Radio-Electronics®

EARLY DAYS OF TV: WHAT EVER HAPPENED TO CHANNEL 1?

$1.25 MAR. 1982

Laser-scanned and compact
DIGITAL AUDIO DISC
For super hi-fi

How it works:
ROAD INFORMATION SYSTEM
New use for FM SCA

Experimenter's notebook
OPERATIONAL AMPLIFIERS
How to design your own circuits

Build your own
UHF ANTENNA PREAMP
For better TV Reception

A
P ENERATORS
F workbench

PLUS:
- HOBBY CORNER
- COMPUTER CORNER
- SERVICE CLINIC
- STATE-OF-SOLID-STATE

THE

performers-

3 SMASH HITS . . . the 60 Series family

Ruggedness • Safety • Overload Protection

These VOM's have X-TRA™ rugged construction that can take a 5 ft. drop onto a concrete floor! They're safety engineered throughout with an unusual diode and multiple fuse arrangement providing overload protection for all ranges. Single selector switch reduces errors, in fact, the 60's eliminate over 90% of costly repairs from VOM misuse.

MODEL 60 VOM—28 ranges, approved by Mining Enforcement and Safety Administration (2G-2880), only $140.00. Model 60-A has 1½% DC accuracy plus mirrored scale, only $151.00.

MODEL 60-NA VOM—50 ranges, 1½% DC accuracy, mirrored scale, multiplier switch, only $191.00.

MODEL 64 FET-VO—FET design (high input impedance), Low-Power Ohms-LPΩ™—for in circuit testing, junction test circuit, exclusive MICRO POWER-TMP™ for long battery life under continuous operation, only $202.00.

Prices include test leads, new screw-on insulated alligator clips for probes, batteries, spare fuses, instruction manual and 1 year warranty.

For a demonstration, contact your Triplett distributor, Mod Center or representative.

Triplett Corporation, Bluffton, Ohio 45817
(419) 358-5015, TWX (810) 490-2400.

LOW AS **$140**

THE MARK OF QUALITY OVER 75 YEARS

Triplett performance... a tough act to follow

TRIPLETT

CIRCLE 40 ON FREE INFORMATION CARD

CIRCLE 39 FOR In-Plant Demonstration

We take the nail-biting out of mail-order shopping.

16K RAM KITS 13.95

Set of 8 NEC 4116 200 ns. Guaranteed one full year.

DISKETTES

ALPHA DISKS 21.95

Single sided, certified Double Density 40 Tracks, with Hub-ring. Box of 10. Guaranteed one full year.

VERBATIM DATALIFE

MD 525-01, 10, 16	26.50
MD 550-01, 10, 16	44.50
MD 557-01, 10, 16	45.60
MD 577-01, 10, 16	34.80
FD 32 or 34-9000	36.00
FD 32 or 34-8000	44.95
FD 34-4001	48.60

DISKETTE STORAGE

5¼" PLASTIC LIBRARY CASE	2.50
8" PLASTIC LIBRARY CASE	3.50
PLASTIC STORAGE BINDER w/ Inserts	9.95
PROTECTOR 5¼" (50 Disk Capacity)	21.95
PROTECTOR 8" (50 Disk Capacity)	24.95

PRINTERS

ANADEX DP 9500	1295.00
ANADEX DP 9501	1295.00
C-ITOH 25 CPS PARALLEL	1440.00
C-ITOH 25 CPS SERIAL	1495.00
C-ITOH 45 CPS PARALLEL	1770.00
C-ITOH 40 CPS SERIAL	1870.00
EPSON MX-80	$CALL
EPSON MX-80 F/T	$CALL
EPSON MX-100 GRAPHIC	$CALL
EPSON GRAFTRAX	90.00
IDS-445G PAPER TIGER	779.00
IDS-460G PAPER TIGER	945.00
IDS-560G PAPER TIGER	1195.00
NEC SPINWRITER 3510 S. RO	2195.00
NEC SPINWRITER 3530 P. RO	2195.00
NEC SPINWRITER 7710 S. RO	2645.00
NEC SPINWRITER 7730 P. RO	2645.00
NEC SPINWRITER 7700 D SELLUM	2795.00
NEC SPINWRITER 3500 SELLUM	2295.00
OKIDATA MICROLINE 80	389.00
OKIDATA MICROLINE 82A	569.00
OKIDATA MICROLINE 83A	799.00
OKIDATA MICROLINE 84	1199.00
QUME 9/45	2149.00
MALIBU 200 DUAL MODE	2695.00

APPLE HARDWARE

VERSA WRITER DIGITIZER	259.00
ABT APPLE KEYPAD	119.00
MICROSOFT Z-80 SOFTWARD	299.00
MICROSOFT RAMCARD	159.00
VIDEX 80 x 24 VIDEO CARD	299.00
VIDEX KEYBOARD ENHANCER II	129.00
VIDEX ENHANCER REV 0-6	99.00
VIDEX SOFT SWITCH	29.00
M & R SUPERTERM 80 x 24 VIDEO BD	315.00
NEC 12" GREEN MONITOR	199.00
NEC 13" COLOR MONITOR	399.00
SANYO 12" MONITOR (B & W)	249.00
SANYO 12" MONITOR (GREEN)	269.00
SANYO 13" COLOR MONITOR	469.00
SSM AIO BOARD (INTERFACE) A & T	165.00
SSM AIO BOARD (INTERFACE) KIT	135.00
ZENITH 13" HI RES. GREEN MON	139.00
APPLE FAN	44.95
T/G JOYSTICK	54.95
T/G PADDLE	34.95
VERSA E-Z PORT	21.95
MICRO SCI A40 W/CONTROLLER	479.00
MICRO SCI A40 W/O CONTROLLER	409.00
MICRO SCI A70 W/CONTROLLER	629.00
MICRO SCI A70 W/O CONTROLLER	549.00
THE MILL-PASCAL SPEED UP	329.00
PROMETHEUS VERSACARD	229.00

MODEMS

NOVATION CAT ACOUSTIC MODEM	145.00
NOVATION D-CAT DIRECT CONNECT	165.00
NOVATION AUTO-CAT AUTO ANS	219.00
NOVATION APPLE-CAT	349.00
UDS 103 LP DIRECT CONNECT	175.00
UDS 103 JLP AUTO ANS	209.00
HAYES MICROMODEM II (APPLE)	299.00
HAYES 100 MODEM (S-100)	325.00
HAYES SMART MODEM (RS-232)	249.00
HAYES CHRONOGRAPH	225.00
LEXICON LX-11 MODEM	109.00

ISOLATORS

ISO-1 3-SOCKET	53.95
ISO-2 6-SOCKET	53.95

BARE DRIVES

TANDON 5¼ INCH

100-1 SINGLE HEAD 40 TRK	219.00
100-2 DUAL HEAD 40 TRK	299.00
100-3 SINGLE HEAD 80 TRK	299.00
100-4 DUAL HEAD 80 TRK	429.00

TANDON THINLINE 8 INCH

848-1 SINGLE SIDE	459.00
848-2 DUAL SIDE	549.00

MICRO PRO

APPLE CP/M®

WORDSTAR*	259.00
SUPERSORT*	145.00
MAILMERGE*	90.00
DATASTAR*	215.00
SPELLSTAR*	169.00
CALCSTAR*	239.00

CP/M®

WORDSTAR	310.00
SUPERSORT	195.00
MAILMERGE	110.00
DATASTAR	245.00
SPELLSTAR	195.00
CALCSTAR	169.00

MICROSOFT

APPLE

FORTRAN*	165.00
BASIC COMPILER*	315.00
COBOL*	595.00
Z-80 SOFTCARD	299.00
RAMCARD	159.00
TYPING TUTOR	17.95
OLYMPIC DECATHLON	24.95
TASC APPLESOFT COMPILER	159.00

CP/M®

BASIC 80	299.00
BASIC COMPILER	319.00
FORTRAN 80	369.00
COBOL 80	595.00

APPLE SOFTWARE

MAGIC WINDOW	79.00
DB MASTER (NEW)	179.00
PFS: PERSONAL FILING SYSTEM	79.00
PFS: REPORT	79.00
Z-TERM*	89.95
ASCII EXPRESS	63.95
HAYDEN APPLESOFT COMPILER	149.00
EASY WRITER-PRO	199.00
EXPEDITER II APPLESOFT COMPILER	73.95
A-STAT COMP. STATISTICS PKG.	119.00
SUPER TEXT II	129.00

PERSONAL SOFTWARE

DESKTOP PLAN II	159.00
CCA DATA MGMT. SYSTEM	89.00
VISIPLOT	159.00
VISITREND/VISIPLOT	199.00
VISIDEX	159.00
VISITERM	129.00
VISICALC 3.3	159.00
VISIFILES	199.00

We built a reputation on our prices and your satisfaction.

We guarantee everything for 30 days. If anything is wrong, return the item and we'll make it right. And, of course, we'll pay the shipping charges.

We accept Visa and Master Card on all orders; COD orders, up to $300.00.

Add $2.00 for standard UPS shipping and handling on orders under 50 lbs, delivered in continental U.S. Call for shipping charges over 50 lbs. Foreign, FPO and APO orders, add 15% for shipping. Californians add 6% sales tax.

Prices quoted are for stock on hand and subject to change without notice.

To order, or for information, call:

(213) 706-0333

31245 LA BAYA DRIVE, WESTLAKE VILLAGE, CALIFORNIA 91362

Alpha Byte COMPUTER PRODUCTS

CIRCLE 45 ON FREE INFORMATION CARD

Save on Scanners! NEW Rebates!

Communications Electronics™ the world's largest distributor of radio scanners, celebrates 1982 with big savings on *Bearcat* scanners. Electra Company, the manufacturers of *Bearcat* scanners is offering consumer rebates on their great line of scanners, when purchased between February 1 and March 15, 1982.

With your scanner, you can monitor the exciting two-way radio conversations of police and fire departments, intelligence agencies, mobile telephones, energy/oil exploration crews, and more. Some scanners can even monitor aircraft transmissions! You can actually hear the news *before* it's news. If you do not own a scanner for yourself, now's the time to buy your new scanner from **Communications Electronics**. Choose the scanner that's right for you, then call our *toll-free* number to place your order with your Visa or Master Card.

We give you excellent service because **CE** distributes more scanners worldwide than *anyone* else. Our warehouse facilities are equipped to process thousands of scanner orders every week. We also export scanners to over 300 countries and military installations. Almost all items are **in stock** for **quick shipment**, so if you're a person who prefers fact to fantasy and who needs to know what's *really* happening around you, order your scanner today from **CE**!

NEW! Bearcat®† 350

The Ultimate Synthesized Scanner!

List price $599.95/CE **price $399.00/$50.00 rebate**
Your final cost is a low $349.00

7-Band, 50 Channel • Alpha-Numeric • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC

Bands: 30-50, 118-136 AM, 144-174, 421-512 MHz.

The new *Bearcat* 350 introduces an incredible breakthrough in synthesized scanning: Alpha-Numeric Display. Push a button—and the Vacuum Fluorescent Display switches from "numeric" to word descriptions of what's being monitored. 50 channels in 5 banks. Plus, Auto & Manual Search, Search Direction, Limit & Count. Direct Channel Access. Selective Scan Delay. Dual Scan Speeds. Automatic Lockout. Automatic Squelch. Non-Volatile Memory. Order your *Bearcat* 350 today!

Bearcat® 300

List price $549.95/CE **price $349.00/$50.00 rebate**
Your final cost is a low $299.00

7-Band, 50 Channel • Service Search • No-crystal scanner • AM Aircraft and Public Service bands. • Priority Channel • AC/DC

Bands: 32-50, 118-136 AM, 144-174, 421-512 MHz.

The *Bearcat* 300 is the most advanced automatic scanning radio that has ever been offered to the public. The *Bearcat* 300 uses a bright green fluorescent digital display, so it's ideal for mobile applications. The *Bearcat* 300 now has these added features: Service Search, Display Intensity Control, Hold Search and Resume Search keys, Separate Band keys to permit lock-in/lock-out of any band for more efficient service search.

NEW! Bearcat® 350

FREE Bearcat® Rebate Offer

Get a coupon good for a $50 rebate when you purchase a *Bearcat* 350 or 300; $25 rebate on model 250 or 20/20; $15 rebate on model 210XL; $10 rebate on model 160 or 4-6 Thin Scan. To get your rebate, mail rebate coupon with your original dated sales receipt and the *Bearcat* model number from the carton to Electra. You'll receive your rebate in four to six weeks. Offer valid only on purchases made betwen February 1, 1982 and March 15, 1982. All requests must be postmarked by March 31, 1982. Limit of one rebate per household. Coupon must accompany all rebate requests and may not be reproduced. Offer good only in the U.S.A. Void where taxed or prohibited by law. Resellers, companies, clubs and organizations–both profit and non-profit–are not eligible for rebates. Employees of Electra Company, their advertising agencies, distributors and retailers of *Bearcat* Scanners are also not eligible for rebates. Please be sure to send in the correct amount for your scanner. Pay the listed **CE** price in this ad. *Do not* deduct the rebate amount since your rebate will be sent directly to you from Electra. Orders received with insufficient payments will not be processed and will be returned. Offer subject to change without notice.

Bearcat® 250

List price $429.95/CE **price $279.00/$25.00 rebate**
Your final cost is a low $254.00

6-Band, 50 Channel • Crystalless • Searches Stores • Recalls • Digital clock • AC/DC Priority Channel • 3-Band • Count Feature.

Frequency range 32-50, 146-174, 420-512 MHz.

The *Bearcat* 250 performs any scanning function you could possibly want. With push button ease you can program up to 50 channels for automatic monitoring. Push another button and search for new frequencies. There are no crystals to limit what you want to hear. A special search feature of the *Bearcat* 250 actually stores 64 frequencies and recalls them, one at a time, at your convenience.

NEW! Bearcat® 20/20

List price $449.95/CE **price $289.00/$25.00 rebate**
Your final cost is a low $264.00

7-Band, 40 Channel • Crystalless • Searches AM Aircraft and Public Service bands • AC/DC Priority Channel • Direct Channel Access • Delay

Frequency range 32-50, 118-136 AM, 144-174, 420-512 MHz.

The *Bearcat* 20/20 automatic scanning radio replaces the *Bearcat* 220 and monitors 40 frequencies from 7 bands, including aircraft. A two-position switch, located on the front panel, allows monitoring of 20 channels at a time.

Bearcat® 210XL

List price $349.95/CE **price $229.00/$15.00 rebate**
Your final cost is a low $214.00

6-Band, 18 Channel • Crystalless • AC/DC

Frequency range: 32-50, 144-174, 421-512 MHz.

The *Bearcat* 210XL scanning radio is the second generation scanner that replaces the popular *Bearcat* 210 and 211. It has almost twice the scanning capacity of the *Bearcat* 210 with 18 channels plus dual scanning speeds and a bright green fluorescent display. Automatic search finds new frequencies. Features scan delay, single antenna, patented track tuning and more!

Bearcat® 160

List price $299.95/CE **price $194.00/$10.00 rebate**
Your final cost is a low $184.00

5-Band, 16 Channel • AC only • Priority Dual Scan Speeds • Direct Channel Access

Frequency range: 32-50, 144-174, 440-512 MHz.

The *Bearcat* 160 is the least expensive *Bearcat* crystalless scanner. Smooth keyboard. No buttons to punch. No knobs to turn. Instead, finger-tip pads provide control of *all* scanning operations.

NEW! Bearcat® 100

The first no-crystal programmable handheld scanner.

Allow 30-120 days for delivery after receipt of order due to the high demand for this product.

List price $449.95/CE **price $299.00**

8-Band, 16 Channel • Liquid Crystal Display Search • Limit • Hold • Lockout • AC/DC

Frequency range: 30-50, 138-174, 406-512 MHz.

The world's first no-crystal handheld scanner has compressed into a 3" x 7" x 1¼" case more scanning power than is found in many base or mobile scanners. The *Bearcat* 100 has a full 16 channels with frequency coverage that includes all public service bands (Low, High, UHF and "T" bands), the 2-Meter and 70 cm. Amateur bands, *plus* Military and Federal Government frequencies. It has chrome-plated keys for functions that are user controlled, such as lockout, manual and automatic scan. Even search is provided, both manual and automatic. Wow...what a scanner!

The *Bearcat* 100 produces audio power output of 300 milliwatts, is track-tuned and has selectivity of better than 50 dB down and sensitivity of 0.6 microvolts on VHF and 1.0 microvolts on UHF. Power consumption is kept extremely low by using a liquid crystal display and exclusive low power integrated circuits.

Included in our low **CE** price is a sturdy carrying case, earphone, battery charger/AC adapter, six AA ni-cad batteries and flexible antenna. For earliest delivery from **CE**, reserve your *Bearcat* 100 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).

Bearcat® Four-Six ThinScan™

List price $189.95/CE **price $124.00/$10.00 rebate**
Your final cost is a low $114.00

Frequency range: 33-47, 152-164, 450-508 MHz.

The incredible, *Bearcat* Four-Six Thin Scan™ is like having an information center in your pocket. This four band, 6 channel crystal controlled scanner has patented Track Tuning on UHF. Scan Delay and Channel Lockout. Measures 2¾ x 6¼ x 1." Includes rubber ducky antenna. Order crystal certificate for each channel. Made in Japan.

Fanon Slimline 6-HLU

List price $169.95/CE **price $109.00**

Low cost 6-channel, 3-band scanner!

The *Fanon* Slimline 6-HLU gives you six channels of crystal controlled excitement. Unique Automatic Peak Tuning Circuit adjusts the receiver front end for maximum sensitivity across the entire UHF band. Individual channel lockout switches. Frequency range 30-50, 146-175 and 450-512 MHz. Size 2¾ x6¼ x 1." Includes rubber ducky antenna. If you *don't* need the UHF band, get the **Fanon model 6-HL** for $99.00 each, and save money. Same high performance and features as the model HLU without the UHF band. Order crystal certificates for each channel. Made in Japan.

OTHER SCANNERS & ACCESSORIES

NEW! **Regency**® ‡ **D810 Scanner**	$319.00
NEW! **Rgency**® **D300 Scanner**	$219.00
NEW! **Regency**® **D100 Scanner**	$169.00
NEW! **Regency**® **H604 Scanner**	$129.00
Regency® **M400 Scanner**	$259.00
Regency® **M100 Scanner**	$199.00
Regency® **R1040 Scanner**	$149.00
SCMA-6 Fanon Mobile Adapter/Battery Charger	$49.00
CHB-6 Fanon AC Adapter/Battery Charger	$15.00
CAT-6 Fanon carrying case with belt clip	$15.00
AUC-3 Fanon auto lighter adapter/Battery Charger	$15.00
PSK-6 Base Power Supply/Bracket for SCMA-6	$20.00
SP50 *Bearcat* AC Adapter	$9.00
SP51 *Bearcat* Battery Charger	$9.00
SP58 *Bearcat* 4-6 ThinScan™ carrying case	$12.00
MA506 *Regency* carrying case for H604	$15.00
FB-E Frequency Directory for Eastern U.S.A.	$12.00
FB-W Frequency Directory for Western U.S.A.	$12.00
FFD Federal Frequency Directory for U.S.A.	$12.00
TSG "Top Secret" Registry of U.S. Government Freq.	$10.00
ASD Frequency Directory for Aircraft Band	$10.00
B-4 1.2 V AAA Ni-Cad batteries (set of four)	$9.00
A-135cc Crystal certificate	$3.00

Add $3.00 shipping for all *accessories* ordered at the same time.

INCREASED PERFORMANCE ANTENNAS

If you want the utmost in performance from your scanner, it is essential that you use an external antenna. We have six base and mobile antennas specifically designed for receiving all bands. Order **#A60** is a magnet mount mobile antenna. Order **#A61** is a gutter clip mobile antenna. Order **#A62** is a trunk-lip mobile antenna. Order **#A63** is a ¾ inch hole mount. Order **#A64** is a ⅜ inch snap-in mount, and **#A70** is an all band base station antenna. All antennas are $35.00 and $3.00 for UPS shipping in the continental United States.

BUY WITH CONFIDENCE

To ***get the fastest delivery from CE*** of any scanner, send or phone your order directly to our Scanner Distribution Center.™ Be sure to calculate your price using the CE prices in this ad. Michigan residents please add 4% sales tax. 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. Out of stock items will be placed on backorder automatically unless CE is instructed differently. 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. International orders are invited with a $20.00 surcharge for special handling *in addition* to shipping charges. All shipments are F.O.B. Ann Arbor, Michigan. No COD's please. Non-certified and foreign checks require bank clearance. Minimum order $35.00.

Mail orders to: **Communications Electronics**,™ Box 1002, Ann Arbor, Michigan 48106 U.S.A. Add $7.00 per scanner or phone product for U.P.S. *ground* shipping and handling, or $14.00 for faster U.P.S. *air* shipping to some locations. If you have a Visa or Master Card, you may call anytime and place a credit card order. **Order toll free** in the U.S.A. Dial 800-521-4414. If you are outside the U.S. or in Michigan, dial 313-994-4444. **Dealer inquiries invited.** Order without obligation today!

Scanner Distribution Center™ and CE logos are trademarks of Communications Electronics.™
† *Bearcat* is a federally registered trademark of Electra Company, a Division of Masco Corporation of Indiana.
‡ *Regency* is a federally registered trademark of Regency Electronics Inc. AD #121081

CODE OF ETHICS · VISA · MasterCard

COMMUNICATIONS ELECTRONICS™

854 Phoenix □ Box 1002 □ Ann Arbor, Michigan 48106 U.S.A.
Call TOLL-FREE (800) 521-4414 or outside U.S.A. (313) 994-4444

CIRCLE 48 ON FREE INFORMATION CARD

Radio-Electronics

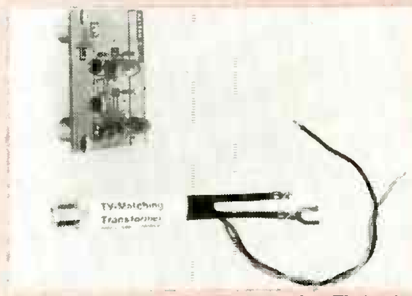
THE MAGAZINE FOR NEW IDEAS IN ELECTRONICS

Electronics publishers since 1908

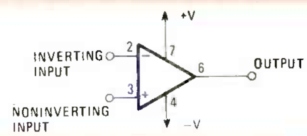
MARCH 1982 Vol. 53 No. 3

ON THE COVER

So far, the only way you could hear real digital sound reproduced on your own equipment was to invest in a $3000 PCM attachment for your VCR. Shortly, though, digital audio, using your existing amplifier and speakers, will be available for about the cost of a good turntable. New techniques—particularly in the area of laser scanning—will put 60 minutes of ultra-high-fidelity audio on one side of a disc you can hold in the palm of your hand. To find out what's in store, and how it works, turn to page 39.



GOOD UHF TELEVISION RECEPTION has always been more difficult to get than VHF. Part of the solution lies in a good antenna-system. An antenna-mounted preamplifier can also help. A preamp you can build that offers 25-dB of gain is described starting on page 59.



OPERATIONAL AMPLIFIERS (OP-AMPS) are an important—but frequently misunderstood—member of the IC family. Learn what makes them so useful and how to work with them beginning on page 54.

Radio-Electronics, (ISSN 0033-7862) Published monthly by Gernsback Publications, Inc., 200 Park Avenue South, New York, NY 10003. Second-Class Postage Paid at New York, N.Y. and additional mailing offices. One-year subscription rate: U.S.A. and U.S. possessions, $13.00. Canada, $16.00. Other countries, $20.50 (cash orders only, payable in U.S.A. currency.) Single copies $1.25.

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

VIDEO ELECTRONICS

DAVID LACHENBRUCH
CONTRIBUTING EDITOR

VCR DILEMMA

How to cope with the legal problems posed by the technological revolution is becoming a major political issue. Nowhere else is that as evident as it is in the case of home videotaping. In this instance, the immediate issue is whether private individuals who tape copyrighted programs off the air, or from cable TV, should pay for the privilege—and if so, how. The Appeals Court ruling in the Betamax case held that taping of such shows for personal viewing is a violation of the Copyright Law, and that manufacturers and sellers of VCR's are contributory infringers of the law. The three-judge court's decision indicated strongly that because Congress hadn't considered video technology when it passed the recent, revised, Copyright Law, perhaps congressional action would be necessary to cope with the problem.

Although the decision is being appealed to the Supreme Court, the action is likely to occur in Congress, where legislation has been introduced both to permit free taping and to add a fee to VCR's and/or videocassettes to be paid to the copyright holders of TV programs. The major antagonists are the electronics manufacturers, represented by the EIA, and the big movie companies, represented by Motion Picture Association of America. The EIA and its adherents argue that "time-shift" taping is merely another way of viewing a program at a more convenient time, accomplished in the privacy of the taper/viewer's home, and that the copyright owner of the program has already been paid for the televising of the show. The MPAA counters that home taping robs the copyright owner of his product without compensation and, at the very least, diminishes the value of the program in re-runs.

RENTABETA

In pre-recorded videocassettes, rental is becoming a major business. One study has indicated that for every program cassette sold, 20 are rented. But in the past, movie-cassette rental was open only to the 3% of the population who owned video recorders. Now the opportunity is being extended to the other 97%—the non VCR owners—through Rentabeta, developed by Superscope.

The principle of Rentabeta is simple—"the take-home movie in a video player." The rental package includes a Toshiba portable VCR, specially modified so that it is a play-only machine, in a case which can be locked by the dealer so the cassette cannot be removed. The customer chooses the cassette he wishes, it's loaded by the dealer into the player, and he carries the entire package home. Although rentals are expected to differ from dealer to dealer, the suggested price for rental of a machine loaded with one cassette is $8. Dealers may supply more than one cassette and leave the player unlocked so that the viewers can change cassettes themselves. Rentabeta players can be modified so they can't be rewound, permitting each cassette to be viewed only once. That has been suggested as a possible method of keeping positive track of the number of times each cassette has been viewed, so that producers of the rented movies can be paid royalties.

KODAK ANSWERS SONY

Responding to Sony's Mavica electronic still-camera (see **Radio-Electronics,** January 1982), Eastman Kodak President Colby Chandler said that his company had the capability to build an all-electronic camera. However, the solid-state sensor alone would cost as much as an entire film-camera, and picture information per frame would be about one-quarter that of a 110-size film frame or 1/20 of a 35-mm frame. He said that an electronic sensor with a million picture elements could made an acceptable 2×4-inch print, but he noted that a 110 frame has more than 2 million elements, and 35mm over 10 million (while Sony's Mavica sensor has 280,000).

He hinted at a possible Eastman Kodak electronic film-viewing system combining chemical and electronic technology, in these words: "Along with their initial print order, users of such a system might receive an image carrier that drops easily into a videoplayer attached to a TV set. With a hand-held remote unit, consumers might have selective control of images on the TV screen. At the touch of a button, the user could enlarge its image and freeze it for closer viewing. At the touch of another, the viewer could encode the film frame. Now the image—as the viewer has chosen to see it—would return to view in the form selected, when next it is inserted in the player." He indicated that that is one product being evaluated for the consumer market. **R-E**

ADVANCE IS PROUD TO INTRODUCE
The HITACHI Line
of High Quality Oscilloscopes
All Hitachi Instruments Are Backed by A Two-Year Warranty

AT LAST A 100MHz OSCILLOSCOPE WORTH WAITING FOR WITH NO WAITING

CALL FOR INTRODUCTORY OFFER

HITACHI 100MHz OSCILLOSCOPE MODEL V-1050

- 20kV CRT supply
- Large, bright 8 x 10 cm screen
- Four-trace operation (Ch1, Ch2, A trigger, B trigger)
- High sensitivity 500 uV/div (5MHz)
- High accuracy ±2% (+10°C to 35°C)
- Alternate timebase operation
- Full TV triggering

IN STOCK FOR IMMEDIATE DELIVERY

C.R.T.
Type
Hitachi 150BNB31 rectangular mesh type tube with 20kV acceleration potential and metal backed phosphor

VERTICAL DEFLECTION (2 Identical Channels)
Bandwidth and Rise Time
DC to at least 100MHz and rise time 3.5ns or less. DC to at least 5MHz and rise time 70ns or less at 10 X magnification. Lower -3db point, AC coupling 10Hz or less. 10x probe: 1Hz or less.

HORIZONTAL DEFLECTION
Time Base A
20ns/div. to 0.5s/div. in 23 calibrated steps, 1-2-5 sequence. Uncalibrated continuous control between steps 1: < 2.5
Time Base B
20ns/div. to 50ms/div. in 20 calibrated steps 1-2-5 sequence. 10x mag extends fastest sweep rate to 2ns/div.
Calibrated Sweep Delay
Continuous calibrated control between 0.5 and 10x time base A setting.

V-202 & V352 20MHz & 35MHz DUAL TRACE OSCILLOSCOPES

NEW

1. Square CRT with internal graticule (illuminated scale)
2. High-accuracy voltage axis and time axis set at ±3% (certified at 10° to 35°C)
3. High-sensitivity 1mV/div
4. Low drift
5. Dynamic range 8 div.
6. TV sync-separator circuit
7. Built-in signal delay line (V-352)
8. X-Y operation
9. Sweep-time magnifier (10 times)
10. Trace rotation system
11. Fine-adjusting, click-positioning function

SAVE UP TO $500 WITH SPECIAL REBATES

V-550B 50MHz, DUAL TRACE DELAYED SWEEP PORTABLE OSCILLOSCOPE

Delayed sweep permits 1,000 X Magnification

Variable Hold-off Circuitry Facilitates Pulse Measurement

- Large, Bright 8 x 10cm Screen
- High Sensitivity 1mv/div (10MHz)
- 5 ns/div Sweep Rate
- 3rd Channel Display (Trigger View)
- Variable Trigger Hold-off
- Full TV Triggering
- Single Sweep
- Automatic Focus Correction

ADVANCE ELECTRONICS

THE TEST EQUIPMENT SPECIALISTS

TOLL FREE HOT LINE 800-223-0474

master charge VISA

54 WEST 45th STREET, NEW YORK, N.Y. 10036 212-687-2224

WHAT'S NEWS

New device cuts HV transmission losses

A new type of thyristor (silicon controlled rectifier) that promises to slash operating costs of high-voltage direct current (HVDC) power-transmission lines, was described by GE scientist Victor Temple at the International Electron Devices Meeting at Washington, DC, last December. Thyristors are power semi-conductor-devices that are used to switch and control large amounts of electric power, turning it on and off in a few microseconds.

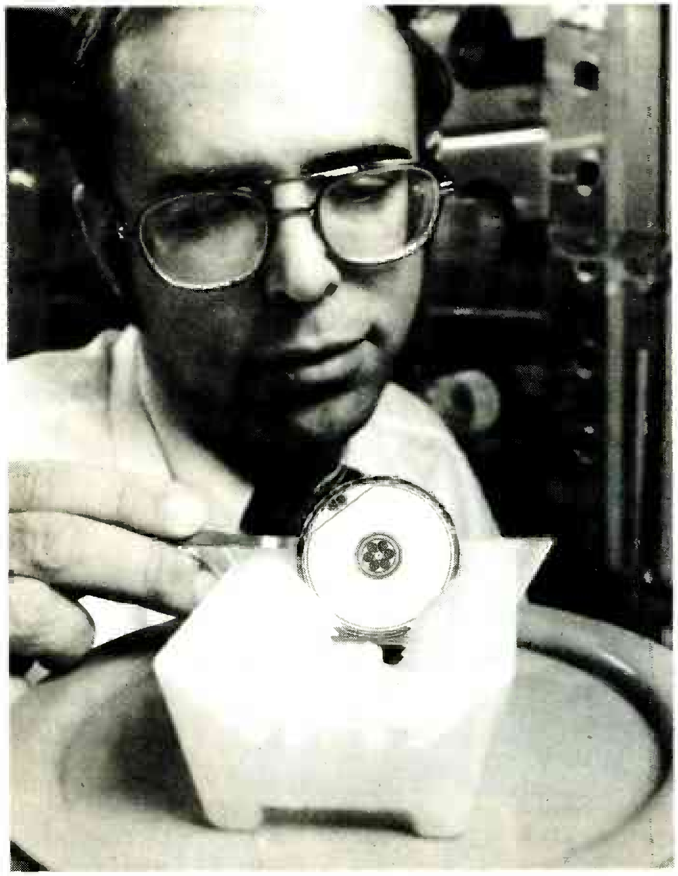
HVDC lines can carry twice as much power as AC lines with the same peak voltage rating, thus slashing transmission costs. But the high costs of the converter stations that turn the AC into DC for long-distance transmission and back into AC for local distribution can cut deeply into those savings.

Thyristors for HVDC application are made from thin, .04-inch thick slices of silicon that are three inches in diameter. Normally they are activated by an electrical gate current. The new thyristor is activated by weak pulses of light carried on fiber-optic cables. Because of its innovative design, it can handle large currents while consuming little power itself, thus reducing converter-station losses.

Light-activated thyristors are not new, but all previous types have had the disadvantage that the weak gate signal activates only a small portion of the thyristor. The current pouring through heats that portion to unsafe temperatures, and may cause melting breakdown.

In the new thyristor, resistors inserted in the silicon wafer between amplifying stages limit the current to safe levels. A resistor is etched in the wafer between the gate-amplifying stage and the pilot-amplifying stage. Another resistor is inserted between the pilot and the main stage.

In addition to HVDC converter stations, GE's light-fired thyristor has potential power-control applications in heavy industry, such as steel mills, and in locomotives.



GE's NEW THYRISTOR, inspected here by Dr. Victor A.K. Temple, promises great reductions in high-voltage DC power-line costs. Through its innovative design, it can handle large currents while consuming little power itself, reducing the conversion losses of HVDC transmission systems. Work on the device, still in the early developmental stage, is being sponsored by the Electrical Power Research Institute, the research arm of the electric utility industry.

Tektronix opens direct mail center

On January 1, 1982, Tektronix opened a direct-order channel, through which purchasers, by calling a toll-free number, may obtain information or order instruments.

The National Marketing Center, in Beaverton, OR, will expand customer service as well as meet the needs of new electronics purchasers. By calling 1-800-547-1845, customers can reach experienced sales engineers who will supply immediate technical consultation, applications assistance, and answers to a wide variety of measurement and safety problems.

The Center offers a direct contact for customers who purchase just one or two instruments and would not normally be served by a field service engineer.

The toll-free number will be staffed from 5 am EST till 8 pm EST.

Right to videotape supported by EIA

The right to private citizens to tape television programs for their own use must be protected by law at once, testified Jack Wayman, Senior Vice President of the Consumer Electronics Group of the Electronic Industries Association, before the U.S. Senate Judiciary Committee. That legislation is necessary, he said, as a result of the recent court decision that holds it illegal for consumers to videotape selected programs off the air, even for private, non-commercial use.

Wayman pointed out that, in general, copyright owners are not damaged by private taping of TV. "Surveys show," he said, "that 70 to 90 percent of all VCR owners use their VCR's primarily to 'time shift'—to view programs they could not have watched at the time of transmission." That kind of taping indirectly benefits the copyright owner by increasing the broadcast audience and thus the value of the program to the broadcaster.

If Senate Bill 1758, legalizing private copying, is not passed immediately, Wayman said, some movie company might obtain an injunction against VCR's. That could cause severe economic damage not only to manufacturers, but to the dozens of American companies that distribute the product, and the more than 25,000 retail outlets that are now selling VCR's as well as blank and pre-recorded tapes. The industry could be paralyzed for a long time, while the matter remained in litigation, possibly going all the way to the Supreme Court.

The analogous right to record audio material has never been seriously challenged, as long as the recordings were not offered for sale, though drastic penalties have been imposed for selling such recordings.

Fort Worth will get a videotext system

Tandy Corp/Radio Shack plan to install and operate an electronic information base (videotext) in the Forth Worth/Tarrant County area. Objectives will be to provide subscribers with continuously updated information,

continued on page 12

Accurate, Timely, Thorough . . .

RCA 1982 TELEVISION SERVICE DATA

Accurate because it is prepared by service-experienced RCA Technical Publications editors who work closely with the engineers who design RCA Consumer Electronics products . . . **Timely** because it is promptly mailed (postpaid) directly to subscribers when the product is introduced . . . **Thorough** because it offers all of the following features that are essential for proficient servicing:

- **Easy-to-Trace Schematics**
- **Circuit Board Composite Views**
- **Chassis and/or Instrument Layout Diagrams**
- **Instrument Disassembly/Reassembly Instructions**
- **Service Adjustment Procedures**
- **Replacement Parts Lists**

- Complete coverage of all color and b/w TV Models Introduced in 1982
- TV Service Bulletins
- Ten-year RCA Service Data Index
- Saddlestitched format with drilled holes for easy insertion in optional three-ring binders

And More . . .

Your yearly subscription to RCA TELEVISION SERVICE DATA includes:

- *Complete Service Data* for all color and b/w TV models introduced during 1982
- *Service Bulletins* that keep you abreast of the latest circuit changes, recommended servicing procedures, and parts information
- *Ten-Year RCA Service Data Index* that references RCA Service Data by both model and chassis, and includes RCA Warranty Obligation Codes and a separate listing of RCA Service Bulletins

■ WITH TWO DURABLE VINYL-COVERED, THREE-RING BINDERS **Only $56.85***

■ WITHOUT BINDERS **Only $44.95***

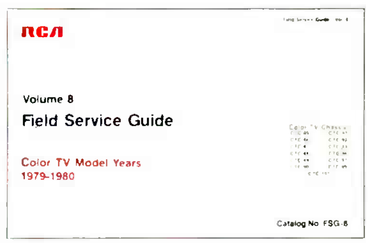
***INCLUDES RCA'S "PARTS INFORMATION SERVICE" . . .**
Quarterly mailings from RCA Distributor & Special Products Division that give you replacement parts price schedules. Tuner - and Module-to-Chassis cross references, and other parts-related information that servicers and dealers have been asking for . . . making your 1982 RCA TELEVISION SERVICE DATA subscription an even bigger bargain.

RCA FIELD-SERVICE GUIDE

Key field-service information from regular RCA Color TV service data . . . in a convenient, easy-to-use volume that covers two years of RCA Color TV models . . . complete chassis and tuner schematic diagrams and board views . . . chassis top and back views . . . field-service adjustments . . . parts lists . . . model index . . . troubleshooting tips . . . quick find indexes and cross references . . . each volume 17″ X 11″, Saddlestitched.

VOLUME 8 (1979-1980)
RCA Color TV Chassis
CTC 85, -86, -87, -88, -89, -90, -91, -92, -93, -96 -97, -99, -101

Only **$12.95**



1982 RCA SERVICE DATA SUBSCRIPTION ORDER FORM

CHECK APPROPRIATE BOX/INDICATE QUANTITIES AND PRICE TOTALS/ENCLOSE CHECK

MAIL TO: RCA TECHNICAL PUBLICATIONS 1-450
600 N. SHERMAN DRIVE
INDIANAPOLIS, IN 46201

1982 SERVICE DATA SUBSCRIPTION	PRICE	QUANTITY	PRICE TOTAL
☐ TELEVISION, WITH TWO BINDERS	$56.85 ea.	______	$ ______
☐ TELEVISION, WITHOUT BINDERS	$44.95 ea.	______	$ ______
☐ ADDITIONAL TV DATA BINDERS	$ 5.95 ea.	______	$ ______
FIELD-SERVICE GUIDE			
☐ VOLUME 8	$12.95 ea.	______	$ ______

(Please Print)

NAME ______________________ TOTAL (AMOUNT OF YOUR CHECK*) $ __________

STREET ADDRESS ______________________________

CITY ______________ STATE ______________ ZIP CODE ______________

*MAKE CHECK PAYABLE TO RCA CONSUMER ELECTRONICS

8203RE

Choose your training!

Only NRI gives you so many ways to get started on your TV/Video/Audio servicing career.

Only NRI gives you such a choice of practical experience projects with your training in servicing TV, video-cassette recorders and disc units, and audio systems. You can elect to build NRI's 25" (diagonal) color TV with state-of-the-art fully-computerized programmable controls. Or, take your bench training on the latest model RCA programmable videocassette recorder with exclusive videotaped lessons. Or concentrate on the world of audio as you work with a complete AM/FM stereo sound system. Any way you go, it's your choice... more choices than any other school.

Train with this programmable RCA video-cassette recorder

Each Course Complete

No matter which hands-on training program you select, your NRI course is complete. You get all 58 lessons covering every aspect of the field. TV, audio, and videocassette are just a start. You learn to install and service car radios and stereo systems... antenna systems including satellite TV...video disc players...cable TV... microprocessor controls and much more. NRI training is complete, thorough, and effective.

Learn at Home in Your Spare Time

NRI trains you at home, at your convenience. No need to quit your job or tie up your evenings with night school pressures. NRI "fast-track" training makes learning easier... Action Audio Cassettes guide you step by step... NRI "hands-on" projects give you practical bench experience as you progress. You not only get theory, you actually build and test electronic circuits using professional equipment included with your course.

Train as you assemble this fully-computerized, programmable 25" diagonal color TV

Learn by doing with NRI hands-on projects and professional instruments that you use and keep.

Professional Instruments Included

You'll work with the famous NRI Discovery Lab,® where theory comes alive, exploring concepts and learning by doing. You'll use the Beckman LCD digital multimeter to read currents and resistances, keep it for professional troubleshooting. You'll build a CMOS digital frequency counter, another valuable servicing tool. And, depending on which experience project you choose, you'll also build your own 5" solid-state oscilloscope and a 10-function TV pattern generator. Use them for learning, use them for earning.

NRI Picked by the Pros

A national survey of successful TV repairmen shows that more than half had home-study training, and among them, it's NRI 3 to 1 over any other school. That's why, more than 67 years and a million and a quarter students later, NRI is still the leader. You can't beat the up-to-the-minute training for effectiveness and value. See how NRI can do it for you.

Train on this AM/FM stereo system complete with speakers

Send for Free Catalog... No Salesman Will Call

Send today for our free, 100-page catalog which shows you all the kits and equipment you get, detailed lesson outlines, and convenient time payment plans. Or check out other fast-moving opportunity fields like Microcomputers & Microprocessors, Electronic Design Technology, Digital and Communications Electronics, and more. Mail the postage-paid card today and choose your training. If card has been removed, please write.

NRI Schools
McGraw-Hill Continuing Education Center
3939 Wisconsin Ave.
Washington, D.C. 20016

We'll give you tomorrow.

WHAT'S NEWS

continued from page 6

on demand, 24 hours a day.

News will be from local, regional, state, and national sources and will include sports, special events, business and financial news, and weather information.

Equipment used will be the *TRS-80 Model II* computer and the newly developed Communications Multiplexer.

According to Charles Phillips of Radio Shack, "We have not made a final decision on whether or not a subscription fee will be charged, but while much of the information will be free to the viewer, certain items will carry an access charge. We also plan to offer advertisers the opportunity to sponsor certain information pages."

The system will be offered to residents of the test area in early 1982.

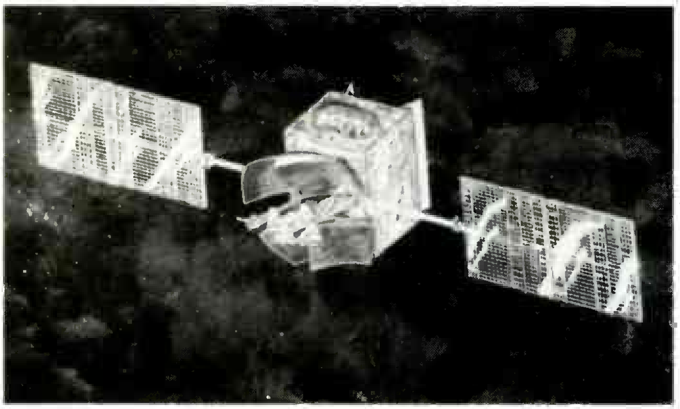
RCA's Satcom III relays cable TV

The third RCA communications satellite, Satcom III-R, launched last November into a geosynchronous orbit 23,000 miles above the equator, is intended to serve customers in the cable-TV industry. The 2,385-pound satellite was placed in position at 132 degrees West. It was the 11th U.S. domestic commercial satellite to go into orbit.

Like the earlier Satcoms, Satcom III-R has 24 transponders each of which can carry 1,400 voice circuits, one FM/color TV transmission, or 64 million bits per second of computer data.

The Satcom satellites cover all 50 states and Puerto Rico. More than 4,000 earth stations, serving 14 million homes, have access to those spacecraft. Without the spacecraft, thousands of miles of ground cables and microwave links would be required to perform the same service.

Satcom III-R is powered by two solar array panels and three nickel-cadmium batteries. Maximum output is 950 watts at 35 volts (regulated) at the beginning of service and 750 watts at the end of the satellite's 10-year life. The batteries supply power during the two solar eclipse periods that take place each year.



RCA's SATCOM III-R SATELLITE

New high-current cell supplies 5-15 amperes

A new high-current lithium thionyl-chloride cell just announced by the Altus Corp of San Jose, CA, is capable of putting out 5 amperes continuously and up to 15 amperes in short pulses.

The new flat-disc cell, designated the *AL250*, has an open-circuit voltage of 3.5 volts, operates at temperatures from −40 to +70 degrees centigrade, and can stand prolonged storage at extreme temperatures without noticeable losses in capacity or response time. Its shelf life is estimated at more than 10 years.

The cell is said to be absolutely safe under abusive conditions, such as incineration, crushing, or penetration.

ALTUS AL250, 3.5-VOLT, 5-AMPERE CELLS

FCC urged to speed satellite TV licenses

The Satellite Television Corporation (STC), a subsidiary of COMSAT, has urged the FCC to process pending direct-broadcast satellite (DBS) applications on an individual basis.

Individual processing will "...eliminate the possibility that consideration of a few troublesome proposals would delay the issuance of authorizations to applicants whose DBS systems clearly will serve the public interest."

STC was the U.S. pioneer in proposing DBS service for the United States. If the FCC moves expeditiously to approve DBS applications in early 1982, STC will be able to initiate its DBS pay-TV service in late 1985, or early 1986.

STC has asked for FCC approval to offer a satellite-to-home subscription television service using DBS satellites. It would offer three channels of premium programming, without advertising. Individual subscribers would receive the scrambled signals using 2½-foot dish antennas.

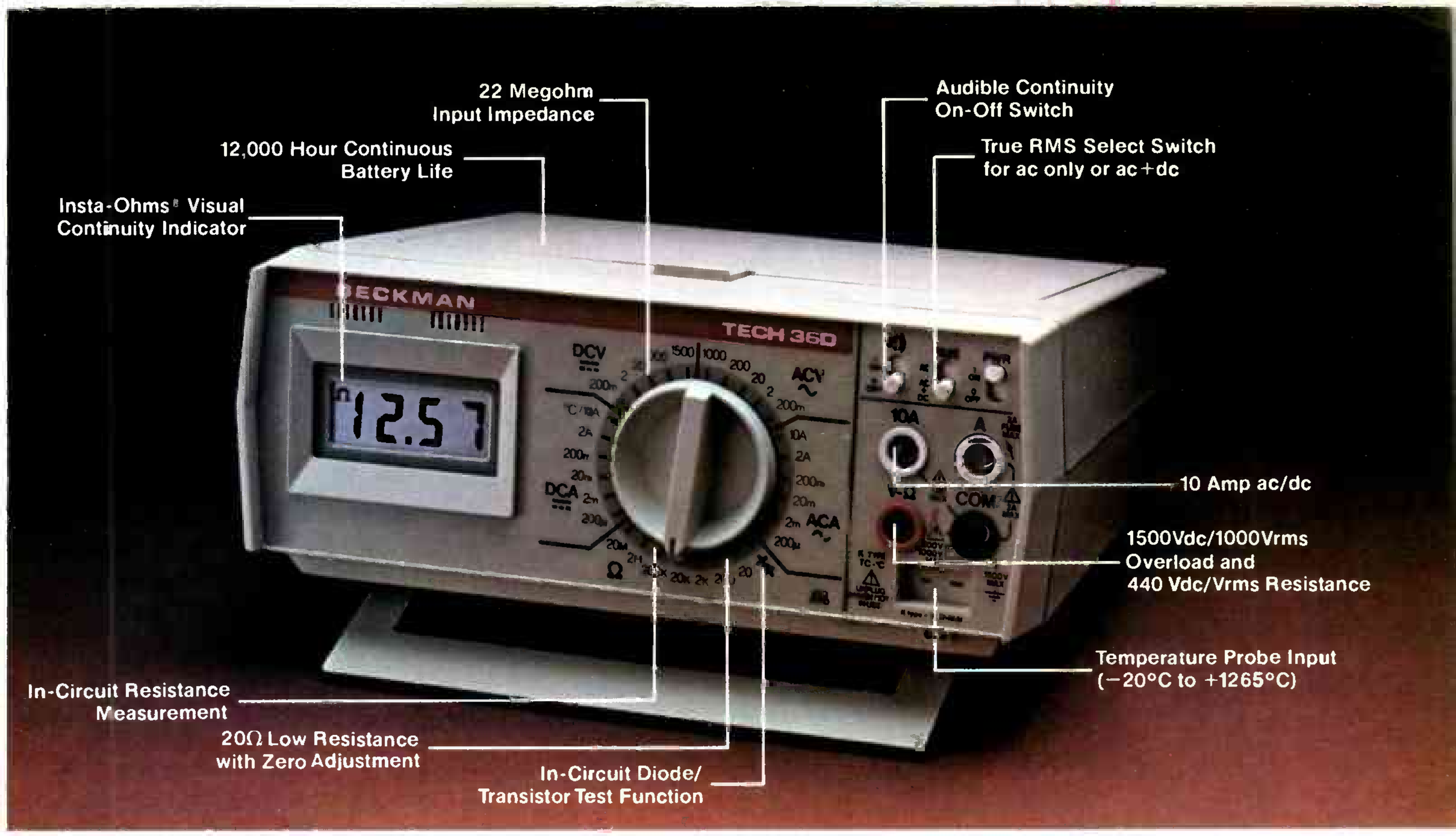
New message service between U.S. cities

RCA Network Services, an operating unit of RCA Communications, Inc., has filed an application with the FCC to construct and operate a nationwide digital electronic message-service (DEMS) among the nation's fifty major metropolitan areas.

The company believes that the first six areas—Atlanta, Chicago, Houston, Los Angeles, New York, and San Francisco—could be operational within 15 months of FCC approval and that the entire network could be in operation in seven years.

The DEMS network will provide high-speed, end-to-end private-line and switched services to the public. It is designed to handle digital bit-streams at rates ranging from 2.4 kilobits/second to 1.5 megabits/second, offering a flexible service to handle a wide variety of user applications: communicating word-processors, remote computer entry, high-speed facsimile, and videoconferencing.

RCA's proposed service will use satellite and microwave facilities for long-haul transmissions and the new Digital Transmission System (DTS) technology for transmission within cities. **R-E**



Introducing the TECH™ 360 DMM. Never has it been so easy to do so much for so little.

Beckman's TECH 360 bench/portable DMM puts unmatched capability and convenience at your fingertips.

You can select from 8 functions and 31 ranges with one turn of the single selector switch.

On or off the bench, you can accurately measure all complex waveforms with True RMS AC functions. Extend resistance measurement to 1/100 ohm resolution. Read temperatures from −20°C to 1265°C. Perform continuity checks quickly, with audible and visible indications. Measure up to 10 amps without adding special adaptors. All with 0.1% basic Vdc accuracy.

12,000 hour battery life

Designed for ultimate ease of operation, the TECH 360 delivers 12,000 hours continuous service (up to 4 years of normal use) from standard heavy-duty batteries. You'll never have to search for power outlets or contend with ground loop errors. The expense of rechargeable battery packs is eliminated.

The TECH 360 is available for just $289 (U.S. only), including batteries. The companion TECH 350 (without RMS and temperature measuring capability) is priced at $229.

For information on the complete line of Beckman DMMs and accessories, call your local distributor today. For the one nearest you call: (714) 993-8803 or write Beckman Instruments, Inc., Electro-Products Group, 210 South Ranger Street, Brea, California 92621.

Convenient storage and multiple viewing angles are featured in the new line of Beckman bench/portable DMMs.

CIRCLE 46 ON FREE INFORMATION CARD

BECKMAN

Radio-Electronics

Hugo Gernsback (1884-1967) founder
M. Harvey Gernsback, editor-in-chief
Larry Steckler, CET, publisher
Arthur Kleiman, managing editor
Josef Bernard, K2HUF, technical editor
Carl Laron, WB2SLR, assistant editor
Jack Darr, CET, service editor
Leonard Feldman
contributing hi-fi/video editor
Robert F. Scott, semiconductor editor
Herb Friedman, communications editor
Gary H. Arlen, contributing editor
David Lachenbruch, contributing editor
Earl "Doc" Savage, K4SDS, hobby editor
Ruby Yee, production manager
Robert A. W. Lowndes, production associate
Joan Burwick, production assistant
Joan Roman, circulation director
Arline R. Fishman,
advertising coordinator

Cover photo by Robert Lewis

Radio-Electronics is indexed in *Applied Science & Technology Index* and *Readers Guide to Periodical Literature*.

Gernsback Publications, Inc.
200 Park Ave. S., New York, NY 10003
President: M. Harvey Gernsback
Vice President: Larry Steckler

ADVERTISING SALES 212-777-6400

Larry Steckler
Publisher

EAST

Stanley Levitan
Radio-Electronics
200 Park Ave. South
New York, NY 10003
212-777-6400

MIDWEST/Texas/Arkansas/Okla.

Ralph Bergen
The Ralph Bergen Co., Inc.
540 Frontage Road—Suite 325
Northfield, Illinois 60093
312-446-1444

PACIFIC COAST
Mountain States

Marvin Green
Radio-Electronics
413 So. La Brea Ave.
Los Angeles, Ca 90036
213-938-0166-7

SOUTHEAST

Paul McGinnis
Paul McGinnis Company
60 East 42nd Street
New York, N.Y. 10017
212-490-1021

Facts from Fluke on low-cost DMM's

For a measurement like this, every millivolt matters.

In digital multimeters, accuracy and resolution go hand in hand. After all, an extra millivolt of resolution means nothing unless you can trust its accuracy. For critical measurements like checking avionics, calibrating medical systems, or simply verifying the performance of your circuit, it takes a precision DMM to fill the bill.

The new 4½-digit Fluke 8050A delivers 0.03% basic dc accuracy and 0.005% of full scale resolution. Measure ac and dc voltages with 10 μV of sensitivity. Or resolve 10 nA of current and 10 milliohms of resistance. All guaranteed for one full year.

That's the kind of performance you demand in a bench/portable DMM. And it's from Fluke, the leader in DMM's with a thirty year reputation for reliable, high-quality precision instrumentation.

Of course, there's more to the 8050A story. With our hybrid True RMS converter you get honest, accurate ac answers to 50 kHz without missing any significant distortion components. A dB function features 16 selectable reference impedances. And the relative mode lets you make offset measurements in all instrument functions.

You'll also find all the other dependable Fluke features on the new 8050A. Conductance for those high resistance and leakage measurements to 100,000 Megohms. Extensive overload protection and safety features. A full line of accessories. And a low price of only $369 U.S.

For all the facts on the new 8050A's accuracy and reliability, call toll free **800-426-0361**; use the coupon below; or contact your Fluke stocking distributor, sales office or representative.

FLUKE®

IN THE U.S. AND NON-EUROPEAN COUNTRIES:
John Fluke Mfg. Co., Inc.
P.O. Box C9090, M/S 250C
Everett, WA 98206
(206) 356-5400
Telex: 152662

IN EUROPE:
Fluke (Holland) B.V.
P.O. Box 5053, 5004 EB
Tilburg, The Netherlands
(013) 673 973
Telex: 52237

#1109-8/8050
RE 3/82

☐ Please send 8050A specifications.

☐ Please send all the facts on Fluke low-cost DMM's.

☐ Please have a salesman call.

Name

Title Mail Stop

Company

Address

City State Zip

Telephone ( ) Ext.

For technical data circle no. 43

LETTERS

UNICORN-1 ROBOT

I was impressed by the very thorough series of articles, "Unicorn-1 Robot," that appeared in **Radio-Electronics,** August 1980 through June 1981. However, there appear to be a few errors that should be noted.

In the March 1981 issue (page 65), the relay driver circuit will not work as explained in the text. As shown, the 2N2222 transistor and relay will be turned *on* in absence of a command. That is opposite the condition that is desired. In other words, what is required at the transistor base is a logic-low to de-energize the relay in the stand-by mode.

There are a couple of modifications that can be made without altering the printed-circuit boards. The choices are:

Latch Board: take the output signal from the Q pins 6 and 8, or:

Relay Driver Board: drive the transistor directly from the decoder board or latch board by eliminating the octal inverter (2813A) and placing jumper wire between input and output pins of the IC socket.

The suggestion to use PNP transistors is not recommended because that places 5-volts across the base-emitter junction and the driver in series; that could damage the transistor.

In the April 1981 issue (page 68), Fig. 80, and (page 69), Fig. 82, the latch board input and output signals on pins 9 and 11 of the 7474 IC are reversed.

WALTER PALANKER,
Magnolia, NJ

PROGRAMMING FLAW

I am the proud owner of a new personal computer system, and because of that, your October 1981 issue of **Radio-Electronics** caught my eye. I got a lot out of that issue!

I did a lot of shopping around before I decided on the TRS-80, 16K, color outfit. Along with it, I purchased some software

continued on page 22

More ways to C the value... with B&K-PRECISION

Now you can choose the capacitance measurement instrument you need from the industry's most complete line. For high-speed sorting, there's the 835 Digital Capacitance Comparitor; and for less specialized applications, the 830 Autoranging C-Meter and the 820 Manual Ranging C-Meter. All are GSA listed.

The 835 is a rugged production tool for isolating out-of-tolerance capacitors in the shortest possible time. Program-in acceptable high and low capacitance limits and then start testing. The 835 indicates "LO," "GOOD" or "HI." It also indicates capacitance values on an autoranging C-meter.

Combining autoranging and portability, the B&K-PRECISION 830 C-meter offers features that are tough to match at any price. Resolution is 0.1 pF, with readings displayed on a large 3-1/2-digit LCD display. Basic accuracy is 0.2%, much greater than the tolerance of most capacitors. Ease of operation is another strength of the 830. Even untrained workers can quickly learn its operation, though its performance also makes it ideal for engineering lab use. A selectable "range hold" is also featured.

For field or bench applications suited to manual ranging, B&K-PRECISION offers the 820—the industry's best C-meter value. The 820 displays readings to a full 1 Farad on a 4-digit LED display. Accuracy is within 0.5%.

All of the B&K-PRECISION C-measurement products are protected against charged capacitors. They all also allow you to measure unmarked capacitors, verify capacitor tolerance, measure cable capacitance, select and match capacitors for critical applications, perform quality assurance, measure complex networks, set trimmer capacitors and check capacitance in switches and other components. Options include the CF-10 test fixture for volume sorting; and for the 830 and 820, rechargeable batteries, AC charger and carrying case.

For immediate delivery or more details, see your local distributor, and see why B&K-PRECISION continues to be the leading supplier of digital capacitance measurement instruments. For the name of your nearest distributor call toll-free

800-621-4627.

B+K PRECISION DYNASCAN CORPORATION

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

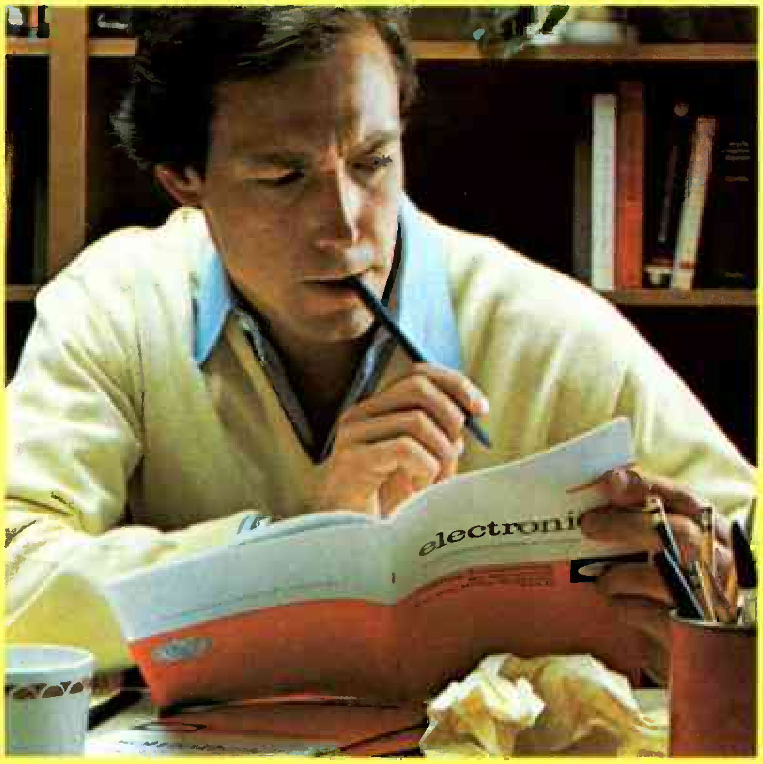
International Sales, 6460 W. Cortland Street, Chicago, IL 60635 USA: TELEX: 25-3475

Canadian Sales, Atlas Electronics, Ontario

Model 820 $185
Model 830 $229
Model 835 $675

CIRCLE 41 ON FREE INFORMATION CARD

Learning electronics is no picnic.



At any level it takes work and a few sacrifices. But with CIE, it's worth it.

LETTERS

continued from page 16

which included the "Computer Learning Lab." When I ran that particular program I discovered what I thought to be a major flaw in programming. That error was verified by my local dealer. I wrote to Tandy at the address listed in your magazine. That was over a month ago, and I thought that you might be interested to learn that no one has had the decency to acknowledge either the probable software problem or my letter.

Naturally, my impression is that the sales for Tandy stop short of customer service.

Thank you for your attention and for a truly informative magazine.
MRS. WENDY C. LOOMIS,
Binghamton, NY

Dear Mrs. Loomis:

Thank you for purchasing a Color Computer from Radio Shack. I am distressed to hear that you discovered a programming bug, notified Radio Shack, and that no one has gotten back to you to solve or confirm your problem.

Not having seen a copy of the article in the October 1981 issue of ***Radio-Electronics*** *to which you referred, and not knowing which address you were told to write to, I cannot comment on why there has been no response to your problem.*

The only programming error which we have found since releasing the "Color Computer Learning Lab" is in the chapter covering Sorts (Lesson 14). The sort routine, as shown in the manual and on the tape, will not sort the last value. Changing line 230 as follows will fix the problem:

230 FOR B = A+1 TO N.

That change should be made on pages 93 and 98 of your manual and to the program tape. Our customer-service group has this correction, and should have sent it to you. Any further problems concerning the Color Computer or the software for the Color machine should be sent to:

TRS-80 Customer Service, 400 Atrium, One Tandy Center, Ft. Worth, TX 76102.

You should include a phone number where possible, as sometimes it is quicker to call with the information or answer.

Radio Shack believes very strongly in support after sale. I am truly sorry for any inconvenience we may have caused you. Be assured that we will make every effort to assure that it does not happen again.
BARRY O. THOMPSON,
Product Line Manager—Color Computer

VHS DECKS

Your magazine and several others continually state that Akai has the only VHS decks with stereo sound. That isn't so; we have several Panasonic *NV-8200* VHS decks, as well as some Sony Beta *SLO-323* decks, both of which have two-channel audio, and have been giving us excellent service, since we put them into use last summer.

Also, with the increased interest in getting the best audio/video performance from one's own equipment, it might be interesting to your readers if you could come up with a circuit to add video and audio input jacks safely to existing receivers that lack this capability.
JIM CASSEDY,
Production Technician, Alcon Video/ Film Prods.,
San Francisco, CA

CX DECODER

There are a couple of small corrections to be made to the first part of the "CX Decoder" article, appearing in the December 1981 **Radio-Electronics.**

On page 46, the last sentence in the first paragraph of column 3 should read: "That higher bias also results in a higher gain in the *peak* mode than in the *CX* mode when expansion is not taking place." On the schematic, the value of R29 was left out; that should be 1K. I'm sure that I confused the draftsman, because my schematic shows pin 11 of IC4 connected both to −15 volts and ground. In any case, pin 11 of IC4 should go to ground, and not to −15 volts.

We will pack an errata slip with each kit-part order to catch those three points. The only other potential problem that I noted is that the print of the PC board seems to have blurred lightly, and you may get complains of shorting between adjacent conductors, because the board is so tightly laid out.

Aside from that, I am delighted with the article.
JOEL M. COHEN **R-E**

SATELLITE/TELETEXT NEWS

GARY ARLEN
CONTRIBUTING EDITOR

AUCTION SELLS TRANSPONDERS

In an unusual effort to allocate transponders aboard Satcom IV (which was due to go up in January), RCA Americom—which operates the satellite—sponsored an auction at swanky Sotheby Parke Bernet gallery in New York, better known for selling expensive art items. When the 45-minute action was over, six companies had paid a total of $90.1 million for the seven transponders which were being offered. The highest bid was $14.4 million, offered by "Transponder Leasing Co." That bought transponder two, probably for future voice and data communications services. Some names were familiar, and all of them paid more than $10.7 million per transponder. Among them were Home Box Office, which will operate on transponder 15; RCTV, the new service offering "The Entertainment Channel" of cultural and theatrical performances, which purchased transponder 11; Warner Amex Satellite will use transponder four; UTV Cable Network, a new entertainment and merchandising service, will have transponder 23; Inner City Broadcasting will go on transponder 16, and Bill Batts, an individual representing a Tennessee religious broadcasting group, will transmit on transponder three.

All of those allocations are in addition to the previous commitments—including some video as well as data services—which were already set for the new bird.

Meanwhile, some of the new Satcom IV residents are expanding their other transponder activities. HBO, of course, is well ensconced on several other current and future birds. RCTV recently entered into an agreement with Spanish International Network, which would give RCTV use of another Satcom IV transponder.

THE FCC'S TELETEXT NON-STANDARD

In keeping with official Washington's policy of "deregulation," the FCC has decided not to establish a formal teletext technical standard for the U.S., choosing instead to let the "marketplace" decide which format should be used. That means that competing French, British, and Canadian technologies will have to fight it out to win allies who will use their respective technologies on U.S. television stations. CBS says that it intends to begin transmitting teletext nationally during 1982; that could encourage its affiliates to adopt the French Antiope format, which CBS favors. Meanwhile, others are beginning to use other formats; for example, WKRC-TV Channel 12 in Cincinnati is planning to test the British Prestel format.

Although it won't adopt formal teletext standards, the FCC is currently considering a number of related technical issues. The Commission will consider the possibility of permitting teletext to be transmitted via lines 14 through 18, plus lines 20 and 21 of the vertical blanking-interval. The FCC is also considering possible future use of lines 10-13, using a phased-in schedule, once it is confirmed that those lines won't cause visual degradation of regular video images on TV receivers.

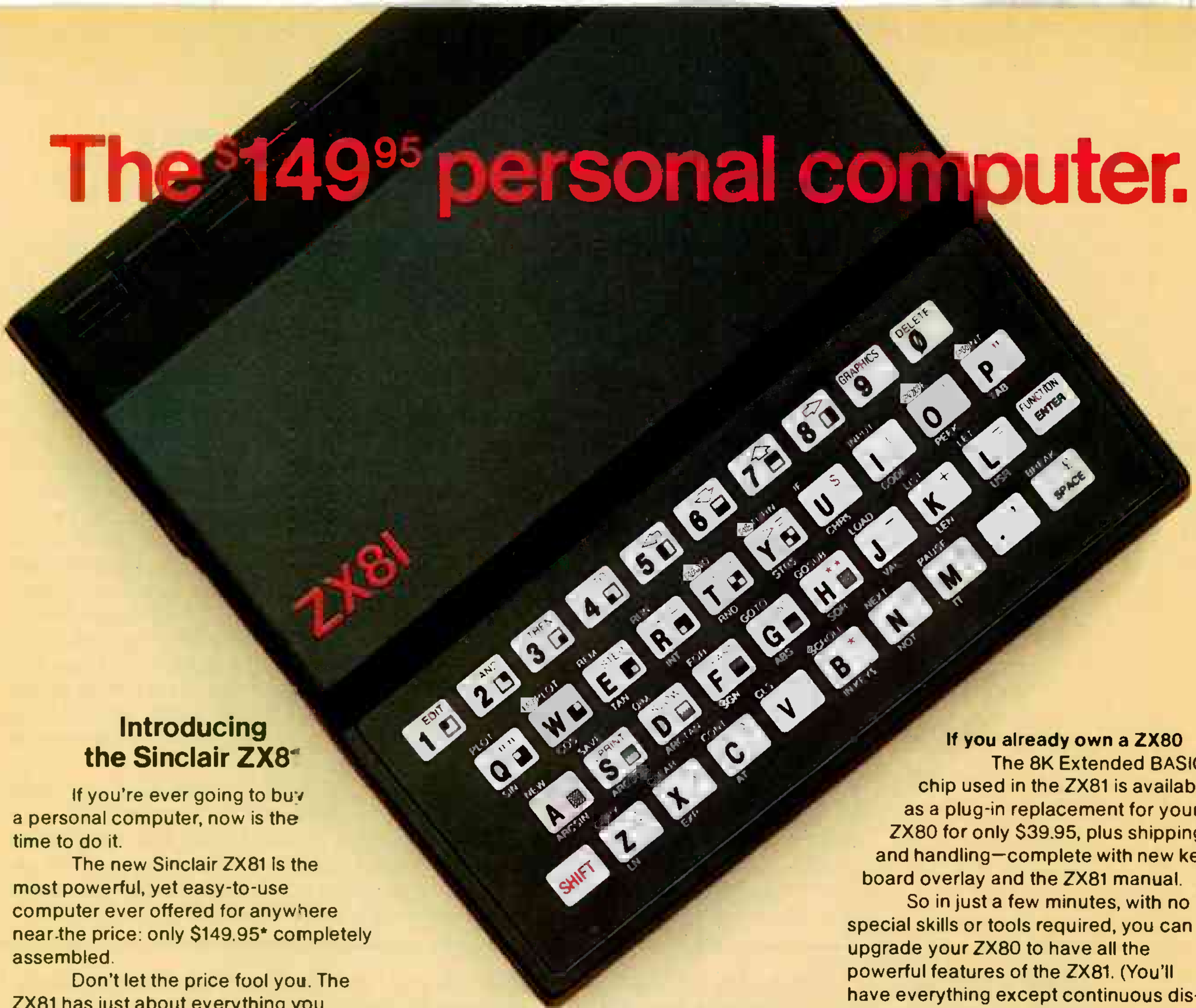
AROUND THE SATELLITE CIRCUIT

The continuing scramble skyward by several leading program suppliers promises to offer ever-more attractive shows during the coming year. Among the newest entries is "The Disney Channel," a service due to get under way early next year (1983). It will use two transponders aboard Westar V, which will be launched this fall. Walt Disney Productions and Westinghouse Broadcasting are cooperating to develop the 16-hour-per-day channel of pay-cable programming.

American Satellite Co. will provide all-digital satellite transmission for the Home Music Store, a new home-recording service offered by Digital Music Co. The electronic feed, due to get under way in July (1982) will provide cable-TV subscribers with master-tape-quality digital music for listening and licensed recording. Cable subscribers will need a special decoder to input the high-quality audio feed into their tape recorders. Music will be uplinked from Los Angeles to ASC's Westar transponders.

Comsat has proposed to provide the first full-time satellite TV service from the U.S. to an overseas location. The new service, due to begin in Fall 1982, will permit continuous video transmission from the U.S. to Australia, where it will be used by that nation's Channel 9. Comsat officials say that the type of international feed, which will be uplinked from a new facility in Southern California and travel via a Pacific Intelsat bird, is the forerunner of a "new kind of international TV service which will develop in the next few years." R-E

The $149⁹⁵ personal computer.



Introducing the Sinclair ZX81

If you're ever going to buy a personal computer, now is the time to do it.

The new Sinclair ZX81 is the most powerful, yet easy-to-use computer ever offered for anywhere near the price: only $149.95* completely assembled.

Don't let the price fool you. The ZX81 has just about everything you could ask for in a personal computer.

A breakthrough in personal computers

The ZX81 is a major advance over the original Sinclair ZX80—the world's largest selling personal computer and the first for under $200.

In fact, the ZX81's new 8K Extended BASIC offers features found only on computers costing two or three times as much.

Just look at what you get:

- Continuous display, including moving graphics
- Multi-dimensional string and numerical arrays
- Mathematical and scientific functions accurate to 8 decimal places
- Unique one-touch entry of key words like PRINT, RUN and LIST
- Automatic syntax error detection and easy editing
- Randomize function useful for both games and serious applications
- Built-in interface for ZX Printer
- 1K of memory expandable to 16K

The ZX81 is also very convenient to use. It hooks up to any television set to produce a clear 32-column by 24-line display. And you can use a regular cassette recorder to store and recall programs by name.

*Plus shipping and handling. Price includes connectors for TV and cassette, AC adaptor, and FREE manual.

If you already own a ZX80

The 8K Extended BASIC chip used in the ZX81 is available as a plug-in replacement for your ZX80 for only $39.95, plus shipping and handling—complete with new keyboard overlay and the ZX81 manual.

So in just a few minutes, with no special skills or tools required, you can upgrade your ZX80 to have all the powerful features of the ZX81. (You'll have everything except continuous display, but you can still use the PAUSE and SCROLL commands to get moving graphics.)

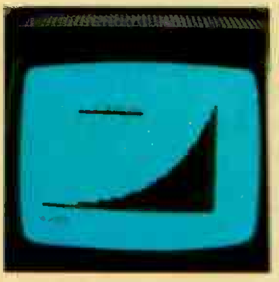
With the 8K BASIC chip, your ZX80 will also be equipped to use the ZX Printer and Sinclair software.

Order at no risk**

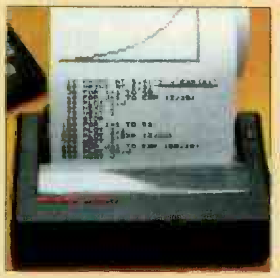
We'll give you 10 days to try out the ZX81. If you're not completely satisfied, just return it to Sinclair Research and we'll give you a full refund.

And if you have a problem with your ZX81, send it to Sinclair Research within 90 days and we'll repair or replace it at no charge.

**Does not apply to ZX81 kits.



NEW SOFTWARE: Sinclair has published pre-recorded programs on cassettes for your ZX81, or ZX80 with 8K BASIC. We're constantly coming out with new programs, so we'll send you our latest software catalog with your computer.



ZX PRINTER: The Sinclair ZX Printer will work with your ZX81, or ZX80 with 8K BASIC. It will be available in the near future and will cost less than $100.

16K MEMORY MODULE: Like any powerful, full fledged computer, the ZX81 is expandable. Sinclair's 16K memory module plugs right onto the back of your ZX81 (or ZX80, with or without 8K BASIC). Cost is $99.95, plus shipping and handling.

ZX81 MANUAL: The ZX81 comes with a comprehensive 164-page programming guide and operating manual designed for both beginners and experienced computer users. A $10.95 value, it's yours free with the ZX81.

The 99^{95} personal computer.

Introducing the ZX81 kit

If you really want to save money, and you enjoy building electronic kits, you can order the ZX81 in kit form for the incredible price of just $99.95.* It's the same, full-featured computer, only you put it together yourself. We'll send complete, easy-to-follow instructions on how you can assemble your ZX81 in just a few hours. All you have to supply is the soldering iron.

How to order

Sinclair Research is the world's largest manufacturer of personal computers.

The ZX81 represents the latest technology in microelectronics, and it picks up right where the ZX80 left off. Thousands are selling every week.

We urge you to place your order for the new ZX81 today. The sooner you order, the sooner you can start enjoying your own computer.

To order, simply call our toll free number, and use your MasterCard or VISA.

To order by mail, please use the coupon. And send your check or money order. We regret that we cannot accept purchase orders or C.O.D.'s.

CALL 800-543-3000. Ask for operator #509. In Ohio call 800-582-1364. In Canada call 513-729-4300. Ask for operator #509. Phones open 24 hours a day, 7 days a week. Have your MasterCard or VISA ready.

These numbers are for orders only. For information, you must write to Sinclair Research Ltd., 2 Sinclair Plaza, Nashua, NH 03061.

sinclair

AD CODE 03RE	PRICE†	QTY.	AMOUNT
ZX81	$149.95		
ZX81 Kit	99.95		
8K BASIC chip (for ZX80)	39.95		
16K Memory Module (for ZX81 or ZX80)	99.95		
Shipping and Handling	4.95		$4.95
		TOTAL	

MAIL TO: Sinclair Research Ltd., One Sinclair Plaza, Nashua, NH 03061.

NAME ______

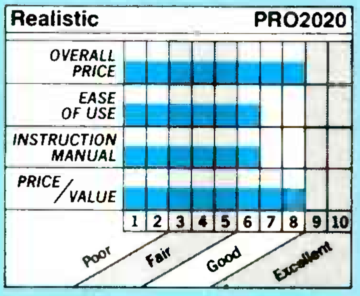
ADDRESS ______

CITY/STATE/ZIP ______

† U.S. Dollars

EQUIPMENT REPORTS

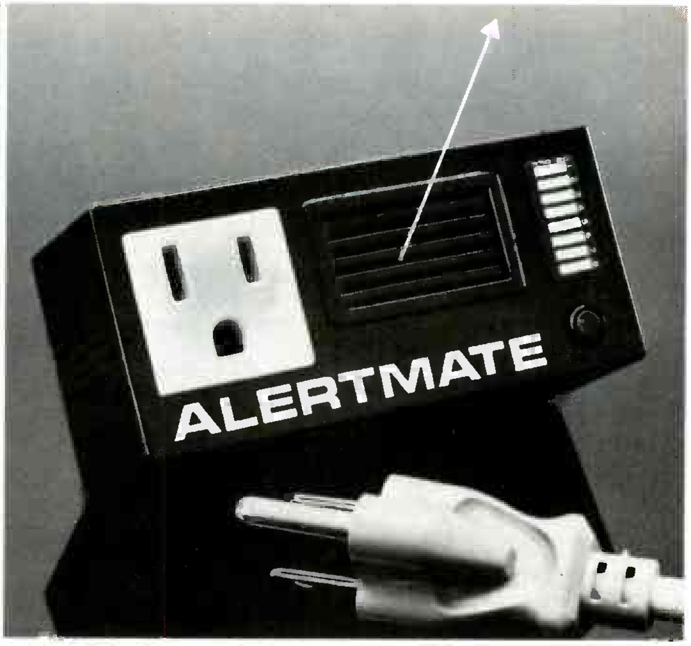
Realistic PRO-2020 Programmable Scanner



CIRCLE 101 ON FREE INFORMATION CARD

THE INCREASING AVAILABILITY OF FREquency-synthesized scanners has been a boon to listening enthusiasts. One of the newest scanners is the Realistic *PRO-2020* programmable AM/FM scanner from Radio Shack (One Tandy Center, Fort Worth, TX 76102). Covering 30-50, 108-136, 138-174, and 410-512 MHz, it has one of the widest tun-

continued on page 34



GET BURGLARS COMING AND GOING.

Every 10 seconds, a burglary takes place somewhere in the United States. There was a 20% rise in violent crime during 1980, the highest in 10 years.

Luckily, we have two unique products to help keep you from becoming another crime statistic.

1. Portable intrusion alarm

How can you protect your home or business without spending a fortune on a perimeter security system? How about when you're sleeping in a hotel room, an easy mark for the growing population of hotel burglars?

Simply place the pocket-sized SensAlert™ in any room, aiming the sensor towards doors or windows. As soon as an intruder enters, the movement triggers a piercing alarm.

At home, a SensAlert in every room protects you while you're in the house. It's different from (and less expensive than) perimeter security systems, which are turned on while you're away. Even place SensAlert at your backyard gate while you sunbathe; the tone tells you someone's arrived.

Carry a SensAlert in your briefcase or pocket when you travel, to protect the entire hotel room, not just the door.

There's no installation and no electric wire; SensAlert is battery-operated. It can be set to work either in the daytime or at night.

A free sign for your door knob is included with each order. It warns that the room is protected by SensAlert.

Put SensAlert in your desk drawer at the office. It will go off if anyone opens it while you're out.

A built-in light allows you to use SensAlert as an emergency flashlight. The alarm can also be triggered manually, for a distress signal.

2. Plug-in theft protection

Valuable electrical equipment is at the top of a burglar's hit list. Typewriters, adding machines, TV's, stereos, tape recorders, power tools.

It only takes a few seconds to unplug and carry off a TV or typewriter. A quick, easy theft and resale. You're vulnerable at home and at the office.

Before Alertmate™, you had two choices: bolt appliances to furniture, or invest in a costly and complex security system.

Now, you can simply plug the Alertmate into the wall outlet, secure it with one screw, and plug in the appliance.

If a thief pulls out the plug, a piercing alarm goes off. And keeps going. A definite theft deterrent! The only way to deactivate the alarm is to plug the appliance back in, or dial the correct number code. The alarm will also ring if the cord is cut.

A free sticker is included. It states that the equipment is protected by Alertmate, and gives you a space to write in the name of an individual who has the combination.

When you want to move equipment yourself, you simply deactivate the alarm with the combination. Protect each piece of expensive equipment inexpensively and easily, with Alertmate.

30-day free trial

It could cost you over $1,000 to install security systems giving you the same amount of protection as SensAlert and Alertmate.

1. Alertmate, the plug-in alarm for valuable equipment, is only $24.95 including the free sticker plus $2.50 postage and handling.
2. SensAlert, the portable intrusion alarm with flashlight, soft-tone feature, and free door hanger, is $39.95 plus $2.50 postage and handling.

Order both at $64.90 and pay the $2.50 postage and handling only once: (Total: $67.40) Batteries not included. Credit card holders: use our toll free number.

Order Toll Free: (800)423-6383

In California: (800)352-6207

SUNSHINE EXPRESS

4357 Chase Avenue
Los Angeles, CA 90066

Simulated TV Reception

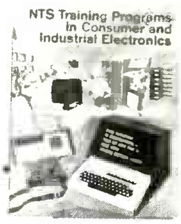
4.

3.

1. **The NTS/Rockwell AIM 65 Microcomputer** A single board unit with on-board 20 column alphanumeric printer and 20 character display. A 6502-based unit 4K RAM, expandable. 2. **The NTS/KIM-1 Microcomputer** A single board unit with 6 digit LED display and on-board 24 key hexadecimal calculator-type keyboard. A 6502 based microcomputer with 1K RAM, expandable. 3. **The NTS/HEATH H-89 Microcomputer** features floppy disk storage, "smart" video terminal, two Z80 microprocessors, 16K RAM memory, expandable to 48K. 4. **The NTS/HEATH GR-2001 Digital Color TV (25" diagonal)** features specialized AGC-SYNC muting, filtered color and new solid-state high voltage tripler rectifier.

NTS NATIONAL TECHNICAL SCHOOLS

TECHNICAL-TRADE TRAINING SINCE 1905
Resident and Home-Study Schools
4000 SO. FIGUEROA ST., LOS ANGELES, CA. 90037



NATIONAL TECHNICAL SCHOOLS
4000 South Figueroa Street,
Los Angeles, California 90037 Dept. 206-032

Please rush FREE color catalog on course checked below

- ☐ **MicroComputers/MicroProcessors**
- ☐ **Communications Electronics**
- ☐ **Digital Electronics**
- ☐ **Industrial Technology**
- ☐ **Auto Mechanics**
- ☐ **Air Conditioning**
- ☐ **Home Appliances**
- ☐ **Color TV Servicing**

Name ______ Age ______

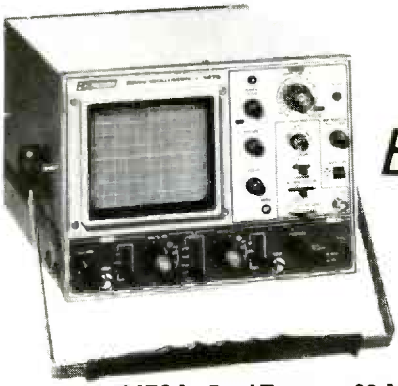
Address ______

Apt. ______ City ______

State ______ Zip ______

☐ Check if interested in G.I. information.
☐ Check if interested ONLY in classroom training in Los Angeles.

THESE 1981 B&K OSCILLOSCOPES ARE IN STOCK AND AVAILABLE FOR IMMEDIATE DELIVERY



B+K PRECISION

1479A	Dual-Trace	30 MHz
1477	Dual-Trace	15 MHz
1432	Dual-Trace	15 MHz Portable
1476	Dual-Trace	10 MHz
1466	Single-Trace	10 MHz
1405	Single-Trace	5 MHz
1420	Dual-Trace	15 MHz Portable

CALL FOR OUR EARLY BIRD SPECIAL LOW PRICE

PORTABLE OSCILLOSCOPES
BATTERY OPERATED

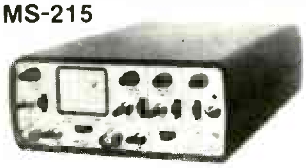
NLS Non-Linear Systems

Call For Our Prices

MS-15

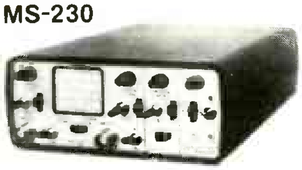
Single Trace 15MHz

MS-215



Dual Trace 15 MHz

MS-230



Dual Trace 30MHz

FLUKE® DIGITAL MULTIMETERS

Model 8022B: The Troubleshooter

$139

- **Six functions**
  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
- 3½-digit resolution
- 0.25% basic dc accuracy
- LCD display
- Overload protection

Model 8020B: The Analyst

$189

Model 8024A: The Investigator

$239

NEW

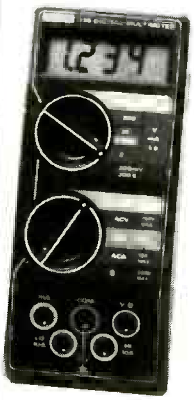
Model 8020B:

- **Seven functions**
  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
  conductance (1/R)
- 3½-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection
- Two year parts and labor warranty

Model 8024A:

- **Nine functions**
  dc voltage
  ac voltage
  dc current
  ac current
  resistance
  diode test
  conductance (1/R)
  logic level and continuity detect
  temperature (K-type thermocouple)
- Peak hold on voltage and current functions
- Selectable audible indicator for continuity or level detection
- 3½-digit resolution
- 0.1% basic dc accuracy
- LCD display
- Overload protection

KEITHLEY MODEL 130 DIGITAL MULTIMETER



	RANGE	ACCURACY
DC VOLTAGE	200mV, 2V, 20V, 200V, 1000V	.5%
AC VOLTAGE	200mV, 2V, 20V, 200V, 750V	1%
DC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	2%
AC CURRENT	2mA, 20mA, 200mA, 2000mA, 10A	3%
RESISTANCE	200Ω, 2kΩ, 20kΩ, 200kΩ, 20MΩ	.5%

$125.

DATA PRECISION Model 938
0.1%, 3½-Digit, LCD DIGITAL CAPACITANCE METER

$219

- WIDE RANGING — from 199.9 pF full scale (0.1 pF resolution) up to 1999 μF full scale, in eight ranges...virtually every capacitance you'll ever need to measure.
- FAST AND EASY TO USE — Direct reading, pushbutton ranges. Just plug in and read.
- EXCEPTIONALLY ACCURATE — provides ±0.1% basic accuracy.
- TOUGH AND COMPACT — Built to take rough usage without loss of calibration accuracy. Fits and goes anywhere; takes very little bench space; always handy for quick capacitance checkout, matching, calibration, and tracking.
- PORTABLE — Palm-sized, light-weight, operates up to approximately 200 hours on a single 9V alkaline battery.
- EASY READING — big, clear, high-contrast 3½-digit LCD display, a full 0.5" high, readable anywhere.
- VALUE PACKED — Outstanding measurement capability and dependability. Outperforms DC time-constant meters, and even bridges costing 2 to 5 times as much.
- RELIABLE — warranteed for 2 full years.

EQUIPMENT REPORTS

continued from page 26

ing ranges available on the programmable-scanner market.

The *PRO-2020* will scan up to 20 channels and has automatic up- and down-search capability as well. Mobile or fixed-station operation is possible, and a 9-volt battery is used as a backup to hold memory in case of power failure.

The large fluorescent display indicates channel number, frequencies, scan status, search monitoring, and other functions. A priority feature for any of the 20 channels is included. Functions, channel selections, etc. are entered using a large 24-button keypad; there is audible feedback (the scanner "beeps" at you) each time a programming key is pressed. A LOCK OUT key allows you to disable unwanted channels temporarily, and a built-in SKIP function lets the scanner jump over those unwanted channels, speeding up the scan rate.

Fast (9 channels/second) and slow (4 channels/second) search and scan speeds can be selected using the keypad. A keypad-selected DELAY function can be used if you want to keep the scanner on a channel for two seconds after the end of a transmission; that function allows you to catch a reply transmission that you might otherwise have missed by moving immediately to the next active channel.

Inside the cabinet

The dual-conversion (10.7 MHz and 455 kHz) superheterodyne circuitry uses an LSI microprocessor chip, an LSI phase-locked-loop system, seven CMOS IC's, eight additional IC's, 40 transistors, and 45 diodes.

Spurious-signal rejection is specified as 50 dB for VHF frequencies; spurious-signal rejection for UHF frequencies is not indicated. IF selectivity is +9 kHz at −6 dB; +15 kHz −50 dB.

The sensitivity of this model is greatly improved compared to previous Radio Shack scanners. When checked against a competitive scanner costing nearly twice as much, the apparent sensitivity was nearly identical; when we measured the sensitivity of the two units, they were within 0.1 dB of each other. The claimed sensitivity was 0.5 μV for the low and high bands, and 1.0 μV for the VHF aircraft-band and at UHF frequencies.

This large (10 × 11 × 3) scanner also includes a screw-on collapsible whip antenna for close-in reception. A rear-apron external-antenna jack allows the use of a rooftop antenna for improving the quality of long distance and weak-signal reception.

The instruction manual is well written and useful. It contains concise step-by-step programming information as well as an informative practical guide to scanner applications and frequency allocations.

A block diagram is also included; although it would be of little use in the maintenance of the receiver, it does give the technically-inclined user some idea of how the scanner works.

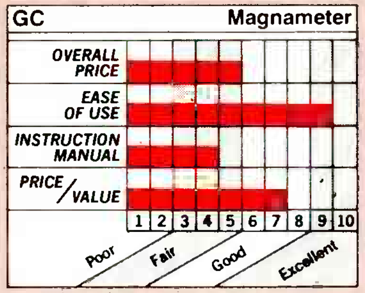
Our test

Signal sensitivity was found to be uniformly good over all frequency-ranges. Measurements showed the *PRO-2020* to be virtually identical to the most sensitive of its competitors. While search and scan speeds are not as rapid as those of some other scanners, the receiver does have a unique feature—a sophisticated window-detector that assures the user that the scanner will stop precisely on frequency, without overshoot or undershoot.

In this age of bells and whistles, the Realistic *PRO-2020* offers high performance and straightforward design at a reasonable cost. The *PRO-2020* sells for $299.95 and is available at Radio Shack stores. **R-E**

GC Electronics Magnameter Microwave Oven Tester

CIRCLE 102 ON FREE INFORMATION CARD



FOR MANY YEARS, THE GC ELECTRONICS Co. has been making a huge variety of parts for electronics work. They've been around for longer than I can remember, at the same address, 400 S. Wyman, Rockford, IL 61101. Now, they've gone into the test-instrument field.

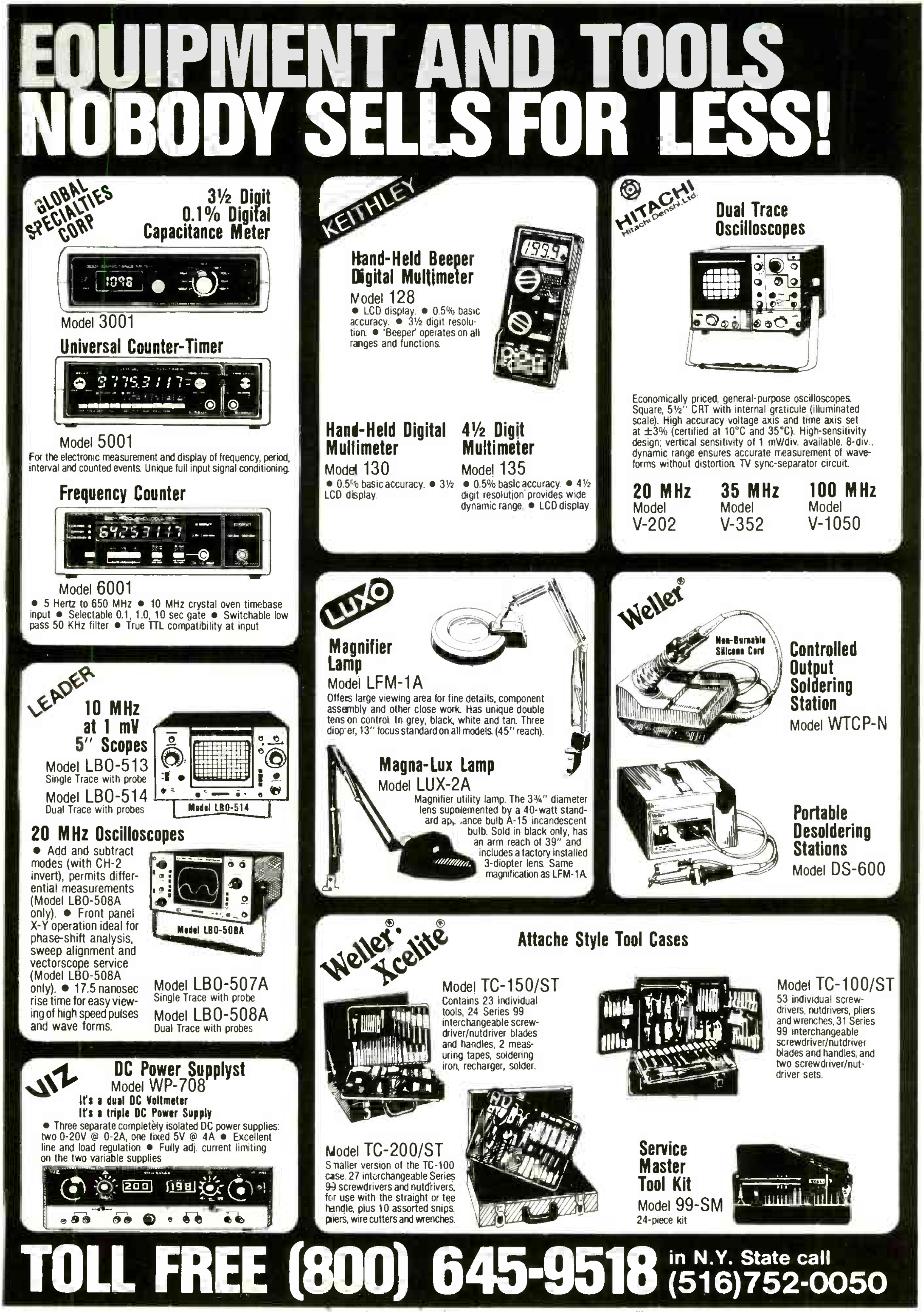
This one is the *Magnameter*, catalog No. 20-226. It's a specialized microwave oven tester, for analyzing the operation of the magnetron by reading secondary voltage and current. The meter has two ranges, with a toggle switch to select between the two. With the range switch in the HIGH position, the meter reads secondary voltages up to 10 kV. In the LOW position, the meter reads up to 10 volts. That range is used to measure the plate current of the magnetron, by reading the voltage drop across the plate resistor. For those ovens with no plate resistor, a heavy-duty 10-ohm tester is included, encased in plastic with alligator clips on both ends. That can be connected in the ground loop of the power-supply circuit. If the oven has a plate resistor of a value other than 10 ohms, a handy conversion chart is included for reading current.

The construction of the instrument is good; the case is high-impact plastic, and the test leads are very heavily insulated; twice the size of ordinary ones. Rubber-booted alligator clips are used on all three leads—ground, low, and high. After the tests are completed, a DISCHARGE switch on the side of the case can be depressed to short out any remaining charge left in the circuit. A neon lamp labelled HIGH VOLTAGE, and located on the front panel, glows whenever high voltages are present in the circuit—even if the oven is off.

The *Magnameter* is a compact instrument, and it comes with a tilt handle that can be used as a bail or stand. Test-leads are permanently connected, and all connections are made with the microwave oven's power switch turned off. The test leads are long enough to let you set the meter on top of the microwave-oven chassis.

The two major faults associated with microwave ovens are shorted magnetrons and shorted power transformers. By disconnecting the plate lead to the magnetron and measuring the output voltage of the power supply, then reconnecting the plate lead and measuring the plate voltage and plate current, you can isolate those two faults very quickly, and that's the name of the game.

The *Magnameter* seems to be built to give good service for a long time. List-priced at only $86.68, it looks like quite a lot of meter for the money; it should come in handy if you're going into that end of the electronics business. **R-E**



EQUIPMENT AND TOOLS NOBODY SELLS FOR LESS!
GLOBAL SPECIALTIES CORP
3½ Digit 0.1% Digital Capacitance Meter
Model 3001
Universal Counter-Timer
Model 5001
For the electronic measurement and display of frequency, period, interval and counted events. Unique full input signal conditioning.
Frequency Counter
Model 6001
• 5 Hertz to 650 MHz • 10 MHz crystal oven timebase input • Selectable 0.1, 1.0, 10 sec gate • Switchable low pass 50 KHz filter • True TTL compatibility at input
KEITHLEY
Hand-Held Beeper Digital Multimeter
Model 128
• LCD display. • 0.5% basic accuracy. • 3½ digit resolution. • 'Beeper' operates on all ranges and functions.
Hand-Held Digital Multimeter
Model 130
• 0.5% basic accuracy. • 3½ LCD display.
4½ Digit Multimeter
Model 135
• 0.5% basic accuracy. • 4½ digit resolution provides wide dynamic range. • LCD display.
HITACHI
Hitachi Denshi, Ltd.
Dual Trace Oscilloscopes
Economically priced, general-purpose oscilloscopes. Square, 5½" CRT with internal graticule (illuminated scale). High accuracy voltage axis and time axis set at ±3% (certified at 10°C and 35°C). High-sensitivity design; vertical sensitivity of 1 mV/div. available. 8-div.. dynamic range ensures accurate measurement of waveforms without distortion. TV sync-separator circuit.
20 MHz Model V-202
35 MHz Model V-352
100 MHz Model V-1050
LEADER
10 MHz at 1 mV 5" Scopes
Model LBO-513
Single Trace with probe
Model LBO-514
Dual Trace with probes
Model LBO-514
20 MHz Oscilloscopes
• Add and subtract modes (with CH-2 invert), permits differential measurements (Model LBO-508A only). • Front panel X-Y operation ideal for phase-shift analysis, sweep alignment and vectorscope service (Model LBO-508A only). • 17.5 nanosec rise time for easy viewing of high speed pulses and wave forms.
Model LBO-508A
Model LBO-507A
Single Trace with probe
Model LBO-508A
Dual Trace with probes
LUXO
Magnifier Lamp
Model LFM-1A
Offers large viewing area for fine details, component assembly and other close work. Has unique double tens on control. In grey, black, white and tan. Three diopter, 13" focus standard on all models. (45" reach).
Magna-Lux Lamp
Model LUX-2A
Magnifier utility lamp. The 3¾" diameter lens supplemented by a 40-watt standard appliance bulb A-15 incandescent bulb. Sold in black only, has an arm reach of 39" and includes a factory installed 3-diopter lens. Same magnification as LFM-1A.
Weller®
Non-Burnable Silicone Cord
Controlled Output Soldering Station
Model WTCP-N
Portable Desoldering Stations
Model DS-600
VIZ
DC Power Supplyst
Model WP-708
It's a dual DC Voltmeter
It's a triple DC Power Supply
• Three separate completely isolated DC power supplies: two 0-20V @ 0-2A, one fixed 5V @ 4A • Excellent line and load regulation • Fully adj. current limiting on the two variable supplies
Weller® Xcelite®
Attache Style Tool Cases
Model TC-150/ST
Contains 23 individual tools, 24 Series 99 interchangeable screwdriver/nutdriver blades and handles, 2 measuring tapes, soldering iron, recharger, solder.
Model TC-100/ST
53 individual screwdrivers, nutdrivers, pliers and wrenches, 31 Series 99 interchangeable screwdriver/nutdriver blades and handles, and two screwdriver/nutdriver sets.
Model TC-200/ST
Smaller version of the TC-100 case. 27 interchangeable Series 99 screwdrivers and nutdrivers, for use with the straight or tee handle, plus 10 assorted snips, pliers, wire cutters and wrenches.
Service Master Tool Kit
Model 99-SM
24-piece kit
TOLL FREE (800) 645-9518
in N.Y. State call (516)752-0050

WK-7	COMPLETE IC INSERTER/EXTRACTOR KIT

INDIVIDUAL COMPONENTS

MOS-1416	14-16 PIN MOS CMOS SAFE INSERTER
MOS-2428	24-28 PIN MOS CMOS SAFE INSERTER
MOS-40	36-40 PIN MOS CMOS SAFE INSERTER
EX-1	14-16 PIN EXTRACTOR TOOL
EX-2	24-40 PIN CMOS SAFE EXTRACTOR TOOL

CALL YOUR LOCAL OK DISTRIBUTOR FOR FURTHER INFORMATION

OK® MACHINE & TOOL CORPORATION 3455 CONNER ST., BRONX, N.Y. 10475 (212) 994-6600/TELEX 125091

CIRCLE 42 ON FREE INFORMATION CARD

DIGITAL AUDIO DISC

So far, digital-audio recording technology has confined itself to tape. Now, digital discs are about to make their debut.

LEN FELDMAN
CONTRIBUTING EDITOR

THE SPRING OF 1981 WILL PROBABLY GO down in history as the time when a major revolution in the science of sound recording took place. During April and May of that year, Holland's Philips Company and Japan's Sony Corporation, in jointly held presentations in Europe and the United States, announced their plans for the introduction of what has come to be known as the compact digital audio disc, or C-DAD.

If the companies meet their production target-dates, Japanese and European music lovers should be able to purchase a new kind of disc player in late 1982, while U.S. audio enthusiasts will have to wait a bit longer—until the beginning of 1983. From all indications, the long wait will be worthwhile, for the new digital C-DAD disc (sometimes acronyms become part of the language long before the item they represent is available) offers a level of performance that has been impossible to obtain with conventional analog records, no matter how carefully they were recorded and processed.

C-DAD format

The new Philips-Sony C-DAD disc is shown alongside a conventional LP record in Fig. 1. It is capable of playing one hour of stereophonic music *per side*, and can also hold up to four channels of audio on a side with reduced playing time.

Information on the C-DAD disc consists of approximately six *billion* digital "bits," which are linearly encoded along a helical track of pits and flats. The tiny pits are about 0.6 microns in width and 0.2 microns deep. The pits and flats represent the "ones" and "zeros" in the digital code used to store the signals. A solid-state laser beam is used to sense the sequence of pits and flats using a spot of light with a diameter several times smaller than that of a human hair. As shown in Fig. 2, the laser beam reads the presence or absence of the pits contained in the disc's surface beneath a protective plastic coating. The scanning rate is approximately 4.3 million bits-per-second. Variations in the reflected light rays are then converted into digital code and finally, through D/A conversion, back into a continuous audio waveform.

FIG. 1—THE 4.7-INCH DIAMETER C-DAD disc contains one hour of music on a side compared to a little over 20 minutes for a conventional 12-inch LP.

Since there is no physical contact between the pickup and the surface of the disc, the pickup must be guided by a dynamic-tracking servo system. The lack of physical contact also means that record wear is totally eliminated.

Unlike the turntables used to play today's analog records, the rotating platter that spins the C-DAD disc has a variable rotational speed—200 rpm when the laser is at the circumference of the disc and around 500 rpm when it is 50 millimeters from the center, the inner radial limit. Scanning takes place from *inside* to *outside* and rotation is *counterclockwise*. The total storage capacity of the C-DAD disc is over 8 billion bits per side—far more than is necessary for the 60 minutes of playing time that has been standardized for the disc. That provides a great many additional possibilities for designing C-DAD players. Both the Philips and Sony prototype players that were shown last spring (see Fig. 3) were able to "read out" such additional useful information as the number of the selection being heard, its length, the sequence of numbers programmed to be heard, etc. Owners of C-DAD disc players will be able to make use of sophisticated programming circuitry, enabling them to determine which songs they want to hear and in what sequence they want to hear them.

Audio quality and performance

The frequency response of the sys-

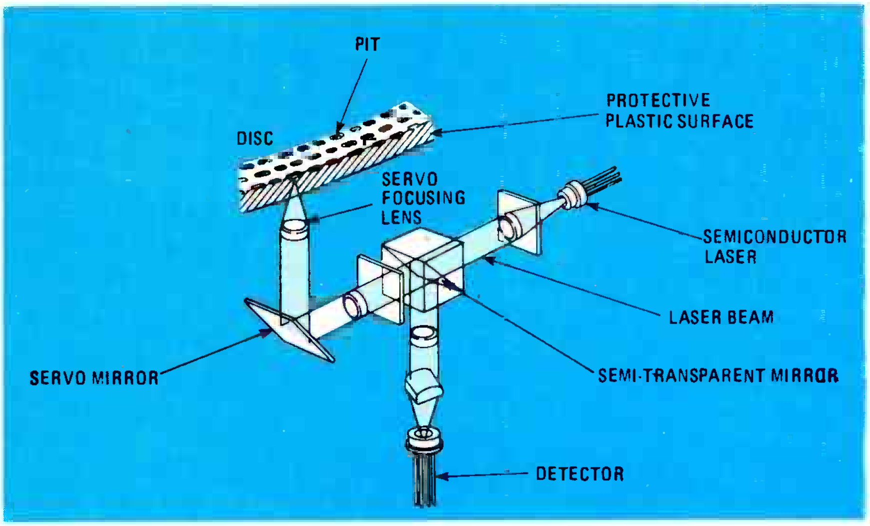


FIG. 2—THE C-DAD SYSTEM uses a tightly focused laser beam to read digital information represented by a series of pits on the disc.

TABLE 1

Specification	C-DAD disc	LP record
Frequency response	20–20,000 Hz	30–20,000 Hz
S/N ratio	More than 90 dB	More than 60 dB
Dynamic range	More than 90 dB	Max. 55 dB (1 kHz)
Channel separation	More than 90 dB	25–35 dB
High-frequency distortion rate	Less than 0.05%	0.2%
Wow & flutter	0%	0.03% (WRMS)
Playing time	60 Minutes	30 Minutes
Disc diameter	4.7 inches	12 inches

tem is absolutely flat from 20 Hz to 20,000 Hz. The digital sampling-frequency is 44.1 kHz, which would theoretically give a response up to 22.05 kHz. Some margin, though, is left for high frequency cut-off filtering.

The signal-to-noise ratio for the 16-bit digitizing format is better than 90 dB (theoretically, it could be as high as 97.5 dB); dynamic range—the difference in level between softest and loudest sounds that can be handled—is also better than 90 dB. Channel separation is 90 dB as well, while total harmonic distortion, referred to peak levels, is 0.05% or less (0.03%, theoretical).

As with any true digital-sound system there is no measurable rumble or wow-and-flutter. Tracking, decoding, and rotational speeds are synchronized by a central clock generator inside the player and the clock is itself governed by information encoded in the track on the disc. Since the digital data representing the music is stored briefly in semiconductor memory in the player before being clocked out at a steady rate to the digital-to-analog converter, there can be no wow or flutter in the conventional sense.

There is also no audible intermodulation-distortion of the type that plagues conventional analog recordings to such a large degree. To fully appreciate the significance of these performance levels, see Table 1, which compares the C-DAD system with conventional LP records.

Competing digital-disc systems

Of the many digital-audio disc systems that have surfaced over the last several years, two besides the C-DAD system have been successfully demonstrated and been under consideration by a 51-member Digital-Audio Disc Council. That group deliberated about standardization for about three years (and has only recently been disbanded) in Japan. The two other systems are:

1. A capacitance-pickup system, developed by JVC as an adjunct to its VHD videodisc system which is to be marketed in early 1982 and which has been given the name AHD (*A*udio *H*igh *D*ensity).
2. A mechanical "groove-type" system developed by Telefunken.

Discs for the variable-capacitance system (AHD) are made of conductive materials. As shown in Fig. 4, digital signals in the form of tiny pits are engraved in these discs. As a miniature metal electrode follows the pits, signals, represented by changes in electrostatic capacitance, are detected. To maintain the necessary accuracy, the pits are engraved on the surface of the disc along with pilot signals impressed on either side of the audio signal pits. Since there are no physical grooves impressed into its surface, the pilot signals are used as part of a dynamic-tracking servo system to keep the electrode stylus properly positioned along the signal track of the AHD audio disc.

In the mechanical system developed by Telefunken, playback is accomplished in a manner similar to that used by ordinary analog players (see Fig. 5). That is, signals cut into the grooves of the disc are first converted into mechanical vibrations as the stylus traces them and the vibrations are then transmitted through a pickup arm to a piezoelectric converter, where they are changed into electrical signals.

Table 2 offers a comparison of these two systems and the Sony-Philips C-DAD one. Of the three, only the Sony-Philips and the JVC systems seem likely to reach the marketplace in the near future. JVC's argument in favor of its system is based largely upon the fact that a single player would be able to

FIG. 3—C-DAD PLAYER prototypes shown in 1981. Sony's is at left; Philips' at right.

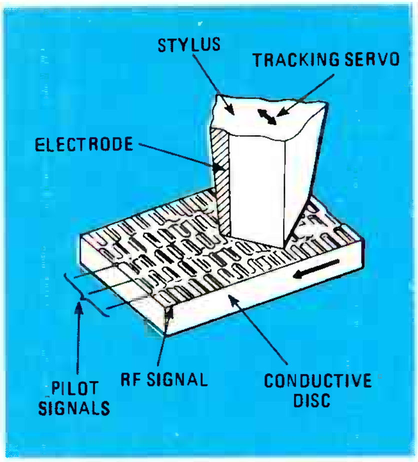


FIG. 4—JVC'S AHD digital-audio disc system works on the same principles as its VHD video-disc system.

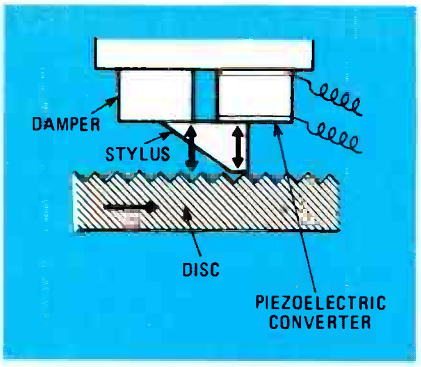


FIG. 5—THE MECHANICAL SYSTEM developed by Telefunken for digital discs is similar to that used for today's analog records.

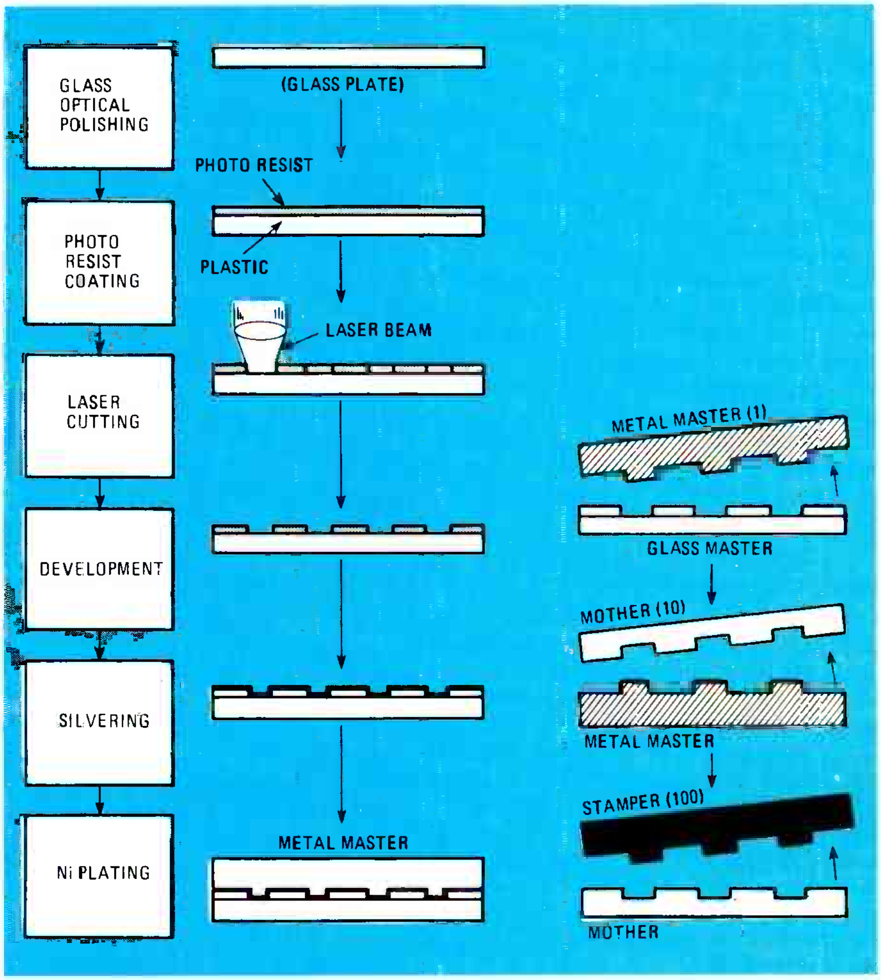


FIG. 6—STAGES INVOLVED in the manufacture of C-DAD discs. Numbers in parentheses at right indicate how many of each piece are produced.

TABLE 2

Characteristics	Sony-Philips	JVC	Telefunken
Signal-pickup method	Optical	Capacitance	Mechanical
Pickup	Non-contacting	Contacting	Contacting
Signal location	Beneath surface	On surface	On surface
Grooves	No	No	Yes
Surface material	Transparent plastic	Carbon-impregnated vinyl	Various
Disc caddy (holder)	Not required	Required	Required
Disc size	120 mm	260 mm	135 mm 70 mm
Playing time	60 minutes (2 channels)	60 minutes (4 channels)	60 minutes (2 channels) 30 minutes (2 channels)
Format	16-bit	16-bit	14-bit

handle both its videodiscs (the VHD discs that are to be marketed in 1982) and the AHD digital-audio discs, since both use a capacitance-pickup principle. Of course, a digital-to-analog converter/processor would have to be added to the JVC system for decoding the digital-audio discs; the addition of such a D/A converter/processor would make the lower-cost argument somewhat questionable.

The JVC AHD disc, like its companion VHD disc, is a little over 10 inches in diameter and comes supplied in a "caddy" or holder that protects the disc surface when it is not being played. The smaller, optically-tracked, C-DAD disc requires no such protective sleeve, of course, and is in no way affected by dirt or dust on its surface since the focal point of the laser beam is beneath the transparent surface of the disc. An important point that has been emphasized many times by Sony and Philips is that the small C-DAD disc and its correspondingly small player can easily be adapted for use in cars and other moving vehicles, since the vibration of a vehicle should have little or no effect upon laser tracking.

The trend towards C-DAD

There seems to be a growing trend towards endorsement of the C-DAD system by equipment manufacturers and "software" (recorded material) producers around the world. Matsushita Electric Company (whose line of brands includes Panasonic, Quasar, Technics and National), although committed to the JVC VHD system for videodiscs, has nevertheless indicated that it will produce disc players for the Sony-Philips system. Recently, the worldwide Polygram Group, one of the leading international record manufacturers, and CBS/Sony, Inc., the largest record company in Japan, announced plans to produce music programs in the C-DAD format. In 1982, for example, CBS/Sony will release more than 100 C-DAD albums in Japan simultaneously with the introduction of the C-DAD players. On the hardware side, companies such as Marantz have already demonstrated their own versions of players which are compatible with the Sony-Philips optical-laser disc system. And, while the 51-member Digital Audio Council mentioned earlier did not specifically endorse the C-DAD system, its final report noted its compact size and its applicability to mobile use, which many interpreted as being just about as close to an endorsement as such a committee would ever be likely to come.

How C-DAD discs are made

Once you get past the hurdle of paying for a C-DAD optical-laser player (about the price of a high-end turntable), the software or discs themselves should be no more expensive, on a "per-minute-of-music" basis, than high-quality LP records. The process of making digital discs is quite different from the process currently used to make analog LP records, but once it has been mastered, it should be possible to turn out the new discs on a mass-production basis that will reduce disc prices drastically.

Mechanical cutting-techniques are impractical for digital-disc production because the pits to be carved are far too small. Instead, the process shown in Fig. 6 is used. First, a glass plate coated with photo-resist material is exposed to a digitally-modulated laser beam. The plate is then developed to form pits corresponding to the presence or absence of digital signals. After a silvering process, that glass plate becomes the "master."

It is next pressed against a nickle plate to make an inverse copy (the pits become small bumps and the flats become depressions) of the photo-etched depressions on that plate. A digital master is thus produced which, in turn, is used as the "mother" for making production "stampers." Each stage inverts the surface of the disc (pits-bumps-pits-bumps, etc.). The stampers have bumps.

The final production stages are shown in Fig. 7. Using the stamper, C-DAD discs are produced in large quantities in much the same manner as conventional analog records. The signal-bearing surface of each disc is then coated with a reflective material, followed by a coating of protective, transparent plastic. Aside from any labelling and packaging that may be required, that completes the manufacture of a single-sided disc.

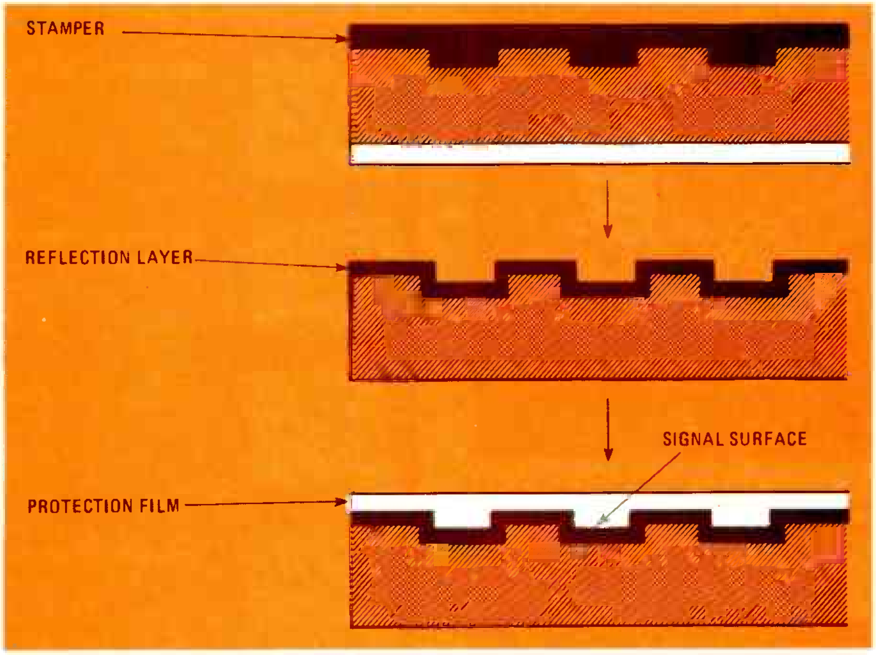


FIG. 7—FINAL STAGE in C-DAD disc production involves adding a reflective layer to the surface and protecting it with a clear plastic coating.

"DIGITAL" vs. DIGITAL

FOR THE PAST SEVERAL YEARS 12-INCH "DIGITAL" discs have been available from companies such as Telarc, Teldec, London, and others.

It is a common misconception that those are *true* digital discs, but that is not the case.

True digital discs carry the audio information as a series of binary-coded numbers—that is the method used by the C-DAD.

Digitally-mastered discs—the 12-inchers currently on the market—are so called because the *master tapes* from which they are produced are digitally-encoded. The discs themselves carry a conventional analog signal.

Those discs do have an advantage over ones recorded using analog processes all the way through—the quality of the master tapes is higher and some of that quality is carried over into the analog pressing. Dynamic range is greater, tape hiss is non-existent, etc. The discs themselves, though, are still prone to the shortcomings of analog recordings—surface noise, restricted dynamic range, tracking problems, and so forth.

While "digital" (digitally-mastered) discs certainly represent a tremendous improvement over their all-analog predecessors, their quality is still far removed from that obtainable from all-digital recordings. **R-E**

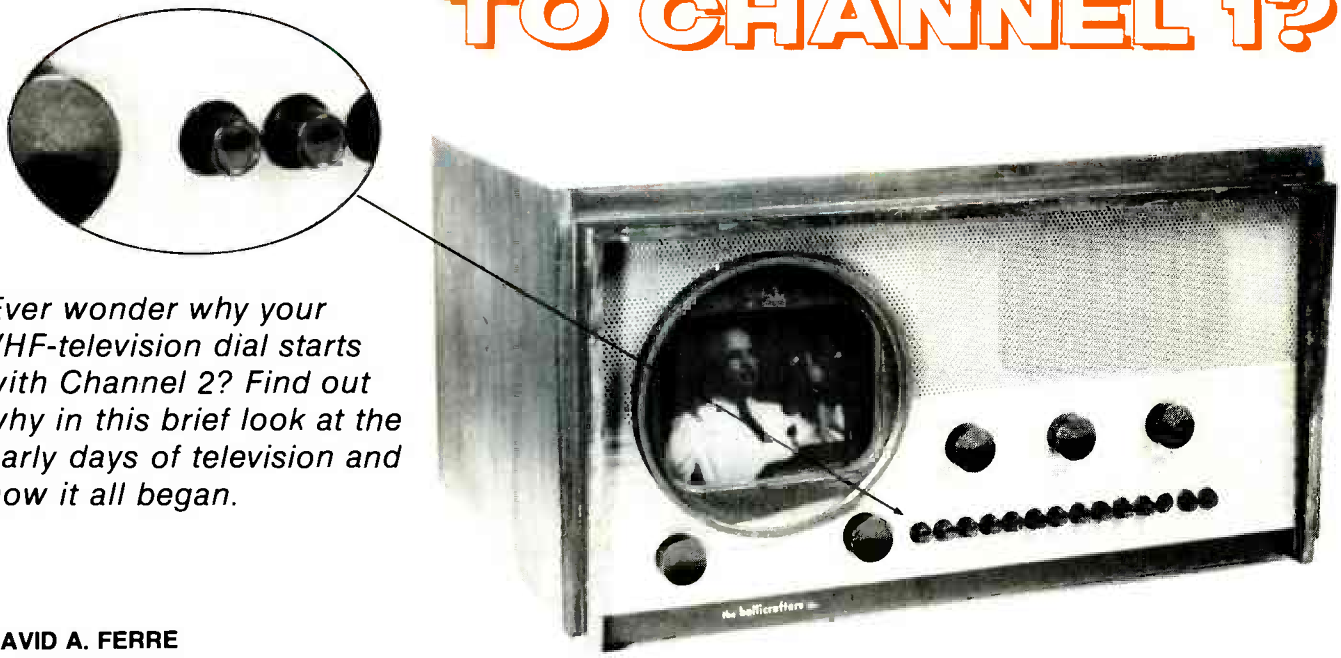
For a two-sided disc, an additional process to combine two single-sided discs would be required, but it is entirely possible to produce such two-sided discs.

Digital source-material

Recognizing the advantages of digital recording almost as soon as it was made available on a commercial basis to recording studios several years ago, many recording companies around the world have been producing digital master-tapes for release as digitally-mastered, improved *analog* LP's (often erroneously referred to as "digital" records). Although many of those recordings have been praised as being clearly superior in sound quality to conventional LP's, they obviously cannot approach the performance levels that will be reached by C-DAD discs once they are made available. (See sidebar for more information.)

The fact that so many digital master tapes now exist in the archives of major recording studios bodes well for the future of true digital-discs. All those tapes can be used to make true digital-audio discs, with no degradation in quality from master tape to disc. The Sony-Philips system, in fact, uses the same 16-bit PCM (*P*ulse *C*ode *M*odulation) encoding currently being used for professional digital-audio purposes. Therefore, C-DAD recordings can be made in studios using existing PCM equipment. It is also possible to translate existing analog recordings, using PCM processors, to the C-DAD format. However, should that be done, the resulting product would not exhibit the increased dynamic range and other improvements made possible by digital-recording technology. **R-E**

WHAT EVER HAPPENED TO CHANNEL 1?



Ever wonder why your VHF-television dial starts with Channel 2? Find out why in this brief look at the early days of television and how it all began.

DAVID A. FERRE

WHEN A TELEVISION RECEIVER IS PURchased in the United States, you can take it anywhere in the country, plug it in, pull up the "rabbit ears," and tune in a station. That is possible because we have national broadcasting standards that are common throughout the country. Yet, at one time commercial television was going to be introduced to the American public without standards; fortunately, that "experiment" ended before it even started. But let's not get ahead of our story!

Up to 1934

During the first few months of 1933, RCA demonstrated the first successful all-electronic television system. Broadcasts were made from the RCA experimental television transmitter, W2XBS, located at the top of the Empire State Building in New York City. The characteristics of that early all-electronic television system were modest:

Lines:	240
Frames:	24 per second
Scanning:	sequential (no interlacing)
Bandwidth:	2 MHz
Video carrier:	AM modulated, full sideband
Audio carrier:	AM modulated, full sideband

Yet, the results were far better than any mechanical television system had ever accomplished. For those experiments, the video carrier was at approximately 45 MHz.

It may be hard for us to appreciate fully what RCA had accomplished in 1933. But to give you an idea: Many of the experimental television broadcasters were still using frequencies in the 2- to 3-MHz range, and bandwidths of 100 kHz. In addition, the earlier systems were mechanical using gears, motors, mirrors, etc. As television advanced, each step pointed towards non-mechanical systems, and higher bandwidths and carrier frequencies.

The Federal Communications Commission was established by an act of Congress on June 22, 1934. It was about that time that a portion of the VHF radio spectrum was allocated to television for the first time (see Fig. 1). Previously, any frequency above 30 MHz was available to experimenters. Those experimenters included a number of pioneering amateur-radio operators; there were also experimental stations that included television. In 1934, the experimenters were moved to the frequencies above 110 MHz, while television was allocated two bands, 42-56 and 60-86 MHz. There were no channels associated with the allocations, but it was a beginning; television was making its first move.

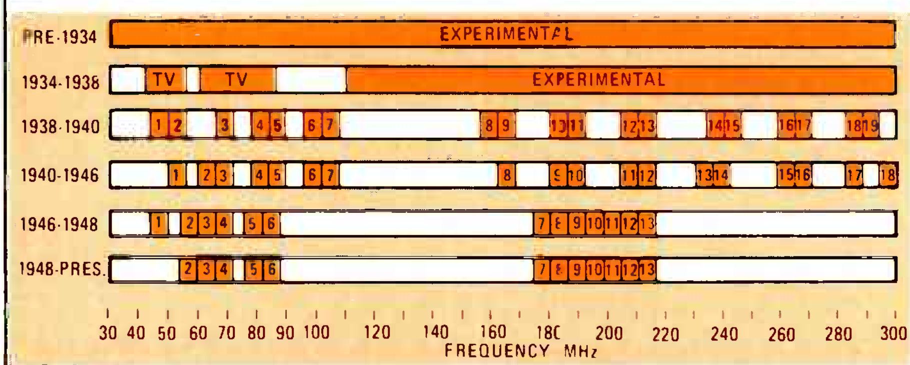


FIG. 1—HOW THE TELEVISION ALLOCATIONS have changed over the years. This chart shows the approximate frequencies of the channels; the exact frequencies are given in Table 1.

1934 to 1938

Progress was slow for television during those years. The depression was at its worst, and even mighty RCA lost money. But advances were made in RCA's all-electronic system. In June, 1936, RCA announced the start of a massive field test. A total of 100 experimental-television receivers were distributed to RCA employees for placement in their homes and offices (see Fig. 2). RCA then began regular television broadcasts from W2XBS, using their new Radio City television studios. Those studios were linked to the Empire State Building transmitter by an experimental 177-MHz radio link and a coaxial cable. The composition of the television signal used for that test was as follows:

Lines:	343
Frames:	30 per second
Scanning:	interlaced (2:1)
Bandwidth:	5.75 MHz
Video carrier:	AM modulated, full sideband
Audio carrier:	AM modulated, full sideband

On June 15, 1936, the FCC began informal hearings concerning the radio spectrum above 30 MHz. There was an increasing demand for those frequencies and a new word began to be heard at the FCC; that word was standards. The Radio Manufacturers Association (RMA), the trade association for the radio and television equipment manufacturers, had formed a sub-committee on television. They attended the June, 1936 hearings because of their interest in the possible future commercialization of television. In addition to urging definite channel allocations, the RMA had a set of television channel standards to present (see Fig. 3-a). Although those standards were incomplete in some respects, one important recommendation that the RMA made to the Commission was that the bandwidth of a television channel should be 6 MHz—the same bandwidth that is used today. The RMA television standards were:

Lines:	441
Frames:	30 per second
Scanning:	interlaced (2:1)
Bandwidth:	6 MHz
Video carrier:	AM modulated, full sideband
Audio carrier:	AM modulated, full sideband

It is interesting to note that the proposed 441-line standard was beyond the capabilities of any system that had been demonstrated up to that point. It wasn't until eight months later, on February 11, 1937, that a manufacturer (Philco) gave a convincing demonstration of a television system that completely met the RMA standards.

The FCC hearings that had started on June 15, 1936, resulted in the allocation of 19 television channels, each with a bandwidth of 6 MHz. The new allocations, which are shown in Fig. 1 and Table 1, became effective October 13, 1938. The RMA revised and completed their set of television standards, which were essentially the same as the 1936 standards except for one important difference: The video carrier would now be transmitted with a full upper sideband and only a partial lower sideband, as shown in Fig. 3-b. That vestigial sideband system was eventually adopted by the FCC and is used today.

FIG. 2—ONE OF THE LAST in existence, this receiver was one of the ones used in RCA's test of the first all-electronic television system. The vertically-mounted picture tube was viewed through a mirror in the cabinet top.

Television now had allocations and channel numbers. Our mysterious Channel 1 was assigned to the 44- to 50-MHz band as shown in Table 1. RCA's experimental station quickly received a permit for one of those new television allocations and selected Channel 1!

1938 to 1940

The television industry was generally pleased with the FCC allocation of 19 TV channels. They were hoping for a continuous band of frequencies to simplify tuner design, and were somewhat disappointed that 12 of the 19 channels were above 150 MHz; those frequencies were virtually unused, and thought to be useful only for television-relay networks. But the seven channels between 44 and 108 MHz were enough to begin plans for commercial television operation. By then it was believed that the RMA standards would be adopted by the FCC and commercialization could begin. But not everybody agreed with the RMA standards, and the FCC wasn't about to approve any standard unless the television industry was in almost total agreement.

On October 20, 1938, just one week

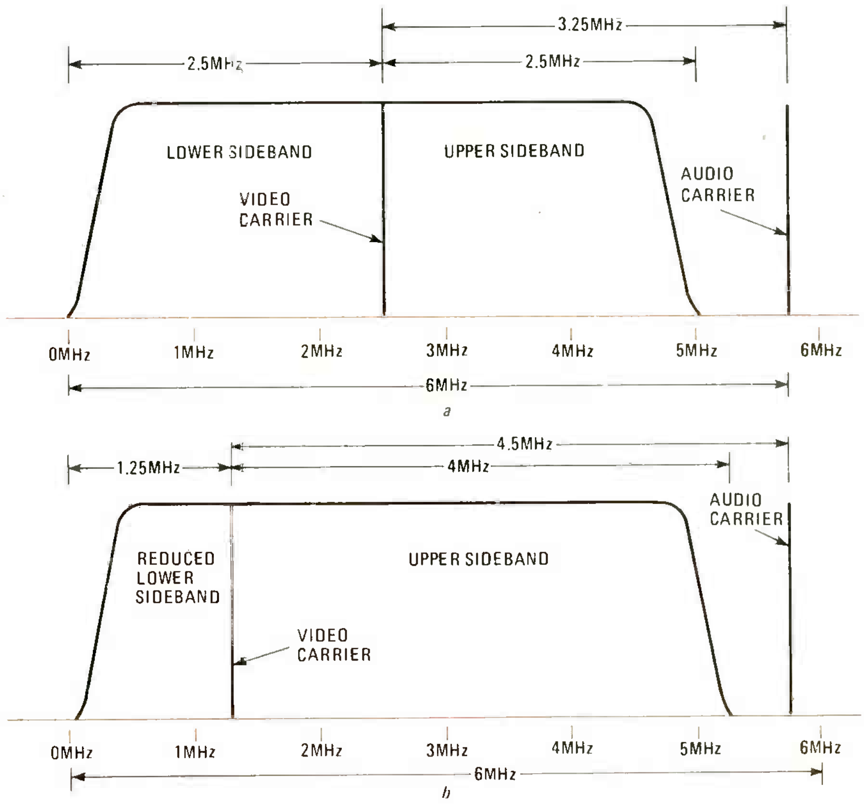


FIG. 3—THE FIRST STANDARDIZATION of a television signal, the system shown in a featured full upper and lower sidebands. A later revision, shown in b, featured a reduced lower sideband. That vestigial sideband technique is the one is use today.

TABLE 1

Channel	Year 1938-1940	1940-1946	1946-1948	1948-PRESENT
1	44-50	50-56	44-50	–
2	50-56	60-66	54-60	54-60
3	66-72	66-72	60-66	60-66
4	78-84	78-84	66-72	66-72
5	84-90	84-90	76-82	76-82
6	96-102	96-102	82-88	82-88
7	102-108	102-108	174-180	174-180
8	156-162	162-168	180-186	180-186
9	162-168	180-186	186-192	186-192
10	180-186	186-192	192-198	192-198
11	186-192	204-210	198-204	198-204
12	204-210	210-216	204-210	204-210
13	210-216	230-236	210-216	210-216
14	234-240	236-242	–	–
15	240-246	258-264	–	–
16	258-264	264-270	–	–
17	264-270	282-288	–	–
18	282-288	288-294	–	–
19	288-294			

after the allocations became effective, RCA announced that regular television programming would begin as a "public service" on April 30, 1939. That date coincided with the opening of the 1939 New York World's Fair. A number of manufacturers began producing television receivers, and by the opening of the fair they were in the stores and ready for sale. The opening ceremonies of the fair were broadcast on Channel 1 by RCA's W2XBS, and featured the President of the United States. After that event, broadcasts were scheduled on a regular basis.

By the end of May 1939, large department stores, such as Macy's in New York, offered as many as nine different models for sale; those were supplied by three manufacturers (Andrea, DuMont, and RCA). Screen sizes for those telvision sets ranged from 5 to 14 inches, and prices ranged from $189.50 to $600.00. Most of the early sets were complete receivers, but one, the *model TT-5* from RCA (shown in Fig. 4), had no audio section; if audio was desired, it had to be connected to a compatible RCA receiver. Unfortunately, sales of those early television sets were not very good, and by the end of 1939 fewer than 400 of them had been sold in the New York area.

All of the major television broadcasters (incidently, the stations were still considered experimental) had adopted the RMA standards by the end of 1939. That included the stations in New York City, Chicago, Los Angeles, and Schenectady. The FCC was urged to adopt the RMA standards so that commercialization could begin. The FCC responded to the pressure from the TV industry by publishing rules for limited commercialization on December 22, 1939. It was a kind of Christmas present for the television industry.

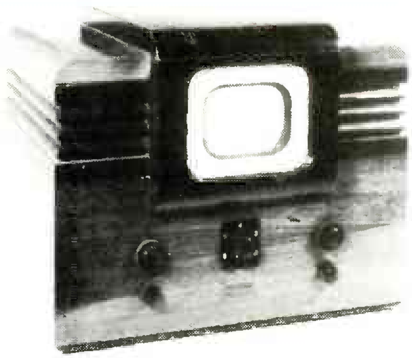


FIG. 4—THIS EARLY TELEVISION SET, the RCA *model TT-5*, was one of the first offered for sale to the general public. It featured a five-inch screen, five-channel coverage, but no audio section; it sold for $199.50 in 1939.

At the time those rules were published, the FCC also announced that hearings would be held in January, before establishing a date for limited commercialization. At those hearings, it was made clear to the FCC that many of the broadcasters did not agree that the RMA standards were the best. Philco urged the FCC to adopt their system of television with 605 lines and 24 frames-per-second. DuMont wanted standards that included 625 lines and 15 frames-per-second. In addition, there was some vague talk about something called color television. Nevertheless, in an order issued on February 29, 1940, the FCC ruled that limited commercialization could begin on September 1, but warned that nothing should be done to encourage a large public investment in television receivers. They refused to adopt any standards, with the implication that each of the broadcasters could use whatever standards they liked best, with the public deciding who had the best system.

RCA responded to the authorization for limited commercialization with full-page newspaper ads in early March announcing the "arrival of television," and ordered the immediate production of 25,000 television receivers. The FCC realized that limited commercialization wasn't going to work, as the sale of thousands of television sets would, in effect, "freeze" the standards, making a change to other standards almost impossible. Within a few days of the RCA newspaper ads, the FCC's permission for limited commercialization was withdrawn.

Television was also about to undergo some more changes. *F*requency *M*odulation (FM) had been introduced by its developer, Major Edwin H. Armstrong, in 1935. Shortly after its introduction, FM was granted five experimental frequencies between 42.6 and 43.4 MHz. By 1940, the FCC had 150 applications for experimental FM stations on file that could not be processed because of lack of frequencies. As a result of hearings held on March 18, 1940, the FCC assigned FM a continuous band of frequencies (that was done to simplify tuner design), and expanded the FM allocation to include the frequencies from 42 to 50 MHz. The new allocation included the 44- to 50-MHz band that had previously been assigned to Channel 1.

But that is not what happened to Channel 1! The TV channels were renumbered with Channel 1 now assigned to 50-56 MHz band and the remaining channels were shifted around the spectrum. But when the smoke cleared, the television industry had lost one channel, leaving them with 18 allocations.

The new FM channels and the changes in the television allocations became effective on June 20, 1940; commercial FM broadcasting was authorized to begin on January 1, 1941.

1940 to 1946

When the revised 18-channel TV allocations went into effect, the television industry was unhappy, to say the least. The limited commercialization plan was suspended; the FCC continued its refusal to set television standards; a television channel was lost to FM, and, because of the changes in the allocations, many of the experimental TV broadcasters had to go off the air to complete extensive transmitter changes. For example, the RCA experimental transmitter, W2XBS, had been operating on the old Channel 1 (44-50 MHz); because of the changes, they were forced to switch to the new Channel 1 (50-60 MHz).

However, soon after that things began to look up. A member of the RMA had met with the FCC to ask just what the television industry could do to win approval of a set of standards. The FCC replied that if the industry could agree on *one* set of standards, they would be approved without delay. Quickly, the RMA organized the National Television Standards Committee (NTSC). The NTSC was open to all major interests in the television field whether they were associated with the RMA or not. Eventually, over 160 individuals became associated with the NTSC. On July 31, 1940, under the RMA's sponsorship and with the FCC's blessing, the NTSC held its first meeting.

With the opportunity to propose a set of standards to the FCC, you might have expected that the NTSC would simply have endorsed the existing RMA standards, but that is not what happened. Every aspect of the television-standards question was re-examined and discussed at length. On January 27, 1941, the NTSC met with the FCC and presented a progress report. The preliminary NTSC standard presented to the FCC at that meeting closely paralleled the RMA standards. That seemed to indicate that the RMA standards were essentially correct. There was one important difference, however: The audio carrier was to be FM. The FCC had one reservation about the proposed standard—they felt that the 441-line standard recommended by the NTSC was too low. That standard went way back to the first RMA standards of 1936, when both video sidebands were transmitted. It was common knowledge that the vestigial sideband system in use since 1938 allowed a much higher line count and, accordingly, a better television picture. The NTSC agreed to re-examine that question and said that it would present more information at hearings that were to be held in March, 1941.

Those hearings were held on March 20, 1941. The NTSC standard that was presented at the hearing was almost identical to the one proposed earlier, except that the number of lines was increased to 525 lines. (Although the number of lines seemed to be random, it was not. The line count had to be an odd number and to be related to few multiples of odd numbers, such as $3\times3\times7\times7=441$ or $3\times5\times5\times7=525$, for example. That was necessary for generation of the synchronizing pulse.) The new standard was as follows:

Lines:	525
Frames:	30-per-second
Scanning:	interlaced (2:1)
Bandwidth:	6 MHz
Video carrier:	AM modulated, vestigial sideband
Audio carrier:	FM modulated, ±75 kHz deviation (later ±25 kHz deviation)

Virtually all of the participants in the hearings (they went on for four days) agreed that the NTSC Standards were correct and should be adopted quickly. The FCC was convinced that the industry had finally agreed and the NTSC Standards were adopted as the national standard in April 1941. The effective date was July 1, 1941; commercial television could finally begin!

When that "Opening Day" for commercial television finally arrived, only two television stations were licensed and ready for operation; WNBT (NBC, old W2XBS) transmitting on Channel 1, and WCBW (CBS, old W2XAX) transmitting on Channel 2. Both of those stations were in New York City. Soon after (on September 1, 1941) WPTZ in Philadelphia, transmitting on Channel 3, came on the air. By the spring of 1942, a total of four commercial stations were in full operation and 10,000 television receivers had been sold.

Television's growth was halted by World War II, with the Defense Communications Board ordering the construction of new radio and television stations to end. Television programming was reduced to just four hours per week for the broadcasters already in operation (all devoted to war-related activities).

As the end of the war approached, the FCC was faced with a monumental task. The war effort had brought about an extraordinary leap in communications technology. Frequencies that had been thought to be useless were now in tremendous demand. The entire spectrum had to be re-examined, with new allocations made and old ones revised. The FCC began by holding hearings on September 28, 1944. They were promptly overwhelmed. The 18-channel television allocations in effect since 1940 were attacked by one group as being wasteful of the valuable VHF spectrum, yet another group urged an increase to 26 channels. Others urged the FCC to move all of the television allocations to UHF frequencies immediately. But the television industry aruged that television had waited long enough and should develop now, using the existing allocations.

After hearings that were held on February 14, 1945, it became clear that no group was going to get everything it wanted. In the FCC's final decision, released on June 27, 1945, television's allocation was reduced to 13 channels, and FM was moved from the 42-50 MHz slot to 88-106 MHz (the band was later increased to 88-108 MHz). The television interests were very unhappy that they were left with only 13 channels, but the FM interests suffered a major blow because all of the existing stations had to go off the air and switch to new frequencies. In addition, 500,000 home-FM receivers were now obsolete.

The reduction to 13 television channels was accompanied by new and reorganized frequency allocations (see Table 1). Again the broadcasters had to go off the air to switch frequencies.

Our Channel 1 was still around, but it was moved back to the 44- to 50-MHz band that it had occupied from 1938 to 1940. In addition, there was a restriction for Channel 1: It could only be assigned as a community channel, and was limited to a maximum power of 1000 watts. Other TV channels were for metropolitan stations, with a maximum power of 50,000 watts permitted. All channels, except Channel 6, were shared with fixed and mobile services—a fact that left the television interests concerned about interference. The changes became effective March 1, 1946.

1946 to 1948

Even with the reduced number of channels, the boom was on! Manufacturers quickly began producing television receivers, transmitters, antennas, etc. New television stations were being built all over the United States. The FCC had identified the top 140 metropolitan cities and assigned each at least one channel; a total of 400 were to be allotted. The FCC received many more applications than it had available channels. In an effort to provide the public with as many channels as possible, the FCC routinely threw away the "safety factor" of mileage between licensed transmitters. Television-receiver sales were doing very well, with 175,000 sold by the end of 1947. Manufacturers were selling television sets as fast as they could be made, even though the sets were rather expensive. (A typical set with a 10-inch screen sold for $375.)

But problems began to appear. Propagation theories at that time predicted that television signals would not be received over the horizon—but they were, quite readily. So, even with just 50 stations on the air, interference problems were beginning to appear. Meanwhile, the FCC had reduced the minimum distance between stations using the same channel to just 80 miles. An engineering study released by the FCC warned of interference problems if immediate action wasn't taken. That led to an FCC report, issued on May 5, 1948, that ruled that television could no longer share its frequencies with fixed and mobile services, and that the 72- to 76-MHz band could be used for fixed radio services only.

But where could the mobile services be located if they could no longer share the television allocations, and could no longer use the 72- to 76-MHz band? There was only one place to go—the television industry would have to give up another TV channel. But which channel would that be? The American Radio Relay League (an association of amateur radio operators) urged that Channel 2 be deleted so that the second harmonics of the 28- 29.7-MHz amateur-radio band would not interfere with

continued on page 89

NEW USE FOR FM SCA AUTOMATIC ROAD INFORMATION SYSTEM

Most people think of SCA as a means of piping mood music into stores and restaurants. West Germany has found a much more valuable way to use that service.

LEN FELDMAN
CONTRIBUTING HI-FI/VIDEO EDITOR

A FEW YEARS AFTER MAJOR ARMSTRONG FIRST DEMONSTRATED a workable system of wideband-FM radio broadcasting back in the 1930's, he demonstrated how a subcarrier could be used to modulate the main carrier of an FM station, and how that subcarrier could carry information that was totally different from what was being transmitted on the main carrier.

Many years later, in 1961, the basic techniques developed by Armstrong and modified by others resulted in the beginning of stereophonic broadcasting in the U.S., using subcarrier techniques which, though somewhat different from those first proposed by Armstrong, nevertheless fall into the general category for multiplexed FM.

SCA

In 1954—several years before stereo broadcasting began—the Federal Communications Commission, concerned over the increasing economic plight of struggling FM stations, authorized what came to be known as SCA transmissions. (SCA stands for *S*ubsidiary *C*ommunications *A*uthorization.) In those pre-stereo days, FM stations were permitted to transmit one or more subcarriers at frequencies between 25 kHz and 75 kHz above the main carrier, and to modulate those subcarriers with virtually any sort of useful information for use on a point-to-point basis. In other words, the station could *lease* its subcarriers to companies. The companies leasing the subcarriers could then charge a rental fee for receivers provided to subscribers who wanted to hear whatever was being transmitted on the subcarriers.

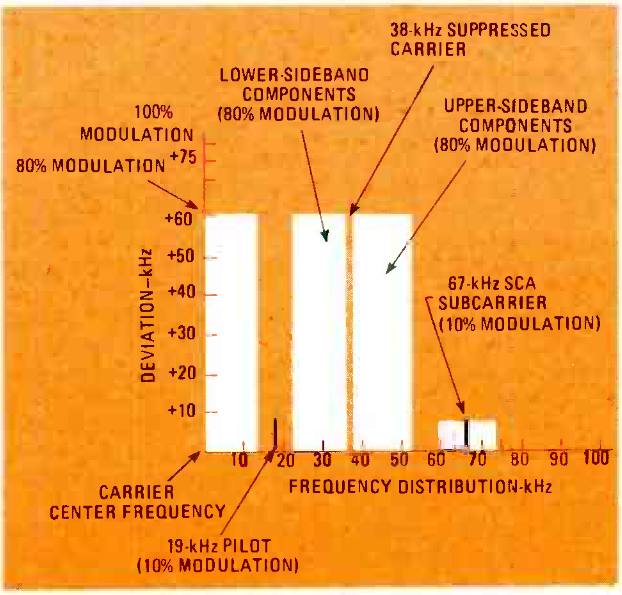


FIG. 1—AN FM-STEREO STATION that offers an SCA service does so at a frequency 67 kHz above the center frequency of its carrier.

The best known use of those subscriber-oriented services is for commercial-free background music. Such music, brought to us by such familiar names as Muzak, has been the butt of jokes and disparaging remarks almost from the day that SCA service began. Less familiar is the fact that SCA transmissions do not always consist of background music. In many parts of the country, SCA channels are used to provide a "talking book" service for the blind. And, with the shortage of regular radio-channel space becoming acute, some enterprising broadcasters are turning to SCA to provide foreign-language or ethnic programming for audiences whose numbers are too small to justify the assignment of a station-frequency by the FCC.

With the advent of FM stereo in 1961, the space available for SCA channels was sharply reduced. Figure 1 shows the modulation spectrum of an FM-stereo transmitter. All of the frequencies given in the following discussion are referenced to the main carrier frequency. The sum (L+R) of the two audio channels occupies spectrum space from 30 Hz to 15 kHz (the highest audio frequency permitted on FM), the stereo pilot-signal is found at 19 kHz, and the sidebands of the suppressed-carrier 38-kHz AM subcarrier signal containing the difference (L−R stereo information) occupy the space from 23 kHz to 53 kHz. That leaves only the spectrum space from 53 kHz to 75 kHz for SCA or private subcarrier use. Some guard-band space must be provided for, so the first practical subcarrier will have a frequency of around 57 kHz. Stations transmitting in stereo and also providing an

SCA service generally select 67 kHz as their subcarrier frequency.

Auto road information

We recently learned about a new use for SCA, which is currently in service in West Germany. The new service is helping to solve road problems in that country. As most drivers know, there are AM and FM radio stations in almost every part of this country that broadcast traffic information as part of their regular programming. The same is true in West Germany and in other European countries. But the high density of traffic in Europe has caused problems that did not exist even a few years ago.

The traffic problems, of course, are worst during rush hours, weekend peaks, vacation periods, etc. When the capacity of a road is exceeded, traffic jams occur, leading to road accidents—rear-end collisions and the like. The authorities in West Germany reasoned that information supplied promptly to drivers would help keep traffic problems to a minimum. Indeed, way back in the 1960's the government-controlled Radio Broadcast Network began giving traffic information at the end of hourly news broadcasts. It was quickly realized, however, that even such an expanded information service would be of little use unless the information were of a local nature (so that drivers in the immediate area of a problem were informed of it), and unless drivers could be readily alerted to the problem.

As early as 1969, West Germany's well known Blaupunkt radio company began working on the problem and came up with a system that made it possible to distinguish a station that broadcast traffic news and information from the many other stations on the FM broadcast band. Some time later, that system was elaborated upon and became known as ARI (*A*utomatic *R*oad *I*information). After extensive testing, the system was adopted in West Germany in 1974, and is in use today. Since then, the system has been submitted to the European Broadcasting Union (EBU) for adoptation as a standard and, after practical tests in Switzerland, has been recommended to all European countries for the dissemination of traffic information. Austria introduced the system in 1976, and trials in other European countries have also been taking place to assess ARI's merits.

The ARI system

The ARI system is used to identify stations that broadcast information about traffic conditions, as opposed to those that do not. That is especially useful to a driver who comes from another geographical area and is not familiar with local stations. Using a specially designed, ARI-equipped, radio, the driver can "tune out" stations that do not broadcast traffic information, leaving only the traffic-information stations audible.

One option in an ARI-equipped car radio automatically increases the volume to a predetermined level at the start of any traffic announcement, and returns it to its previous level at the conclusion of the announcement. Another option available in ARI-equipped radios provides a visual indication (similar to the familiar stereo-indicator light) when the driver tunes to a "traffic information" station. It is also possible to have traffic announcements override a cassette-tape program that the driver may be listening to while driving, with automatic return to the cassette when the announcement has been completed.

Still another version of the ARI-equipped radio provides an advance warning that a traffic announcement is about to be made, using a brief "signature tune" to avoid startling a driver whose radio had been muted before the announcement. A suitably equipped ARI car radio can even warn a driver when a station's signal strength falls below usable levels as he leaves the station's area of coverage. That is useful as it will allow him to tune to another ARI-equipped station in his new region of travel.

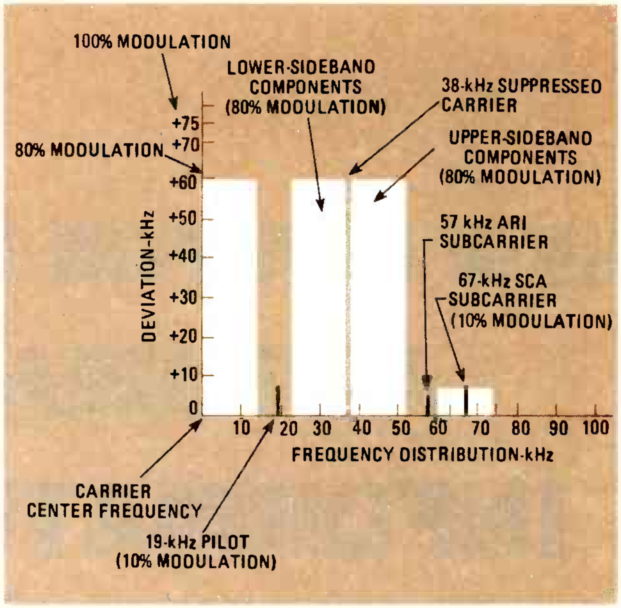


FIG. 2—THE ARI SYSTEM adds a 57-kHz subcarrier to indicate the presence of an ARI station.

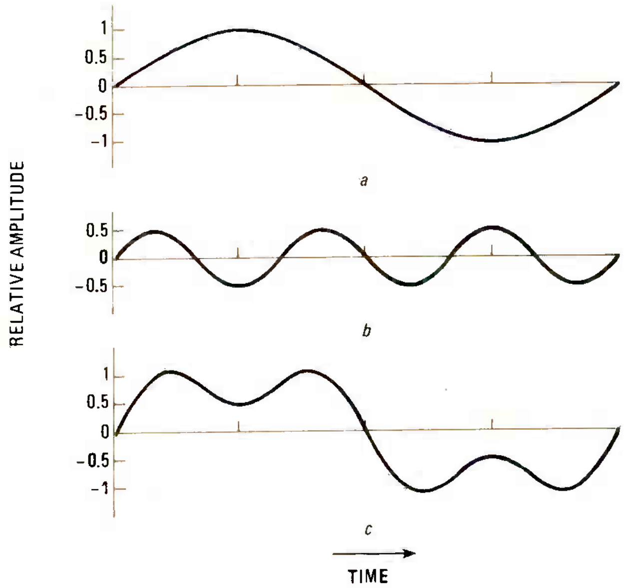


FIG. 3—THE PEAK AMPLITUDE of the 19-kHz stereo pilot-signal plus the 57-kHz ARI subcarrier does not exceed that of the pilot signal alone.

How ARI works

An important characteristic of the ARI system is its ability to identify the station or stations in a given area that provide traffic information on a regular basis. Ordinarily, a driver would find it difficult and time consuming to single out a traffic-news station from all the others on the FM band in most metropolitan regions. With the ARI system, those stations that broadcast traffic information and are part of the ARI network transmit a continuous 57-kHz sub-carrier signal, known as the Station Identification signal (or "SK," from the German word "*S*ender*k*ennung"). That signal, nestled between a normally used 67-kHz SCA subcarrier, and the upper frequency of 53 kHz that is present during FM-stereo broadcasts, is derived by tripling the 19-kHz pilot signal associated with stereo transmissions. The 57-kHz signal is therefore locked to the stereo pilot-signal both in phase and frequency relationship.

The complete modulation spectrum of an FM transmitter operating in both stereo and ARI is shown in Fig. 2. Figure 3 illustrates an important aspect of the ARI system. The 57-kHz subcarrier modulates the main carrier at half the level that the

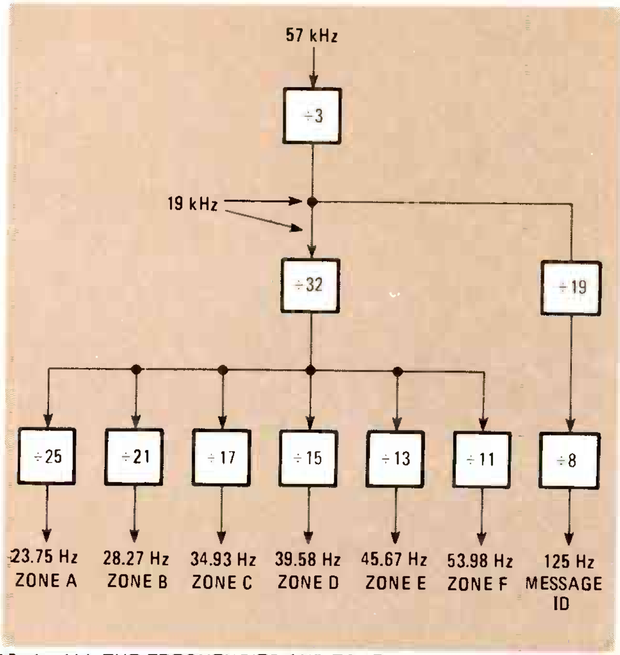


FIG. 4—ALL THE FREQUENCIES AND TONES used in the ARI signal are derived from the 19-kHz stereo pilot-tone.

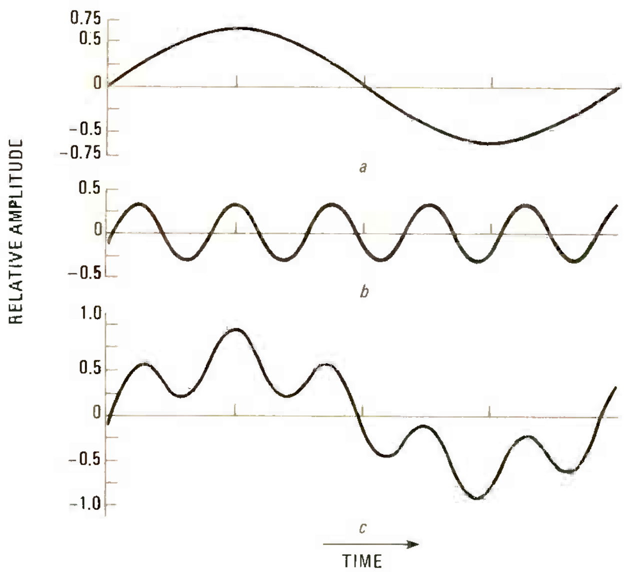


FIG. 5—ZONE-IDENTIFICATION TONE (*a*) is added to message-identification tone (*b*) to produce complex waveform (c).

19-kHz pilot signal modulates the main carrier, or between four and five percent of total modulation. The waveform shown in Fig. 3-a represents the amplitude of the 19-kHz pilot signal, while the one in Fig. 3-b is a representation of the 57-kHz ARI station-identification signal (the third harmonic of 19 kHz). Figure 3-c shows the algebraic addition of the two signals and it is clear that the peak amplitude of the resulting waveform is never greater than that of the original pilot signal. Thus, the combination of the pilot signal and the station-identification signal does not increase the frequency deviation of the main carrier. That also means that signal-to-noise ratios and station coverage-areas are not affected by the addition of the station identification signal.

Area identification

The limited range of FM transmissions presents both advantages and disadvantages in a traffic-information system such as that. On the one hand, drivers can be certain that the traffic information they receive applies to the region in which they are. But it is also possible that, in certain areas, they would be able to receive more than one traffic-news station. A driver would want to be sure that he had selected the right station.

To solve that problem, Blaupunkt developed a special zone-indicating system for ARI. The total area to be covered is divided into traffic areas that correspond closely to areas covered by local radio stations. As many as six different zone identifications can be used, designated by the letters "A" through "F."

Each zone is assigned a very-low-frequency tone, which is used to modulate the 57-kHz ARI subcarrier, as shown in Fig. 4. Extensive measurements and field observations have shown that no audible interference occurs as a result of that added modulation. Zone or area identification frequencies are derived by dividing down the 19-kHz pilot tone; the values used in performing the division are also shown in Fig. 4. Depth of modulation of the 57-kHz ARI subcarrier signal is limited to just 60%.

Traffic message signals

While many drivers want to stay tuned to traffic-news stations throughout their travels, there are others who would prefer to hear only the traffic announcements but not the rest of the program material. For example, they might wish to converse with fellow passengers, preferring to keep the radio's volume level low, or to listen to a cassette tape for part of their trip, even though their car radio remained tuned to an ARI station.

For that reason, it was decided to use a seventh low-frequency tone, at a frequency of 125 Hz, to modulate the 57-kHz subcarrier and serve as a message-identification signal. The modulation level of that extra signal is set at half the value used for zone-identification tones and the tone is transmitted for the entire duration of the traffic message. Figure 5 shows how the modulating frequency of a zone or area identification adds to the 125 Hz "message identification" modulating frequency, with the latter having 50% of the amplitude of the former.

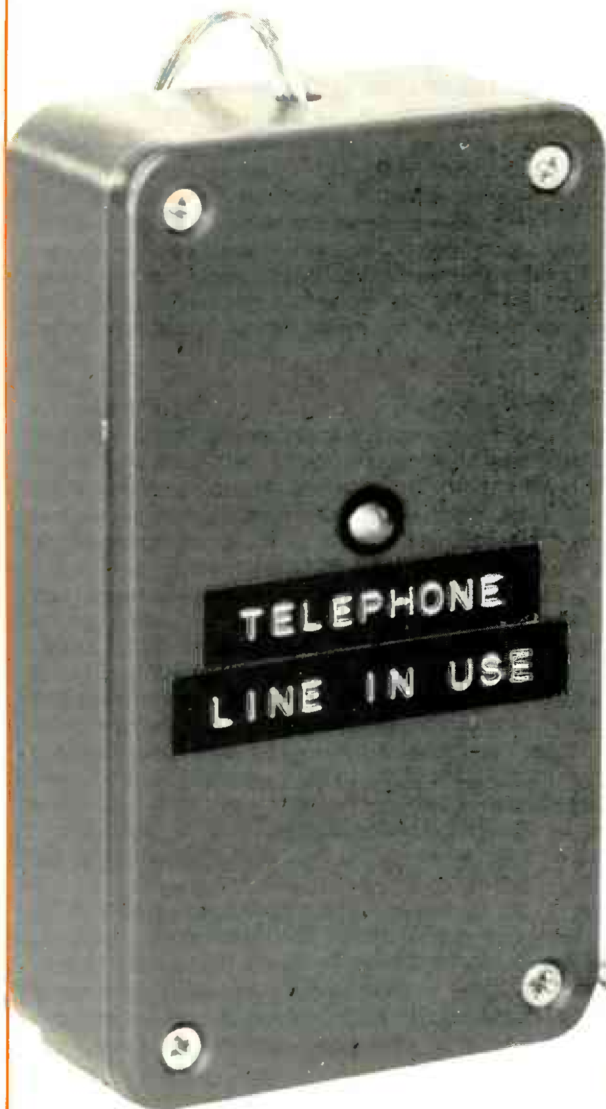
An important advantage of the ARI system is that all of the tones it uses, as well as the basic 57-kHz subcarrier itself, are derived from the stereo pilot-frequency through division or multiplication of the 19-kHz stereo pilot signal. Because of that relationship to the 19-kHz stereo pilot-signal, the design of the ARI radio receiver is greatly simplified.

What's available

The simplest and least expensive type of ARI receiver is one in which only traffic-news station-identification is used. In that type of receiver, an indicator light comes on when the driver tunes to a traffic-information station. If he wishes, he can push a button to mute all other stations, allowing only the ARI-equipped one(s) to come through. A somewhat more sophisticated receiver is one that combines station identification and message indication. Still another type can interrupt the playing of a tape cassette when a traffic message begins, switching to FM reception for the duration of the message, and then switch back to the cassette.

The ultimate ARI system uses a car radio with signal-search capability combined with an ARI circuit. The signal-search feature is designed to stop only at traffic-information stations and, when leaving the area of the local transmitter, it automatically searches for another traffic-information station. If, having left one zone and entered another, no other station with the same identification letter can be received, a warning tone informs the driver that a new zone-letter should be selected.

Reports from West Germany indicate that the ARI system has proven to be of great benefit. With all industrialized countries looking for unused communications channels, SCA frequencies offer a convenient means for providing new and innovative forms of point-to-point communications. **R-E**



TELEPHONE IN-USE MONITOR

Do you embarrass easily? This phone line monitor will eliminate unintentional eavesdropping by indicating when a phone line's in use.

CHRISTOPHER M. DUNN

EVER PICK UP THE EXTENSION PHONE IN your home, only to find out that the line is already in use, and have someone get upset because you're interrupting his (or her) call? (It's always my sister talking to one of her boyfriends.) Well, if you have that annoying situation, or would just like to know when the phone line is in use, this simple and inexpensive device will do the trick.

What the phone-line monitor does is to flash an LED whenever a telephone connected to that line is off its hook. Most of the parts needed to build it can most likely be found in your junk box, and construction is simple—the monitor can easily go on a piece of perforated board.

How it works

Let's look at what happens to the telephone line when someone takes a phone off the hook. Normally, with all phones hung up, a potential of approximately 48-volts DC exists across the two wires of the line. If any phone is picked up, it shunts across the line, and the voltage drops down to about six volts. That change is what is used to trip the monitor.

The circuit is shown in Fig 1. With the monitor connected across the phone line's red and green wires, and with all phones on-hook, a relatively strong potential is developed across resistor R2 (through R1 and R3—more about them later). That positive voltage keeps the base-emitter junction of transistor Q1 biased off. With Q1 off, there is no base current for transistor Q2; it is off, too. That keeps IC1 from flashing the LED because the return path back to the battery is not complete. This IC, an LM3909 is a low-power LED-flasher that needs only an electrolytic capacitor to flash an LED from

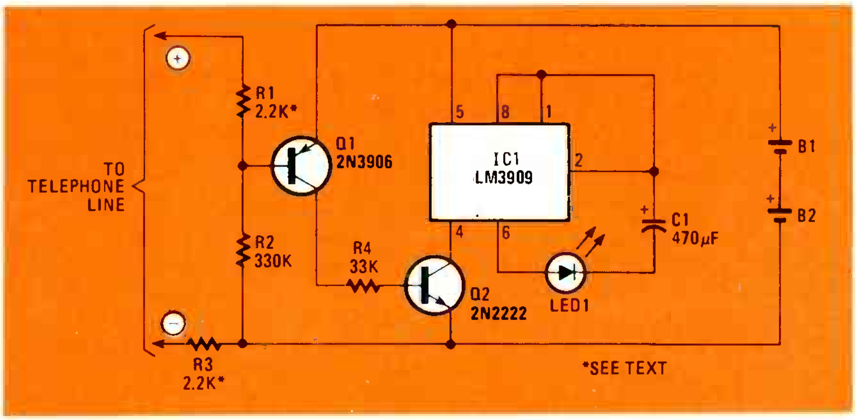


FIG. 1—BOTH POLARITY AND VOLTAGE at phone lines must be known in order for monitor to work. Use a voltmeter to determine them.

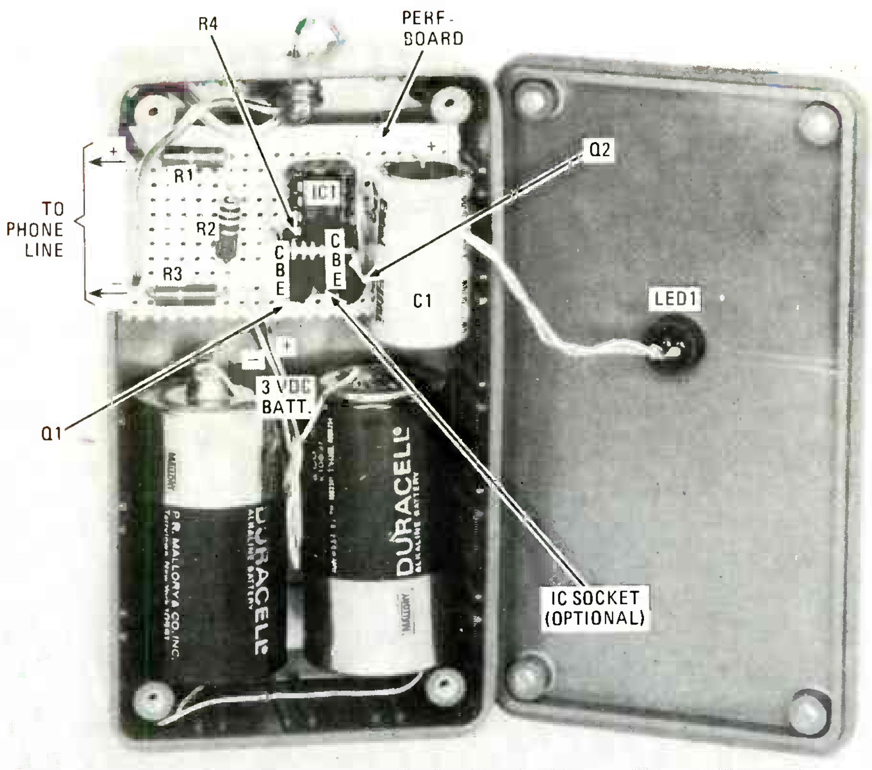


FIG. 2—COMPONENT PLACEMENT is not critical. Board and batteries are held in place by double-sided foam tape. If you wish, an IC socket can be used to hold the transistors as well as the IC. Keep the transistor leads as short as possible.

PARTS LIST

All resistors ½ watt, 10%
R1, R3—2.2 megohms*
R2—330,000 ohms
R4—33,000 ohms
Capacitors
C1—470 µF, 10 volts, electrolytic
Semiconductors
LED1—jumbo red LED
Q1—2N3906 or similar PNP-type
Q2—2N2222 or similar NPN-type
IC1—LM3909 LED flasher
B1, B2—1½-volt "C" cell
Miscellaneous: perforated construction board, case, 16-pin IC socket, double-sided foam tape, etc.
*See text

WARNING
Current FCC rules (Part 68) forbid direct connection of customer-owned equipment that is not FCC type-approved to telephone company lines. To use unapproved equipment, an approved protective coupler must be installed. Check with your local phone company for details.

1½ or 3 volts. I picked that arrangement for flashing the LED because the IC consumes so little power that, even if it were active continuously, the two "C" flashlight batteries would last well over a year.

When someone picks up a telephone, the phone-line voltage drops, and the potential across R2 practically disappears. That allows transistor Q1 to conduct, which, in turn, supplies base current to Q2, which also then conducts. When Q2 switches on, it provides the return path for IC1, and the LED starts flashing about three times a second. If all phones are hung up again, the voltage returns to 48 volts, shutting everything off.

Because the device connects directly to the phone line, I have taken precautions to insure that the line-monitor does not interfere with the normal operation of the phone system.

First, the unit is battery-operated, using two "C" cells. Under no circumstances should an external power supply be used. That insures that no hazardous voltages or earth grounds can be connected to the phone line.

Second, R1 and R3 provide 2.2 megohms of resistance on either side of the active circuit. (4.4 megohms total). While a single, large resistor could have been used in place of R1 and R3, I find it good practice to isolate as much as possible—again, as a safety precaution. Those resistors load down the line little, if at all.

Construction

The circuit can be built on perforated construction board and mounted in any small box (Fig. 2). The "C" cells may be held by battery clips, or soldered directly to wires from the board. Everything is held in place by double-sided foam tape. The LED is mounted in the lid of the box. In Fig. 2, you will notice that a 16pin IC socket is used to hold both the IC and the two transistors. While I found that to be the most convenient way to mount those components, the socket is optional.

Don't be surprised if the monitor starts blinking at you as soon as you apply power. Remember, it's a *high* voltage that turns it off. With nothing connected to it, the monitor thinks it's seeing a low voltage (in this case, *very* low), and turns on.

Installation

The values given for resistors R1 and R3 (2.2 megohms) are for telephone systems using 48 volts, as measured with all the phones on the hook. In some parts of the country the voltage used may be different and, if you are uncertain about its value in your area, check it out with a voltmeter. Be careful when you make that measurement—that voltage can be dangerous!

If you obtain a reading that is considerably different from 48 volts, take that reading and divide it by 22. That will give you the correct value, in megohms, for R1 and R3.

The monitor will not work if it is hooked up backwards (R1 *must* go to the positive line), but it will not be harmed, either. Just reverse the leads to the phone, and you'll be in business.

With the monitor connected, before you pick up the phone, check to make sure the LED is not flashing. If it is, the line is in use. (It's probably my sister again.)

Also, check the November 1979 issue of **Radio-Electronics** for the Music-on-Hold adaptor. Build them in the same box for a super telephone add-on. **R-E**

HOW TO ALIGN VIDEO IF CIRCUITS

Aligning video-IF strips isn't as difficult as you may think. Here are some helpful hints.

JACK DARR
SERVICE EDITOR

MANY TECHNICIANS CONSIDER VIDEO-IF alignment to be the most complex task they have to perform. But that's not true—the stages involved are not more complicated, it's just that there are more of them than in a radio! And, as the saying goes, "Complicated things are just a lot of simple ones strung together."

AM and FM radios have relatively narrow bandpasses—10 kHz in the case of AM; from 200 to 250 kHz in the case of FM. Generally, they use cascaded circuits (one circuit right after the other) operating on a single frequency. Video-IF stages have bandpasses as wide as 5 MHz—they're known as controlled-bandpass, wideband IF's—and in most respects are similar to the ones in radios, except that the tuned circuits are *not* all aligned on the same frequency.

The important thing in performing video IF-stage alignment is not gain, but rather the overall response of each stage. That is easy to adjust with a sweep generator, which we'll discuss shortly.

The video IF-strip consists of several cascaded amplifier stages, each with a tuned circuit at its input, output, or at both ends. Each stage has an ideal bell-shaped curve representing its response. The cartoon in Fig. 1 shows how the tuned circuits in an IF stage work. Each resonant circuit in the stage "pushes the curve up" at its resonant frequency. Using several circuits gives us the wide bandwidth we need. (The two figures sitting on the ends of the curve and holding it down will be discussed later.)

Figure 2-a shows the overall response of one IF-stage, with one of the tuned circuits peaked at the wrong frequency. The dip in the curve caused by this misalignment is obvious. In Fig. 2-b the misaligned circuit has been retuned to the correct frequency and the overall response of the stage is now what was intended. That's how *all* the resonant circuits in an IF stage work—they alter both the height *and the shape* of the curve at the points they affect. When an IF stage is properly aligned, the resulting curve looks pretty much like the one in Fig. 2-b.

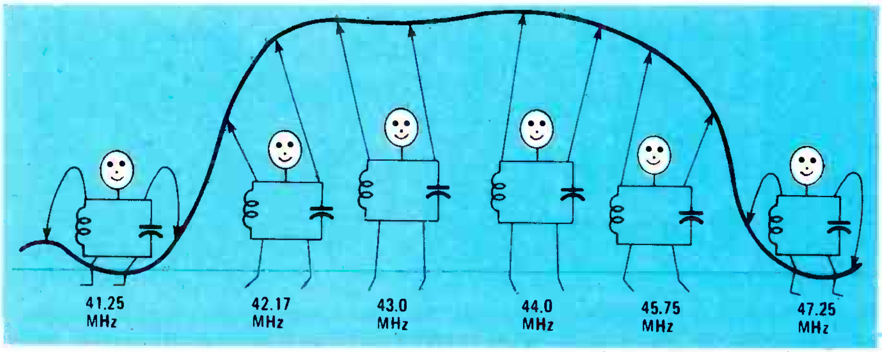


FIG. 1—EACH RESONANT CIRCUIT in the IF strip works to give the bandpass curve the correct shape.

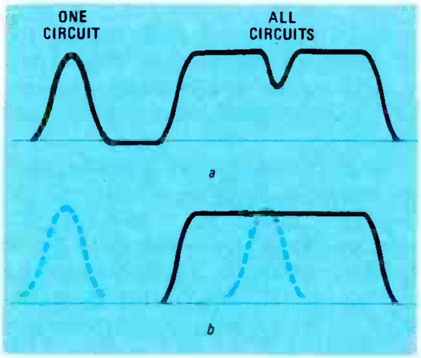


FIG. 2—AN OFF-FREQUENCY circuit will alter the shape of the curve. Retuning it will restore the curve to normal.

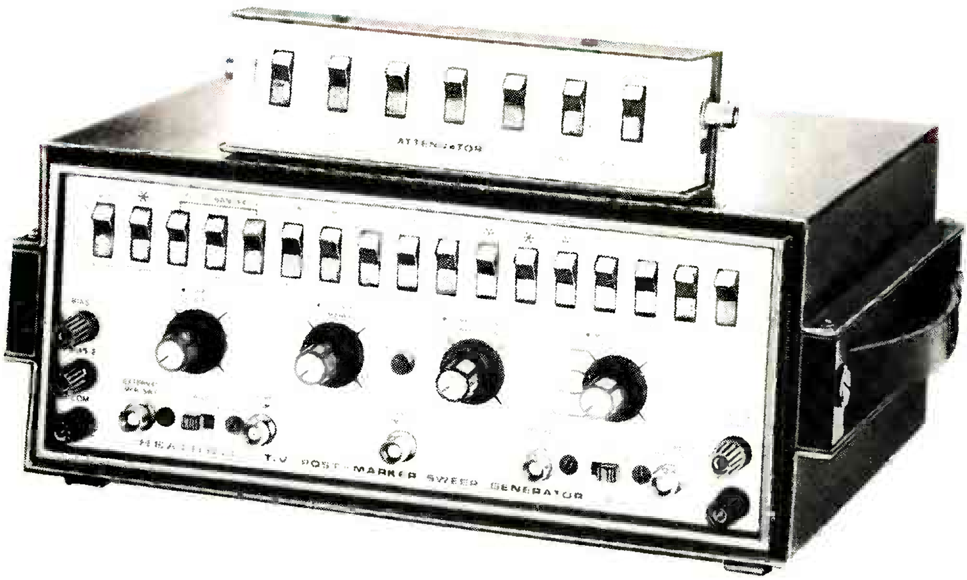
Traps

Shaping the response of an IF stage means not only boosting certain frequencies, but also attenuating or eliminating some of them. That's what the two figures sitting on the ends of the curve in Fig. 1 are doing.

Figure 3 shows the two types of resonant circuits used in curve shaping. The parallel-resonant circuit at the right of Fig. 3-a boosts the response at the resonant frequency, as shown in Fig. 3-b. The series-resonant circuit at the left of Fig. 3-a does the opposite—it removes signals at its resonant frequency. (It has a very low impedance at resonance.)

Series-resonant circuits are used to reduce the strength of, or get rid of entirely, unwanted signals at specific frequencies. When they perform that function, they are called *traps*.

Traps are never used within the bandpass range; they are used to shape the slopes of the ends of the curve and to insure that signals from other channels do not get into the IF strip. The major



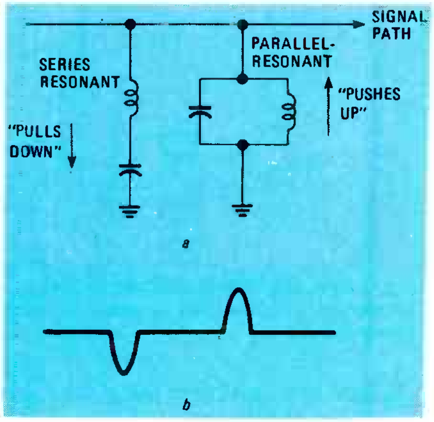


FIG. 3—A SERIES-RESONANT circuit has low impedance and acts as a trap. A parallel-resonant one reinforces the signal.

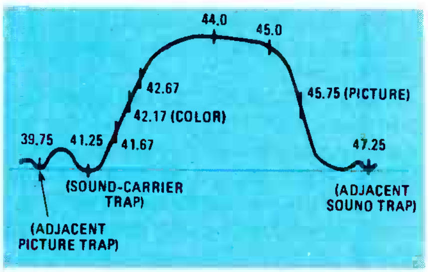


FIG. 4—A REPRESENTATIVE IF CURVE, showing all the key marker-frequencies.

difference between tuning traps and the other resonant circuits in the IF strip is that the traps are always adjusted to give *minimum* response. Because they determine the shape of the endpoints of the response curve, tuning the traps is always the first part of any TV-IF alignment procedure.

Sweep alignment

To align a TV-IF circuit properly, it is important to be able to see the response of the entire curve. That way, the effect of any adjustment on the overall shape of the curve is instantly obvious. If you try using single-signal methods, and tuning each circuit for maximum, you can wind up with some *very* interesting results! Therefore, sweep-alignment equipment, which allows you to view the entire curve at once, is required.

The original sweep-frequency generators were called "wobbulators" because they wobbled (swept) the signal back and forth; the response-curve of the IF strip was displayed on an oscilloscope. What they didn't do was to locate, or mark, the critical frequencies on that curve.

There are *nine* different frequencies (see Fig. 4) that are critical to IF-strip alignment, and it is important that adjustments be made exactly at those frequencies. To locate them, a marker generator is used.

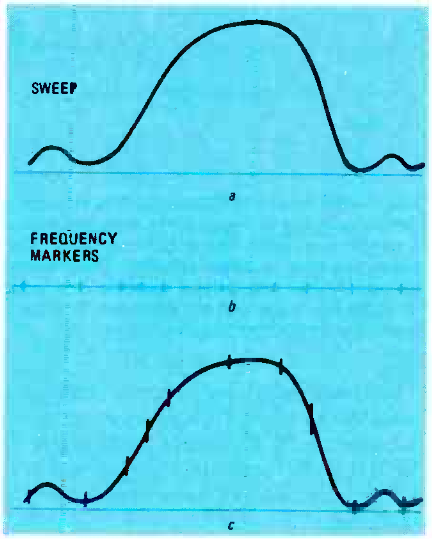


FIG. 5—SWEEP AND MARKER SIGNALS are mixed in the marker adder to create a marked-sweep curve to be fed to an oscilloscope.

Marker generators

In the early days, markers were placed on the curve by a tunable RF signal-generator. The disadvantage of that was that only one marker could be seen at a time. The signal generator had to be retuned each time a new frequency was checked. (There was a way around that. The critical points could be marked, one by one, on the screen of the oscilloscope with a grease pencil. That system worked fairly well as long as the sweep generator was not retuned.)

Another disadvantage was that when the marker frequencies were fed through the video-IF-strip together with the sweep signal, the curve could be badly distorted if the level of the marker signal was too high. The marker generator also had to be *very* accurately calibrated.

Current sweep-generators

The current generation of sweep generators makes alignment a lot simpler. They have two very useful features. First, they have separate, crystal-controlled, markers for each key frequency. Any, or all, of the markers can be used at any time.

The other feature is a circuit called a post-injection marker-adder (or just "marker adder," for short). The marker adder is actually separate from the sweep generator and only the sweep signal goes through the circuits being aligned. A small portion of that signal is fed to the marker adder, and the markers are added electronically at that point. The marker-adder's output is then fed to the scope. Figure 5 will give you an idea of how that works.

The crystal-controlled markers are extremely accurate because each one is generated by a separate circuit. Furthermore the markers cannot cause curve distortion in the IF stage because they never pass through it.

With today's equipment, and a little knowledge of what's going on, video-IF-strip alignment turns out to be a lot less complicated than you may have thought it to be. **R-E**

DESIGNING CIRCUITS WITH OP-AMPS

Perhaps the most universal integrated circuit is the operational amplifier. Here's how to design your own op-amp circuits

JOSEPH J. CARR

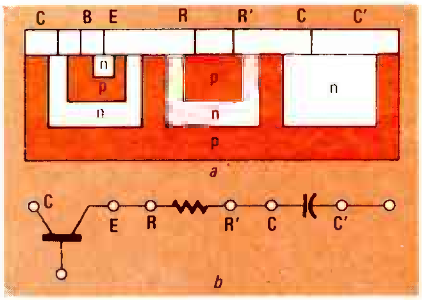


FIG. 1—AN INTEGRATED CIRCUIT is formed by diffusing layers of p-type and n-type material on a p-type substrate. The uppermost layer is an insulating layer of silicon dioxide. Connections to the n-type and p-type material are made through this layer and are indicated by vertical lines. The equivalent circuit is shown in *b*.

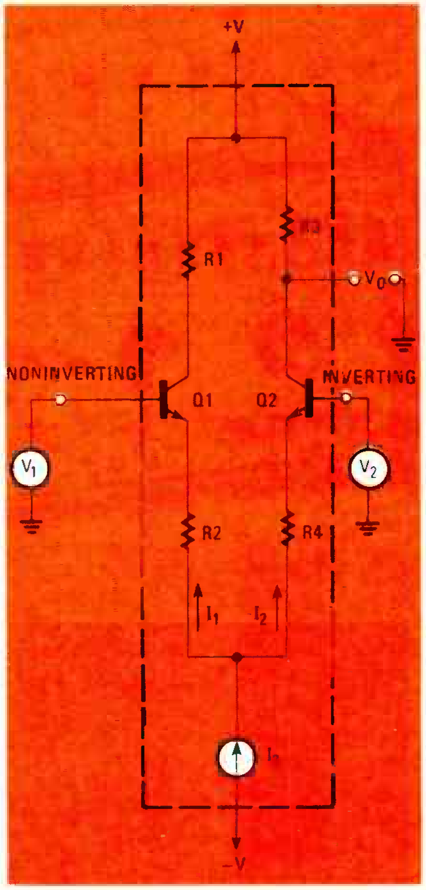


FIG. 2—OP-AMP INPUT CIRCUIT is actually a differential amplifier that requires a bipolar power supply.

THE INTEGRATED CIRCUIT WAS INVENTed in the early 60's, and has taken off like a rocket ever since. Devices have grown steadily in complexity. The early μA703, for example, contained only a few transistors and a couple of resistors, and was used extensively as an FM IF amplifier...and not much else. The μA703 was a real hit, but that device is now considered "low technology" and is no longer used.

We now have MSI and LSI (*M*edium *S*cale *I*ntegrated and *L*arge *S*cale (*I*ntegrated) devices that may contain hundreds or thousands of transistors and other components on a single chip. They are even developing VLSI (*V*ery *L*arge *S*cale *I*ntegrated) circuits.

The biggest portion of the IC market are the digital IC's, but don't count analog devices down and out quite yet; they are alive and kicking in many areas of technology and can out-perform devices made only a few years ago.

There are several technologies used for creating transistors and other components on a slab of semiconductor material. This slab is referred to as a substrate. There may be several layers of material in the integrated circuit of which the substrate is the bottom-most. The usual substrate is approximately 6 mils thick, with a typical cross-sectional area being 50 × 50 mils, with some up to 160 × 160 mils. In Fig. 1-a, the substrate is shown as P-type semiconductor material.

The second layer is made of N-type material, and is grown as an extension of the P-type substrate crystal. In operation, that PN junction must be maintained at a reverse bias potential or the IC will be destroyed. That region is approximately 5 to 30 micrometers thick. The next region is P-type material, while the uppermost is again N-type material. Lastly, a layer of silicon dioxide is formed over the top of the silicon slab. The silicon dioxide is an insulating material and connections to the various regions are made through that layer, indicated in Fig. 1-a as vertical lines.

The equivalent circuit is shown in Fig. 1-b. In this case, a transistor is in series with a resistor and capacitor. The transistor is formed from elements of the second, third, and fourth layers of the substrate. Since the transistor is an NPN device, the collector and emitter terminals are connected to N-type (second and fourth) layers of the substrate. The series resistor is formed by the resistance of a section of the N-type second layer. It is connected to the emitter section by depositing a metallized strip over the silicon dioxide.

The capacitor is formed by sandwiching the silicon dioxide between an N-type layer and a metalization layer. The dielectric of the capacitor is the silicon dioxide layer.

Integrated circuits do not often contain capacitors because of the size and cost. In general, only small-value (picofarad-range) capacitors can be integrated onto the substrate. Hybrid circuits, which use a combination of integrated-circuit technologies and discrete component techniques, often use small tiny capacitors called chip capacitors. Those capacitors are mounted on a ceramic substrate along with several unpackaged IC chips.

The operational amplifier

The operational amplifier is a linear integrated circuit that has an immense variety of applications. The op-amp can be used in relatively complex circuits, yet the design rules are easy to master. The typical operational amplifier has two inputs, called inverting and noninverting inputs. That is not a requirement in the definition of the operational amplifier, but it is true that almost all op-amps have two inputs: Only a few devices on the fringes of the linear IC market are op-amp-like, yet have but one input (the LM302 device, for example).

The operational amplifier was designed originally to perform mathematical operations in analog computers. That means that it had to operate on a variety of input-data values, and then be able to produce an output of either polarity depending upon the required answer.

As a result, operational amplifiers require a dual-polarity power supply. The positive (+V) power supply is positive with respect to ground, while the negative (−V) power supply is negative with respect to ground.

Figure 2 shows a typical input circuit for an operational amplifier. The two transistors (Q1 and Q2) of the differential pair are connected so that their emitters are fed from a single constant-current source (I_3). The constant-current source will produce a constant current, despite changes in the load resistance. Most IC constant-current sources are bipolar transistors, biased in a particular manner. In Fig. 2, the two emitter currents (I_1 and I_2) are derived from the constant source I_3. We know from Kirchoff's current law that the following relationship holds true:

$$I_1 + I_2 - I_3 = 0 \qquad (1)$$

or

$$I_1 + I_2 = I_3 \qquad (2)$$

For the purposes of this discussion, we are going to assume that the emitter and collector currents of the two transistors are equal (i.e., $I_{C1} = I_{C2}$ and $I_{E1} = I_{E2}$). In actual fact they are different by two to five percent, but that does not present a problem.

Let's assume that a voltage (V_1) is applied to the base of transistor Q1. What happens? How does the circuit respond? When V_1 is made positive, the collector and emitter current of Q1 (I_1) will increase. That increase in current I_1 must (by equations 1 and 2) cause a decrease in current I_2. Current I_2 is the emitter current in the transistor Q_2. Since I_2 decreases, the voltage drop across resistor R3 also decreases (i.e. $I_2 \times$ R3 decreases). The output voltage V_0 is the difference between the collector potential and the voltage drop across resistor R3, so a reduction in I_2 causes an increase in V_0. Here we have a positive increase in V_1 causing an increase in output-potential V_0. The base of transistor Q1 is, therefore, the non-inverting input.

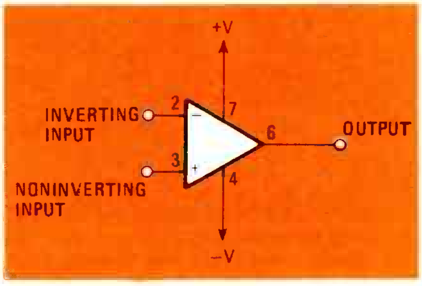


FIG. 3—SCHEMATIC SYMBOL and industry standard pinout of an operational amplifier.

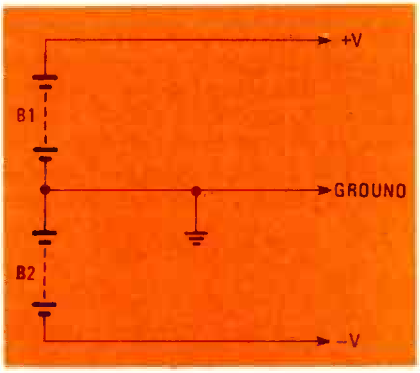


FIG. 4—BIPOLAR POWER SUPPLY can be built using batteries as shown.

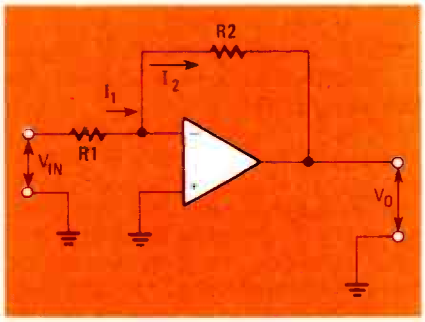


FIG. 5—BASIC INVERTING AMPLIFIER. The gain is determined by the ratio of R2 and R1. Point A is called a virtual ground.

TABLE 1

1. Infinite input impedance
2. Infinite open-loop (no feedback) gain
3. Zero output impedance
4. Infinite bandwidth
5. Zero noise contribution
6. Both input voltages track each other.

Now let's examine what happens when an input voltage (V_2) is applied to the base of transistor Q2. When voltage V_2 is positive, current I_2 increases. When current I_2 increases, the voltage drop across resistor R3 increases. The increased voltage drop across R3 causes a decrease in the output voltage. Therefore, the bass of transistor Q2 is the inverting input: a positive input voltage produces a decrease in the output voltage.

Output-voltage V_0 is normally zero when both input voltages (V_1 and V_2) are equal.

Operational amplifier symbol

The operational amplifier symbol used in circuit diagrams is shown in Fig. 3. It consists of a triangle with the output at one apex, usually oriented horizontally. Some texts follow the IEEE convention of using the straight-back symbol (as shown here) for linear amplifier IC devices, and a similar version with a curve back for the operational amplifier. In **Radio-Electronics**, however, we use the more common convention—as shown in Fig. 3.

The two inputs of the operational amplifier are labeled (−) for the inverting input and (+) for the noninverting input. The +V and −V power-supply terminals may or may not be shown in some schematics. Many people delete the power-supply terminals on their drawings for the sake of simplicity. Make no mistake about it, however: The power-supply terminals are still to be connected! The pin-out numbers shown in the illustration were originally for the 741 device only, but that particular arrangement is now considered the "industry standard." Most commercial integrated-circuit op-amps use that pinout.

The +V and −V power-supply terminals are not +V and ground, but two separate power supplies of opposite polarity with respect to ground. The +V power supply is positive with respect to ground, while the −V power supply is negative with respect to ground. A battery version of the typical operational amplifier power supply is shown in Fig. 4. Note that this power supply has a ground connection, but there is no ground terminal on the operational amplifier symbol! The input and output potentials are measured with respect to ground, so the ground must come from the power supply.

Operational amplifier properties

A simple linear amplifier using an operational amplifier is shown in Fig. 5. We can analyze the operation of this circuit by using Kirchoff's current law and the basic properties of the operational amplifier. For purposes of discussion, we will consider the properties of an *ideal* operation amplifier. Table 1 lists the six basic properties of the ideal operational amplifier:

An infinite input impedance means that the input neither sinks nor sources current. The input impedance of any amplifier is given by V_{in}/I_{in}. If the input will neither accept (sink) nor generate (source) current, then I_{in} is zero and the input impedance is infinite. In actual operational amplifiers, which are not ideal, the input impedance is not quite infinite; but it's extremely high. Some low-cost cheapie operational amplifiers are only able to offer input impedances of 100,000 ohms, but most devices can boast 1 megohm or more. A few devices, such as the RCA BiMOS devices (which have MOSFET input transistors) have input impedances of 1.5 teraohms (1.5×10^{12} ohms)! That reflects input currents of picoamperes or nanoamperes.

Infinite open-loop gain means that the amplifier gain is infinite when there is no negative feedback present. In real operational amplifiers, the open-loop gain will be 20,000 for cheapies, and over 1,000,000 for some premium devices.

An ideal operational amplifier is said to have a zero output impedance. In real operational amplifiers, however, we find output impedances of less than 200 ohms, with most under 75 ohms.

Infinite bandwidth means that the device will amplify all signals applied to the input, regardless of frequency. But, that is not the case in real operational amplifiers. Many devices operate into the HF region and some devices operate into the low VHF region. Most common operational amplifiers, however, are severely limited in frequency response. The popular 741 device, for example, has a frequency response of only a few kilohertz.

Zero noise-contribution means that the op-amp adds no noise to the signal it amplifies. Unfortunately, most operational amplifiers fall far short of that ideal: Some premium (high cost) devices offer very good noise performance, but most common operational amplifiers do not perform well as low noise-amplifiers.

Both input voltages track each other. What does that mean? It means that applying a voltage to one input requires us to treat the other input mathematically as if it, too, were connected to the same voltage. That is not merely some theoretical device used in mathematical formulas; it is real. If you apply 4 volts to the noninverting input, then you can measure 4 volts at the inverting input also! That phenomenon is one of the most important of the ideal properties!

Inverting-follower circuits

Figure 5 shows the circuit for the inverting-follower configuration. An inverting follower uses the inverting input of the operational amplifier. Note that the noninverting input is grounded in this circuit. That is the same as saying that the noninverting input is at zero potential. A result of ideal property No. 6 listed in Table 1 is that the inverting input must now be treated as if it were also at zero potential. The inverting input is essentially grounded, even though

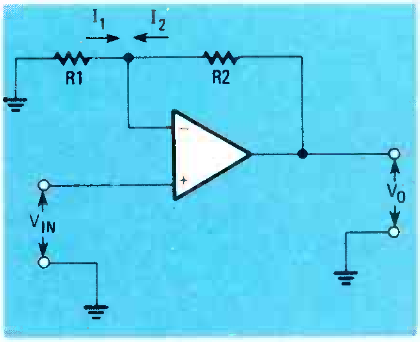


FIG. 6—BASIC NON-INVERTING amplifier. The input signal is fed to the non-inverting input terminal.

not physically connected to ground. That confusing state of affairs is not made too much clearer by the name usually given to the phenomenon: "virtual ground." The virtual ground is *treated* as a ground even though it is not actually grounded through a piece of wire.

What do we know about the circuit in Fig. 5? We know that the currents are as follows:

$$I_1 = V_{in}/R1 \qquad (3)$$

and,

$$I_2 = V_0/R2 \qquad (4)$$

we also know from Kirchoff's current law that:

$$I_1 = -I_2 \qquad (5)$$

So, by substituting equations 3 and 4 into equation 5, we obtain:

$$V_{in}/R1 = -V_0/R2 \qquad (6)$$

We can solve equation 6 for V_0, thereby obtaining the transfer equation for the inverting follower:

$$V_0 = -V_{in} \times R2/R1 \qquad (7)$$

The gain of any amplifier is the quotient V_0/V_{in}, which in this case is R2/R1. That relationship means that we can set the gain of the inverting-follower operational amplifier circuit by setting the ratio of two resistors! The absolute values of the resistors are not important, only their ratio. For example, if the feedback resistor (R2) is 100,000 ohms, and the input resistor is 1000 ohms, then the gain R2/R1 is 100,000/1,000, or 100.

There is a problem associated with the inverting follower. The input impedance is low, being limited to the value of input-resistor R1. That is because one end of R1 is grounded as a result of the "virtual" ground. The apparent solution to the problem is to use an input resistor that has a sufficiently high value. But that is not always possible, due to gain problems (remember, the open-loop gain is not infinite), and because certain problems with real operational amplifiers are made worse by using high-value resistors in the feedback and input circuits. Unless phase inversion is needed in the circuit, there may be good reason to opt for the non-inverting follower.

Non-inverting follower with gain

Figure 6 shows the circuit for the non-inverting-follower configuration. In this circuit, the signal is applied directly to the non-inverting input of the operational amplifier. The feedback network is the same as in the inverting follower, except that R1 is now grounded.

Recall ideal property No. 6 listed in Table 1: Applying voltage V_{in} to the noninverting input has the effect of placing the other (inverting) input at the same potential. Since there is no phase inversion in the circuit, the output signal has the same polarity as the input signal, so:

$$I_1 = I_2$$

By the same sort of reasoning as in the previous case:

$$I_1 = V_{in}/R1 \qquad (9)$$

and:

$$I_2 = (V_o - V_{in})/R2 \qquad (10)$$

We can obtain the transfer equation for the circuit by substituting equations 9 and 10 into equation 8, which yields:

$$V_{in}/R1 = (V_o - V_{in})/R2 \qquad (11)$$

Algebraically rearranging equation 11 yields:

$$V_{in} \times [(R2/R1) + 1] = V_o \qquad (12)$$

Equation 12 is the transfer equation for the non-inverting follower with gain circuit shown in Fig. 6. Note that the circuit will always have a gain of at least 1, since the gain factor is (R2/R1) + 1.

The input impedance of the non-inverting-follower circuit is very high, being limited by the input impedance of the operational amplifier. Recall that typical operational amplifiers have an input impedance greater than 1 megohm, with some models offering impedances as high as 10^{12} ohms. The non-inverting follower, therefore, is best suited for use with high-impedance circuits. In the case of some oscillator and timer circuits, it also relieves us of the problem of considering the effects of the input impedance of the amplifier on R-C time constants.

Unity gain non-inverting followers

In the non-inverting-follower circuit shown in Fig. 6, the feedback was only a fraction of the output signal and was set by a voltage divider consisting of R1 and R2. Let's investigate what happens when we feed back all of the output signal. We can accomplish that by connecting the output of the operational amplifier to the inverting input directly, as

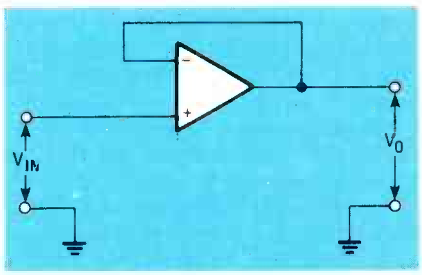


FIG. 7—UNITY-GAIN AMPLIFIER has high input impedance and low output impedance. This circuit is used as a buffer.

shown in Fig. 7.

Substituting R1 = 0 in equation 12 yields:

$$V_o = V_{in} \quad (13)$$

Thus, the gain of the circuit shown in Fig. 7 is equal to 1. To understand why, recall ideal property No. 6. We know that if V_{in} is applied to the non-inverting input, then that same potential must also exist on the inverting input. But the inverting input is also connected to the output, so V_{in} must also exist on the output of the operational amplifier!

OK, but what's the use of a unity-gain amplifier? Aren't amplifiers supposed to amplify? The voltage amplification is nearly unity in that circuit (0.9999999), yet the output impedance is very low. Since the input impedance of the operational amplifier is very high, then it becomes obvious that the unity-gain follower can be used for impedance transformation without loss of amplitude between a high-impedance source and a low-impedance load. Also, the unity-gain non-inverting follower can be used as a buffer stage to provide some isolation without either a change of amplitude, or phase inversion.

Differential amplifiers

The two input terminals of an operational amplifier are complementary; that is, they produce an equal but opposite effect on the output signal. If a voltage is applied to the non-inverting input, the output will have the same polarity as the input signal. But, if that same voltage is applied to the inverting input, then the output will have the opposite polarity. The gain of the amplifier in each case is the same, but the output polarity is opposite. The inputs of the operational amplifier are, therefore, differential. The actual input voltage seen by the op-amp is the difference between the potentials applied to the inverting and non-inverting inputs. We can, therefore, use the operational amplifier to make a differential amplifier.

An example of a simple operational differential amplifier (diff-amp) is shown in Fig. 8. This circuit is the simplest form of a diff-amp.

The gain of this circuit is:

$$\text{Gain} = R3/R1 \quad (14)$$

Provided that

$$R1 = R2 \quad (15)$$

$$R3 = R4 \quad (16)$$

The ideal differential amplifier will not respond to a common-mode voltage (that is, a signal voltage applied equally to both inputs simultaneously). The real differential amplifier, however, will respond somewhat to a common-mode voltage and produce a small output voltage, called the common-mode error voltage. The ratio of the common-mode voltage (a voltage applied equally to both input terminals) to the common-mode error voltage (resulting error voltage that appears at the output of the

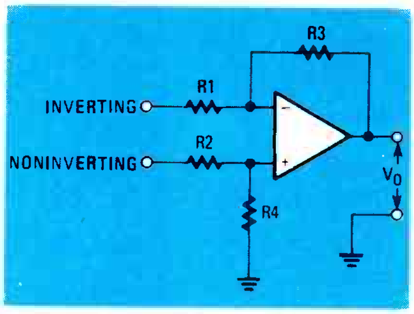


FIG. 8—DIFFERENTIAL AMPLIFIER circuit amplifies the difference between the two input signals.

op-amp) is called the common-mode rejection ratio (CMRR) and is expressed in dB. Some operational amplifiers have a CMRR of 120 dB (1,000,000:1), while even garbage-grade blister-pack op-amps have CMRR ratings in the range of 60 dB!

The differential amplifier is used extensively in circuits where noise pick-up is a factor. The human electrocardiogram signal, for example, is very weak (1 mV), yet interference from 60-Hz power lines can be several volts on an 8-foot cable leading to the patient being monitored. The result is that the signal is completely swamped by 60-Hz interference that is 1000 times greater! However, if we treat the electrocardiogram signal from the surface of a patient's body as a differential signal, we find that the 60-Hz signal will be seen by the differential amplifier as a common-mode signal, whereas the electrocardiogram signal is seen as a differential signal. The gain of the amplifier may be 1000 for the differential signal and the amplifier will significantly attentuate the 60-Hz components. The result is an electrocardiogram trace that is essentially free of 60-Hz interference.

Operational amplifier problems

The properties of the ideal operational amplifier are never realized in practical devices. The ideal properties are closely approximated in some premium devices, but there is always some discrepancy. Those problems fall into several categories. We have already discussed the matter of frequency response and common-mode rejection ratios. We also find that there are several DC-offset problems that cause the output voltage to be non-zero at times when it should be zero.

There are several sources of offset voltage. One is the bias currents of the transistors used in the input circuit. Remember that the ideal operational amplifier has an infinite input impedance, which means that the input terminals will not sink any current. But real operational amplifiers are built from real transistors that require bias current. The bias current for some premium grade devices may be nanoamperes, or even picoamperes, but in some cheapies the bias current may be a fraction of a milliampere! The error voltage generated at the output of the operational amplifier by this bias current is equal to:

$$I_{bias} \times R_f$$

where R_f is the resistance of the feedback resistor. Also, the bias current will cause a voltage drop to appear at the input terminal that is equal to the product of the bias current and the parallel combination of the feedback and input resistances [R1 × R2/(R1 + R2)].

One method for reducing the error voltage caused by the input-bias current is shown in Fig. 9. That circuit works because the operational amplifier input circuit is symmetrical, meaning that identical currents will flow in both input terminals. If the value of resistor R3 is equal to the parallel combination of R1 and R2, then both input terminals see an equal resistance to ground. The bias current at each input terminal will then generate an equal error voltage at each input terminal and the common-mode rejection ratio will cancel the effect at the output terminal.

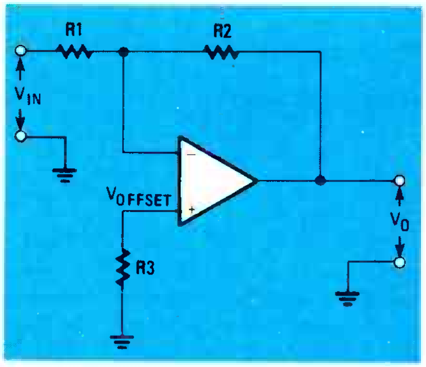


FIG. 9—INPUT BIAS CURRENT causes an error voltage to appear at the output of the op-amp. The voltage drop across resistor R3 (caused by the input bias current) cancels the output error voltage.

Unfortunately, input-bias currents are not the only source of offset voltages on the output line. There are actually several causes, some of them inside of the operational amplifier and others from outside sources (for example, the power supply). The circuits shown in Figs. 10 and 11 will allow us to cancel any type of offset voltage, including the offset voltage caused by the input-bias current.

The circuit shown in Fig. 10 is used with operational amplifiers that have offset compensation terminals. Those terminals allow us to balance the emitter currents of the input amplifier transistors to allow for offset variations.

Another, more universal, method for cancelling the offset voltage is shown in Fig. 11. In this circuit, which can be used whether or not the operational amplifier has offset-compensation terminals, we add a current to the input sum-

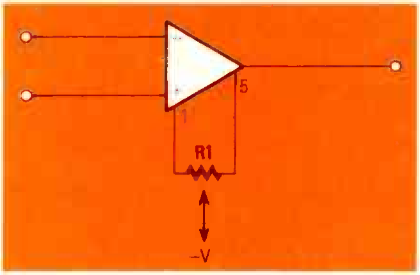


FIG. 10—OFFSET COMPENSATION terminals are provided on some op-amps. Potentiometer R1 is adjusted to eliminate offset errors that appear at the output.

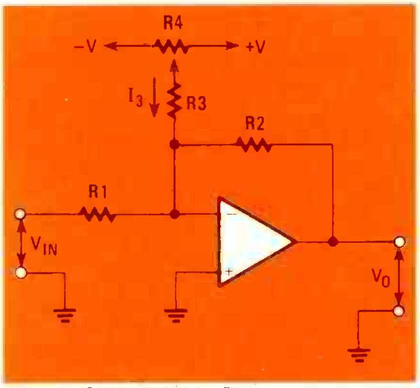


FIG. 11—SIMPLE CIRCUIT for eliminating offset errors with op-amps that do not provide offset compensation terminals.

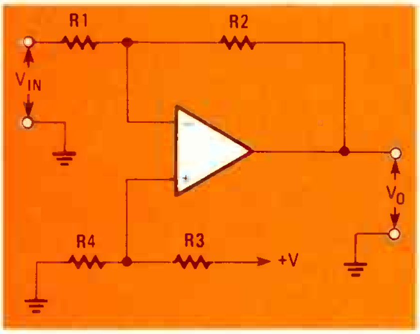


FIG. 12—SINGLE-POLARITY POWER SUPPLY can be used with an op-amp by biasing the non-inverting input at half the power-supply voltage. In this case, resistors R3 and R4 are equal.

mation junction of the inverting follower (or the non-inverting follower, if desired) that exactly cancels the output offset voltage. Resistors R1 and R2 are the normal input and feedback resistors used in the amplifier, while R3 and R4 are part of the offset cancellation circuit. Potentiometer R4 is adjusted so that current I_3 exactly cancels the normal offset voltage and no more (otherwise, the offset-cancellation voltage becomes an offset in its own right.)

The operational amplifier is designed to operate from bipolar power supplies. During normal operation, the –V and +V power supply contributions to the output voltage depend upon the polarity of the input signal. When the input signal is zero, the respective contributions are zero. But what happens when the operational amplifier must be operated from a single-polarity power supply? In that case we must bias one input (usually the non-inverting input) to some potential between zero and the power-supply voltage. The output voltage will be equal to that potential when the input signal is zero, and will swing about the bias potential when the input signal is non-zero. In most cases (see Fig. 12) the non-inverting input is biased at one-half +V by making resistors R2 and R3 equal to each other. **R-E**

"NO! NO! NO! That's not what I meant by trouble-shooting!"

SERVICE QUESTIONS

HALF RED-BLUE, HALF GREEN

I've got a Philco C7261TMA-1 whose screen is red-blue on the left and green on the right. I changed the picture tube (the old one was bad, anyhow), but that didn't help. Where do I go from here?—L.B., Salt Lake City, UT

I've seen almost the same thing—also in a Philco. The left half was gold and the other blue. Try scoping all the B+ lines around the bandpass-amplifier stages—any point that has a bypass capacitor on it. You should see no signals at all. If you do, one of the bypasses isn't working and you will get feedback that upsets the color.

(Feedback: Thanks for the idea. The scope showed all kinds of signals on the B+ lines. I replaced both of the big filter capacitors and that cured the color problem and some others in the horizontal and vertical circuits.)

TOP-STRETCH CURE

My good buddy Bill Stiles, of Hollsboro, MO, has sent me another of his jewels. He had asked about top-stretch in an Admiral 12H10 and I suggested checking the .039 µF capacitors in the vertical-output grid circuit.

He did, and although they checked out OK, he decided to replace C74 and C76 anyway. That cured the stretch! (And showed up another problem. The vertical-centering control wouldn't work properly. A new one set everything right.)

If you run into this sort of problem in this or similar chassis, try new capacitors, even if the old ones look OK.

HOT RESISTOR

This RCA CTC-31A burns up R163 (the plate load-resistor from the horizontal-oscillator plate to B+) and then loses drive. A new resistor brings back the HV for about two minutes and then the resistor burns up again. The tubes, etc. all seem to check out. What's going on here?—B.C., Kent, OH

This sounds familiar—we ran into almost the same thing in a CTC-22 some time ago. The horizontal-oscillator plate in this set is fed by a "parallel path:" At turn-on, voltage is fed through R163 from B+; after the set warms up, the oscillator is fed through a pair of 220K resistors in series from boost and R163 doesn't have to carry so much current.

Check to see whether one or both of the 220K units are bad and replace what's necessary. If they were bad, R163 would have had to carry the full load, and it's only a ½-watt type. Replace it with a 1-watter just for luck.

ODD PICTURE

I've got a TS941 Quasar. I get a couple of black patches near the top of the raster—they come and go, as well as writhe. Eventually the picture goes dark and narrow and compresses in the center, making a bright vertical streak. This is weird!—J.G., Oak Park, IL

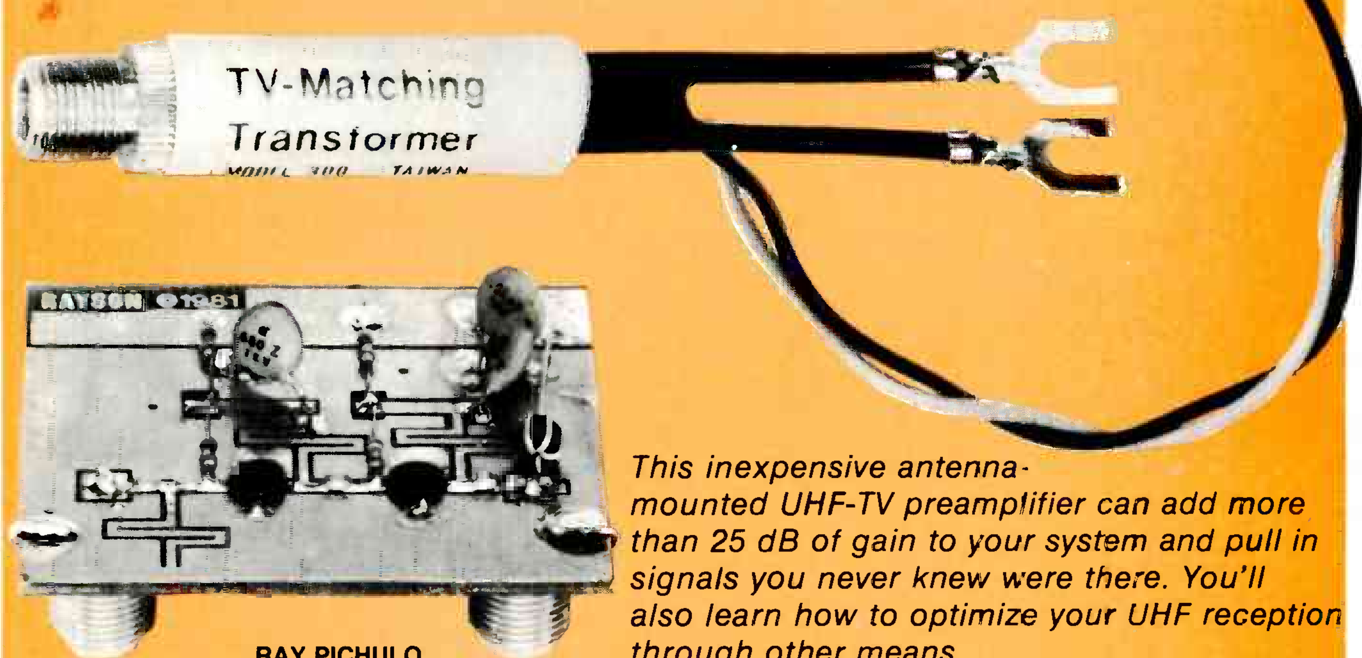
It certainly *is*. I've heard of something like this before. The cause of the problem is usually a big 500 µF filter capacitor, Q508, located under the power-supply chassis. The negative connection breaks loose or becomes intermittent. Make sure the ground lead is good, and well soldered.

LOSS OF VIDEO

I've got good sound but no video in this RCA KCS-169B. The base of the video amplifier (Q3) is OK with no signal (+2 volts), but goes to –5.5 volts when signal is applied, cutting off that stage. Replacing the transistor did no good. The video signal to the base is too high (5.5 volts); it should be 2 volts. Any suggestions?—W.M., Springville, NY

Yes! You should recheck the Q3's base circuit; that is L8, R22, R24, and R3 to ground. Apparently there is some positive voltage being fed into the control circuit from the detector-return circuit and R21 to ground. I'd say that this should go more positive with increasing signal strength since it comes off the detector cathode. That should prevent the base of Q3 from being driven into cutoff. Check the video-bias control to see if it does anything; it should. I'd also check the little choke for an open circuit, etc. Also check for bad solder joints. **R-E**

UHF-TV PREAMPLIFIER



This inexpensive antenna-mounted UHF-TV preamplifier can add more than 25 dB of gain to your system and pull in signals you never knew were there. You'll also learn how to optimize your UHF reception through other means.

RAY PICHULO

UNTIL RECENTLY, NOBODY SEEMED TO care too much about good UHF-TV reception, and most people were content to take whatever quality they could get. The situation became serious enough to warrant an investigation by a committee made up of FCC and industry representatives. They published their findings late in 1980, and their major conclusion was that the most direct way to improve UHF-TV reception was through effective receiving-antenna systems.

Adding more gain

Antenna selection and feedline considerations were discussed in the July, 1981 issue of **Radio-Electronics**, and we'll take a closer look at them in Part 2 of this article, but what happens if the proper antenna and feedline are used and we still don't get the results we want. What then? The next step is to consider a mast-mounted preamplifier.

First, let's clear up a common misconception about preamplifiers. Many people believe that a preamplifier aids reception by boosting the signal level; that's only partly true. What is more important is that a preamplifier reduces the system noise-figure, which is the overall limiting factor to any receiving system's sensitivity.

There are two sources of noise—external and internal. External noise may be either atmospheric noise or man-made noise from electrical discharges. At UHF frequencies, external noise is very low, so the major noise source is internal—circuit noise. There is a great deal of room for improvement here, since a typical UHF tuner has a noise-figure of approximately 12 dB. The amount of noise introduced by the front end of a receiver plays a major part in establishing the overall receiver noise-figure, because each successive stage amplifies the noise introduced in the preceding stages.

The effect of gain on overall-system noise-figure can be calculated using the following formula:

$$N_T = N_1 + \frac{N_2 - 1}{G_1} + \frac{N_3 - 1}{G_1 G_2}$$

Where:
N_T = overall-system noise-factor
N_1 = noise-factor of the first stage
N_2 = noise-factor of the second stage
N_3 = noise-factor of the third stage
G_1 = power gain of the first stage
G_2 = power gain of the second stage

Note that all numbers must be in terms of power gain, because the use of dB will result in large errors—especially when low noise-figures are involved. Noise-factor can be converted to noise-figure using the following formula:

$$Nf\ (g) = 10 \log_{10} N$$

Where:
g = gain in dB
N = noise factor
Nf = noise figure

Noise-figure can be converted to noise-factor by using the formula:

$$N = \frac{\log^{-1} Nf\ (g)}{10}$$

In the same way, power gain (G) can be calculated from gain (g) as follows:

$$G = \frac{\log^{-1} (g)}{10}$$

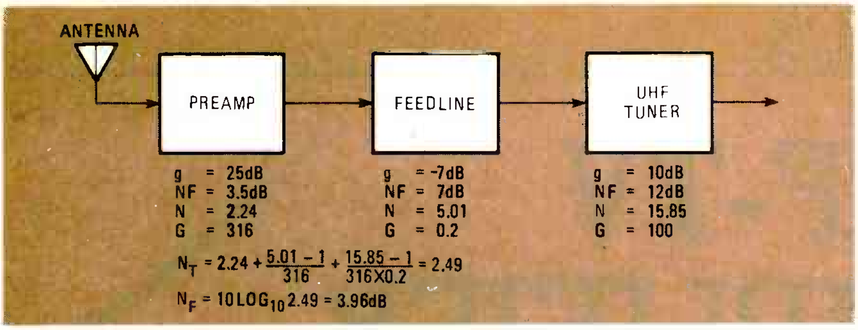


FIG. 1—PLACING A PREAMPLIFIER with a gain of 25 dB and a noise-figure of 3.5 dB at the antenna-end of a UHF receiving-system gives a total noise-figure of 3.96 dB.

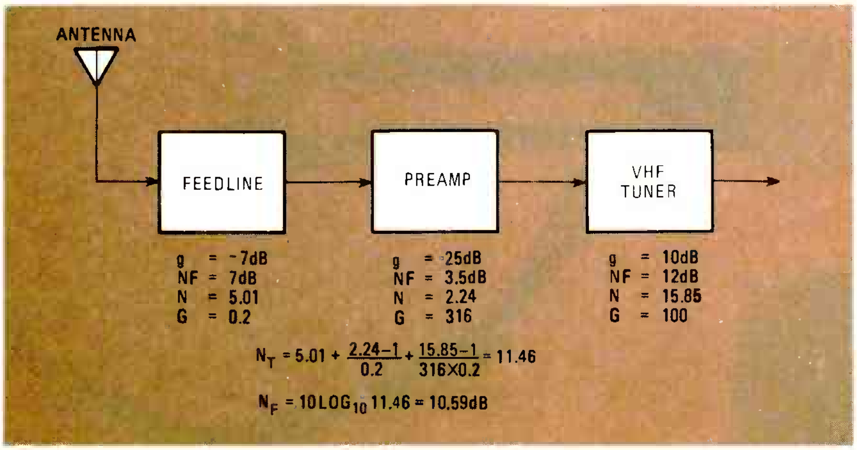


FIG. 2—PLACING THE SAME PREAMP at the receiver-end of the system increases the noise-figure to 10.59 dB.

PARTS LIST—PREAMP

All resistors ⅛ watt, 5%
R1—82,000 ohms
R2—820 ohms
R3—39,000 ohms
R4—390 ohms
Capacitors
C1, C2—3.3 pF chip capacitor
C3, C4—2.7 pF chip capacitor
C5, C6—680 pF, ceramic disc
C7—0.01 μF, ceramic disc
Semiconductors
Q1, Q2—BFQ85 or BFR90
L1-L3—See text
L4—10 μH choke (3½ turns No. 30 wire-wrap wire through ⅛-inch ferrite bead)
J1, J2—bulkhead-mount female "F" connectors
Miscellaneous: Double-sided PC board (etched one side), enclosure, solder, etc.

A kit of all parts for the UHF preamp, including power supply and balun (the balun will be discussed next month), is available for $34.50 plus $2.00 for shipping and handling. An assembled version is available for $47.50 plus $2.00 for shipping and handling. Both are available from:

RaySon Electronics Corp.
1010 12th St., Suite 5
Sparks, NV 89431

Micromart
508 Central Avenue
Westfield, NJ 07090
(201) 654-6008

Quest Electronics
P.O. Box 4430
Santa Clara, CA 95054
(800) 538-8196 (except CA)
(408) 988-1640

All suppliers accept MC and Visa. Please add sales tax where applicable.

Now that we've introduced those relationships, let's look at a model of a typical receiving system. Figure 1 shows a block diagram in which we consider the feedline to be the first stage. (That is valid in our calculations, as you will see.) Gain can be negative as well as positive; in the case of the feedline, we consider the insertion loss to be negative gain. The noise-figure of the feedline is essentially equal to the loss.

Let's see what happens when we add a preamplifier with a gain of 25 dB and a noise-figure of 3.5 dB, first at the antenna as shown in Fig. 1, then with the amplifier at the input of the receiver as in Fig. 2.

With the preamp at the antenna, the total calculated noise-figure for the three elements shown in Fig. 1 is 3.96 dB. By putting the feedline ahead of the preamplifier, as shown in Fig. 2, the noise-figure increases to 10.59 dB. As you can see, the noise-figure is improved by 6.6 dB by putting the element with the lowest noise-figure (the preamp) first. A general rule of thumb in receiver design is that each stage should have at least 10 dB more gain than the noise-figure (in dB) of the subsequent stages of the receiver. By placing the preamp first we eliminate the noise-factor and attenuation effects of the feedline, because the preamp has a gain of more than 10 dB over the losses induced by the feedline.

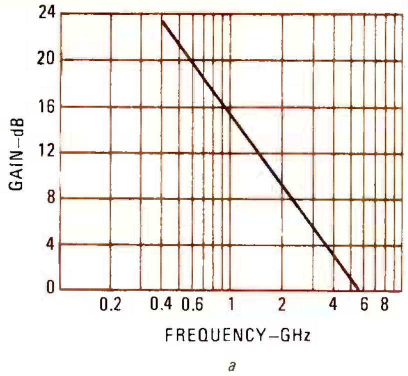
Another benefit of having the preamplifier located at the antenna is improved flatness of the transmission line's VSWR (*V*oltage *S*tanding *W*ave *R*atio); even the best antenna designs do not have a constant feedpoint impedance over their frequency range. The result is that the VSWR of the feedline varies with frequency. Two adverse effects of a high VSWR are increased losses, and reflections that degrade picture quality—especially in the case of color. With the preamp, however, it is easy to design a broadband output-circuit, thus making the match to the line better and lowering the VSWR on the longest part of the feedline. The antenna will still exhibit whatever mismatch characteristics it has, but the resulting mismatch will occur only on the portion of the line between the antenna and preamplifier. That will be of little consequence, because of the short line-length involved, and the preamplifier will effectively buffer the remaining feedline to the set or distribution system.

Commercially available UHF preamps have gains ranging from 12 to 22 dB with noise-figures in the range of 3 to 8 dB. (You can perform gain and noise calculations as shown above using the appropriate figures).

A preamp you can build

You can improve your UHF reception for less than $35.00. The preamp that will do the job is unusual because, for its price, it provides exceptional gain (25 dB typically) with an exceptionally low noise-figure (only 3.5 dB, maximum). Its performance exceeds that of any of the under-$100 commercial preamps tested by the FCC. While the device is intended to be used outdoors as an antenna-mounted unit, it can also deliver reasonable performance if used indoors at the TV receiver.

Several factors contribute to its high performance, the primary one being use of two microwave-type transistors. Those devices are useful up to 1.5 GHz and have a noise-figure of less than 2 dB over the entire UHF-TV spectrum. Figure 3 shows gain vs. frequency and noise-figure vs. frequency plots for the transistors. (They are actually integrated circuits that have broadband impedance-matching networks right on the chip.) The devices have nominal input and output impedances of 75 ohms, so no tuning is required and circuits built around them are extremely stable.



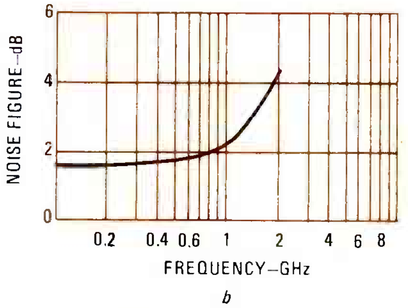


FIG. 3—TRANSISTORS USED IN PREAMP show excellent gain-vs.-frequency (*a*) and noise-figure-vs.-frequency (*b*) responses.

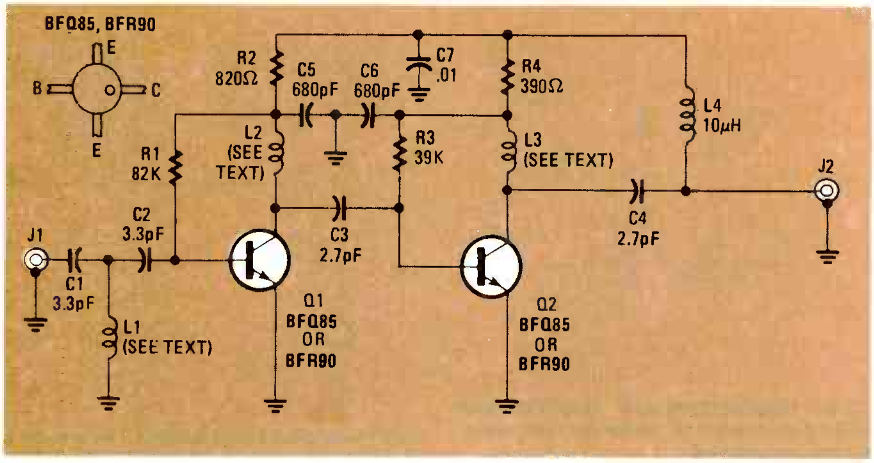


FIG. 4—FIRST STAGE OF PREAMP is biased for optimum noise-figure; second stage for optimum gain.

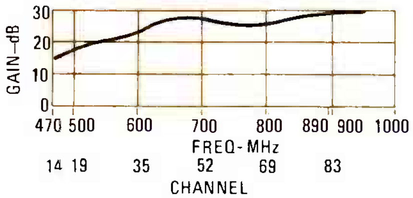


FIG. 5—HIGH-END RESPONSE of preamp is in excess of 25 dB.

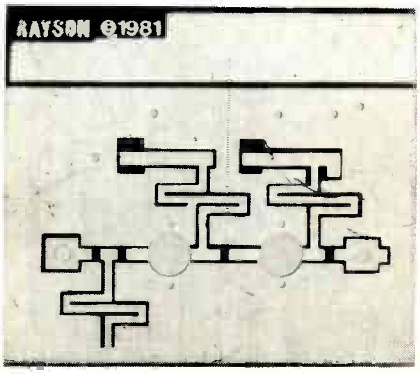


FIG. 7—BARE PC BOARD shows where holes for "F" connectors, transistors and disc capacitors are drilled.

The second contributing factor to that preamp's performance is the PC board's design; the RF path on the board is actually a 75-ohm transmission-line section, or *stripline*. The use of stripline construction continues the 75-ohm transmission line right to the input and output terminals of the transistors, thus insuring proper impedance-matching to the devices for optimum performance. To take maximum advantage of the stripline construction, the RF coupling-capacitors are microwave chip-capacitors, which are designed to be integrated into the stripline with a minimum of disturbance in the line's characteristics. Stripline construction is used almost exclusively in microwave equipment and this preamp makes an ideal project for experimenters to gain experience with microwave-equipment construction techniques.

Figure 4 shows a schematic of the circuit. The input and output circuits are both 75 ohms. (Since we discussed the differences in losses between wet 300-ohm twinlead and wet 75-ohm coax earlier, there should be no doubt as to why the output cable to the TV set should be coaxial cable).

The first stage of the preamp is biased for a collector current of approximately 4 mA for the best noise-figure, and the second stage is biased for a collector current of approximately 10 mA for optimum gain. The input filter, consisting of C1, C2, and L1, is a high-pass filter that rejects anything below about 500 MHz. While that frequency falls around channel 20, the rolloff characteristics are sufficiently broad for the amplifier to have a gain of 15 to 18 dB at the low end of the UHF band. Considering the overall response of a typical antenna, feedline and TV tuner, the low-end rolloff of the amplifier is more than offset by the higher response of the other system components. The amplifier's frequency response is shown in Fig. 5, a normalized response-curve for three prototypes tested. It should be noted that the high-end response is better than 25 dB even at channel 70, a feature that is not found in many commercially-available amplifiers; many of them roll off sharply before channel 60.

Preamp construction

Figure 6 is a foil pattern for the stripline preamplifier. For the stripline section to exhibit the desired characteristics, the board material must be glass-epoxy *double sided* material, 1/16-inch thick.

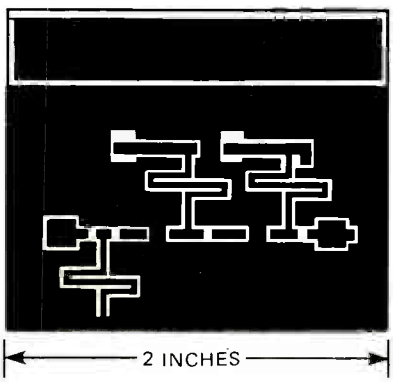


FIG. 6—PREAMP IS CONSTRUCTED on double-sided PC board, only one side of which is etched.

The three elongated "S"-shaped sections are inductors L1, L2, and L3; L4 is made by winding 3½ turns of No. 30 wire-wrap wire through a small (⅛-inch) ferrite bead. The bead should be located as close to J2 as possible.

The input and output connectors are F-type connectors that are soldered to the rear (unetched side) of the board, with the center pins passing through the board directly into the stripline sections. The copper around the two center-connector holes on the rear must be removed so the pin will not short out against it. That is easily done by hand with a ⅛-inch or larger drill bit. Apply pressure gently while twisting it in the hole—the foil will be removed and the insulating glass-epoxy board exposed. Stop there—you don't want to weaken the material. Figure 7 shows the large and small holes that have to be drilled for the jacks, transistors, and disc capacitors.

Assembly is reasonably straightforward; Fig. 8 shows the component placement. The two emitter leads on the transistors are bent at right angles just beyond the point where they narrow. The base and collector leads are cut short at the same point. The transistors are inserted into the holes in the board from its etched side with the collector lead (marked by a dot on the case) facing down and toward the out-

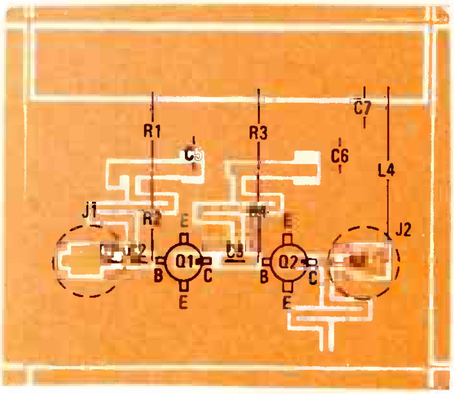


FIG. 8—TRANSISTORS ARE MOUNTED from etched side of board. "F" connectors are mounted from unetched side.

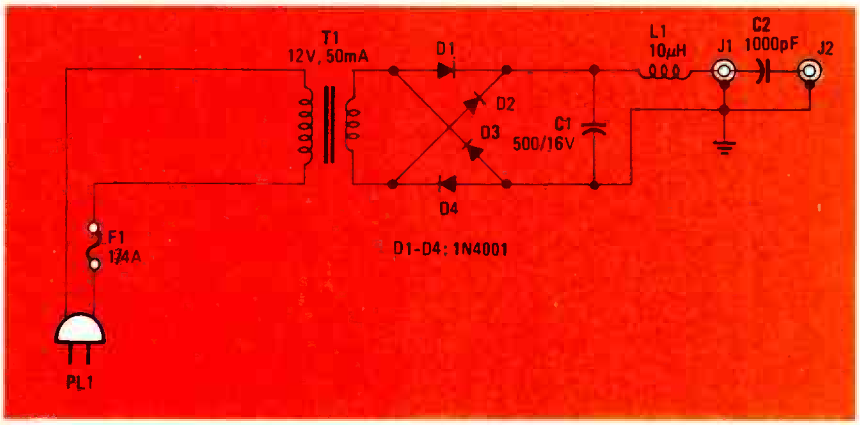


FIG. 11—SIMPLE POWER SUPPLY for preamp. If desired, an off-the-shelf 9-volt wall-plug DC supply can be used, or 12-volts taken from TV set providing it is not "hot chassis" type.

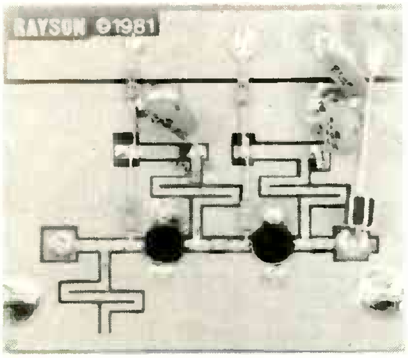


FIG. 9—MOST COMPONENTS are tack-soldered to etched side of board. Exceptions are disc capacitors, transistors, and connectors.

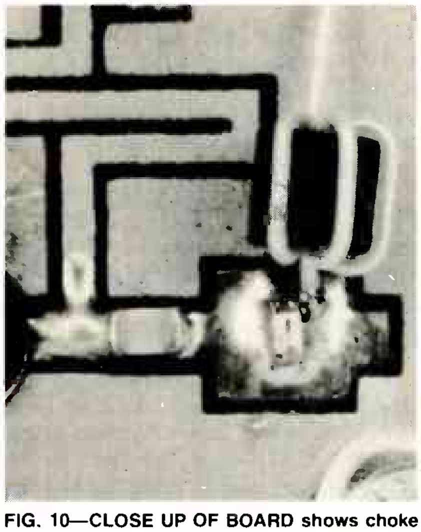


FIG. 10—CLOSE UP OF BOARD shows choke L4 and small chip capacitor to its right. See text for details on soldering chip capacitors.

put connector (J2). The emitter leads must be passed through the board and soldered on both sides of it. The other transistor-leads should lie flat against the stripline section.

While it is possible to use ¼-watt resistors, ⅛-watt units have been found to give better performance. Keep all leads as short as you can.

The chip capacitors have to be very carefully installed. They are extremely small and light, and the surface tension of molten solder will cause them to stick to the tip of the iron. To mount them on the board, you should work slowly and carefully with a fine tip on the iron and fine-gauge solder. Apply a very small amount of solder to the PC board first, and then, with a pair of tweezers, carefully position one end of the capacitor against it. Heat the solder momentarily with the iron until the solder flows, and hold the capacitor in position with the tweezers while you remove the iron. That will tack one end of the capacitor to the board and then you can go ahead and solder the other end.

PARTS LIST—POWER SUPPLY

Capacitors
C1—500 µF, 16 volts, electrolytic
C2—1000 pF, ceramic disc
Semiconductors
D1–D4—1N4001
L1—10 µH choke (3 ½ turns No. 30 wire-wrap wire through ⅛-inch ferrite bead)
T1—12 volts, 50 mA or greater
F1—¼ amp fuse
J1, J2—female "F" connectors
Miscellaneous: baluns (see text), wire, solder, etc.

The two sides of the board have to be connected for best operation. That is easily done by forming two short lengths of wire (resistor leads, for example) into "U"'s, slipping them onto the board with one leg of the "U" on each side of it, and soldering. The "U"'s should be located as close as possible to the input and output jacks.

The circuit can be assembled in less than an hour, and once it's together, it's ready to use. The completed board is shown in Fig. 9. (Note that two of the holes shown in Fig. 7 are not used.) A close-up view of coil L4 and one of the chip capacitors is shown in Fig. 10.

Since the preamp is a broadband device, there is no tuning or alignment required. It should be mounted in an enclosure; the two coaxial connectors secure it to that enclosure. The box can be either metal or plastic, and the preamp can be used either indoors or outdoors. Best results are obtained when the preamp is mounted right at the antenna, but in many instances, good results can still be obtained with the preamp mounted indoors near the TV set. An interesting combination for indoor use has the stripline preamplifier with the $6.95 Radio Shack 15-623 antenna. Georgia Tech engineers rated that antenna as "...significantly superior to other indoor antennas evaluated."

Power supply

The preamp requires approximately 12-volts DC for operation. The voltage is not especially critical, and the preamp will operate reasonably well at any voltage between 9 and 15 volts; however, the best noise-figure is attained at 12 volts. The power is run up the feedline. Choke L4 on the preamp board prevents the output signal from flowing into the power bus, while C4 blocks the DC from being short circuited by Q2.

The preamp requires only 15 mA for operation. Figure 11 shows the circuit for a power supply that can be used to power the unit, and a means for connecting the 12-volts to the set end of the cable. J1 connects to the preamp and J2 connects to the set.

If you do not want to build your own supply, you can use a small wall-plug *DC* supply. A 9-volt, 100-mA supply will deliver between 12 and 14 volts when lightly loaded. Surprisingly, 200-mA supplies provided only 11 to 12 volts under the same conditions. However, either would be adequate—there is little difference in performance apparent with supply voltages between 9 and 15 volts.

If you're careful, power can also be "stolen" from the TV set itself if it is not of the hot-chassis type.

You'll need to modify a commercially available balun for use with the preamp. We'll show you how to do that, and some things to consider when selecting an antenna and feedline, when we continue this article. **R-E**

CIRCUITS

Troubleshooting DIGITAL CIRCUITS

Troubleshooting procedures and tools for digital logic-circuits are quite different from those used in analog work. Here's an introduction to working with digital IC's.

ROBERT L. GOODMAN

THE DIGITAL INTEGRATED-CIRCUIT HAS revolutionized the electronics industry and, in many areas, now dominates it. Because of the digital explosion, you will find more compact, complex, and powerful troubleshooting instruments and devices. Unfortunately, the digital-IC boom has given a big headache to the analog-circuit troubleshooter. Because of the fundamental differences between analog and digital circuits, the troubleshooting techniques and the types of instruments that must be used differ greatly from those required in analog work. One of the first, and most useful, tools you will encounter in troubleshooting digital-logic circuits is the logic probe.

About logic probes

Digital logic works using two voltage levels to express either an "on" or an "off" state. "On" is usually in the neighborhood of +5 volts, and is referred to as a *logic-high* state or "1." "Off" is at or near 0 volts, and is called a *logic-low* state or "0." We'll go into more detail on the workings of digital logic later.

Logic probes quickly tell you how—or whether—a digital circuit is operating at the point being tested by indicating what logic state is present. Suppose, for example, that a test point is supposed to go to a logic-high state under certain conditions. A logic probe will indicate whether or not the line actually does go high when it's supposed to, or whether it is, perhaps, permanently at a logic-high level.

Some probes have a memory function and can be used to monitor a line for intermittent pulses, or noise spikes ("glitches") that can upset logic-circuit operation.

Logic probes are powerful troubleshooting tools because of their portability, low price, and simple operation.

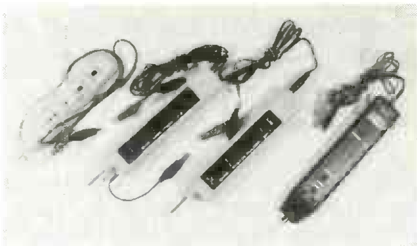


FIG. 1—SOME OF THE logic probes and pulsers used for digital troubleshooting.

Most logic probes provide the following features:

- High or low pulse-indication
- Pulse-train indication
- Stretching capability for short pulses
- 10 nanosecond pulse-response
- Pulse memory
- Undefined logic-state indication
- Ability to test different logic-families

Figure 1 shows a few of the various logic probes that are available. From left to right they are the Global Specialties Corp. model *LP-1* and *LP-2* logic probes, the *DP-1* pulser, and B&K-Precision's model *DP-50* logic probe.

Using a logic probe

Logic probes indicate logic states with lamps or LED's. Some use colored LED's in various patterns to show logic states. The LED's show whether a logic state is high, low, or alternating (pulsing); or whether an open circuit exists.

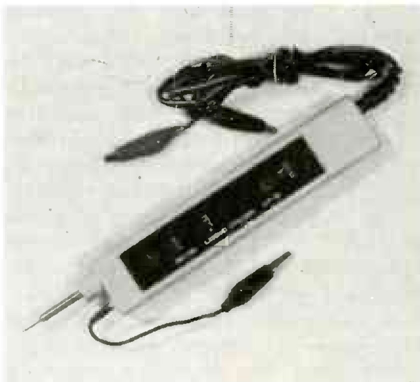


FIG. 2—GLOBAL SPECIALTIES' *LP-2* logic probe, like most others, derives its power from the circuit under test through clip leads (top).

The Global Specialties *LP-2* logic probe shown in Fig. 2 is protected against over-voltage and reverse voltage that might be applied to its power leads. To use the probe, connect its black-clip lead to the power-supply common (−) and the red-clip lead to V_{cc} of the system under test. In order to minimize the possibility of power-supply spikes or other spurious signals from affecting the operation of the probe, connect the power leads as close to the point being tested as possible.

The B&K-Precision *DP-50* digital probe (shown in Fig. 3) is designed for quick analysis of digital circuits, and is compatible with TTL, DTL, RTL, CMOS and high-noise-immunity logic. Three LED's at the probe-tip indicate the presence of digital pulses, and high and low logic-states. Two switches allow you to select TTL or CMOS logic-thresholds, and PULSE STRETCH or MEMORY modes. In the PULSE STRETCH mode, short-duration pulses are stretched for a clear visual indication. In the MEMORY mode, a single digital pulse will cause an LED to remain lit until the memory circuit is reset. The probe thus has the ability to "freeze" an indication of digital-logic action.

Pulse stretching

Probably one of the most important features of a logic probe is its ability to "stretch" a 10-nanosecond (ten-billionths of a second) pulse to 100 milliseconds so that the LED will stay illuminated long enough to be observed. That pulse stretching is accomplished by using the leading edge of the short pulse detected to trigger a flip-flop whose time delay is 100 ms. Single pulses flash the probe's LED's once, while trains of pulses will usually cause them to blink at a 10-Hz rate, regardless of pulse-frequency. Generally, just knowing that pulse activity is present is enough. (If the pulse-frequency is important, use a frequency counter or oscilloscope.)

Digital vs. analog troubleshooting

When troubleshooting circuits containing analog devices, you usually need only test resistance, capacitance, or voltages. The total circuit may be quite complex, but each component in the circuit performs a simple task and its operation can usually be checked out easily. If necessary, each resistor, capacitor, diode, and transistor can be tested individually by using a signal generator, VTVM or DMM, diode checker, or scope, together with conventional troubleshooting techniques. With integrated circuits, though, it is impossible to check the individual components on the chip; you must troubleshoot the device as a whole.

A significant difference between circuitry made up of discrete components and digital IC's lies in the complexity of the functions performed by the latter. Instead of measuring simple characteristics, you need to observe complex and rapidly occurring digital signals and to determine whether they're correct.

Verifying proper digital-IC operation requires observing several inputs while simultaneously observing two or more outputs. Thus another difference between analog circuitry built from discrete components and digital IC's is the number of inputs and outputs for each component and the need to check them simultaneously.

FIG. 3—SWITCH-SELECTABLE threshold levels (TTL/CMOS) are common on logic probes such as B&K-Precision's *DP-50*.

Digital IC's contain many complex circuits. Should any portion of such an IC fail, it would be difficult to pinpoint the area of failure—and impossible to repair or replace it (you can rebuild picture tubes, but not IC's). Consequently, to troubleshoot circuits made up of digital IC's involves locating not a portion of an IC that's gone bad, but, rather, just the IC itself. Replacing it usually restores the circuit to working order.

For effective troubleshooting of digital circuits, it is necessary to take advantage of the digital nature of the signals involved. Tests and techniques to troubleshoot analog circuits do not do that and are inefficient when used for digital circuits.

TTL logic-signals

A typical TTL (*T*ransistor-*T*ransitor *L*ogic—the most common digital-logic family) logic signal is shown in Fig. 4. The appearance of a similar pulse-train on the screen of an oscilloscope is shown in Fig. 5. The scope displays voltage with respect to time, but for digital pulses, exact values are not important. A digital signal exists in one of two or three states—high, low, or undefined (in-between states)—each determined by a threshold voltage. It is the value of the signal voltage *with respect to those thresholds* that determines the logic-state of a digital signal.

As Fig. 6 shows, if the signal level is greater than 2.4 volts, it is considered to be a logic "high." For a logic-"low" the voltage must be below 0.8 volts. The precise value is not important as long as it is above or below the threshold, and not in the "undefined" area. When using a scope, you must always determine whether the signal meets the threshold requirement for the desired digital state; a logic probe will tell you that.

Each gate in a TTL logic family has a certain propagation-delay time, rise time, and fall time. Those times rarely change, so scope checks of timing parameters contribute very little to the troubleshooting process.

The circuit in Fig. 7, showing a simple TTL totem-pole device (the output transistors are "stacked" like a totem pole, hence the name), illustrates a problem created by the TTL logic-family In either state—high or low—it has a low output-impedance. In the low state that is about 5 or 10 ohms to ground.

That presents a problem for in-circuit pulse injection (used to determine how the device is operating by "force-feeding" it a pulse). A device used to inject a pulse at a point that is driven by a TTL output must have sufficient power to override the low-impedance output state. Most signal sources used for troubleshooting do not have that capability. Thus the troubleshooter is forced either to cut the printed-circuit runs or lift IC leads in order to pulse the circuit to be tested; that is time consuming and also can damage other circuits.

For those reasons a scope and traditional signal-sources are not very useful. And, since many diodes and transistors are packaged *in* the IC, diode checkers are largely useless. With the complexity of today's electronic circuits, it makes good sense to find the most efficient troubleshooting method. In most cases, oscilloscopes, diode checkers, and voltmeters are best suited for use with analog circuits, where they really shine. Special-purpose equipment, such as logic probes and pulsers (see below), should be used when working on digital equipment.

Logic probes provide a quick way not only to detect, but also locate, breaks in a PC run. Since an open signal-path may allow IC inputs after the break to "float" to an undefined state, a logic probe can be used to test the input of each IC for such a state. Once a floating input is detected, the logic

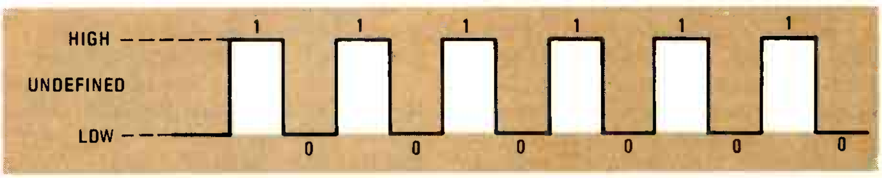


FIG. 4–TRAIN OF DIGITAL PULSES consists of a square wave whose values alternate between (approximately) 5-volts and 0-volts.

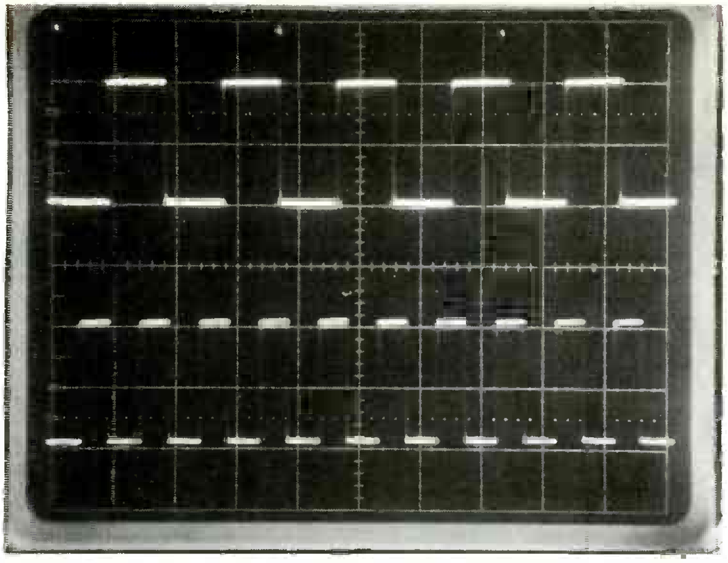


FIG. 5—DUAL-TRACE SCOPE shows two trains of pulses. Vertical lines in square wave are nearly invisible because transition between states is extremely fast.

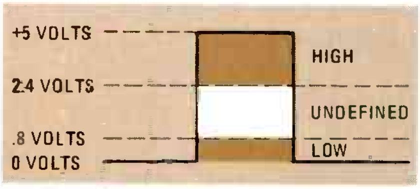


FIG. 6—VOLTAGE THRESHOLDS determining logic states. Contrary to popular belief, a logic-"high" is not always 5-volts.

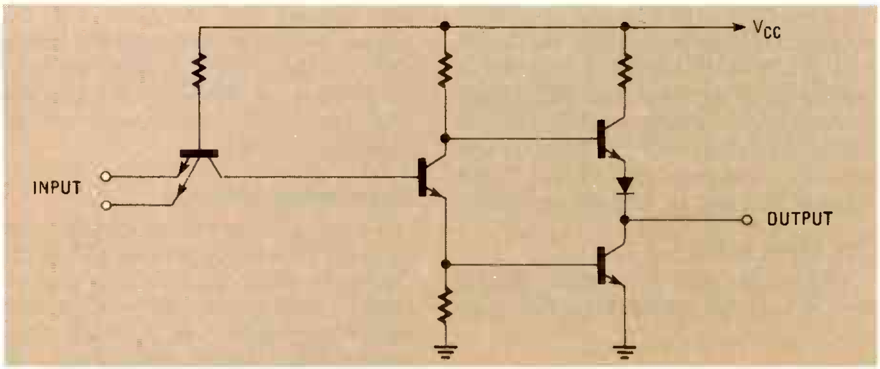


FIG. 7—TWO-INPUT NAND GATE. Totem-pole configuration at output results in low impedance, making some conventional tests difficult to perform.

probe can be used to follow the circuit back from the input searching for the break. That can be done because the circuit before the break will show valid logic levels (either high, low, or pulsing) while the circuit after the break will probably show undefined levels.

IC failures

To troubleshoot digital-IC circuits, it is important to know what types of faults to expect. They can be divided into two main classes—those caused by failures inside the IC, and those caused by circuit failures outside the IC.

There are four types of internal IC-failure: (1) an open bond at either an input or output, (2) a short between an input or output and V_{CC} or ground, (3) a short between two pins, and (4) a failure in the internal circuitry (often called the steering circuitry) of the IC.

In addition to those four internal failures, there are four types of faults that can take place in the circuitry external to the IC. They are: (1) a short between a signal path and V_{CC} or ground, (2) a short between signal paths, (3) an open signal path, and (4) a failure of an analog component, such as a resistor, capacitor, or semiconductor device.

Logic pulsers

Logic pulsers inject a single pulse of the proper amplitude and polarity into a circuit. If a point was at a logic-"low," it will automatically be pulsed high, and if it was high it will be pulsed low. Pulsers are useful for forcing the inputs of digital IC's to change state so that the resulting outputs can be observed. Pulsers have a high current-output, but use a low duty-cycle to protect the IC's from damage.

In their many applications, digital IC's have certainly made our lives easier. Knowing how they work and how to troubleshoot them should make *your* life easier, too. **R-E**

ALL ABOUT PULSE GENERATORS

Once found only in sophisticated design labs, the tremendous growth in the use of digital circuits and devices has made the pulse generator a valuable instrument for any service shop or experimenter's workbench.

CHARLES GILMORE

NOT TOO LONG AGO THERE WERE FEW pulse generators outside of sophisticated design laboratories. Today, they are found in service shops, on experimenters' benches, and anywhere else that electronics testing is done. Two factors have influenced the wider use of those instruments: need and lower prices. The dramatic growth in the use of logic circuits caused the need; the price-drop soon followed, and pulse generators are now truly low-cost signal sources.

Not long ago, few pulse generators were available for under $1000. Now, there are many available for under $400. Although many sophisticated, and expensive, pulse generators are still available, the lower-priced units have enough features to make them extremely useful.

Currently, the need for a pulse generator arises mostly from the extensive use of many different varieties of digital logic in industrial, laboratory, and consumer applications (although a pulse generator is also useful when working with analog circuits). It is not possible to service or design logic-based electronic systems using only a sine-wave generator or a square-wave generator. A sine-wave generator or square-wave generator cannot vary the pulse width of its output signal; it also cannot generate a wide enough range of frequencies. In addition, frequently the output impedance of a sine-wave generator or a square-wave generator is not low enough to drive logic circuits.

A more elaborate function generator with DC offset, variable symmetry control, and a wide frequency range may fulfill the need for a pulse generator partially, if the requirements are simple. When extensive use of logic circuits is involved, however, a function generator is not adequate. Function generators cannot produce pulses of less than 5% duty cycle, and low-cost or reasonably priced units do not provide the 10-MHz to 20-MHz capability required of pulse generators used with TTL (*T*ransistor-*T*ransistor *L*ogic) or ECL (*E*mitter-*C*oupled *L*ogic) systems. Of course, the function generator contains many other features that may or may not be needed.

The basic pulse

Before discussing the pulse generator, it may help to review the basic characteristics of a pulse. Figure 1 shows the basic timing and amplitude relationships of a pulse. In Fig. 1-a, the period between the start of each pulse is a length of time, *T*, that is considerably greater than the pulse width, *t*. Figure 1-b shows exaggerated leading and trailing edges to illustrate such parameters as rise-time and fall-time. The basic pulse parameters are explained in Table 1.

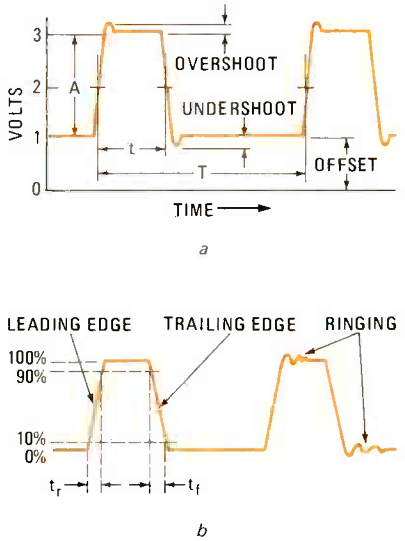


FIG. 1—THE TIMING AND AMPLITUDE relationships of a basic pulse are shown in *a*. A pulse with exaggerated leading and trailing edges is shown in *b*.

Basic pulse generator

Figure 2 shows a simplified block diagram of a pulse generator. The circuitry for each block is fairly conventional. Numerous outputs, special buffer amplifiers, and power supplies can be added to each stage to reach the level of sophistication needed for a particular application.

The basic pulse repetition rate is controlled by the *repetition-rate generator*—a free-running astable multivibrator capable of covering the frequency range required by the pulse generator.

Pulse generators offer a switch-selected alternate source for rate generation called the *external trigger*. Signals applied to the external trigger input pass through triggering circuitry much like that found in an oscilloscope. Those circuits establish the triggering amplitude and polarity. Additional inputs to the trigger amplifier may include a line-frequency source and a manual pushbutton for one-shot operation.

A second external amplifier can be used to gate the main repetition-rate generator in a manner similar to the gated mode of function generators. Signals from the gating amplifier permit

TABLE 1

Pulse period—pulse period *T* is the time between two pulses. It is measured between either the leading or trailing edges.

Repetition rate—indicates the number of pulses over a fixed period of time, usually 1 second. The repetition rate depends on the pulse period *T*: Repetition rate = $1/T$.

Pulse width—the time between the 50% amplitude points of any single pulse is defined as the pulse width *t*.

Pulse amplitude—pulse amplitude *A* is the voltage to which the pulse rises above its own baseline, measured after any overshoot has been reduced to zero.

Pulse offset—the value and polarity of the difference between the pulse baseline and 0 volts.

Overshoot—that portion of a pulse at the end of the leading edge, where the leading edge extends above the normal pulse amplitude. Overshoot is usually expressed as a percent of total amplitude.

Undershoot—that portion at the end of the trailing edge where the trailing edge extends below the baseline. That is usually expressed as a percent of pulse amplitude.

Leading edge—the portion of the pulse where a negative-to-positive transition occurs.

Trailing edge—that portion of the pulse in which the positive-to-negative transition occurs.

Rise time—the time required for the pulse to pass from 10% of total amplitude to 90% of total amplitude (T_r).

Fall time—the time required at the trailing edge for the pulse to pass from 90% of full amplitude to 10% of full amplitude (T_f). Rise time and fall time are not necessarily equal.

Ringing—damped oscillation at the end of the leading or trailing edge of the pulse.

Duty cycle—the ratio of pulse width to the pulse period, expressed in percent. Sometimes that is referred to as the duty factor.

Pulse polarity—indicates whether the desired pulse extends positively or negatively with respect to the baseline. Pulse polarity is independent of the absolute DC-value of the baseline.

the repetition-rate generator to output pulses only when a gating signal is applied; otherwise no pulses are generated. A burst of pulses can be produced in that mode.

Signals from the repetition-rate generator or from the trigger circuits are applied to the delay generator (if the pulse generator has one). The delay generator is a wide-range monostable multivibrator.

Once the delay generator has completed its cycle, the main pulse generator is triggered. The pulse generator is also a monostable multivibrator with a wide dynamic range to generate the necessary pulse widths. That monostable multivibrator can be quite sophisticated. It must cover an extremely wide range of pulse widths (typically 7 to 8 decades) and operate at fairly high duty-cycles. Some generators need to operate at duty cycles that are greater than 100%. The output stages of the monostable multivibrator may include independent charge and discharge switches so that independently variable rate times and fall times can be generated. That feature is usually found only on more expensive pulse generators.

The output of the monostable multivibrator is applied to one or two output amplifiers. Those amplifiers must be DC-coupled, variable-gain wideband amplifiers. On more sophisticated generators, where extremely close control of pulse characteristics is desired, two amplifiers are used. One of the amplifiers handles the positive pulses: the other handles the negative pulses. In that manner, each amplifier can be tailored to its particular function. In other pulse generators, a single amplifier is used. In either case, extremely wideband amplifiers must be used to reproduce faithfully pulses whose rise times lie in the nanosecond range, without ringing or other aberrations.

Pulse amplitude is usually regulated solely by a variable-gain control that is part of the output amplifier. A few of the higher-priced pulse generators include a step attenuator at the output. As the output amplifier is DC-coupled, a DC offset signal can be applied to the amplifier, along with the pulses, so that the pulse baseline can be changed with reference to 0 volts. Normally, the offset voltage is unaffected by adjustments of the continuously variable output attenuator.

Pulse generators that include a delay-generator frequently have a specialized mode referred to as a double- or twin-pulse mode. In a double-pulse mode, the main pulse generator is triggered not only by the delay-generator output, but also by the signal directly, at the same time that the signal triggers the delay generator. The result is two pulses, the first, generated at the time of triggering, and the second, at the time the delay generator has completed its cycle.

There are many special applications that require a capability other than those offered by a standard pulse-generator. For such applications, certain portions of the basic pulse generator can be adapted to accommodate those special requirements.

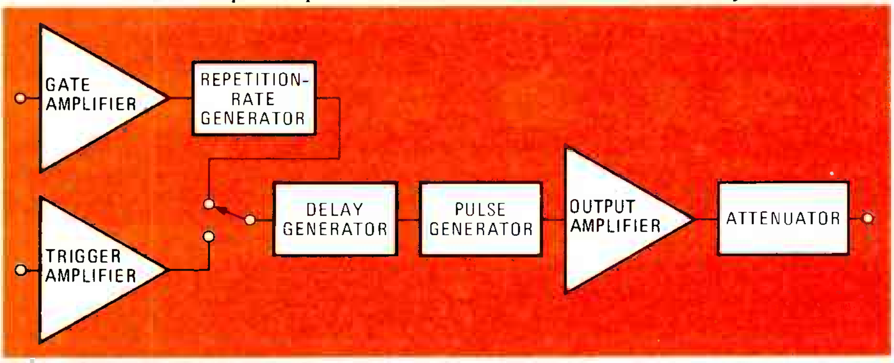


FIG. 2—**SIMPLIFIED BLOCK DIAGRAM** of a basic pulse generator is shown here. Many outputs, special buffer amplifiers, and power supplies can be added to each stage to make a more sophisticated instrument.

Word generators

The word generator is one of those specialized versions. Its function is to generate a series of pulses that form a serial digital word. Usually, those generators are operated in either a one-shot or a repetitive mode. The pulse-generator circuitry (a simple monostable multivibrator) is replaced by a more sophisticated circuit that is capable of producing a series of pulses. Usually 8, 16, or 32 pulses-per-trigger-signal are produced.

High-speed pulse generators

Two types of pulse generators fall into the high-speed category. Pulse generators whose repetition rates are in the 100-MHz to 250-MHz range are designed especially for working with extremely high-speed ECL circuitry.

They are particularly useful when designing or servicing complicated portions of high-speed computers and some instruments. Because of their high repetition rates, high-speed pulse generators require that all circuitry within the pulse generator perform many times better than the circuitry of a conventional pulse generator.

Pulse generators may also be required to produce pulses with extremely fast rise-times. The conventional pulse generator has typical rise times in the range of 5 to 7 nanoseconds. Rise times that are measured in hundreds of picoseconds are available with specialized pulse-generators. Pulse generators with those fast rise times generally do not have variable rise-time and fall-time capability.

Pulse-burst mode

The pulse-burst option permits you to select the number of pulses that are generated when a trigger signal is received. That mode differs from the word generator in that the logic state of each pulse is not controlled individually. However, you can trigger from 1 to 10,000 pulses in a single burst. The pulse-burst mode is particularly convenient when you are working with counters or other circuits where response to the wave-shape and repetition rate, as well as to a particular number of pulses, is important.

High-voltage generators

High-voltage outputs on pulse generators are becoming less and less common. However, pulse generators designed for certain communications, biological, or physiological applications, and those to be used with tube-type circuits, may have very high voltage-signals. Usually, such pulse generators are severely limited in terms of rise time, pulse-repetition rate, and output impedance.

Pulse-repetition rate

The controls that vary the pulse-repetition rate on most generators consist of a decade switch combined with a continuously variable control. Repetition-rate specifications include the minimum and maximum frequency capability, and the number of decades involved. Maximum repetition rates of 10 to 20 MHz are typical of low-cost generators. A few of those generators have maximum repetition rates that extend to 50 MHz. The minimum repetition rates of pulse generators vary widely. Some low-cost generators can have a minimum repetition rate of as little as 0.1 Hz, while others have minimum repetition rates that are as high as 10 Hz.

The selection of a repetition rate must be made with the application in mind. If the generator is to be used for TTL or ECL logic analysis or servicing, a maximum repetition rate of at least 10 MHz is a must; 20 MHz is certainly more desirable. Minimum repetition rates are not tied to any particular logic-family type, but depend on the application. For most applications, a minimum repetition rate of 5 to 10 Hz is sufficient. For special applications, however, lower repetition rates may be needed. Extremely low repetition rates can be obtained by triggering the pulse generator from an external low-frequency source, such as a function generator.

The repetition-rate specification is not always given as the frequency. Some manufacturers list it as a repetition rate or frequency; others supply the information as a pulse period or time specification. The conversion between pulse period *T* and frequency *f* is easily made by the relationship:

$$T = 1/f$$

Repetition-rate accuracy is rarely specified on low-cost pulse generators. Where it *is* specified, it is indicated as a percentage of the maximum range. The accuracy of the repetition-rate setting is very unreliable, and whenever an accurate pulse-repetition rate is needed, it should be obtained either by triggering the pulse generator from a known frequency source, such as a signal generator, or by measuring the repetition rate at the trigger output, using a digital frequency meter or oscilloscope. Extremely low repetition rates may require using a digital period meter.

Repetition-rate jitter refers to the consistency of the period from one set of pulses to another. Jitter is caused by noise in the pulse-repetition-rate generator, and is specified as a percentage of the repetition rate or period. Although not specified on many low-cost pulse generators, repetition-rate jitter is typically 0.1% to 0.5%. That specification may include a fixed minimum amount of jitter in addition to the percentage of repetition-rate setting. Repetition-rate jitter does not decrease dramatically with the increased price of a generator.

Pulse characteristics

The most important pulse characteristic in most applications is the pulse-width range, which is usually controlled in the same way as a repetition-rate generator—that is, in decade steps with a continuously variable control covering the range between each step. Pulse-width controls frequently do not have accuracy specifications, and when such specifications are given, an accuracy of pulse-width settings on the order of 10% to 15% can be expected. Once again, like the pulse-repetition rate, the pulse width must be closely monitored by a digital period-meter, or by an oscilloscope, to achieve more precise settings. Pulse-width characteristics of generators cover a fairly wide range.

The narrowest pulse obtainable varies between 10 and 15 nanoseconds. Almost all low-cost generators have the same minimum pulse width but the maximum pulse width varies widely from manufacturer to manufacturer. Typically, the maximum pulse width varies from 10 milliseconds to 10 seconds. In most cases, narrow pulses are needed, and generators that produce pulses with minimum widths of 10 to 15 nanoseconds are suitable for use in most TTL (and some ECL) systems. For most general applications, a pulse generator is suitable if it can generate pulses with widths of at least 100 milliseconds. Pulses that are wider than that (from 100 milliseconds to 10 seconds) may be convenient for certain applications, but in general, they are not widely used.

Some manufacturers provide a pulse-width jitter specification that is fairly similar to that of the pulse-repetition rate, and indicates the maximum variation in width from pulse to pulse that can be expected. Pulse-width jitter specifications normally range from 0.1% to 05.%.

Pulse rise-time is an important specification. To be suitable for high-speed logic operation, pulse rise times and fall times must be less than 10 nanoseconds, with 5 to 7 nanoseconds being a typical specification.

The maximum duty cycle is usually listed as a pulse specification. Most pulse generators are limited to duty cycles of 70%. Some special-purpose pulse generators offer duty cycles of up to 100%. The maximum duty cycle usually decreases at the high repetition-rate settings.

Leading-edge and trailing-edge overshoot and undershoot are specified as a percentage of the maximum permissible output-amplitude. Those, like many other specifications, are only valid when the pulse generator output is terminated into its characteristic impedance.

Delay generator

Specifications for a delay generator are nearly similar to those for the main pulse generator. That is, they specify delay width, although the range of that width is usually much more limited than that of the main pulse generator itself. Jitter specifications can also be applied to the delay generator. Adjustments to the delay generator's operating parameters are made the same way as those that are made for the main-pulse pulse generator. The controls for both parameters (pulse width and jitter) are not interactive.

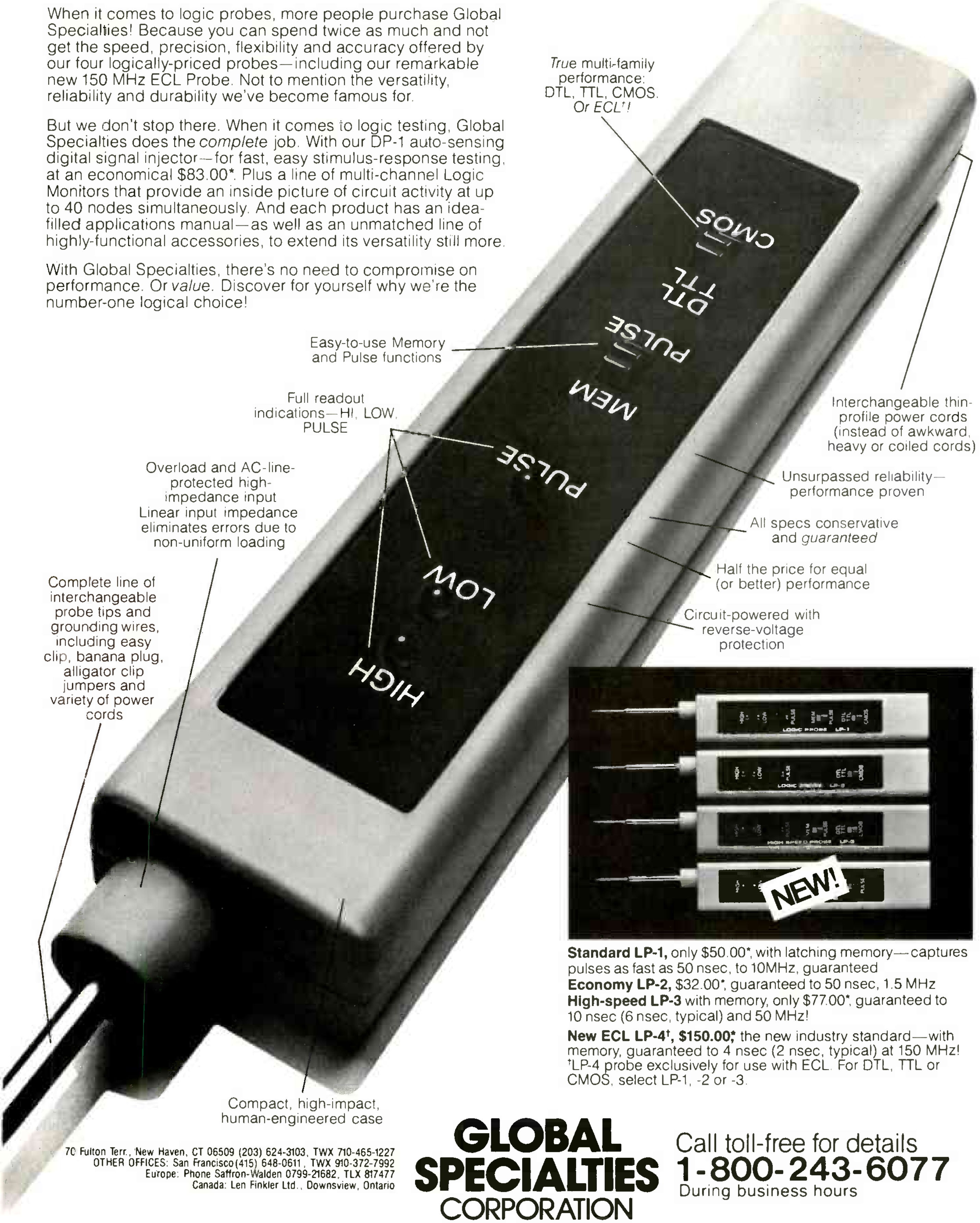
Next month, we'll continue our look at pulse-generator characteristics, and begin to look at some applications for those devices. **R-E**

Here's why we're Number One.

When it comes to logic probes, more people purchase Global Specialties! Because you can spend twice as much and not get the speed, precision, flexibility and accuracy offered by our four logically-priced probes—including our remarkable new 150 MHz ECL Probe. Not to mention the versatility, reliability and durability we've become famous for.

But we don't stop there. When it comes to logic testing, Global Specialties does the *complete* job. With our DP-1 auto-sensing digital signal injector—for fast, easy stimulus-response testing, at an economical $83.00*. Plus a line of multi-channel Logic Monitors that provide an inside picture of circuit activity at up to 40 nodes simultaneously. And each product has an idea-filled applications manual—as well as an unmatched line of highly-functional accessories, to extend its versatility still more.

With Global Specialties, there's no need to compromise on performance. Or *value*. Discover for yourself why we're the number-one logical choice!



Standard LP-1, only $50.00*, with latching memory—captures pulses as fast as 50 nsec, to 10MHz, guaranteed
Economy LP-2, $32.00*, guaranteed to 50 nsec, 1.5 MHz
High-speed LP-3 with memory, only $77.00*, guaranteed to 10 nsec (6 nsec, typical) and 50 MHz!
New ECL LP-4†, $150.00*, the new industry standard—with memory, guaranteed to 4 nsec (2 nsec, typical) at 150 MHz!
†LP-4 probe exclusively for use with ECL. For DTL, TTL or CMOS, select LP-1, -2 or -3.

70 Fulton Terr., New Haven, CT 06509 (203) 624-3103, TWX 710-465-1227
OTHER OFFICES: San Francisco (415) 648-0611, TWX 910-372-7992
Europe: Phone Saffron-Walden 0799-21682, TLX 817477
Canada: Len Finkler Ltd., Downsview, Ontario

GLOBAL SPECIALTIES CORPORATION

Call toll-free for details
1-800-243-6077
During business hours

HOBBY CORNER

Put that old calculator to good use

EARL "DOC" SAVAGE, K4SDS, HOBBY EDITOR

HOW WOULD YOU LIKE TO OWN, FOR only $30, a digital capacitance meter that will measure from a few picofarads to the largest value you are likely to encounter? Or, for the same price, a digital ohmmeter with an upper range that you can measure well into the multi-megohms? How about a digital stop-watch/timer, a shutter-speed tester, a tachometer, a light meter, or a speed-ometer?

Some of those devices sound all but impossible for the price. You probably wouldn't believe it if I told you that you could have all of them for about $30 total! Well, believe it because its true. Let's see how you can do it.

First of all, I'm allowing $10 to buy a basic "four-banger" calculator. Even if you go out and buy a new one, that's more than enough money. When I started looking recently, I found five of the little things scattered around my home. You probably have several, yourself. Further, I saw an ad offering six manufacturers' rejects for one buck.

The only absolute restriction on the type of calculator is that it must have a "constant add" function: that is, each consecutive time the EQUALS key is pressed, the total is increased by one of the earlier entered digits (probably the last one entered).

Also, it is desirable that the calculator have a fast internal clock oscillator. That is more likely to be found in the cheaper models. The faster the clock, the shorter are the intervals between calculations.

Back to the cost, five dollars is allowed for the purchase of a few common capacitors, resistors, and switches. Of course, you'll only need the full $5 in the unlikely event that you don't even own a junk box.

The final $15 of your allotment will have to be spent. It is for a nifty little *RC-111* module from Kaltek (Box 7462, Rochester, NY 14615). This amazing device measures approx. ¾×¾×⅜-inch, and it makes the whole thing possible. The *RC-111*, plus a very few additional components will convert your four-banger into any of the instruments listed above plus a few others. Because of the small size and parts count, often everything will fit right into the calculator case.

Of course, you *can* build separate instruments, but with suitable switching or plug-in arrangements, you can have a multi-purpose instrument. And, by the way, whatever you build, the calculator will still have its original functions. Here's how the *RC-111* does its magic.

Before I start, though, let me say that the manual that comes with the *RC-111* is quite complete. It gives plenty of diagrams and information for building the instruments. If I miss a point in this brief account, you can bet that the manual didn't.

Two of the eight pins on the module are connected to the calculator (or other) battery. It will operate on any voltage from 3- to 15-volts DC, and that range takes in the battery voltage of almost all calculators.

Two of the module pins are connected across the constant add key of the calculator. That is usually the one marked "=", but all you have to do is to punch a little addition problem to determine which it is on yours.

Let's look at a simple circuit application for the *RC-111*, and then a few variations. Figure 1 is about as simple as they come. It is a timer or stop-watch. As you can see, the ± and D/K pins are connected to the calculator battery and key, respectively.

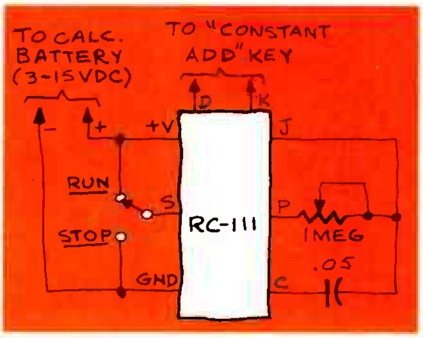


FIG. 1

The capacitor and pot connected to pins J, P, and C are adjusted to give a count rate appropriate to any given use. For the present application, you will want to adjust the rate to an interval of 1, 0.1, or 0.01 second. In fact, you can increase the accuracy to maximum (decrease the interval to minimum) by making the rate just as fast as the calculator will count—that's why the internal clock rate of the calculator can become important.

The switch can be of the push, slide, or toggle variety as you prefer. When pin S is positive, the *RC-111* counts; when negative, it stops. All you have to do is enter "1" or "1 + 1", depending upon the calculator model, then operate the switch during the period to be timed. The readout shows units, tenths, or hundredths of seconds. Note that you will have to subtract one from the readout if you use a "1+1" calculator, but most of us can do that in our heads!

A .05 μF polystyrene-type capacitor located at pin C will provide very good accuracy. For the highest accuracy, you can eliminate the capacitor and pot, and feed pulses from a crystal timebase oscillator into pin J.

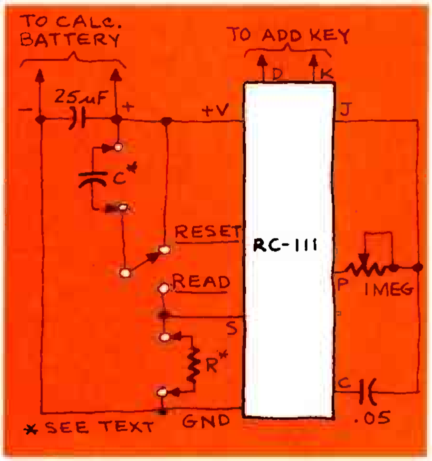


FIG. 2

There you have a neat and simple timer. If you keep in mind the functioning of pin S, the circuit in Fig. 2 is easy to understand. With the switch in the RESET position, pin S is negative and nothing happens. When placed in the READ position, pin S goes positive and the calculator counts until capacitor C charges. At that time, pin S goes low, the counting stops, and the time can be read from the display.

Now, you don't care how many tenths or hundredths of a second it takes a capacitor to charge. What you *do* want to know is the value of the capacitor in micro- or picofarads. That's easy to arrange: Just adjust resistor R, or the

continued on page 72

MARCH SPECIALS

WE CARRY THE COMPLETE LINE OF ATARI SOFTWARE, PERIPHERALS AND ACCESSORIES.

OKIDATA MICROLINE 80

$329.00

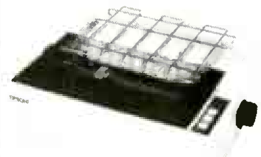
ATARI 810 DISK DRIVE

$429.00

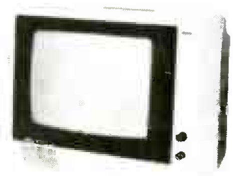
PERSONAL COMPUTERS

CBM 8032 Computer	1149.00	Epson MX-100 FT	729.00
CBM 8050 Disk Drive	1349.00	NEC PC-8023 Printer	629.00
CBM 4032 Computer	1029.00	NEC 7710 Spinwriter	2345.00
CBM 4040 Disk Drive	1029.00	NEC 7720 Spinwriter	2695.00
CBM 4022	649.00	NEC 7730 Spinwriter	2345.00
CBM VIC-20	269.00	NEC JC 1201 M(A) — Color 12" Monitor	359.00
Amdek 100G	159.00	NEC 12" JB 1201M Monitor	159.00
Amdek Color – 1 13" Color Monitor	329.00	Okidata Microline-80	329.00
Microtek 16K Ramboard for Atari 800	79.00	Okidata Microline-82A	499.00
Microtek 32K Ramboard for Atari 400 and 800	149.00	Okidata Microline-83A	729.00
Qume Sprint 9/45 (Full Panel)	2295.00	Diablo 630	1995.00
Atari 400 16K	339.00	M & R Sup-R-Terminal	279.00
Atari 410 Recorder	60.00	Microsoft Soft Card (Z-80)	279.00
Atari 825 Printer	599.00	Hazeltine 1420	799.00
Atari 850 Interface	139.00	Northstar Horizon II 32K QD	2925.00
Atari 810 Disk Drive	429.00	Anadex DP-9500/9501	1249.00
Atari 800 16K	749.00	Televideo 910	559.00
Epson MX-70	349.00	Televideo 912C	669.00
Epson MX-80	449.00	Televideo 920C	689.00
Epson MX-80 FT	549.00	Televideo 950	929.00

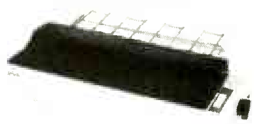
NEC GREEN 12" MONITOR JB 1201M
$159.00



EPSON MX-80
INTERFACE & CABLES IEEE $55. RS-232 $70. TRS-80 CABLE $35.
$449.00



AMDEK COLOR-1 MONITOR
$329.00



EPSON MX-100 FT PRINTER
$729.00

PRICES ARE SUBJECT TO CHANGE WITHOUT NOTICE

CALL TOLL FREE!

EAST COAST
1-800-556-7586
COMPUTER SHOPPING CENTER
12 Meeting Street
Cumberland, RI 02864
1-401-722-1027
TELEX 952106

WEST COAST
1-800-235-3581
COMPUTER SHOPPING CENTER
3533 Old Conejo Rd. #102
Newbury Park, CA 91320
1-805-499-3678
CA. TOLL FREE 1-800-322-1873
TELEX 182889

COMPUTER SHOPPING CENTER

We Accept C.O.D.'s • Stock Shipments Same Day or Next • No Surcharge for Credit Cards • All Equipment Factory Fresh w/MFT Warranty • We Carry the Complete Line of Personal Software • Prices do not Reflect Shipping Charges
Rhode Island and California Residents please add 6% Sales Tax

CIRCLE 44 ON FREE INFORMATION CARD

HOBBY CORNER

continued from page 70

capacitor connected to pin C, or the pot connected to pin P, so the calculator counts in microfarads or picofarads! Of course, you do that by using a known capacitor for C to calibrate your capacitance meter.

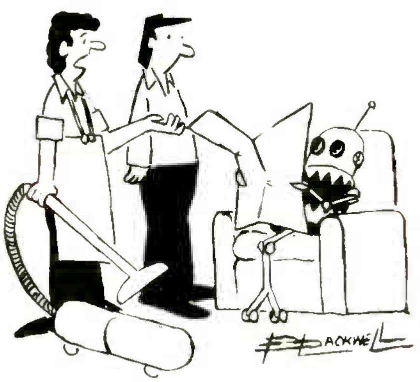
You are probably way ahead of me—yes, the circuit in Fig. 2 is also an ohmmeter. Using a known capacitor C, the readout can be calibrated in the same manner as before to show the value of resistor R. The reading can be in ohms, kilohms, or megohms, depending upon your calibration scale.

Now you are well on your way. By controlling the module rate and the on-time with the polarity of pin S, you can measure all kinds of things. As you see, there is no problem in adjusting the module rate to your needs.

Pin S can be "switched" from minus to plus in a variety of ways. Two are shown in the examples above. Of course, a transistor switch can be used. Another way is with a magnetically operated reed switch. Then, too, the common photocell and the photo-transistor can be used to change the potential on pin S.

By using different switching methods on pin S, and having the actual switching controlled by various actions, you can have any of the instruments mentioned earlier. For example, you can see that a magnet on a bike wheel activating a reed switch will count the rotations of the wheel and you can calibrate that into miles-per-hour, feet-per-minute, or whatever strikes your fancy. Several of those applications are illustrated in the *RC-111* manual.

It should be obvious to you at this point that an old calculator and an *RC-111* module can team up to do a variety of jobs. If you come up with any unusual applications, I would be glad to hear of them. **R-E**

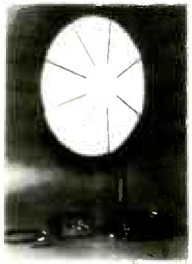


"I originally built the robot to do simple tasks. Then I added to it, making it more and more sophisticated, until finally..."

CALL NOW AND
RESERVE YOUR SPACE

- $550 for a 6X frequency insertion.
- Reaches 211,387 readers.
- Fast reader service cycle.
- Short lead time for the placement of ads.
- We typeset and layout the ad at no additional charge.

Call 212-777-6400 to reserve space. Ask for Arline Fishman. Limited number of pages available. Mail materials to: mini-ADS, RADIO-ELECTRONICS, 200 Park Ave. South, New York, NY 10003.



AMATEUR MICROWAVE RECEIVER SYSTEM (pictured) provides wide-band, high gain reception of amateur television transmissions from 2.1 GHz to 2.6 GHz. View on your television. Order MA1: **$169.95.** *MICROWAVE TELEVISION EDUCATION MANUAL* includes detailed microwave downconverter, power-supply, and antenna plans: **$16.25.** *SUBSCRIPTION TELEVISION EDUCATION MANUAL:* **$14.95.** Add 5% shipping and handling. *Informative catalog:* **$2.00. ABEX, P.O. Box 26601-RE, San Francisco, CA 94126-6601.**

CIRCLE 71 ON FREE INFORMATION CARD

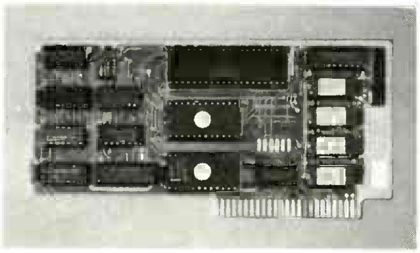
This **DYNAMIC NOISE REDUCTION SYSTEM** is a significantly improved version of the NR-2 (featured in R.E. Aug./Sept. 79) employing the most advanced IC's to reduce the noise in your stereo system by up to 14dB. Works with all program sources (including Dolby® tapes) to make your sounds virtually noise free. *AAS-450,* **$189.00,** VISA, M/C welcome. **Advanced Analog Systems Inc., 790 Lucerne Dr., Sunnyvale, CA 94086, (408) 730-9786.**

Dolby ® is T.M. of Dolby Licensing, S.F. CA

CIRCLE 78 ON FREE INFORMATION CARD

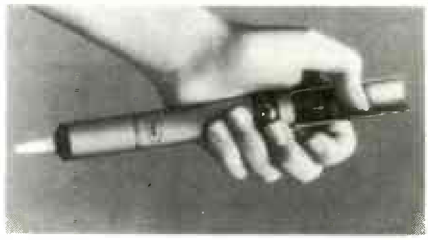
AUDIO DELAY LINE, Make your listening room sound like a concert hall. The *ARS-911* adds the effect of spacial dimension to your sounds; that big real life feeling. Featured in R.E. (Sept./Oct. 81) *ARS-911* Kit only **$149.95.** VISA, M/C welcome.—**Advanced Analog Systems Inc., 790 Lucerne Dr., Sunnyvale, CA 94086, (408) 730-9786.**

CIRCLE 77 ON FREE INFORMATION CARD



The Microbuffer II is an intelligent buffered parallel printer interface for the Apple II computer. Includes 16K of on-board RAM. Buffer memory size is user expandable to 32K. Compatible with Applesoft, CP/M, and Pascal. Includes advanced high resolution graphics print routines for the Epson MX-80 with Graphtrax, Anadex, IDS Paper Tiger, NEC Prowriter. Price: $259. **Contact Practical Peripherals, Inc., 31245 La Baya Dr., Westlake Village, Calif. 91362 (213) 706-0339.**

CIRCLE 73 ON FREE INFORMATION CARD

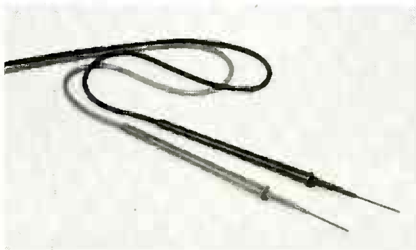


UNGAR'S NEW LIGHTWEIGHT DESOLDERING PUMP, Economical, easy-to-use, one hand operation. *Pump Number 7874* features easy-set plunger with built-in safety shield, press release switch, no-clog automatic tip cleaner and replaceable Teflon® Tip #7875. Pump is 3/4" D. × 8½" L., made of aluminum with durable anodized finish. *Suggested Resale:* **$14.95 each.** Available through your Ungar Distributor or contact...**UNGAR, Division of Eldon Industries, Inc., P.O. Box 6005, Compton, CA 90220, (213) 774-5950, (800) 421-1538.**

CIRCLE 75 ON FREE INFORMATION CARD

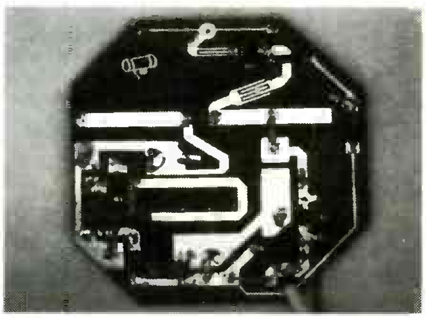
1.2 GHz FREQUENCY COUNTER with 0.1 PPM high accuracy, 0.001 Hz resolution, and 10 MHz proportional oven for—**$299.95.** *DigiMax Instruments* presents a full line of frequency counters featuring accuracy, performance, and low prices, starting from **$149.95.** For more information contact: **DigiMax Instruments Corporation, 5625 Kearny Villa Rd., San Diego, CA. 92123, (714) 569-6582.** Toll Free (outside CA.) (800) 854-1566, Telex-697120-DATAMAX.

CIRCLE 74 ON FREE INFORMATION CARD



AT LAST! COMPLETELY REPAIRABLE TEST PROBES. MICROPROBES from Huntron Instruments feature a needle-sharp stainless steel point on a telescoping, length adjustable electrode insulated to withstand 1KV right down to the ground tip. Super-Slim valox probe bodies and 5 foot superflex leads. **All parts are replaceable! $9.95 + $3.50** handling. Add CALIF. or WASH. tax. **Visa/Mastercharge accepted. Huntron Instruments, 15123 Hwy. 99 North-Lynnwood, WA 98037 (800) 426-9265.**

CIRCLE 72 ON FREE INFORMATION CARD



2300 MHz DOWNCONVERTER kit for Amateur microwave reception. $35.00 postpaid. Highest quality components. Send SASE for information filled catalog of other converter kits, preamps, accessories and parts. VISA and MASTERCARD accepted.

SMP - Superior Microwave Products, Inc.
PO Box 1241 **Vienna, VA 22180**
1-800-368-3028 1-703-255-2918

CIRCLE 76 ON FREE INFORMATION CARD

COMMUNICATIONS CORNER

Speech-scrambling techniques

HERB FRIEDMAN, COMMUNICATIONS EDITOR

ONE OF THE REAL THRILLS OF SHORT-wave listening is hearing the news before it's seen on TV or the headlines of the major newspapers (whatever "major" is supposed to imply). I can remember using a surplus BC-348 receiver to "read the mail" on the overseas phone circuits and government transmitters, and "astounding" my friends and family when I told them of some new war or scandal that hadn't yet made the local papers or the "on-the-hour" newscast of the local radio stations. Today, it's somewhat more difficult to get the facts first-hand because much of what you'd like to know about is sent by radio teletype—called RTTY—or scrambled radio telephone, but it is still possible to monitor many of those transmissions.

To monitor RTTY you need to know the operating times and frequencies of the various transmissions; and if you don't want to spend most of your time fiddling with the dials, you also need to know the station's baud rate (speed of transmission) and shift frequency. I could take up this whole issue of **Radio-Electronics** and still not give you enough information to get any enjoyment out of RTTY.

A better introduction to RTTY is an excellent handbook that I recently received in the mail: *World Press Services Frequencies*. That little gem is not only a handbook on how RTTY works, and the equipment that you'll need to receive it; it also lists the frequencies, times, baud rates, shift frequencies, etc. of the commercial press services such as UPI, XINHUA (China), Reuters, Tass (Russia), and so forth. It's a thorough job and the work was obviously a time consuming labor of love by the author, Thomas Harrington, W8OMV.

Just keep in mind that while there's no law to stop you from reading the mail, you cannot divulge anything you hear to another party. The book is priced at $5.95 and is published by Universal Electronics, Inc.; they are located at 1280 Aida Drive, Reynoldsburg, OH 43068.

Scrambled communications

Not all scrambled communications systems use sophisticated computer circuits, and many of the ones that don't can be easily monitored. That is particularly true of some of the systems that are commonly used on the UHF frequencies.

Among the earliest, and still effective means of scrambling communications so that the "average" SWL (ShortWave Listener) cannot monitor them is speech inversion. That system makes a transmitted signal sound like the "Donald Duck" chatter of SSB. In speech inversion, all that is done is to mix the voice frequencies and a steady carrier in a ring modulator.

To get a better idea of how speech inversion works, let's look at a simplified example. Assume that the voice frequencies are 300-2500 Hz, and that the carrier is 3000 Hz, as shown in Fig. 1-a. When the voice signal and the carrier are mixed in a ring modulator, what comes out is the sum and difference frequencies. (A ring modulator is a balanced modulator. A four-quadrant multiplier IC can be used as a ring modulator.) When the sum is removed, you are left with the difference, which is an exact inversion of the original speech frequencies. When the speech is inverted, 300 Hz becomes 2700 Hz, and 2500 Hz becomes 500 Hz, as shown in Fig. 1-b. Anyone monitoring a signal that has been inverted in that manner will hear "garbage."

At the receiver, the scrambled signal is decoded by once again mixing the signal with a carrier in a ring modulator. That will re-invert the signal. If the carrier is 3000 Hz as before, the original 300-2500-Hz input signal is recovered, as shown in Fig. 2. One problem with that scrambling system is that if someone assumes that the transmission is SSB and adjusts the BFO to "tune in" the signal, he may be able to decode the scrambling since one BFO setting will re-invert the signal in exactly the same manner as is done by the descrambler or decoder.

Several years ago, before the "age of the microprocessor," I experimented with an "unbreakable" scrambler. (At least, I thought it was unbreakable at the time.) In those experiments, I used a signal from a national radio network as the "carrier." The "receiving" station—rather than broadcasting the signal, a telephone hook-up was used—picked up the same signal from a local radio station and used it for decoding a transmission.

Fortunately, I knew little about

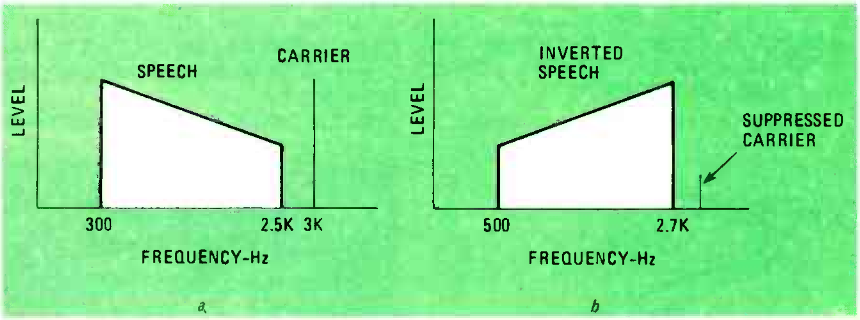


FIG. 1

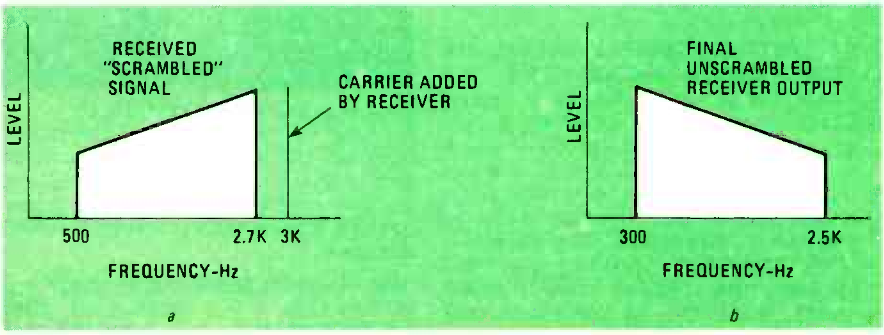


FIG. 2

scrambling at the time (which isn't all that much more than I know now) so I did not know that there were at least ten good reasons why the idea should not work. Of course the darned thing worked! The sound was somewhat garbled, but a message using some non-technical, simply constructed phrases could be understood. Had I known more about filters, and had the time to work on the thing, it probably would have proved commercially viable. But I was doing my experimentation just for fun, and once satisfied that my idea would more or less work, packed everything into a box and simply forgot about it.

Today, much scrambling is done using a microprocessor. Instead of the steady tone of a carrier, or the radio-station signal of my "Friedman Special," a constantly changing sampling rate is used to digitize a speech signal. The digital transmission also serves to program the microprocessor at the receiving station to decode the signal. When total security is required, the digitized transmission only serves to synchronize the microprocessor at the receiver. Since no key to the sampling sequence is transmitted, the scrambling is almost unbreakable. (I say "almost" because in electronics nothing is any better than "almost." By the time you read this, someone may very well be selling a 50-cent IC that is capable of "breaking" all of the digital scramblers currently in use.)

Though the digital scramblers are essentially unbreakable, many scrambler users make things simple, to keep overall costs down and receiving problems at a minimum. They are not as interested in absolute security as in making their copy unintelligible to the general public. After all, anyone that really wants to break a scrambler code can probably do so.

One major problem for the SWL is that HF-circuit scramblers are usually used with SSB. That means that you need a second local oscillator, because the receiver's regular BFO is being used to receive the SSB signal. You can either mix the received audio in a ring modulator with a variable-frequency/variable-level audio oscillator, or radiate a small tunable "IF frequency" into the antenna input, as was done in the early days of CB SSB. The whole thing is a lot of fun to try, although it is rather time-consuming when you're trying to establish the best "carrier" level in the descrambler.

If any of you give it a try, please drop me a line, in care of **Radio-Electronics**, and let me know how you make out. Perhaps some other readers will be interested in your results: we'll run the highlights of your experiments in future issues. R-E

COMPUTER CORNER

Games (computer) people play.

LES SPINDLE*

DESPITE THE OFTEN-HEARD PHRASE "personal computer," microcomputers today are largely used as serious devices for practical business applications; the "computer-in-every-home" era still seems to be a considerable time away. To fuel the fires of home-computer sales, manufacturers and vendors try to impress upon consumers the image of the home computer as a practical device; but the largest percentage of software purchased by home users falls into the same category that predominated five years ago—fun and entertainment applications.

That should come as no surprise. The widespread use of some of the most sophisticated electronic developments of the last hundred years—television, radio, and the telephone—can still be attributed at least as much to their capabilities for providing amusement as to their use for communications.

Because of that, the computer-game industry is a booming business, with millions of dollars worth of game cassettes and disks being sold annually. Hundreds of software companies, large and small, release new offerings every month. Some examples of game software are shown in Fig. 1.

Electronic-game history

The computer-game scramble began in 1966, when Ralph Baer sold the rights to his video-game invention, *Odyssey*, to Magnavox. The game reached the market in 1972, and the phenomenon was on its way.

The early games were simple, ping-pong-type diversions with little challenge or variety. The next phase offered more options for players by using switches to select various modes of operation. In 1977, with Fairchild's *Video Entertainment Center*, programmability was added.

Most modern games are sophisticated and challenging, because they offer the possibility for the player not only to alter the existing games, but also to devise new ones. That's made possible by a microprocessor in each game console, and by the availability of ROM (*R*ead-*O*nly *M*emory) cartridges containing the game elements.

All the games discussed so far have been "dedicated" devices—all they can do is play games. The next step is a microcomputer system that permits you to expand your game-playing horizons beyond the limitations imposed by the dedicated game-machines. You can write your own games if you wish, and save the game results on cassette to determine your errors, or continue a game that had been started previously. And—perhaps the most important thing—after you've had your fill of game-playing, you can turn the computer to more practical applications.

Some manufacturers are turning out game consoles that are actually complete microcomputer systems, complete with keyboards and memory. The *Interact*, from Microelectronic Systems Corp., for instance, uses an 8080 microprocessor and offers some software in addition to games, including home and business applications-programs.

One popular computer that is especially suited for game-playing is the *Apple II*. While its capabilities extend far beyond that, it offers superb game-potential for the computer enthusiast who appreciates the computer's entertainment value as well as its practical side. With a keyboard, game paddles, excellent graphics capabilities, and a sound generator, the computer is the ideal choice for creating games and playing those created by others. Needless to say, there is a wealth of game software available for the *Apple*.

Game types

What kind of games can you expect to find for computers? There is a wide variety available, but a few popular formats tend to dominate the market. If you consider television to be a "sitcom factory" where one hit series spawns dozens of spinoffs, ripoffs, and imitations, you haven't seen anything until you've played the hundred-and-first version of a Space Invaders or Star Trek computer game. That doesn't seem to bother buyers, though; the formats that sell are the familiar ones.

At the simplest level, board-type games continue to be popular. Games such as tic-tac-toe, checkers, chess, and backgammon, hardly make extensive use of color graphics or other dazzling effects, but are formidable brain-teasers and entertain players for hours at a stretch. Several computer-chess competitions are held by computer clubs and other organizations

FIG. 1

*Managing Editor, *Interface Age* magazine here and in other parts of the world.

Guessing games provide some intellectual stimulation and, in some cases, are educational. Arithmetic calculations and problems in logic expand the programs into truly stimulating exercises. For example, one game challenges the player to search a grid of dots to locate a hidden object. Clues and hints are provided along the way to bring the astute player, step-by-step, closer to solving the puzzle.

Casino games satisfy the gambling instinct in computer buffs, creating exciting situations with poker, roulette, and blackjack competitions. While you can't win any money, you can't lose it, either.

Simulations

Computers are widely used to perform simulations—programs that mimic real-life events, and whose outcome can be changed by changing the values of the data used.

Simulations are used in business to make long-range financial decisions by posing hypothetical situations to the computer. The armed forces frequently make use of computer simulations, and medical schools often depend on simulations for training purposes—electrons are more expendable than lives.

Simulations are also widely used in games. The Star Trek games cast the player as captain of the starship *Enterprise;* the object is to seek out and destroy Klingon battle cruisers without being destroyed yourself.

Another popular simulation is Adventure, a game in which you explore a vast, complex, underground world filled with treasures, magic, and menaces. The game is highly addictive and, when you've exhausted one version of Adventure—if that's possible—there are many more waiting.

Still another simulation puts you in the position of an air-traffic controller, guiding over 20 planes into, out of, and around your airport.

Home-computer versions of popular arcade games are also available. There are Space Invaders games to run on almost any machine. Missile Command and Pac-Man are two other games that have been adapted for microcomputers.

How do you select the best version of a game? Ask the man who plays one. Frequent your local computer club, follow the software reviews in computer magazines, and ask fellow computer owners whether you can try their games before investing in your own. You'll find the world of computer hobbyists—game enthusiasts, in particular—to be a friendly and cooperative brotherhood.

There's a saying: "You can tell the man from the boy by the price of his toy." Whoever coined that phrase must have been a computer buff. **R-E**

STATE OF SOLID STATE

Play a tune with these new IC's

ROBERT F. SCOTT, SEMICONDUCTOR EDITOR

HARDLY A DAY PASSES THAT I DON'T read about some interesting new or improved semiconductor device, or of an innovative application for a more familiar one. But all too often, some of the most exciting devices are available only to equipment manufacturers, or are priced beyond the range of the average hobbyist.

That is not the case with a series of IC's available from Epson America. It has released a series of 24 melody-generator CMOS LSI devices. They are programmed to play selected melodies and to produce chime and alarm tones. They can be used in musical toys, to replace doorbells and chimes, as replacements for the mechanical devices in music boxes, and to produce musical tones that are a pleasant change from the strident clanging of a gong or the rasping sounds of a buzzer used in many applications. The devices are nearly complete in themselves, requiring only a speaker, 1.5-volt battery, and a few external parts for operation.

TABLE 1

FUNCTION	S1	S2	S3	S4
Melody 1	on	off	off	on
Melody 2	on	off	off	on
Buzzer	—	on	off	on
Chime	—	off	on	on
Test mode/melody 1	on	on	on	on
Test model/melody 2	on	on	on	on

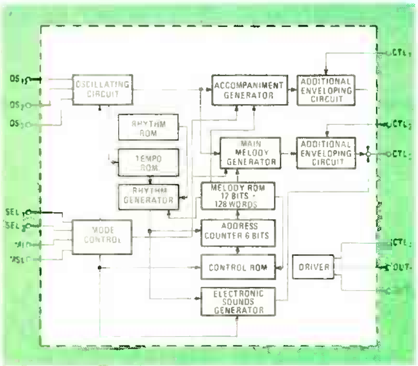


FIG. 1

The 7910 series of IC's provides a selection of two preprogrammed tunes plus a chime and an alarm tone. The melody arrangements are diphonic—two notes sound at once. The 7930 series of IC's play only a single tune. The 7920's are simple 8-pin DIP devices, made by omitting the audio preamp/driver from the 7930.

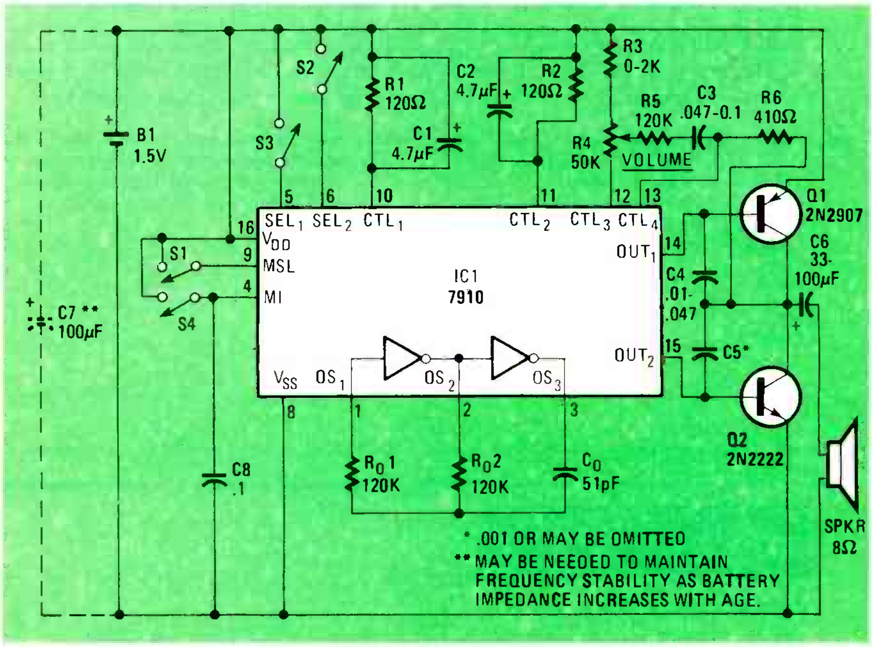


FIG. 2

Figure 1 is a block diagram of a 7910 and Fig. 2 is a circuit that can be used to drive the IC. The built-in oscillator—two series-connected inverters connected between pins 1, 2, and 3 (terminals OS_1, OS_2 and OS_3) and tuned by R_O1, R_O2, and C_O—generates a nominal frequency of 47.5 kHz. That signal is processed by the various internal circuits to develop the notes, tempo, keying, shaping, and other controls needed to produce a specific melody, chime, or alarm.

Pin 4 (terminal MI) is the on-off control point. The tune starts at the beginning of the melody when that terminal is switched HIGH (connected to V_{DD}) and continues until the circuit to terminal MI is opened (switched to LOW). If the terminal is still switched HIGH when the tune ends, the tune is simply played over.

Control terminals CTL_1 and CTL_2 (pins 10 and 11), when connected to R1-C1 and R2-C2, regulate the time constant of the envelope. The overall tone can be changed by varying C1, C2, R1, and R2. Terminal CTL_3 (pin 12) is the unamplified output of the melody-generator section of the IC. Terminal CTL_4 (pin 13) is the input to the built-in audio preamplifier. In Fig. 2, R4 is the volume control. Terminals OUT_1 and OUT_2 (pins 14 and 15) are the preamp outputs used to drive the complementary bipolar output-transistors.

Terminals SEL_1, SEL_2, and MSL (pins 5, 6, and 9) are used to control the output of the IC. The terminals are connected to switches (S1-S3) that are used to select melodies, chimes, or alarm, depending on their setting. Table 1 shows the switch settings for a 7910 programmed for two melodies and two alarm sounds. In the MELODY TEST modes, the tempo of the selected melody is stepped up eight times. The switch settings for 7910's that have two melodies and no alarm, or no melodies and two alarm sounds, are similar to those in the table.

I've mentioned the possibility of using a melody generator as a replacement for a doorbell. For that application, I suggest the 7910-O, P, X, or CH versions. Those are different 16-note arrangements of Westminster chimes; the devices are suitable for use as doorbells since they are programmed to play through just once and then stop.

At present, there are fifteen different IC's in the 7910 series, seven in the 7930 series, and two in the 7920 series. The melodies available are too numerous to list here, but, to give you some idea of what is available, they range from "Jingle Bells" and "Silent Night" in the 7910-CU to a Chopin nocturne and a Mozart minuet in the 7910-CE.

Sample quantities (1 to 9) of the 7910, 7930, and 7920 cost $10, $8, and $7 each, respectively. Circuit boards are available and cost $15 for the 7910; boards for the 7930 and 7920 cost $10. If you order the IC and circuit board together ($25 for the 7910, $18 for the 7930 and 7920), you get an evaluation kit that includes all parts; all you have to add are an 8-ohm speaker and a 1.5-volt AA cell. To order any of those items, write to Epson America, 3415 Kashiwa St., Torrence, CA 90505. When ordering, include $1 for shipping and handling. (California and New York residents, add appropriate sales tax.) Incidentally, tune lists and data sheets for the IC's are also available. **R-E**

"Now if you're into satellite TV, this is the house for you!"

SERVICE CLINIC

Vertical-retrace-line problems

JACK DARR, SERVICE EDITOR

OVER THE YEARS I'VE RECEIVED A LOT of letters concerning vertical-retrace-line problems. That used to be one of the most "popular" complaints. The problem is easy to identify—there are four or five bright lines at the top of the screen, and they always start at the upper right corner and slant down toward the left. In the early 1950's, TV sets suffered a lot from that complaint, and it was frequently said that the sets came with built-in retrace lines. I've had quite a few letters about the problem recently, and the last one said, "Why don't you write a 'Service Clinic' column about it?" Always happy to receive inspiration, I accepted, and here it is.

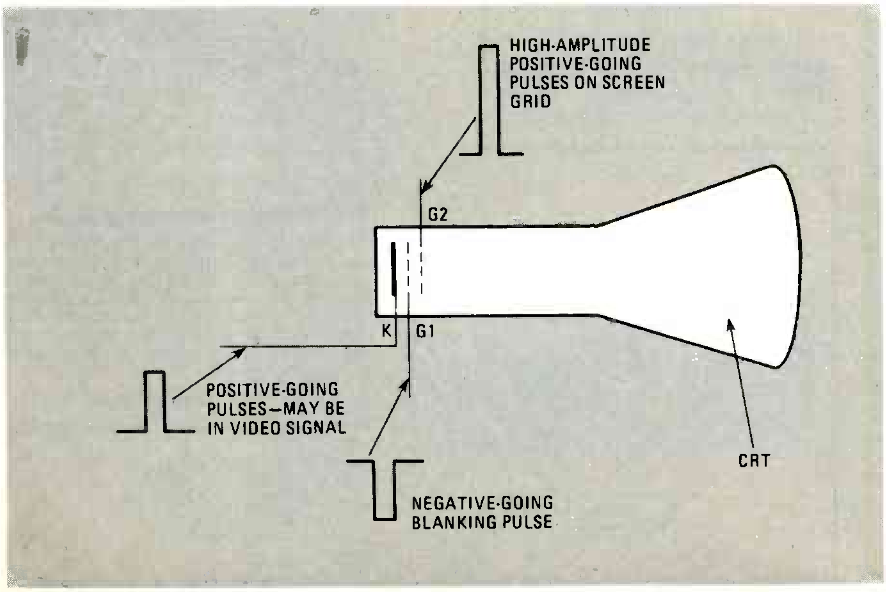
Vertical blanking is simple. You feed a vertical-frequency pulse into one of the video circuits, or directly to the picture tube (see Fig. 1). That pulse must be exactly as long as the vertical-blanking interval, and with enough amplitude, and the right polarity, to cause the electron beam in the picture tube to be cut off.

Naturally, the pulse must be present during the vertical-blanking interval (which is the black horizontal bar between frames, as if you didn't know!)

A lot of different vertical-blanking circuits have been used. Early sets fed positive-going pulses to the cathode of the picture tube, or negative-going pulses to the grid. The important thing is that the polarity of the pulse has to be in the direction of cutoff, and the amplitude high enough to cause full cutoff. One oddball circuit I remember fed rather-high-voltage negative pulses to the picture tube's screen grid! That was on a black-and-white tube set, of course. If you're restoring antiques, watch for it; usually pulses were fed in through capacitors, with shunt resistors. Check for leaky or open capacitors, or resistors whose values have drifted.

Later-model sets, especially solid-state ones, feed blanking pulses into one of the early video-amplifier stages. Very often the first video-stage is used. Popular circuits feed vertical-blanking pulses either into the base or emitter of that transistor. For NPN transistors, the pulse applied to the base is negative-going (reverse biased) while a pulse to the emitter is positive-going. The pulses are often fed through series or shunt diodes; more about them later.

The actual vertical-blanking pulses can be picked off the vertical oscillator-output circuit at quite a few points. What's needed is a point that has a pulse of the proper polarity and amplitude. Sometimes the pulse is shaped by R-C networks. One of the older sets even took the pulse from the vertical yoke! Some solid-state sets use a vertical-blanking amplifier-transistor, for a higher-amplitude pulse, wave-shaping etc. You can find the pickoff point by looking for a line that isn't used in the vertical circuitry, but goes out and away, usually toward the top of the schematic.



Other trouble sources

There are a few other things—not in the vertical circuits—that can cause retrace lines to show up. In older sets, if the brightness or contrast is too high, you may see retrace lines. That can be fixed by readjusting the controls. Also, if the AGC is set too far toward "white-out," that can cause the lines to appear. Reset the AGC control and see if that helps.

In the cases just mentioned, the lines show up because the picture tube is simply being driven too hard for the normal blanking-pulse to cause it to be cut off. In recent sets, automatic brightness-limiter circuits have contributed a lot to curing the problem. But they can also be the cause of the lines: If you see retrace lines in a set with an ABL, make sure that the circuit's working.

Check the schematic to see if a vertical-blanking amplifier-transistor is used. If so, and you see retrace lines, use a scope on that stage to make sure it is working. An open transistor could be the source of your trouble. If the transistor is leaky, it can do strange things to the blanking pulse—make it wider, distort its shape, etc., which causes really odd symptoms on the screen.

Blanking diodes

Here's some more about the blanking diodes. Any defect in them causes problems. If a series diode is open, you'll lose the pulse entirely. A series diode that is shorted also causes odd problems. And leakage in those diodes really causes some oddball ones! One is "window-shading:" when the brightness is turned down, the raster goes dark from top to bottom just as though someone were pulling a shade down over it. That would be caused by the vertical-blanking diode. If the raster goes out from left to right, as if someone were pulling a drape across it, that usually means a leaky horizontal-blanking diode.

A shorted horizontal-blanking diode often produces the "jail bars" symptom—there will be five or six black vertical bars in the picture; the picture will be seen between the bars. Those bars are due to the normally-present series of "ringing pulses" present on the horizontal part of the HV pulse; the shorted diode lets them get through. (It's supposed to clip them off and leave only the spike.)

There are even stranger problems, too. In one old set, we had what looked like retrace lines; closer examination showed that they didn't slant but were almost horizontal, and had flashes of color and bright points in them. After quite a bit of checking, the cause turned out to be a bad integrator circuit in the feedback loop. It was one of the ceramic-types, which looks like a ceramic capacitor with three leads. It was causing a very narrow and sharp top-foldover of the raster; the odd things seen, including the color, were the VITS signals, which are in the vertical-blanking interval.

An oscilloscope is the best piece of test equipment to use with that type of problem, or with any sync problem—you can follow the blanking pulses from their point of origin all the way to their destination, to make sure they get there, or to find the point where they drop out. When you find that point check voltages, components, etc. **R-E**

SERVICE QUESTIONS

THIS CAN'T HAPPEN!

This happened with a Magnavox T920 chassis: There was no vertical sync. The set worked fine on the test jig, but not in its cabinet. I tried a new yoke and convergence board with no luck. That left only the picture tube. I had another picture tube in a cabinet with the chassis out, so I used the Magnavox yoke and convergence assembly, slipped the chassis in, and it worked fine. So I replaced the picture tube and now everything's back to normal. I know this isn't supposed to happen, but it did!—*W.S., Houston, TX*

I'm sure glad you didn't ask me why!

HOT FOLDOVER

I have a Sylvania EO-9 that develops a bad foldover after it has been run for a while. I've replaced the IC-300 V/H divider and checked many of the resistors and capacitors around it without any luck. I tried cooling things down and found that if I cooled the IC, the picture would straighten out and stay normal for five or ten minutes. I put the original IC back and found that the same thing happens. The schematic shows a voltage regulator, SC310, but I can't find it. Any help would be appreciated.—R.H. Susquehanna, PA

It sounds as if your problem is in the voltages at the IC. You indicated that you measured +5.97 volts at pin three, the V_{CC} input. That's too high! The correct voltage should be +4.3 volts.

From the parts list, SC310 is a 4.3-volt Zener diode. I'd say that it's either open or missing. Get a 4.3- or 4.7-volt Zener and tie it directly from pin three to ground. That should do the job, and the original IC may still be usable.

BAD PICTURE TUBE?

We've got a GE 25YM that was damaged by lightning. We replaced some parts that obviously needed replacing. That didn't work—you turn the set on and the circuit breaker trips. Our old tester told us that the picture tube (25-EKP22) was shorted even though an ohmmeter didn't indicate anything was wrong. What's your opinion?—J.P., Cortez, CO

I think your picture-tube tester is right. I've run into several sets with the picture tubes shorted so badly that they kill the HV and trip the breaker. (I didn't believe it the first time—the set would run with the HV lead disconnected. On a test jig it gave a perfect picture. So, we changed the picture tube and that was that.)

NO VIDEO, LOW VOLTAGE

I have no picture, only a raster with colored horizontal lines, on a Zenith K1908C. Checking, I found only +50 volts on the supply to the video-output module, instead of the +238 volts shown on the schematic. The boost is a bit high, but the HV is normal. The +238 volts is derived from the flyback. Do you think the flyback is bad?—E.M., N. Olmsted, OH

No, not the flyback. Note that many other voltages that are derived from the flyback are OK: the boost, HV, etc. Your problem is either an open rectifier on the +238-volt source, or something of that sort. Check any resistors that are in series with that supply, between it and the video-output module. The symptoms are not those of a short; that leaves only a bad diode or an open series-resistor as the likely cause.

HORIZONTAL RIPPLE

I've got a bad case of what looks like full-wave horizontal ripple in a Sylvania E01-9. I replaced the main filter capacitors, but it's still there. If I disconnect the degaussing coil, the ripple just gets worse. That shouldn't have anything to do with the filtering, should it?—J.T., Memphis, TN.

No—the degaussing coil isn't involved. I ran into that situation some time back and the problem turned out to be an open diode in the full-wave bridge rectifier. You have a similar case, so check all of the diodes *and* the solder joints. **R-E**

NEW BOOKS

For more details use free information card inside back cover.

USING MICROCOMPUTERS IN BUSINESS. A Guide for the Perplexed, by Stanley S. Veit. Hayden Book Company, Inc., 50 Essex Street, Rochelle Park, NJ 07662. 142 pp including appendices and index; 6 × 9 inches; softcover. $9.95.

This book, written by the man who opened the "second-oldest computer store in the world," is an essential background reference for any purchaser of computer systems or software for a business. It describes the advantage of "computerization" and provides the potential user with the data necessary to make intelligent choices.

Chapters 1 and 2 cover various types of businesses and the programs they need, with reference to the ability of small computers to handle those needs. They are followed by chapters on word processing; data-base management sytems; how to install a computer without disrupting your business; buying your system; computer languages; the limitations of the microcomputer; software; where to find it and how to judge it, and what to do when the system goes down. The two final chapters deal with how a microcomputer works and microcomputer memory.

The book has many photos and easy-to-follow diagrams, and is written in plain language, without technical jargon. It answers the most-often-asked questions about computers and offers advice, information, and warnings which have been proved valid.

CIRCLE 150 ON FREE INFORMATION CARD

WHY DO YOU NEED A PERSONAL COMPUTER? by Lance A. Leventhal and Irvin Stafford. John Wiley & Sons, Inc., One Wiley Drive, Somerset, NJ 08873. 278 pp including appendices and index; 6¾ × 10 inches; softcover; $8.95.

This is a non-technical, fully illustrated, down-to-earth introduction to the world of personal computers. It offers detailed guidelines on the advantages and drawbacks of every type of personal computer; gives sources of equipment and information; provides a step-by-step introduction to the BASIC language, along with an easy-to-follow course in writing programs; information on how to maintain a computer and what to do if it breaks down; a user-directed discussion of peripherals and interfacing, and an extended glossary.

The reader will learn how versatile personal computers are and the many everyday applications they can perform, as well as what will be needed for a useful system and how to select a system that meets the user's personal requirements. Innumerable low-cost personal computers are widely advertised; this book will help the reader to choose among the many offerings and understand what the advertisements really mean.

CIRCLE 151 ON FREE INFORMATION CARD

THE COMPLETE HANDBOOK OF MAGNETIC RECORDING, by Finn Jorgensen. TAB Books, Inc., Blue Ridge Summit, PA 17214. 448 pp including appendix, additional reading list, and index; 5⅛ × 8¾ inches; softcover; $10.95.

This textbook of "know-how" and reference, covering all aspects of magnetic recording, is written both for the technically inclined person working in the field and for the equipment user who wants to get in-depth knowledge of magnetic recording equipment and principles.

Chapter 1 gives a brief history, followed by an introduction to recording equipment (chapter 2). The rest of the book falls into three main sections: Fundamentals; Heads, Tapes, and Discs, and Equipment and Application.

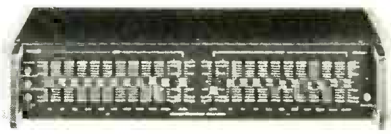
The process of recording receives full attention, too: pulse recording and playback; noise; signal detection; equalization bits; error rates; coding; standards; measurements; recording with an AC-bias; amplitude and phase response; SNR improvements; tape drives, and sound-film recording—all are covered in detail, along with FM and PCM recording (including analog-to-digital conversion and high-density digital recording!) R-E

CIRCLE 152 ON FREE INFORMATION CARD

NEW PRODUCTS

For more details use free information card inside back cover.

GRAPHIC EQUALIZER, *model EQ2400*, is a stereo frequency equalizer for the home recordist or music listener. The user can listen to music "flat" while making and monitoring an equalized recording, or



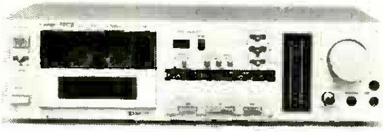
CIRCLE 141 ON FREE INFORMATION CARD

can make and monitor an unequalized tape while listening to music that's equalized to suit the sonic characteristics of one's listening room.

There are ten linear slide controls for each stereo channel, each with true octave spacing calibrated to ±15 dB. That will not only improve the sound of the user's cartridge but also remove hiss, rumble, and surface noise.

The *model EQ2400* has a frequency response of 10 to 100,000 Hz ±1 dB. Total harmonic distortion is less than .01% and intermodulation distortion is less than .02%. There are two main, and two tape-monitor inputs, plus two main and two tape outputs, equalization and defeat selector, and tape-monitor controls. The *model EQ2400* can be connected easily to any receiver, pre-amp, or integrated amplifier with tape monitor, signal processor, or pre-amp output. The *model EQ2400* is priced at $199.00. — **Numark Electronics Corp.,** 503 Raritan Center, PO Box 493, Edison, NJ 08817.

CASSETTE DECK, *model ND-1000*, is a two-motor, direct-drive system that assures accurate tape travel. Its three tape heads also add to tape-transport accuracy, while permitting off-the-tape monitoring as well. The transport also features full IC logic control, permitting smooth tape-function switching without the need to go through the "stop" position. The IC logic permits all tape-mode functions to be turned on from across the room, with the addition of an optional remote-control unit.



CIRCLE 142 ON FREE INFORMATION CARD

The *model ND-1000* accepts metal, normal, and CrO_2 tapes, and applies accurate equalization with each. Other features include two 12-section LED peak-level displays for accurate monitoring, separate left and right level controls, and a front-panel output-level control. Its standard *Dolby B* noise-reduction system is augmented by an MPX filter for interference-free off-the-air recording. There are also an automatic rewind function, a timer-activated record/playback function, and an automatic memory-stop/memory-play function.

The *model ND-1000* is priced at $650.00. — **Nikko Audio,** 320 Oser Avenue, Hauppauge, NY 11787.

SPECTRUM ANALYZER, *model ESA-1000,* is the first such instrument to incorporate bandwidths and detector characteristics mandated by CISPR publications and recommended for FCC-compliance testing, both conducted and radiated. The *model ESA-1000* permits direct visual measurement of electric-field strength, in addition to the conventional spectrum-analyzer capability, to provide a "quick look" at its entire 100 kHz-1000 MHz coverage range. The instrument's scan-rate can be reduced, and accurate measurements taken, using the built-in quasi-peak detector.

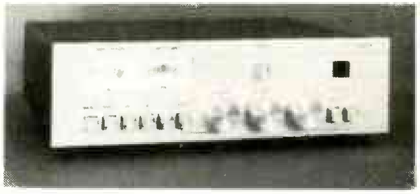
CIRCLE 143 ON FREE INFORMATION CARD

There is a complete range of options, including a rechargeable battery pack for field use, and a digital memory module with capability to store data from a slow scan, as required by quasi-peak time constants, and then retrace the scan data at a fast rate for wide-dispersion viewing. The *model ESA-1000* is being marketed at a basic price/unit under $9000.00.—**Penril Corp.,** 5520 Randolph Road, Rockville, MD 20852.

EARTH STATION RECEIVER, *model ESR24,* covers a frequency range of 3.7-4.2 GHz, is designed for satellite-TV recep-

CIRCLE 69 ON FREE INFORMATION CARD

tion, and features digital channel-display, preset and variable audio subcarrier selector, automatic frequency-control for stability, and full metering. For installation



CIRCLE 144 ON FREE INFORMATION CARD

versatility, the down-converter module (supplied) may be mounted internally, or at the antenna. Accessories for the *model ESR24* include remote control, a remote tuning-meter, and splash-proof housing. The styling makes it suitable for commercial or private installations. The *model ESR24* is priced at under $1000.00.—**R.L. Drake, Company,** 540 Richard St., Miamisburg, OH 45342.

SPEAKERS, *Ohm Walsh 2,* have inverted transducers that radiate a measurable coherent wave front into the total frontal listening area. That special method of coherent sound-propagation provides

CIRCLE 145 ON FREE INFORMATION CARD

virtually perfect stereo imaging and energy response from any listening position. The speakers are finished in genuine walnut veneer on all four sides; they are also available in oak, teak, and rosewood veneers at increased cost. They measure 31½ × 11½ inches, can be driven by as little as 20 watts, and have a maximum power handling of 120 watts. The *Ohm Walsh 2* speakers are priced at $275.00 each. — **OHM Acoustics Corp.,** 241 Taaffe Place, Brooklyn, NY 11205.

CW COMPUTER-INTERFACE, *model MFJ-1200,* converts audio from your receiver to TTL or RS-232 so your computer can "understand" it. It also lets your computer-output "key" your transmitter. When combined with a personal computer and an

CIRCLE 60 ON FREE INFORMATION CARD

appropriate program, it can give you a complete and versatile CW keyboard/reader combination.

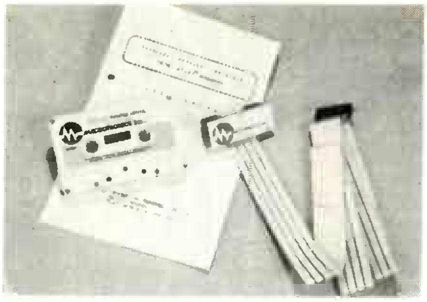
CIRCLE 146 ON FREE INFORMATION CARD

For receiving CW, the *model MFJ-1200* processes the received CW audio from your rig to provide a clean, computer-compatible TTL or RS-232 level. First it limits the noise on incoming CW signals, then filters it to remove interfering signals, sends the desired signal through a detection stage, post-filters the detected signal, shapes the signal, and finally shifts the level of the signal to TTL or RS-232 so that your computer can use it.

For transmitting CW, the *model MFJ-1200* takes keyboard-generated CW at TTL or RS-232 output levels from your computer and drives high-voltage keying circuits to key your tube or solid-state transmitter (−300 volts, 10mA maximum, +300 volts, 100mA maximum).

The *model MFJ-1200* has three red LED's to indicate tuning, transmit mode, and "on". A REVERSE/NORMAL switch will invert the output level to the computer, if desired. It operates on 6- to 9-volts DC or 110-volts AC, with the optional *MFJ-1309* AC supply ($9.95). The *model MFJ-1200* is priced at $69.95, plus $4.00 for shipping and handling.—**MFJ Enterprises, Inc.,** PO Box 494, Mississippi State, MS 39752.

PARALLEL PRINTER INTERFACES, *model A4P* and *model A8P* (shown) are designed for the Atari line of microcomputers. They allow the *Atari 400* or *Atari 800* to drive a parallel ASCII printer directly. A cable assembly plugs into controller jacks 3 & 4 on the front of the Atari microcomputer. A short (15-second) program is read into the computer from cassette; from then on, all printer data is directed to the parallel-printer interface, instead of to the Atari serial port. For example, LIST"P will list a BASIC program on the printer, LPRINT in a BASIC program will directly output to the printer, and LIST#P: will list assembler source listings on the printer.



CIRCLE 147 ON FREE INFORMATION CARD

The program will remain in memory until the computer power is turned off—it is unaffected by SYSTEM RESET, BREAK, ESC, OPTION, SELECT, or START. The interface

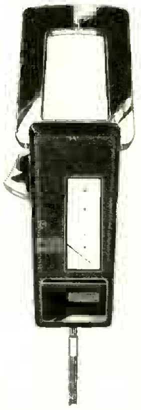
CIRCLE 66 ON FREE INFORMATION CARD

works equally well with BASIC, DOS, or the Atari Assembler/Debug. It will work with virtually any program that directs printer data through the IOCB. It will work with machine-language programs that do not reside in or clear memory locations 0700H to 07AAH.

The *model A4P* is for the *Atari 400*, while the *model A8P* is for the *Atari 800* microcomputer. Both have the same price: $69.95.—**Macrotonics, Inc.,** 1125 N. Golden State Blvd., Suite G, Turlock CA 95380.

BUS-BAR SNAP-AROUND, *model SPR-1030,* is designed and engineered for 3-inch bus-bar measurements, as well as for use on round cable up to $2^{15}/_{16}$ inches OD. The scale, which rotates for easier readings, has continuous duty for every range.

There are five current ranges up to 1000-amps AC and three voltage scales up to 750-volts AC (self-contained); the unit comes with a one-piece Ohmprobe for both resistance and continuity testing. Full-scale accuracy on signals from 50-400 Hz is ±3%. Safety features include shock-resistant ABS plastic housings; twist and lock threaded voltage leads; fully insulated jaws, and the ability to withstand overloads. The *model SPR-1030* comes with carrying case, voltage test leads, Ohmprobe fused battery attachment; battery; fuse, and operating instructions. It is priced at $124.95. — **A.W. Sperry Instruments, Inc.,** 245 Marcus Blvd., Hauppauge, NY 11787.



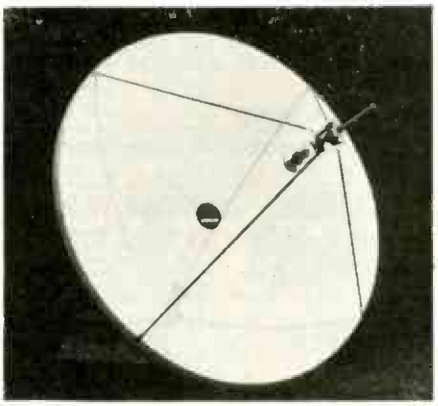
CIRCLE 148 ON FREE INFORMATION CARD

GRAPHIC PRINTER, *model VIC 1515,* is designed to go with the *model VIC 20* personal computer. The *model VIC 1515,* which can print any of the alphabetic, numeric, and graphic characters common to the *model VIC 20,* is a dot-matrix printer with a speed of 30 characters per second. It allows the *model VIC 20* user to

CIRCLE 149 ON FREE INFORMATION CARD

get hard copy for forms, program listings, mailing labels, charts, graphs, and more. Special enhancements also allow it to print extra-wide and reversed (white-on-black) characters. The *VIC 1515* is priced at $395.00.—**Commodore Business Machines, Inc.,** 681 Moore Road, King of Prussia, PA 19406.

SATELLITE-TV ANTENNA, the *Skyview IV*, is a lightweight, 11-foot fiberglass parabolic-antenna designed for lost-cost shipping, expandability, and ease of operation. It is expandable to 13 feet by adding extender panels. Installation requires only a simple, three-foot-square concrete pad and four holes.



CIRCLE 150 ON FREE INFORMATION CARD

The *Skyview IV* weighs 400 pounds, including mount, and has better protection against wind (125-mile-load survival rating), rough handling, and weather than conventional aluminum construction. It is easy to operate; it can be shifted from satellite to satellite with a simple hand-crank adjustment, and can receive all North American communications satellites.

The *Skyview IV* is priced at $1945.00.

Also available is the *Skyview IV System*, a complete home satellite-TV receiving system based on the *Skyview IV* parabolic antenna and including a *D-2X* receiver, 120° LNA, RF modulator, and all cabling. The price is $4595.00.—**Downlink, Inc.,** 30 Park Street, Putnam, CT 06260. **R-E**

CHANNEL 1?

continued from page 46

television reception. The television industry, although not pleased about losing yet another TV channel, agreed that 12 clear channels were preferable to 12 shared channels. If they had to lose a channel, they preferred that it be Channel 1, because its absence would have the least impact on commercializing television.

The FCC went along with the television industry's position, and on June 14, 1948, Channel 1 was deleted from the allocation plan. Channel 1's frequencies were assigned to the fixed land and mobile services. At the same time, the FCC decided not to renumber the channels—that's what happened to Channel 1! **R-E**

MARKET CENTER

SATELLITE TV TONIGHT LIVE !

- DISH ANTENNA
- PREAMPLIFIER
- RECEIVER

$399

MDS COMPLETE RECEIVING SYSTEM READY FOR TV HOOK-UP

$295 SATELLITE ANTENNA (10 FT. x 10 FT.)
FOR THE DO-IT-YOURSELFER

JUST PUBLISHED — MAGNIFICENTLY ILLUSTRATED DIAGRAMS - GRAPHS - EXTENSIVE PHOTO-GRAPHS - MAJOR SOURCES - ANTENNAS - LOW NOISE AMPLIFIERS - RECEIVERS AND MORE.

THIS AMAZING BOOK DESCRIBES THE ENTIRE FIELD OF SATELLITE TRANSMISSION AND RECEPTION WITH THE THOROUGHNESS OF AN ENCYCLOPEDIA. ONE CAREFUL STEP AT A TIME OUR COMPREHENSIVE BOOK HAS BEEN WRITTEN SO THAT EVEN A BEGINNER CAN EASILY UNDERSTAND THE SIMPLIFYING TECHNOLOGY BECAUSE WE MADE IT SO EASY TO LEARN.

NOW YOU CAN HAVE A 100 PLUS CHANNEL RECEPTION SYSTEM AND ENJOY EVERYTHING BEING TELECAST IN THE WORLD.

SATELLITE T.V. INC.
P.O. BOX 3618, DEPT. RE-3
LANTANA, FL 33462
SEND $9.95 PLUS $2.50 SHIPPING & HANDLING OR CALL OUR 24 HR. C.O.D. ORDER LINE (305) 845-3840

NAME ______
ADDRESS ______

SATELLITE TELEVISION

SATELLITE TV antenna, 10 ft. fiberglass, complete, polar mount, $1950.00, electronics at cost also. **TRI-STAR COMMUNICATIONS,** Box 843, Erie, MI 48133 (419) 726-1095

FREE $200 value TVRO P.C. board set, when you join our development group. Complete systems low as $700. Newest low cost designs, antennas, group purchasing, more. Info $1.00, membership $50. 509-534-8088 6-9 PM PST. **COMPUTER SATELLITE SERVICES,** 1604 N. Smith St., Spokane WA 99207

SATELLITE TV. Books, parts, low-noise microwave transistors. Specs and catalog $2.00. **ELITE ELECTRONICS,** RR1, St. George, Ontario, Canada N0E 1N0

GEOSTATIONARY satellite TV antenna aiming angles. Azimuth and elevation (true and magnetic) coordinates calculated by digital computer for your location. 23 satellites. Send name, address, your location's latitude and longitude (deg. min. sec,); or distance and direction from nearby town; or explicit geographical location in your city; plus $6.50 to: HUTSON INDUSTRIES, INC., P.O. Box 155, Scooba, MS 39358

SATELLITE equipment catalog. Over 25 of the best manufacturers and suppliers, LNA's, receivers, antennas and complete systems covered in detail. Four different sections. $12.00. **TMS CO.,** P.O. Box 8369, Roseville, MN 55113

SATELLITE system, only $1925.00 complete, receiver kits available. **WESTCOM,** 715 Washington, Ayden, NC 28513. Dealers wanted.

SATELLITE Receiver kit, Antenna Kit, IF Strips, Mixers, IC'S LNA'S, Hardware. Alignment service. **LANEY SCIENTIFIC INSTRUMENTS,** Box 20131, Jackson, MS 39209

MICROWAVE TV SYSTEM

- Precision 25" Parabolic Antenna
- Prebuilt Converter and Preamp
- Assembled Power Supply
- Low-loss Coaxial Cables
- One Year Warranty
- Completely Built and Tested

DATA SERVICE CO.
3110 Evelyn Street
Roseville, MN 55113
612-636-9469

SATELLITE super-mixer; DBM-4150A. Clean up your TVRO receiver! Near-theoretical performance; flat response, DC-1500IF, SMA connectors; $69.50 — CK/MO/COD. **RIGEL SYSTEMS,** 2974R Scott Blvd., Santa Clara, CA 95050 (408) 727-4231.

SATELLITE TELEVISION FEED HORN (BRASS), Standard CPR229 flange, for parabolic dish f/D.3-.45, Frequency 3.30-4.90GHz. $30.00 Postpaid USA Mastercard-Money order-cashier check. **FRIEDSAM TV HARDWARE,** 112 West Main, Marshallville, GA 31057 (912) 967-2828.

To run your own classified ad, put one word on each of the lines below and send this form along with your check for $1.65 per word (minimum 15 words) to:

Radio-Electronics, 200 Park Avenue South, N.Y., N.Y. 10003

ORDER FORM

PLEASE INDICATE in which category of classified advertising you wish your ad to appear. For special headings, there is a surcharge of $10.

( ) Plans/Kits ( ) Business Opportunities ( ) For Sale
( ) Education/Instruction ( ) Wanted ( ) ______
Special Category: $10

(PLEASE PRINT EACH WORD SEPARATELY, IN BLOCK LETTERS.)

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
31	32	33	34	35

PLEASE INCLUDE FOR OUR FILES YOUR PERMANENT ADDRESS AND PHONE NUMBER.

Satellite TV
FOR THE HOME

Sick of Network TV?

Our receiver lets you get over 75 channels of television directly from earth-orbiting cable TV satellites!: HBO, Showtime, super stations, sports and movies worldwide.

We don't just sell information! We Manufacture Hardware!

From offshore oil rigs, data links to hotels and backyard installations, we wrote the book. Constantly updated, our **94 Page** technical information book and catalog gives you all the facts. Inexpensive dishes, feeds, telemetry software, kits and more. Recommended reading by NASA, The Office of Consumer Affairs and quality companies like Rockwell/Collins. Send $7.95 today!

CALL
24-hrs. C.O.D. Hotline
(305) 339-7600

© *SPACECOAST*
RESEARCH CORPORATION
P.O. Box 442-E, Altamonte Spgs, FL 32701

INTERESTED in Home Satellite Television — Don't buy anything until you've read the **HOME-SAT HANDBOOK & BUYERS GUIDE.** Our book tells everything about home satellite TV and may **save you hundreds, even thousands of dollars** in your selection and installation of a system! $7.50; also: **Homesat Monthly Newsletter,** one year, $5. Order both for only $12. **H &G HOMESAT SERVICES,** Box 422, Seaford, NY 11873

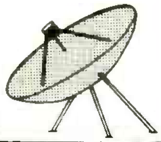
SATELLITE TELEVISION EARTH STATION KIT
LOW COST COMPLETE SYSTEM

Special Offer $2,995.00

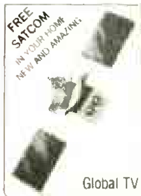
Kit includes all electronic and mechanical parts needed to assemble a complete operating Earth Station. You provide the labor and hand tools.

Included in the kit are a 12-foot fully steerable parabolic dish, low noise amplifier, antenna, rotator, receiver, modulator, necessary cables/connectors and complete assembly/operating instructions. EVERYTHING — down to the last nut, bolt and screw is provided.

Illustrated Brochure with Complete Details — $2.00



MICROTENNA ASSOCIATES
2335 South, 2300 West
Salt Lake City, Utah 84119



SATELLITE TV
FANTASTIC 80 TV CHANNELS

New antenna construction plans plus big 8 × 11 book loaded with aiming info, kits, LNAs and receivers at **wholesale** prices. Far better than cable TV! Enjoy crystal clear reception. Send **$9.95** today. Add $2.00 for 1st class (air mail) or call our 24 hr. COD order line (305) 862-5068 Now

Global TV Electronics, P.O. Box 219-F, Maitland, FL 32751

SATELLITE TV Antenna — We make the best 10 foot fiberglass dish in the Midwest!!! Receive 75 TV channels direct from the satellite. We have openings for dealers. For complete spec's and satellite TV information send $2.25 for postage and handling to **SPACE ANTENNAS,** 127 W. 10, KCMO. 64105.

Satellite Earth Station
complete systems from $2,200.00
Send $4.00 for our complete 50 page color catalog
TEI ELECTRONICS
P.O. Box 181108, Dept. 286A, Memphis, TN. 38118
901-795-4504

BUSINESS OPPORTUNITIES

MECHANICALLY inclined individuals desiring ownership of Small Electronics Manufacturing Business - without investment. Write: **BUSINESS,** 92-R, Brighton 11th, Brooklyn, NY 11235

HIGHLY PROFITABLE **ONE-MAN ELECTRONIC FACTORY**
Investment unnecessary, knowledge not required, sales handled by professionals. Ideal home business. Write today for facts! **Postcard will do, Barta-RE-W, Box 248, Walnut Creek, CA 94597.**

WINNERS! Build on your technical skills to create a successful computer business. Free report tells how. **SEABIRD PRESS,** Box 461T, Lexington, MA 02173

LAWYER Business litigation, patents, appeals. **JEROME FIELD,** B 292, Brooklyn 11230. Phone (212) 434-0781. Eves. 434-1825

EDUCATION & INSTRUCTION

UNIVERSITY degrees by mail! Bachelors, Masters, Ph.D's... Free revealing details. **COUNSELING,** Box 317-RE3, Tustin, CA 92680

ATTENTION ELECTRONIC TECHNICIANS

Highly Effective Home Study BSEE Degree Program for Experienced Electronic Technicians. Our New Advanced Placement Program grants Credit for previous Schooling & Professional Experience. Advance Rapidly! Our 36th Year!
FREE DESCRIPTIVE LITERATURE!
Cook's Institute of Electronics Engineering
DESK 15, P.O. BOX 20345, JACKSON, MS 39209

SUBSCRIPTION television education manual. Complete theory in circuits $9.95. **D & S ENTERPRISES,** PO Box 110901RE, Nashville, TN 37211

FREE KIT Catalog
FUNCTION GENERATOR KIT $59.95
Auto-Ranging Cap-meter kit $79.95
contains TEST & EXPERIMENTER'S EQUIP.
Phone 415-447-3433
Write or Phone for FREE CATALOG. Average 1 minute Saturday call is 21¢.
DAGE SCIENTIFIC INSTRUMENTS BOX 1054R LIVERMORE CA 94550

PLANS & KITS

OSCILLOSCOPE performance from your unmodified television for less than $25. Super simple, accurate, practical. Order Tele-Scope circuit board and plans $8.50. Get two for dual trace $15. **MICROGRID,** Box 613, Ithaca, NY 14850

THEY TALK – YOU LISTEN!

Improve your monitoring receivers with unique accessories. Preamps, descramblers, notch filters, active antennas, preselectors, multi-couplers, frequency lists, beam antennas and more.
FREE CATALOG **FREE**
GROVE ENTERPRISES, INC. Dept. J Brasstown, NC 28902

KIRLIAN photography as a hobby. Complete plans for do-it-yourself machine. Includes easy instructions and ways to improve quality of prints. $5.00. **C.E.L.C. ELECTRONICS,** P.O. Box 805, Missouri City, TX 77459

NEGATIVE ion generators. Send for free information to **THE SEAWARD COMPANY,** P.O. Box 2039, Burbank, CA 91507

MICROWAVE downconverter kit $169.00. Includes everything. Informative catalog on subscription TV products $2.00. **J & W ELECTRONICS,** P.O. Box 61, Cumberland, RI 02864

SATELLITE TVRO parabolic aluminum dish, local materials $500. Plans, formulas $10.00. **WARD MICROWAVE,** Box 100, Conway, NC 27820

DECODE Morse, RTTY, and ASCII signals from airwaves with new **Code*Star.** LED readout or connect with your computer/printer. Keyboard, other items also available. Kits or assembled. **MICROCRAFT,** Box 513R, Thiensville, WI 53092 (414) 241-8144

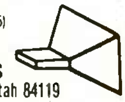
WERSI KEYBOARD KITS
WERSI Organs are demonstrably superior in overall performance, to ALL commercially built instruments, regardless of price. Best of all, you save 1/2 to 2/3 the cost with our easy to build kits. (Also factory assembled).
And now — after 3 years in research, the totally unprecedented "Pianostar" electronic piano (and much more!) has been unveiled to international raves! You have to hear it to believe it!
Explore the exciting world of WERSI,
Free information package.
Call free, 24 hrs.: 1-800-233-3865
(in PA call: 717/299-4327, 9-5)
Ask for "WERSI DATA PAK #M33"
Please specify Piano or Organ

MICROWAVE television "downconverters" under $50.00. High quality, easily assembled. Catalogue: $2.00 (refundable). **NDS,** Box 12652-R, Dallas, TX 75225

PCB. 15c sq-in. Free drilling. Satisfaction guaranteed. **INTERNATIONAL ENTERPRISE,** 6452 Hazel Circle, Simi Valley, CA 93063

MUSICAL car horn 64 tunes. No chips to buy. Kit with case less horn, $31.95. Factory assembled with horn, $41.95. Add $2.50 shipping. **ELECTRONIC SOUND,** P.O. Box 401951, Garland, TX 75040

MICROWAVE HORN ANTENNA KIT
1.7-2.6 GHz Frequency Range 17-19 lb Gain Kit w/Assembly Instructions $39.95*
Down Converter Board $19.95* (w/Antenna Kit $14.95)
Parts Kit for Board $29.95* (w/Antenna or Board $24.95)
Complete Package (Antenna, Board & Parts Kit) $79.95



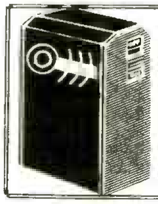
MICROTENNA ASSOCIATES
2335 South 2300 West, Salt Lake City, Utah 84119
Check or M.O. only — Allow 2-4 Weeks Delivery (Cost includes shipping)
*Utah Residents Please Add 5% Sales Tax

PRINTED circuit boards from sketch or artwork. Kit projects. Free details. **DANOCINTHS INC.,** Box 261, Westland, MI 48185

CABLE TV converters and equipment. Plans and parts. Build or buy. For information send $2.00. **C & D ELECTRONICS,** PO Box 21, Jenison, MI 49428

CATALOG of electronic designs. Radio, audio, telephone, self defense & surveillance. **Also 100 MPG carburetors.** Free details. **PETER-SCHMITT ENTERPRISES,** #131, Box 07071, Milwaukee, WI 53207-0071.

ELECTRONIC catalog. Over 4,500 items. Parts & components. Everything needed by the hobbyist or technician. $2.00 postage & handling (United States only), refundable with first $15.00 order. **T & M ELECTRONICS,** 474 East Main Street, Patchogue, NY 11772 (516) 289-2520



MINI FM MIC
Compact size, only 2"x1"x¾". Transmit to FM radio 88-108 MHz. Exceptional audio quality. Transmits stable signal up to 900 ft. Complete kit incl. case, battery & instructions. Only $13.95. Assembled $18.95. Add $1.55 S&H ea. Send 18¢ stamp for brochure.
S.E. Corp., Box 16969-R
Temple Terrace, Fl 33687

ELECTRO-music kits. Touch-sensitive electronic pianos: string synthesizers: programmable drums and orchestral generators: electronic organ rotors. **G&R ADVANCED ELECTRONIC DESIGNS, INC.,** P.O. Box 38, Streetsville, Ontario, L5M 2B7

SUBSCRIPTION TV PLANS: 2300 MHz Microwave Downconverter plus BONUS UHF system, both for $15.00! Best systems available, no internal connections to TV. Parts, PCB's, Kits available, MC/VISA accepted. Other plans: Negative Ion Generator, Telephone Memory Dialer, UHF/VHF Antenna Amplifier, Wireless FM Intercom, $4.00 each. Send SASE for more information. COLLINS ELECTRONICS, Box 5624, San Bernardino, CA 92412

COMPUTER MARKET CENTER

COMPUTER MARKET CENTER ADVERTISING RATES 1" by 1 column (1 5/8") $55.00. 1 1/2" by 1 column (1 5/8") $82.50. 2" by 1 column (1 5/8") $110.00. All ads must be prepaid. Send order and remittances to Computer Market Center, **Radio-Electronics Magazine,** 200 Park Avenue South, New York, New York, 10003. Address telephone inquiries to 212-777-6400. Frequency rates are available.

TEXAS

USED COMPUTER TERMINALS, PRINTERS, MODEMS, SURPLUS ELECTRONIC PARTS. CATALOG $1.00
RONDURE COMPANY
THE COMPUTER ROOM
2522 BUTLER STREET
DALLAS, TEXAS 75235
(214) 630-4621

RETAILERS
An ad for your computer store in this space in Radio-Electronics COMPUTER MARKET CENTER puts you in touch with our computer audience. They use microcomputer equipment for both business and hobby interests. For further details call 212-777-6400.

BUY THIS SPACE
$55.00 puts your ad in this space in front of 197,223 active Radio-Electronics readers. To place your ad write Computer Market Center, Radio-Electronics, 200 Park Avenue South, New York, New York 10003 or call 212-777-6400.

CIRCLE 21 ON FREE INFORMATION CARD

FOR SALE

MICROWAVE receiver system. Write: "Dealers Wanted," Dept. RE, POB 4181, Scottsdale, AZ 85258 (602)941-9345

VARIETY electronic surplus parts and equipment in our monthly picture flyer. Send $2.00 for 6 issues. **STAR-TRONICS,** POB 683. McMinnville, OR 97128

SCANNER/monitor accessories—kits and factory assembled. Free catalog. **CAPRI ELECTRONICS,** Route 1R, Canon, GA 30520

POLICE/fire scanners, scanner crystals, antennas, radar detectors. **HPR,** Box 19224, Denver, CO 80219

TEST equipment, new and used. Catalog $1.00. **PTI,** Box 8756, White Bear Lake, MN 55110. (612) 429-2975

FREE speaker catalog! Woofers, mids, tweeters, hardware, crossovers, grille cloth, plans, kits, information, much more. Discount prices. **UNIVERSAL SOUND,** Dept. RE, 2253 Ringling Blvd., Sarasota, FL 33577, (813) 953-5363

SAVE up to 50% on name brand test equipment. Free catalog and price list. **SALEN ELECTRONICS,** Box 82-F, Skokie, IL 60077

TELEPHONE or office bugged? Latest detection equipment finds out fast. Literature $1.00. **CLIFTON,** Box 220-M, Miami, FL 33168

THE Intelligence Library. Restricted technical secrets—books on **electronic surveillance, lock-picking, demolitions, investigation,** etc. Free brochures: **MENTOR,** Dept. Z, 135-53 No. Blvd., Flushing, NY 11354

PICTURE tube rebuilding equipment—we sell and buy new and used equipment. Free training. **ATOLL TELEVISION,** 6425 Irving Park, Chicago, IL 60634. Phone 312-545-6667

MICROWAVE 2 GHz. Best in the West! Downconverter kits $39.00. Complete with antenna and control box $99.00. Factory assembled — 90-day warranty $159.00. **GALAXY ELECTRONICS,** 6007 N. 61st Ave., Glendale AZ 85301 (602) 247-1151

CHEMICALS, apparatus, project books, wide selection. Catalog $1.00 send to: **PIONEER Ltd. Ind,** 14a Hughey St., Nashua, NH 03060

COLLECTOR items: full set Sam's Photofact, Volume 1 - 20, some TV repair manuals, assorted Rider manuals, all excellent condition. **DOUG VAN DYCK,** 617 N. Holly St., Medford, OR 97501 (503) 779-5612.

ELECTRONIC equipment, Panasonic gear, metal detectors, satellite TV systems. **SCHAFFER ENTERPRISES,** Box 1362, Brookings, OR 97415

2150 megahertz downconverters $99.95 up, assembled. Details for SASE. **GW ELECTRONICS,** POB 688, Greenwood, IN 46142

REVERBERATION for organs and keyboards — Simply connected to any electronic organ, even those with multiple outlet channels. Room size and reverberation time adjustable. Nothing comparable in this price range is offered on the market. Send for free brochure. **DEVTRONIX ORGANS, INC.,** Dept. 60, 6101 Warehouse Way, Sacramento, CA 95826

TOUCH-TONE Decoder chip. Only one chip needed to decode DTMF signals. Includes crystal and spec sheet. $64.50. Send for fre catalog on others. **NELRAD COMMUNICATIONS,** Box 150, Webster, MN 55088.

TUBES. Retired repairman's stock. SASE for details. **KA5DUE,** 506 E. La Paloma Lane, Roswell, NM 88201

TI 58/59 users — have fun with your calculator. Two games available. Treasure Island — protect your gold from pirates. Sticks — whoever takes the last stick loses. $3.00 each. **PREMIER SIFTWARD,** PO Box 12011, Austin, TX 78711

BIPOLAR ±15V @ 50 mA powersupply. 10 mV regulation, 0.1 mV ripple. Kit only $12.95 plus $2.00 shipping. **SOUND CONCEPTS,** Brookline, MA 02146

POWER-AMP sub-assemblies, 100 watts rms. .05% distortion. **completely** assembled and tested. for more information write to, **CLAXTON AUDIO,** 3174 Periwinkle, Memphis TN 38127

SYNTHESIZER module P11. 100 continuous direct binary coded channels at 10 KHz steps. 38 MHz out: with schematic, specs, application notes. ppos to **PRESTON,** 7 Doris Place, East Islip, NY 11730

COMPUTER SOFTWARE

HP-41C software. Electronics, engineering, business applications. Free information. **SOFTWARE SPECIALISTS, INC.,** Dept. RE/1, Box 329, Springboro, OH 45066

CB RADIO

GET more CB channels and range! Frequency Expanders, boosters, speech processors, FM converters, ignition noise blankers, how-to books, plans, modifications. Catalog $2. **CB CITY,** Box 31500RE, Phoenix, AZ 85046

WANTED

WANTED, large quantities of surplus electronic parts/computer boards/motors, etc. Anything for the home constructor considererd. Send full details, samples, prices to: TRADE SURPLUS, 75/77 Hayfield Road, Salford, Manchester, M6 8QA, England. Telephone 061 743 1184, Telex 665383 TRADA G.

COMPUTERS

SAVE 90%. Build your own computer, CRT, and interfaces. Free details. **DIGATEK CORPORATION,** Suite E, 2723 West Butler Drive, Phoenix, AZ 85021

CASSETTES/REEL-TO-REEL TAPES

OPEN reel tape—mostly Ampex, used once, unspliced, unboxed. 1800' 50 reels; $65.00. Sample: $2.00. 3600' 10 reels; $25.00. Sample: $2.50. New, premium C-60 cassettes; sample: $1.00. AUDIO TAPES, Box 9584-G, Alexandria, VA 22304

ATTENTION WRITERS

DO you want to write your own book? We're looking for electronics writers to do just that. Obtain our electronics needs list, or send your own ideas, by writing to Liz Akers, Acquisitions Editor, **TAB BOOKS,** Inc., Blue Ridge Summit, PA 17214 (717-794-2191).

LOW TIM DC STEREO PRE-AMP KIT TA-10 20

Incorporates brand-new D.C. design that gives a frequency response from 0Hz-100KHz ± 0.5dB! Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuation! Specifications: ● T.H.D. less than .005% ● T.I.M. less than .005% ● Frequency response: DC to 100KHz ± 0.5dB ● RIAA deviation: ± 0.2dB ● S/N ratio: better than 70dB ● Sensitivity: Phono 2MV 47K/Aux. 100MV 100K ● Output level: 1.3V ● Max output: 15V ● Tone control: bass ± 10dB @ 50Hz/treble ± 10dB @ 15Hz ● Power supply: ± 24 D.C. @ 0.5A

Kit comes with regulated power supply, all you need is a 48V C.T. transformer @ 0.5A.

ONLY $44.50

X'former

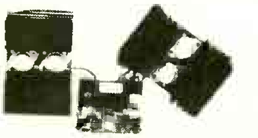
$4.50 ea.

100W CLASS A POWER AMP KIT

Dynamic Bias Class "A" circuit design makes this unit unique in its class. Crystal clear, 100 watts power output will satisfy the most picky fans. A perfect combination with the TA-1020 low T.I.M. stereo pre-amp.

Specifications:

- Output power: 100W RMS into 8-ohm 125W RMS into 4-ohm
- Frequency response: 10Hz-100KHz
- T.H.D.: less than 0.008%
- S/N ratio: better than 80dB
- Input sensitivity: IV max.
- Power supply: ± 40V @ 5 amp
- One channel, needs two for stereo



TA-1000KIT
$51.95
Power transformer
$24.00 each

50 WATTS AUTO STEREO BOOSTER BY VERTRONIX

Specifications:
- 50 watts RMS total (25W + 25W)
- Frequency Response: ± 0.5dB, 20Hz ~ 20KHz
- T.H.D.: 0.2% at full rated output
- Input Impedance: 20K ohms
- Crosstalk: Better than 90dB
- Sensitivity: 1.5V for full rated output
- S/N Ratio: Greater than 95dB
- Speaker Load: 2 ~ 8 ohms
- Voltage Supply: 9 ~ 18V D.C.

Model V-Amp 500

REG. PRICE $119.00 EACH
OUR SPECIAL PRICE $55.00 EACH

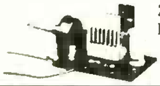
"FISHER" 30 WATT STEREO AMP

MAIN AMP (15W x 2)

Kit includes 2 pcs. Fisher PA 301 Hybrid IC all electronic parts with PC Board. Power supply ± 16V DC (not included). Power band with (KF 1% ± 3dB). Voltage gain 33dB. 20Hz-20KHz.

Super Buy Only $18.50

5W AUDIO AMP KIT

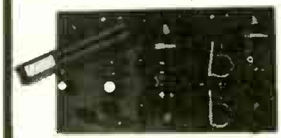


2 LM 380 with Volume Control Power Supply 6 ~ 18V DC

ONLY $6.00 EACH

2 WATT AUDIO AMP

Pre assembled units. All you need is to hook up the speaker and the volume control. Supply voltage from 9 ~ 15V D.C. measures only 2" x 3½", making it good for portable or discrete applications. Comes with hook up data.



BUY 2 FOR $4.99

1 WATT AUDIO AMP

All parts are pre-assembled on a mini PC Board. Supply Voltage 6 ~ 9V D.C.

SPECIAL PRICE $1.95 ea.

NEW MARK III
9 Steps 4 Colors
LED VU

Stereo level indicator kit with arc-shape display panel!!! This Mark III LED level indicator is a new design PC board with an arc-shape 4 colors LED display (change color from red, yellow, green and the peak output indicated by rose). The power range is very large from −30dB to +5dB. The Mark III indicator is applicable to 1 watt - 200 watts amplifier operating voltage is 3V-9V DC at max 400 MA. The circuit uses 10 LEDs per channel. It is very easy to connect to the amplifier. Just hook up with the speaker output!

IN KIT FORM $18.50

MARK IV 15 STEPS LED POWER LEVEL INDICATOR KIT

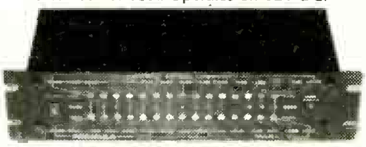
This new stereo level indicator kit consists of 36 4-color LED (15 per channel) to indicate the sound level output of your amplifier from −36dB +3dB. Comes with a well-designed silk screen printed plastic panel and has a selector switch to allow floating or gradual output indicating. Power supply is 6 12V D.C. with THG on board input sensitivity controls. This unit can work with any amplifier from 1W to 200W!

Kit includes 70 pcs. driver transistors, 38 pcs. matched 4-color LED, all other electronic components, PC board and front panel.

MARK IV KIT
$31.50

MARK V 15 STEPS LED POWER OUTPUT INDICATOR KIT

All functions same as Mark IV but this is with heavy duty aluminum front plate and case. Can be easily slot into the front panel of your auto, truck or boat. Operates on 12V DC.



$41.50 EACH KIT

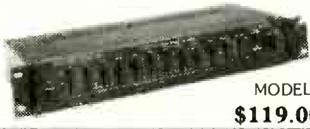
SOLID STATE STEREO GRAPHIC EQUALIZER PRE AMP KIT TA-2500

Specifications:
- Total Harmonic Distortion: Less than 0.05%
- Intermodulation Distortion: (70Hz:7KHz = 4:1 SMPTE Method) Less than 0.03%
- Frequency Response: Overall 10Hz ~ 100KHz +0.5dB, −1dB.
- RIAA Curve Deviation: (Phono) +0.2dB, −0.2dB (30Hz ~ 15KHz)
- Channel separation (at rated output 1KHz)
- Phono, Tuner, Aux and Tape Monitor better than 70dB.
- Input sensitivity and impedance (1KHz for rated output)

Phono: 2MV 47K ohms Aux: 130MV 50K ohms
Tuner: 130MV 50K ohms Tape: 130MV 50K ohms

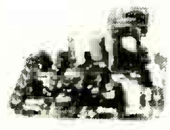
Graphic Equalizer control: 10 Band Slide Control
Frequency Bands: 31.5Hz: G3Hz: 125Hz: 250Hz: 500Hz: 1KHz: 2KHz: 4KHz: 8KHz: 16KHz also with on panel selector for Phono, Tuner, Aux 1 and Aux 2.
Power Supply: 117 VAC

Kit comes with all electronic components, transformer, instructions and a 19" rack mount type metal cabinet.



MODEL TA-2500
$119.00 PER KIT

ELECTRONIC DUAL SPEAKER PROTECTOR



Cutt off when circuit is shorted or over load to protect your amplifier as well as your speakers. A must for OCL circuits.

KIT FORM **$8.75 EA.**

PROFESSIONAL REGULATED VARIABLE D.C. POWER SUPPLY KIT

All solid state circuitry with high efficiency power transistor 2SD388 and I.C. voltage regulator MC1733. Output voltage can be adjusted from 0-30V at 1 amp current limited or 0-15V at 2 amp current limited. Internal resistance is less than 0.005 ohm: ripple and noise less than 1 MV. dual on panel meter for voltage and amp reading, also with on board LED and audible over load indicator. Kit comes with predrilled P.C. board, instructions, all necessary electronic components, transformer and a professional look metal cabinet. The best project for school and the most useful instrument for repairman. Build one today!

MODEL TR 88A 0 ~ 15V D.C. 2 amp
MODEL TR 88B 0 ~ 30V D.C. 1 amp

$59.50 PER KIT

REGULATED DUAL VOLTAGE SUPPLY KIT

± 4 ~ 30V DC 800 MA adjustable, fully regulated by Fairchild 78MG and 79MG voltage regulator I.C. Kit includes all electronic parts, filter capacitors, I.C., heat sinks and P.C. board.

$12.50 PER KIT

POWER SUPPLY KIT

0-30V D.C. REGULATED

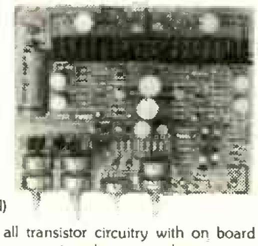
Uses UA723 and ZN3055 Power TR output can be adjusted from 0-30V, 2 AMP. Complete with PC board and all electronic parts. Tranformer for Power Supply. 2 AMP 24V x 2 **$9.50**

0-30 Power Supply
$10.50 each

TA-323 6 WATTS TOTAL 30W + 30W STEREO AMP KIT

★ SPECIAL ★

EXCELLENT PRICE!



MODEL 001-0034
Transformer (Optional)

This is a solid state all transistor circuitry with on board stereo pre-amp for most microphone or phone input. Power output employs 2 pairs matching Darlington Transistors. Driven by the popular 2N3053 Driver Transistors. Four built on board controls for; volume, balance, treble and bass. Power supplies requires 48 VET 2.5 amp transformer. T.H.D. of less than 0.1% between 100 Hz and 10KHz at full power. (30 Watts + 30 Watts loaded by 8~).

$29.50 PER KIT
$10.50 EACH

POCKET STEREO CASSETTE PLAYER WITH STEREO HEAD PHONE

This unit is a high fidelity stereo player which will give you years of listening pleasure and follow you wherever you go. Made by the same company in Japan who use the "Big Name."

Complete set comes with 1 Stereo headphone, 3 AA size alkaline batteries, 1 leather like carrying case for player and 1 carrying case for storage of 4 cassette tapes and 1 demo tape.

MODEL SWM-33
OUR DIRECT IMPORT PRICE **$67.50**

FORMULA INTERNATIONAL INC. 3/82

	SHIPPING AND HANDLING CHARGES Under $50.00 purchase	Over $50.00 purchase
Inside California	10%	5%
Outside Calif. (includes Mexico & Canada)	15%	10%
Overseas	25%	20%

Send $1.00 For Detailed Catalogue

Minimum Order $10.00/Calif. Residents Add 6% Sales Tax
Phone Orders Accepted on Visa or MC ONLY. NO C.O.D./Store Hours 10-7 Mon thu Sat

VISA

12603 CRENSHAW BLVD., HAWTHORNE, CA 90250
PHONE: (213) 973-1921 ● (213) 679-5162

CIRCLE 2 ON FREE INFORMATION CARD

FOR COMMERCIAL FREE TV BOX BUILDERS

MC 1358	$2.50	LM 7815	$1.20
MC 1350	$2.00	NE 565	$2.00
MC 1330	$3.00	Connectors Set	$1.00
LM 1458	$1.00	I.C. Socket Set	$2.00
LM 380	$2.00	Matching Transformer	$1.40
Sanyo UHF Tuner	$35.00	Toriod Coils (Set of 4)	$3.00
Capacitors Set	$12.50	Speaker Cabinet	$12.95
Resistors Set	$2.00	Transformer 18V 800MA	$3.00
Trim Pots. Trim Caps Set	$13.50		
Pots and Knobs	$2.00		

We sell you all the above components in a package for **$125.00** and you will receive a free predrilled P.C. board and instructions at no charge!

SANYO UHF VARACTOR TUNER

For UHF CH 14 83

Tuning voltage +1V~ +28V D.C. Input impedance 75 OHM. I.F. band width 7~16 MHz. Noise figure 11.5dB MAX. Size 2⅝" x 1¼" x ¾". Supply voltage 15V D.C. Sound I.F. = 58.0 MHz. Video I.F. = 62.5 MHz.

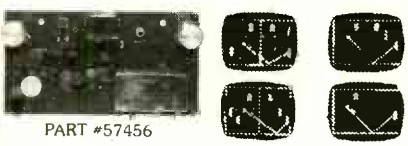
All units are brand new from Sanyo.
MODEL 115-B-405A
$35.00 EACH

Tuner is the most important part for the circuit. Don't let those $19.00 tuners fool you!

TV GAME BOARD

PLAYS 4 GAMES: TENNIS; HOCKEY; HANDBALL AND JAI-ALAI.

All boards complete with all parts ready to play. Requires 6C size batteries and a small speaker for sound effects. The boards were surplus from a famous game manufacturer. They will play on all US standard black and white or color TV sets. (Regular price for these games were $39.50 each) **OUR PRICE ONLY $6.50 EACH**



PART #57456

ELECTRONIC PIN BALL MACHINE

That sounds and plays like the real thing. All units are brand new but without the case. Functions of the game include double flipper control, kicker control, 1-4 players, 3 speed ball control, tilt switch, automatic score, extra bonus cave and many more. All solid state with LED panel, no moving parts. Requires 9V battery to operate, speaker not included.

A perfect gift for yourself or friends.

SPECIAL **$8.99** EACH SPEAKER **$1.25** EACH

ELECTRONIC MUSICAL TELEPHONE REST KIT

This telephone rest can be used as a door charm, an audible indicator and for many other sound projects. The special custom made I.C. is pre programmed with 4 musical tunes. Kit comes with a nice looking plastic case, pre-drilled P.C. board, volume control, special sound I.C. speakers and all electronic components and instructions: Ideal for home or school projects.

MODEL FIH-3000

BUY NOW!

SPECIAL PRICE! ONLY

$15.50 PER KIT

DIGITAL TIMER/CLOCK

- 24 Hour preset timer to turn on or off
- 12 Hour green 0.5" display for time
- operated on 12~16V A.C.

The whole timer is self contained in a compact plastic case (as seen in photo). Designed for VTR with push button switch for easy setting. Limited quantity available.

NOW ONLY $12.94 MODEL VEQ 0143

SANYO ANTENNA SIGNAL BOOSTER

This Booster is specially designed for UHF Channels (14-83). After installed this unit (between the antenna input cable and the UHF tuner) will have a minimum of 10dB gain, that is approximately 2 times better than what you are seeing now. Ideal for those who live in apartments that cannot put up an outdoor antenna. Size is so small; only 2" x 1½" x 1". Supply voltage is 15 VDC.

★ **NEW ITEM** ★

MODEL 001-0076

$12.50 EACH

13 FUNCTIONS LCD TIME MODULE

- Displays month, date and day of the week
- Displays hour, minute and second
- AM, PM Indicator
- Alarm 1 and Alarm 2 (Independent)
- 10 Hours Stop Watch
- 12 Hours presettable count down time
- Hour Charm Indicator
- Back light by touch of the switch

MODEL 001-0062
$7.94 EACH

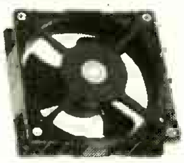
These modules are brand new and made by LITRONIX. Designed for a man's watch. Can be used for many applications. Comes with 2 silver batteries and the ceramic round transducer.

MATCHED PAIR POWER TRANSISTORS BY MOTOROLA

MJ2955 2N3055	PNP NPN	150 Watts	BV=60 V, I.C.=15 A	$3.50 per pair
MJE2955 MJE3055	PNP NPN	90 Watts	BV=60 V, I.C.=10 A	$3.00 per pair
MJ15003 MJ15004	NPN PNP	250 Watts	BV=140 V, I.C.=20 A	$12.00 per pair

All above parts guaranteed to be prime and come with data sheets.

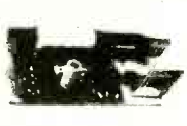
MUFFIN FANS FOR EQUIPMENT COOLING



These fans are pulled out from used computers. But carefully cleaned by ultrasonic cleaner. All in "like-new" condition. Size 4 11/16" x 1-1/2" x 4 11/16".
MODEL MF505
$9.50 EACH

FLUORESCENT LIGHT DRIVER KIT

12V DC POWERED



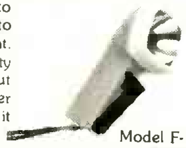
Lights up 8~15 Watt Fluorescent Light Tubes. Ideal for camper, outdoor, auto or boat. Kit includes high voltage coil, power transistor, heat sink, all other electronic parts and PC Board, light tube not included!

$6.50 Per Kit

PRESS-A-LIGHT SELF GENERATED FLASHLIGHT

EXCLUSIVE! **$3.95 ea.**

Never worry about battery, because it has none! Easy to carry in pocket and handy to use. Ideal for emergency light. It generates its own electricity by squeezing grip lever. Put one in your car, boat, camper or home. You may need it some time!



Model F-179

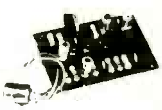
CRYSTAL CONTROLLED WIRELESS MICROPHONE SYSTEM

No FCC license required.
OUR PRICE $49.50
ADDITIONAL MICROPHONE (TRANSMITTER) AVAILABLE AT **$28.00** EACH

MURA WMS-49

Transmitter: FET mic for flat 30 ~18 KHz response extra controlled 49MHz AM Band for drift-free performance. 100 MW output (range approx. ¼ mile) for reliable long range transmission. Powered by a 9V radio battery (included).
Receiver: Extra controlled locks on 49MHz transmitter signal. With on panel VU meter monitors the signal strength from the microphone. Standard phone jack outlet connection to a P.A. or other phone input. 9V battery included. This professional set is ideal for on stage, in field, church, in house or outdoor use.

SUPER FM WIRELESS MIC KIT—MARK III



This new designed circuit uses high FEQ. FET transistors with 2 stages pre amp. Transmits FM Range (88-120 MHz) up to 2 blocks away and with the ultra sensitive condensor microphone that comes with the kit, allows you to pick up any sound within 15 ft. away! Kit includes all electronic parts, OSC coils, and P.C. Board. Power supply 9V D.C.

FMC-105 **$11.50 PER KIT**

WEM-36 FM WIRELESS MICROPHONE

TEET MODEL WEM-36 is a factory assembled FM wireless microphone powered by two AA size batteries. Transmits in the range of 88-108 MHz with 3 transistor circuits to meet with F.C.C. part 15 regulations. Element is built in a plastic tube type case with an omni-directional electret condenser microphone unit. By using a standard FM radio, signal can be heard anywhere on a one-acre lot. Sound quality was judged "very good."

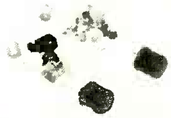
MODEL WEM-36 **$16.50 EACH**

WHISTLE ACTIVATED SWITCH BOARD

All boards are pre-assembled and tested. Your whistle to its FET condenser microphone from a distance, as far as 30 feet away (sensitivity can be easily adjusted) will turn the switch on, then match your whistle to it again, then it turns off. Ideal for remote control toys, electrical appliance such as lights, coffee pots, TV, Hi-Fi, radio or other projects. Unit works on 9V D.C.

MODEL 968
$4.50 EACH

ULTRASONIC SWITCH KIT

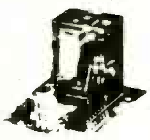


Kit includes the Ultra Sonic Transducers, 2 PC Boards for transmitter and receiver. All electronic parts and instructions. Easy to build and a lot of uses such as remote control for TV, garage door, alarm system or counter. Unit operates by 9-12 DC. **$15.50**

ELECTRONIC SWITCH KIT

CONDENSER TYPE
Touch On Touch Off
uses 7473 I.C. and 12V relay

$5.50 each



FORMULA INTERNATIONAL INC.

3/82

	SHIPPING AND HANDLING CHARGES Under $50.00 purchase	Over $50.00 purchase
Inside California	10%	5%
Outside Calif. (includes Mexico & Canada)	15%	10%
Overseas	25%	20%

Minimum Order $10.00/Calif. Residents Add 6% Sales Tax
Phone Orders Accepted on Visa or MC ONLY, NO C.O.D./Store Hours 10-7 Mon. thu Sat

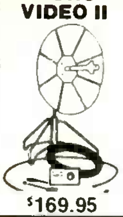
Send $1.00 For Detailed Catalogue

VISA

12603 CRENSHAW BLVD., HAWTHORNE, CA 90250
PHONE: (213) 973-1921 • (213) 679-5162

CIRCLE 2 ON FREE INFORMATION CARD

MICRO-VIDEO II



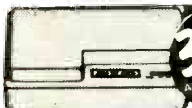
$169.95

Cable T.V. Decoders
In Stock
Complete Satellite Systems

- Micro-Wave T.V. System
- Precision Parabolic Antenna
- Advanced Down Converter
- Power Supply
- Low-Loss Coaxial Cables
- Complete - Ready To Install

Call Toll-Free 1 - 800 - 626-5533

SOUND & VIDEO RESEARCH
P.O. Box 19462
Louisville, KY 40219



39.95 ADD $2.50 FOR POSTAGE

30 CHANNEL CABLE TV CONVERTER

ORDER No. 171AE047

ETCO ROUTE 9N, PLATTSBURGH, N.Y. 12901
Tel.: (518) 561-8700.

FREE! UNUSUAL 96 PAGE ELECTRONIC PARTS & IDEAS CATALOG!

USO

"In Harmony"

You know harmony means more than just entertainment at the USO. It's volunteers working together to create a "back home" environment for servicemen and women stationed far from home. It's informal classes...inter-cultural understanding...and orientation information. USO...it's sweet music.

Dixie Humming Birds

Support USO through the United Way, OCFC, or local USO campaign

AMAZING DEVICES

PHASORS/SHOCKWAVE

PPF-1. *PHASOR PAIN FIELD* — Is being tested by Gov't for riot control. Soon to come under weapons restrictions as an internal machine. Easily hand-held. Hazardous — Use with discretion. SOLD ONLY FOR ANIMAL CONTROL.
PPF-1 .... PLANS **$15.00**

IPG-3. *INVISIBLE PAIN FIELD GENERATOR* — Produces directional field of moderately intense pain to lower back of head up to 50 ft. Cigarette pack sized enclosure is easily hidden.
IPG-3 ..... PLANS ..... **$7.00** **IPG-3K** ..... KIT **$39.50**
IPG-30 .... ASSEMBLED FOR ANIMAL CONTROL **$49.50**

HUG-1. *HIGH POWERED ULTRASONIC GUN* — Produces directional 130 dbs of sound pressure energy at 20-24 kHz. Hand-held, intended for lab use.
HUG-1 .... PLANS **$10.00**

LASERS

PARTICLE BEAM WEAPON .... PLANS **$15.00**

LHP-2. *BEGINNER VISIBLE RED NON-HAZARDOUS OPTICAL DEVICE*. Adjustable pulse.
LHP-2 ..... PLANS ..... **$7.00** **LHP-2K** ..... KIT **$39.50**

LP-3/LRG-3. *LASER PISTOL AND RIFLE COMBINATION* — 7-24 watts of infrared energy.
LP-3/LRG-3 .... PLANS **$10.00**

LGU-1. *VISIBLE RED LASER GUN* for holography, special effects, cloud writing, etc.
LGU-1 .... PLANS **$10.00**

LC-1. *BURNING/CUTTING CO2 LASER* — 10-40 watts continuous.
LC-1 .... PLANS **$15.00**

RUB-1. *WELDING/DRILLING RUBY/YAG LASER*, intense red.
RUB-1 .... PLANS **$15.00**

HPS-1. *HIGH POWERED PORTABLE ENERGY SOURCE FOR LASERS & MAGNETIC WEAPONS* exploding wires, shock waves, etc.
HPS-1 ..... PLANS ..... **$8.00** **HPS-1K** ..... KIT **$49.50**

SECURITY/PERSONAL PROTECTION

INF-1. *INFINITY TRANSMITTER* — Uses telephone lines for selective home or office listening while away on business or vacation
INF-1 .... PLANS **$15.00**

SD-4. *SEE IN THE DARK* — Device, long range. **SD-4** ..... PLANS **$10.00**

VWPM-5. *WIRELESS TELEPHONE TRANSMITTER* — Long range.
VWPM-5 ..... PLANS ..... **$10.00** **VWPM-5K** ..... KIT **$34.50**

FBT-7. *WIRELESS MICROPHONE* — Extended range.
FBT-7 ..... PLANS ..... **$7.00** **FBT-7K** ..... KIT **$34.50**

HOD-1/TT-6. *ELECTRONIC TRACKING AND HOMING DEVICE* —
HOD-1/TT-6 ..... PLANS ..... **$6.00** **HOD-1K/TT-6K** ..... KIT **$39.50**

TAT-2. *TALK AND TELL* — Device records telephone when in use.
TAT-2 ..... PLANS ..... **$5.00** **TAT-2K** ..... KIT **$14.50**

PSW-3. *PHASOR STUN WAND* — Produces energy capable of burning flesh. Intended as a last resort personnel defense weapon.
PSW-3 ..... PLANS ..... **$8.00** **PSW-3K** ..... KIT **$59.50**

Send for free catalog descriptions of above items, kits and parts, plus hundreds more. We accept. Master Charge and VISA or when ordering send check or money order to:

SCIENTIFIC SYSTEMS
DEPT. R8 BOX 716, AMHERST N.H. 03031

CIRCLE 36 ON FREE INFORMATION CARD

Westland Electronics
I N C O R P O R A T E D

Memory

4116-250nS	8/14.95
4116-200nS	8/17.95
4164-200nS	17.95 ea. 8/128.00
2114L	8/17.95
6116 2K x 8 CMOS RAM 200nS	13.95
2708 EPROM	3.49
2716 EPROM	5.49
2732 EPROM	12.99
2764 EPROM	34.95
Z6132 4K x 8 Quasi-Static RAM	24.95

Microprocessor & Interface

1771	24.50	6845	18.49	DAC-0800	3.99
1791	34.95	6850	4.49	INS8250	14.90
21L02	1.49	8085A	8.95	MM58167	8.75
2112	2.39	8212	2.75	TMS9900	29.95
2516	5.49	8214	3.95	TR1602B	2.49
2532	12.99	8216	2.75	SC-01	55.00
2651	12.95	8224	3.29	Z80A-CPU	7.95
4044L-2	2.49	8226	2.79	Z80ACTC	7.49
6502	8.99	8228	4.49	Z80ADart	19.95
6800	6.99	8251	6.95	Z80APIO	7.49
6802	11.95	8255	6.49	Z80ASIO	17.95
6809	19.95	AY5-1013A	4.95	Z8603	74.95
6821	4.95	AY5-2376	14.95	Z8671	29.95

1 Amp TO-220 Voltage Regulators

PART #	1-24	25-99	100-499
7805 (LM340T-5)	.85	.75	.65
7812 (LM340T-12)	.85	.75	.65
7815 (LM340T-15)	.85	.75	.65
7818 (LM340T-18)	.85	.75	.65

Linear Integrated Circuits

8038	3.95	LM393	.97	MC3302	.90
LF351	.75	LM733	.99	MC1458	.59
LF353	1.29	LM741-8	.35	MC1514	1.39
LF357	1.39	LM741-14	.35	NE555	.45
LM301	.45	LM747	.77	NE556	.98
LM307	.49	LM748	.49	NE565	1.25
LM311	.95	LM1310	2.49	NE5534	2.35
LM318	1.75	LM1458	.69	NE5538	2.25
LM324	.90	LM1800	2.49	SSM2010	7.50
LM339	.79	LM1818	3.49	SSM2020	7.50
LM358	.90	LM1889	2.99	SSM2030	7.50
LM377	2.49	LM2900	.69	SSM2040	7.50
LM380N-14	1.25	LM3900	.89	SSM2044	5.75
LM381	1.89	LM3905	1.49	SSM2055	6.50
LM383	3.29	LM3914	3.79	XR2206	5.19
LM384	1.95	LM3915	3.79	XR4136	.99
LM386	.99	LM3916	3.79	XR4741	1.95
LM387	1.49	LM4500	3.29	XR558	1.99

5% Carbon Film Resistors

We stock all 5% standard values between 1 Ohm and 1 Meg Ohm.

¼ Watt

Package of 5	.20
Package of 100 (one value)	1.65
Package of 1000 (one value)	12.00

½ Watt

Package of 5	.25
Package of 100 (one value)	1.75
Package of 1000 (one value)	15.00

Sampler box consisting of 5 each of all 145 standard 5% values between 1 Ohm and 1 Meg Ohm.

¼ Watt Sampler Box	22.00
½ Watt Sampler Box	27.00

Minimum Order $10.00

Shipping

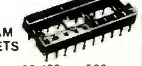
10-24.99	3.00	Above 50.00	FREE
25-49.99	1.50	C.O.D.	Add 1.65

WESTLAND ELECTRONICS
37387 Ford Rd. • Westland, Mi 48185
Order Line – 1-800-521-0664
In Michigan – 313-728-0650

CIRCLE 26 ON FREE INFORMATION CARD

TRI-TEK

LO PROFILE DUAL BEAM FACE WIPE (TIN) SOCKETS



		1-24	25-99	100-499	500 up
6 PIN	LP	.08	.075	.070	.060
8 PIN	LP	.09	.085	.079	.065
14 PIN	LP	.15	.135	.120	.112
16 PIN	LP	.17	.150	.135	.128
18 PIN	LP	.19	.170	.150	.144
20 PIN	LP	.22	.195	.170	.160
22 PIN	LP	.25	.230	.210	.178
24 PIN	LP	.26	.240	.220	.195
28 PIN	LP	.31	.290	.270	.228
40 PIN	LP	.44	.415	.370	.325

3 LEVEL WIRE WRAP DIP SOCKETS (TIN)

		1-24	25-99	100-499	500 up
8 PIN	WWT	.33	.31	.290	.270
14 PIN	WWT	.38	.36	.330	.320
16 PIN	WWT	.42	.39	.370	.360
18 PIN	WWT	.58	.55	.515	.471
20 PIN	WWT	.63	.64	.704	.620
24 PIN	WWT	.81	.77	.726	.662
28 PIN	WWT	.93	.87	.882	.798
40 PIN	WWT	1.27	1.20	1.136	1.092

D Subminiature Connectors — Compare These Prices!!

PLUGS	1-9	10-24	25-99	SOCKETS	1-9	10-24	25-99
(DE) 9P	$1.95	$1.75	$1.60	(DE) 9S	$3.10	$2.75	$2.50
(DA)15P	2.35	2.10	1.90	(DA)15S	4.20	3.75	3.45
(DB)25P	2.60	2.35	2.15	(DB)25S	3.35	3.05	2.85
(DC)37P	4.55	4.15	3.80	(DC)37s	8.85	8.00	7.35
(DD)50P	5.65	5.15	4.65	(DD)50S	11.65	10.60	9.65

DB 51226 Cover For DB 25P and S (RS 232 Type) $1.39

CYBERTONE like a super loud SONALERT this "warbling" alarm works from 9-12VDC and has variable rate and pitch. Ideal for smoke or burglar alarms or far-out games. Only 1¾" diameter, 6" long leads. Model CT-1100. $7.95

25Amp STUD DIODES 200V .... 59¢ 600V .... 79¢
200 ohm Carbon mike element 1¾" diameter .... 98¢
Miniature 600Ω—600Ω modem transformer $1.49
6 foot 3wire Grey line cord. Rt angle plug $1.69

JOHNSON ¼" BUSHING Air Variable Capacitors .... 49¢
#189-567 2-19.3pf, #189-563 1.4-9.2pf, #100-107-1 2.3-14.2pf

Calender/Clock Chip and Vacuum-Fluorescent Display.
Mostek MK50362-N, 20 pin clock/calender I.C. with a FUTABA 5-LT-02-8G V.F. display and spec sheets, ½" high characters, AM/PM indicators, colon. Blue-green color ideal for daylight operation. $5.98/set

6 digit L.E.D. display .... 65" common cathode $3.98
FND 503 ..... 85¢ FND507 ..... $1.49 MAN6710 (DUAL) $1.98
Switch Craft 142A miniature 'TINI-D' phone jack .... 49¢
Line master chrome foot switch SPDT 6' cord #GEM 36 .... $4.98
Line master black foot switch SPDT 7 Amp #NO-T-51-S $2.98
Cherry E-53 Super Sensitive snap switch SPDT .... 2/$1.00
C&K DPDT ¼" toggle switch w/flat designer handle #U 21 ..... 98¢

MOOSE™ National Semi LM 396 Regulator adjustable from 1.25-15V at 10 Amp. w/specs $19.95

Super Cap. 1 FARAD at 5V. Use as memory supply back-up. Only 1¾" dia. x ¾" tall w/P.C. leads $10.50

R/C transmitter/receiver chip set. National LM1871/72 has RF & Encode/Decode up to 6 channels of digital or analog link. With specs $15.95/set

100V	25 Amp Bridge Rectifier (Rem. from Eq.) $1.79
400V	4 Amp TRIAC w/Heat Sink RCA 405036 .... 69¢
400V	35 Amp Q mode TRIAC. (isolated) $1.99
80V	5A Darlington TIP121 in T0-220 package .... 99¢
200V	4A T0-202 TRIAC Q 2004F3 .... 59¢

NYLON CABLE TIES
4" $1.35/C, $11.00/K 5" $1.95/C, $15.75/K 7" $2.50/C, 21/K

TRI-TEK

7808 N. 27th Avenue
Phoenix, Arizona 85021

ORDER TOLL FREE: 1-800-528-0183
(Order desk only)

TERMS: $10.00 minimum order.
Visa, MC, BAC, Check, M.O. or UPS C.O.D.
U.S. Funds only. AZ residents add 5% sales tax.
Prepaid orders over $50 shipping prepaid.

OTHERS: Add $3.00 shipping & handling.
Add $1.50 for C.O.D. orders.
Outside U.S., add 20%.

CIRCLE 23 ON FREE INFORMATION CARD

CIRCLE 5 ON FREE INFORMATION CARD

ETCO

CABLE TV CONVERTERS AND OTHER GOOD STUFF!

SMASHING ALL SALES RECORDS – OUR NEW 30 CHANNEL CABLE TV CONVERTER!
Converts mid & super band cable channels for viewing on your TV set! No. 349AE047
39.95 $34.95 ea./5

HOT NEW IMPORT! REMOTE CONTROL 30 CHANNEL CABLE TV CONVERTER!
89.95 $79.95 ea./5 $74.95 ea./10
Includes remote TV on/off switch and fine tuning control! No. 349VA275

ETCO MKII WIRELESS – THE ULTIMATE CABLE TV CONVERTER!
Set TV to channel 3, and the hand held remote control does it all! No. 349ZA008
189.00

VIDCOR 2000 CONVERTER ELIMINATES PROBLEMS WHEN VIDEOTAPING FROM CABLE TV
89.95
Restores your VCR's capability for programming. Restores remote channel control. Enables videotaping of one cable program while watching another. No. 349VA950

UNUSUAL FACTORY SURPLUS MID-BAND – SUPER-BAND CABLE TV TUNER
Converts cable channels to a common IF frequency. Experimenters – build cable converters, decoders, etc. With schematic. No. 349VA342
19.95 $17.50 ea./10
349VA389 - Detailed schematic & spec sheet - $1.50

FACTORY SURPLUS UHF TUNERS
4.95 $3.95 ea./10
Brand new production surplus. All solid state. Ideal for experimental work building, cable TV converters, etc. No. 349SU099

MINIATURE FM WIRELESS MICROPHONE
Hides in the palm of your hand. Reception on any standard FM radio or receiver. No. 349VA482
29.95 $27.50 ea./5 $24.95 ea./10

QUARTER-MILE WIRELESS MICROPHONE & RECEIVER SYSTEM
69.95 $49.95 ea./5
FCC approved crystal controlled wireless mike & receiver. All battery operated. Electret wide-range response. VU meter. No. 349VA093

FACTORY SURPLUS VHF / UHF "TWIN" VARACTOR TUNERS!
Admiral No. NC 3143-1. BRAND NEW! Ideal for building or repairing electronically tuned TV "FRONT ENDS". A hard to find item at a sensational price! No. 349VC308
39.95 $34.95 ea./5

DUMPING! NORELCO ENDLESS LOOP CASSETTES!
4.95 $4.49 ea./10
Impossible to find at any price!
3 minutes – No. 349VA605
6 minutes – No. 349VA606

IN STOCK – THE MURA CORDLESS TELEPHONE SYSTEM!
Answer & originate calls with this wireless pocketphone. 400 ft. range! Rechargeable! Last number recall! Paging feature! Use with rotary, touch systems! No. 349VA274
144.88 $129.95 ea./5

SALE OF QUARTZ BATTERY-OPERATED CLOCK MOVEMENTS!
9.95 $8.95 ea./5
Accuracy of 1 min. / year up to 4 years operation on 1 alkaline "C" cell. Imported from West Germany. No. 349VA561
349VA565 Matching hands - $2.49/set. $1.95/set / 5

20 AMP REGULATED 12VDC POWER SUPPLY!
13.8 vdc no load, 12.5 vdc full load. Easily handles ham station, marine radio, SSB linears up to 400w P.E.P. Brand new, factory sealed. 110 VAC No. 349VA394
69.88 $59.88 ea./5
349VA395 - as above, 10 amps - $54.95 $49.95 ea./5.

FREE OUR LATEST 98 PAGE FASCINATING CATALOG – jam-packed with unique items, electronic bargains and unusual offers. Write or circle the information card number below.

ETCO ELECTRONICS
NORTH COUNTRY SHOPPING CENTER
PLATTSBURGH, N.Y. 12901

Check with order, please. Visa & Mastercard OK. (Sorry, no C.O.D.'s Add 15% for UPS & Handling (Excess refunded). N.Y. State residents add 7% sales tax. Dealer & Export inquiries invited. Our telephone order desk never closes. Call 1-518-561-8700.

CIRCLE 24 ON FREE INFORMATION CARD

KNAPP ELECTRONIC PARTS

Modutec Meter 2¼ x 3" 0-30 AMP 0-5 VDC 100 ua. @ 600 OHM I.R. $3.95

Capacitor 5200 mf. 25v. 49¢ 10/$4.50

Voltage Regulator Fantastic Buy! 14.2v. TO-3 3 AMP $1.09

Transformer Dual bobbin 30V. +14V. 1.5 AMP 3" Mount Centers 2" high $3.00

Tri-Color LEDS Red/Green reverse volt. Yellow A.C. 2/$1.50

Voltage Regulators +5V. 7805, -5v. 79M05, +6V. 7806, +12V. 7812 5/$5.50 10/$9.95

Infrared Emitter and Photo Diode Detector XC880-A TIL413 short leads 1 pr. $2.00

Chassis (H.D.) 4 X 8 x 2 1/4 H. Fantastic! 79¢

Jumbo LEDS Red, Green or Yellow 100/$8.00 per color

Mura Cordless Telephone As is Complete with schematics $43.50

Deluxe Cowl Cabinet *Blue Top Grey Lower $2.49 3" X 4" X 2 1/8" H.

Coto Mini Relay 6V. SPST CR 4003-6 79¢

24v. DC Relay 3PDT 10 AMP Gold contacts Like P+B KUP Series $2.49

Voltage Regulator Boards Just hook up to transformer 12V. or 9V.1.5A $1.29

Solid State Buzzer 12V. 98¢

Power One Power Supply ±.5% Regulated 5V. @ 6 AMPS $23.50

Popular Prime Transistors ECG 123 AP or ECG159 6/$1.00 100/$10.00

Special RG59U Cable Foam + 80% Shield $5.00/100 FT.

Power Tec ±.5% Regulated 5V. @ 12 AMPS $33.50

Mini Switches Micro Switch SPDT w/long blue paddle 79¢

Dip Tantalum Caps dipped and solid 100 @ 3V. 6.8, 10, 15, 22, 33, 47, @ 6.3V. 22, 68 @ 10V. 1.5, 3.3, 4.7, 6.8 @ 16V. 15 @ 20V. .47, .68, 1.5, 2.2, 3.3, 4.7, 6.8 @ 35V. .22, .68, 1 @ 50V. 25¢

Audio Amplifier 8 watt 4" x 3" x 2"H $5.95

TRANSFORMER 36V. 200 MA. 99¢

Compu-Lite red push (illuminated) mom #849-1191 69¢

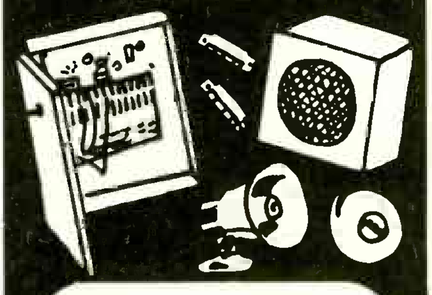
SEND FOR FREE 1982 CATALOG or call us at (813) 392-0406

add 10% for shipping and handling — min charge $2.50

H.J. Knapp of Florida, Inc.
4750 96th St. N. St. Petersburg, Florida 33708

CIRCLE 25 ON FREE INFORMATION CARD

FREE CATALOG OF Burglar/Fire Alarms



Controls • Power Sources • Remote Stations • Holdup Alarms • Wireless Components • Magnetic Contacts • Ultrasonic • Microwave • Infrared • Sirens • Bells • Glass Protection • Shock Sensors • Phone Dialers • CCTV • Locks • Safes

mountain west
4215 N. 16th St. Dept. RE-3
Phoenix, Arizona 86016
1-800-528-6169

CIRCLE 30 ON FREE INFORMATION CARD

PAT. # 4,259,705

WARNING! Electric Power Pollution, Spikes, Interference & Lightning HAZARDOUS to HIGH TECH EQUIPMENT!!

MicroComputers, VTR, Hi-Fi, Lasers, Spectrometers are often damaged or disrupted due to Power Pollution.

High Tech components may interact!

Our patented ISOLATORS eliminate equipment interaction, curb damaging Power Line Spikes, Tame Lightning bursts & clean up interference.

Isolated 3-prong sockets; integral Spike/Lightning Suppressor. 125 V, 15 A, 1875 W Total, 1 KW per socket.

ISO-1 ISOLATOR. 3 Isolated Sockets; Quality Spike Suppression; Basic Protection $69.95

ISO-3 SUPER-ISOLATOR. 3 DUAL Isolated Sockets; Suppressor; Commercial Protection $104.95

ISO-17 MAGNUM ISOLATOR. 4 QUAD Isolated Skts; Suppressor; Laboratory Grade Protection $181.95

Master-Charge, Visa, American Express
TOLL FREE ORDER DESK 1-800-225-4876
(except AK, HI, MA, PR & Canada)
SATISFACTION GUARANTEED!

Electronic Specialists, Inc.
171 South Main Street, Natick, MA 01760
Technical & Non-800: 1-617-655-1532

CIRCLE 31 ON FREE INFORMATION CARD

ADVANCED COMPUTER PRODUCTS

FIRST TO OFFER PRIME PRODUCTS TO THE HOBBYIST AT FAIR PRICES!

1. Proven Quality Factory tested products only.

2. Guaranteed Satisfaction

Call For Special School Discounts

SALE 4164 $19.95

V-1000 Vista "V-DRIVE"

Qume DATATRAK 8

THE LAST WORD IN 8" FLOPPY-DISK ENCLOSURES

THE VISTA V-1000 FLOPPY DISK DRIVE SUBSYSTEM ● Deluxe chassis with internal side easy access for drive positioning and mounting ● Built to mechanically and electrically accommodate single sided drives—including the most popular 8-inch Winchester and Shugart floppy disk drives, and 8-inch streaming tape units ● Storage capacity from 0.5 to 40 megabytes ● Industrial quality cabinet with die cast front bezel ● Meets all UL and OSHA standards ● Additional Savings! Front and rear retma rail mounts provided at no extra charge (no external slides) ● Desk or rack mountable ● Features modular construction with removeable sub assembly that allows easy cabinet positioning and mounting ● Drives pull out for easy service and maintenance.

DISCOUNT PRICES

CABINET	$ 395
CABINET with (2) single sided drives (including power supply & cable)	$1495
CABINET with (2) double sided drives (including power supply & cable)	$1995

Vista V-80 5¼" DISK

FOR TRS 80® MODEL I, PMC 80, ZENITH H89, S-100, etc.

ONLY 310⁰⁰ ea.

MODEL V-801, 80 TRACKS, SS ONLY 425⁰⁰ ea.

2 DRIVE CABLE . . 29.95 4 DRIVE CABLE . . 39.95

MOSTEK MK4015 4K Dynamic RAM

Refresh while supply lasts only .49¢

Pin equivalent to MK4027 except has 1 ms.

S-100 WW

$2.99 each

FIRST QUALITY AT SURPLUS PRICE

2708 EPROMS

PRIME-450 Ns.

8 for $29.95

4K STATIC RAM SELL-OFF

Zilog 6104-4

Same as TMS 4044 but designed specifically for Z-80 based systems. This is full-spec 4K x 1 RAM, 450 Ns.

While supply lasts $1.49 each.

SPECIAL PURCHASE

$59.95 Limited Supply $59.95

16K Altair RAM Boards. Fully Populated as is.

FLOPPY DISK DRIVES

QUME* Datatrack 8
- Double Sided
- Double Density

ACP LOW PRICE $569.95

Tandom TM100-1 5¼" Disk Drive	249.95
MPI B51-5¼", 40 tracks	239.95
Shugart SA400-5¼" 35 tracks	295.00
Shugart 800/801R 8"	449.00
Siemens Shugart Compatible Model FDD-120-8D	429.00
PERSCI Model 277 Dual	1195.00
MPI B52 5¼" Dual	348.00
WANGO/SIEMENS 82	290.00
MPI 91 Double Track Density Single Side, 80 Tracks	375.00
MPI 92 Double Track Density Double Side, 160 Track	475.00

6800 MICROMODULE™ PRICE LIST

MODEL NO.	DESCRIPTION	PRICE
9600A	Single Board Microcomputer	$495.00
9609	Advanced Single Bd. Comp. (6809)	595.00
9601	16 Slot Mother Board	175.00
9602	Card Cage	75.00
9603	8 Slot Mother Board	100.00
9604	Power Supply	275.00
9605	DC Input Power Supply	325.00
9610	Utility Proto Board	39.00
9611	Arith Proc/Memory Module	495.00
9612	Buffered Utility Proto Board	49.00
9616	32K EPROM/RAM Module	250.00
9617	EPROM Programming Head	250.00
9620	16 Channel Parallel I/O Module	295.00
9622	Serial-Parallel I/O Module	325.00
9627	16K Static RAM Module 470ns	395.00
9629	32K Static RAM 450ns	695.00
9629A	32K Static RAM 200ns	895.00
9630	Card Extender	68.00
9640	Multiple Programmable Timer	395.00
9650	8 Channel Duplex Serial I/O Mod	395.00
9655	Intelligent Tape Controller	550.00
96103	32/32 I/O Module	275.00
96702	Contact Closure Module	350.00

UNPOPULATED BOARDS (Also Available)

$24.95 TRS-80/APPLE $24.95

MEMORY EXPANSION KITS. 4116's, 16K (200/250 ns.)

16K 8 pcs for $24.95 RAM

Specify Computer

Call For Volume Pricing

CENTRONICS PRINTER

Model 737

- Centronics complete printer
- The 737 has everything. Check and compare the features.
- New low price $835.00

32K STATIC RAM BOARD

2 or 4 MHz Expandable uses 2114L's

S-100

16K 4 MHz Kit	159.95
16K 4 MHz A&T	217.95
32K MHz Kit	289.95
32K 4 MHz A&T	339.00
Bare Board	39.95
Bare Bd. w/all parts less mem	99.95

NEW! from Zilog

Z-8 CPU comes with Tiny Basic & debug program on the I.C.

$69.95 w/data

BIPOLAR CPU SALE

Signetics 8 x 300 8 bit CPU

While stock lasts 14.95 ea.

UV "Eprom" Eraser

Model UVs-11E $69.95

Holds 4 Eprom's at a time

Backed by 45 years experience

Model S-52T . . . $325.00

Professional Industrial Model

NON-LINEAR SYSTEMS, INC. NLS

TOUCH-TEST 20

DIGITAL MULTIMETER $319⁹⁵

BECKMAN DIGITAL MULTIMETERS

AS LOW AS 100⁰⁰

TECH 300 Digital Multimeter	$110
TECH 310 Digital Multimeter	$140
TECH 330 Digital Multimeter	$189
VC-201 Vinyl Carrying Case	$10
DC-202 Deluxe Carrying Case	$24
HV-211 High Voltage Probe	$35
RP-221 RF Probe	$35
Ct-231 AC Current Clamp	$42
DL-241 Deluxe Test Lead Kit	$10
TL-242 Square Test Leads	$6

INTERSYSTEMS

The Preferred S-100 Box

The new Series II CPU Board features a 4 MHz Z-80A CPU and full-feature front panel. 20-slot actively terminated motherboard, with 25 amp power supply (50/60 Hz operation, incl. 68 cfm fan).

DPS-1, $1795

SYSTEM 2A with Z-80A CPU 4 MHz, 64K RAM, I/O Board, 20 slots, front panel, double density disk controller board. Full 1-year warranty.

List $3795 ACP Price $2995

NEC PC-8000 Series Microcomputer System.

NEW INTRO PRICING $1099.00

- Z-80A CPU 4 MHz
- 5 user programmable function keys
- 82 Keys with numeric keypad
- 160x100 resolution
- 80 character screen

PC-8001A Microcomputer w/32KRAM	$1295.00	1099.00
PC-8012A I/O Unit w/32K RAM, Expansion slots	795.00	699.00
PC-8031A Dual Mini-Disk Drive Unit	1295.00	1099.00
PC-8032A Add-On Dual Mini-Disk Drive Unit	1095.00	949.00
PC-8023A Impact Matrix Printer, Tractor/Friction Feed	860.00	769.00
PC-8094A Cable for PC-8023A Printer	49.95	44.95
JB-1201M(A) High Resolution Green Monitor	265.00	239.00
JC-1202DH(A) High Resolution Color Monitor w/RGB Input	1195.00	1049.00
PC-8091A RGB Cable for JC-1202DH(A) Color Monitor	19.95	17.95
Basic Language Learning Guide		19.95
PC-8001A Microcomputer Reference Manual		19.95
PC-8012A I/O Unit User's Manual		14.95
PC-8031A Dual Disk User's Manual		14.95

MICROPROCESSORS

Z8001 16 bit to 8Mb	$189.00
Z8002 16 bit to 64K	149.00
Z80	9.95
Z80A	13.95
F-8 (3850)	16.95
2650	16.95
CD 1802	9.75
8080A	4.75
8080A 4MHz	19.95
SALE 8085	14.95
8008-1	14.95
2901	9.90
2901A	14.95
2903 4-bit Superslice	29.95
TMS 9900JL	49.95
CP1600	39.95
6502	9.95
6502A	16.95
IM6100	29.95
6800	11.75
6800B 2.0 MHz	19.95
6802P	17.95
8035	14.95
8039	19.95
INS 8073N	24.95
8755	49.95
8748	69.95
6809	37.95
8086	69.95

ADVANCED SUPPORT

AM9511 Arith. Processor	175.00
9512 Arith Processor	175.00
9513 Univ. Timing	79.95
AM9517 DMA Controller	18.95
AM9519 Universal Interrupt	18.95

Z-80 SUPPORT CHIPS

Z80-PIO	2.5 MHz	8.75
Z80A-PIO	4.0 MHz	12.95
Z80-CTC	2.5 MHz	8.75
Z80A-CTC	4.0 MHz	12.95
Z80-DMA	2.5 MHz	29.95
Z80A-DMA	4.0 MHz	36.95
Z80-SIO/0	2.5 MHz	35.95
Z80A-SIO/0	4.0 MHz	39.40
Z80-SIO/1	2.5 MHz	35.95
Z80A-SIO/1	4.0 MHz	39.40
Z80-SIO/2	2.5 MHz	35.95
Z80A-SIO/2	4.0 MHz	39.40

8080/8085 SUPPORT

8155/8156 I/O	24.95
8755 I/O with Eprom	69.95
8202 Dyn. Ram Cont.	39.95
8205/74S 138 Decoder	3.95
8212 8 bit I/o	2.75
8214 Priority Int.	5.25
8216 Bus Driver	2.75
8224 Clock Gen	2.95
8224-4 (4MHz)	9.75
8226 Bus Driver	2.95
8T26 Bus Driver	2.95
8228 Sys. Control	4.50
8238 Sys. Cont.	5.50
8243 I/O Exp.	9.50
8250 Asyn. Comm	15.95
8251 Prog. I/O	6.95
8253 Int. Timer	12.95
8255 Prog. I/O	5.50
8257 Prog. DMA	16.95
8259 Prog. Int.	15.95
8275 CRT Controller	45.95
8279 Prog. Keyboard	15.95

6800 SUPPORT CHIPS

6810 128 x 8 Ram	4.75
6820	6.50
6821	6.50
6828 Priority Int.	10.75
6834-1 512 x 8 Eprom	18.95
6845/HD46505 CRT Cont.	29.95
6847 Color CRT	29.95
6850 ACIA	5.95
6852 Serial Adapter	5.95
6860 Modem	10.95
6862 Modulator	11.95
6871A 1.0MHz OSC	25.95
6875	6.95
6880 Bus Driver	2.19
MC68488	19.95
68047	24.95

6502 SUPPORT CHIPS

6520 PIA	7.50
6522 Mult.	11.95
6530-002,003,004,005	21.95
6532	19.95
6551	19.95

BIPOLAR PROMS

We do Custom Programming

82S23/6330/5600/74S188	4.25
82S115 (512x8)TS	12.95
82S123/5610/74S288 (32x8)TS	4.25
82S126/5603/74S387 (256x4)OC	4.25
82S129/5623/74S287 (256x4)TS	4.25
82S130/5604/74S570 (512x4)OC	6.50
82S131/74S571 (512x4)TS	6.95
82S137/74S573 (1024x4)TS	12.95
82S141/3624/74S474 (512x8)TS	12.95
82S147/74S472 (512x8)TS	12.95
74S471/6309 (256x8)TS	7.95

MOS PROMS

2764 (8Kx8)TS	89.95
2732 (4Kx8)TS	16.95
2716/2516;5V (2Kx8)TS	8.95
TMS2716, ± 5V, 12V	17.95
2758, 5V, (450NS)	7.50
2708 (450Ns)	5.75
2708 (650Ns)	5.25
1702A	5.75
MM5203AQ	14.50
MM5204Q	9.95

CHARACTER GEN.

2513-001 (5V) Upper	9.50
2513-005 (5V) Lower	10.95
2513-ADM3 (5V) Lower	14.95
MCM66710 Ascii Shifted	12.95
MCM66740 Math Symbol	13.45
MCM66750 Alpha Control	13.45

UARTS/BAUD RATE

TR1602B (5V 12V)	3.95
AY51013 (5V, 12V)	4.95
AY51014A/1612 (5-14V)	6.95
AY51015A/1863 (5V)	6.95
IM6402	7.95
IM6403	8.95
2350 USRT	9.95
1671B Astros	24.95
SALE TR1472B	9.95
MC14411	11.95
4702	14.95
WD1941	9.95
COM 5016	16.95
INS 8250	15.95

KEYBOARD ENCODERS

AY5-2376	13.75
AY5-3600	13.75

STATIC RAMS

	1-24	25-99	100
21L02 450ns	1.30	1.25	.99
21L02 250ns (SALE 2102 .89)	1.59	1.55	1.15
2111	3.75	3.65	3.55
2112-1	2.95	2.85	2.65
2101-1	2.90	2.70	2.55
2114N (450 NS.)	3.75	3.50	3.25
2114L-250ns (4045)	6.50	5.95	5.50
2114L 450ns. (4045)	4.75	4.25	3.95
4044 250 ns.	8.95	7.50	6.90
4044 450ns	5.95	5.95	4.75
EMM4200A	9.75	8.75	7.95
EMM4402	7.95	7.25	6.25
AMD9140/41	10.95	10.25	9.25
AMD9130/31	12.95	11.95	10.25
1101	1.95	1.75	1.25
P2125/93425 (45ns)	9.95	8.35	8.25
6518 1K x 1 CMOS	7.95	7.95	7.25
2147 Low Power 4K Static	9.95	8.95	6.95
93415	9.95	8.95	8.50

DYNAMIC RAMS

416/4116 16K (16 Pin)	2.49
Set of 8 416's 200 Ns	24.95
4115 8K (16 Pin)	2.49
4050 4K x 1 (18 Pin)	4.95
4060 4K x 1 (22 Pin)	4.95
4096 4K x 1 (16 Pin)	3.95
4027 4K x 1 (16 Pin)	4.75
4027 4K x 1 (16 Pin)/UPD 414	4.95

64K RAMS $19.95

5261	1.95	1103	.95
5262	1.95	4008L	4.95
5270	4.95	6605	7.95
5280	4.95	6604	4.95
		6002	1.50

SOCKETS

# Pins	Lo-Pro Soldertail	Wire Wrap 3 Level Tin	Wire Wrap 3 Level Gold
8	15	32	45
14	19	36	59
16	20	38	62
18	24	59	84
20	29	69	99
22	24	79	1.10
24	38	85	1.20
28	43	1.10	1.49
36	58	1.25	1.69
40	60	1.40	1.89

ZERO INSERTION FORCE

16 Pin $5.50 24 Pin $7.50 40 Pin $10.25

LED READOUTS

Part No.	Size	Color	Description	Price
DL704	300	Red	Comm Cathode	99
DL707	300	Red	Comm Anode	99
FND357	357	Red	Comm Cathode	99
FND501	500	Red	Comm Cathode (+1)	99
FND503 (500)	500	Red	Comm Cathode	99
FND507 (510)	500	Red	Comm Anode	99
FND508	500	Red	Comm Anode (+1)	99
FND530	500	Green	Comm Cathode	1.49
FND550	500	Orange	Comm Cathode	1.49
FND803 (800)	800	Red	Comm Cathode	1.75
FND807 (810)	800	Red	Comm Anode	1.75
HP5082-7340	600	Red	4 x 7 Hexdecimal	25.95
HP5082-7300	600	Red	4 x 7 Sgl Digit RHD	18.95
HP5082-7731	300	Red	Comm Anode	75
TIL305		Red	Array 5 x 7	7.95
TIL308	270	Red	Numerical Display	10.95
TIL309	270	Red	Numerical Display	9.95
TIL311	270	Red	4 x 7 Hexadecimal	10.95
MAN2A	320	Red	Array	5.95
MAN10A	270	Red	Alpha Numeric	8.95
XAN3061	300	Red	Comm Anode Right DP	1.25
XAN3062	300	Red	Comm Anode Left DP	1.25
XAN3063	300	Red	Overflow CA Left DP	1.25
XAN3064	300	Red	Comm Cathode Right DP	1.25
XAN3051	300	Green	Comm Anode Right DP	1.99
XAN3052	300	Green	Comm Anode Left DP	1.99
XAN3053	300	Green	Overflow CA Left DP	1.99
XAN3054	300	Green	Comm Cathode Right DP	1.99
XAN3081	300	Yellow	Comm Anode Right DP	2.10
XAN3082	300	Yellow	Comm Anode Left DP	2.10
XAN3083	300	Yellow	Overflow CA Left DP	2.10
XAN3084	300	Yellow	Comm Cathode Right DP	2.10

IC SPECIAL PURCHASE

82S09 64x9 Ram	8.95
DP8304 Octal Driver	2.95
DAC86EX D/A Conv.	6.95
MC1650 Hi Speed A/D	7.95
MC6852 SSDA	3.49
MC10145 16x4 ECL Ram	4.50
MK3850/F8 CPU	4.95
MK3853 Static Mem I/O	4.95

SN75136	.46	78M06	.49
MC10210	.89	79M06	.49
LM339	.79	74157	.49
LM710CN	.29	74161	.49
LM711CN	.29	74C74	.39

ICM 7045 Precision StopWatch	23.95
ICM 7207 Oscillator Controller	7.50
Seven Decade Counter 7208	18.95
MC14433P 3½ Digit A/D Converter	13.95
ICL 8211 Voltage Reference	1.95
LM 1850N Ground Fault IC	3/1.00
LM 2900N Quad Amplifier	2/1.00
LM 2917N Freq. to Volt Conv	2/1.99
AY-3-3550 4½ digit DMM	24.95
AY-5-3507 40MHz DVM	9.95
MEM 4963 Mosfet Smoke Detector	7.95
27S08 32 x 8 Prom (IM 5600)	2.95
ULN 2003A 7 channel Driver	.99
MCM 14505 64 bit Static Ram	6.95
MOC 1003 (4N28) Opto Coupler	3/1.00
SPX33 Opto Coupler	3/1.00
IH 5045 CMOS Switch DBST	4.50
UA 3045 Trans. Array	1.25
TR 1402A UART	1.95
MK 1007 Dyn. Mem. Shift Reg	3.95
5318 TV Ch. Disp. Circuit	4.50
8080A 8 Bit CPU	4.95
8700 CJ 8 Bit A/D	9.95
MM5280/VPD 411/C2 107/TMS 4060/ 4Kx1 Dynamic 22 Pin RAM	1.75
6604/VPD 414/4027/2660 MK 4096/ 4Kx1 Dynamic 16 Pin	1.95

7520/25	.50	LM 387	1.25
1488/1489	2/1.99	LM 4558	3/1.99
LM323K	4.95	RC 4136	2/1.99
MC1372	8.95	RC 4131	2/1.99
MM5298-4A/B	2.95	COM 5027	39.95
LM 377	1.25	COM 5037	49.95
LM380	1.25		

VERBATIM DISKETTES

100% CERTIFIED ERROR-FREE!

● 35 TRACKS, DOUBLE DENSITY, SINGLE-SIDED 5¼

TYPE	DESCRIPTION	PRICE/BOX 10
525-01	Soft Sectored TRS 80 etc	$29.95
525-10	10 Hole Hard NS, Apple etc	$29.95
525-16	16 Hole Hard Micropolis	$29.95

● 40 & 77 TRACK DOUBLE DENSITY – SINGLE SIDED 5¼" W/HUB REINFORCEMENT RING

577-01	Soft Sectored TRS 80, etc	$32.25
577-10	10 Hole Hard NS Apple etc	32.25
577-16	16 Hole Hard Micropolis	32.25

● 40 TRACKS DOUBLE SIDED, DOUBLE DENSITY 5¼

550-01	Soft Sectored SA 450 MPI 52	$39.95
550-10	10 Hole Hard BASF WANGCO	$39.95
550-16	16 Hole Hard Micro²	$39.95

● 8" 100% CERTIFIED DISKETTES

FD800-01	Soft Single Density, 3740	$33.50
FD800-32	32 Hard Single Density Shug	33.50
FD802-01	Soft Double Density, 3740	44.80
FD850-01	Soft Double Sided Double Density 3740	49.80

VOLUME DEALER PRICING AVAILABLE

WE ALSO STOCK DYSAN-CALL

FLOPPY DISK I/O

1771-01 8" & Minifloppy	24.95
1781 Dual Floppy	29.95
1791-01 Dual Floppy	36.95
1791-02 Dual Floppy	44.95
1793 DD, DS Floppy	44.95
1797 DD, DS Floppy	54.95
1691 Data Separator	18.95
2143 Clock Gen.	18.95

FLOPPY CHIP SET

Double Density Double Sided Includes: 1797 1691 2143

$79.95/set

A/D CONVERTERS

8700 8 bit Binary	13.50
8701 10 bit Binary	22.00
8703 8 bit TS	13.50
9400 Volt to Freq. Conv.	7.25
8750 3½ Digit BCD	13.95
1408L6 6 bit	3.95
1408L8 8 bit	5.95
DAC01 D to A	5.95
DAC08	9.95
DAC 100	9.95

TV CHIPS/SOUND

AY38500-1 6 Games B/W	4.95
AY38515 Color Converter	2.95
AY38603-1 Roadrace Game	8.95
AY38606-1 Wipeout Game	9.50
AY38607-1 Shooting Gallery	8.95
AY38910 Sound Generator	12.95
SN76477 TI Sound Generator	3.95
MM5320/21 TV Synch Gen.	9.95
MM5369 Prescaler	3.95
LM1889 RF Modulator	3.95
MM57100 NSC Color TV	6.95
MM57104 Clock Gen	3.75
M&R Modulator	29.95

WAVEFORM GEN.

8038 Function Gen.	4.50
MC4024VCO	2.95
LM566 VCO	1.95
XR2206 Function Generator	5.25

SHIFT REGISTERS

2504V	1.49	MM500H	.50
2507V	1.49	MM5056N	2.95
2517V	1.49	MM5060N	2.95
2524V	1.49	2510A	1.95
2525	1.49	2847	4.95
2527	1.49	3341	4.95
2528	1.49	3351	17.95
2529	1.49	3357	6.95
2533	1.49	9403	24.95
3347	5.95	9408	9.95

CTS DIPSWITCHES

CTS206-2	1.75	CTS206-7	1.75
CTS206-4	1.75	CTS206-8	1.95
CTS206-5	1.75	CTS206-9	1.95
CTS206-6	1.75	CTS206-10	1.95

CONNECTORS (GOLD)

DB25P (RS232)	3.25
DB25S Female	3.75
Hood	1.25
Set w/Hood. Sale	$7.50
22/44 W/W, S/T, KIM	2.95
43/86 W/W, S/T, MOT	6.50
50/100 S-100 Connector w/w	4.95
50/100 S-100 Connector s/t	3.95

NAKED PC

S-100 Sound Board	$34.95
8080A CPU	34.95
32K Static RAM (2114)	39.95
8K Eprom (2708)	24.95
2708/2716 Eprom	34.95
ACP Proto Bd	22.95
Vector 8800 Proto	22.20
Vector 8803 11 slot MB	29.95
ACP Extender w/Conn	18.95
13 Slot Mother Board (WMC)	32.95
9 Slot Mother Board (WMC)	29.95
8 Slot Mother (Expandable)	34.95
Floppy PCB (8" SHUGART)	39.95
S100 (AY5-8910) Sound Bd.	34.95
Apple Sound Bd	24.95

PRINTERS

EPSON

MX-80	$495.00
MX-80 FT	595.00
MX-100	895.00
MX-70	425.00
Centronics 739	799.00
Vista V-300 25 cps	1495.00
V-300/45 cps	1795.00
Malibu 165	1995.00
Anadex 9500/9501	1450.00
Base II 800 MST	549.00

TERMINALS

TELEVIDEO

912C	$799
920C	$849
950C	$995
AddS Viewpoint	$599
Ampex Dialog 80	[illegible]
Soroc IQ120	[illegible]
IQ135	$899
IQ140	1149.00

SANYO MONITORS

VM4509 9" BW Sale Price	159.95
DM5012 12" B/W	239.00
DM5112 12" Green	249.00
DM6013 13" Color	415.00
NEC Green	259.00
AMDEK/LEEDEX Video 100	149.00
AMDEK/LEEDEX 13" Color	399.00
AMKEK/LEEDEX 12" Green	179.00

TERMS: Use check, M/C, VISA, AMEX, CB, or COD. COD requires 25% deposit. Charge Orders please include expiration date. Foreign pay U.S. Funds. Order by phone, mail or TWX. MINIMUM $10.00. Please include magazine issue and phone no. SHIPPING. U.S.A. add $2.00 for first 2 lbs. For surface add 30¢ for additional lbs. For air add 70¢ for additional lbs. FOREIGN. Add 10% shipping and handling. COD's $1.85 extra. Not responsible for typos. Some items subject to prior sale. We reserve right to limit quantities, some items subject to precious metal adder. Retail pricing may vary from Mail Order. We reserve the right to substitute manufacturer.

RETAIL STORES OPEN MON-SAT

STORE #1: 1310 "B" E. Edinger, Santa Ana, CA 92705 Showrooms, Retail, Warehouse

STORE #2: 542 W. Trimble Road, San Jose, CA 95131 • (408) 946-7010

**Retail prices may vary.

P.O. Box 17329 Irvine, Calif. 92713

Direct Order Lines: (714) 558-8813

(800) 854-8230 or (800) 854-8241

FOR INTERNATIONAL ORDERS:

1310 E. Edinger (714) 953-0604

Santa Ana, CA 92705 TWX: 910-595-1565

CIRCLE 3 ON FREE INFORMATION CARD

7400

SN7400N	.19	SN74123N	.59
SN7401N	.22	SN74125N	.39
SN7402N	.22	SN74126N	.44
SN7403N	.22	SN74128N	.59
SN7404N	.22	SN74132N	.69
SN7405N	.23	SN74136N	.75
SN7406N	.23	SN74139N	.95
SN7407N	.23	SN74141N	.79
SN7408N	.26	SN74142N	2.95
SN7409N	.23	SN74143N	2.95
SN7410N	.22	SN74144N	2.95
SN7411N	.29	SN74145N	.62
SN7412N	.29	SN74147N	1.95
SN7413N	.39	SN74148N	1.20
SN7414N	.59	SN74150N	1.09
SN7416N	.29	SN74151N	.67
SN7417N	.29	SN74152N	.67
SN7420N	.22	SN74153N	.67
SN7421N	.35	SN74154N	1.19
SN7422N	.29	SN74155N	.78
SN7423N	.29	SN74156N	.78
SN7425N	.29	SN74157N	.69
SN7426N	.29	SN74158N	1.65
SN7427N	.25	SN74160N	.88
SN7429N	.45	SN74161N	.88
SN7430N	.23	SN74162N	.89
SN7432N	.29	SN74163N	.87
SN7437N	.25	SN74164N	.87
SN7438N	.29	SN74165N	.87
SN7439N	.29	SN74166N	1.20
SN7440N	.19	SN74167N	1.95
SN7441N	.79	SN74170N	1.69
SN7442N	.57	SN74172N	4.75
SN7443N	.95	SN74173N	.79
SN7444N	.95	SN74174N	.89
SN7445N	.79	SN74175N	.85
SN7446N	.79	SN74176N	.75
SN7447N	.65	SN74177N	.75
SN7448N	.79	SN74179N	1.34
SN7450N	.19	SN74180N	.75
SN7451N	.19	SN74181N	1.75
SN7453N	.19	SN74182N	.75
SN7454N	.19	SN74184N	2.25
SN7459N	.25	SN74185N	2.25
SN7460N	.23	SN74186N	9.95
SN7470N	.29	SN74188N	3.90
SN7472N	.29	SN74190N	1.15
SN7473N	.34	SN74191N	1.15
SN7474N	.34	SN74192N	.85
SN7475N	.38	SN74193N	.85
SN7476N	.34	SN74194N	.85
SN7479N	4.60	SN74195N	.68
SN7480N	.49	SN74196N	.85
SN7482N	.95	SN74197N	.85
SN7483N	.55	SN74198N	1.39
SN7485N	.65	SN74199N	1.39
SN7486N	.35	SN74221N	1.19
SN7489N	1.75	SN74251N	.95
SN7490N	.39	SN74273N	1.05
SN7491N	.57	SN74279N	.75
SN7492N	.45	SN74283N	1.40
SN7493N	.45	SN74284N	3.90
SN7494N	.69	SN74285N	3.90
SN7495N	.65	SN74290N	1.25
SN7496N	.69	SN74298N	.95
SN7497N	2.90	SN74365N	.68
SN74100N	1.20	SN74366N	.68
SN74107N	.33	SN74367N	.68
SN74109N	.37	SN74368N	.68
SN74116N	1.95	SN74390N	1.45
SN74121N	.29	SN74393N	1.90
SN74122N	.39	SN74490N	1.90

CMOS

CD4000	.35	CD4098	2.29
CD4001	.35	CD4099	2.25
CD4002	.35	MC14408	12.95
CD4006	1.05	MC14409	12.95
CD4007	.25	MC14410	12.95
CD4008	1.39	MC14412	12.95
CD4009	.45	MC14415	8.95
CD4010	.45	MC14419	4.95
CD4011	.35	CD4501	.39
CD4012	.25	CD4502	1.65
CD4013	.45	CD4503	.69
CD4014	1.39	CD4505	8.95
CD4015	1.15	CD4506	.75
CD4016	.59	CD4507	.95
CD4017	1.19	CD4508	3.75
CD4018	.89	CD4510	1.19
CD4019	.45	CD4511	1.19
CD4020	1.10	CD4512	1.39
CD4021	1.19	CD4515	2.75
CD4022	1.15	CD4516	1.45
CD4023	.29	CD4518	1.39
CD4024	.75	CD4520	1.25
CD4025	.25	CD4555	4.95
CD4027	.65	CD4556	.99
CD4028	.85	CD4566	2.25
CD4029	1.29	74C00	.35
CD4030	.45	74C02	.35
CD4031	3.25	74C04	.35
CD4032	2.15	74C08	.35
CD4034	3.25	74C10	.35
CD4035	.95	74C14	.72
CD4037	1.95	74C20	.35
CD4040	1.29	74C30	.35
CD4041	1.25	74C32	.99
CD4042	.95	74C42	1.35
CD4043	.85	74C48	1.89
CD4044	.85	74C73	.75
CD4046	1.75	74C74	.75
CD4047	1.25	74C85	1.79
CD4048	.99	74C89	5.95
CD4049	.45	74C90	1.19
CD4050	.69	74C93	1.19
CD4051	1.10	74C95	1.49
CD4052	1.10	74C107	1.19
CD4053	1.10	74C151	2.49
CD4055	3.95	74C154	3.50
CD4056	2.95	74C157	2.10
CD4059	9.25	74C160	1.65
CD4060	1.39	74C161	1.55
CD4066	.75	74C163	1.65
CD4069	.35	74C164	1.55
CD4070	.49	74C173	1.35
CD4071	.35	74C174	1.35
CD4072	.35	74C175	1.35
CD4073	.35	74C192	1.65
CD4075	.35	74C193	1.65
CD4076	1.29	74C195	1.55
CD4077	.35	74C240	2.19
CD4078	.35	74C244	2.19
CD4081	.35	74C373	2.39
CD4082	.35	74C374	2.39
CD4085	1.95	74C922	5.39
CD4089	2.95	74C923	5.65
CD4093	.99	MM80C95	1.50
CD4094	2.95	MM80C97	1.25

74LS00

74LS00N	.26	74LS164N	1.19
74LS01N	.28	74LS165N	.89
74LS02N	.28	74LS166N	2.48
74LS03N	.28	74LS168N	1.15
74LS04N	.35	74LS169N	1.15
74LS05N	.28	74LS170N	1.99
74LS08N	.28	74LS173N	.89
74LS09N	.35	74LS174N	.89
74LS10N	.28	74LS175N	.89
74LS11N	.39	74LS181N	2.20
74LS12N	.33	74LS190N	1.15
74LS13N	.47	74LS191N	1.15
74LS14N	.95	74LS192N	.98
74LS15N	.33	74LS193N	.98
74LS20N	.26	74LS194N	1.15
74LS21N	.33	74LS195N	.95
74LS22N	.33	74LS196N	.89
74LS26N	.33	74LS197N	.89
74LS27N	.33	74LS221N	1.15
74LS28N	.33	74LS240N	1.69
74LS30N	.26	74LS241N	1.69
74LS32N	.33	74LS242N	1.69
74LS33N	.55	74LS243N	1.69
74LS37N	.45	74LS244N	1.49
74LS38N	.39	74LS245N	2.20
74LS40N	.26	74LS247N	1.10
74LS42N	.79	74LS248N	1.10
74LS47N	.79	74LS249N	1.19
74LS48N	.95	74LS251N	1.40
74LS51N	.26	74LS253N	.98
74LS54N	.29	74LS257N	.85
74LS55N	.29	74LS258N	.98
74LS73N	.45	74LS259N	2.95
74LS74N	.42	74LS260N	.65
74LS75N	.59	74LS261N	2.49
74LS76N	.45	74LS266N	.59
74LS78N	.45	74LS273N	1.75
74LS83AN	.79	74LS275N	4.40
74LS85N	1.19	74LS279N	.59
74LS86N	.45	74LS283N	.99
74LS90N	.57	74LS290N	.99
74LS92N	.75	74LS293N	.99
74LS93N	.75	74LS295N	1.10
74LS95N	.88	74LS298N	1.19
74LS96N	.98	74LS324N	1.75
74LS107N	.45	74LS347N	1.95
74LS109N	.45	74LS348N	1.95
74LS112N	.43	74LS352N	1.19
74LS113N	.43	74LS353N	1.19
74LS114N	.43	74LS363N	1.49
74LS122N	.55	74LS365N	.69
74LS123N	1.19	74LS366N	.69
74LS124N	1.35	74LS367N	.69
74LS125N	.89	74LS368N	.69
74LS126N	.52	74LS373N	1.89
74LS132N	.79	74LS374N	1.89
74LS136N	.49	74LS375N	.69
74LS138N	.85	74LS377N	1.95
74LS139N	.85	74LS385N	1.95
74LS145N	1.25	74LS386N	.65
74LS148N	1.49	74LS390N	1.95
74LS151N	.79	74LS393N	1.95
74LS153N	.79	74LS395N	1.70
74LS154N	1.70	74LS399N	2.35
74LS155N	1.19	74LS424N	2.95
74LS156N	.99	74LS668N	1.75
74LS157N	.85	74LS670N	2.29
74LS158N	.75	81LS95N	1.69
74LS160N	1.05	81LS96N	1.69
74LS161N	1.15	81LS97N	1.69
74LS162N	1.05	81LS98N	1.69
74LS163N	1.05		

LINEAR

78H05	5.95	MC1358	1.75
78M06	1.49	LM1414N	1.90
78M.G.	1.49	LM1458CN/N	.40
LM105H	.99	MC1488N	.99
LM108AH	2.95	MC1489N	.99
LM300H	.79	LM1496N	.89
LM301CN/H	.35	LM1556N	1.50
LM304H	.98	LM1820N	.95
LM305H	.89	LM1850N	.95
LM306H	3.25	LM1889N	3.10
LM307CN/H	.29	LM2111N	1.75
LM308CN/H	.98	LM2900N	.99
LM309K	1.49	LM2901N	2.50
LM310CN	1.25	LM2917N	2.95
LM311DCN/H	.89	CA3013T	2.19
LM312H	1.75	CA3018T	1.99
LM317T	1.70	CA3021T	3.49
LM318CN/H	1.49	CA3023T	2.99
LM319N/H	1.25	CA3035T	2.75
LM320K-XX*	1.35	CA3039T	1.29
LM320T-XX*	1.25	CA3046N	1.29
LM320H-XX*	1.25	LM3053N	1.49
LM323K	4.95	CA3059N	3.19
LM324N	.95	CA3060N	3.19
LM337K	5.95	CA3062N	4.95
LM338K	6.95	LM3065N	1.49
LM339N	.95	CA3080T	1.29
LM340K-XX*	1.75	CA3081N	1.69
LM340T-XX*	1.25	CA3082N	1.69
LM340H-XX*	1.25	CA3083N	1.55
LM344H	1.95	CA3086N	.80
LM348N	1.20	CA3089N	2.99
LM350K	5.60	CA3096N	3.49
LM358CN	.98	CA3097N	1.99
LM360N	1.49	CA3130T	1.30
LM372N	1.95	CA3140T	1.19
LM376N	3.75	CA3146N	2.49
LM377N	2.75	CA3160T	1.19
LM380CN/N	1.25	CA3190N	1.95
LM381N	1.79	CA3410N	.59
LM383T	1.95	MC3423N	1.49
LM386N	1.25	MC3460N	3.95
LM387N	1.40	SG3524N	3.95
LM390N	1.95	CA3600N	3.39
NE531V/T	3.75	LM3900N	.59
NE555V	.39	LM3905N	1.19
NE556N	.98	LM3909N	.98
NE561T	19.95	LM3914N	3.75
NE565N/H	1.25	LM3915N	3.95
NE566H/V	1.75	LM3916N	3.75
NE567V/H	1.50	RC4131N	2.95
NE592N	2.75	RC4136N	1.10
LM702H	.99	RC4151N	3.70
LM709N/H	.29	RC4194TK	4.95
LM710N/H	.75	RC4195TK	5.40
LM711N/H	.39	ULN2001	1.25
LM715N	1.95	ULN2003	1.50
LM723N/H	.65	SN75450N	.59
LM733N/H	.98	SN75451N	.39
LM739N	1.15	SN75452N	.49
LM741CN/H	.33	SN75453N	.49
LM741CN-14	.19	SN75454N	.49
LM747N/H	.75	SN75491N	.89
LM748N/H	.39	SN75492N	.89
LM760CN	2.95	SN75493N	.89
LM1310N	1.90	SN75494N	.89
MC1330	1.95	TL494CN	4.20
MC1350	1.95	TL496CP	1.65

16K UPGRADE ONLY **$24.95** SPECIFY COMPUTER

ADVANCED COMPUTER PRODUCTS

HEWLETT PACKARD

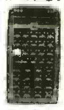
HP-85 $2695.00

HP 7225 Graphics Plotter	1795.00
HP 16K Memory Module	265.00
HP 5 1/4" Dual Master Flex. Disk Drive	2100.00
HP 5 1/4" Single Master Flex. Disc Drive	1295.00
HP Personality Module	700.00
HP ROM Drawer	40.00
HP Plotter/Printer ROM	130.00
HP Input/Output ROM	260.00
HP Matrix ROM	130.00
HP Serial Interface (RS-232C)	350.00

HP-83 $1895.00

HP-41: Powerful, Yet Easy to Use

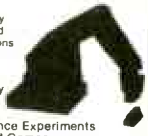
HP 41-CV



- The HP-41 communicates with you in words as well as numbers.
- You can customize the HP-41 to your own design.
- Programming is fast and easy.
- Continuous Memory saves everything.
- Optional Peripherals allow you to expand capabilities.

	HP-41 System I	398.00
	HP-41 System II	675.00
HP-41CV 275.00	HP-Card Reader	178.00
	HP-Optical Wand	105.00
HP-41C 198.00	HP-Plotter/Printer	315.00
	HP-Quad RAM	85.00

Microbot MINIMOVER-5 ROBOTIC ARM



Completely Assembled W/Applications Manual

- Automation or Robotic Assembly
- Education in Robotic Priciples
- Artificial Inteligence Experiments
- Computer Art and Games

$1695.00

Armbasic Software for TRS-80 w/Applications Manual $39.95
Applications/Referance Manual $16.95

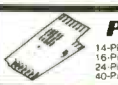
California Computer Systems 2200

SUPER S-100 BUY!

- 12 Slot Mainframe
- 64 Dynamic RAM
- CP/M™ 2.2
- Z-80 CPU 4 MHz w/Serial IO
- Double Density Disk Controller
- Interface to Vista V-1000 Chassis

SPECIAL PACKAGE PRICE FOR COMPLETE SYSTEM 1899.00
with (2) Shugart Double Density Floppys mounted. add 1495.00

Proto Clips



14-Pin Clip	PC-14	$ 4.25
16-Pin Clip	PC-16	$ 4.50
24-Pin Clip	PC-24	$ 9.50
40-Pin Clip	PC-40	$14.95

Proto Boards

PB-6	16.95	PB-104	54.00
PB-100	18.00	PB-203	97.00
PB-101	21.00	PB-203A	149.00
PB-102	25.00	PB-203A-Kit	129.00
PB-103	43.00		

Novation

AUTO-CAT™
Automatic Answer
Direct Connect
0-300 Band
List 279.95
ACP 245.95

CAT™
Answer Originate
List 198.00
ACP 169.00

D-CAT™
direct Connect
0-300 Band.
List 249.00
ACP 189.00

Rockwell Single Board Computers

AIM 65 w/1K	435.00
AIM 65 w/4K	475.00
8K BASIC ROM	99.00
4K ASSEMBLER ROM	84.00
POWER SUPPLY	64.95
ENCLOSURE	49.95
TOTAL SYSTEM w/4K	669.00
SYNERTEK SYM-1	239.00
SD Z-80 STARTER KIT	367.00
SD Z-80 STARTER KIT A&T	450.00
SD SBC 100 Z-80 A&T	367.00
SD SBC 200 Z-80 A&T	399.00
RCA COSMAC VIP	199.00
CROMEMCO Z-80 SBC	449.00

apple computer Sales and Service

Apple II® 64K Maxi-System

- Z-80 Softcard
- 16K Ram Card
- Disk II w/controller
- Apple II w/48K

Call for more pricing!

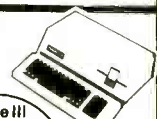
Total Value $2719.00 your price $2229.00
save! *For Pascal System add $425.00*

"Apple Products Sold In-Store ONLY"

VISTA COMPUTER		
Datasaver™ Uninterruptable P.S.	395.00	New
Vocalyzer™ Voice Card	225.00	New
Vision 80™ 80x24 Card	325.00	New
Vision 40™ 40 col. enhancement	175.00	New
A 800 Quad Denisty 8" Controller	595.00	New
Microsoft Z-80 Softcard	259.00	
Microsoft 16K Ramcard	169.00	
SSM AIO Serial/Parallel IO	165.00	
CCS Asynchronous 7710 A Serial	139.00	
Apple Joystick "GESU"	54.95	
Mountain Computer		
Romplus +	169.00	
Rom Writer	159.00	
Introl/X-10	180.00	
Introl/X-10 Remote Cont. Sys.	249.00	
Super Talker	275.00	
Music System	499.00	
CPS Multifunction	229.00	New
Expansion Chassis	699.00	New
DC Hayes Micromodem II	299.00	New
DC Hayes Smart Modem	349.95	New
Thunderclock	125.00	New
X-10 I/O Option*	49.00	New
Pascal For Above*	29.00	New

CCS Parallel Card 7720A	155.00	
Apple Computer		
Apple Hi-Speed Serial I/O	174.95	
Centronics Printer I/O	179.95	
Applesoft II Firmware	159.95	
Apple Clock	244.95	
Apple Graphics Tablet	599.95	
Apple Prototype Card	21.95	
Apple Disk II w/ cont 3.3	559.95	
Apple Disk II	459.95	
Pascal Language Card	425.95	
Parallel Printer Cardd	159.95	
Communications Card	189.00	
Integer ROM Card	159.95	
Calif. Prod Visicalc Keyboard	169.95	
M & R Apple Fan	49.95	New
M & R Sup R' Mod	29.95	
Corvus 5Mb Hard Disk	3699.00	New
Corvus 10Mb Hard Disk	Call	
Corvus 20Mb Hard Disk	Call	New
Corvus Contellation	Call	
Corvus Mirror	Call	
ACP 16K Upgrade Kit	24.95	
Scott Voice Recognition VET-2	895.00	New

apple /// Triple Play!



1. Apple III 128K RAM Information Analysis Pkg. 12" Green Phosphor Monitor **4200.00**
2. Apple III 128K RAM Information Analysis Pkg 12" Green Phosphor Monitor Disk II for Apple III **5100.00**
3. Apple III 128K RAM Information Analysis Pkg 12" Green Phosphor Monitor Disk II for Apple III Silentype Printer **5500.00**

Buy a System and Save

New apple software

We only offer Apple CPM software which has been evaluated by our software staff.

Visicalc—Now Better Than Ever	169.00
Visiplot—Graph your Visicalc Worksheets	149.00
Visitrend/Visiplot—Visiplot w/Trend Analysis	239.00
Visidex—The Ultimate DBMS Visicalc Compatible	219.00
Visiterm—Communicate w/other Systems	209.00
BPI General Ledger	299.00
BPI Accounts Receivable	299.00
BPI Inventory	299.00
Stockfile Inventory System	349.00
Infotory Inventory System	289.00
Microcom Microcourier	229.00
Microcom Microtelegraph	229.00
Accounting Plus II Biz Pkg.	1250.00
Stoneware DB Master	189.00
Stoneware Utility Pkg (For above)	89.00

WORDSTAR-The Benchmark of Wordprocessing software requires Z-80 & 80x24 349.00
VTS-80 CP/M-Wordprocessor has no screen menus uses new keycaps (supplied) to display Key functions 319.00 New
MAIL-MERGE-A Wordstar Enhancement Pkg. allows form-letter generation & chained printing 169.00
SPELLGUARD-Will proofread Wordstar & VTS-80 Text files against an expandable 20,000 word dictionary 169.00
SUPER SORT-Will sort, merge, & perform record selection on your CP/M Data Files 169.00
FORTRA 80-By Microsoft 195.00
COBOL 80-By Microsoft 749.00

ACS BASIC ACCOUNTING SYSTEM, Total accounting system includes G/L, A/R, A/P, PAYROLL 699.00 New

Breakthru in Apple II® Mass Storage!

Vista A800 Quad Density DMA 8" Disk Controller

NEW 2.5 MB

Model A800.... only $595.00

Special Complete Subsystem Offer

- V1000 w/two Qume Datatrack 8
- Cable, ready to run
- A800 Apple II 8" Disk Controller

Total Value $2939.00 your price $2495.00

ATARI 800 & 400 Personal Computer System

ATARI 800 $799.00
ATARI 400 $375.00

ATARI 800 Includes: Computer Console, BASIC Lang. Cartridge, BASIC Language Programming Manual. 800 Operator's Manual w/Notebook, 16K RAM Module, Power Supply, TV Switch Box.

Peripherals	
810 Disc Drive	499.00
820 Printer (40 Col.)	295.00
825 Printer (80 Col.)	795.00
8K RAM	49.95
16K RAM	94.95
850 Interface	189.95
Program Recorder	69.00
Software — ROM Cartridges	
Education System Master Cartridge	28.00
Atari BASIC	55.00
Assembler Debug	55.00
Basketball	42.00
Life	42.00
Super Breakout™	42.00
Music Composer	55.00
Super Bug™	42.00

Computer Chess	55.00
Home Finance	55.00
Education System Cassette Programs	
U.S. History	35.00
U.S. Government	35.00
Supervisory Skills	35.00
World History (Western)	35.00
Basic Sociology	35.00
Counseling Procedures	35.00
Principles of Accounting	35.00
Physics	35.00
Great Classics (English)	35.00
Business Communications	35.00
Basic Psychology	35.00
Effective Writing	35.00
Auto Mechanics	35.00
Principles of Economics	35.00

Spelling	35.00
Basic Electricity	35.00
Basic Algebra	35.00
Basic Game and Program Cassettes	
Guide to BASIC Programming	18.00
BASIC Game Programs	19.00
Add-On Memory	
8K RAM Memory Module	110.00
16K RAM Memory Module	225.00
Diskettes	
Blank Diskettes	
Disk File Manager	5.00
Accessory Controllers	
Driving Controller Pair	18.00
Paddle Controller Pair	18.00
Joystick Controller Pair	18.00

RETAIL STORES OPEN MON-SAT
STORE #1: 1310 "B" E. Edinger, Santa Ana, CA 92705 Showrooms, Retail, Warehouse
STORE #2: 542 Trimble Road, San Jose, CA 95131 • (408) 946-7010
**Retail prices may vary.

P.O. Box 17329 Irvine, Calif. 92713
Direct Order Lines: (714) 558-8813
(800) 854-8230 or (800) 854-8241

DRIVER'S LICENSE # OR MAJOR CREDIT CARD # IS REQUIRED ON ALL CHECKS. MONEY ORDER OR CASHIER CHECK WILL FACILITATE THE SHIPMENT OF YOUR PURCHASE.

CIRCLE 3 ON FREE INFORMATION CARD

ramsey the first name in Counters !

9 DIGITS 600 MHz $129.95 WIRED

PRICES

CT-90 wired 1 year warranty	$129.95
CT-90 Kit, 90 day parts warranty	109.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC Adapter/Charger	12.95
OV-1, Micro-power Oven time base	49.95
External time base input	14.95

The CT-90 is the most versatile, feature packed counter available for less than $300.00! Advanced design features include; three selectable gate times, nine digits, gate indicator and a unique display hold function which holds the displayed count after the input signal is removed! Also, a 10mHz TCXO time base is used which enables easy zero beat calibration checks against WWV. Optionally, an internal nicad battery pack, external time base input and Micro-power high stability crystal oven time base are available. The CT-90, performance you can count on!

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 10 MV to 150 MHz Less than 50 MV to 500 MHz
Resolution:	0.1 Hz (10 MHz range) 1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	9 digits 0.4" LED
Time base:	Standard-10.000 mHz, 1.0 ppm 20-40°C. Optional Micro-power oven-0.1 ppm 20-40°C
Power:	8-15 VAC @ 250 ma

7 DIGITS 525 MHz $99.95 WIRED

SPECIFICATIONS:

Range:	20 Hz to 525 MHz
Sensitivity:	Less than 50 MV to 150 MHz Less than 150 MV to 500 MHz
Resolution:	1.0 Hz (5 MHz range) 10.0 Hz (50 MHz range) 100.0 Hz (500 MHz range)
Display:	7 digits 0.4" LED
Time base:	1.0 ppm TCXO 20-40°C
Power:	12 VAC @ 250 ma

The CT-70 breaks the price barrier on lab quality frequency counters. Deluxe features such as; three frequency ranges - each with pre-amplification, dual selectable gate times, and gate activity indication make measurements a snap. The wide frequency range enables you to accurately measure signals from audio thru UHF with 1.0 ppm accuracy - that's .0001%! The CT-70 is the answer to all your measurement needs, in the field, lab or ham shack.

PRICES:

CT-70 wired, 1 year warranty	$99.95
CT-70 Kit, 90 day parts warranty	84.95
AC-1 AC adapter	3.95
BP-1 Nicad pack + AC adapter/charger	12.95

7 DIGITS 500 MHz $79.95 WIRED

PRICES:

MINI-100 wired, 1 year warranty	$79.95
AC-Z Ac adapter for MINI-100	3.95
BP-Z Nicad pack and AC adapter/charger	12.95

Here's a handy, general purpose counter that provides most counter functions at an unbelievable price. The MINI-100 doesn't have the full frequency range or input impedance qualities found in higher price units, but for basic RF signal measurements, it can't be beat! Accurate measurements can be made from 1 MHz all the way up to 500 MHz with excellent sensitivity throughout the range, and the two gate times let you select the resolution desired. Add the nicad pack option and the MINI-100 makes an ideal addition to your tool box for "in-the-field" frequency checks and repairs.

SPECIFICATIONS:

Range:	1 MHz to 500 MHz
Sensitivity:	Less than 25 MV
Resolution:	100 Hz (slow gate) 1.0 KHz (fast gate)
Display:	7 digits, 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	5 VDC @ 200 ma

8 DIGITS 600 MHz $159.95 WIRED

NEW READ RECEIVER FREQUENCY

SPECIFICATIONS:

Range:	20 Hz to 600 MHz
Sensitivity:	Less than 25 mv to 150 MHz Less than 150 mv to 600 MHz
Resolution:	1.0 Hz (60 MHz range) 10.0 Hz (600 MHz range)
Display:	8 digits 0.4" LED
Time base:	2.0 ppm 20-40°C
Power:	110 VAC or 12 VDC

The CT-50 is a versatile lab bench counter that will measure up to 600 MHz with 8 digit precision. And, one of its best features is the Receive Frequency Adapter, which turns the CT-50 into a digital readout for any receiver. The adapter is easily programmed for any receiver and a simple connection to the receiver's VFO is all that is required for use. Adding the receiver adapter in no way limits the operation of the CT-50, the adapter can be conveniently switched on or off. The CT-50, a counter that can work double-duty!

PRICES:

CT-50 wired, 1 year warranty	$159.95
CT-50 Kit, 90 day parts warranty	119.95
RA-1, receiver adapter kit	14.95
RA-1 wired and pre-programmed (send copy of receiver schematic)	29.95

DIGITAL MULTIMETER $99.95 WIRED

PRICES:

DM-700 wired, 1 year warranty	$99.95
DM-700 Kit, 90 day parts warranty	79.95
AC-1, AC adaptor	3.95
BP-3, Nicad pack +AC adapter/charger	19.95
MP-1, Probe kit	2.95

The DM-700 offers professional quality performance at a hobbyist price. Features include; 26 different ranges and 5 functions, all arranged in a convenient, easy to use format. Measurements are displayed on a large 3½ digit, ½ inch LED readout with automatic decimal placement, automatic polarity, overrange indication and overload protection up to 1250 volts on all ranges, making it virtually goof-proof! The DM-700 looks great, a handsome, jet black, rugged ABS case with convenient retractable tilt bail makes it an ideal addition to any shop.

SPECIFICATIONS:

DC/AC volts:	100uV to 1 KV, 5 ranges
DC/AC current	0.1uA to 2.0 Amps, 5 ranges
Resistance:	0.1 ohms to 20 Megohms, 6 ranges
Input impedance:	10 Megohms, DC/AC volts
Accuracy:	0.1% basic DC volts
Power:	4 'C' cells

AUDIO SCALER

For high resolution audio measurements, multiplies UP in frequency.

- Great for PL tones
- Multiplies by 10 or 100
- 0.01 Hz resolution!

$29.95 Kit $39.95 Wired

ACCESSORIES

Telescopic whip antenna - BNC plug	$ 7.95
High impedance probe, light loading	15.95
Low pass probe, for audio measurements	15.95
Direct probe, general purpose usage	12.95
Tilt bail, for CT 70, 90, MINI-100	3.95
Color burst calibration unit, calibrates counter against color TV signal	14.95

COUNTER PREAMP

For measuring extremely weak signals from 10 to 1,000 MHz. Small size, powered by plug transformer-included.

- Flat 25 db gain
- BNC Connectors
- Great for sniffing RF with pick-up loop

$34.95 Kit $44.95 Wired

ramsey electronics, inc.
2575 BAIRD RD. • PENFIELD, NY 14526

PHONE ORDERS
CALL 716-586-3950

TERMS Satisfaction guaranteed - examine for 10 days, if not pleased, return in original form for refund. Add 5% for shipping - insurance to a maximum of $10. Overseas add 15%. COD add $2. Orders under $10, add $1.50. NY residents add 7% tax.

CIRCLE 6 ON FREE INFORMATION CARD

7400

SN7400N	.20
SN7401N	.20
SN7402N	.25
SN7403N	.25
SN7404N	.25
SN7405N	.29
SN7406N	.35
SN7407N	.35
SN7408N	.29
SN7409N	.29
SN7410N	.25
SN7411N	.29
SN7412N	.35
SN7413N	.40
SN7414N	.69
SN7416N	.29
SN7417N	.29
SN7420N	.25
SN7421N	.29
SN7422N	.45
SN7423N	.29
SN7425N	.29
SN7426N	.29
SN7427N	.25
SN7428N	.49
SN7430N	.25
SN7432N	.29
SN7437N	.25
SN7438N	.40
SN7439N	.25
SN7440N	.20
SN7441N	.89
SN7442N	.59
SN7443N	1.10
SN7444N	1.10
SN7445N	.89
SN7446N	.79
SN7447N	.69
SN7448N	.79
SN7450N	.20
SN7451N	.20
SN7453N	.20
SN7454N	.20
SN7459A	.25
SN7460N	.20
SN7470N	.29

SN7472N	.29
SN7473N	.35
SN7474N	.35
SN7475N	.49
SN7476N	.35
SN7479N	5.00
SN7480N	.50
SN7482N	.99
SN7483N	.69
SN7485N	.89
SN7486N	.35
SN7489N	1.75
SN7490N	.49
SN7491N	.59
SN7492N	.45
SN7493N	.45
SN7494N	.69
SN7495N	.69
SN7496N	.69
SN7497N	3.00
SN74100N	1.49
SN74104N	.89
SN74105N	.89
SN74107N	.35
SN74109N	.39
SN74116N	1.95
SN74121N	.39
SN74122N	.55
SN74123N	.59
SN74125N	.49
SN74126N	.49
SN74132N	.75
SN74136N	.75
SN74141N	.99
SN74142N	3.25
SN74143N	3.49
SN74144N	3.49
SN74145N	.79
SN74147N	1.95
SN74148N	1.29
SN74150N	1.25
SN74151N	.69
SN74152N	.69
SN74153N	.79
SN74154N	1.25
SN74155N	.79

SN74156N	.79
SN74157N	.69
SN74160N	.89
SN74161N	.89
SN74162N	.89
SN74163N	.89
SN74164N	.89
SN74165N	.89
SN74166N	1.25
SN74167N	2.79
SN74170N	1.95
SN74172N	4.95
SN74173N	1.39
SN74174N	.99
SN74175N	.89
SN74176N	.79
SN74177N	.79
SN74179N	1.49
SN74180N	.79
SN74181N	2.25
SN74182N	.79
SN74184N	2.49
SN74185N	2.49
SN74190N	1.25
SN74191N	1.25
SN74192N	.89
SN74193N	.89
SN74194N	.89
SN74195N	.69
SN74196N	.89
SN74197N	.89
SN74198N	1.49
SN74199N	1.49
SN74221N	1.25
SN74251N	.99
SN74276N	1.95
SN74279N	.79
SN74283N	1.49
SN74284N	3.95
SN74285N	3.95
SN74365N	.69
SN74366N	.69
SN74367N	.69
SN74368N	.69
SN74390N	1.49
SN74393N	1.49

74LS

74LS00	.29
74LS01	.29
74LS02	.29
74LS03	.29
74LS04	.35
74LS05	.35
74LS08	.35
74LS09	.35
74LS10	.35
74LS11	.39
74LS12	.35
74LS13	.59
74LS14	.99
74LS15	.35
74LS20	.35
74LS21	.35
74LS22	.35
74LS26	.35
74LS27	.35
74LS28	.35
74LS30	.35
74LS32	.35
74LS33	.59
74LS37	.45
74LS38	.39
74LS40	.35
74LS42	.89
74LS47	.89
74LS48	1.15
74LS49	1.15
74LS51	.35
74LS54	.35
74LS55	.35
74LS73	.45
74LS74	.45
74LS75	.59
74LS76	.45
74LS78	.49
74LS83	.89
74LS85	1.25
74LS86	.49
74LS90	.69

74LS92	.75
74LS93	.75
74LS95	.99
74LS96	1.15
74LS107	.45
74LS109	.45
74LS112	.45
74LS113	.49
74LS114	.49
74LS122	.89
74LS123	1.25
74LS125	.59
74LS126	.59
74LS132	.99
74LS133	.89
74LS136	.49
74LS138	.89
74LS139	.89
74LS151	.89
74LS153	.89
74LS154	1.75
74LS155	.89
74LS156	.89
74LS157	.89
74LS158	.89
74LS160	1.15
74LS161	1.15
74LS162	1.15
74LS163	1.15
74LS164	1.15
74LS165	1.15
74LS168	1.19
74LS169	1.19
74LS170	1.95
74LS173	.99
74LS174	.99
74LS175	.99
74LS181	2.95
74LS190	1.25
74LS191	1.25

74LS192	1.15
74LS193	1.15
74LS194	1.15
74LS195	1.15
74LS197	1.19
74LS221	1.19
74LS240	1.49
74LS241	1.49
74LS242	1.49
74LS243	1.49
74LS244	1.49
74LS245	2.95
74LS247	1.19
74LS248	1.19
74LS249	1.19
74LS251	.99
74LS253	.99
74LS257	.89
74LS258	.69
74LS260	.69
74LS266	.69
74LS273	1.95
74LS279	.89
74LS283	.89
74LS290	.99
74LS293	.99
74LS298	1.25
74LS352	1.29
74LS353	1.29
74LS365	.69
74LS366	.69
74LS367	.69
74LS368	.69
74LS373	1.95
74LS374	1.95
74LS375	.89
74LS386	.69
74LS393	2.49
74LS399	2.49
74LS670	2.49
81LS95	1.95
81LS97	1.95

74S

74S00	.45
74S02	.45
74S03	.45
74S04	.55
74S05	.55
74S08	.50
74S09	.50
74S10	.45
74S11	.45
74S15	.45
74S20	.45
74S22	.45
74S30	.45
74S32	.55
74S38	1.25
74S40	.50
74S51	.45
74S64	.50
74S65	.50
74S74	.75
74S86	.79
74S112	.79
74S113	.79
74S114	.79

74S124	3.95
74S133	.55
74S134	.69
74S135	1.19
74S136	1.75
74S138	1.35
74S139	1.35
74S140	.79
74S151	1.35
74S153	1.35
74S157	1.35
74S158	1.35
74S160	2.95
74S174	1.59
74S175	1.59
74S188	2.95
74S194	1.95
74S195	1.95
74S196	1.95
74S240	2.95
74S241	2.95
74S242	3.25

74S243	3.25
74S244	3.25
74S251	1.45
74S253	1.45
74S257	1.35
74S258	1.35
74S260	.79
74S280	2.95
74S287	3.25
74S288	2.75
74S373	3.49
74S374	3.49
74S387	2.95
74S471	10.95
74S472	10.95
74S473	10.95
74S474	12.95
74S475	12.95
74S570	5.95
74S571	5.95
74S572	9.95
74S573	9.95
74S940	3.15
74S941	3.15

CA–LINEAR

CA3010H	.99
CA3013H	2.15
CA3023H	3.25
CA3035H	2.49
CA3039H	1.35
CA3046N	1.30
CA3059N	3.25

CA3060N	3.25
CA3080H	1.25
CA3081N	2.00
CA3082N	2.00
CA3083N	1.60
CA3086N	.85

CA3089N	3.75
CA3096N	3.95
CA3130H	1.39
CA3140H	1.25
CA3160H	1.25
CA3401N	.59
CA3600N	3.50

CD–CMOS

CD4000	.39
CD4001	.39
CD4002	.39
CD4006	1.19
CD4007	.25
CD4009	.49
CD4010	.49
CD4011	.39
CD4012	.25
CD4013	.49
CD4014	1.39
CD4015	1.19
CD4016	.59
CD4017	1.19
CD4018	.99
CD4019	.49
CD4020	1.19
CD4021	1.39
CD4022	1.19
CD4023	.29
CD4024	.79
CD4025	.23
CD4026	2.95
CD4027	.69
CD4028	.89
CD4029	1.49
CD4030	.49
CD4034	3.49
CD4035	.99
CD4040	1.49

CD4041	1.49
CD4042	.99
CD4043	.89
CD4044	.89
CD4046	1.79
CD4047	2.50
CD4048	1.35
CD4049	.49
CD4050	.69
CD4051	1.19
CD4052	1.19
CD4053	1.19
CD4056	2.95
CD4059	9.95
CD4060	1.49
CD4066	.79
CD4068	.39
CD4069	.45
CD4070	.55
CD4071	.49
CD4072	.49
CD4073	.39
CD4075	.39
CD4076	1.39
CD4078	.55
CD4081	.39
CD4082	.39
CD4093	.99

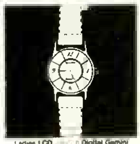
CD 4098	2.49
CD4506	.75
CD4507	.99
CD4508	3.95
CD4510	1.39
CD4511	1.29
CD4512	1.49
CD4514	3.95
CD4515	2.95
CD4516	1.49
CD4518	1.79
CD4519	.89
CD4520	1.29
CD4526	1.79
CD4528	1.79
CD4529	1.95
CD4543	2.79
CD4562	11.95
CD4566	2.79
CD4583	2.49
CD4584	.75
CD4723	1.95
CD4724	1.95
MC14409	17.95
MC14410	18.95
MC14411	15.95
MC14412	15.95
MC14419	7.95
MC14433	15.95
MC14538	2.49
MC14541	1.95

Bulova Quartz Ladies Watches

LIMITED QUANTITY

WHILE THEY LAST!

ONE YEAR FACTORY WARRANTY



Ladies LCD Digital Gemini Gold with Leather Strap 82395-5Y .. Sugg. Retail $140.00

Ladies LCD (Square) Digital Gemini Silver with Silver Mesh Metal Strap 80395-5W .. Sugg. Retail $150.00

Ladies LCD (Round) Digital Gemini Gold with Gold Link Metal Strap 82386-5Y .. Sugg. Retail $165.00

Ladies LCD (Square) Digital Gemini Gold with Leather Strap 82397-1Y .. Sugg. Retail $150.00

YOUR CHOICE — 50%-OFF SUGG. RETAIL PRICE

CALL OR SEND ORDER IN REFERENCING TO THIS AD FOR SPECIAL PRICE

Because of Limited Supply, please provide a second and third choice

EXAMPLE: 82395-5Y, SUGG. RETAIL $140.00, 50% OFF—YOUR COST $70.00

LITRONIX Stick Display Sale

WHILE THEY LAST!

SALE!

MULTI DIGIT REFLECTOR ARRAYS FOR CLOCKS

Part Number/Color	Char. Ht. (in.)	Polarity	Description Segment/Digit	Overall Size Length × Height × Depth	Light Output typ	Light Output min	Light Output @mA	Forward Voltage typ	Forward Voltage max	Continuous Forward Current per Segment (mA) max	Price	2 For Sale
DL-[illegible] (Red)	[illegible]	C.C. MPX	With Colon and Auxiliary Indicators	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	1.[illegible]	2/2.[illegible]
DL-[illegible] (Red)				[illegible]	—	[illegible]					1.79	2/2.[illegible]
DL-[illegible] (Grn)		C.C. non-MPX		[illegible]	[illegible]	[illegible]					4.[illegible]	2/7.[illegible]
DL-[illegible] (Red)				[illegible]							2.40	2/2.[illegible]

MULTI-DIGIT REFLECTOR ARRAYS

Part Number/Color	Char. Ht. (in.)	Polarity	Description	Overall Size	typ	min	@mA	typ	max	max	Price	2 For Sale
DL-[illegible] (Red)	[illegible]	C.C. MPX	7 Seg. 2-Digit RHDP	[illegible]	[illegible]	[illegible]	[illegible]	1.7	[illegible]	[illegible]	.79	2/1.[illegible]
DL-[illegible] (Grn)	[illegible]	C.A. MPX	9 Seg. 2 Digit	[illegible]		[illegible]	[illegible]		[illegible]	[illegible]	[illegible]	2/1.19
DL-[illegible] (Red)	[illegible]	C.C. MPX	9 Seg. 4 Digit RHDP	[illegible]	[illegible]	[illegible]	[illegible]	1.7	[illegible]	[illegible]	1.[illegible]	2/1.[illegible]
DL-[illegible] (Red)	[illegible]	C.A. MPX	7 Seg. 3 Digit RHDP	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	2/3.[illegible]

NATIONAL Stick Display Sale

LIMITED QUANTITY!

SALE!

LED NUMERIC ARRAYS

Part No.	Digit Size (Red)	Format	Drive Comm. Cathode/Comm. Anode	Overall Size	Price	
NSA1166	100 @ Bubble Stick	888888	C.C. 6 Digit Multiplexed	2"L x .72"H x .27"D	[illegible]	2/.99
NSA1188	100 @ Bubble Stick	88888888	C.C. 8 Digit Multiplexed	2"L x .72"H x .27"D	[illegible]	2/.99
NSA288	100 @ Bubble Stick	888888888	C.C. 9 Digit Multiplexed	1.98"L x .72"H x .27"D	[illegible]	2/.99
NSA1140	100 @ Bubble Stick	88 88	C.C. 4 Digit Multiplexed	2"L x .72"H x .27"D	[illegible]	2/.79
NSA11[illegible]	100 @ Bubble Stick	8 88 88	C.C. 5 Digit Multiplexed	2"L x .72"H x .27"D	[illegible]	2/.79
NSA[illegible]	100 @ Bubble Stick	8888888	C.C. [illegible] Digit Multiplexed	[illegible]	[illegible]	2/1.19

MULTI-DIGIT LED NUMERIC DISPLAYS

Part No.	Digit Size (Red)	Format	Drive	Overall Size	Price	
NSN373	3 No Decimal	88	C.C. 2 Digit Direct	[illegible]	[illegible]	2/1.79
NSN374	3 No Decimal	88	C.A. 2 Digit Direct	[illegible]	[illegible]	[illegible]
NSN581	5 No Decimal	88	C.A. 2 Digit Direct	[illegible]	[illegible]	[illegible]
NSN582	5 No Decimal	88	C.A. 2 Digit Direct	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	88	C.C. 2 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	88	C.A. 2 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	88	C.C. 2 Digit Multiplexed	[illegible]	[illegible]	[illegible]
NS8210[illegible]	3	[illegible]	C.C. 8 Digit [illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.A. 3½ Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 4 Digit - Colon/PM Indicator	[illegible]	[illegible]	2/1.19
[illegible]	[illegible]	[illegible]	C.C. 6 Digit - AM/PM, Colon Ind.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.A. 6 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.A. 3½ Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 4 Digit - AM/PM, Colon Ind.	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.A. 3½ Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 4 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.A. 6 Digit Multiplexed	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	C.C. 8 Digit Multiplexed	[illegible]	[illegible]	2/1.[illegible]

*Standard Stocked Items — only pin-out specifications available on non stocked items

COMPUTER GRADE CAPACITORS

MFD	WVDC	PRICE
250	150	1.95
500	200	2.49
1,250	3	.99
1,500	25	1.95
1,500	50	2.95
1,500	10	2.95
2,000	10	2.95
2,250	100	3.95
2,300	33	2.95
2,500	15	2.95
3,000	25	1.95
3,600	15	2.95
4,500	40	3.95
5,000	50	3.95
5,500	25	4.49
8,100	40	2.48
8,600	15	4.95

MFD	WVDC	PRICE
10,000	15	2.95
10,000	25	3.95
11,000	16	4.95
11,000	25	5.49
11,500	60	5.95
12,000	15	2.95
13,000	10	2.95
14,000	13	2.95
14,000	35	3.95
16,000	15	3.95
18,000	10	3.95
19,000	20	2.95
20,000	55	2.95
21,000	15	3.95
23,000	7	1.95
23,000	10	2.95
23,000	20	2.95

MFD	WVDC	PRICE
24,000	20	2.95
27,000	18	2.95
32,500	25	4.95
40,000	25	5.95
43,000	15	5.95
50,000	20	7.95
52,000	15	5.95
55,000	20	5.95
58,000	15	5.95
65,000	10	7.95
73,800	15	7.95
80,000	10	8.95
90,000	15	8.95
150,000	15	9.95
200,000	3	12.95

OVER 200 OTHER VALUES AVAILABLE — CALL OR WRITE FOR YOUR REQUIREMENT

LOW PROFILE (TIN) SOCKETS

	1-24	25-49	50-100
8 pin LP	.17	.16	.15
14 pin LP	.20	.19	.18
16 pin LP	.22	.21	.20
18 pin LP	.29	.28	.27
20 pin LP	.34	.32	.30
22 pin LP	.37	.36	.35
24 pin LP	.38	.37	.36
28 pin LP	.45	.44	.43
36 pin LP	.60	.59	.58
40 pin LP	.63	.62	.61

SOLDERTAIL STANDARD (TIN)

	1-24	25-49	50-100
14 pin ST	.27	.25	.24
16 pin ST	.30	.27	.25
18 pin ST	.35	.32	.30
24 pin ST	.49	.45	.42
28 pin ST	.99	.90	.81
36 pin ST	1.39	1.26	1.15
40 pin ST	1.59	1.45	1.30

SOLDERTAIL (GOLD) STANDARD

	1-24	25-49	50-100
8 pin SG	.39	.35	.31
14 pin SG	.49	.45	.41
16 pin SG	.54	.49	.44
18 pin SG	.59	.53	.48
24 pin SG	.79	.75	.69
28 pin SG	1.10	1.00	.90
36 pin SG	1.65	1.40	1.26
40 pin SG	1.75	1.59	1.45

WIRE WRAP SOCKETS (GOLD) LEVEL #3

	1-24	25-49	50-100
8 pin WW	.59	.54	.49
10 pin WW	.69	.63	.58
14 pin WW	.79	.73	.67
16 pin WW	.85	.77	.70
18 pin WW	.99	.90	.81
20 pin WW	1.19	1.08	.99
22 pin WW	1.49	1.35	1.23
24 pin WW	1.39	1.26	1.14
28 pin WW	1.69	1.53	1.38
36 pin WW	2.19	1.99	1.79
40 pin WW	2.29	2.09	1.89

1/4 WATT RESISTOR ASSORTMENTS – 5%

ASST. 1	5 ea.	10 Ohm 12 Ohm 15 Ohm 18 Ohm 22 Ohm / 27 Ohm 33 Ohm 39 Ohm 47 Ohm 56 Ohm	50 pcs.	$1.95
ASST. 2	5 ea.	68 Ohm 82 Ohm 100 Ohm 120 Ohm 150 Ohm / 180 Ohm 220 Ohm 270 Ohm 330 Ohm 390 Ohm	50 pcs.	$1.95
ASST. 3	5 ea.	470 Ohm 560 Ohm 680 Ohm 820 Ohm 1K / 1.2K 1.5K 1.8K 2.2K 2.7K	50 pcs.	$1.95
ASST. 4	5 ea.	3.3K 3.9K 4.7K 5.6K 6.8K / 8.2K 10K 12K 15K 18K	50 pcs.	$1.95
ASST. 5	5 ea.	22K 27K 33K 39K 47K / 56K 68K 82K 100K 120K	50 pcs.	$1.95
ASST. 6	5 ea.	150K 180K 220K 270K 330K / 390K 470K 560K 680K 820K	50 pcs.	$1.95
ASST. 7	5 ea.	1M 1.2M 1.5M 1.8M 2.2M / 2.7M 3.3M 3.9M 4.7M 5.6M	50 pcs.	$1.95
ASST. 8R		Includes Resistor Assts. 1-7 (350 pcs.)		$10.95 ea.

$10.00 Minimum Order — U.S. Funds Only
California Residents Add 6% Sales Tax
Postage — Add 5% plus $1.50 Insurance
Send S.A.S.E. for Monthly Sale Flyer!

Spec Sheets — 25¢
Send 85¢ Postage for your *FREE* 1982 JAMECO CATALOG
Prices Subject to Change

NEW 1982 CATALOG

Mail Order Electronics - Worldwide

Jameco ELECTRONICS

1355 SHOREWAY ROAD, BELMONT, CA 94002

PHONE ORDERS WELCOME — (415) 592-8097

3/82

INTERSIL

Part No.	Function	Price
7045IPI	CMOS Precision Timer	14.95
7045EV/Kit*	Stopwatch Chip, XTL	24.95
7106CPL	3½ Digit A/D (LCD Drive)	16.95
7106EV/Kit*	IC, Circuit Board, Display	34.95
7107CPL	3½ Digit A/D (LED Drive)	15.95
7107EV/Kit*	IC, Circuit Board, Display	29.95
7116CPL	3½ Digit A/D LCD Dis. HLD.	18.95
7117CPL	3½ Digit A/D LED Dis. HLD.	17.95
7201IDR	Low Battery Volt Indicator	2.25
7205IPG	CMOS LED Stopwatch/Timer	12.95
7205EV/Kit*	Stopwatch Chip, XTL	19.95
7206CJPE	Tone Generator	5.15
7205CEV/Kit*	Tone Generator Chip, XTL	12.95
7207AIPD	Oscillator Controller	6.50
7207AEV/Kit*	Freq. Counter Chip, XTL	13.95
7208IPI	Seven Decade Counter	17.95
7209IPA	Clock Generator	3.95
7215IPG	4 Func. CMOS Stopwatch CKT	13.95
7215EV/Kit*	4 Func. Stopwatch Chip, XTL	19.95
7216AIJI	8-Digit Univ. Counter C.A.	32.00
7216CIJI	8-Digit Freq. Counter C.A.	26.95
7216DIPI	8-Digit Freq. Counter C.C.	21.95
7217IJI	4-Digit LED Up/Down Counter	12.95
7218CIJI	8-Digit Univ. LED Drive	10.95
7224IPL	LCD 4½ Digit Up Counter DRI	11.25
7226AIJL	8-Digit Univ. Counter	31.95
7226AEV/Kit*	5 Function Counter Chip, XTL	74.95
7240IJE	CMOS Bin Prog. Timer/Counter	4.95
7242IJA	CMOS Divide-by-256 RC Timer	2.05
7250IJE	CMOS BCD Prog. Timer/Counter	6.00
7260IJE	CMOS BCD Prog. Timer/Counter	5.25
7555IPA	CMOS 555 Timer (8 pin)	1.45
7556IPD	CMOS 556 Timer (14 pin)	2.20
7611BCPA	CMOS Op Amp Comparator 5MV	2.25
7612BCPA	CMOS Op Amp Ext. Cmvr. 5MV	2.95
7621BCPA	CMOS Dual Op Amp Comp. 5MV	3.95
7631CCPE	CMOS Tri Op Amp Comp. 10MV	5.35
7641CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7642CCPD	CMOS Quad Op Amp Comp. 10MV	7.50
7660CPA	Voltage Converter	2.95
8038CCPD	Waveform Generator	4.95
8048CCPE	Monolithic Logarithmic Amp	21.60
8069CCQ	50ppm Band—GAP Volt Ref. Diode	2.50
8211CPA	Volt Ref/Indicator	2.95
8212CPA	Volt Ref/Indicator	2.95

74C

74C00	.39
74C02	.39
74C04	.39
74C08	.39
74C10	.39
74C14	.75
74C20	.39
74C30	.39
74C42	1.39
74C48	1.95
74C73	.79
74C74	.79
74C85	1.95
74C86	.99
74C89	6.95
74C90	1.29
74C93	1.29

74C95	1.59
74C107	1.89
74C151	2.95
74C154	3.95
74C157	2.25
74C160	1.69
74C161	1.60
74C162	1.49
74C163	1.69
74C164	1.59
74C173	1.39
74C174	1.39
74C175	1.19
74C192	1.69
74C193	1.69
74C195	1.59

74C221	1.95
74C240	2.25
74C244	2.25
74C373	2.49
74C374	2.59
74C901	.69
74C903	.69
74C911	10.95
74C912	10.95
74C915	1.69
74C917	10.95
74C922	5.49
74C923	5.75
74C925	7.50
74C926	7.50
80C95	.79
80C97	.79

LINEAR

LH0002CN	6.85
LM10CLH	4.50
LM11CLH	4.75
LH0070-OH	4.95
TL071CP	.79
TL072CP	1.39
TL074CN	2.49
LH0082CD	35.80
TL082CP	1.19
TL084CN	2.19
LH0094CD	36.80
LM300H	.99
LM301CN	.35
LM302H	1.95
LM304H	1.95
LM305H	.99
LM307CN	.45
LM308CN	1.00
LM309H	1.95
LM309K	1.25
LM310CN	1.75
LM311/CN	.90
LM312H	2.49
LM317MP	1.15
LM317T	1.75
LM317K	3.95
LM318CN	1.95
LM319N	1.95
LM320K-5	1.35
LM320K-12	1.35
LM320K-15	1.35
LM320T-5	1.25
LM320T-12	1.25
LM320T-15	1.25
LM323K	5.95
LM324N	.99
LM329DZ	.65
LM331N	3.95
LM334Z	1.30
LM335Z	1.40
LM336Z	1.75
LM337T	1.95
LM337MP	1.15
LM338K	6.95
LM339N	.99
LM340K-5	1.35
LM340K-12	1.35
LM340K-15	1.35

LM340T-5	1.25
LM340T-12	1.25
LM340T-15	1.25
LM341P-5	.75
LM341P-12	.75
LM341P-15	.75
LM342P-5	.69
LM342P-12	.69
LM342P-15	.69
LM348N	1.25
LM350K	5.75
LF351N	.60
LF353N	1.00
LF355N	1.10
LF356N	1.10
LM358N	1.00
LM359N	1.79
LM370N	4.49
LM373N	3.25
LM377N	2.95
LM380N	1.25
LM381N	1.79
LM382N	1.79
LM384N	1.95
LM386N-3	1.29
LM387N	1.45
LM389N	1.35
LM392N	.69
LF398N	4.00
LM399H	5.00
TL494CN	4.49
TL496CP	1.75
NE510A	6.00
NE529A	4.95
NE531H	3.95
NE536H	6.00
NE540H	6.00
NE544N	4.95
NE550A	1.30
NE555V	.39
LM556N	.99
NE564N	3.95
LM565N	1.25
LM566CN	1.95
LM567V	1.25
NE570N	4.95

LM702H	.79
LM703CN	.89
LM709N	.29
LM710N	.79
LM711N	.79
LM723N	.69
LM733N	1.00
LM739N	1.19
LM741CN	.35
MC1741SCG	3.00
LM747N	.79
LM748N	.59
LM1014N	2.75
LM1310N	1.95
LM1458CN	.59
LM1488N	1.25
LM1489N	1.25
LM1496N	1.95
LM1556V	1.75
LM1800N	2.95
LM1871N	5.49
LM1872N	5.49
LM1877N-9	3.25
LM1889N	3.20
LM1896N	1.75
LM2002T	1.49
LM2877P	2.05
LM2878P	2.25
LM2896P-1	2.25
LM3189N	2.95
LM3900N	.69
LM3905CN	1.25
LM3909N	1.15
LM3914N	3.95
LM3915N	3.95
LM3916N	3.95
RC4136N	1.25
RC4151NB	3.95
RC4194TK	6.95
RC4195TK	5.49
LM4500A	3.25
ICL8038B	4.95
LM13080N	1.29
LM13600N	1.49
75138N	1.95
75450N	.89
75451CN	.39
75492	.89

CAPACITOR CORNER

50 VOLT CERAMIC DISC CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
10 pf	.08	.06	.05	.001µF	.08	.06	.05
22 pf	.08	.06	.05	.0047µF	.08	.06	.05
47 pf	.08	.06	.05	.01µF	.08	.06	.05
100 pf	.08	.06	.05	.022µF	.09	.07	.06
220 pf	.08	.06	.05	.047µF	.09	.07	.06
470 pf	.08	.06	.05	.1µF	.15	.12	.10

100 VOLT MYLAR FILM CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
.001mf	.12	.10	.07	.022mf	.13	.11	.08
.0022mf	.12	.10	.07	.047mf	.21	.17	.13
.0047mf	.12	.10	.07	.1mf	.27	.23	.17
.01mf	.12	.10	.07	.22mf	.33	.27	.22

+20% DIPPED TANTALUMS (Solid) CAPACITORS

Value	1-9	10-99	100+	Value	1-9	10-99	100+
.1/35V	.39	.34	.29	1.5/35V	.41	.37	.29
.15/35V	.39	.34	.29	2.2/35V	.51	.45	.34
.22/35V	.39	.34	.29	3.3/25V	.53	.47	.37
.33/35V	.39	.34	.29	4.7/25V	.63	.56	.45
.47/35V	.39	.34	.29	6.8/25V	.79	.69	.55
.68/35V	.39	.34	.29	15/25V	1.39	1.25	.95
1.0/35V	.39	.34	.29	22/6V	.79	.69	.55

MINI. ALUMINUM ELECTROLYTIC CAPACITORS

Axial	1-99	100-499	500+	Radial	1-99	100-499	500+
.47/50V	.16	.14	.10	.47/25V	.15	.13	.12
1.0/50V	.19	.16	.12	.47/50V	.16	.14	.13
3.3/50V	.17	.15	.11	1.0/16V	.15	.13	.12
4.7/25V	.18	.15	.11	1.0/25V	.16	.14	.13
10/25V	.18	.15	.11	1.0/50V	.17	.15	.14
10/50V	.19	.16	.12	4.7/16V	.15	.13	.12
22/25V	.19	.16	.12	4.7/25V	.16	.14	.13
22/50V	.24	.20	.18	4.7/50V	.17	.15	.14
47/25V	.25	.21	.19	10/16V	.15	.13	.12
47/50V	.29	.25	.23	10/25V	.16	.14	.13
100/25V	.28	.24	.22	10/50V	.17	.15	.14
100/50V	.41	.37	.34	47/50V	.25	.21	.19
220/25V	.39	.34	.33	100/16V	.21	.17	.14
220/50V	.49	.45	.41	100/25V	.25	.23	.21
470/25V	.54	.49	.45	100/50V	.37	.34	.31
1000/16V	.79	.69	.61	220/16V	.25	.21	.19
2200/16V	.89	.79	.69	470/25V	.35	.31	.27

CIRCLE 4 ON FREE INFORMATION CARD

CPU'S & SUPPORT CHIPS

8080A	3.75	8251	5.75
8085A	7.50	8255	6.95
AMD 2901	8.95	8259	6.95
8202	35.00	8257 (AM9517)	7.95
8212	2.25	8X300	49.00
8214	3.60	Z80A CPU	6.75
8216	2.90	Z80A S10	12.95
8224	3.25	Z80A P10	5.75
MM5307	9.95	TMS 9927 NL	9.95
8226	2.75	8275	16.95
8228	4.50		

RAM's / ROM's

RAM's		ROM's	
8264 (200 NS)	14.00	2708	3.25
2114L-3	1.85	2716 - 5V	6.25
4116-3	1.45	2732	16.95
4116-2	2.25	1702A	4.95
21L02-3	.90	2532	16.95
2102-4	.80	2732	14.95
TMS 3409	1.75	82S23	1.50
MK4027-3	3.50	82S112	2.50
MK4096 11	2.95	82S115	2.50
TMS4045-25	4.50	82S123	1.50
MS4050NL	3.95	82S129	1.50
2101-1	2.45	82S130	1.50
Z6104 4	2.50	82S131	1.50
MK4008P	1.95	82S181	3.00
IM7001	4.95	3628A 3	3.00
5101E	2.95	AM9218C	2.95
2111AL	2.45	8256-5 (74188A)	1.25

UART's

AY5-1013	3.75	M8868A	8.95
TR1602B	3.95	COM2017	3.75
PT1482B	3.25	AY3 8700	2.25

INTERFACE & DRIVERS		SHIFT REGISTERS	
FD1771	19.95	MM1402	1.75
FD1791	34.95	MM1403	1.75
1488	.90	MM1404	1.75
1489	1.10	MM5013	2.50
8130	2.50	MM5016	2.50
8830	2.50	MM5055	2.50
8833	2.50	MM5056	2.50
8834	2.00	MM5057	2.50
8837	2.00	MM5058	2.50
8838	2.00	MM5060	2.50
MM5321	9.50		
MM5369	2.50		

14 PIN HEADERS .... 3/$1.00
16 PIN HEADERS .... .40
24 PIN HEADERS .... .75
40 PIN HEADERS 1.10
50 PIN EDGEBOARD CONN. 3.95
26 PIN EDGEBOARD CONN. 2.50
50 PIN RIGHT ANGLE GONN. 3.95
20 PIN RIGHT ANGLE CONN. 2.25

50 PIN RIBBON CONNECTORS $3.25
40 PIN RIBBON CABLE CONN $2.75
20 PIN RIBBON CABLE CONN $2.25
10 PIN RIBBON CABLE CONN $1.50

PRINTED CIRCUIT BOARD
4" × 6" DOUBLE SIDED EPOXY BOARD 1/16" THICK, $.60 ea. .... 5/$2.60

EPOXY GLASS VECTOR BOARD

1/16" thick with 1/10" spacing
4½" x 6½" $1.95

DATEL'S DAC-08EQ
8 bit DAC — $4.95

CRYSTALS

2.000, 18.432, 20.000 — $4.25 ea.
3.000, 5.000, 8.000, 3.579, 6.000, 10.000, 4.000, 6.144, 18.000 — $3.25 ea.

REDICON SAD 1024 ANALOG DELAY LINE .. $10.95

74S00	30	74S74	70	74S158	1.25
74S02	30	74S86	.60	74S169	1.75
74S03	30	74S89	1.90	74S174	1.40
74S04	40	74S112	85	74S175	1.40
74S05	.45	74S133	1.40	74S194	1.10
74S08	.40	74S135	1.50	74S257	1.50
74S10	30	74S138	1.25	74S258	1.40
74S11	35	74S139	1.10	74S280	1.50
74S15	.40	74S140	1.00	74S280	1.50
74S20	40	74S153	1.10	74S373	2.25
74S30	40	74S151	1.25		
74S32	40	74S157	1.25		

7 WATT LD 65 LASER DIODE(IR) $8.95

25 watt Infra Red Pulse (SG 2006 equiv.) Laser Diode (Spec sheet included) $24.95

2N3820 P FET .... $ .45
2N 5457 N FET .... $ .45
2N2646 UJT .... $ .45
ER 900 TRIGGER DIODES .... 4/$1.00
2N 6028 PROG. UJT .... $ .65

DISC CAPACITORS

.1UF 16V .... 10/$1.00 .... 100/$8.00
.01UF 35V .... 16/$1.00 .... 100/$5.00

IN4148 (IN914) 15/1.00

TANTALUM CAPACITORS

.47UF 35V	5/$1.00	10UF 35V	$ .40
.68UF 35V	5/$1.00	22UF 10V	$ .30
1UF 35V	5/$1.00	15UF 16V	3/$1.00
2.2UF 20V	5/$1.00	30UF 6V	5/$1.00
3.3UF 20V	4/$1.00	33UF 20V	$ .60
4.7UF 35V	4/$1.00	47UF 20V	$ .85
6.8UF 35V	3/$1.00	68UF 10V	$1.00
		120UF 6V	$ .75
		200UF 20V	$1.75

SANKEN AUDIO POWER AMPS

Si 1020 G 20 WATTS . $12.50
Si 1050 G 50 WATTS . $27.50

200 PRV 1A LASCR .95

RS232 CONNECTORS

DB 25P male $2.75
DB 25S female 3.75
HOODS 1.50

C/MOS

4001	.20	4027	.40	4081	.20	74C74	.50
4002	.20	4028	.55	4082	.20	74C76	.70
4006	.65	4029	.75	4093	.60	74C83	1.30
4007	.27	4030	.35	4099	1.75	74C85	1.40
4008	.65	4034	2.25	4501	.95	74C86	.50
4009	.45	4035	.75	4510	.65	74C90	.90
4010	.45	4040	.65	4511	.65	74C93	.95
4011	.20	4042	.65	4514	1.40	74C151	1.75
4012	.20	4043	.65	4515	1.50	74C157	1.75
4013	.30	4044	.55	4516	.75	74C160	1.20
4014	.55	4046	.90	4518	1.25	74C161	1.15
4015	.55	4047	.90	4520	.70	74C163	1.15
4016	.30	4049	.40	4553	2.75	74C165	1.25
4017	.60	4050	.40	74C00	.27	74C173	1.30
4018	.80	4051	.80	74C02	.27	74C174	1.30
4019	.45	4052	.75	74C08	.27	74C175	1.20
4020	.70	4053	.75	74C10	.27	74C192	1.30
4021	.55	4066	.50	74C14	1.20	74C901	.50
4022	.80	4069	.20	74C20	.27	74C914	1.75
4023	.20	4071	.25	74C32	.45		
4024	.45	4072	.20	74C73	.75		
4025	.25	4076	.65				
		4077	.35				

SPECIALS

2114L-4 .... $ 1.75
8 x 300 — SIGNETICS 16 BIT MICROCONTROLLER 49.00
10 ea 8164E 64K RAM (150NS) 99.50

DOUBLE SIDED DIP RIBBON CABLE JUMPER ASSEMBLIES
16 PIN 4" LONG .... $ 2.00
14 PIN 12" LONG .... $ 2.50

RS 232 CABLE

10 Conductor, # 22 color coded wire, gray PVC outer cover, 3/8" diameter .40 per ft. — 100'/$30.00
Add 20% postage for orders under 100'.
Add 10% postage for orders over 100'.

8080A	3.75	4116-2	1.85
Z80A CPU	5.75	TMS9927NL — CRT CONTROLLER	9.95
8264 (4164 2) 64K RAM	14.00	8275 CRT CONTROLLER	16.95
2732 - 32K ROM	14.95	FD1791	34.95
2114-L3	2.50	FD1771	19.95

SPECIALS GOOD THRU MAR. 1982

MINIATURE MULTI-TURN TRIMMING POTS
50, 100, 500, 1K, 5K, 10K, 50K, 250K ... $75 each 3/$2.00

NO. 30 WIRE WRAP WIRE SINGLE STRAND 100' $1.40
40 CONDUCTOR 3M CABLE #28 WIRE $.75/ft.

DIP SWITCHES

CTS 206 4 — 4 POSITION 1.25
CTS 206 7 — 7 POSITION 1.40
CTS 206 8 — 8 POSITION 1.50
CTS 206 10 — 10 POSITION 1.95

TOGGLE SWITCHES
106D — SPDT — 1.10
206D — DPDT — 1.60
206P — DPDT — CENTER OFF $1.75

SCR's

	1.5A	6A	35A	110A
100	.45	.60	1.40	
200	.70	80	1.90	9.00
400	1.20	1.40	2.60	12.00
600		1.80	3.60	15.00

TRIAC's

PRV	1A	10A	25A
100	.45	.80	1.55
200	.84	1.30	2.10
400	1.30	1.90	3.10
600	2.00	2.75	4.30

L1411-IR DETECTOR .... 3/$1.00
FP 100 PHOTO TRANS .... $ .50
RED, YELLOW, GREEN or AMBER LARGE LED's .2" .... 6/$1.00
RED/GREEN BIPOLAR LED's .... $ .55
MLED92 IR LED .... $ .75
MRD148 PHOTO DARL. XTOR .... $ .50
TIL 119OPTO ISOLATOR .... $ .60
IL-5 OPTO ISOLATOR .... $ .45
1 WATT ZENERS: 3.3, 4.7, 5.1, 5.6, 6.8, 8.2, 9.1, 10, 12, 15, 18, or 22V .... 6/$1.00

SFC 3301 — 50 PRV 30A
FAST RECOVERY DIODE (35ns) .. $2.25
20KV 250MA DIODE $1.90

SILICON POWER RECTIFIERS

PRV	1A	3A	12A	50A	125A	240A
100	.06	.14	.35	.90	4.25	6.00
200	.07	.20	.40	1.30	5.25	9.00
400	.09	.25	.65	1.50	6.50	12.00
600	.11	.30	.80	2.00	8.50	15.00
800	.15	.35	1.00	2.50	10.50	18.00
1000	.20	.45	1.25	3.00	12.50	26.00

CLOCK CHIPS

MM5314 .... $4.75 MM5316 .... $4.95
MM5387AA 5.95

.5V at 800ma SOLAR CELLS
3" diameter $4.35

7 SEGMENT DISPLAYS

FSC8024-4 digit		DL-707 C.A. .3"	$ .75
C.C. 8" display	$5.95	DL 747 C.A. .6"	$1.50
FND 503 C.C. .5"	$ .85	FND810 .8" CA	$1.95
FND 510 C.A. .5"	$ .85	FND803 .8" CC	$1.95
DL-704 .3" C.C.	$ .85	MAN 5 C.C. Green	$ .75
		MAN 82 C.A. Yellow	$ .75

TRANSISTOR SPECIALS

2N1307 PNP GE TO 5 .... $ .40
2N404A PNP GE TO-5 .... 3/$1.00
HEP G6014 — PNP GE TO 3 .... $ .85
TIP 111 $ .50 TIP 145 .... $1.35
2N6233 NPN SWITCHING POWER $1.95
MRF-8004 CB RF TRANSISTOR NPN .... $ .75
2N3772 NPN Si TO-3 .... $1.00
2N4908 PNP Si TO-3 .... $1.00
2N3137 NPN Si RF .... $ .55
2N3919 NPN Si TO-3 RF $1.50
2N1420 NPN Si TO-5 .... 3/$1.00
2N2222 NPN Si TO-18 .... 5/$1.00
2N2907 PNP Si TO 18 .... 5/$1.00
2N3055 NPN Si TO-3 .... $ .60
2N3904 NPN Si TO 92 .... 6/$1.00
2N3906 PNP Si TO 92 .... 6/$1.00
2N5296 NPN Si TO 220 .... $ .55
2N6109 PNP Si TO 220 .... $ .55
TIP 31B NPN Si TO 220 .... $ .60
TIP 32B PNP Si TO 220 .... $ .65
TIP 34 PNP Si .... $ .95
TIP 121 PNP Si U84 .... $ .60
TIP 141 NPN Si U97 .... $1.00
MJE 3055 .... $ .85

TTL IC SERIES

7400	.17	7472	.35	74163	.60
7401	.17	7473	.35	74164	.60
7402	.17	7474	.40	74165	.60
7403	.17	7475	.40	74166	.70
7404	.24	7476	.40	74170	1.60
7405	.24	7480	.45	74173	.75
7406	.33	7483	.50	74174	.65
7407	.35	7485	.65	74175	.60
7408	.27	7486	.42	74176	.75
7409	.24	7490	.45	74177	.75
7410	.17	7491	.45	74180	.75
7411	.22	7492	.45	74181	1.90
7412	.30	7493	.45	74182	.45
7413	.42	7494	.60	74190	.70
7414	.50	7495	.60	74191	.75
7416	.33	7496	.60	74192	.70
7417	.37	74107	.35	74193	.79
7420	.17	74121	.35	74194	.85
7425	.30	74122	.39	74195	.45
7426	.33	74123	.42	74196	.75
7427	.30	74125	.45	74197	.75
7430	.17	74126	.45	74273	.85
7432	.27	74145	.75	74279	.60
7437	.27	74148	1.25	74365	.66
7438	.27	74150	1.10	74367	.65
7440	.17	74151	.50	74368	.65
7441	.75	74153	.40	74390	.90
7442	.45	75154	1.10	75324	1.75
7445	.70	74155	.50	75325	1.50
7446	.75	74157	.50	75492	1.05
7447	.65	74160	.85	8T31	2.00
7448	.65	74161	.65	8T32	2.75
7450	.17	74162	.60	9601	.75
				9602	.75
				DS0056H	1.50

FULL WAVE BRIDGE

PRV	2A	6A	25A
100			1.40
200	.80	1.30	2.20
400	1.00	1.65	3.30
600	1.30	1.90	4.40

12V DC RELAYS TTL SIZE
S.P. 1200 ohm coil .95
D.P. 400 ohm coil 1.25

DIP SOCKETS

8 PIN	.17	22 PIN	30
14 PIN	.20	24 PIN	35
16 PIN	.22	28 PIN	40
18 PIN	25	40 PIN	60

74LS SERIES

74LS00	17	74LS93	.39	74LS195	90
74LS01	18	74LS96	.56	74LS196	85
74LS02	22	74LS107	40	74LS197	.85
74LS03	22	74LS108	.38	74LS221	80
74LS04	22	74LS112	38	74LS240	39
74LS05	22	74LS113	45	74LS241	89
74LS08	.20	74LS114	.55	74LS242	89
74LS09	22	74LS123	.59	74LS243	89
74LS10	20	74LS124	1.25	74LS244	1.10
74LS11	22	74LS125	.45	74LS245	1.50
74LS12	22	74LS126	45	74LS247	.75
74LS13	45	74LS132	.50	74LS248	1.10
74LS14	40	74LS136	.45	74LS251	55
74LS15	35	74LS138	.48	74LS253	.56
74LS20	18	74LS139	.48	74LS257	56
74LS21	18	74LS151	40	74LS258	55
74LS22	25	74LS153	40	74LS259	1.10
74LS26	35	74LS155	60	74LS266	60
74LS27	28	74LS156	70	74LS273	1.15
74LS28	45	74LS157	48	74LS279	48
74LS30	18	74LS158	48	74LS280	1.80
74LS32	35	74LS160	75	74LS283	75
74LS37	30	74LS161	58	74LS290	72
74LS38	30	74LS162	.70	74LS365	52
74LS40	40	74LS163	58	74LS366	52
74LS42	.44	74LS164	.58	74LS367	52
74LS47	65	74LS165	75	74LS368	52
74LS51	20	74LS169	1.75	74LS373	1.25
74LS54	20	74LS170	1.50	74LS374	1.25
74LS73	35	74LS173	.59	74LS377	1.25
74LS74	35	74LS174	.45	74LS386	.50
74LS75	35	74LS175	40	74LS390	98
74LS76	45	74LS181	1.95	74LS393	98
74LS83	75	74LS190	72	74LS670	1.80
74LS85	85	74LS191	.72	81LS97	1.10
74LS86	40	74LS192	.65	81LS98	1.10
74LS90	39	74LS193	.60		
74LS92	.45	74LS194	1.10		

LINEAR CIRCUITS

LM201	.75	LM348	90	709	25
LM301/748	30	LM358	.50	710	45
741CV	.25	LM361	1.75	749	95
741C	35	LM377	1.80	711CH	40
747	.50	LM380	95	LM1808	1.75
1456	.80	LM382	.80	LM1889	1.95
1458	.50	LM383	2.50	CA758	1.75
4136	85	LM386	.80	CA3018	1.95
3900	45	LM387	1.25	CA3078	1.50
LM307	.30	LM393	1.00	CA3080	95
LM308	.75	LM553	2.25	CA3086	95
LM324	65	LM555	.45	CA3094	2.25
LM339	65	LM556	85	CA 3140	1.20
LF351	.75	564B	3.95	LM2901	95
LF353	1.25	566	1.40	8038CC	3.90
LF355	1.25	567	85	N5596A	1.50
LF356	1.35			TL062 CP	95
LM311	.50			TL064 CN	1.50
LM318	1.00				

REGULATORS

LM317T	$1.75	78L05	$ .45
LM337	$2.50	LM305G	$ .75
79HGKC-5V at 5A	$6.95	340T-5, 6, 8, 9, 12, 15, 18 or 24V	$ .85
723	$ .50	LAS1412 - 12V 3A	$3.95
320T 5, 12, 15 or 24	$ .90		
78M05	$ .35		

POSTAGE RATES
ADD 10% FOR ORDERS UNDER $20.00
ADD 5% FOR ORDERS BETWEEN $20.00 AND $50.00
ADD 3% FOR ORDERS ABOVE $50.00

TERMS: FOB CAMBRIDGE, MASS. SEND CHECK OR MONEY ORDER. MINIMUM TELEPHONE, C.O.D. PURCHASE ORDER OR CHARGE $20.00 MINIMUM MAIL ORDER $5.00

SEND $.25 FOR OUR CATALOG FEATURING TRANSISTORS & RECTIFIERS. 145 HAMPSHIRE ST., CAMBRIDGE, MASS. 02139

SOLID STATE SALES
P.O. BOX 74D
SOMERVILLE, MASS. 02143

TEL. (617) 547-7053
WE SHIP OVER 95% OF OUR ORDERS WITHIN 24 HOURS OF RECEIPT
TOLL FREE 1-800-343-5230
FOR ORDERS ONLY

---

(602) 266-9758 (602) 266-9758

ARIZONA ELECTRONIC SURPLUS
6835 North 16th Street
Phoenix, Arizona 85016

TV BOX BUILDERS

Sanyo UHF Varactor Tuner	$34.95	LM 301	$.90
Transformer 9 & 16.5V @ 1A	3.45	LM 1458	$1.00
LM 7812	$1.35	LM 380	$1.90
LM 7815	$1.15	NE 565	$1.90
78L15	$1.05	MC1330	$2.40
LM1800	$2.45	MC1350	$1.90
LM1889	$2.75	MC1358	$2.10
		74123	$1.80

*Simple Simon was simple — But this one is a SNAP** ONLY $109.95

PRICE INCLUDES: I.C.s/Resistors/Capacitors/Variable Resistors/Trim Cap/Coils/Transformer Diodes/Regulator/Sony Varactor Tuner

Plus you get a FREE Drilled & Etched 4½x5 Printed Circuit Board w/assembly.

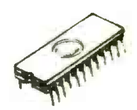
— Instructions with each $109.95 order —

WALL TRANSFORMER $4.45
17V.A.C. — 7.5V.A. with 6 ft. cord

CH3/CH4 Modulator $17.95

MICRO PROCESSOR IC's

Z80 CPU $5.75
Z80 SIO/I $10.95
Z80 DMA $10.95
Z80 PIO $5.00
D2716-6 Intel $3.25
D2708 .... $2.75



EPROM'S

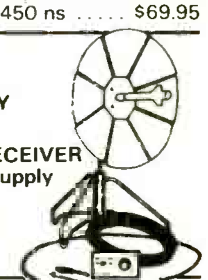
C1702A 2K 1US $7.50
C2708 1K x 8 450 ns $3.50
C2716/1MS2516 (Intel version)
16K 450NS Single 5V Supply $4.75
TMS2532 (T I Pin Out)
32K (4096 x 8) 450 ns $14.95
TMS2546 64K (8K x 8) 450 ns $69.95

HMR II*

6 MO. WARRANTY

HAM MICROWAVE RECEIVER w/Cable & Power Supply

$149.95



ORDERING INSTRUCTIONS *Minimum order $10.00*
C.O.D. Payment by cash or money order, company check.
C.O.D. — $2.25 + $2.35 shipping.
CREDIT CARDS — Master Charge & Visa.
SHIPPING MINIMUM $2.35 + 35¢ per $100.00 for insurance.

**We do not sell these items for the use of receiving subscription type TV transmissions.*

CIRCLE 13 ON FREE INFORMATION CARD
CIRCLE 19 ON FREE INFORMATION CARD

16K Memory

4116-200ns **8/15.95**

ALL MERCHANDISE 100% GUARANTEED!

CALL US FOR VOLUME QUOTES

EPROMS

			Each	8 pcs
1702	256 x 8	(1ns)	4.95	4.50
2708	1024 x 8	(450ns)	2.99	2.75
2758	1024 x 8	(5V) (450ns)	9.95	8.95
TMS2516	2048 x 8	(5V) (450ns)	6.95	5.95
2716	2048 x 8	(5V) (450ns)	5.50	4.95
2716-1	2048 x 8	(5V) (350ns)	9.00	8.50
TMS2716	2048 x 8	(450ns)	9.95	8.95
TMS2532	4096 x 8	(5V) (450ns)	12.95	11.95
2732	4096 x 8	(EV) (450ns) (200ns)	CALL	
2764	8192 x 8	(EV) (450ns)	CALL	

DYNAMIC RAMS

				100 pcs
4027	4096 x 1	(250ns)	2.50	2.00
4116-120	16,384 x 1	(120ns)	8/29.95	CALL
4116-150	16,384 x 1	(150ns)	8/18.95	1.95
4116-200	16,384 x 1	(200ns)	8/15.95	1.80
4116-300	16,384 x 1	(300ns)	8/14.95	1.75
4164	64,536 x 1	(200ns)		CALL

STATIC RAMS

				100 pcs
2101	256 x 4	(450ns)	1.95	1.85
2102-1	1024 x 1	(450ns)	.89	.85
21L02-4	1024 x 1	(LP) (450ns)	1.29	1.15
21L02-2	1024 x 1	(LP) (250ns)	1.69	1.55
2111	256 x 4	(450ns)	2.99	2.49
2112	256 x 4	(450ns)	2.99	2.79
2114	1024 x 4	(450ns)	8/16.95	1.95
2114L-2	1024 x 4	(LP) (200ns)	8/19.95	2.35
2114L-3	1024 x 4	(LP) (300ns)	8/18.95	2.25
2114L-4	1024 x 4	(LP) (450ns)	8/17.95	2.10
2147	4096 x 1	(55ns)	9.95	CALL
TMS4044-4	4096 x 1	(450ns)	3.49	3.25
TMS4044-3	4096 x 1	(300ns)	3.99	3.75
TMS40L44-2	4096 x 1	(LP) (200ns)	4.49	4.25
TMM2016	2048 x 8	(200ns) (150ns)		CALL
HM6116	2048 x 8	(200ns) (150ns) (120ns)		CALL

LP = LOW POWER

CRYSTALS

32.768 KHZ	3.95
1.0 MHZ	4.95
1.8432	4.95
2.0	3.95
2.097152	3.95
2.4576	3.95
3.2768	3.95
3.579545	3.95
4.0	3.95
5.0	3.95
5.0688	3.95
5.185	3.95
5.7143	3.95
6.5536	3.95
8.0	3.95
10.0	3.95
14.31818	3.95
18.0	3.95
18.432	3.95
20.0	3.95
22.1184	3.95
32.0	3.95

March Specials

Z-80A-CPU	6.00
Z-80A-PIO	6.00
8214	2.95
8216	1.50
6800	4.95
6810	3.95

TMS 40L44-20

4096 x 1 low power 200ns RAMS

By Texas Instruments · not equivalent part number made by another manufacturer as sold by others:

4.49 each 125.00/32 pcs.

Specials end March 28, 1982
Please state "March Specials" when ordering

6502

6502	6.95
6502-A	12.95
6504	6.95
6505	8.95
6507	9.95
6520	4.35
6522	9.95
6532	14.95
6551	11.85

Z80

Z80-CPU	8.95
Z80A-CPU	6.00
Z80-P10	6.50
Z80A-P10	6.00
Z80-CTC	5.95
Z80A-CTC	8.65
Z80-DART	15.25
Z80A-DART	18.75
Z80-DMA	17.50
Z80A-DMA	27.50
Z80-S10/0	23.95
Z80A-S10/0	28.95
Z80-S10/1	23.95
Z80A-S10/1	28.95
Z80-S10/2	23.95
Z80A-S10/2	28.95
Z80-S10/09	17.95
Z80A-S10/9	22.95
Z80B-CPU	18.95
Z80B-CTC	17.95
Z80B-P10	17.95
Z8671	39.95
Z6132	34.95

800-538-5000
800-662-6279
(CALIFORNIA RESIDENTS)

CALL JDR BEFORE YOU BUY!
WE WILL BEAT ANY COMPETITORS' PRICES

MISC.

AY5-2376	12.50
11C90	13.95
XR2206	4.95
3242	7.95
3480	9.00
MC4024	3.95
MC4044	4.50
7103	9.50
7106	9.95
7107	12.95
76477	3.95
8038	3.95
95H90	7.99
9602	1.50

DISC CONTROLLERS

1771	24.95
1791	36.95
1793	44.95
1797	54.95

UARTS

AY3-1014	6.95
AY5-1013	3.95
TR1602	4.95
IM6402	7.95

INTERFACE

8T26	1.69
8T28	2.49
8T95	.99
8T96	.99
8T97	.99
8T98	.99
DM8131	2.95
DS8836	1.29

CLOCK CIRCUITS

MM5369	3.95
MM5375	3.95
MSM5832	7.45
7207	7.50
7208	15.95

CONVERTERS

MC1408 L8	4.95
DAC-0800	4.95
ADC-0804	4.95

74LS00 SERIES

				74LS166	2.40	74LS293	1.85
74LS00	.25	74LS85	1.15	74LS168	1.75	74LS295	1.05
74LS01	.25	74LS86	.40	74LS169	1.75	74LS298	1.20
74LS02	.25	74LS90	.65	74LS170	1.75	74LS324	1.75
74LS03	.25	74LS91	.89	74LS173	.80	74LS352	1.55
74LS04	.25	74LS92	.70	74LS174	.95	74LS353	1.55
74LS05	.25	74LS93	.65	74LS175	.95	74LS363	1.35
74LS08	.35	74LS95	.85	74LS181	2.15	74LS364	1.95
74LS10	.25	74LS96	.95	74LS189	9.95	74LS365	.95
74LS11	.35	74LS107	.40	74LS190	1.00	74LS366	.95
74LS12	.35	74LS109	.40	74LS191	1.00	74LS367	.70
74LS13	.45	74LS112	.45	74LS192	.85	74LS368	.70
74LS14	1.00	74LS113	.45	74LS193	.95	74LS373	.99
74LS15	.35	74LS114	.50	74LS194	1.00	74LS374	1.75
74LS20	.25	74LS122	.45	74LS195	.95	74LS377	1.45
74LS21	.35	74LS123	.95	74LS196	.85	74LS378	1.18
74LS22	.25	74LS124	2.99	74LS197	.85	74LS379	1.35
74LS26	.35	74LS125	.95	74LS221	1.20	74LS385	1.90
74LS27	.35	74LS126	.85	74LS240	.99	74LS386	.65
74LS28	.35	74LS132	.75	74LS241	.99	74LS390	1.90
74LS30	.25	74LS136	.55	74LS242	1.85	74LS393	1.90
74LS32	.35	74LS137	.99	74LS243	1.85	74LS395	1.65
74LS33	.55	74LS138	.75	74LS244	.99	74LS399	1.70
74LS37	.55	74LS139	.75	74LS245	1.90	74LS424	2.95
74LS38	.35	74LS145	1.20	74LS247	.76	74LS447	.37
74LS40	.35	74LS147	2.49	74LS248	1.25	74LS490	1.95
74LS42	.55	74LS148	1.35	74LS249	.99	74LS668	1.69
74LS47	.75	74LS151	.75	74LS251	1.30	74LS669	1.89
74LS48	.75	74LS153	.75	74LS253	.85	74LS670	2.20
74LS49	.75	74LS154	2.35	74LS257	.85	74LS674	9.65
74LS51	.25	74LS155	1.15	74LS258	.85	74LS682	3.20
74LS54	.35	74LS156	.95	74LS259	2.85	74LS683	2.30
74LS55	.35	74LS157	.75	74LS260	.65	74LS684	2.40
74LS63	1.25	74LS158	.75	74LS266	.55	74LS685	2.40
74LS73	.40	74LS160	.90	74LS273	1.65	74LS688	2.40
74LS74	.45	74LS161	.95	74LS275	3.35	74LS689	2.40
74LS75	.50	74LS162	.95	74LS279	.55	81LS95	1.69
74LS76	.40	74LS163	.95	74LS280	1.98	81LS96	1.69
74LS78	.50	74LS164	.95	74LS283	1.00	81LS97	1.69
74LS83	.75	74LS165	.95	74LS290	1.25	81LS98	1.69

CMOS

74C00	.35	74C374	2.75	4019	.45	4098	2.49
74C02	.35	74C901	.80	4020	.95	4099	1.95
74C04	.35	74C902	.85	4021	.95	14409	12.95
74C08	.35	74C903	.85	4022	1.15	14410	12.95
74C10	.35	74C905	10.95	4023	.35	14411	11.95
74C14	1.50	74C906	.95	4024	.75	14412	12.95
74C20	.35	74C907	1.00	4025	.35	14419	4.95
74C30	.35	74C908	2.00	4026	1.65	4502	.95
74C32	.50	74C909	2.75	4027	.65	4503	.65
74C42	1.75	74C910	9.95	4028	.80	4508	1.95
74C48	2.10	74C911	10.00	4029	.95	4510	.95
74C73	.65	74C912	10.00	4030	.45	4511	.95
74C74	.85	74C914	1.95	4034	2.95	4512	.95
74C76	.80	74C915	2.00	4035	.85	4514	1.25
74C83	1.95	74C918	2.75	4040	.95	4515	2.25
74C85	1.95	74C920	17.95	4041	1.25	4516	1.55
74C86	.95	74C921	15.95	4042	.75	4518	1.25
74C89	4.50	74C922	5.95	4043	.85	4519	1.25
74C90	1.75	74C923	5.95	4044	.85	4520	1.25
74C93	1.75	74C925	6.75	4046	.95	4522	1.25
74C95	1.75	74C926	7.95	4047	.95	4526	1.25
74C107	1.00	74C927	7.95	4049	.55	4527	1.95
74C150	5.75	74C928	7.95	4050	.55	4528	1.25
74C151	2.25	74C929	19.95	4051	.95	4531	.95
74C154	3.25	74C930	19.95	4053	.95	4532	1.95
74C157	1.75	4000	.35	4060	1.45	4538	1.95
74C160	2.00	4001	.35	4066	.75	4539	1.95
74C161	2.00	4002	.25	4068	.40	4543	2.70
74C162	2.00	4006	.95	4069	.35	4555	.95
76C163	2.00	4007	.29	4070	.35	4556	.95
74C164	2.00	4008	.95	4071	.30	4581	1.95
74C165	2.00	4009	.45	4072	.30	4582	1.95
74C173	2.00	4010	.45	4073	.30	4584	.95
74C174	2.25	4011	.35	4075	.30	4585	.95
74C175	2.25	4012	.25	4076	.95	4702	12.95
74C192	2.25	4013	.45	4078	.30	4724	1.50
74C193	2.25	4014	.95	4081	.30	80C07	.95
74C195	2.25	4015	.95	4082	.30	80C95	.85
74C200	5.75	4016	.45	4085	.95	80C96	.95
74C221	2.25	4017	1.15	4086	.95	80C97	.95
74C373	2.75	4018	.95	4093	.95	80C98	1.20

HOURS: Mon. - Fri., 9 to 5; Sat., 11 to 3

VISIT OUR RETAIL STORE!

master charge VISA

JDR MICRODEVICES, INC.
1224 So. Bascom Ave.
San Jose, CA 95128
800-538-5000 • 800-662-6279 (CA)
(408) 995-5430 • Telex 171-110

TERMS: For shipping include \$2.00 for UPS ground, \$3.00 for UPS Blue Label air. \$10.00 minimum order. Bay Area residents add 6½% sales tax. California residents add 6% sales tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice. Send SASE for complete list.

CIRCLE 11 ON FREE INFORMATION CARD

2716 EPROMS 450NS (5V) 8/4.95 ea.

ALL MERCHANDISE 100% GUARANTEED!

CALL US FOR VOLUME QUOTES

8000

8035	16.95
8039	19.95
8080A	3.95
8085	12.95
8085A-2	16.95
8086	99.95
8088	39.95
8155	11.95
8156	11.95
8185	29.95
8185-2	39.95
8741	39.95
8748	29.95
8755	44.95

6800

6800	5.70
6802	10.95
6808	9.95
6809	24.95
6809E	29.95
6810	4.60
6820	4.95
6821	4.95
6828	9.95
6834	16.95
6840	14.95
6843	42.95
6844	44.95
6845	16.95
6847	15.95
6850	4.75
6852	5.75
6860	10.95
6862	11.95
6875	6.95
6880	2.95
68B00	10.95
68B21	12.95
68B50	12.95

8200

8202	45.00
8205	3.50
8212	1.85
8214	3.85
8216	1.80
8224	2.50
8226	1.80
8228	4.90
8237	19.95
8238	4.95
8239	4.85
8243	4.45
8250	14.95
8251	4.75
8253	9.25
8253-5	9.85
8255	4.75
8255-5	5.25
8257	8.75
8259	6.90
8272	39.95
8275	29.95
8279	9.50
8279-5	10.50
8282	6.65
8283	6.65
8284	5.70
8286	6.65
8287	6.50
8288	25.00
8289	49.95

TV CIRCUITS

MC1330	1.89
MC1350	1.29
MC1358	1.79
LM380	1.29
LM386	1.50
LM565	.99
LM741	.29
LM1310	2.90
LM1800	2.99
LM1889	1.49

APPLE FAN $69.00

- EXTRA PLUG-IN CARDS CAN CAUSE YOUR APPLE TO OVERHEAT
- ULTRA-QUIET APPLE FAN DRAWS COOL AIR THROUGH YOUR COMPUTER
- ELIMINATES DOWN TIME
- SAVES REPAIR CHARGES
- INCREASES RELIABILITY
- CLIPS ON — NO HOLES OR SCREWS
- COLOR MATCHES APPLE
- LONG LIFE, LOW NOISE MOTOR

*APPLE IS A TRADEMARK OF APPLE COMPUTER INC.

EPROM ERASERS

PE-14	78.50
PE-14T (with timer)	108.50
PE-24T (with timer)	154.50

ALL ARE HIGH QUALITY UNITS ENCLOSED IN A BLACK ANODIZED ALUMINUM ENCLOSURE.

OUR AD MAY BE IMITATED BUT OUR SERVICE CAN NEVER BE DUPLICATED.

IC SOCKETS

	1-99	100
8 pin ST	.13	.11
14 pin ST	.15	.12
16 pin ST	.17	.13
18 pin ST	.20	.18
20 pin ST	.29	.27
22 pin ST	.30	.27
24 pin ST	.30	.27
28 pin ST	.40	.32
40 pin ST	.49	.39

ST = SOLDERTAIL

8 pin WW	.59	.49
14 pin WW	.69	.52
16 pin WW	.69	.58
18 pin WW	.99	.90
20 pin WW	1.09	.98
22 pin WW	1.39	1.28
24 pin WW	1.49	1.35
28 pin WW	1.69	1.49
40 pin WW	1.99	1.80

WW = WIREWRAP

CONNECTORS

RS232 MALE	3.25
RS232 FEMALE	3.75
RS232 HOOD	1.25
S-100 ST	3.95
S-100 WW	4.95

DIP SWITCHES

4 POSITION	.85
5 POSITION	.90
6 POSITION	.90
7 POSITION	.95
8 POSITION	.95

TRANSISTORS

PN2222	10/1.00	100/ 8.99
2N2222	.25	50/10.99
2N2907	.25	50/10.99
2N3055	.79	10/ 6.99
2N3904	10/1.00	100/ 8.99
2N3906	10/1.00	100/ 8.99
1N4148 (1N914)		10/ 1.00
1N4004		25/ 1.00

VOLTAGE REG's

7805T	.79	7905T	.89
7808T	.99	7912T	.89
7812T	.79	7915T	1.19
7815T	.99	7924T	1.19
7824T	.99		
7805K	1.39	7905K	1.49
7812K	1.39	7912K	1.49
7815K	1.39	79LO5	.79
78LO5	.69	79L12	.79
78L12	.69	79L15	.79
78L15	.69		
		LM317K	3.95
LM309K	1.49	LM323K	4.95
LM317T	1.95	LM337K	3.95

T = TO-220 K = TO-3 L = TO-92

LINEAR

LM301V	.34
LM308V	.98
LM309K	1.49
LM311	.64
LM317T	1.95
LM317K	3.95
LM318	1.49
LM323K	4.95
LM324	.59
LM337K	3.95
LM339	.99
LM377	2.29
LM380	1.29
LM386V	1.50
LM555V	.39
LM556	.69
LM565	.99
LM566V	1.49
LM567V	1.29
LM723	.49
LM733	.98
LM741V	.29
LM747	.79
LM748V	.59
LM1310	2.90
MC1330V	1.89
MC1350V	1.29
MC1358	1.79
LM1414	1.59
LM1458V	.69
LM1488	.99
LM1489	.99
LM1800	2.99
LM1889	2.49
LM3900	.59
LM3909V	.98
LM3914	3.95
LM3915	3.95
LM3916	3.95
75451V	.39
75452V	.39
75453V	.39

LEDS

Jumbo Red	10/1.00
Jumbo Green	6/1.00
Jumbo Yellow	6/1.00
5082-7760 .43'CC	.79
MAN74 .3'CC	.99
MAN72 .3'CA	.99

74S00 SERIES

74S00	44	74S74	.69	74S163	3.75	74S257	1.39
74S02	48	74S85	2.39	74S168	4.65	74S258	1.49
74S03	48	74S86	1.44	74S169	5.44	74S260	1.83
74S04	.79	74S112	1.59	74S174	1.09	74S274	19.95
74S05	.79	74S113	1.98	74S175	1.09	74S275	19.95
74S08	.48	74S114	1.50	74S181	4.47	74S280	2.90
74S09	.98	74S124	2.77	74S182	2.95	74S287	4.75
74S10	.69	74S132	1.24	74S188	3.95	74S288	4.45
74S11	.88	74S133	.98	74S189	14.95	74S289	6.98
74S15	.70	74S134	.69	74S194	2.95	74S301	6.95
74S20	.68	74S135	1.48	74S195	1.89	74S373	3.45
74S22	.98	74S138	1.08	74S196	4.90	74S374	3.45
74S30	.48	74S139	1.25	74S197	4.25	74S381	7.95
74S32	.98	74S140	1.45	74S201	14.95	74S387	5.75
74S37	1.87	74S151	1.19	74S225	8.95	74S412	2.98
74S38	1.68	74S153	1.19	74S240	3.98	74S471	9.95
74S40	.44	74S157	1.19	74S241	3.75	74S472	16.85
74S51	.78	74S158	1.45	74S244	3.98	74S474	17.85
74S64	.79	74S161	2.85	74S251	1.90	74S482	15.60
74S65	1.25	74S162	3.70	74S253	7.45	74S570	7.80
						74S571	7.80

7400 SERIES

7400	.19	7451	.23	74136	.50	74186	18.50
7401	.19	7453	.23	74141	.65	74190	1.15
7402	.19	7454	.23	74142	2.95	74191	1.15
7403	.19	7460	.23	74143	2.95	74192	.79
7404	.19	7470	.35	74144	2.95	74193	.79
7405	.22	7472	.29	74145	.60	74194	.85
7406	.22	7473	.34	74147	1.75	74195	.85
7407	.22	7474	.35	74148	1.20	74196	.79
7408	.24	7475	.49	74150	1.35	74197	.75
7409	.19	7476	.35	74151	.65	74198	1.35
7410	.19	7480	.59	74152	.65	74199	1.35
7411	.25	7481	1.10	74153	.55	74221	1.35
7412	.30	7482	.95	74154	1.40	74246	1.35
7413	.35	7483	.50	74155	.75	74247	1.25
7414	.55	7485	.65	74156	.65	74248	1.85
7416	.25	7486	.35	74157	.55	74249	1.95
7417	.25	7489	4.95	74159	1.65	74251	.75
7420	.19	7490	.35	74160	.85	74259	2.25
7421	.35	7491	.40	74161	.70	74265	1.35
7422	.29	7492	.50	74162	.85	74273	1.95
7423	.29	7493	.49	74163	.85	74276	1.25
7425	.29	7494	.65	74164	.85	74279	.75
7426	.29	7495	.55	74165	.85	74283	2.00
7427	.29	7496	.70	74166	1.00	74284	3.75
7428	.45	7497	2.75	74167	2.95	74285	3.75
7430	.19	74100	1.00	74170	1.65	74290	.95
7432	.29	74107	.30	74172	5.95	74293	.75
7433	.45	74109	.45	74173	.75	74298	.85
7437	.29	74110	.45	74174	.89	74351	2.25
7438	.29	74111	.55	74175	.89	74365	.65
7440	.19	74116	1.55	74176	.89	74366	.65
7442	.49	74120	1.20	74177	.75	74367	.65
7443	.65	74121	.29	74178	1.15	74368	.65
7444	.69	74122	.45	74179	1.75	74376	2.20
7445	.69	74123	.55	74180	.75	74390	1.75
7446	.59	74125	.45	74181	2.25	74393	1.35
7447	.69	74126	.45	74182	.75	74425	3.15
7448	.69	74128	.55	74184	2.00	74426	.85
7450	.19	74132	.45	74185	2.00	74490	2.55

HOURS: Mon. - Fri., 9 to 5; Sat. 11 to 3

master charge VISA

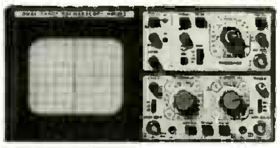
VISIT OUR RETAIL STORE!

JDR MICRODEVICES, INC.
1224 S. Bascom Ave.
San Jose, CA 95128
800-538-5000 • 800-662-6279 (CA)
(408) 995-5430 • Telex 171-110

TERMS: For shipping include $2.00 for UPS Ground, $3.00 for UPS Blue Label Air. $10.00 minimum order. Bay Area residents add 6½% sales tax. California residents add 6% sales tax. We reserve the right to limit quantities and substitute manufacturer. Prices subject to change without notice. Send SASE for complete list.

HAMEG Oscilloscopes to meet every need

20 MHz DUAL TRACE

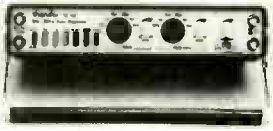


The high performance of the HM203 has been achieved by the optimum use of both discrete semiconductor and integrated circuit technology. Quality and long term reliability are assured through the use of high quality components throughout this instrument. Each unit is supplied with a comprehensive manual which includes operating and servicing instructions, circuit diagrams, and PCB layouts.

- DC-20 MHz • 8 x 10cm Display
- Triggering up to 30 MHz

HM203 .... $580.00
HM203N $600.00

TG105 PULSE GENERATOR



- Period: 200nsec to 200ms (5MHz to 5Hz)
- Pulse Width: 100nsec to 100ms
- 50 ohm output range: 0.1V-10V
- TTL output • Sync. output
- Operating Modes: Run, External trigger, External gate, Manual 1-shot or Gate
- Compliment and square wave

TG105 .... Reg. Price $219.00
★SPECIAL WITH COUPON $195.00★

ANCRONA P.O. Box 2208R, Culver City, CA 90230

★SPECIAL★ COUPON

Bring this Coupon into one of our stores or mail to our Mail Order address shown below and receive the Special Discounts listed on this page with purchases of $50.00 or more.

Offer EXPIRES on April 30, 1982

NAME
ADDRESS
CITY STATE
ZIP PHONE

Coupons accepted only with full name and address filled in

MICROPROCESSOR CONTROLLED EPROM PROGRAMMER

PROGRAMS
VERIFIES
TESTS - COPIES

☐2516 ☐2716 ☐2732 ☐2732A

The K2578 EPROM Programmer is a microprocessor based standalone unit complete with power supply, housing and test socket. The unit comes standard with 16Kbit RAM (2K byte), and is expandable to 32Kbit (4K byte). It has a crystal controlled clock and requires no personality modules. It will program, test, copy or verify the EPROMs listed above.

Model K2578 Regular $649.95 ... Special with Coupon $525.95
Model K2578-Kit Regular $549.95 ... Special with Coupon $425.95

The Sound Choice from KEITHLEY

A smart choice for field service, the 128 beeper DMM is designed for the real world of hard knocks. The audible tone allows rapid troubleshooting. Use it for continuity checks, logic levels or hot tests. Designed for maximum full function flexibility, the 128 is loaded with practical capabilities, not expensive frills.

Model 128
only $139.00
Case/Stand ...$10.00

See/hear display includes a large, 0.6" LCD, over/under array and audible tone.

Beeper operates on all 5 functions — ACV, DCV, ACA, DCA, Ohms — and on all ranges for each function.

Special diode test range permits testing of LEDs and multiple junction components such as darlingtons.

Unique adjustable beeper threshold can be user-set to suite the different requirements of various applications.

Meter maintains 10M Ohm input resistance even with the beeper on.

MINIATURE DOT MATRIX IMPACT PRINTER

MODEL DP-822

The Unique New Printer That Gives You All These Exciting Features.

- Low Cost
- Disposable printing head
- Simple interface
- Handles any type font
- Needs only one 12-volt DC power supply
- Uses standard 2¼" adding machine tape or carbonless paper
- 21-column printing at 25 lines per second
- Easy to install and maintain

Model DP-822 $80.00
★SPECIAL $70.00 WITH COUPON★

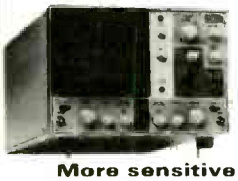
Dot Matrix Printer Control/Drive Card
Model DP-822-08B $125.00

Capacitance Meter

- Easy to use - plug in capacitor, push range button and read the value to 0.1%
- 0.5 in. liquid crystal display
- Exclusive "Δcharge/Δvolt" measurement circuit (patent pending) holds ±0.1% basic accuracy for a full year.
- Up to 200 hrs operation on standard 9V Batt.
- 8 easy pushbutton ranges cover 0.1pf to 1999 microfarads.
- Best of all it's easy on the budget - only

MODEL 938 $185

30 MHz HITACHI



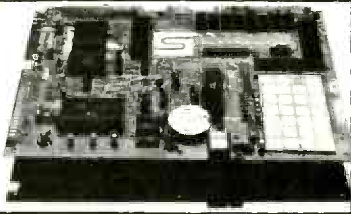
DUAL TRACE PORTABLE OSCILLOSCOPE

MODEL V-302B $995.00

More sensitive to your input
★SPECIAL WITH COUPON $796.00★

Synertek Systems

SYM-1



$239.00

ANCRONA HAS MOTOROLA SEMICONDUCTORS

BFR90	$1.91	MC1373P	$5.19	MC6808P	$13.90	MDA100A	$2.05
BFR91	2.42	MC1391P	1.44	MC6809P	18.85	MDA101A	2.21
CA3054	1.54	MC1408L6	3.84	MC6821P	4.54	MDA200	2.21
CA3059	3.34	MC1408L8	6.55	MC6840P	8.73	MDA204	2.67
CA3079	2.23	MC1455P1	.99	MC6845P	19.90	MDA206	2.99
DAC08CP	3.49	MC1458CP-1	1.08	MC6847P	16.06	MDA2501	4.19
MBD101	.73	MC1458P1	1.08	MC6850L	11.31	MDA2502	4.32
MBD102	.88	MC1488L	1.68	MC6850P	4.40	MDA2504	4.58
MBD201	1.03	MC1489AL	1.89	MC6852P	5.45	MDA3500	4.46
MBD501	1.57	MC1489L	1.68	MC6860P	12.92	MDA3502	4.71
MC1310P	6.29	MC1496G	2.07	MC6875L	13.49	MJE3055T	1.29
MC1330A1P	2.20	MC3325P	2.10	MC10116P	.92	MOC3010	1.91
MC1349P	1.72	MC3340P	2.10	MC14412VP	15.53	MOC3011	2.27
MC1350P	1.44	MC4024P	6.59	MC14495P	3.96	MOC3031	2.93
MC1358P	1.91	MC6800P	8.73	MCM6674P	11.17	MRF901	3.15
MC1372P	6.48	MC6802P	10.13	MCR103	.79	MRF911	3.04

★ SPECIAL 20% DISCOUNT WITH COUPON ★

Z-80 SERIES MICROPROCESSOR IC's

2.5 MHz				4.0 MHz			
		Z-80-DART	$14.30			Z-80A-DART	$15.50
Z-80-CPU	$7.10	Z-80-S10/0	20.10	Z-80A-CPU	$8.05	Z-80A-S10/0	21.15
Z-80-CTC	5.90	Z-80-S10/9	14.50	Z-80A-CTC	6.35	Z-80A-S10/9	15.70
Z-80-P10	5.90	Z80-DMA	21.50	Z-80A-P10	6.35	Z-80A-DMA	22.70

★ SPECIAL 20% DISCOUNT WITH COUPON ★

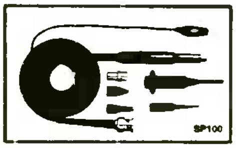
6500 SERIES MICROPROCESSOR IC's

A = (2 MHz) B = (3 MHz) C = (4 MHz)

P6502	$ 8.82	P6506A	$8.82	P6520A	$3.74	P6530-005	$15.84
P6502A	9.66	P6507	8.09	P6820	3.40	P6532	10.82
P6502B	15.02	P6507A	8.82	P68B20	3.74	P6532A	11.87
P6502C	21.00	P6512	8.82	P6521	4.90	P6545-1	17.51
P6503	8.09	P6512A	9.66	P6521A	5.34	P6545A-1	22.44
P6503A	8.82	P6513	8.09	P6821	4.90	P6551	10.71
P6504	8.09	P6513A	8.82	P68B21	5.34	P6551A	11.76
P6504A	8.82	P6514	8.09	P6522	8.40	P6591	40.00
P6505	8.09	P6514A	8.82	P6522A	11.24	P1791-02	40.00
P6505A	8.82	P6515	8.09	P6530-004	15.84	P1793-02	40.00
P6506	8.09	P6520	3.40				

★ SPECIAL 20% DISCOUNT WITH COUPON ★

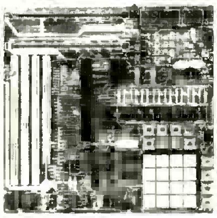
Universal Oscilloscope Probe $36.00



SWITCHABLE X1 and X10 Attenuation Factor

KEY ADDITIONAL FEATURES: • 100MHz bandwidth • Heavy duty tip • Break resistant center conductor • Slender, flexible cable • 6ft. cable length • Wide compensation range • Fits all scopes • Ground reference can be activated at tip • Includes SPRUNG HOOK, I.C. TIP, BNC ADAPTOR, INSULATING TIP and TRIMMER TOOL ACCESSORIES.

SD SYSTEMS Z-80 STARTER KIT



A COMPLETE MICRO-COMPUTER ON A BOARD
Regular $401.00
★SPECIAL with COUPON★ $368.00

FEATURES

- Z-80 CPU with 158 instructions
- On-Board Keyboard and Display
- On-Board PROM Programmer for PROMS (2716, 2758, TI2516)
- Kansas City Standard Cassette Int
- Simple Key Controlled Audio Cassette Load and Dump
- Expansion Provision for Mounting Two S-100 Connectors
- Wire Wrap Area for Custom Circuitry
- Single Step through RAM or PROM
- Memory Examine and Change
- Port Examine and Change
- Z-80 CPU Register and Change
- 2K Byte ZBUG Monitor in ROM
- 1K Bytes of RAM (expandable to 2K)
- 4 Channel Hardware Counter/Timer
- Two Bi-Directional 8-Bit I/O Ports
- Up to 5 Programmable Breakpoints
- Switch Selectable PROM or Monitor Restart
- Vectored Interrupts provided by Z-80-CTC and Z-80-P10

ANCRONA

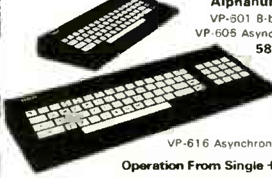
P.O. BOX 2208R, CULVER CITY, CA 90230

STORES DO NOT ACCEPT MAIL ORDERS **MAIL ORDER**

PHONE ORDERS: (213) 641-4064

Minimum Order $10.00. Add $2.00 to cover postage and handling. Master Charge and VISA welcomed. Please include your charge card number, interbank number and expiration date. Some items are subject to prior sale. Not responsible for typos. Store pricing may vary from Mail Order pricing. We reserve the right to substitute manufacturer.

Full ASCII Encoded Keyboards



RCA 128-Character, 58-Key Typewritter Format for Alphanumeric Entry

VP-601 8-bit parallel output $69.00
VP-606 Async serial output $99.00

58-Key Typewritter Format Plus Calculator-Type Keypad for Fast Numeric Entry

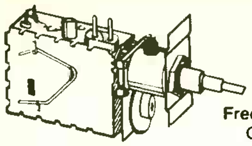
VIP-611 8-bit parallel output $89.00
VP-616 Asynchronus serial output ... $119.00

Operation From Single +5 Volt Supply

VISIT A STORE NEAR YOU TODAY - We stock a large selection of Technical Books, Discrete Components, Integrated Circuits, Test Equipment and Electronic Supplies.

ATLANTA	CULVER CITY	HOUSTON	PORTLAND	SANTA ANA	SUNNYVALE	TUCSON
3330 Piedmont Rd. N.E.	11080 Jefferson Blvd.	2649 Richmond	1125 N.E. 82nd Ave.	1300 E. Edinger Ave.	1054 E. El Camino Real	4518 E. Broadway
Atlanta, GA 30305	Culver City, CA 90230	Houston, TX 77098	Portland, OR 97220	Santa Ana, CA 92705	Sunnyvale, CA 94087	Tucson, AZ 85711
(404) 261-7100	(213) 390-3595	(713) 529-3489	(503) 257-9464	(714) 547-8424	(408) 243-4121	(602) 881-2348

MORE GAIN
THAN A VARACTOR UHF TUNER



We start with a Mechanical UHF Tuner, add 2 coils and a diode, then peak it on our Spectrum Analyzer for maximum gain.

Frequency Range 470-899 MHz channels 14-83
Output Channel 3. Available on request: Ch 2 or 4.

PART NO.	DESCRIPTION	PRICE
B20	Modified High Gain UHF Tuner	$15.00
B21	Pre-Drilled circuit board, screen printed layout, soldrmast on foil side, needs only one jumper	$17.00
B22	Complete parts kit includes: All resistors (30), PCB Potentiometers (1-5K, 3-10K), Power Transformer (1A/24v), Panel Mount Potentiometer (10K), Integrated Circuits (7), Diodes (4), Voltage Regulator, Heat Sink, Electrolytic Capacitors (6), Disc Capacitors (35), Variable Capacitors (4), Coil Kit with #26 wire (4), IC Sockets (4-8 pin, 3-14 pin), Speaker (4", 3 oz), Standoffs, Hookup Wire, All misc. Hardware and the most complete and comprehensive 17 page instruction manual we have seen. All items individually packaged	$80.00

When ordering 3 above items $110.00
Order 5 each of the 3 items .... $ 95.00/set
Order 10 each of the 3 items .... $ 85.00/set

ACCESSORIES, AMPLIFIERS

A02	New 2 stage 28 db gain amplifier	Kit $18.00 / Assembled $25.00
A03	New 14 db Gain single stage amp	Kit $10.50 / Assembled $15.50
A04	75-300 ohm matching transformer	$ 1.15
F-59	Coaxial connectors	$ 0.35

Mail order only.
Send check or money order to:

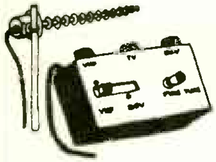
GILCO INTERNATIONAL, INC.
P.O. Box 8817,
Coral Gables, FL 33124
Tel. (305) 823-5891 For COD orders

Minimum order $25.00.
Add 10% shipping and handling.
Florida orders will not be accepted.
For orders over $50, Add 5%.

MICROWAVE TV CONVERTERS

MODEL DCV-1-A

DOWN CONVERTER/ANTENNA COMBINATION



- 2 MICROWAVE PREAMP STAGES for maximum gain
- ONE PIECE CONSTRUCTION simplifies installation
- ALUMINUM AND ZINC PLATED STEEL for durability
- BUILT IN A/B SWITCH with more than 95dB isolation
- 2.1–2.6 GHz Covers all ham, commercial and ITFS channels

Years of enjoyment are yours with our model DCV-1-A. Two preamp stages coupled with the yagi antenna/housing provide a typical system gain of 53dB.

YOU GET: 75' downlead
3' jumper
300 ohm matching transformer
detailed instructions

ASSEMBLED & TESTED
LIST – $175.00
ONLY $149.95
INTRODUCTORY PRICE

WE CARRY A COMPLETE LINE INCLUDING PARABOLICS

DEALER INQUIRIES INVITED

TRITON MARKETING CORP.
1933 ROCKAWAY PARKWAY
BROOKLYN, N.Y. 11236
212-531-9004

POLY PAKS

FREE!
1982 DISCOUNT ELECTRONICS CATALOG

JOIN THE PAK!

Send for our Free catalog and become a member of our exclusive Pak. Our members receive Poly Paks' exciting catalog several times a year. We offer: Penny Sales, Free Premiums and Low, Low Prices on a wide variety of Electronic Products such as Computer Peripherals, Integrated Circuits, Speakers, Audio Equipment, Rechargeable Batteries, Solar Products, Semiconductors, and much, much more! Take advantage of our 25 years as America's foremost Supplier of discount electronics.

Over 4.5 Million Satisfied Customers

RUSH ME YOUR FREE DISCOUNT CATALOG!

NAME: ____________
ADDRESS: ____________
CITY: ____________
STATE: ____________ ZIP: ____________

CLIP AND MAIL COUPON TODAY TO:
POLY PAKS, INC.
P.O. Box 942, RA-3
S. LYNNFIELD, MA. 01940 (617) 245-3828

CIRCLE 32 ON FREE INFORMATION CARD

Limited time, Introductory offer!

Assembled
~~$299.95~~
$249.95

KIT
~~$249.95~~
$219.95

PACCOM 8085A
TRAINING UNIT

Rated Best Value by instructors!

LEARN COMPUTING FROM THE GROUND UP!
- Design and code microprocessor software.
- Use logic and bit manipulation techniques.
- Enter and execute programs on your own computer.
- Understand microprocessor architecture.
- Control programmable input/output ports.
- Implement real-time interrupt and data transfer. Design your own micro-computer.

Comes to you complete:
- Step by step instruction manual, operators manual.
- 8085A sub-routine manual, 352 pg. Cookbook.
- 334 pg. Software Des. book, 190 programs.
- Fully expandable, deluxe operating system.

Hardware includes:
- Fully assembled, tested 8085A unit.
- CPU circuitry with 44 pin connector.
- User determined BUS system.
- Wire wrap area for buffers, gates, etc.
- Two EPROM sockets.

ETRONIX 14803 NE 40th, DEPT RE382 Redmond, WA 98052

CALL **1-800-426-1044** TOLL-FREE
☐ SEND FREE INTRO PLUS PARTS LIST

CIRCLE 33 ON FREE INFORMATION CARD

SCR SUPER-BUYS

① **FREE SCRAMBLER PLANS** plus a brochure describing our new UHF-VHF Conversion Kit are yours just by sending us your name, address and a 20c stamp. — **FREE**

② **9-INCH BLACK AND WHITE CRT MONITOR.** Ideal for microcomputer or security use. 22 transistors. Designed for excellent resolution. Frequency response — 12 MHz. Continuous DC restoration for superior contrast. **List Price $225.00 each.** — Our Factory Direct Price **$165.00 ea.**

③ **UHF-VHF CONVERSION KIT.** Complete with PC board; all required components; cabinet with speaker; and comprehensive brochure incl. schematic, board layout, mounting and hook-up diagrams, parts list and assembly and set-up instructions. All parts are industrial prime quality. — Our Own Famous Kit **$119.95 ea.**

④ **NEW ZENITH ZVM-121 HIGH-LEGIBILITY CRT MONITOR.** Features 12'' green phosphor CRT, with 15 MHz Bandwidth. 40 or 80 character widths are operator switch-selectable. Fully compatible with 80-column Apple cards, etc. — Our Factory Direct Price **$117.95 ea.**

⑤ **MITSUMI VARACTOR-TUNER.** Channels 15-82. Modified for kit use. — **$30.00 ea.**
Standard versions. — **$28.00 ea.**

SCR ELECTRONICS INC. (714) 527-2554 • (213) 598-7553
5303 Lincoln Ave., Cypress, CA 90630

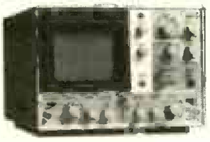
$10.00 MIN. ORDER HANDLING/SHIPPING $5.00
Pay by CHECK, M.O., VISA, M/C, C.O.D.
UPS ANYWHERE IN CONTINENTAL U.S.
For Free Buyers Guide Catalog Circle No. 79

CIRCLE 35 ON FREE INFORMATION CARD

UNBELIEVABLE!

HITACHI
30 MHZ DUAL TRACE OSCILLOSCOPE

AT THE LOWEST PRICES YOU CAN FIND!



Model V302B

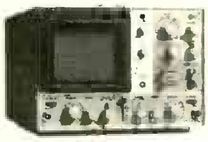
List 995.00

Sale 815.00

See below for freight allowance

- Signal delay line
- 5" CRT
- 12 ns rise time
- TV sync separator
- 1 mV/division sensitivity (max.)
- Vertical magnifier (x5)
- Sweep magnifier (x10)
- X-Y operation
- Front panel trace rotation
- CH1, CH2, Add, Diff. display modes
- "Z" axis (intensity) modulation
- Two years parts and labor warranty
- Two -X10 probes included!

15 MHz dual trace
AN EVEN GREATER VALUE!



Model V152B

List 735.00

Sale 599.95

- 5" CRT
- 24 ns rise time
- TV Sync separator
- 1 mV/div sensitivity to 5 MHz
- Vertical and sweep magnifiers
- Front panel trace rotation
- Five modes of vertical deflection
- Two years parts and labor warranty
- Two -X10 probes included

ALL OTHER HITACHI SCOPES ON SALE

50 MHz, 100 MHz, 35 MHz, 20 MHz. Call for details
Also available:
Leader Instruments, Beckman, Univolt, Fluke, and other quality test equipment.

To order call toll free: (800) 423-5336
In Calif. (800) 423-5336
Local, Alaska, Hawaii (213) 701-5848

A DIV. OF ALLIANCE RESEARCH CORP

ORA Electronics

18215 Parthenia St. Northridge, CA 91325

TERMS: All items are subject to prior sale. Limited quantity on hand.
Payment: Visa, Mastercard accepted. Exact freight and insurance will be added.
C.O.D. orders accepted from recognized businesses.
Prepaid orders: Payment must be made with U.S. currency. Orders paid with personal or company check will be held for check to clear.
Free freight policy: Prepaid orders paid by cashiers check will be shipped UPS freight free to any point in the continental U.S. (Alaska, Hawaii, Canada excluded.)

BUY of the YEAR!!!

Parallel, TTL Input WORD PROCESSOR I/O "Selectric"® TYPEWRITER/PRINTER

The manufacturer put 'em into storage to depreciate 'em... Now they're FINALLY AVAILABLE!! Removed from working systems, these fantastic machines have built-in driver and decoder circuitry and take TTL level, 6-bit character, plus 4-bit function input signals... Easily driven by most any micro. Use as a typewriter (with minor 'repeat' circuitry) or as a KSR I/O printer or both. Requires 115, 60Hz for typewriter motor, 5 VDC for TTL and 24 VDC for solenoids. "Table top" style case. Each "Selectric"* I/O machine is complete and in *operational condition!* Includes schematics, data, case, platen and ribbon. (Type element not included).

New Type Element .... $21.00 ea. I/O Selectric .... **$399.00 ea.**

Add $20 for Packaging and Handling - Pay Shipping on Delivery

WORD PROCESSOR CPU ASSEMBLY

Linked to and used with the above machine, this unit completes a system which originally sold for over $3000.00 each! Features include: standard cassette deck, auto centering, auto repeat, auto underline, suppressed notations, record/playback, auto merge, editing, margin adjusting and much, much more. Parts include tape or "mag" card deck, cabinet, fans, power supply, mother board, connectors, cables, LEDS and more. Worth much more than our price for the parts alone. Includes schematics and data. Tested and functional.

.... **Only $199.00 ea.**

Add $20 for Pkg. and Handling - Pay Shipping on Delivery

Additional Cassette or 'Mag' Card Ass'bly
Add-on package includes everything you need to add on the second deck. Easy to retrofit.
.... **Only $199.00 ea.**

New, Unused Cassettes or 'Mag' Cards
For above Word Processor.
Tape Cassette .... **$7.99 ea., 10/$69.00**
'Mag' Card .... **$2.49 ea., 10/$19.00**

We Offer New and Used FLOPPY DRIVES, DISK DRIVES, PRINTERS, & MORE at BARGAIN PRICES!!! Ask for our Latest Flyer Listing NOW!

COMPUTERS, PERIPHERALS, UNLIMITED!

WAREHOUSE:
18 Granite St., Haverhill, Mass. 01830
MAIL ORDER:
Box 204, Newton, N.H. 03858
TELEPHONE ORDERS:
617/372-8637
Sorry, No Collect Calls
MasterCharge & VISA Accepted

CIRCLE 28 ON FREE INFORMATION CARD

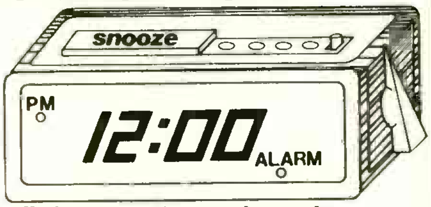
Components Express, Inc.

"Have you kissed your computer lately?"

1380 E. Edinger, Unit CC Santa Ana, CA 92705 (714) 558-3972

BROAD BAND MICROWAVE RECEIVER SYSTEM 1.8GHZ to 2.4 GHZ

only
$295.



With built-in-converter to channel 2, 3, or 4 of any standard TV set.

- 24" Dish
- Feed-Horn Receiver
- Mounting Bracket
- Mounting Clamp
- Instructions
- 300 Ohm to 75 Ohm Adapter
- 750 Ohm to 300 Ohm Adapter
- 60 Feet Coax Cable with Connectors
- 3 Feet Coax Cable with Connectors

RANGE: Line of sight to 250 miles.
SCOPE: Will receive within the frequency band from satelites, primary microwave stations, and repeater microwave booster stations.
CONTENTS: Completely packaged in 19"x19"x4 1/2" corrugated carton complete with list.
WARRANTY:
180 days for all factory defects and electronic failures for normal useage and handling. Defective sub assemblies will be replaced with new or re-manufactured sub assembly on a 48 hour exchange guarantee.

This system is not a kit and requires no additional devices or equipment other than a TV set to place in operation.

Dealer inquiries invited.

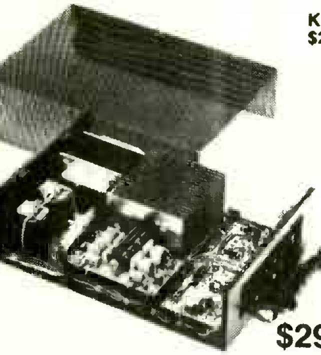
CIRCLE 17 ON FREE INFORMATION CARD

FUJITECH AUDIO KITS

LATEST AUDIO TECHNOLOGY FROM JAPAN

Model A501 Power Amp
- Pure Class A 25W + 25W
- Switchable to Class AB 100W + 100W
- Switchable to Bridge Class A 100W mono
- Switchable to Bridge Class AB 300W mono
- Frequency Response 5-200KHz (-1dB)
- Signal-to-Noise Ratio 120dB
- Non-magnetic Chassis
- "Out-board" comprehensive protection circuitry
- DC circuitry with limited use of NFB
- High Efficiency Fluid Convection Cooling
- THD under 0.007%

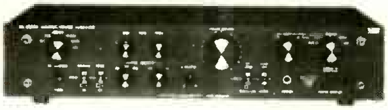
KIT ONLY $299.00



$299.00

Model A502 DC Stereo Control Center
- Direct DC coupling from Input to Output
- DC servo circuitry
- Cascade FET Input in all stages
- Separate Moving Coil RIAA amplifier
- Distortion below 0.005% (3V)
- Max Output 15V
- Frequency Response 20Hz-20KHz ±0.2 dB
- Maximum Phono Input
  MC = 16mv RMS (1KHz)
  MM = 270mv RMS (1KHz)
- Built-in Headphone amplifier
- Relay Output Muting

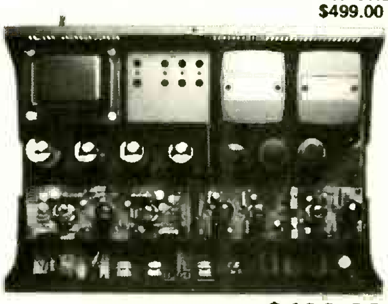
KIT ONLY $349.00



$349.00

Model A1033 Integrated Tube Amplifier
- Latest Japanese Design
- Distortionless Output Transformer using special winding techniques
- Most circuitry on PCB for easy assembly and humfree performance
- Output 30W × 2 Ultra Linear (Switchable to Triode) 15W × 2 Triode Output (near class A performance)
- THD under 0.4%
- Frequency Response 30~30,000 Hz (-1dB)
- Separate Pre-Out and Main-In

KIT ONLY $499.00

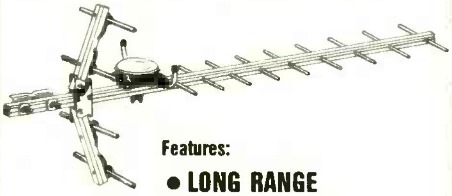


$499.00

Send $5.00 for each assembly manual, refundable with order.

Monarchy Engineering, Inc.
380 Swift Avenue, Unit 21
South San Francisco, CA 94080
Visa or Mastercharge acceptable.

INTRODUCING OUR NEW STVA 14 ELEMENT CORNER REFLECTOR YAGI ANTENNA



Features:
- **LONG RANGE**
- **14.5 dB GAIN**
- **SELECTABLE 75 or 300 Ohm IMPEDANCE**
- **NARROW PATTERN for adjacent interference rejection**
- **ANODIZED FINISH**
- **STURDY CONSTRUCTION**

STVA-3 14.5 dB Selectable Corner Yagi Cut for Channels 60 thru 68. . . . **$16.95**
STVA-4 14.5 dB Selectable Corner Yagi Cut for Channels 44 thru 52. . . . **$16.95**

VTR ACCESSORIES

SIMPLE SIMON VIDEO STABILIZER

Model VS-125

Simple Simon Video Stabilizer, Model VS-125, eliminates the vertical roll and jitter from "copy guard" video tapes when playing through large screen projectors or on another VTR. Simple to use, just adjust the lock control for a stable picture. Once the control is set, the tape will play all the way through without further adjustments. Includes 12V power supply.

VS-125 Video Stabilizer wired **$54.95**

SIMPLE SIMON VIDEO SWITCHING BOX

Model VSB-300

The Affordable Video Control Center!

Excellent in isolation and no loss routing system. Simple Simons VSB-300 Video Switching Box enables you to bring a variety of video components together for easy viewing/dubbing. Also you gain the ability to record one channel while viewing another. Unit includes two F-type quick connector ended cables.

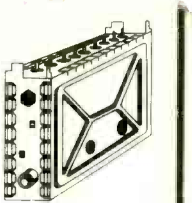
VSB-300 Video Switching Box wired **$19.95**

SIMPLE SIMON EL… 7 + 11 SWD…

MITSUMI VARACTOR UHF TUNER

Model UES-A56F

$34.95

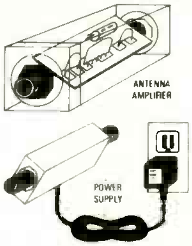


Freq. Range UHF470 - 889MHz
Antenna Input 75 ohms
Channels 14-83 Output Channel 3

KIT NO	PART NO	DESCRIPTION	PRICE
1	VT1-SW	Varactor UHF Tuner, Model UES-A56F	$34.95
2	CB1-SW	Printed Circuit Board, Pre-Drilled	18.95
3	TP7-SW	P.C.B. Potentiometers, 1-20K, 1-1K, and 5-10K ohms, 7-pieces	5.95
4	FR35-SW	Resistor Kit, ¼ Watt, 5% Carbon Film, 32-pieces	4.95
5	PT1-SW	Power Transformer, PRI-117VAC, SEC-24VAC, 250ma	6.95
6	PP2-SW	Panel Mount Potentiometers and Knobs, 1-1KBT and 1-5KAT w/Switch	5.95
7	SS14-SW	IC's 7-pcs, Diodes 4-pcs, Regulators 2-pcs Heat Sink 1-piece	29.95
8	CE9-SW	Electrolytic Capacitor Kit, 9-pieces	5.95
9	CC33-SW	Ceramic Disk Capacitor Kit, 50 W.V., 33-pieces	7.95
10	CT-SW	Varible Ceramic Trimmer Capacitor Kit, 5-65pfd, 6-pieces	5.95
11	L4-SW	Coil Kit, 18mhs 2-pieces, .22µhs 1-piece (prewound inductors) and 1 T37-12 Ferrite Torroid Core with 3 ft. of #26 wire.	5.00
12	ICS-SW	I.C. Sockets, Tin inlay, 8-pin 5-pieces and 14-pin 2-pieces	1.95
13	SR-SW	Speaker, 4x6" Oval and Prepunched Wood Enclosure	14.95
14	MISC-SW	Misc. Parts Kit Includes Hardware, (6/32, 8/32 Nuts, & Bolts), Hookup Wire, Ant. Terms, DPDT Ant. Switch, Fuse, Fuseholder, etc.	9.95

When Ordering All Items, (1 thru 14), Total Price 139.95

UHF ANTENNAS and ACCESSORIES



ZYZZX

VHF-UHF WIDEBAND ANTENNA AMPLIFIER

MODEL ALL-1
50 MHz — 900 MHz
12 dB GAIN ± 0.5dB

A Revolutionary New One Stage HYBRID IC Broadband Amplifier

This unit is not available anywhere else in the world. One unit serves many purposes and is available in Kit or Assembled form. Ideal for outdoor or indoor use. Input-output impedance is 75 ohms. Amplifier includes separate co-ax feed power supply. Easily assembled in 25 minutes. No coils, capacitors etc. to tune or adjust.

ALL-1 Complete Kit with power supply $24.95
ALL-1 Wired and Tested with power supply $34.95

Our New STVA 14.5 dB GAIN, 14 ELEMENT CORNER REFLECTOR YAGI ANTENNA

STVA-3 Yagi Antenna, 14.5 dB, 75 ohm, Chan. 60-68 . . . $16.95
STVA-4 Yagi Antenna, 14.5 dB, 75 ohm, Chan. 44-52 . . . $16.95

STVA-1 Yagi Antenna, 11.5 dB, 75 ohm, Chan. 42-54 . . . . $9.95
STVA-2 Yagi Antenna, 11.5 dB, 75 ohm, Chan. 20-28 . . . . $9.95

RG-59/U	75 ohm Low Loss Coax Cable	$ .12 p/ft
F-59	Coaxial Connectors, ea	.39
MT-1	Special UHF 75-300 ohm Matching Transformer, ea.	1.45
ALL-1	HYBRID IC Wideband VHF-UHF-FM Antenna Amplifier Kit	24.95
ALL-1	HYBRID IC Wideband VHF-UHF-FM Ant. Amp. Assembled	34.95

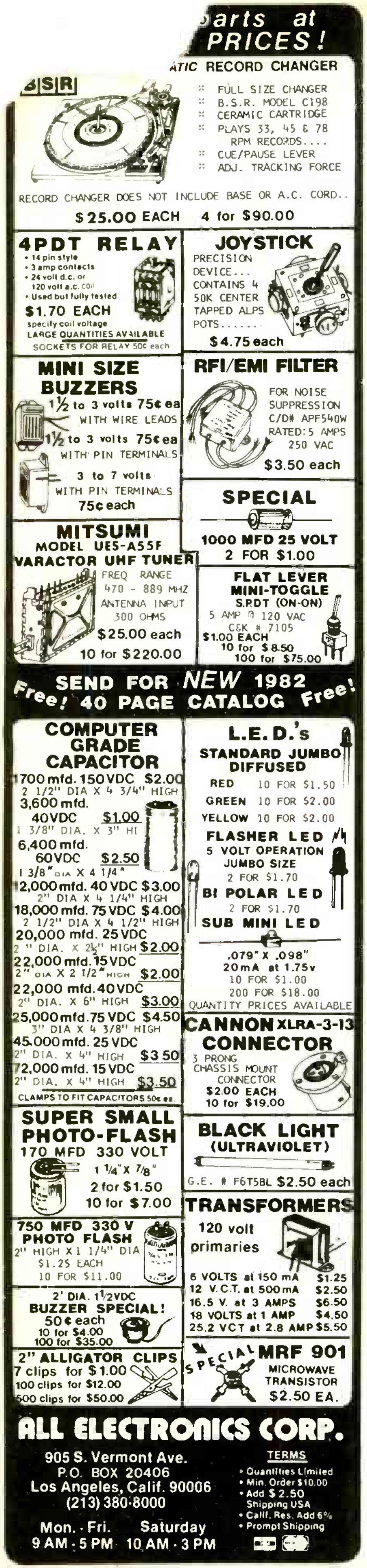
Available by Mail Order Only — Send Check or Money Order To:

SIMPLE SIMON ELECTRONIC KITS,™ Inc.

Calif. Orders:
3871 S. Valley View, Suite 12
Las Vegas, Nevada 89103
Tel: (702) 322-5273

All Other Orders:
11850 S. Hawthorne, Blvd.
Hawthorne, Calif. 90250
Tel: (213) 675-3347

Minimum Order: $16.95. Add 10% Shipping and Handling on orders under $40.00. For orders over $40.00, add 5%. Minimum Shipping and Handling $2.00. **Catalog $1.00.**
— VISA and Mastercard Acceptable —



ADVERTISING INDEX

RADIO-ELECTRONICS does not assume any responsibility for errors that may appear in the index below.

MOVING?

Don't miss a single copy of **Radio-Electronics.** Give us:

Six weeks' notice

Your old address and zip code

Your new address and zip code

ATTACH LABEL HERE

name (please print)

address

city state zip code

Mail to: Radio-Electronics
SUBSCRIPTION DEPT., P.O. BOX 2520,
BOULDER, COLO. 80322

4TH 1981 A PROFESSIONAL
DENT TESTING LABORATORY
K40 THE HIGHEST PERFORMANC
RADAR DETECTOR IN THE WORLD!

1 ESCORT, WHISTLER, FOX, JR. MICROWAVE, SUPER SNOOPER AND FUZZBUSTER ALL COMPETED IN THE CONTEST.

2 THE BRAND NEW K40 RADAR DETECTOR USING A UNIQUE WAVE GUIDE COUPLED DIE CAST ANTENNA DETECTED X BAND RADAR AN AVERAGE OF 54% FURTHER THAN ALL OTHER DETECTORS AND 67% FURTHER ON THE K BAND FREQUENCY.

OUTPERFORMS ESCORT

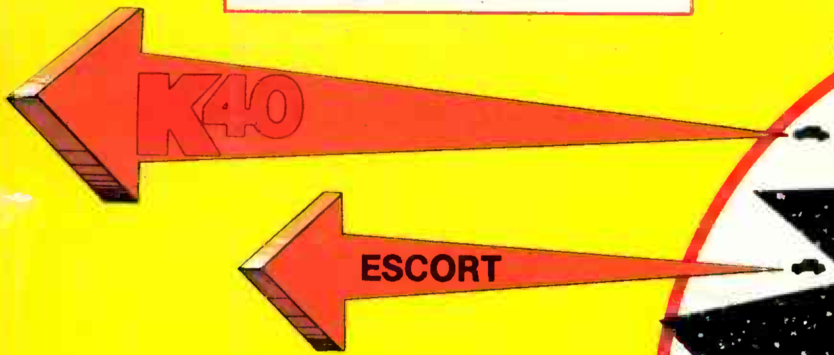
THE K40 OUTPERFORMED THE ESCORT 17% ON K-BAND AND 34% ON X-BAND. THE K40 AVERAGED 28% MORE DISTANCE THAN ESCORT AND 60% FURTHER THAN ALL OTHERS COMBINED.

3 HERE'S THE TEST* THAT PROVED IT!

TEST RESULTS

MANUFACTURER	COMBINED X & K-BAND DISTANCE FROM GUN
K40	2.96 MILES
ESCORT	2.30 MILES
GUL	2.28 MILES
BEL	2.52 MILES
RADAR INTERCEPTOR	1.92 MILES
WHISTLER Q1000	1.43 MILES
AUTOTRONICS	1.30 MILES
FOX	1.25 MILES

*April 24, 1981 TKI International



K40 THE WORLD'S HIGHEST PERFORMANCE RADAR DETECTOR

$380.00

IT COSTS MORE BECAUSE IT'S MADE BETTER!

DOUBLE GUARANTEE

GUARANTEE I: We're so convinced our K40 Radar Detector will intercept Police Radar Better Than Any Commercial Radar Device, we'll allow you to test our K40 in your car for 7 days . . . if not satisfied with its performance, return to your K40 dealer who installed it for a prompt and full refund.

GUARANTEE II: Unconditionally guaranteed for 12 months. Guaranteed against cracking, chipping or rusting. Guaranteed against mechanical failure. Guaranteed against electrical failure. No exclusions. No gimmicks. For a FULL 12 MONTHS.

CALL 800-323-5608 (ILLINOIS-800-942-8175) FOR THE DEALER NEAREST YOU.

AMERICAN ANTENNA
ELGIN, ILLINOIS 60120

. . . Sold exclusively by 3500 American CB Dealers throughout the U.S. & Canada.

CIRCLE 38 ON FREE INFORMATION CARD