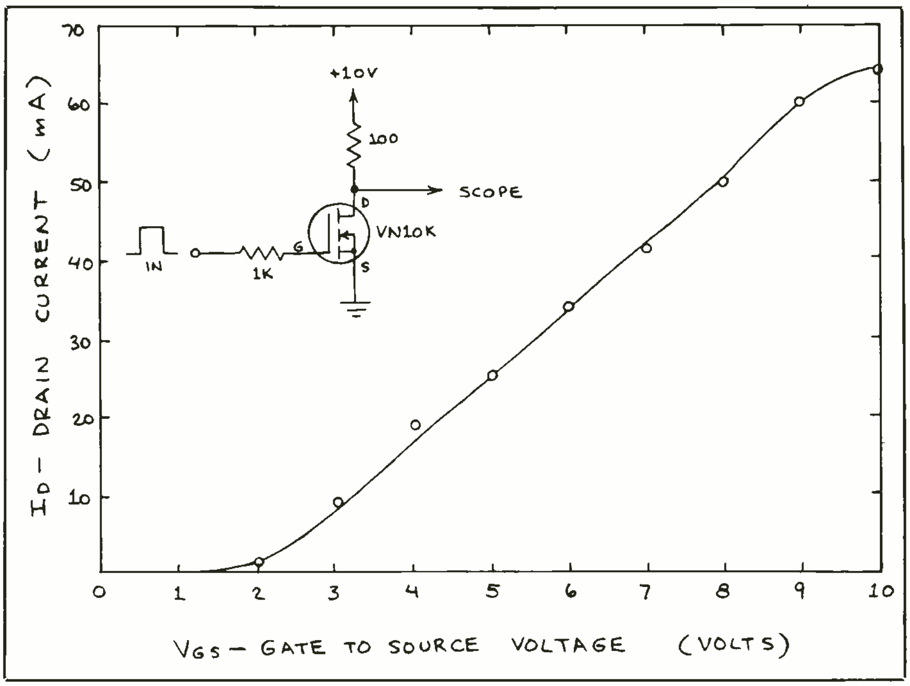


Fig. 1. Measured I_D versus V_{GS} for the VN10K power MOSFET.

Power MOSFET Basics

Conventional MOSFET transistors can be connected in parallel for increased current-handling capability. Power MOSFETs contain a single silicon chip upon which have been formed hundreds of individual parallel-connected transistors. Some power MOSFETs employ a 3-dimensional geometry wherein the active regions of each transistor are recessed in the chip. This increases the available surface area of the chip and, hence, the density of individual transistors that can be fabricated on a single chip.

A significant difference between the conventional MOSFETs and power MOSFETs is the direction of current flow. In a conventional MOSFET current flows laterally (across the chip surface). In a power MOSFET, current flows vertically through the chip. Since this results in a substantially shorter current path, switching speed is much faster and on resistance is much lower. Moreover, removing heat from the chip is simplified, since the bottom of the chip serves as the device's drain.

These are the reasons why the power MOSFET structure can be used to switch much higher currents than conventional MOSFETs. Indeed, the on resistance of a power MOSFET can be as little as a few tenths of an ohm. Power MOSFETs also have important advantages over bipolar power transistors.

Advantages and Disadvantages

Now that power MOSFETs are so readily available, it is important to understand their advantages over conventional bipolar power transistors. Chief among these are:

(1.) Like conventional MOSFETs, power MOSFETs have a very-high input impedance and operate from relatively low voltages. This makes them easy to drive and interface.

(2.) The on resistance of a power MOSFET can be as little as a few tenths of an ohm.

(3.) Power MOSFETs have nanosecond switching speeds.

(4.) The source-drain current of a power MOSFET decreases as the temperature of the chip rises, making power MOSFETs more thermally stable than bipolar power transistors.

(5.) Power MOSFETs can be easily connected in parallel to increase current-handling capability and to reduce on resistance.

(6.) Depending on the device, power MOSFETs can switch up to hundreds of volts and tens of amperes.

(7.) Power MOSFETs can be operated as digital switches and linear amplifiers.

With all their advantages, it's logical to wonder why power MOSFETs have not completely supplanted bipolar power transistors. One reason is that time is required for designers to become familiar with and gain confidence in a new device. The other is that the many advantages of power MOSFETs are tempered by several disadvantages:

(1.) If a fast-rising voltage is applied from the drain to the source of a power MOSFET, the device may turn on even though a gate signal is not present, a phenomenon that can destroy the transistor.

(2.) Because power MOSFETs can switch on very rapidly, under certain conditions they are susceptible to self-induced high-frequency oscillation.

(3.) Like all MOS devices, power MOSFETs require special handling to prevent damage from electrostatic discharge.

(4.) The manufacture of power MOSFETs requires more processing steps than bipolar transistors.

Handling Precautions

Handling precautions normally applied to

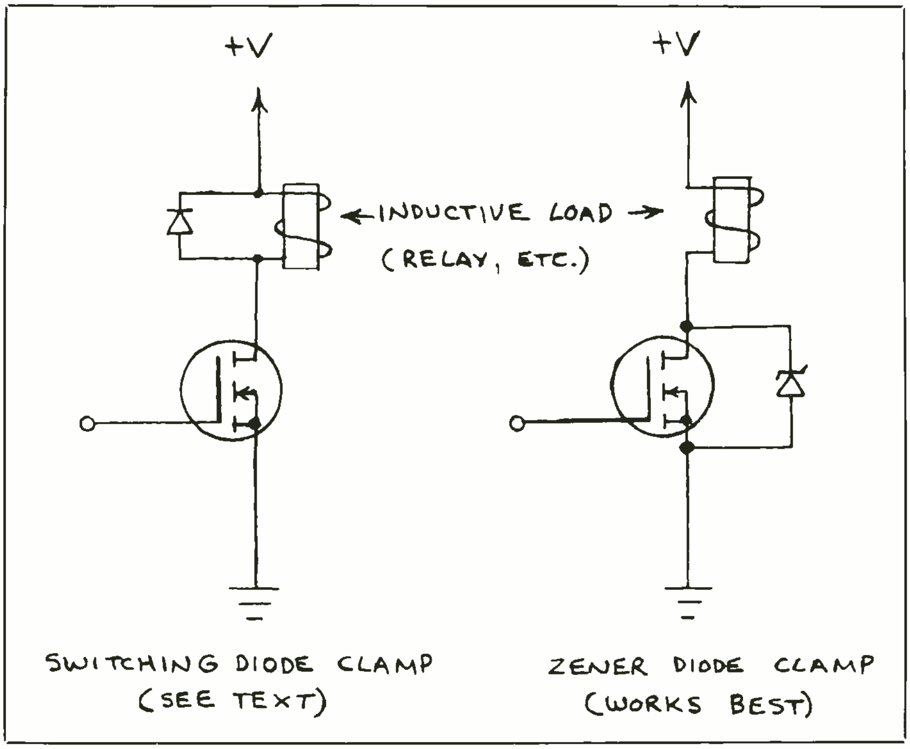


Fig. 2. Protecting a MOSFET from inductive voltage spikes.

all MOS devices should be applied to power MOSFETs:

(1.) Protect unused MOSFETs by shorting their leads together with foil or by inserting them into conductive foam.

(2.) When handling a power MOSFET, avoid touching the leads of the device. If it's necessary to touch the leads, first be sure to ground the hand that does the touching. Use a conductive wristband connected to a ground by means of a clip lead.

(3.) Use a battery-powered soldering iron if possible. If a line-powered iron is used, be sure its tip is grounded.

(4.) Never insert into or remove a power MOSFET from a circuit when power supply is switched on.

Power MOSFET Operation

It is important that you understand that the power MOSFET, like the bipolar transistor, can be operated as a linear (amplifier) or switching (digital) device. A simple experiment will help you better understand both these operating modes.

Figure 1 shows the circuit for the experiment. In operation, a source of variable-amplitude square pulses is applied to the gate of a power MOSFET. A 1,000-ohm (1k) resistor is inserted between the pulse source and the gate to prevent high-frequency oscillation. An oscilloscope is connected across a 100-ohm resistor that is, in turn, connected between a 10-volt supply and the drain of the MOSFET. (Move this resistor to the source side of the MOSFET if you want to use a double-trace scope to simultaneously monitor the input pulses and the drain current.)

Also included in Fig. 1 is a plot of the drain current through the 100-ohm resistor for a range of voltages from the pulse generator (gate-to-source voltage). The curve is very linear over most of its range.

For applications in which the MOSFET drives a low-impedance source—such as an incandescent lamp, relay, or motor—it is obvious from Fig, 1 that the gate-to-source voltage must be close to 10 volts. On the other hand, the gate-to-source voltage can be as little as 2 volts if the MOSFET is intended to switch another MOSFET or turn on a high-efficiency LED. For linear applications, the gate-to-source voltage is varied across its range.

Operating Tips

Because power MOSFETs have a frequency response of up to several hundred megahertz (MHz), they are susceptable to unwanted high-frequency oscillation, which can cause device destruction. Oscillation can be prevented by keeping the connection leads to the MOSFET, especially those for the gate, as short as possible. If the gate connection cannot be kept short, oscillation can be prevented by inserting a resistor of a few hundred ohms in series with the gate. The resistor should be placed as close as possible to the gate of the MOSFET. Another preventative is to place a ferrite bead over the gate lead as close as possible to the MOSFET.

Driving a power MOSFET from a CMOS chip is the essence of simplicity. All that's necessary is to connect the output from the CMOS chip directly to the gate of the MOSFET. Of course, the circuit path between the two devices should be short to prevent unwanted oscillation. For best results, the CMOS chip should be powered from a 10-to-15 volt supply to ensure that the device is switched fully on.

Driving a power MOSFET from a TTL chip can introduce an operational complication since the TTL voltage is relatively low. For this reason it's necessary to connect a 10,000-ohm (10k) pull-up resistor between the output of the TTL device (and, therefore, the gate of the MOSFET) and the positive 5 volt supply that powers the TTL chip. While this will permit the MOSFET to be switched on by the TTL chip, maximum available drain current will not be provided. Various methods for interfacing TTL to MOSFET devices that provide full drain-current capability are described in *Design of VMOS Circuits with Experiments* (Robert Stone and Howard Berlin, Sams, 1980). Some manufacturers of power MOSFETs have published brochures and application notes that discuss this subject in detail.

Incidentally, care is required when a power MOSFET is used to drive a relay or other inductive load. Normally, as shown in Fig. 2, a diode is connected in the reverse direction across the relay's coil to absorb the high-voltage inductive kick developed when the relay switches off. The 1N914 silicon switching diode is often used for this purpose. However, this and most other diodes respond too slowly to protect a power MOSFET, which may have a turn-on time measured in pioseconds! Therefore, if the reverse-biased diode method is used, an ultra-fast Schottky switching diode must also be used.

A better approach is to use a zener diode connected as shown in Fig. 2. The zener switches on much faster than a standard silicon diode. The zener must be connected as close as possible to the MOSFET, since the inductance of the intervening current path can itself contribute to the unwanted voltage spike. The breakdown voltage of the Zener should be greater than the supply voltage but less than the breakdown voltage of the power MOSFET. For example, when the circuit is powered by a 12-volt supply, select a 15-volt zener.

Sample Circuits

The best way to become acquainted with the operation of power MOSFETs is to assemble some circuits that use these versatile devices. The circuits that follow demonstrate both linear and switching operation of the MOSFET. Some take advantage of the MOSFET's exceptionally high input impedance.

All the following circuits can be assembled with n-channel power MOSFETs. I used a Siliconix VN10KM or VN67 for *Q1* in the test versions of the circuits I assembled. However, many other n-channel power MOSFETs can be used.

Be sure to follow the power MOSFET handling precautions given above when assembling the circuits. Make the connections to *Q1* in each circuit as short and direct as possible, especially to the gate lead. If you feel the connection to *Q1* of any circuit is excessively long, insert a resistor with a resistance of several hundred ohms in series with the gate lead and very close to *Q1*.

Simple Audio Amplifier

Figure 3 shows a simple audio power amplifier that directly drives an 8-ohm speaker. In operation, *R1, R2,* and *R3* form a voltage divider that supplies sufficient dc gate bias so that *Q1* conducts near the low end of its linear region. Incoming signals are coupled through *C1* and superimposed over the dc bias. Resultant fluctuations in drain current are transformed into sound by the speaker. Resistor *R4* limits current through transistor *Q1* and the speaker to a safe value.

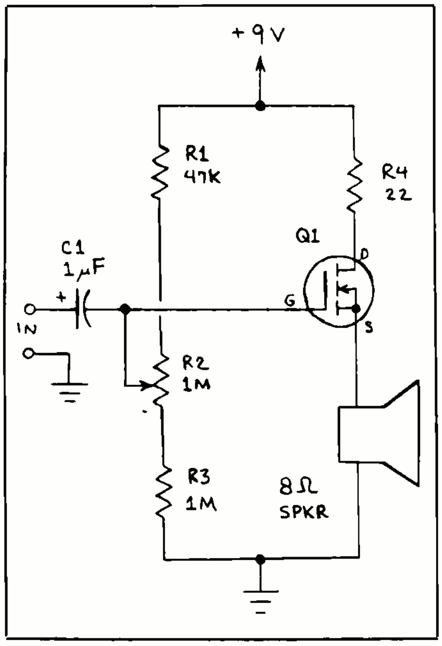


Fig. 3. Single-stage audio amplifier.

For best results, adjust *R2* for optimum sound quality while applying an audio signal to the circuit's input. The circuit will consume less average current if *R2* is adjusted so that *Q1* is biased at the low end of its linear region. If this setting fails to provide sufficient volume from the speaker, increase the amplitude of the input signal. If this is not possible, *R2* can be adjusted to provide a louder output signal at the expense of higher average current consumption.

Linear Lamp Dimmer

The circuit in Fig. 4, like the preceeding one, exploits the linear operating mode of a power MOSFET. Here, *L1* is connected in the drain circuit of *Q1*. The *R1/R2/R3* voltage divider controls the gate voltage and, hence, the drain current and the lamp's intensity. The brightness of the lamp is altered by adjusting the *R2*.

To avoid damaging *Q1*, make sure the drain current does not exceed the maximum permissible for the power MOSFET you are using. If in doubt, refer to the data sheet. You can measure the drain current by temporarily connecting a multimeter (set to measure current) between *L1* and the drain of *Q1*. Finally, be sure to use a lamp rated for 5 to 6 volts.

Pulse-Driven Light Dimmer

The lamp dimmer in Fig. 4 delivers a constant current flow to the lamp it drives. Figure 5 shows a lamp dimmer that operates on an entirely different principle. Here, a 555 timer chip is connected as an astable oscillator that delivers a series of pulses to the gate of n-channel power MOSFET *Q1*, which responds to each pulse by switching on and permitting current to flow through the lamp. If the pulse rate from the 555 is faster than about 20 or so pulses per second, the lamp will appear to be continuously on. Increasing the pulse rate increases the time the lamp is on, thereby causing it to appear brighter.

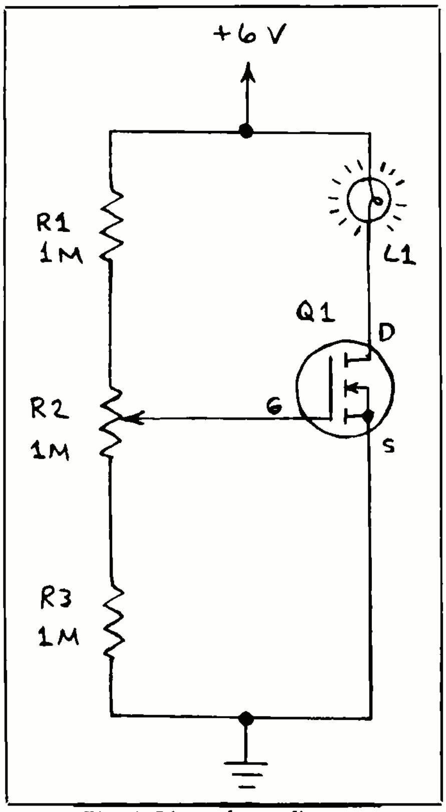


Fig. 4. Linear lamp dimmer.

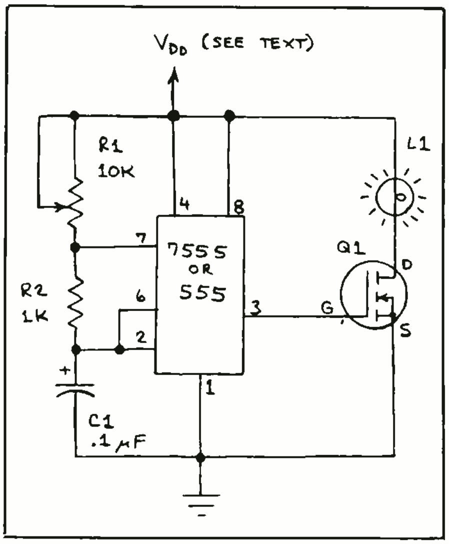


Fig. 5. Pulse-driven light dimmer.

Potentiometer *R1* controls the pulse repetition rate of the 555 and, hence, the apparent brightness of the lamp. Capacitor *C1* also controls the repetition rate.

Note that the timer chip in this circuit can be either a 555 or a 7555, the CMOS equivalent of the 555. Though these two chips are sometimes described as functionally equivalent, keep in mind that the 555 can sink or source more drive current than the 7555. Of course, in this circuit, the timer chip is not required to supply significant drive current since the gate of a power MOSFET has a high input impedance. Therefore, you can easily use a CMOS 7555 instead of an ordinary 555 timer in the Fig.5 circuits.

Power-MOSFET Lamp Flasher

Figure 6 shows a simple lamp flasher designed around half of a 4011 gate package and a power MOSFET. The two 4011 gates are connected as an astable oscillator with a repetition rate governed by the values of *R1* and *C1*. With the values shown in Fig. 6, the oscillator generates a pulse or two each second, the exact rate controlled by adjusting *R1*.

The supply voltage should range from 6 to 15 volts. The value you select should be determined by the ratings of the lamp and the MOSFET. Keep in mind that a higher supply voltage will turn on *Q1* more fully.

Incidentally, be sure to ground the unused gate inputs of the 4011. Otherwise, they may pick up stray signals and cause oscillation that leads to heavy current consumption.

Timer Circuits

A typical power MOSFET has a gate impedance of a billion (10^9) ohms or more. Therefore, it's very easy to assemble simple timer circuits by connecting a charged capacitor to the gate electrode of a MOSFET. The ultra-high gate impedance of the MOSFET will allow the capacitor to discharge at such a slow rate that delay times of more than an hour are possible.

Figure 7 shows a simple off-after-delay timer circuit. The timing cycle is begun by momentarily pressing *S1* to charge *C1*. When *C1* is charged, *Q1* switches on and its drain current causes the piezoelectric buzzer to sound.

Eventually, the combination of natural leakage present within *C1* and gate leakage of *Q1* will discharge the capacitor to a point where the transistor switches off. The buzzer then silences until another timing cycle is begun. The delay time of this circuit is determined by the capacitance and leakage of *C1*. Use a high value of capacitance for long delays. To speed up

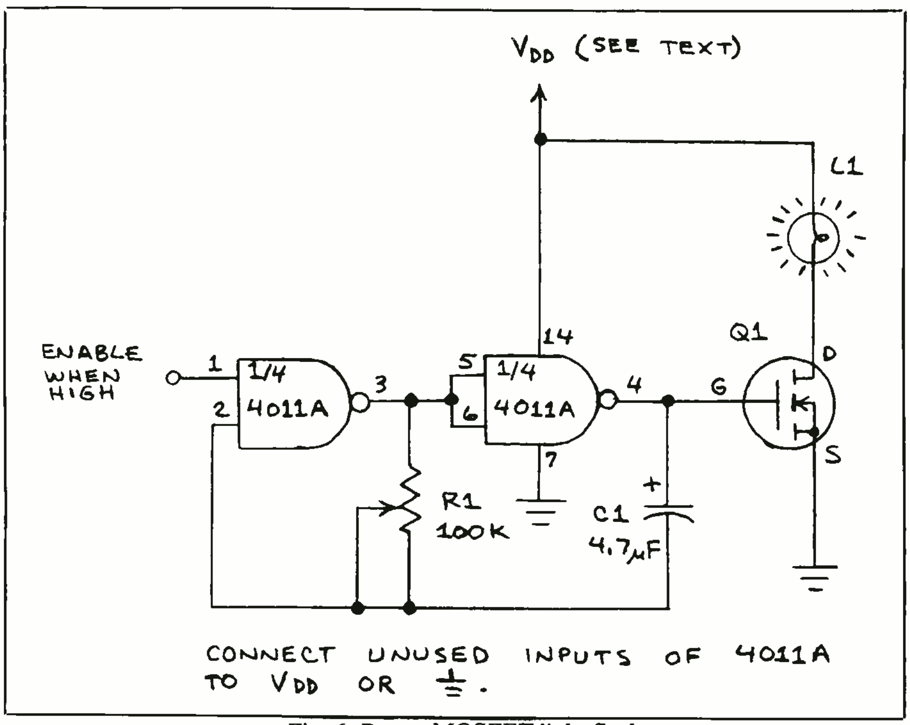


Fig. 6. Power MOSFET light flasher.

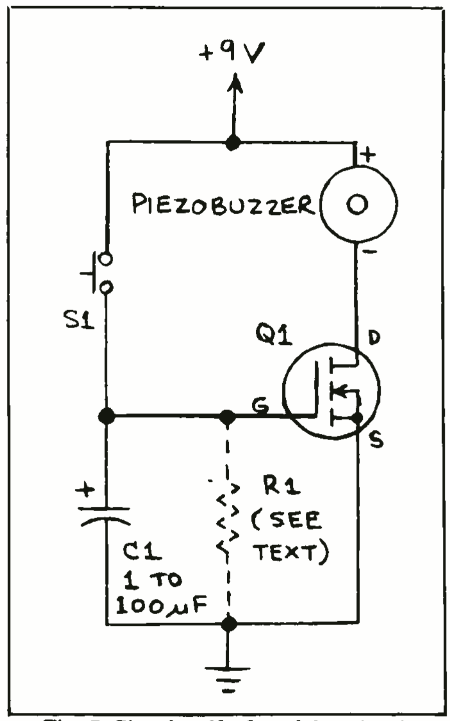


Fig. 7. Simple off-after-delay circuit.

ELECTRONICS NOTEBOOK . . .

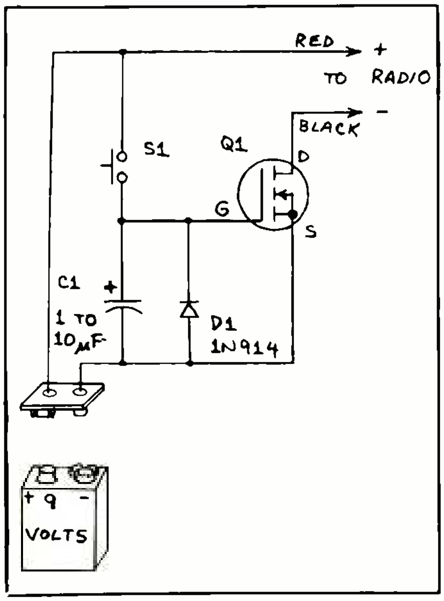


Fig. 8. Simple power MOS radio timer.

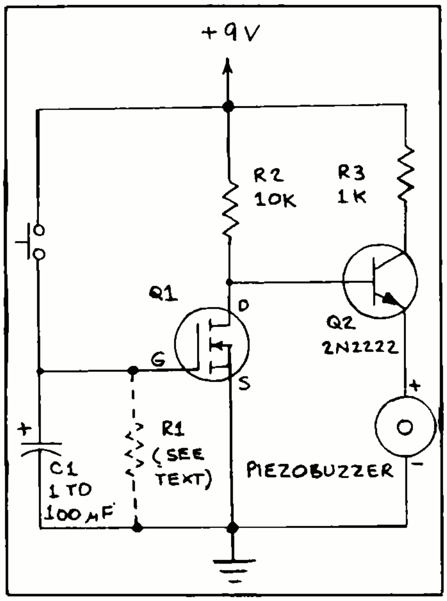


Fig. 9. Simple on-after-delay timer.

the delay, insert a high resistance across *C1* (shown as phantomed *R1* in Fig. 7) to provide a secondary leakage path.

Figure 8 shows how to use the circuit in Fig. 7 to automatically switch off a transistor radio after an hour or so. This circuit was designed by Istvan Mohos of Bergenfield, NJ for a friend who kept falling asleep with his radio on. When *C1* is a 1.5-μF tantalum capacitor, the timer will switch off the radio about 70 minutes after *S1* is pressed. A 1N914 diode, *D1*, connected backwards across *C1*, provides an ultra-high resistance discharge path for the capacitor. The circuit uses so few components it can be built into many battery-powered radios. Keep in mind, however, that modifying a radio might cancel the manufacturer's warranty. Also, for safety reasons, avoid using this circuit with ac/dc radios.

You can modify the circuits in Fig.7 and 8 for other applications. For example, both circuits can control small lamps or relays. When used to control a lamp, the brightness of the lamp will dim noticeably near the end of the timing cycle. This occurs as the MOSFET passes from its full on point through its linear region.

Use the circuit in Fig. 9 for on-after-delay timer applications. Here MOSFET *Q1* controls bipolar transistor *Q2*. Operation of the circuit is exactly opposite that of the Fig. 7 timer.

It is very important to keep the gate leads of *Q1* in each of these timer circuits as short as possible. When *C1* discharges below the turn-on threshold voltage of *Q1*, the gate lead is essentially floating and acts like a miniature antenna that is highly susceptible to stray electrical signals. These signals can switch on *Q1* or cause *Q1* to oscillate at high frequencies. Should this become a problem, place a ferrite bead over *Q1*'s gate lead as close as possible to the body of the MOSFET or connect a resistor of a few hundred ohms very close to the MOSFET's gate.

Going Further

You can find out much more about power MOSFETs by reading the book by Robert Stone and Howard Berlin cited above. Additionally, manufacturers of power MOSFETs publish helpful application brochures and manuals. These manufacturers include Motorola, International Rectifier, Siliconix, Intersil, Ferranti, Siemens, and others.

You may also want to read some of the excellent articles and papers about power MOSFETs published in electronic trade magazines. Steve Ciemente, Brian Pelly and Rutton Ruttonsha of International Rectifier wrote a four-part series on applying power MOSFETs for *EDN* beginning with the May 13, 1981 issue. These same authors wrote an excellent two-part series on the same subject for *Electronic Products* (Jan. 14 and Feb. 7, 1983). You can find these and other articles at a good technical library.

For a very simple explanation of some basic power MOSFET circuits, see *Getting Started in Electronics* (p. 107), a book I wrote for Radio Shack. Finally, stay tuned to this column, for I plan to include circuits that use power MOSFETs in future installments. **ME**

LETTERS . . . *(from page 5)*

• I fabricated the pc board for the "Smoke Alarm Inhibitor" (May 1986) and installed the components as indicated but can't get the project to work. I've checked and rechecked my wiring to no avail. One thing I did notice is that Fig. 1 shows five connections to the relay, but Fig. 2's etching-and-drilling guide shows only four. What's wrong?

John Strzykalski
South Amboy, NJ

A tiny piece of the etching-and-drilling guide's trace appears to have fallen off prior to printing. This is an easy fix. Viewing the guide as shown in Fig. 2, locate pin 6 of K1 (this is the second teardrop pad from the left in the upper of the two parallel rows at the bottom of the board) and solder a short bare jumper wire from this to the round pad immediately above it to make the fifth connection that goes to the anode of D1. —Editor.

• Those readers who built my "Electronic Remote Doorbell" (May 1986) should use a 9-volt *alkaline* battery in the project to obtain long operating life.

Brad Thompson
Maynard, MA

SOFTWARE FOCUS

The Underground

By Art Salsberg

The word "underground" has a special appeal since it implies being secret or clandestine to many people. So *Underground WordStar* by Ward Starr and Mel Murch, a 78-page softcover book and accompanying 5.25" disk for $19.95 plus $2 postage (Hard/Soft Press, Box 1277-M, Riverdale, NY 10471), has a head start.

This book/disk package, available only in IBM PC/compatible format, consists of a host of hints, tips and applications for use within the venerable WordStar word-processing software and its equally popular mate, MailMerge. WS version 3.3 is the standard reference employed by the authors, who sagely observe that different versions not only add elements, but remove some that existed earlier. Nonetheless, there are patch hints issued for other versions.

Much of the "secrets" presented here have appeared elsewhere in print or on SIGs, but they have been largely scattered about. What you have here, therefore, is really a compilation from one source of many moves and turns that make the software more efficient and enable a user to make software changes, as well as presenting some ideas that probably haven't surfaced.

The very useful material is presented in a breezy, easy-to-understand style. You'll learn about the little control tricks that speed up operation, debugging methods, working with a spooler and a RAM disk, how to customize WordStar with all the handholding that one needs, keyboard enhancing, downloading from another computer (with a TRS-100 notebook portable used as an example), and much more.

All the foregoing are supported by fine tables and listings such as keyboard addresses and hex values, patching addresses with their hex values, ASCII decimal/hexadecimal chart, etc.

The disk has six files, three of which use BASICA, which should be copied to the disk. One file gives you an ASCII chart that includes the decimal and hexadecimal equivalent for each code. Another lets you see the actual code on a WordStar program so that patches can be easily made using DEBUG from the disk operating system. A third file shows you how to link multiple files for printing. Next is a color configuration program so that you can select various colors for background, text, borders, and so on. The fifth file makes it much easier to work with MailMerge, while the final file enables you to create a disk emulator and do other nice things with a fake disk.

* * *

Another piece of "underground" software, this one in the form of a book, is *The Computer Underground* by M. Harry (Published by Loompanics Unlimited, P.O. Box 1197, Port Townsend, WA 98368, $14.95 plus $2 shipping).

This 257-page soft-bound book is actually a report on a host of computer security methods and how they are defeated by criminals, phreaks, et al.

The book covers phreaking (illegal telephoning), software piracy, computer security methods, defeating computer security, hacking networks, and a very lengthy appendix that's really part and parcel of the main text that discusses telephony, computer hacking, sample programs, phone numbers and resources.

Obviously, the matter contained in this text isn't an invitation to do anything illegal or unethical. It gives one enormous insight into how these repugnant actions are accomplished, however. One could say that it's too detailed and shouldn't even be published. But the material is readily available on underground computer bulletin boards, which anyone with bad intentions learns soon enough.

Interestingly, the author writes about a sampling of the underground telecomputing community he made. The average age in the study was 15 years old, while Apple computers were the most popular models, with Radio Shack, Commodore and IBM following far behind. Software piracy ranked high as an underground interest, whereas "cracking" (defeating copy protection) ranked low. Two motives surfaced for participating in computer crime: increasing popularity among peers and relieving boredom.

Modern Electronics has a much more mature readership than evidenced by the undergrounder sampling above, of course. Therefore, we do not anticipate nor invite anyone to get this book for other than purposes of curiousity. **ME**

HARDWARE HACKER

Creating your own custom ICs, the MIDI music interface, ASCII/HEX/decimal conversions, finding exotic metals

By Don Lancaster

Sometimes a really big hacker breakthrough will happen instantly in a blinding flash. Other times, an improvement here, a second source there, a big price reduction over there, and some day you wake up and realize that something really great is all of a sudden hacker feasible.

This month's breakthrough is that hackers can finally design and build their own full-feature custom integrated circuits, quickly and cheaply, even on a kitchen table.

We'll jump right into this.

How Can I Build my own Custom ICs?

There have long been three main routes to creating custom integrated circuits. These are the EPROM, the PLA, and the Gate Array. All three have been modified and improved in many ways to the point that you can now create your own full-feature custom integrated circuits. Best of all, you can now do this on your own and even on a kitchen table at reasonable prices, without any arcane emulation software or ridiculous setup charges.

The EPROM is probably the single custom integrated circuit that is already the most familiar to hardware hackers. As you can see from the ads right here in *Modern Electronics*, EPROMs are now cheap, dense and easy to get.

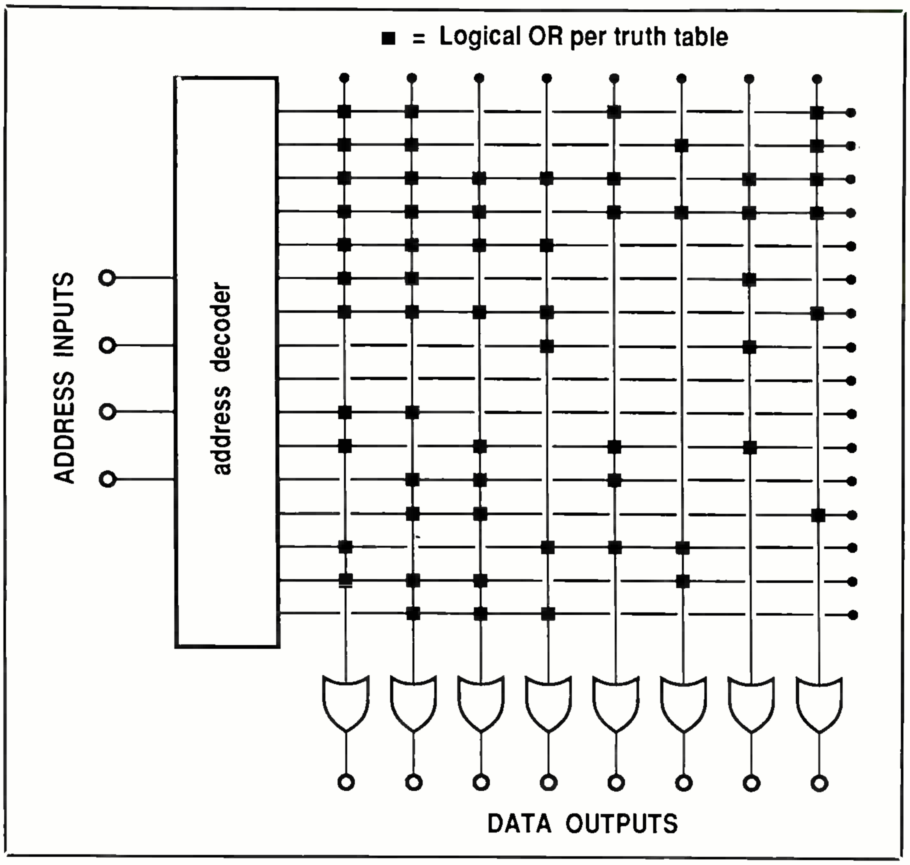


Fig. 1. An EPROM provides outputs for all possible input states.

Figure 1 shows what is inside an EPROM. An EPROM is simply a table lookup device. For every possible input address, a data word is output.

Output words might be a sequence of computer software commands, the values for a sine wave or other trig function, a fixed ASCII message, the allophones in a speech synthesizer, or just about anything else where you need a complete set of often irrational "input address" to "output data" conversions.

To program an EPROM, you first erase it with strong short-wavelength ultraviolet light. Then you go through a programming process that connects ones or zeros to the data lines for every input address combination.

Programming can be done on a stand-alone programmer, on a plug-in card inside a personal computer, or by using one of many custom programming services. *E-Tech Services* is one place I have found that does fast, low cost and no-hassle programming. Chances are your local computer club has at least one EPROM burner available for your use.

There are several things that make EPROMs more attractive today than ever before. You can get EPROMs up to one megabyte in size, although the 64K (8K × 8) 2764 and the 128K (16K × 8) sizes are by far the most popular today. Pricing is so low that you can easily "waste" most of the humongous internal storage of an EPROM and still outperform a more specialized circuit made up of ordinary digital logic chips.

Until very recently, EPROM erasers have been obscenely priced. *JKL Components*, however, has just introduced a miniature and easy-to-use BF727 ultraviolet lamp that lets you snap the eraser over the EPROM without even removing the chip from its socket. More on this beauty after I check it out.

A big safety reminder if you plan to use a UV eraser: Short-wavelength ultraviolet light can instantly cause permanent blindness. Make sure that the erasing scheme you use has a positive safety interlock prevents direct viewing.

A relative of the EPROM, the EEPROM can have single words electrically erased and reprogrammed, without having to erase the whole chip and start over again. Additionally, no high programming voltage is needed.

Even after several false starts, EEPROMS still are not quite here yet for mainstream use. While they are much cheaper than they have been in the past, EEPROMs are still rather expensive compared to ordinary EPROMS. They have reliability and standardization problems, though. Many are guaranteed for only a few thousand write cycles. So, today most people use EPROMs for most everything, but EEPROMs are pretty much still limited to niche uses such as electronic TV tuners, and power-down system constant storage in personal computers and laser printers.

The next step up in complexity is called the PLA, which is short for Programmable Logic Array. These were pioneered by *Monolithic Memories.*

As Fig. 2 shows, PLAs are used to first logically AND combinations of inputs, and then to logically OR the various AND outputs together. It turns out that many Boolean logic equations can be converted into this special form of ANDed combinations followed by ORed recombinations.

Until recently, PLAs were pretty gruesome. They were expensive, hard to program, and there were dozens of different specialized PLA variations that were almost, but not quite, identical to each other. Their power needs were just plain excessive. Ad claims grossly distorted the PLA's capabilities through ludicrously inflated "gate counts." Worst of all, programming was a one-shot deal that blew fuses in the chip.

Much of that is changing now. Old style one-shot PLAs are now under a dollar in quantity; programmers for them are becoming available for personal computers; and a language called PALASM is available to simplify the logic equations needed.

Second-generation reusable PLA devices are now available. *Cypruss Semiconductor* is one source of erasable EPROM-style PLAs, as is *Altera.*

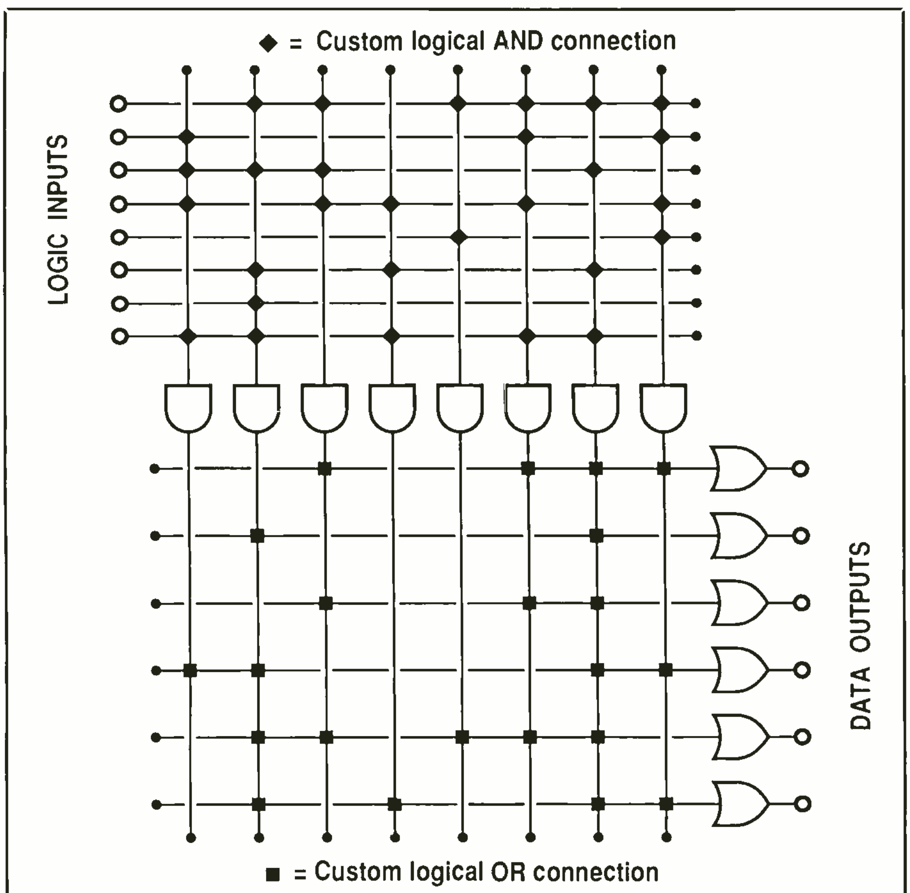


Fig. 2. A PLA performs custom Boolean AND/OR logic on its inputs.

Better still, the GAL series from *Lattice Semiconductor* is both erasable and reprogrammable. Even more impressive is that one single reusable device can be used to emulate just about *any* of the older dedicated one-shot PLA chips. A fancy output stage on each line can be configured to behave as a latching register, a counter, or as a direct logic output, in your choice of "active-high" or "active-low" states.

The ultimate custom integrated circuit is the gate array. You can build *anything* digital using nothing but NAND gates in combination. As Fig. 3 shows, a gate array is nothing but a massive collection of logical NAND gates—hundreds, thousands, or even tens of thousands of them.

Since you can literally do anything with them, gate arrays are far more powerful and far more flexible than EPROMs or PLA devices.

Until recently, the gate array was far and away the most violently, viciously, and vehemently anti-hacker device available anywhere ever. Little things like $35,000 setup charges, 42-week delivery, complex and arcane emulation software that would not run on same computers, and the "it has to be right the first time or forget it" mentality tended to put something of a damper on hacker gate array enthusiasm. Fortunately, that is also changing. *Xylinx* is now offering erasable and reprogrammable gate arrays. These work by downloading the array connections when power is first applied. While pricing is still way out of line, it is only a mater of time until you'll be able to buy program-your-own gate arrays at EPROM prices directly from *Modern Electronics* advertisers.

What is on Special this Month?

Field effect transistors are yet another example of components that have quietly gotten better, ridiculously cheaper, and much more hacker-usable. For example, *Siliconix* has a pair of switching field effect transistor samples that are absolutely ideal hacker parts. The samples are free in singles when you phone or write for them using a letterhead request. First is the 2N7000 Fetlington. This is a small package field effect transistor that is rated 60 volts and up to 200 milliamperes of continuous current. In quantity, this beauty sells for less than a dime. It is ideal for such things are driving relays, small solenoid valves, alarms, incandescent lamps and such.

Siliconix's second sample is the 2N7004 FETDIP. This is a slightly larger device with a much higher power rating. It can handle 100 volts and up to 6 watts of continuous power dissipation with suitable heat sinking. Maximum current is 1 ampere. "On" resistance is a low 0.6 ohm. Uses would include line drivers, high-power switches, current sinks, and just about any other application where you need to switch a "fair to middlin" power load.

Several test circuits are included on each of the sample cards. Higher voltage versions are also available, up to the 2N7006 that is rated to 350 volts. Since negligible input current is needed, these are well suited for microprocessor control of medium power loads.

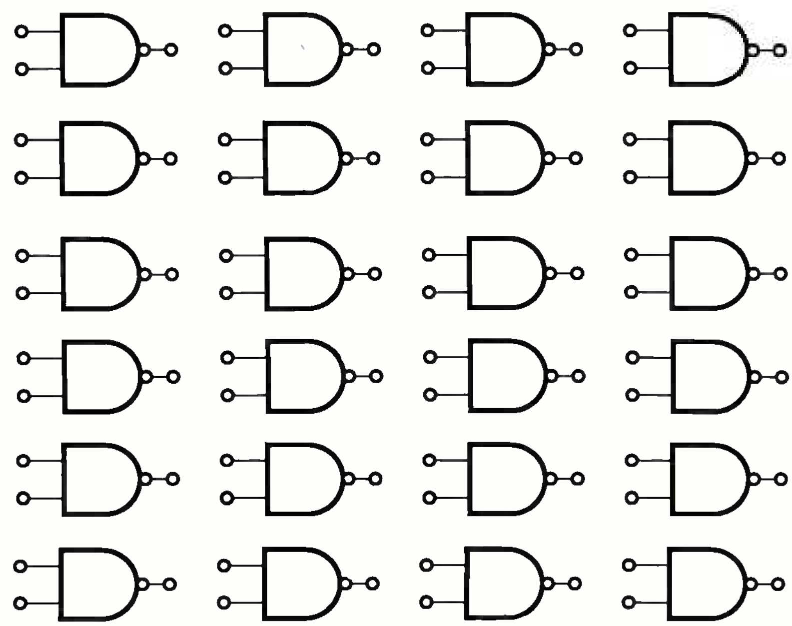


Fig. 3. A gate array is literally an "ocean" of gates.

What is a MIDI Music Interface?

The MIDI interface is used in electronic music to interconnect synthesizers, music modules, and personal computers. As you might suspect, MIDI is becoming quite popular.

Two good books on this are Craig Anderton's *MIDI For Musicians* and Joseph Gadoury's *MIDI Made Simple.* Both are available through *Roland.*

How do you Convert Decimal to ASCII?

There are lots of times and places in microcomputer software when you might like to convert a decimal value to its printable ASCII equivalent, and vice-versa. For instance, you might have the decimal score of a game stashed somewhere and want to route it to a video screen. Or you might want to show the number of characters already used or still available in a word processor.

Decimal numbers are usually represented by 4-bit bytes with 0000 = 0, 0001 = 1, 0010 = 2 . . . up to 1001 = 9. One byte is used for each decimal decade. A single 4-bit byte coded this way is called BCD, short for binary coded decimal. Each byte holds one decimal digit.

Figure 4 shows how to get from BCD decimal to ASCII, the standard character code we looked at in a previous column. The rules here are simple: To get from BCD to ASCII, just add decimal 48 or hex $30. To get from ASCII to BCD, just subtract decimal 48 or hex $30. That's all there is to it.

Sometimes a pair of BCD bytes might be combined into an 8-bit word. This is called packed BCD. If you are using packed BCD, you must first unpack the bytes before ASCII conversion, and later repack them after being converted from the ASCII format.

To unpack a low BCD byte, logically AND it with hex $0F. To unpack a high BCD byte, shift or rotate the word to the right four times, and then once again AND it with hex $0F. To pack a BCD word, shift the high BCD byte to the left four times and then OR it with the low BCD byte.

0	0000	-	0011 0000	$30
1	0001	-	0011 0001	$31
2	0010	-	0011 0010	$32
3	0011	-	0011 0011	$33
4	0100	-	0011 0100	$34
5	0101	-	0011 0101	$35
6	0110	-	0011 0110	$36
7	0111	-	0011 0111	$37
8	1000	-	0011 1000	$38
9	1001	-	0011 1001	$39

Fig. 4. Decimal-to-ASCII conversion.

The 6502 microprocessor has a special decimal mode that works directly in packed BCD. Other micros usually have ways of faking the same thing. These days, though, you usually do *not* pack the BCD decades.

How do you Convert Hexadecimal to ASCII?

Things get a tad more complicated when you try to convert between hexadecimal and ASCII. You might want to do this when you are displaying a "hex dump" of a computer's monitor program on a video screen. Some stand-alone EPROM burners also require their hex bytes be passed back and forth as ASCII characters, as does the bit image information on laser printers.

There are both advantages and penalties to converting hex to ASCII before sending it somewhere. The big advantage is that everything is sent as ordinary numbers or letters. There is thus no possibility of confusing, say a hex $0D for a carriage return, or a $00 for a NUL or a break. Illegal characters cannot be sent since there aren't any. As a further bonus, an ordinary word processor can also be used to process hex characters in ASCII form.

Penalties of hex to ASCII conversion involve both speed and storage size. It takes *two* printable characters to show a single 8-bit hex word pair. Thus, it will take you *twice* as long to send converted bytes over a serial interface than it would to send straight hex.

It also takes twice the space to store hex values in ASCII form. Which gets particularly nasty when printing video or photographs on a laser printer.

To review, a 4-bit byte can be shown in hexadecimal. There are 16 possible 4-bit states. The first 10 states, 0000 through 1001, are shown as decimal digits, exactly as is done with BCD. The final six states are often shown as upper-case letters, with $1010 = A, $1011 = B, up through $1111 = F.

Figure 5 shows how to do these conversions. To get from hex to ASCII, add decimal 48 or hex $30 if the number is 10 or more, add decimal 54 or hex $36.

To get from ASCII to hex, you first have to test to find out if you are converting a letter or a numeral. Such "range checking" is always a good idea anyway. If you have a numberal (CHR$ 48-58 or hex $30-39), subtract decimal 48 or hex $30. If you have a letter (CHR$ 65-69 or hex $41-46), subtract decimal 54 or hex $36 instead.

Actual conversion details depend on your programming style and the microprocessor and language in use. In the Apple IIe monitor, there are several built-in machine-language routines for hex-to-ASCII and ASCII-to-hex conversion. Specifically, $FDE3 will convert the low hex accumulator byte to ASCII. $FDDA will convert the entire accumulator to a hex ASCII pair. $F941 will print first the X register and then the accumulator as four successive hex digits. Finally, $FFA7 will reverse the process and convert the ASCII characters in $003E (low) and $003F (high) into a two-byte hexadecimal value.

0	0000	-	0011 0000	$30
1	0001	-	0011 0001	$31
2	0010	-	0011 0010	$32
3	0011	-	0011 0011	$33
4	0100	-	0011 0100	$34
5	0101	-	0011 0101	$35
6	0110	-	0011 0110	$36
7	0111	-	0011 0111	$37
8	1000	-	0011 1000	$38
9	1001	-	0011 1001	$39
A	1010	-	0100 0001	$41
B	1011	-	0100 0010	$42
C	1100	-	0100 0011	$43
D	1101	-	0100 0100	$44
E	1110	-	0100 0101	$45
F	1111	-	0100 0110	$46

Fig. 5. Hex-to-ASCII conversions.

You can tear apart this code for a quick study on conversion details. The innermost secrets of easily and rapidly tearing apart machine-language code appear in my *Enhancing your Apple II*, volume I (SAMS #21822).

Where can I buy "exotic" Metals and Rare Earths?

No problem, so long as you are willing to pay exotic prices for them. There's an outfit called *ESPI* that will sell you most any ultra-high-purity element or compound. You might like to write them for their current catalog and price list.

Some examples: A sheet of gadolinium or hafnium costs $35. Indium wire costs $7 a gram, while Lanthanum Fluoride goes for $4 a gram. Neodymium oxide is a steal at 42 cents per gram. Scandium ingots are $88 each. Zirconium wire goes for $1.70 a gram, and so on.

One obvious caution: Before you try playing with *any* exotic element or chemical compound, be sure to *thoroughly* study its properties ahead of time, particularly the reactivity and toxicity. The good old *Handbook of Chemistry and Physics* is an obvious place to begin your research work.

Finally here's our usual reminder that this is your column and you can get free technical help from usper the "Need Help?" box.

My current free handout is so spectacular I'm not even going to tell you what it is. You may even want to frame it. Just ask for your free copy of *Meowwrrrr*, otherwise known as my *puss de resistance.*

NAMES AND NUMBERS

Altera 3525 Monroe Street Santa Clara, CA 95051 (408) 984-2800	**Lattice Semiconductor** 15400 NW Greenbrier Beaverton, OR 97006 (503) 629-2131
Cypress Semiconductor 3901 North First Street San Jose, CA 95134 (408) 943-2600	**Monolithic Memories** 2175 Mission College Santa Clara, CA 95054 (800) 247-6527
ESPI 31194 La Baya Drive Westlake, CA 91362 (800) 638-2581	**Roland** 7200 Dominion Circle Los Angeles, CA 90040 (213) 685-5141
E-Tech Services Box 2061 Everett, WA 98203 (206) 337-2370	**Siliconix** 2201 Laurelwood Road Santa Clara, CA 95054 (408) 988-8000
JKL Components 13343 Paxton Street Pacoima, CA 91331 (800) 421-7244	**Xilinx** 2069 Hamilton Street San Jose, CA 95125 (408) 559-7778

NEED HELP?

Phone or write your **Hardware Hacker** questions directly to:

Don Lancaster
Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073

Report From Comdex . . . Plus First Impressions: Alpha Software's Keyworks 2.0 and Microsoft's Word 3.0

By Eric Grevstad

"It looks like a quiet summer," said another of the computer journalists covering the Comdex/Spring '86 trade show. We were in the Westin Peachtree lounge 70-odd stories above Atlanta, drinking beer and occasionally closing one eye to confirm the room was rotating. It was my first Comdex in two years, and duller than I remembered.

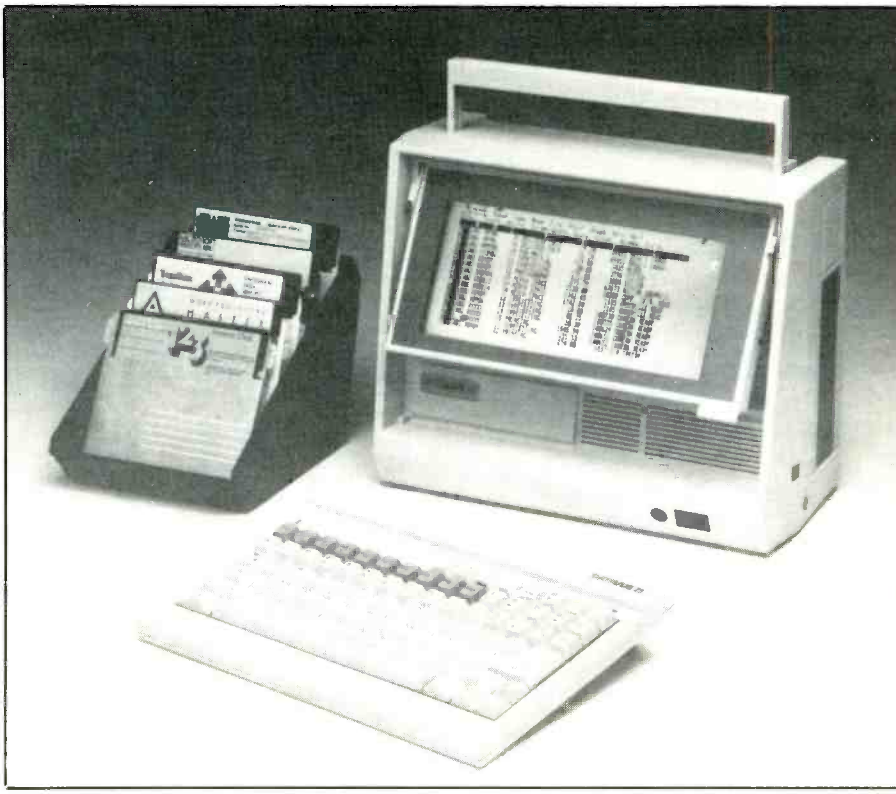
"What surprises me is that it's turned into a hardware show," I said. "A convention center full of monitors and printers. No exhibits from Microsoft, Ashton-Tate, Borland, Javelin, Software Publishing. No new software except a bunch of menus, batch files for managers to let employees pick programs from a hard disk. Big deal."

"There's no more money to be made in software," a technical editor explained. "Everybody has his or her copy of Lotus already. So vendors move in to sell them monitors and graphics boards . . . ."

"Graphics boards!" everyone at the table moaned, shuddering at the memory of two dozen companies' flood of IBM Enhanced Graphics Adapter clones. High-res RGB monitors are still too expensive, but the EGA standard is coming whether you like it or not.

"But there's nothing wrong with hardware products becoming standards or commodity items," I declared. "Two things that were novel a year ago, PC AT compatibles and laser printers, are all over the place now. They're not innovative any more, but they're getting cheaper and acquiring nice features. Look at TeleVideo's TeleCAT-286, an AT clone with all of the latest specifications—512K, an 8-MHz 80286 chip, and a 20-megabyte hard disk, all in a smaller package than IBM's. With monitor included for $2,995, it's got a killer price."

"Same thing with laser printers, Oasys' LaserPro Express topping QMS' Kiss with eight instead of six pages per minute for $1,895 instead of $1,995," agreed a woman beside me. "But I want to see where Kyocera decides to price its F-1010: a cute desktop-sized printer, emulates Hewlett-Packard and Epson and NEC and everybody, ten pages per minutes, 51 built-in fonts. Laser makers are finally choosing something besides the six pages per minute Canon engine that HP and Apple use."



Quadram's Datavue transportable computer offers 5.25- or 3.5-inch disks or a hard disk and a backlit amber LCD display screen that is even better than a plasma-panel screen.

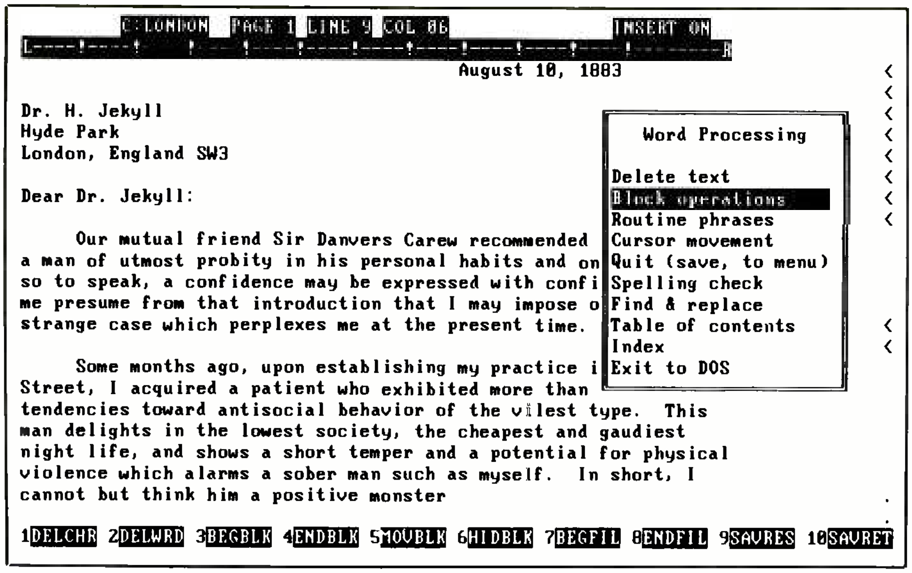
"Don't forget plain old PC clones," hiccuped a newspaper columnist. "Franklin, folks who make that nice Apple IIe clone, say its PC-8000 will cost just $995 with 512K, two disk drives, everything but a monitor. Companies aren't out to undercut IBM anymore; they're out to undercut Tandy and Leading Edge. Geez, Compaqs look expensive these days."

"Speaking of Compaqs," I said, "did you see the crowds around IBM's PC Convertible? No one seems really crazy about it, but it's perked up the briefcase portable market."

"Toshiba is really hustling," nodded my neighbor. "First the PC-compatible T1100 you said you reviewed last month, and now the AT-compatible T3100: 15 pounds, 8-MHz 80286, 640K, a microfloppy disk, a 10-megabyte hard disk, and a gas plasma screen. Gorgeous, if only it didn't cost $4,499."

"I'm growing impressed with the Datavue, that little lunchbox Quadram sells," I added. "Won't run on batteries very long, but as a transportable it's half the size of a Compaq Portable II. Nice keyboard, either 5.25- or 3.5-inch disks or a hard disk, and that backlit amber LCD they call the gaslight screen is the best portable display I've seen. Wonderful, better than a plasma panel. They were previewing an 80286 mode, too."

"This show may not be so bad for PC buffs after all," the technical editor said. "Who cares that the big crowds went to Atari and Commodore? Surprising number of vendors showing 1040ST and Ami-



Spruce up WordStar (or whatever) with Keyworks' custom menus.

ga software, though it was mostly educational or entertainment stuff, great animation and music, instead of business applications."

"Hey," someone asked, "how about that big, ugly box due this fall, one year late, that fits on the side of the Amiga and takes IBM disks and expansion cards?" The meeting broke up in rude laughter, and I went home to review two upgrades to already fine, familiar PC programs.

A Super Keyworks

Alpha Software's Keyworks ($89.95) got off to a slow start in the macro processor market last year. Macros are traditionally power users' tools, and Keyworks had neither the macro capacity of RoseSoft's no-frills, expertly efficient ProKey, nor did it have the SideKick-style gewgaws and operating enhancements of Borland's SuperKey.

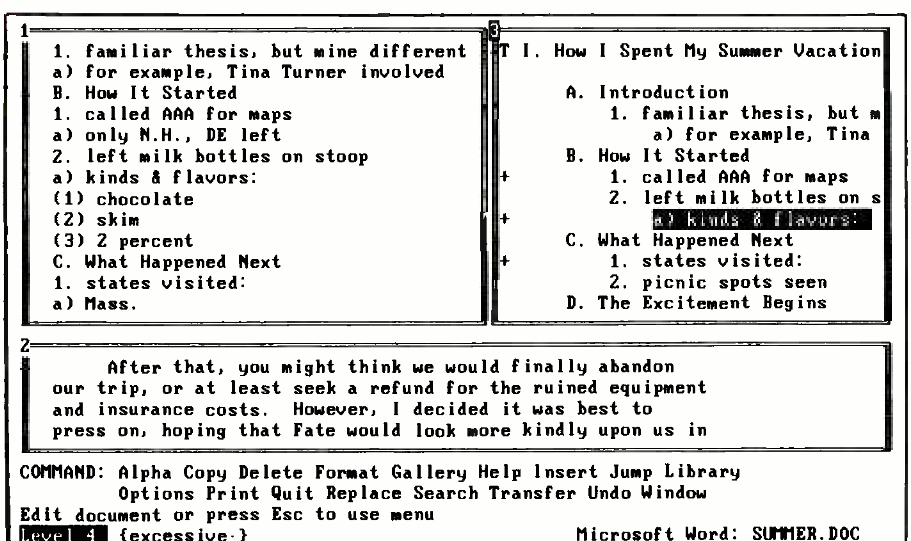
It took buyers a while to discover Keyworks' talent: its easy techniques for building pop-up, moving-bar, mouse-compatible menus that make it the world's best way to customize software, turning an old dog like dBase II into a personalized program as flashy as Framework II. Now that Alpha has released Keyworks 2.0, adding a handful of minor improvements and shamelessly stealing two ideas from SuperKey, there's really no reason to buy Borland's product at all.

To give the bad news first, Keyworks remains a weak choice for hands-off show-offs who want to automate giant tasks—its maximum macro buffer, while stretched to 9,500 keystrokes (stretching Keyworks to a hoggish 100K), is still smaller than its rivals'. Alpha playfully includes a SideKick-style pop-up 1986 calendar, but the macro file takes nearly 8,000 bytes of memory.

But Keyworks still shines in offering word processor-like editing of all macros in memory at once (compared to rivals' one at a time), with some sophisticated new macro functions such as typing the date in various formats and initializing a communication port to specified speed, parity, and other parameters. It still handles file encryption and decryption and gives access to DOS functions from within your application.

As for the SuperKey ideas, Borland's "command stack" (for selective replay from the last 256 characters' worth of DOS commands) has become a 300-character "keystroke recall" buffer for DOS or any recent input, although playback involves a slightly tedious process of highlighting or editing text and pressing the Enter key.

Better yet, Keyworks 2.0 borrows SuperKey's ability to cut and paste text from the screen into a macro for playback later (i.e., in another program)—with the irresistible options of sending the text to a disk file or serial or printer



A Microsoft Word 3.0 document below text and working views of an outline. Note the latter's hidden or collapsed sections.

port, specifying a left margin for the latter so you can copy someone's address from the screen straight onto an envelope. Add that to Keyworks' greatest gift—custom menus that let a manager give the fiercest software to the timidest typist—and you've got a macro champion. Maybe the best utility program ever, though I'll consider letters from SideKick and Norton Utilities fans.

A Better Word

I admit I've wavered due to admiration for Framework II, but otherwise I've kept a stern resolution: I detest and boycott copy-protected software. Specifically, I've avoided Microsoft Word, whose power is awesome but my one legal copy of which vanished in a hard-disk crash last year; even a signed note from my repairman ("Drive contents destroyed, no piracy involved") wouldn't get me a replacement without a surcharge. Now Microsoft has released Word 3.0, with more power and no protection. I'm so pleased I can almost overlook their hiking the price to $450.

Word's windows, coupled with easy commands for selecting, formatting, deleting, and undeleting text, have always made it a prime choice for cut-and-pasters who work with more than one document at once. The new version makes windows useful for one-at-a-time writers, with a ThinkTank-style outline processor built in. It has all the collapsing, expanding, rearranging, and numbering tricks outline buffs could want, once you master its syntax of Alt-9 versus Alt-0, horizontal versus vertical arrows, text exit versus outline edit.

Word 3.0 also adds math and sort functions—hardly spreadsheet or database caliber, but handy for adding numbers (editing and moving commands now work with columns) or sorting simple tables. Between the calculator, the outline processor, and the ability to run anything from the spelling checker to a DOS command from within Word, those of us whose work is mostly word processing may never need to run another program.

What about word processing, you ask? Obviously you haven't met Word, the would-be typesetter's dream program for mixing fonts and formats at levels from one character to laser-printed columnar pages (there's a whole manual detailing the 113 printer drivers). Word 3.0 can prepare indexes or tables of contents, managed through clever "hidden text" markers also used to shift seamlessly from document to outline (or to leave notes or queries behind text, as with the current craze for programs affixing explanatory memos to spreadsheet cells).

Its graphics display remains the best typestyle show short of a Macintosh, though you still have to type a command to see page breaks. It's still impractical without a hard disk and preferably 512K, but removing protection has made it faster at loading and scrolling. Word's tutorial program and on-line help, both first-rate before, are now linked—you can step out for a 15-minute outlining lesson, then back to a document in progress.

Word 3.0 costs a ton, but its price/performance ratio is still good and its ease-of-use/performance ratio is phenomenal. For serious writers, it's a better program among word processors than Lotus 1-2-3 is among spreadsheets. ME

Names and Addresses

Alpha Software Corp.
30 B Street
Burlington, MA 01803
617-229-2924

Franklin Computer Corp.
Route 73 & Haddonfield Road
Pennsauken, NJ 08110
609-488-0600

Kyocera International Inc.
8611 Balboa Ave.
San Diego, CA 92123
619-576-2600

Microsoft Corp.
16011 NE 36th Way, Box 97017
Redmond, WA 98073
206-882-8080

Oasys
8352 Clairemont Mesa Blvd.
San Diego, CA 92111
619-576-9500

QMS Inc.
One Magnum Pass
Mobile, AL 36618

Quadram/Datavue
One Quad Way
Norcross, GA 30093
404-923-6666

TeleVideo Systems Inc.
1170 Morse Ave.
Sunnyvale, CA 94086
408-745-7760

Toshiba America Inc.
Information Systems Division
2441 Michelle Drive
Tustin, CA 92680
714-730-5000

Getting More From Your Scanner

By Loren Freburg

Two loud, shrill tones, guaranteed to get your immediate attention, pierce the silence.

"Code 33 on channel one for the Valley units. George 24 is in pursuit on a twenty thousand and two suspect."

"Santa Rosa, George 24. I'm southbound on Arnold Drive . . . Eleven eighty-six on a brown International Travelall . . . California, zebra- Robert- Adam- six- eight- three . . . Final ten-twenty will be south of Sobre Vista . . . Twenty-eight and twenty-nine."

"George 24, ten-four."

Every day, thousands of scanner/monitor owners listen to action like this Sheriff's Office pursuit of a vehicle suspected of being involved in a "hit and run" automobile accident. And they can understand all of it.

In this example, the radio dispatcher temporarily limited communications on channel one to messages relating only to this single incident. The officer stopped the suspected vehicle just south of Sobre Vista Road and gave the dispatcher the license number. He then requests information about the registered owner and asks if the owner is wanted.

Public service and emergency frequencies are alive on scanners with on-the-spot local reports of fires, traffic accidents, criminal activities, and medical crises, as well as more mundane action such as routine inspections and barking dog complaints. If you are one of the growing number of enthusiasts who have a scanner, or are planning on getting one, here are some hints on making maximum use of your monitor.

The single, most beneficial accessory you can acquire for a scanner is an outside antenna. There are several reasons for this. With an antenna mounted on the roof, distance to the horizon is increased, so the antenna will "see" farther, extending your scanner's pickup range. At high frequencies, radio signals travel predominately in straight lines. Therefore, the added elevation also gets you above possible radio-transmission obstructions such as buildings and power lines. And because electrical conductors in the immediate vicinity of an antenna can dramatically affect its performance, your outdoor antenna will avoid house wiring, rain gutters, and aluminum window frames. The *Radio Amateur's Handbook* is a good source for antenna ideas, if you want to build your own. Otherwise, you can buy one from a dealer, such as Radio Shack.

An extension speaker is another convenient accessory. This will allow you to place the scanner wherever you want, either to get it out of sight, close to an electrical outlet, or near the outside antenna to minimize the length of lead-in needed. The speaker can then be placed anywhere in the house, even in another room. By using a better speaker than the tiny one generally built into a monitor, sound quality can be improved. You don't need a "full-range high-fidelity" unit, of course, since voice has a narrow frequency range. A horn-type public address speaker is a good choice for an external speaker that will plug into a scanner's external jack.

If you want to listen without bothering anyone else, headphones will solve your problem. Again, they should not be a "high-fidelity" type. There are many lightweight, low-cost communication-type headphones. Headphones are for you, too, if you want to listen in noisy surroundings. Before buying a pair, try them on if possible to judge how effective they are in sealing out noise.

An accessory you may already have without realizing it is a tape recorder. Many times an exciting event such as a major fire or the pursuit and capture of burglars can be recorded.

"Software"

In addition to external equipment, there are many types of "software" to increase your enjoyment and appreciation of scanner-listening. The most basic source of information is a station directory that will list frequencies active in your local area. You'll need this information to set local channels. This will probably be available from your scanner salesman. Radio Shack, for example, has Station Directories for all different sections of the country.

At the same time you buy your scanner (and your directory), try to get a list of the more common local frequencies from your dealer. This will get you started while you search the book for other agencies and their frequencies. Often there are new frequencies or "secret" frequencies not listed in the book. Your dealer will probably know them. As you thumb through your new directory, don't be surprised to find far more radio activity than you had given any thought to. Nearby parks, flood-control districts, even the local Humane Society, all use the public service bands. And you can listen in to all of these transmissions.

Your station directory will probably also list the "10-code," used primarily by law enforcement agencies, as the opening paragraphs of this article revealed. This "oral shorthand" keeps communications very brief, and allows extensive and rapid message-handling on only one frequency. If this code isn't in the directory, ask your scanner dealer about it. As a last resort, simply listen a lot to any activity on your scanner. As you figure each one out, keep notes. Eventually you will compile a list of the dozen or so which are used most commonly in your area.

Another list that is sometimes included in a directory is a selection of Penal Code and Vehicle Code violations. These will vary from state to state. In California, for example, Section 459 of the Penal Code covers burglary. Thus, a "459 in progress" is a burglary occurring at the present time. The best source for all the numbers is the public library. Again, keeping notes as you hear the numbers used will tell you which ones to look up.

A map of the area in which you listen is a great aid in learning where the action is occurring. It's also a fine way to get acquainted with streets and districts you weren't familiar with. As you follow the response of police or fire agencies to an emergency, you will gain far more respect for their organized efficiency. You will learn where district borders are and how the agencies cooperate in more serious incidents. A major fire takes on the disciplined sense of a military exercise as different departments "attack" and neighboring fire departments "move up" to cover their empty stations.

Every scanner owner should have his or her own "personalized frequency list." On a single sheet of paper list all of your local services and their operating frequencies. Also indicate the typical use for each frequency. Services often use several channels, for example: a dispatch channel, a record information channel, a car-to-car communications channel, a car-to-station channel, auxiliary channel, etc. If you have programmed these frequencies into your monitor, list also the particular scanner channel on which it may be "accessed." This list is useful when you want to monitor a frequency not previously programmed, or when you decide that it's time to reprogram your monitor radio. You'll be surprised how often that happens as you learn about new frequencies and as activity on the different channels changes.

You might find listening to public utility communications normally pretty dull, and ignore them, but during a storm you get first-hand accounts of where any damage has been, how severe it was, and an idea of what's being done to correct the situation. Forestry Service air frequencies are silent during the rainy season, but after the fire season starts in early summer the action can be more exciting than television. And you don't have to sit and watch anything!

As a dedicated monitor user or "scannerphile," you will want to keep all of your information together. Use a notebook to keep the vehicle code numbers, penal code numbers, frequencies for services, the 10- code, and any other data which you have collected. Keeping good notes will allow you to better enjoy your "tool/toy." If you hear slang, write it down, with a definition if you have figured it out.

For example, in California drunk driving is covered by section 23152 of the Vehicle Code. Thus, a possible drunk driver is referred to as a "Deuce" because the number ends with a 2. Your notebook will likely continue to grow if you're an active scanner listener in this fascinating hobby of eavesdropping.

Using Your Scanner

When programming your scanner, try to keep agencies together as a group, even if you don't intend to listen to all of the frequencies. If you do need to activate one of these auxiliary frequencies, perhaps a city police channel for a more distant part of a large city you live in, it will be easy to locate, even without consulting your notebook.

After selecting which frequencies to program, choose the one which is *least* important to you and try to place it on either your first (#1) channel or your last. Then if you decide later that you want to substitute a new frequency temporarily, you can easily do so without losing an important channel or wasting time trying to decide what agency to drop.

If your monitor has a delay feature (usually about two seconds), be selective about how to use it. If an agency operates in the so-called "duplex" mode, it means that the dispatcher talks on one frequency and the mobile unit answers on a different frequency. Improper use of the delay feature would cause you to lose the first few moments of a reply, and often those first few moments are all there are. If the agency operates in the "simplex" mode, it uses a single frequency, and the delay feature will help you to catch the reply without your scanner possibly moving on to some other active channel. Choose the delay feature only if you really want your scanner to "wait" for more activity before moving on to other channels if you're in a scan mode.

If your scanner has a "priority" feature, again be careful as to how or if you use it. This function allows you to pick one frequency as the single, most important one. If there is *any* activity on that channel, your scanner will leave any other communications you're listening to and lock onto your chosen priority. A typical priority might be your neighborhood fire department.

For temporary "priority," use your scanner's button marked Hold or some related word. This will act the same as the priority feature, but you won't be bothered by interruptions on the other channels. By activating this feature you will simply be monitoring a single channel.

If your monitor allows you to lock out channels individually, you can have frequencies preprogrammed and "at the ready" without actually using them. It is an easy procedure to unlock those channels when you need them.

Communications monitoring can be a lesson in civics. The interplay of various government and non-government agencies is far more complex than you would first imagine. For example, an automobile accident might initially involve the highway patrol or state police and an ambulance. Fire equipment is then often necessary, either for an actual fire, a washdown of spilled fuel, or extrication of trapped victims. Ambulances are dispatched on one frequency, they contact the local hospital on a second frequency, and are often in contact with a paramedic base station for on-the-scene instructions on a third frequency.

The paramedics may also communicate with the fire or police departments on still another frequency. The county sheriff may be called upon for a quick evacuation by their helicopter, a utility company might be called for downed power lines or a damaged fire hydrant, and the highway department can be involved in bringing a load of sand to cover an oil slick. Because each agency uses its own channel, the number of communications frequencies needed in a given incident can be staggering.

During major storms, earthquakes, or floods, the American Red Cross, National Guard, Coast Guard, and Amateur Radio contingents may be mobilized to assist. Trying to monitor all this activity can be confusing at first, but once you learn the various "languages" the information you will get will be more extensive than typical newspaper coverage, and it will be immediate and "live." You will probably also find that your appreciation of interagency cooperation will grow enormously. For such frantic activity it is best to choose only a few frequencies of the most interest to you and lock out the remainder. Otherwise you may miss the more important or exciting information.

If your scanner-monitor can be operated in your automobile, take it with you on trips. If you find that this is just as enthralling as it is at home, then consider some accessories. First, a mounting bracket under your dash and a separate antenna so you don't have to use either the car's radio antenna or the short built-in one. A magnetic, roof-mount type is best because it puts the antenna in the best location, requires no mounting holes, and can be easily removed by you, to prevent theft. The lead-in can be fed through a window and the antenna base will not scratch your paint.

You may also want a more efficient loudspeaker, located in the dash, to help overcome the addition of road noise. And don't forget to take your station directory along to help locate frequencies in neighboring counties or states.

Mobile use of your scanner will keep you up to date on road conditions and weather. Monitoring fish and game communications may help you to find the best fishing hole. In state or federal parks you can gain insight into special activities, dangerous conditions, vacant campsites, or even where the bears are.

If you know in advance which areas you are going to be visiting, make up a list of frequencies beforehand. Then simply reprogram as you cross county, state, or park boundaries. You will feel much less like a stranger. (Note that mobile use of scanners is forbidden in a few states. Check with local authorities.)

Keep Your Program Current

Using a scanner is an on-going, lively hobby. That means that it is continually changing. Don't hesitate to reprogram as your interests and events change. For example, Forest Service frequencies carry little forest or brush-fire communications during the winter, so that would be a good time to replace them, or just put them in hibernation until the following fire season. Local police traffic is generally heaviest on Friday and Saturday nights, so be sure to set your local frequencies to capture this activity at this time. During storms try monitoring the utility companies, highway patrol, or search and rescue units.

Be alert for special activities. As the Olympic torch traversed the nation prior to the Los Angeles Olympics of 1984, it was accompanied by a communications van. Ham-radio operators coordinated passing of the torch between the runners, while a listener could follow the excitement without leaving his living room. The two-meter ham band was used, which is included in the vhf high band of most scanners.

Another two-meter band activity of significance was the first communications from a radio amateur in space. In December of 1983, astronaut Owen Garriott, W5LFL, orbited the earth in the shuttlecraft Columbia, and used a handi-talkie to talk to ground stations as he passed briefly overhead. This could be heard on a scanner with an outside antenna. Will you be ready if this is repeated?

When you can take the time, try locating new frequencies, using your scanner's search mode, if it has this feature. A station directory will give you ideas of what frequency ranges to search for different types of stations. You might want to listen to ships at sea, taxis, tow trucks, or railroads. Or maybe eavesdrop on mobile phone conversations. (See Tom Kneitel's article on new frequencies, *Modern Electronics*, November 1984.)

Don't overlook marine radiotelephone conversations during warm-weather seasons if you live near the shore. And by all means, set aside a channel for aircraft communications if you're not too far from an airport.

Consider joining a scanner association. The RCMA (Radio Communications Monitoring Association) is a group that shares information about new frequencies, and passes along tips for improved performance. Contact them at P.O. Box 4563, Anaheim, CA 92803.

The electromagnetic spectrum is full of varied and exciting communications. To take advantage of what's happening in your local area, though, you must turn on your scanner rather than keep it idle. ME

BOOKS

High Technology Careers by Texe W. Mars. (Dow Jones-Irwin. Soft cover. 177 pages. $9.95.)

This book, while not all-encompassing in its coverage, will get you off to a start in making a high-technology career choice. It is written in a capsule format that gives you in bite-size pieces the pros and cons about some of the hottest employment opportunities in the various technologies.

After telling you about the bright promise of high-tech jobs and your future in here, the book discusses various opportunities in the fields of computers, robotics, space & air, telecommunications, lasers, bioengineering, pharmaceuticals, medical technology and advanced energy sources. Each chapter leads off with a short introduction and talks about job choices available in a specific field, what type of training is needed and where the training can be gotten. Salaries and benefits, where in industry and government you are likely to find employment opportunities and lists of leading employers are also included. Each chapter ends with a "recommended reading" list and a table of professional societies, associations, unions, etc. This book has all the elements you need to help narrow down your career choices. It even tells you the negatives, as a career-guidance manual should.

dBase III Handbook by George C. Chou. (Que Corp. Soft cover. 377 pages. $19.95.)

If you work with dBase III (or expect to), this book will clarify the user's manual provided with the software. Coverage of basic and more advanced operations for displaying and editing data provides a firm understanding of database management for effective use of dBase III. Extensive use is made of simple, concise examples, and the same database is used to illustrate as many different commands as possible.

The first three chapters contain introductory material on the database concept, a generalized run-through of the dBase III software, and the hardware and software required to make dBase III into a usable "system." From there on, the book is a hands-on tutorial for the software system, divided between key input and batch processing. The latter involves programming guidance, including using ASCII characters to form bar charts. At the end of the book, sections detail differences between dBase II and dBase III, methods for data sorting and filing, and using built-in functions to perform sophisticated mathematical operations.

In sum, *dBase III Handbook* is a fine book for learning all the fundamentals of using dBase III for database management. It doesn't relate key operating differences with the less powerful dBase II, which is regrettable since so many owners of the earlier version will upgrade to the newer one. For example, it would be nice to have pointed out that structures can now be modified. Also, information on setting up forms for printout is weak. Otherwise, the book is highly recommended.

NEW LITERATURE

PC Repair Kit Catalog. A new full-color catalog from A.P.E. Corp. features seven pages of listings and descriptions of printed-circuit board repair equipment. Highlighted are a complete repair and rework center for conventional and surface-mount boards, as well as track repair kits for repairing damaged circuit-board traces, plated-through holes and pc laminates. Included are detailed specifications for all kit models listed. For a free copy, write to: A.P.E. Corp., 142 Peconic Ave., Medford, NY 11763.

Educational Products Catalog. Heath/Zenith Educational System's new 48-page Education Catalog lists more than 175 technical training aids in electronics, robotics, computers and automation for schools and industry. Text, trainer and other materials for 12 educational categories are listed and described in the full-color catalog. Each course's description is accompanied by a "Course Outline" that details the topics discussed in each unit. Color-coded category "tags" appear at the tops of all right-hand pages for easy look-up. For a free copy, write to: Heath Co., Dept. 570-535, Benton Harbor, MI 49085.

Mobile Catalog. A 56-page catalog from Antenna Inc. lists the company's complete line of mobile antennas, portables and accessories. It lists products by frequency band for ease of use. Complete electrical and mechanical specifications, features and options for all products listed are given. For a copy of the catalog, write to: Antenna Inc., Rte. 79, Marlboro, NJ 07746.

Therefore, to avoid any alterations whatsoever, it is not uncommon for recording engineers to forego adulterating the program material by emphasizing it, assuring the listener of maximum fidelity.

Summing Up

Reduction of noise, which improves the signal-to-noise ratio, is the major benefit derived from the use of emphasis and deemphasis in CD recording and playback. Most major recordings are derived from multiple recorded tracks that are mixed down to the final two to make up the familiar stereo program. At every stage from microphone all the way to digital converter, the analog amplifiers inevitably cause an incremental increase in the noise floor and reduction of dynamic range.

Using enhancement during the recording process both reduces the effect of noise in playback and assists in overcoming the limitations of the playback equipment. Whether improved signal-to-noise ratio or virtually perfect linearity is more desireable is the choice of the producer of a given Compact Disc. The option of using emphasis/deemphasis gives the producer a powerful tool in dealing with noise when it exists to a degree significant enough to have an audible effect on the played back program. ME

SUBSCRIBER SERVICE

CHANGE OF ADDRESS

Planning to move? Please let us know six weeks in advance so you won't miss a single issue of MODERN ELECTRONICS

Attach old label and print new address in space provided. Also include your mailing label whenever you write concerning your subscription to insure prompt service on your inquiry

MODERN ELECTRONICS
76 N. Broadway,
Hicksville, NY 11801

ATTACH LABEL HERE

NEW ADDRESS HERE *PLEASE PRINT*

NAME ____________

ADDRESS ____________

CITY ____________ STATE ____________

DATE ____________ ZIP ____________

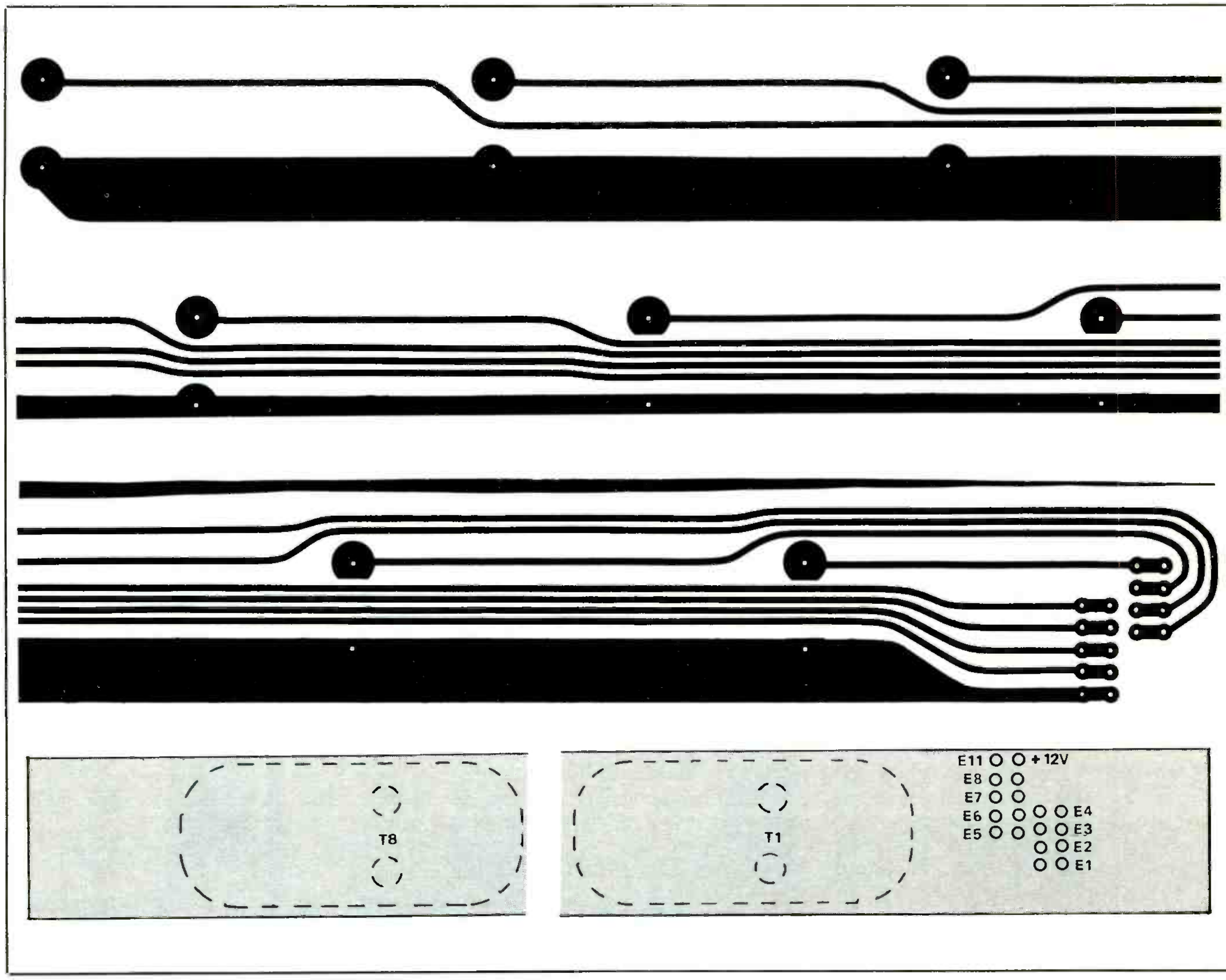


Fig. 3. Actual-size etching-and-drilling guide and reduced components-placement diagram for the display board. To make guide the 24" length required, add ¾" to the left end at top and 2½" to right end at bottom. Join the three pieces end-to-end from top to bottom. Component guide has center section removed to fit on page.

LED cutout. The lens serves two purposes. It protects the circuitry and provides contrast for good visibility of the "local" display under all lighting conditions.

Wire your choice of red or blue lamps into place on the display board (see Fig. 3). Remove ¼" of insulation from all conductors at both ends of a 12-ft.-long 9-conductor cable and two 12-ft.-long. red-insulated stranded hookup wires. If you prefer, you can use individual stranded hookup wires, preferably color coded, or a ribbon cable for the interconnect cable. After removing the insulation, tightly twist together all the fine wires in each conductor and sparingly tin with solder.

Plug one end of the cable into the holes on the display board labeled E1 through E8 with the index (marked) conductor of the ribbon cable going to E1, conductor 2 going to E2, etc. Do not connect the conductor coming from E11 on the lamp display board at this time. If you are using individual hookup wires, keep track of which goes where. Solder each conductor to its copper pad as you install it. Install and solder into place one end of the separate stranded hookup wire to the pad labeled E11. When all soldering is done, seal and weatherproof all connections with hot-melt glue or silicone adhesive.

Mount the lamp assembly behind your car's grille. Secure it in place with plastic ties. If the mounting space is too short, one of the lamps at each end of the assembly may have to be covered, with only minor effect in appearance. You may have to drill small holes in a plastic grille to secure the lamp assembly in place. A bit more work is required for a Camaro or Firebird body style because these cars have no grills or open spaces in which to mount the assembly. Fiberglass front sections with a cutout for the lamp assembly are available for these cars. (For information, write to the source given in the Note following the Parts List.)

Route the cable and individual stranded wire through your car's engine compartment and the firewall. Route the cable into the control circuit box. Taking care to wire to the proper points (see Figs. 1 and 3), connect and solder the conductors at the free end of the cable to the copper pads on the control board. Then connect and solder a 36" length of black-insulated, stranded hookup wire to the pad labeled E12 on the control circuit board and pass the free end through the cable hole. Solder short lengths of hookup wire to the pads labeled E9, E10 and E11. Mount the board in the box with and *R2/S1* in its hole.

Connect and solder the wires coming from holes E9 and E10 to the lugs of the potentiometer and from hole E11 to one lug of the switch as shown in Fig. 1. Connect and solder the cable conductor coming from E11 on the lamp display board to the other lug of the switch.

Assemble the control circuit box and mount it on or under your car's dashboard. Then terminate the free end of the black stranded wire in a spade lug and connect this to a good chassis ground with a screw.

Terminate the end of the red stranded wire with an in-line fuse holder to which is attached a 24" length of red-insulated stranded wire also terminated in a spade lug. Connect this wire to any point in your car's electrical system that has +12 volts on it when the ignition or an accessory is switched on and has no power present with the electrical system shut down. Install a fuse in the fuse holder. If you wire directly to the + terminal on your car's battery, you run the risk of running down the battery if you should forget to turn off the project after turning off the ignition.

Checkout and Use

With the project installed and its switch set to off, turn on your car's ignition (or switch to "accessory"). Set the project's switch to on and observe the LED display. Note that the LEDs sequence back and forth. Vary the setting of the potentiometer and note the change in speed of the sequencing rate. While you are at it, check that the incandescent lamp assembly is sequencing in step with the LEDs.

If everything appears to be working okay, set the potentiometer for the desired sequence rate. Toggle the project's power switch off and, a few seconds later, back on and note that the display (and lights) extinguish and then come back on again. Switch off your car's ignition or accessory and note that the project also switches off, regardless of the setting of *S1*. **ME**

MODERN ELECTRONICS MART

Classified Commercial Rates: 90¢ per word, 15-word minimum ($13.50) prepaid. (Word count includes name and address, ZIP code and abbreviation each count as one word; P.O. Box number and telephone number count as two words each.) Indicate free category heading. A special heading is available for a $6 surcharge. *First word only is set boldface caps* at no charge. Add 20% for additional boldface words.

Mart Display Rates: 1″ × 1 col., $120; 2″ × 1 col., $230; 3″ × 1 col., $330. Prepayment discount 5% for 6 issues; 10% for 12 issues prepaid at once.

(All advertisers with PO Box addresses must supply permanent address and telephone number. Copy is subject to publisher approval.)

Mailing Information: Copy must be received by the publisher by the 20th of the third month preceding the cover date. Send Advertising material with check or money order to: Modern Electronics, Classified Department, 76 N. Broadway, Hicksville, NY 11801.

VIDEO

CABLE TV Secrets - the outlaw publication the Cable Companies tried to Ban. HBO, Movie Channel, Showtime, Descramblers, Converters, etc. Suppliers list included. $8.95. Cable Facts, Box 711-ME, Pataskala, OH 43062.

WORLDS best channel 3 notch filter. $19.95. (Dealer inquiries invited). Crosley(G), Box 840, Champlain, N.Y. 12919.

CABLE and SUBSCRIPTION TV secret manual. Build your own **DESCRAMBLERS,** converters. Instructions, schematics for sine wave inband/outband gated sync SSAVI (HBO, Showtime, Cinemax, UHF, etc.). Send $8.95 to **CABLETRONICS,** Box 30502ME, Bethesda, MD 20814.

UNIVERSAL CRT Adapter. Guaranteed to work with All CRT Testers. Test/Clean/Restore All B/W, Color/Scope/Projection CRT's. Chargecards, COD's. $59.95 1-800-331-9658. Dandy Electronics, 2323 Gibson, Muskogee, OK 74403.

UNSCRAMBLE satellite signals the easy way. Parts available from Radio Shack. Send $19.95 for plans & catalog, board & plans $39.95, Kits from $99.95. Vidio Research, PO Box 2, Kingsport, TN 37662.

ELECTRONICS

NEW! FIBER OPTIC VOICE LINK. SEND YOUR VOICE OVER A BEAM OF LIGHT VIA AN OPTICAL FIBER. COMPLETE KIT INCLUDES MICROPHONE, SPEAKER, FIBER, PCB'S AND ALL PARTS. EASILY ASSEMBLED. INTRODUCTORY OFFER - SEND $34.95 TO: FIBER SCIENCES, KIT-73C, P.O. BOX 5355, CHATSWORTH, CA 91313-5355. CA RESIDENTS ADD 6.5%.

FAST A/D CONVERTERS. Five bit 90 nsec A/D converter module offers 5 MHz effective bandwidth for $25 (DA0175) - build video frame grabber. Eight bit 160 nsec sampling A/D converter for $40 (DA 0188) - add memory and trigger to make digital storage scope peripheral for PC for less than $100. Send SASE for product specifications. **DIPAC ASSOCIATES,** 645 Executive Center Dr. #204, West Palm Beach, FL 33401.

LOWEST POSSIBLE PRICES ANYWHERE! FULL WARRANTY - Most Audio Brands!! C.D.'s - Car Products - Computers (Hardware - Software) - Most Video Brands!! ELECTRIFIED DISCOUNTERS, 996 Orange Ave., P.O. Box 151, West Haven, CT 06516, MC/VISA (203) 937-0106.

SEE IN COMPLETE DARKNESS with amazing new infra-red night viewers. Kit $189. Factory assembled $295. Super long range model $750. (Dealers Wanted) Catalog $1. Crosley (G), Box 840, Champlain, NY 12919 (514-739-9328).

SAVE MONEY, ENERGY! Circuit makes batteries last longer! **USE IN YOUR OWN INVENTION!** State of the art. Almost anyone can build. Plans $10.00. WAYNE KESSLER, Box 665, Plymouth Meeting, PA 19462.

TRIACS- Prime RCA 100% tested. T4700D (400V 15A) . . . . 10/$7.50. T2700D (400V 6A) . . . . 10/$5.00. Shipping $1.00. Use MC/VISA & **Order Toll Free 800-821-5226** Extension 426. JIM RHODES, Inc.

PROJECT Builders, **Parts,** Catalog $1 with FREEBEE. B. Moore, 440 Old Conn Path, Framingham, MA 01701.

LINEAR PARTS, TUBES, TRANSISTORS —MRF454 $16, MRF455 $12, MRF477 $11, MRF492 $18. Catalog, RFPC, Box 700, San Marcos, CA 92069. (619) 744-0728.

RECONDITIONED Test Equipment. $1.25 for catalog Walter's, 2697 Nickel, San Pablo, CA 94806, (415) 724-0587.

$$$$$ Super Savings on electronic parts, components, supplies and computer accessories. Free 40-page catalog for SASE. Get on our mailing list. BCD ELECTRO, P.O. Box 830119, Richardson, TX 75083 or call 214-690-1102.

LASERS and Nightvision surplus components. FREE catalog, M.J. NEAL COMPANY, 6672 Mallard Ct., Orient, OH 43146.

SPECTACULAR STROBE LIGHT CHASERS, Stroboscopic Devices, High Voltage Supplies, Rare Scientific Items, Plans, Kits. Free Catalog. **ALLEGRO ELECTRONIC SYSTEMS,** #3 Mine Mountain, Cornwall Bridge, CT 06754.

SPECTRUM Analyzer/Receiver Kits $60. Send SASE for details. Science Workshop, Box 393ME, Bethpage, N.Y. 11714.

EARLY TV/Radio parts: Transformers, flybacks, speakers, picture tubes, etc., list SASE. Ned Carlson, Box 711, Normal, IL 61761.

COMPUTERS.

BASIC COMPUTERS, 10 lesson correspondence course, $39.50. Certificate. Details free. AMERICAN TECHNICAL INSTITUTE, Box 201, Cedar Mountain, NC 28718.

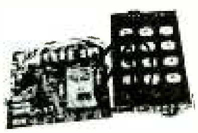
TI-99/4A Discount Software: Free catalog from Microbiz Hawaii, P.O. Box 1108 Pearl City, HI 96782.

CIRCLE 49 ON FREE INFORMATION CARD

SPEAKER CATALOG
1001 bargains in electronics. Save up to 50% call toll free 1-800-346-2433 for ordering only. Order by VISA/MC/AMX. No COD's. Missouri, Alaska, Hawaii call 1-816-842-5092, or write McGee Radio, 1901 McGee St., K.C., MO 64108. Postage for catalog $1.00.

PAY TV and Satellite Descrambling.
73 pages of theory and schematics for all major systems. Fantasy and Anik-D schematics included. Most complete reference available on satellite scrambling $12.95, MDS Handbook $10. Stungun schematics $5. Satellite systems under $600., $11.95. Printed circuits, kits catalog $12.
SHOJIKI ELECTRONICS CORP. 1327P Niagara Street, Niagara Falls, NY 14303 COD's 716-284-2163.

BUILD THIS ELECTRONIC DIGITAL CLOCK



only $12.50
Assembled only $16.50
- Ten thousands of combinations
- Use 9-16VDC
- Led indicator
- Control up to 200W
- Good for home and auto security
- Satisfaction guaranteed

every order please add $2.00 for shipping
M.T.F., Box 810391, Houston, TX 77281

A Great Gift Idea.
Send
MODERN ELECTRONICS
To A Friend.

OKIDATA 93 160 cps Wide Carriage, 40 cps Correspondence Mode, BRAND NEW - FULL WARRANTY. List $900.00 YOUR COST $379.00 Quantity Pricing Available MC/VISA Electrified Discounters, 996 Orange Ave., P.O. Box 151, West Haven, CT 06516, 203-937-0106.

HF WEFAX for the Apple (Mar 86 QST) TELEFAX for the Apple (Dec 85 QEX) WEFAX for the IBM (Jun 85 QST) Circuit Boards, Kits, or Assembled SASE for info: A & A Engineering, 7970 Orchid Dr., Buena Park, CA 90620 (714) 521-4160.

TURN your Commodore 64/Apple II into a Digital Storage Scope, $95/$125. NALAN Computer Specialties, 106 Highland Park Lane, Boone, NC 28608 (704) 264-2921.

REALIGN YOUR HEADS, Do it yourself booklet for Commodore 1541, $2.50 Box M4402, Manchester, N.H. 03108.

CLONE Kits, Modems, Hard Drive Kits, Disk Drives, Diskettes, Printers, Memory, ICs. Distributor Pricing To End Users and Dealers. Free Shipping. For Catalog Call 800-833-2600 in Ohio 513-531-8866.

TI-99/4A Software/Hardware bargains. Hard to find items. Huge selection. Fast Service. Free Catalog. TYNAMIC, Box 690, Hicksville, NY 11801

COMMUNICATIONS

ATTENTION CB'ERS HAMS SWL'S SEND FOR FREE DISCOUNT CATALOG. AMATEUR COMMUNICATIONS, 2317 VANCE JACKSON, SAN ANTONIO, TEXAS 78213 (512) 733-0334.

COMMUNICATIONS PLANS, BOOKS, KITS! AM/FM broadcasting (licensed/unlicensed), 1750 Meter transceivers, ham/CB amplifiers, surveillance bugs, more! FREE catalog. PAN-COM, Box 130-ME8, Paradise, CA 95969.

RADIO, free power, modern day crystal set. Detailed plans $4. MERIDIAN SYSTEMS, Box 116, Eliot, ME 03903.

AUDIO

LIGHTING and PA Equipment. Mobile DJ systems, permanent installations. Free catalog. TC Sound, Box 402, Austin, TX 55912.

INVENTORS

INVENTORS! Can you profit from your idea? Call AMERICAN INVENTORS CORPORATION for free information. Over a decade of service, 1-800-338-5656. In Massachusetts or Canada call (413) 568-3753.

INVENTORS! Have idea for product or invention, don't know what to do? Call AIM we present idea's to manufacturers - Toll Free 1-800-225-5800.

GADGETZ & GIZMOZ

BUGS, Gadgets, Miniature Transmitters, RC Devices. Kits. Free Information Micro'z Gizmo'z, 8280 Janes, Suite 105C, Woodridge, Illinois 60517.

MISCELLANEOUS

ASIAN LADIES want correspondence for friendship, marriage. SUNSHINE INTERNATIONAL, Dept. TW, Box 260, North Hollywood, CA 91603.

VCR VEGETABLE T-SHIRT Humorous twenty-four line poem in white ink on Navy Blue S,M,L,XL. Send $10 to P.O. Box 1927, New York City, N.Y. 10956-1927 (N.Y. residents add tax).

ELECTRONIC REPRESENTATIVES NEEDED!! Unlimited profit potential! Lowest possible prices!! Over 100 brands! Audio - Video - Car Stereo - Computers & Peripherals! ELECTRONIC EXPERTS, 1000 Orange Ave., West Haven, CT 06516.

Order Form
Please print in block letters.

MODERN ELECTRONICS 76 North Broadway, Hicksville, NY 11801

Name ______
Street ______
City ______
State ______ Zip ______

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25
26	27	28	29	30

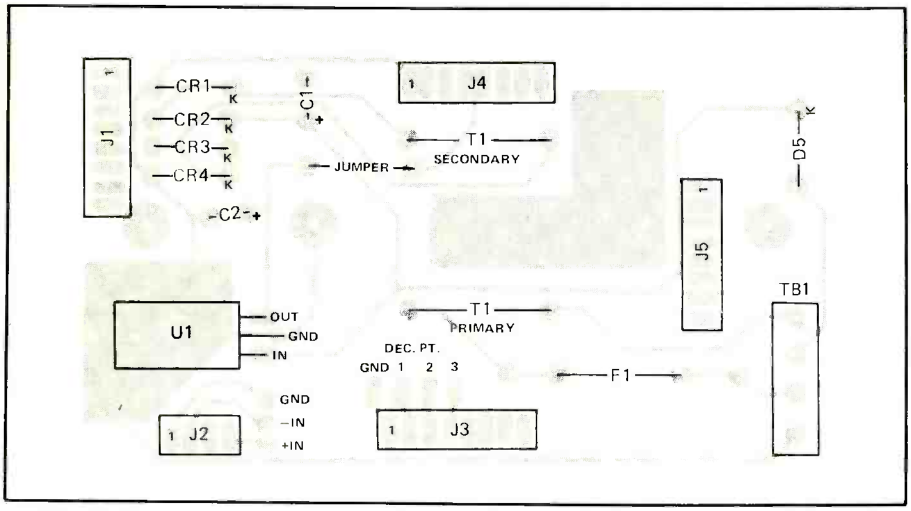


Fig. 7. Components placement/orientation guide for power-supply board.

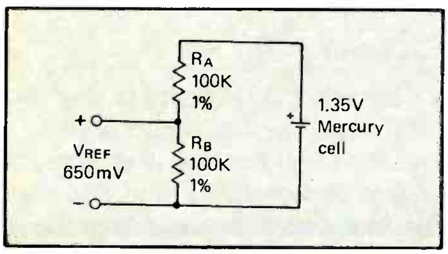


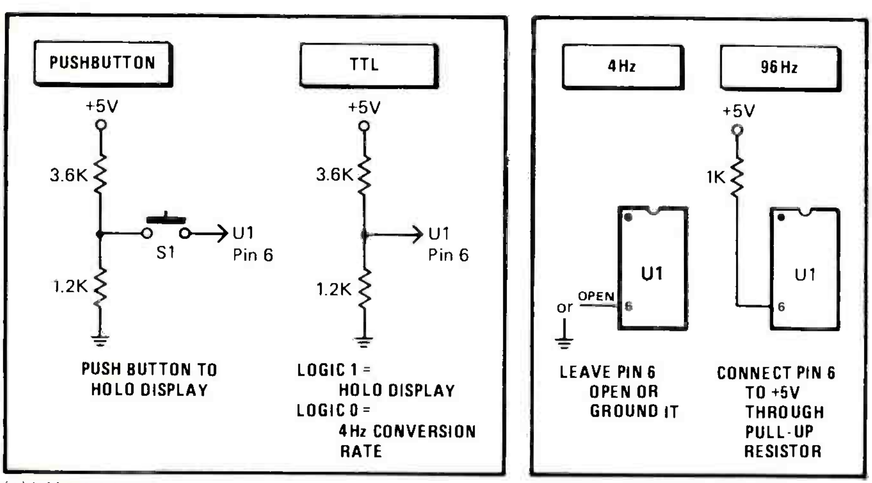
Fig. 8. Millivolt source for calibration can be assembled with two 100k resistors and 1.35-V mercury cell.

ly adjust the the GAIN trimmer for a reading or exactly 650 in the display.

Recheck the 000 reading and readjust if necessary. If you must readjust the ZERO control, reconnect the millivolt source and check the 650 reading. Repeat the GAIN and ZERO adjustments as necessary until no change is observed in the display. Then secure the trimmers with RTV or similar adhesive to prevent vibration from causing the DMS from drifting out of calibration.

The DMS is now calibrated for a + 999- to − 99-mV full-scale range.

In cases where the − IN terminal will not be grounded (floating input), the 100,000-ohm resistor at R_z should remain in place to provide bias feedback. On the other hand, if the − IN terminal is to be grounded, replace this resistor with a jumper wire. Positions R_x and R_y can be used for an onboard scaling network.



(A) HOLD CIRCUITS

(B) CONVERSION RATE CIRCUITS

Fig. 9. Hold (A) and conversion (B) circuits.

Pin 6 of *U1* provides the display-hold function when biased at + 1.2 volts. Several simple circuits for controlling the hold function and programming conversion rates are shown in Fig. 9. The Fig. 9A circuits provide for pushbutton or TTL control of the hold feature; those in Fig. 9B show methods of controlling update rates.

A multiplexed BCD output is available at *J1* (from pins 1, 2, 15 and 16 of *U1*) on the DMS board.

In Closing

As you can see from the foregoing, the Digital Measuring System's panel meter and companion 5-volt power supply serve as a solid foundation on which to build a multipurpose test and measuring instrument. Add-on function modules simply plug into the system via "buses" accessed through headers common to all circuit-board assemblies in the system. **ME**

```
40   REM TRANSMITTER PROGRAM -- DATA LINK
50   REM SET PA2 TO OUTPUT
100  POKE 56578, PEEK (56578) OR 4
150  REM BRING PA2 HIGH
200  POKE 56576, PEEK (56576) OR 4
300  POKE 56579, 255
350  GET C$: IF C$ = "" THEN 350
380  LET Y = ASC(C$+CHR$(10))
385  PRINT CHR$(Y);
390  REM SET X INTO OUTPUT PORT
400  POKE 56577, Y
410  REM BRING PA2 LOW
420  POKE 56576, PEEK (56576) AND 251
430  GOTO 100
450  STOP
```

This program operates the transmitting UART circuit. PA2 line loads and transmits data present on the User Port.

```
1    REM RECEIVER PROGRAM -- DATA LINK
5    REM SET FLAG 2 TO INPUT
10   POKE 56579, 0
100  REM READ FLAG 2
110  POKE 56589, 16
120  Y = PEEK (56589) AND 16
200  IF Y = 0 THEN 120
205  LET X = PEEK (56577)
250  PRINT CHR$(X);
260  GOTO 120
```

Use this program in the receiving C-64. It reads the receiving UART's output and changes the ASCII numbers back to the characters that were transmitted.

will respond to the signals as though they were being typed on the receiving consol's keyboard. Pressing the RETURN key will send the cursor down to the next line on the receiving screen. With a little more work, you can even program the receiving console with the transmitting console.

After both computers have their programs running, anything typed into the transmitting console appears on the receiving screen. Only elementary programs are shown here. Much more can easily be accomplished with more elaborate routines.

To adequately test the transmitter, it is helpful to hear the transmitted signals, using a small walkie-talkie or a weather radio. As keys are pressed on the transmitting console, you should hear the tones they generate loud and clear. If not, bring the radio's or walkie-talkie's antenna closer to the transmitting antenna to improve reception.

Each UART has a reset switch at pin 21 (*S1* and *S4* in Fig. 2). Pressing these switches opens the connections to ground and resets the UARTs. This external reset (XR) clears the UARTs and prepares them for proper operation. Transmission should start after any reset.

It should not be necessary to externally reset the circuits very often. Therefore, if you wish, you can eliminate *S1* and *S4,* replacing them with wires connecting pin 20 of *IC1* and *IC2* to ground. Thereafter, if a reset is necessary, all you have to do is turn off and then on the power to the two project sections. If you note that data does not appear to be getting through the receiver, even though you know it is being sent properly, simply reset the receiver and resend the data.

If you do not have access to a second computer, you can test the receiver circuit with light-emitting diodes wired between the data pins and ground. Connect the long leads of any small LEDs to each of the eight data pins of *IC2* and the short leads to ground. Each LED should now come on whenever a high bit is present on that line and remain off whenever a low bit is present. This is a good way to check the data link if you plan to use the system for other than communicating between two computers.

Summing Up

The Radio Data Link can be used for just about any data transmission application. All you have to do is make minor changes in the programming.

ADVERTISERS' INDEX

CIRCLE 29 ON FREE INFORMATION CARD


SINPO
BUSY
6.089.0
AM
CH
TIMER
ON
CLEAR
SET
HOUR
TIME
CLOCK 1
CLOCK 2
FREQ
ON
OFF
SLEEP
YAESU
COMMUNICATIONS RECEIVER
FRG-8800
MODE
AM
LSB
USB
CW
FM
NAR/WIDE
AGC
NB
DIM
D.LOCK
FAST
SLOW
M SELECT
M SCAN
MHz
kHz
MR
VFO
M CH
ATT
FINE
SQUELCH
TONE
AF GAIN
REC


YAESU
FRG-9600
905.0888


15.000.0
YAESU
COMMUNICATIONS RECEIVER
FRG-8800