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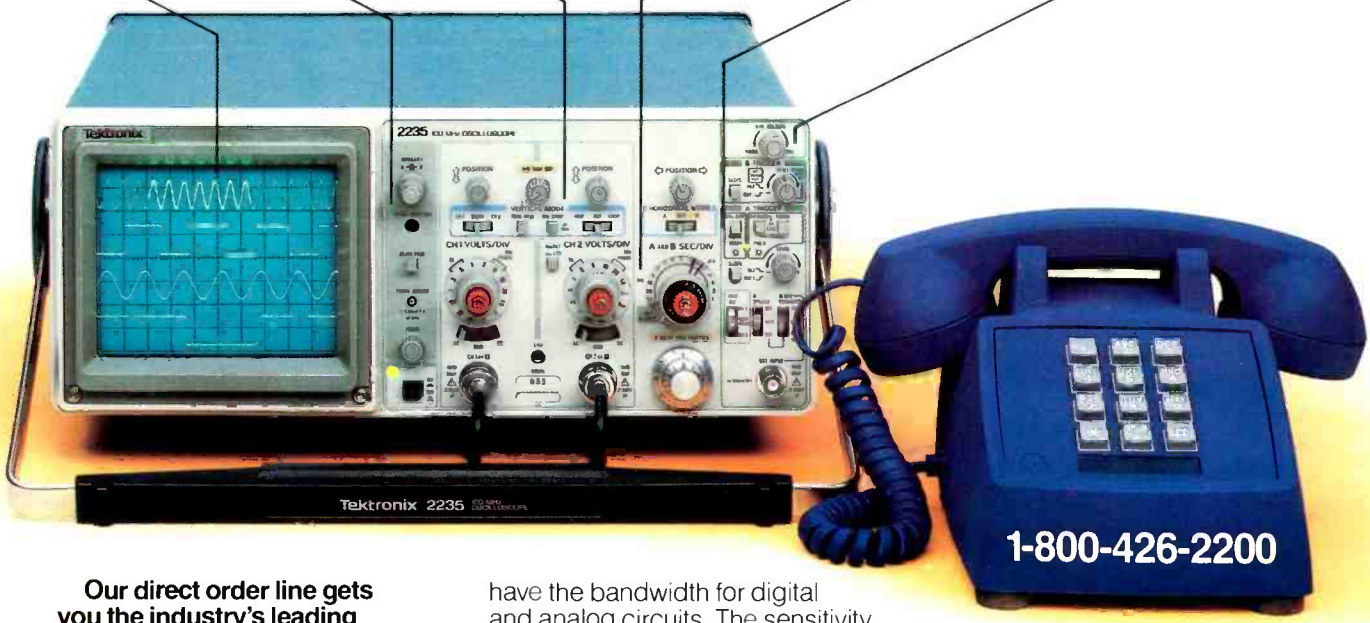

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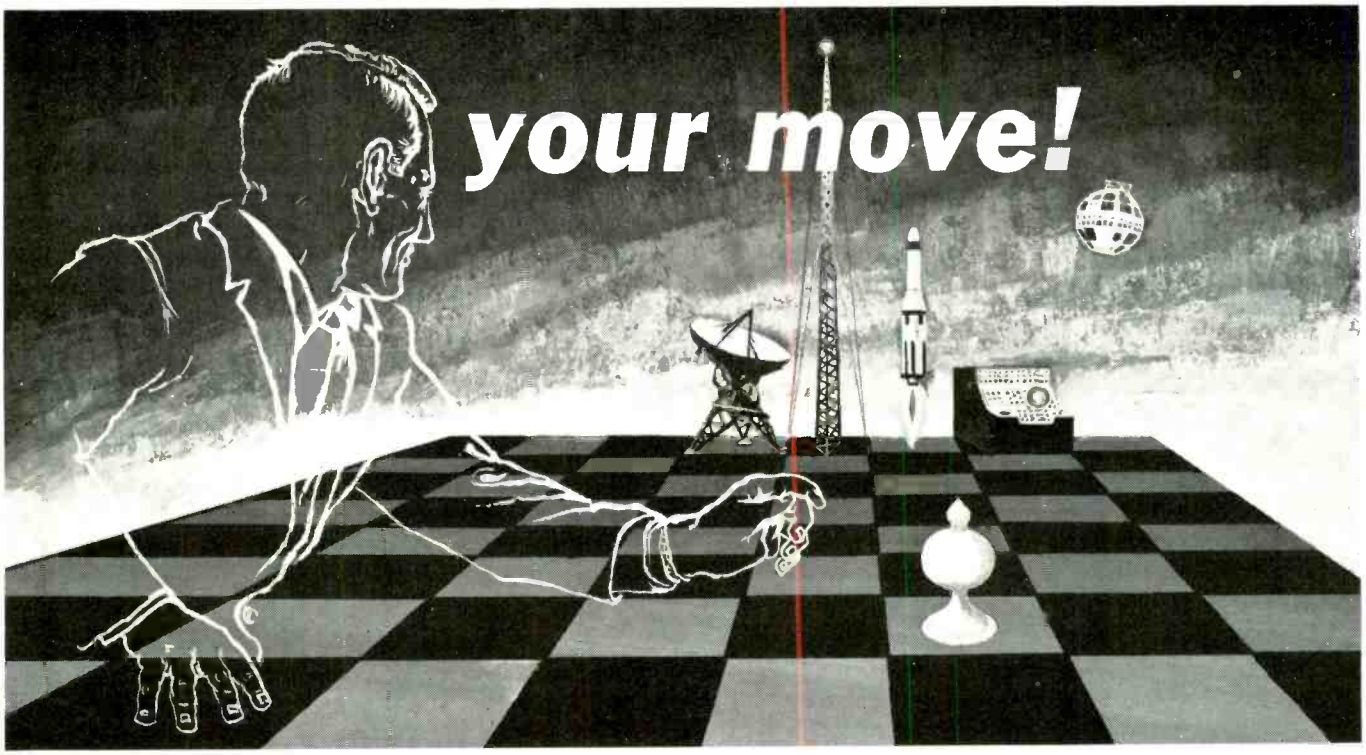

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MODERN ELECTRONICS
THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

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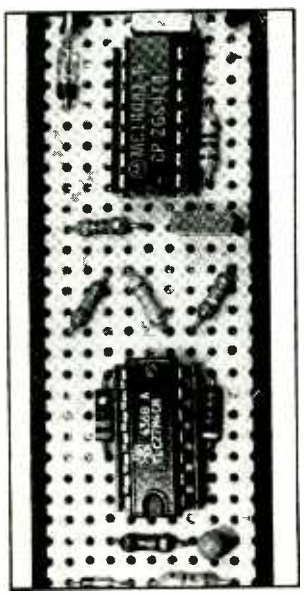
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FEATURES

PRODUCT EVALUATIONS

DEPARTMENTS

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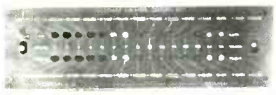
12603 CRENSHAW BOULEVARD•HAWTHORNE, CALIFORNIA 90250•(213) 679-9999

MARK IV — 15 STEP LED POWER LEVEL INDICATOR KIT

This new stereo indicator kit consists of 36 4-color LED's (15 per channel) to indicate the sound level output of your amplifier from −36dB to +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 6-12VDC 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's, all electronic components, PC board and front panel.

MARK IV KIT $31.50



20 STEPS BAR/DOT AUDIO LEVEL DISPLAY KIT

This new designed audio level display unit is using a new integrated circuit from National Semiconductor to drive 20 pieces of color LED's (green, yellow and red) on each channel. It provides two types of display methods for selection 'bar' or 'dot'. The display range is from −57dB to 0dB. Kit is good for any amplifier from 2 watts to 200 watts! Power supply requires 12VAC or DC. So it is great for cars as well! Kit comes with printed circuit board, all LED's, electronic components, switches, and silk screen printed professional front panel.

MODEL TY-45 $38.50

0-15 VOLT 2AMP REGULATED POWER SUPPLY KIT

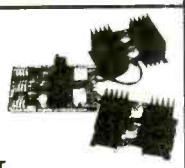
This is a professional power supply kit. Output voltage adjustable from 0-15VDC. Output current also can be limited to two range sections such as 200mA and 2A. An elaborated protection system also designed to give out a beeping sound and a flashing LED warning will appear when output was over loaded or short circuited. High stability and reliability resulting from employing a high quality voltage regulator IC. The front panel of the power supply is well designed with output terminals, on/off switch, voltage adjusting control, jumbo size meter for reading both AMPs and VOLTs, Also with a volt/amp switch as well as current limit select switch. Kit comes with refined metal case, silver color with sand brushed front panel, all electronic parts, pc board, 3" jumbo size meter, transformer, circuit diagram and instructions.

TR-100 KIT

$59.50

TA-1000 KIT $51.95

Power Transformer $24.00 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 TIM stereo preamp.

Specifications • Output power 100W RMS into 8Ω. 125W RMS into 4Ω • Frequency response 10Hz-100KHz • THD less than 0.01% • S/N ratio better than 80dB • Input sensitivity 1V max. • Power supply ±40V at 5A.

LOW TIM DC STEREO PRE-AMP KIT TA-2800

Incorporates brand-new DC design that gives a frequency response from 0-100KHz ±0.5dB. Added features like tone defeat and loudness control let you tailor your own frequency supplies to eliminate power fluctuations!

Specifications: ● THD/TIM less than .005% ● Frequency response DC to 100KHz ±0.5dB ● RIAA deviation ±0.2dB ● S/N ratio better than 70dB ● Sensitivity, Phone 2mV 47KΩ, Aux 100mV 100KΩ ● Output level 1.3V ● Max output 15V ● Tone controls: Bass ±10dB @ 50Hz, Treble ±10dB @ 15Hz ● Power supply ±24VDC @ 0.5A. Kit comes with regulated power supply. All you need is a 48VCT transformer @ 0.5A.

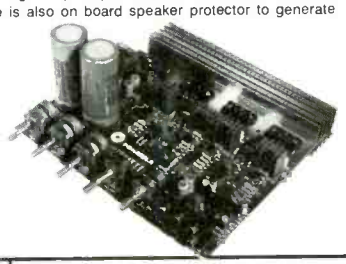
Only $44.50

Transformer $4.50 ea.

80W + 80W STEREO AMPLIFIER KIT

PRE-AMP — TONE CONTROLS — POWER AMP

TA-800 is an 80 watts + 80 watts stereo. The Low T.I.M. preamplifier employs a low distortion linear I.C. (LM4558) and three negative type tone controls for High, Medium and Low frequency control. The rear power amplifier uses newly developed high frequency darlington hybrid type transistors (AN7337/AN7338) in a push-pull circuit. There is also on board speaker protector to generate a delay time between the speakers and the amplifier. Large aluminum heat sink, which is mounted on pc board, requires no external hook-up wires. The kit comes with instructions, all electronic parts, predrilled pc board, and heat sinks. Power transformer not included. Easy to build, guaranteed to work.



TA-800 KIT

$65.00

Transformer (52VCT 4A) $22.50

DISCO LIGHT ORGAN KIT

The TY-23B Color Light Organ is designed for use at home, party, disco or commercial advertisement purpose. It gives you the moving light effect coordinated with the frequency of the music changes. When music or an audio signal input is fed into this unit, it will be divided into High, Medium and Low frequency by means of an electronic equalizer circuit to drive three groups of light bulbs. Each group of lights has an independant sensitivity control.

Besides working as a Color Light Organ, the TY-23B also can be used in "Light Chaser" mode to perform light effects for signs as follows: (1) Switch on one after the other. (2) Flashes all together. (3) Switch off one after the other. Flashing rate can be controlled. The output power of this unit is 3,000 watts (110V) which is 30 100 watt color spot lights or 600 5 watt light bulbs. Build one of these color organs today and enjoy watching your music. Great for school projects! All electronic parts, metal case, predrilled pc board and instructions come with kit.

TY-23B DISCO LIGHT ORGAN KIT $64.50

★ SPECIAL ★

Excellent Price!

Model 001-0034

$29.50 per Kit

Transformer $10.50 ea.

TA-322 30 WATTS TOTAL 15W + 15W STEREO AMP KIT

This is a solid state all transistor circuitry with on board stereo pre-amp for most microphone or phone input. Power output employs a heavy duty Power Hybrid IC. Four built on board controls for, volume, balance, treble and bass. Power supply requires 48VCT 2.5A transformer. THD of less than 0.1% between 100Hz-10KHz at full power (15 Watts + 15 Watts loaded into 8Ω).

60W + 60W O.T.L. AMP

Stereo pre-amp + tone control + power amp. All in on unit, fully assembled! Compact in size: 7"x4¾"x2½". Can be fitted into most cabinets. Power transistors using 2SC1667 X 4 to give a max output of 60W + 60W (8Ω)

• Frequency response: 20Hz−85KHz(−1dB) • Total harmonic distortion: 0.02% (1KHz) • Signal/Noise Ratio: 88 dB (open loop) • Tone control: 100 Hz±16 dB 10 KHz±14dB • Dynamic range: 60 dB • Power Supply: 48V−70V 5 Amp. • Filter Capacitor: 4700μ 75V or better.

MODEL: SA-4520

Part #370-0350 ..... $39.95 ea.

1 Transformer Part #670-0230... $22.50 ea.

2 Filter Capacitor 4700μF 70V $6.50 ea.

MAGNETIC HEAD EQUALIZER

• Standard RIAA curve for all kinds of magnetic heads • 3 stages crossover circuit for best results • Output voltage guaranteed to be stable without any oscillation • Power Supply: 24 V.D.C.

MODEL: MA-142

Part #370-370 ..... $6.95 ea.

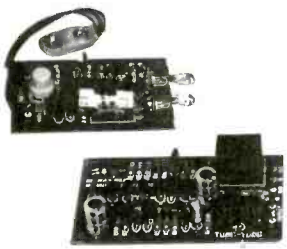
STEREO MIC. AND ECHO MIXER FOR STEREO AMPLIFIER SYSTEM

The circuitry employs all integrated circuits, BBD type echo circuit, echo time can be adjusted (max. .30 Msec.) Also with a microphone preamp on the board. Fully assembled.

MODEL: MX205

Part #370-0360 ..... $29.95 ea.

TY-41 INFRA-RED REMOTE SWITCH KIT



This infra-red remote control switch kit is suitable for many kinds of electrical and electronic applications, such as light controller, garage door opener, TV on/off, alarm system and many others. It does not use any antenna to transmit the signal, but it transmits an invisable light signal so the receiver can pick it up as far as 30 ft. away. Kit comes with all electronic components, pc board, relay and the infra-red LED.

TY-41 INFRA-RED SWITCH KIT $23.50

DIGITAL PANEL METER KIT

3½ Digit Multi-Use Danel Meter. The TY-43 digital panel meter kit using the IC 7107 A/D converter from Intersil is a principal component which direct drives a 16mm high 3½ digit LED display. The unit needs very few external components and is extremely easy to assemble and adjust. You can produce various kinds of voltage, current and resistance measuring meters, by adding a limited number of components, you can even change it into a thermometer, frequency counter and capacitor meter. (Application Circuit diagrams enclosed with kit).

Input sensitivity is DC ±199.9MV full scale
Input impedance is 10^{12} ohms
Operating source is 5 - 6VDC @ 150MA
Overall size: 1½" x 4"

TY-43 DIGITAL PANEL METER KIT $31.50

0-30VDC POWER SUPPLY KIT

This kit includes a high efficency regulating circuitry. By using the IC 723 and darlington power transistor to provide a stable and ripple free DC voltage from 0 - 30 volts at 3 amps or 0 - 15 volts at 5 amps (depends on the power transformer used, not included with kit). Overload and short circuit protection also featured on this kit. Easy to build! Guaranteed to work! All electronic parts, pc board, heat sink for power transistor, instructions included.

TR-355 POWER SUPPLY KIT $14.50

24VCT Transformer (for 0-30V) $10.50

LOW T.I.M. TRANSISTORS 100W + 100W

• Employs Hitachi low noise I.C. for pre-amp • Max. output 16 V P-P (non distortion) • With hi-low filter, and tone defeat circuit • Rear power amp with short circuit protection • Giant heat sink for maximum results • Tone controls ±14dB • All components (except pots for volume, and tone controls) are pre-assembled, the quality is guaranteed. • Power supply DC ±35V-50V

MODEL: SA802C

Part #370-0340 ..... $85.00

POWER TRANSFORMER (68V-80V CT 6 AMP)

Part #670-0220 ..... $24.50

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EDITORIAL

Where Have The Holes Gone?

Get ready for a major change in your electronics repair life as more and more manufacturers turn to surface-mounted devices (SMD). These parts, with their curled connection legs, attach directly to a printed-circuit board's foil pattern . . . so drilled holes for pushing through component wire leads for soldering on the opposite side aren't needed.

"So what!" you say? So the SMD leads are spaced more closely than conventional integrated-circuit leads are. So the devices themselves can be packed more tightly on a pc board, leaving you less room to remove and install them.

In fact, you won't be able to safely remove or install most SMDs with your present soldering equipment. You'll require new low-watt solder irons! Think about it a moment. With SMDs mounted on board footprint pads atop the copper foil, how can you change all the solder connections into a molten state simultaneously to remove the device? It's not as if the connections were there in the clear for you to apply a solder-iron's removal-block tip while pulling upward on the component's body on the other side of the board.

What you'll need in order to work on SMDs is a clamping-like solder iron much like giant tweezers, with an L-tip on one end and an inverted-L on the other to heat up all SMD connections at once. The tips will have to be the proper dimensions, of course, but so do spin-tight tool inserts for driving different nut sizes.

Perhaps you think that holeless pc boards are just a wild dream or limited to some military applications. If you do, you're wrong. They're here now in electronic entertainment equipment and spreading out everywhere else. Estimates are that about 50% of components shipped within five years will be surface-mountable types. (It's said to be at the 5% mark at this time.)

Manufacturers can't afford not to change to surface-mounted devices for a number of competitive reasons: more electronic functions can be put into a single package, more packages can be put on a pc board, pc-board holes don't have to be drilled, and production equipment takes up less space.

The pace to SMDs is quickening as the number of components packaged for surface mounting increases. Automated production equipment developers have already moved in with about a dozen new pick-and-place SMD machines. So have makers of reels that can hold thousands of SMDs on vinyl carrier tape for blindingly fast pick-and-place work—to 6,000 parts per hour!

Good luck!

Art Salsberg

LETTERS

The Way To Go

•Please keep the emphasis on *electronics* in your "magazine for electronics & computer enthusiasts." It's not that I'm uninterested in computers (I subscribe to micro magazines, have two micros, disk and tape drivers, and fiddle with BASIC, Pascal, Pilot, assembly language, and machine language) but I want broader-spectrum editorial coverage too. Now, perhaps I can go back to a Number One: Modern Electronics.

Michael M. Meyers
Montclair, NJ

•I just want to add my own congratulations to the many you folks must be receiving over the recent issues of your splendid magazine. Us ordinary people out here enjoy doing projects and purchase much of the equipment advertised in such technical publications. The projects authored by Anthony J. Caristi are to me by far the most useful and well thought out. He does not talk down to hobbyists, yet spells everything out as if he were anticipating snafus and wants the hobbyist like me to have the thrill of seeing something really useful come to fruition. Mims, Lancaster, Hauser, and Feldman are great too, and deserve their steadily growing fine reputations.

Porter C. Holman
New York, NY

• I was impressed with Fred Blechman's review of the Sinclair QL computer. It was very fair. He mentions the unit he reviewed was the English version. Some changes do exist between the UK and the U.S. one.

I am one of the first to receive the U.S. model QL and would like to point out some of the changes. First, the U.S. QL comes with version 2.00 of all four application programs. With this upgrade, code has been compressed and speeded up. Secondly, SuperBasic also is the newest version. Print VER$ will return the version 'code.' With 'JS' you get the 'WHEN' construct along with 25 extra SuperBasic keywords to help in identifing type of error during error trapping.

As of this writing I know of two companies besides Sinclair who carry QL software and hardware in the U.S., including disk drives.

Robert Woodring
Tonawanda, NY

Likes Surround Sound

•Thank you for the article in February's *Modern Electronics* about the "Surround Sound" enhancer project. Articles like this is one reason why I subscribe to Modern Electronics.

M. Smith
Industry, CA

Corrections

• A True-rms Adapter (June 1985). Fig. 1: delete line connection to OFF *(S1B)*. P. 59: change col. I to "half cycle = V_p." Col. 1—should read "C.F. = $1/\sqrt{\eta}$)" and following should read "For a C.F. of 7," the error is −1% and for a C.F. of" last paragraph on box—expressions should have square-root sign completed. Parts list: *R1* thru *R4* should be metal film; *C1* thru *C4* should be rated at 1 kV, 100 V, 50 V and 10 V, respectively.

MODERN ELECTRONICS NEWS

8-mm VIDEO. The 8-mm video format is heating up the VCR battle with so many new products coming up, both machines and software. Dealers are confused with three formats, none compatible with another. Sony unveiled a tiny handheld 8-mm camcorder and a longer-playing tape (2 hours, up from 1½). Kodak, in turn, introduced a stand-alone 8-mm VCR chock full of features--digital stereo sound, two-piece system for lightweight portable recording, and much more.

CB-RADIO LIVES. CB radio may not be the raging delight of the populace any longer, but it still moves along on our highways. REACT International, a volunteer emergency communications organization founded in 1962, has 1,000 teams and 15,000 members in the U.S. and Canada who monitor Citizens Band Radio Channel 9, the FCC-designated emergency call station. They also provide communications for special events, such as March of Dimes Walkathons, Chicago's Americas Marathon, and similar activities. For membership info, contact REACT Internation, P.O. Box 115, Northbrook, IL 60062.

APPLICATION-SPECIFIC IC'S. With large cell libraries and sophisticated computer-aided design and engineering machines, creating integrated circuits is not the chore it once was. As a result, a company such as Oki Semiconductor is setting up a separate business unit to support small-box designers. Oki figures that five years from now applications-specific devices will account for almost half the world market for ICs.

COLOR TV REPLACEMENT. Half the color-TV sets bought 15 years ago are still used, while four out of five purchased 10 years back are being used, according to a recent EIA Consumer Electronics Group study. Among other interesting findings: 46% of color-TV households have more than one color TV set; 12% have three or more. Impressive color-TV set longevity notwithstanding, the study reveals that about 40% of color TV receivers bought in 1984 were replacements for sets that went out of use.

SHORTER LIFE IN MEMORY-CHIP LANE. Manufacturers of memory chips could once figure many years of solid business for their designs. But movement from the new 256K-bit chips to the next level, 1-Mb, will be here by the time you can say 1987. Prices of dynamic 256 K chips are dropping fast.

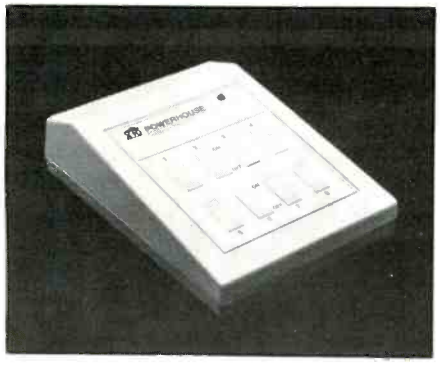
MULTICHANNEL TV SOUND. More than 200 TV broadcast stations are expected to transmit TV sound in stereo by 1986. As a result, many more new TV receivers are coming equipped for reception of MTS, which also accommodates bilingual TV broadcasts. To underscore this, Zenith Electronics' 1986 line of color-TV sets includes 14 models with built-in MTS facilities.

FCC SUPPORTS SATELLITE TV DISHES. In an interesting move that has aroused the ire of many local zoning boards, the Federal Communications Commission has a proposal out to eliminate local restrictions on home satellite TV antenna dishes. It's collecting comments relating to the rule proposal.

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

Appliance Controller Computer Interface

"Powerhouse" is an Apple IIe or IIc or Commodore 64 interface from X-10 (USA) Inc. that lets your computer do something really useful around your home—remotely and automatically control electrical devices. Actually a microcomputer on its own, Powerhouse has its own microprocessor, ROM and RAM, with battery backup to keep the system running for up to 100 hours in the event of a power failure.



Powerhouse sends signals over the ac wiring to control up to 72 electrical devices (each equipped with a separately available X-10 module) plugged into the ac line. The interface uses a color graphics interactive programming approach. Together with use of a joystick and software packaged with the console, it makes programming home control simple and fun to do. The disk software graphically steps you through each room in your home and prompts you to use the joystick to identify the electrical outlets (devices) you want to control. You can then operate each device instantly or program it to turn on and/or off at specific times and days.

Interfacing to your computer is via a standard RS-232C serial I/O port, using the cable supplied with the Powerhouse. On top of the Powerhouse console are eight rocker switches that allow you to instantly turn on and off up to eight appliances. $120.

CIRCLE NO. 109 ON FREE INFORMATION CARD

Deluxe Stereo Receiver

In keeping with high-end design philosophy, Yamaha's new 125-watt/channel Model R-9 AM/FM-stereo receiver offers Auto Class A amplifier and Zero Distortion Rule circuitry, wireless remote control, and video inputs with copy capability. The deluxe receiver's lineup of features include: independent three-speaker system switching; 16 AM/FM station presets; auto-search and manual up/down tuning; last-station memory; digital frequency display; an outboard accessory loop; inputs for both moving-coil and moving-magnet cartridges, a CD player, and auxiliary sources; and a 40-dB continuously variable loudness control.

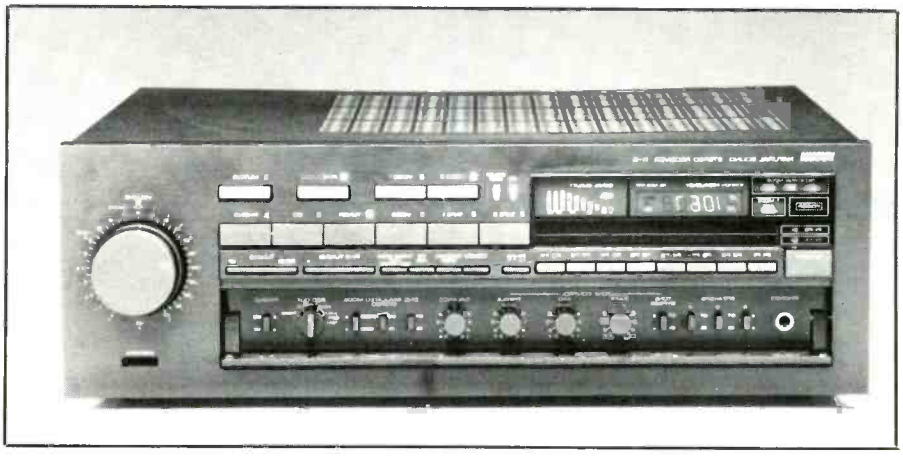
The tuner section uses a microprocessor-controlled Computer Servo Lock tuning system that selects either infinite-resolution FM servo tuning or synthesized PLL tuning to assure best reception. Other tuner features include: Digital Fine Tuning; auto/local/DX switching; and a 10-segment signal-quality meter. In the audio section, an input selector accesses two tape decks, two video sources, phono, CD, or tuner. Direct dubbing from one audio tape deck to another is possible, as is direct copy from video 2 to video 1. Additionally, Yamaha has included in the R-9 simulated-stereo and dynamic noise canceller circuits. The first uses a comb-filter circuit to give mono signals depth and imaging to simulate stereo sound. The latter is designed to be used with the stereo simulator but can work equally well without it.

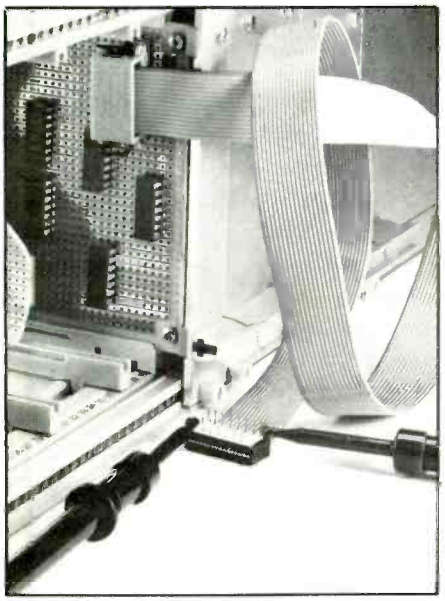
CIRCLE NO. 110 ON FREE INFORMATION CARD

Low-Profile Chip Clip

A low-profile chip clip made by OK Industries is designed to facilitate easy in-circuit testing of 16-pin ICs. The Model LPCC-16 chip clip requires only 0.525″ of clearance. It can be used in most applications where standard chip clips are used, but is especially suited to use in tight areas, such as a fully populated card cage. The low-profile design simplifies pin location, while the padded handles prevent shorts so that ICs can be tested on a board.

The chip clip has a specially designed "locking head" that fits over





the IC under test, a 24″ ribbon cable and a 16-pin DIP plug. Any and all IC pins to which the chip clip is connected can be tested via numbered pins on the device's DIP plug. $14.95.

CIRCLE NO. 111 ON FREE INFORMATION CARD

Function Generator

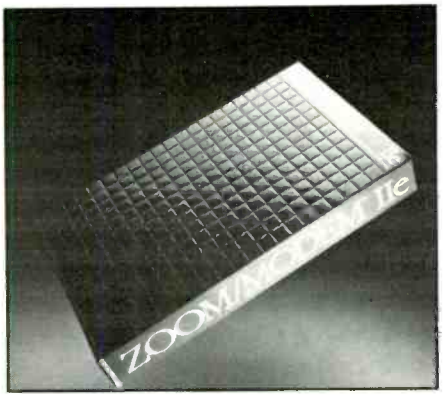
Beckman Industrial's new Circuitmate Model FG2 function generator is designed to produce clean, high-quality signals in the 0.2-Hz to 2.0-MHz range. Its pushbutton switches make output frequency and function selection fast and easy. Outputs include square, triangle and sine waves, and TTL pulse (five TTL load capacity). For low-level applications, a 20-dB attenuator is included.

A duty-cycle control allows you to change the nominal 50% duty cycle of the signal to any desired value. An invert pushbutton can be used to invert or change the duty cycle without requiring adjustment of the duty cycle control. A dc offset control adds a variable dc offset voltage to the offset signal for analog applications that require bias voltage. A voltage control frequency (VCF) input is included for generating sweep signals to enable you to control the generator's frequency with an external dc control voltage. $199.95.

CIRCLE NO. 112 ON FREE INFORMATION CARD

Modem For Apple IIs

Zoom Telephonics' new Zoom/Modem IIe is an advanced Hayes Micromodem IIe-compatible auto-dial/auto-answer 300-baud modem board for the Apple II, II+ and IIe. It comes with DOS/ProDOS-compatible communications software on disk and over $200 in offers from Dow Jones News/Retrieval, News-Net and Delphi. The single-slot modem is supplied with all required cables, serial connection, speaker on/off capability, second on-board telephone jack and menu-driven software that does not require a disk drive for operation.



The Zoom/Modem IIe is also available as part of the Zoom/Modem IIe Plus package, which contains advanced communications software that adds file-transfer from disk to disk over the phone lines, integrated text editing, Xmodem protocol for error-free information transfer, printer access, and automatic directory dialing. $179 for Zoom/Modem IIe; $229 for Zoom/Modem IIe Plus.

CIRCLE NO. 113 ON FREE INFORMATION CARD

Deluxe Satellite-TV Receiver

Ramsey Electronic's new Model XR-1 satellite-TV receiver features quartz-lock frequency-synthesized tuning with microprocessor-controlled video fine tuning circuitry. It also provides a weatherproof block downconverter, matrix stereo audio, dual polarity with electronic switching, full-function wireless infrared remote controller with random-channel access, and electronic TV antenna changeover. Other features include: large LED channel display; LED bargraph display of audio frequency tuning; format reversal button; all-pushbutton operation; LED status indicators for all selected func-

(Continued on page 84)

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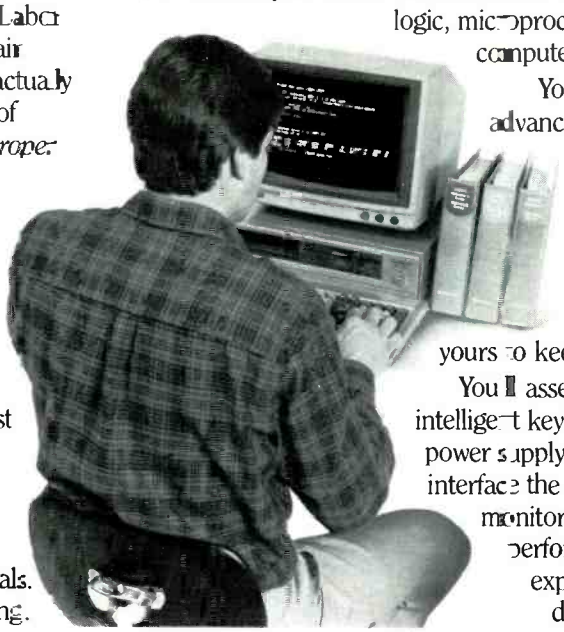

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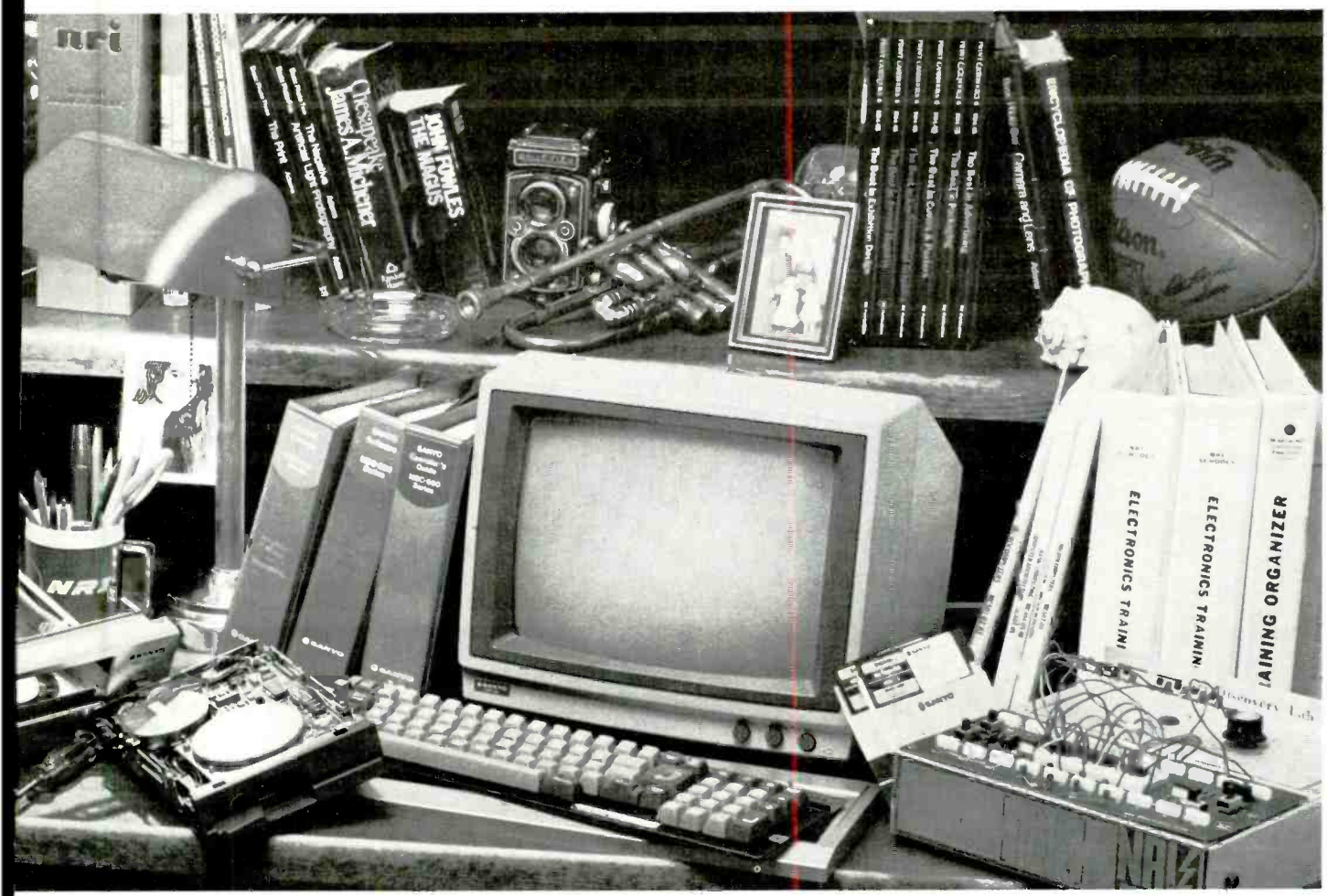

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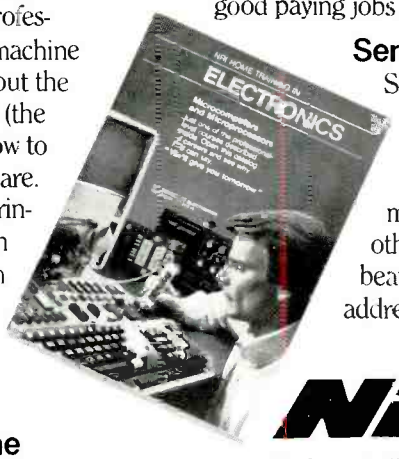

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Video/Audio

A Wireless Sound Transmitter

FM wireless transmitters like the Audio Whizz examined here have always been welcome devices for applications where it's impractical or undesirable to run cable or wires. This wireless device is designed to accept a broad range of audio signals, from a few millivolts to a few volts, and "broadcast" them for pickup by any nearby FM radio set to the proper frequency. In this case, the desired frequency is at the low end of the standard FM broadcast band.

The transmitter, which the maker claims has a range of up to 100 ft., is packaged in a 4″ × 3″ × 1½″ black bakelite enclosure. Supplied with it are a three-ft. audio cable with RCA phono plugs on each end and an adapter for use with a miniature phone jack. The device is powered by a single C battery (not supplied). "List" price is $49.95 from Video Kit Manufacturing Co., Rowland Heights, CA 91748.

User Comments

Removing the enclosure's cover, which is secured by four screws, to insert a battery into a plastic battery holder, you'll observe a paucity of components. There's a potted module with four leads connected to some parts: a 120K resistor, a ceramic trimmer capacitor, and the electrical connection sides of a toggle switch and a phono jack.

To check out the device, the battery must be inserted with correct polarities observed, the battery power switch turned on, a source of audio such as from a VCR's audio output plugged into the transmitter's input jack, and an FM radio or tuner turned on and set to the low part of its band, around 88 MHz.

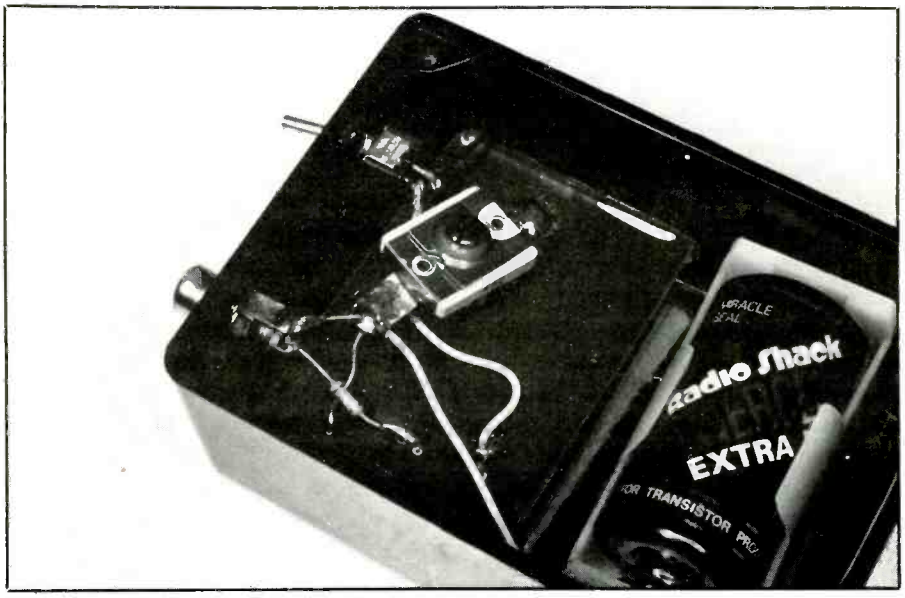
If you cannot pick up the audio signal after searching around a bit with your FM radio's tuning knob or if the Audio Whizz signal comes in atop a strong local station, you'll have to retune the transmitter. To do this, use a nonmental screwdriver to turn the ceramic capacitor's adjustment screw. (You can also use the corner of a plastic credit card). Once adjusted for satisfactory reception on your FM radio, you can put the cover back on.

The utility of such a wireless transmitting device is obvious. For example, connecting the transmitter to the AUDIO OUT of a VCR in your bedroom, you can listen to the sound track via headsets attached to one of those popular personal FM receivers at your side without disturbing your bed partner with loud audio from a TV set. In another application, you could broadcast a phono record or tape from your audio system to any FM radios around the house or even use the Audio Whizz with an electret microphone. For the latter, you'll have to short out the 120K resistor with a small jumper cable since such microphones usually generate only 5 to 10 millivolts. Should you plan to do this frequently, an external shorting switch can be added to the transmitter.

Audio Whizz had a few shortcomings. For satisfactory audio clarity it requires the use of an FM radio and headphones with good sensitivity. Moreover, its 100-ft. maximum transmitting range under the best of conditions could be a bit restrictive. Additionally, there's a possibility of causing some interference when making a video tape from ABC's Channel 7 if the Audio Whizz is on since the device's second harmonic of its around-88 MHz signal is close to Channel 7's 175.25-MHz frequency.

Aside from the foregoing, I found the Audio Whizz to be very handy.—*Fred Blechman.*

Inside look shows trimmer capacitor used to adjust FM frequency.



Computers

Suncom's Graphic Tablet

Graphic tablets add another dimension to computer applications. Using a pen-like pointer on a tablet enables the operator to produce all sorts of wonderful, colorful images on a computer's video display. Suncom's Animation Station—a pressure-sensitive tablet with versions for Apple II, Commodore 64 and Atari 400/800 computers—is a modestly priced one that provides many interesting features, including producing different type fonts, and being able to print what's drawn.

The Animation Station comes with a color software disk program called DesignLab, which is something like Apple Macintosh's MacPaint. Additional software programs for other purposes are said to be available, too, such as a Shape Library, an animated movie program called Take One, a clip-art book, and others. The tablet plugs into the host computer's joystick/game port.

An Apple computer version is priced at $99.95, while Commodore-64 and Atari models have a suggested retail price of $10 less, or $89.95. We examined all versions, which are essentially the same. Each requires one disk drive and 48K of user memory. The focus in this report is on the Atari model.

Description

The 7″ × 9¼″ Animation Station's beige plastic frame houses a recessed 4¼″ × 5¾″ sensor pad that's the device's active area. Green rules form ⅜″ × ⅜″ grids to make it easy to position the pointer's stylus on the pad relative to the video screen location it represents.

Measuring a uniform 1½″ thick, the tablet has anti-skid cushioned feet and a built-in leg brace that can be used to raise the rear of the tablet to form a 15-degree slope. There are dual thumb-activated control button pairs on either side of the active pad for each right- or left-hand use. Bottom buttons "DO" an action, while top buttons "UN-DO" it.

The active area itself is a sandwich of protective and conductive plastic sheets that, when pressed together, create the resistive equivalent of an analog dual-paddle. The latter essentially relays an effective x, y position to the host computer. On the Atari computer, the upper left-hand edge of the tablet corresponds to the 0, 0 of a high resolution graphics screen, while the lower right-hand are the maximum coordinates 159, 191. This results in a theoretical resolution of 33-37 pixels per pad inch or 12 × 12 pixels per grid box.

Specific x,y coordinates of the stylus are displayed on the video screen's bottom section to aid in positioning objects more accurately on the tablet drawing. When not being used, the stylus may be stored in an opening in the Station's upper right-hand corner. A recessed slide switch at the lower right of the unit allows the Station to be used as a video game controller on Commodore and Atari computers, and to emulate a true analog joystick on Apple computer versions.

Software

The Designlab software that comes with the Station has a host of features. Unlike many other "pointing" devices, Designlab allows you to use a printer, since printer dump utilities are wisely included on the disk. This will give the user grey-scale drawings on several single-color dot-matrix printers. The program offers more than 20 different functions. As with most pointing devices, you can draw with several "brush" cursors a series of points, lines, circles, and rectangles by simply pressing the DO (bottom) button while having the stylus in contact with the pad. This same technique accesses the various other menu options, including a wide array of disk utilities that load and save 64 sector picture files, 25 sector text fonts, and 9 sector shape libraries under pad control, as well as format or list entries on your disks.

Whereas the SHAPES mode allows you to call up a wide variety of predefined (and user-defined) shapes from shape libraries, the TEXT mode allows you to choose one of several type styles while using the keyboard to write notes onto your drawings.

The WINDOW mode can cut and paste windowed areas of your drawing as easily as can the more sophisticated Apple Mac-

Paint. You can employ this function to make multiple copies or just for repositioning. SPRAY allows you to become a graffiti artist with the equivalent to an aerosal-can paint brush; SCROLL lets you "microposition" your drawing on the screen, shifting it up, down, right, or left. This program's ZOOM mode, unlike other similar commands, lets you see the macro-picture as well as the zoomed-in portion, move around the picture, and change to one of four available colors in this mode.

Portions of the picture are erased in both this and other modes by selecting the background color as your drawing color. Your COLOR palate allows simultaneous use of 4 different colors/hues (3 plus background) selected from 16 colors and 16 luminances. Drawing is accomplished as if in layers as far as color is concerned, so if you change a layer's color, all drawing with that color changes.

Conclusions

The Animation Stations worked fine, proving that a good computer peripheral need not be very costly. Color graphics were exceptionally good on both a video monitor and a 13" TV receiver. I even tried the Apple version on a monochrome monitor and was able to perform all functions minus seeing color variations.

Of course, the Animation Station's utility is limited to the capabilities of the host computer. Thus, diagonal lines are relegated to a series of jagged straight ones, circles to ovals, and other generally less accurate renditions than one might wish for.

For all such shortcomings, however, given the low cost of the Stations and all the nice things it permits one to do well and easily on low-cost computers, Suncom's Stations are certainly worthwhile additions to computers they're designed to work with. For many people, such a graphics tablet could well renew one's interest in their home computer.

— Charles Rubenstein

CIRCLE 20 ON FREE INFORMATION CARD

Software Function Table

CLEAR:	Erases full screen
OVAL:	Makes circular shape outlines
OVAL 2:	Makes circular discs (filled-in shapes)
BOX:	Makes square and rectangular outlines
BOX 2:	Makes square and rectangular blocks (filled-in)
SKETCH:	Makes a continuous series of dots on screen
DOTS:	Makes a dot of color every time you press a button
LINE:	Draws single, unconnected lines
LINES:	Draws lines that connect to the last line drawn
COLOR:	Changes color to one of 16 possibilities
FILL:	Colors in enclosed areas on screen
SPRAY:	Creates an aerosal-can brush technique
ZOOM:	Magnifies parts of the picture for greater precision
PRINTER:	Sends picture to a printer
DISK:	Formats disks, saves/loads pictures, reads directory
SHAPES:	Uses predefined libraries or create your own
TEXT:	Uses one of several Fonts to write on the picture
WINDOW:	Frames part of the picture for cut & paste
MIRROR (Atari):	Creates mirror images of shapes/text/brushes
SCROLL (Atari):	Moves entire drawing up-down, right-left
HELP:	Calls up instructions on functions
BRUSHES:	7 predefined shapes (one user-derined for Commodore)
"DO" Button:	Press bottom button to draw one of the above
"UN-DO" Button:	Press a top button to erase the last drawn item

Libraries (For Apple Computers)

TEXT:	Standard 8, Bold 10, Bold 17, Italic 8, Large Block 17
PICTURES:	Cable Car
SHAPES:	Animals, Wild Animals, Trees, Buildings, Game pieces, Musical Instruments, Music Symbols, Potpourri, Geometric Shapes, Animation Shapes.
WINDOWS:	Sample letterhead, SUNCOM Space, PQ Controller, Starfighter Apple

(For Atari Computers)

TEXT:	Bold, Italics, Script
PICTURES:	Title, Help, Shuttle, Unicorn
SHAPES:	Animals (1 & 2), Faceparts, Transportation (1 & 2), Weapons, Miscellaneous

(For Commodore-64 Computers)

TEXT:	Standard, Bold, Script, Italics
PICTURES:	Colorwatch, Micrometer, World Map, Authors
SHAPES:	Animals (1 & 2), Transportation (1 & 2), Weapons, Faceparts, Plants, Characters, Miscellaneous
WINDOWS:	Suncom

Experimenter's Radio-Control System

A six-channel license-free remote-control system project you tailor to your needs

By Robert C. Frostholm

Most radio-control (R/C) system plans published in books and magazines are fixed in design, usually to control model airplanes, cars, boats, etc. There are no such limitations imposed on the Experimenter's Radio-Control System presented here. This is a basic transmitter/receiver system with "open-end" outputs that *you* adapt to suit your particular needs. In addition to allowing you to control the usual hobby models, the system can be made to control heating/cooling systems and automatic sprinklers, implement sophisticated robotics, and even set up a digital local-area network. In fact, the uses to which the system can be put are limited only by your inventiveness and knowledge of electronics.

Unlike other R/C systems you may have seen in the past, the Experimenter's Radio-Control system has very few components, the credit for which goes to a pair of matched encoder/transmitter and receiver/decoder integrated circuits from National Semiconductor. With these two ICs and a few extra components, you can build the full system in just a few hours.

Our basic system provides six output channels. Its two digital channels provide simple on/off switching, while its four analog channels provide proportional control.

Encoder/Transmitter

A complete six-channel digital-proportional encoder and r-f transmitter on a single DIP chip makes up the heart of the transmitter. This National Semiconductor LM1871 chip (*IC1* in Fig. 1) is intended for use as a low-power, license-free, nonvoice communications device for use on 27 or 49 MHz. In addition to the radio-control hobby, toy and industrial applications, the encoder can provide a serial input of six words for hard-wire, infrared and fiber-optic communications links.

Potentiometers *R6* and *R7* in Fig. 1 are used to set the pulse widths of the two analog channels, while switches *S1* and *S2* allow you to set the binary-coded pulse-position modulation for the digital channels (see Fig. 2). Thus, the two digital channel outputs (in the receiver) are determined by the number of pulses transmitted, rather than by the width of the channel.

Two timing circuits make up the transmitter's encoder. The waveforms for these are shown in Fig. 3. Frame time is determined by the values of *R5* and *C9* at pin 7 of *IC1*; pulse time at pin 8 is determined by the values of *C7* and *R4*. The relationships are as follows:

Frame time $T_F = R5C9 + 0.63R4C7$
Modulation time $T_M = 0.63R4C7$
Channel time $T_{CH} = 0.63R3C7$

Frame, modulation and channel times should typically be set for 9.5, 0.5 and 0.5 ms, respectively.

Class C was chosen as the operating mode for the crystal-controlled oscillator/transmitter. Resistor *R2* provides base bias current from V (regulated) pin 4 of *IC1*. R-f feedback in the oscillator is via series-mode third-overtone crystal *XTAL1*, which controls the frequency of oscillation. With this arrangement, the best alignment method would be to tune *L1* for minimum supply current while observing the carrier envelope.

Receiver/Decoder

The receiver is based on National's companion LM1872 radio-control receiver/decoder chip, a crystal-controlled superheterodyne design that offers good sensitivity and selectivity (see Fig. 4). In concert with the LM1871 transmitter, the LM1872 provides four independent information channels. The two analog channels are pulse-width modulated (PWM), while the two digital channels offer simple on/off control (see "Modulation Methods" box for more details).

Each digital channel provides sufficient power to directly drive a 100-

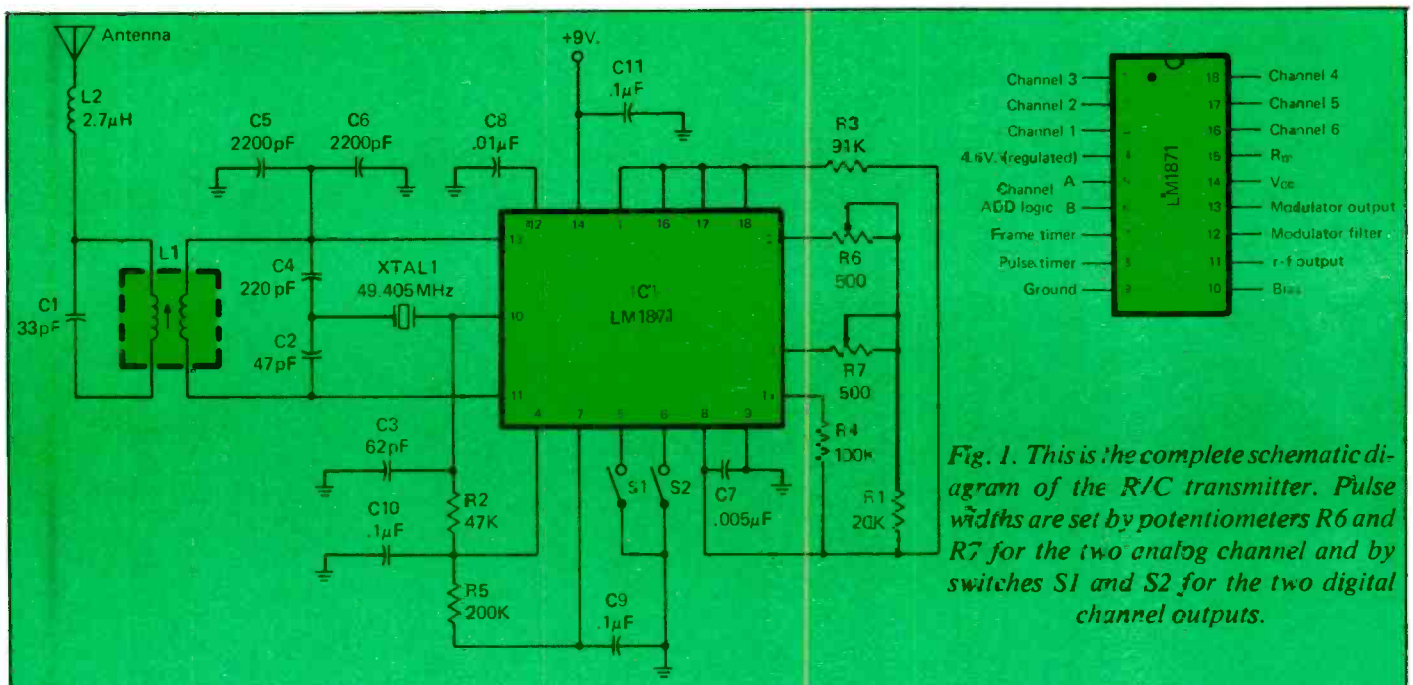


Fig. 1. This is the complete schematic diagram of the R/C transmitter. Pulse widths are set by potentiometers R6 and R7 for the two analog channel and by switches S1 and S2 for the two digital channel outputs.

TRANSMITTER PARTS LIST

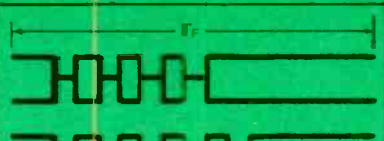
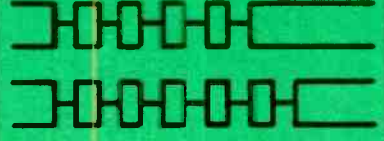
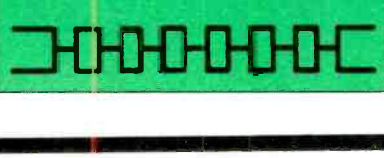
Semiconductors
IC1—LM1871 encoder/transmitter (National Semiconductor)
Capacitors (ceramic disc, 5%)
C1—33 pF
C2—47 pF
C3—62 pF
C4—220 pF
C5,C6—2200 pF
C7—0.005 μF
C8—0.01 μF
C9,C10,C11—0.1 μF
Resistors (½-watt, 5%)
R1—20,000 ohms
R2—47,000 ohms
R3—91,000 ohms
R4—100,000 ohms
R5—200,000 ohms
R6,R7—500-ohm potentiometer
Miscellaneous
L1—Toko No. KEN-K46[illegible]JBE r-f transformer
L2—2.7-μH r-f coil
S1,S2—Spst switch
XTAL—49.405-MHz crystal

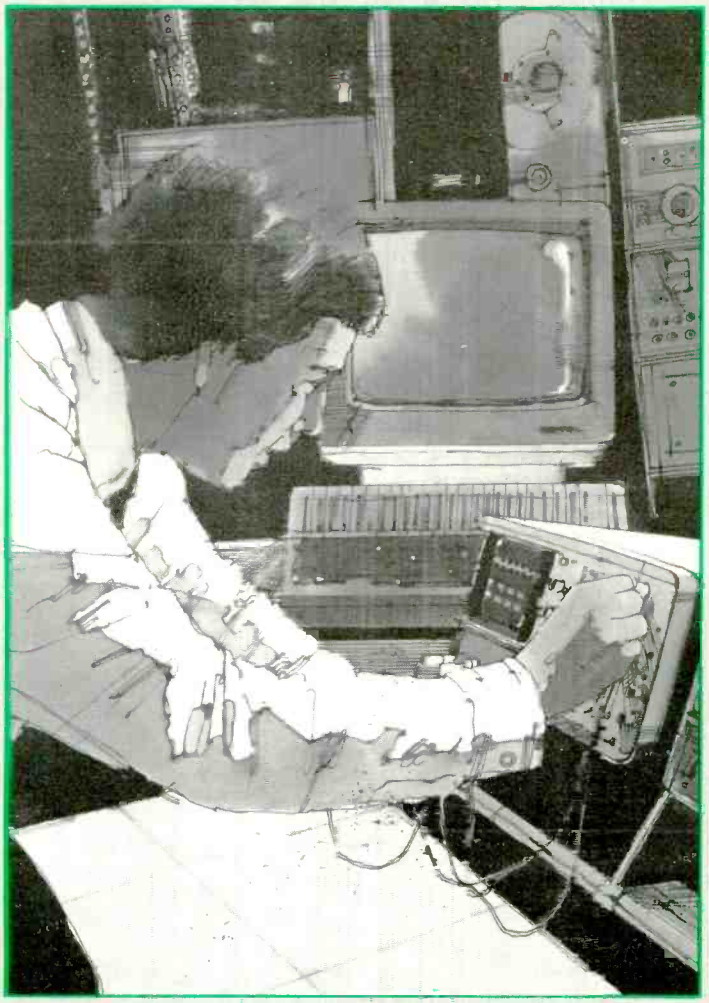
Printed circuit board; socket for IC1 (optional); 9-volt battery and clip; suitable size enclosure; 2-ft. antenna; machine hardware, hookup wire, solder; etc. Note: See Receiver Parts List for kit supplier.

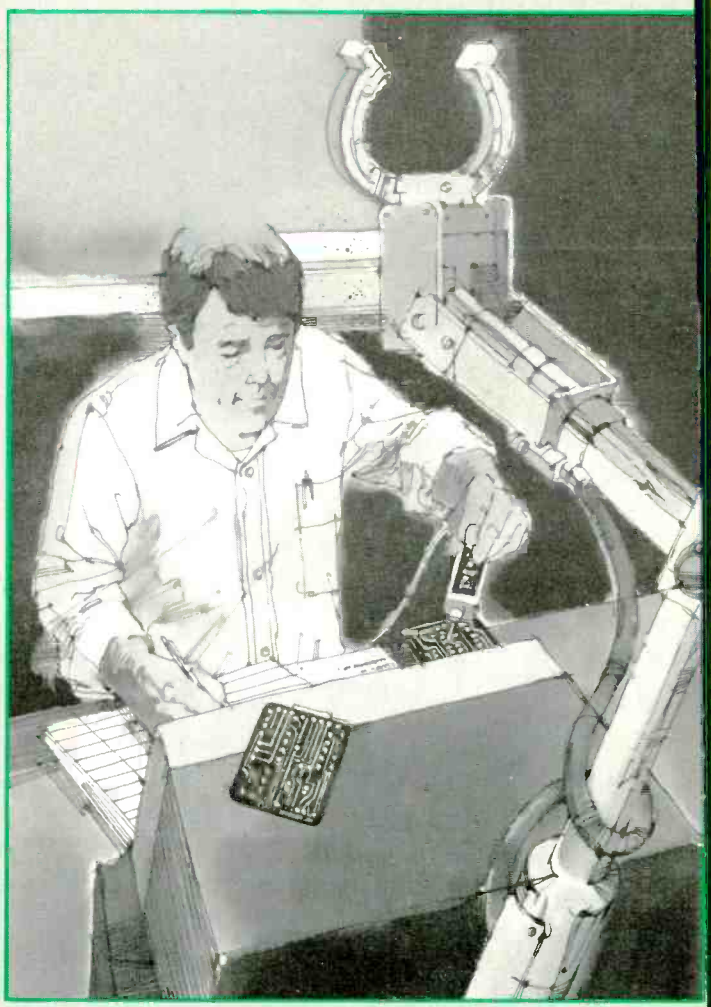
mA load. Instead of providing direct control, each of the LM1872's analog outputs goes to its own separate SN76604 pulse-width demodulator/servo amplifier. The SN76604 has on-chip transistors that are capable of driving a 400-mA load. This servo amplifier is unique in that it provides bidirectional output capability from a single-ended power supply.

In the Fig. 4 circuit, the r-f signal from the transmitter is demodulated and decoded by negative-edge triggering of a cascade of three binary dividers. The dividers count the number of pulses to determine the number of information channels being transmitted.

Fig. 2. Shown here are details of digital channel encoding and decoding via pulse-count modulation. Transmitter conditions in first two columns generate the receiver responses indicated by entries in the last two columns.

LM1871 (TRANSMITTER)			LM1872 (RECEIVER)		
PIN CONDITIONS		TRANSMITTED WAVEFORM	BINARY PULSE COUNT	DIGITAL OUTPUTS	
PIN 5 (CH A)	PIN 6 (CH B)			CH A	CH B
Open	Open		100	Off	Off
Ground	Open		10	On	Off
Open	Ground		110	Off	On
Ground	Ground		11	On	On





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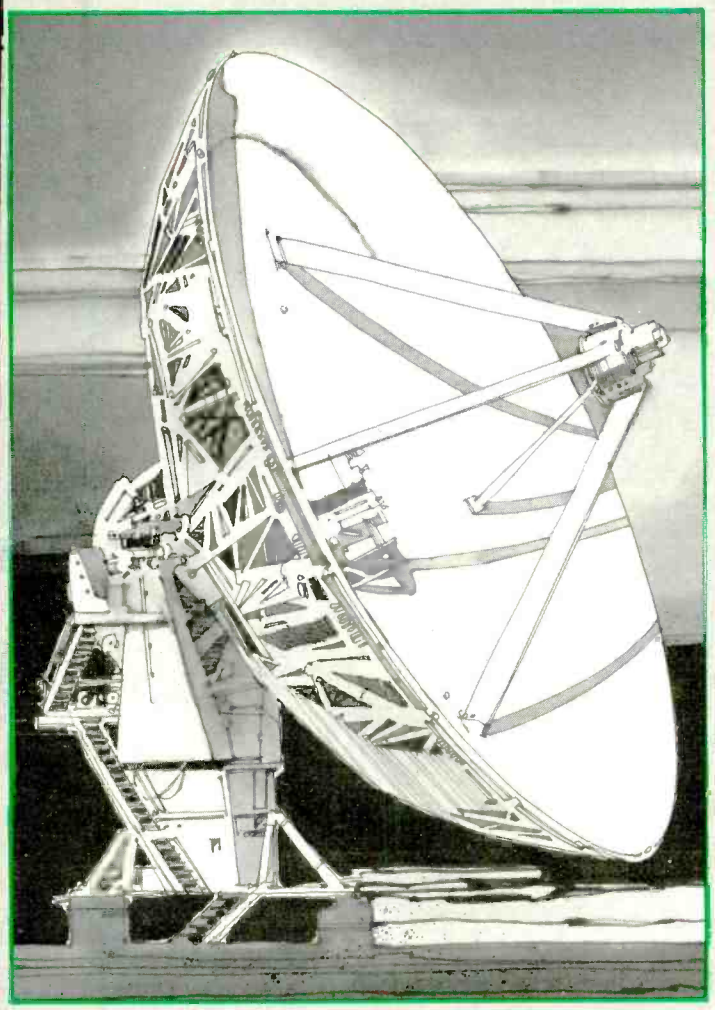

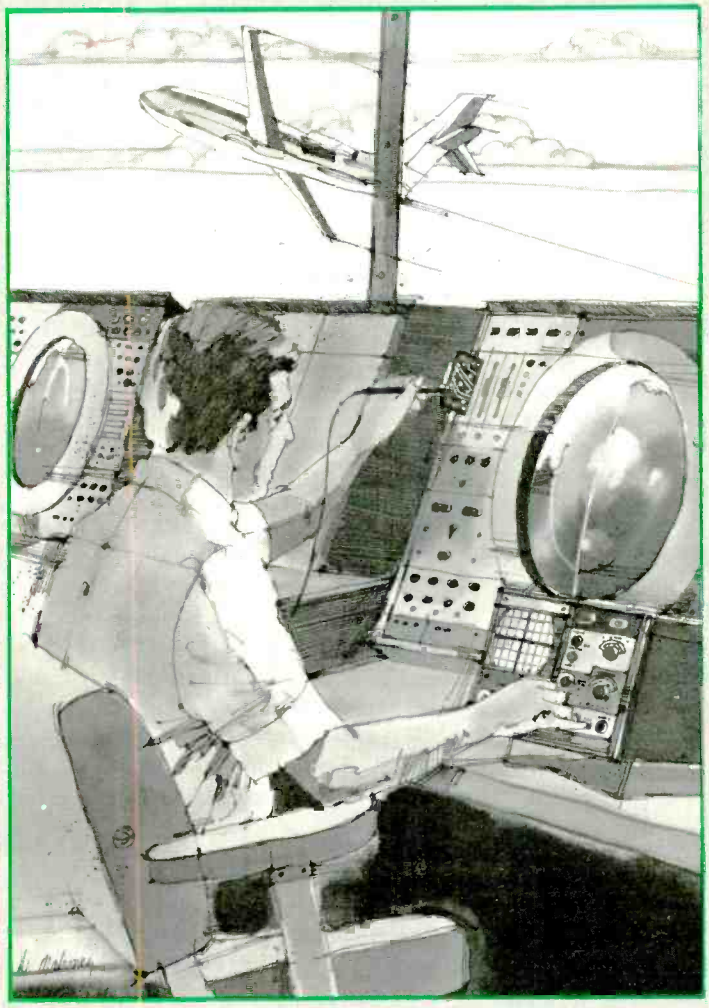

with electronics? anything.

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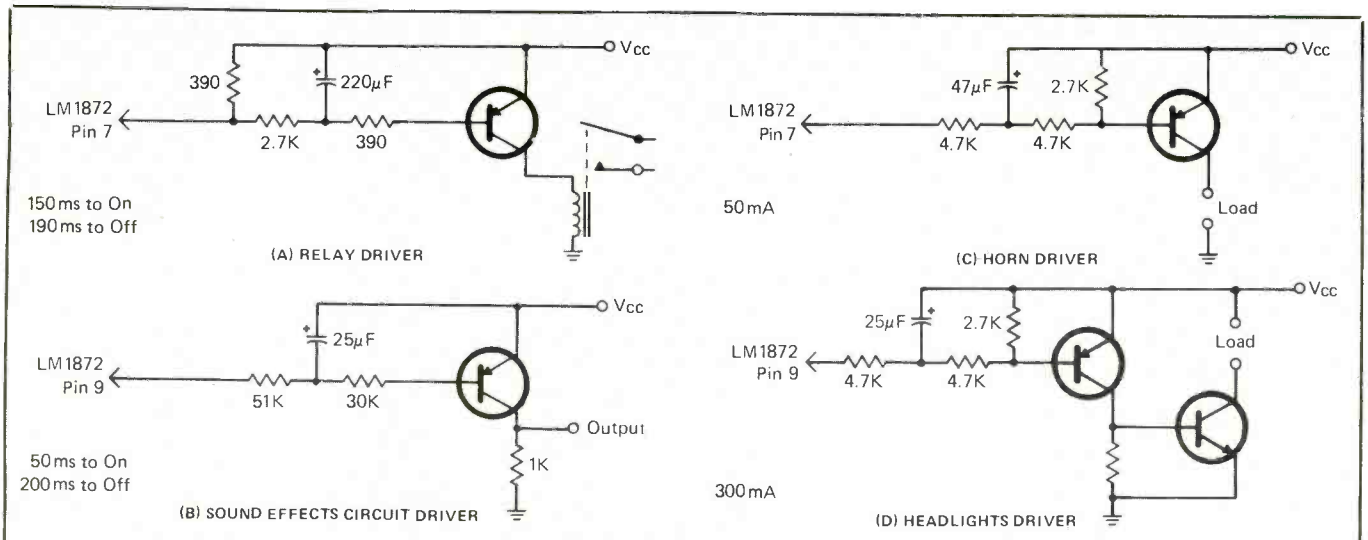


Interfacing to the Real World

For the Experimenter's Radio-Control System receiver's digital outputs to do anything useful, they must be interfaced with the so-called "real world." Shown here are four typical examples of simple interfaces for the digital outputs of the LM1872 (*IC1* in Fig. 4) at pins 7 and 9. These simple circuits—and others you might think of—can be assembled on small pieces of perforated board and housed within the receiver's enclosure or external to it.

Circuit (A) is an example of an interface that can provide on/off control for high-power loads. Power for the load, independent of the receiver's battery supply, is routed through the relay's contacts. Circuit (B) provides a direct on/off *signal,* rather than the mechanical make/break action of circuit (A). Circuits (C) and (D) source current for medium- and realatively high-power loads, respectively. Other interfaces will suggest themselves.

can fabricate your own pc boards, using the actual-size etching-and-drilling guides given in Fig. 6, or purchase an entire kit, which includes ready-to-use pc boards, from the source given in the Receiver Parts List.

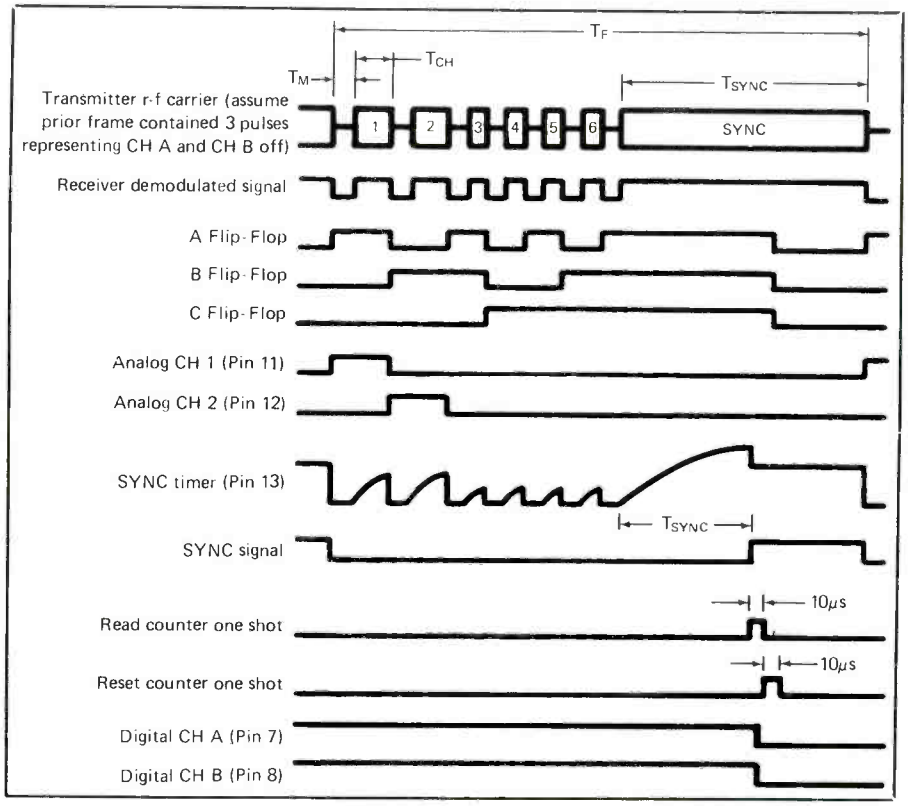
Circuit assembly on the pc boards is a simple, straightforward procedure (see Fig. 7 for details). You simply plug each component into the indicated holes on the board, making sure to properly orient it, and solder its leads or pins to the foil pads on the underside of the board. You can use DIP sockets for the ICs if you wish, but this is not essential.

You can house the transmitter and receiver in any size boxes, preferably metal, that will comfortably accommodate them, their battery supplies, antennas and any controls and interfacing that may be required for your application.

Using the System

A 2-ft. antenna is recommended for

Fig. 5. Timing waveforms available at various points within the receiver.



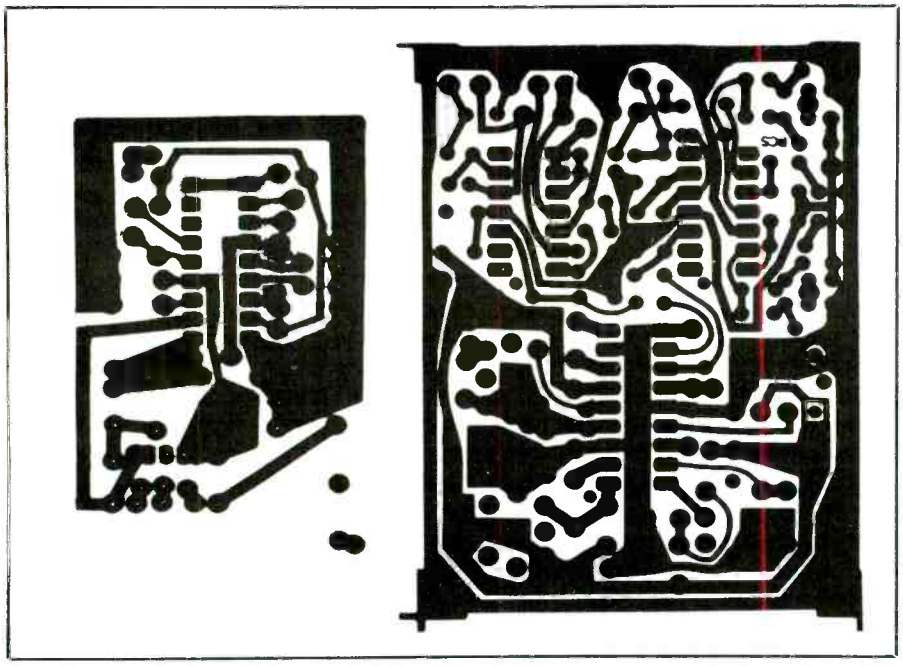


Fig. 6. Actual-size etching-and drilling guides for transmitter (left) and receiver (right) to use when making your own printed-circuit boards.

most applications. This will give roughly a 200-ft. communicating range. If you wish to increase the range of the system, you can increase the length of the receiving antenna. Additional range can also be obtained by increasing receiver sensitivity. Decreasing input transformer *L5*'s turns ratio, for example, will couple more signal into the mixer, but at the expense of a lower tuned-circuit Q, due to mixer loading. Moving the primary tap on mixer transformer *L3* farther from the supply side and/or decreasing the primary-to-secondary turns ratio will also increase gain. Changing *L3* to a 5:1 ratio coil (the specified coil gives a 32:1 ratio) will double 49-MHz sensitivity from 6 to 12 microvolts.

The receiver's digital outputs have significant drive capability. They are capable of sinking 100 mA with a saturation resistance of 7 ohms. Alternatively, they can source 100 mA at up to 1 volt above ground for driving grounded npn transistors and silicon controlled rectifiers (SCRs). For higher currents, the digital outputs can be summed by connecting together pins 7 and 9 of *IC2*.

The 455-kHz intermediate frequency was chosen for convenience. Actually, system i-f can be as low as 50 kHz or as high as 1 MHz, obtainable by changing the values of the appropriate components.

Receiver alignment is quite simple, requiring just a voltmeter capable of tracking down to about 25 mV and a

(Continued on page 89)

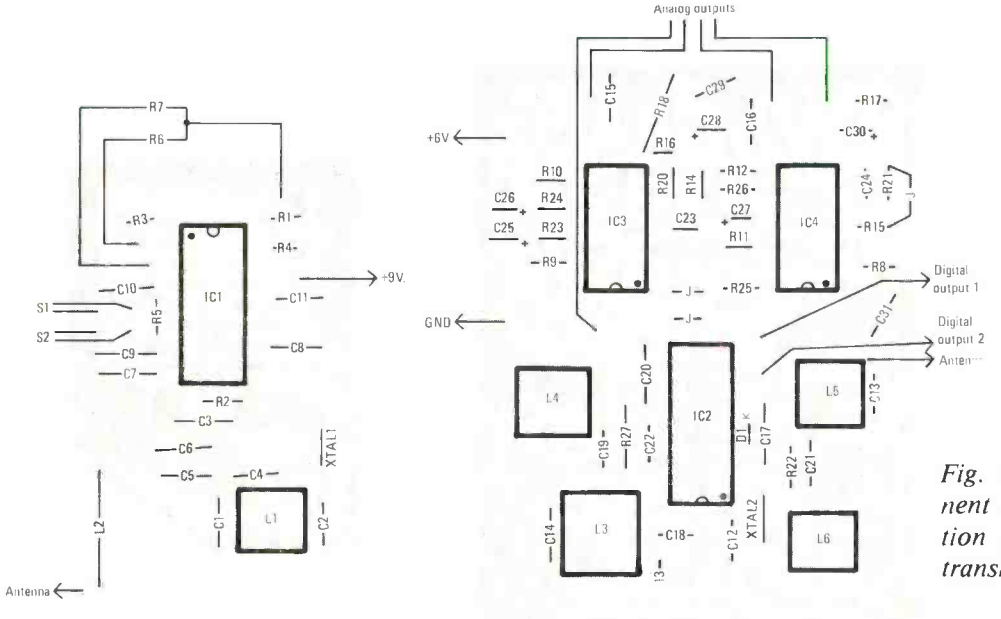


Fig. 7. These are the component installation and orientation guides for the encoder/transmitter (left) and receiver/decoder (right).

Portable Computers '85: One Lap Ahead

Part 2 (Conclusion)

By Eric Grevstad

Last month, we gave you a brief history of the evolving concept of "portable" computers and then concentrated attention on the modern true portable—the stand-alone laptop you can use anywhere. In this installment, we'll tell you about the laptops already competing for your dollars and give you some insights on new models being readied for marketing later on this year or early next year.

Texas Instruments' Pro-Lite features a 12" 80 × 25 LCD screen, 80C88 microprocessor, 720K of diskette storage, and user RAM expansion to 768K.

This Year's Candidates

Turning to today's laptop computers, the first new portables for 1985 turned the tables on the DG/One and IBM gossip at the upper end of the market. Three portable pioneers reaffirmed their commitment to the under-$1000 category, with second-generation machines that feature flip-up LCD screens.

The most familiar is the Tandy 200 ($999), which is a Model 100 with the complaints answered. Judging 80-column LCD characters just too small for comfortable reading, Tandy stayed with its 40-column width, but doubled the vertical measure to 16 lines. Simultaneously, small improvements to the 100's other deficiencies were made: a modem that supports tone as well as pulse dialing, handier cursor movement keys for the keyboard, and 24K RAM expandable to 72K (in three banks).

The Tandy's Microsoft ROMware got an upgrade, too. It has more features for the terminal and word-processing programs, and a scaled-down (63 columns by 99 rows) Multiplan spreadsheet. As with the 100, there's a socket for another 32K ROM program, though only "plain vanilla" Model 100 programs (no BASIC PEEKs or POKEs or machine-language address calls) will work on the Model 200 computer.

By contrast, the Epson Geneva/PX-8 ($995) and NEC PC-8401A Starlet ($999) take a different ap-

Epson's Geneva/PX-8 14-lb. notebook-size computer offers an 80 × 9 LCD screen, three applications programs in ROM, standard CP/M, 32K of ROM and 64K of RAM.

Sharp's PC-5000 provides an 80 × 25 LCD screen and a well into which you drop an optional dot-matrix printer. It uses bubble-memory cartridge, instead of disk, storage.

proach, though largely in the same way. (The NEC has a 16 × 80-character display and a modem, while the Epson has an 8 × 80-character screen and no modem, but it has a microcassette for mass storage.)

More important, both have 64K RAM, CMOS Z80 processors, and the same ROM-chip software—the CP/M operating system and MicroPro's classic WordStar word processor and Calc spreadsheet. The programs, called Portable WordStar and Calc by Epson and WordStar and Calc To Go by NEC, lack some desktop features (help levels in WordStar, for instance), but generally duplicate their 25-line originals. NEC adds terminal and filer programs and sets aside a 32K RAM disk, while Epson chose Microsoft BASIC and a user-settable (up to 24K) RAM disk.

If $1000 is too much to spend for a portable, you might wait and hope for Commodore's rumored $500 or $600 entry. The home computer price busters announced a unit with a 16 × 80-character liquid crystal display (hence its name, the Commodore

Updated version of Model 100, Tandy's Model 200 retains 40-character lines for greater readability but doubles number of lines to 16.

Hands-On Impressions

Between myself and *Modern Electronics* staffers, we've used or observed operation of most of the portable computers on the market. Here are some quick impressions.

The *TRS-80 Model 100* is showing its age, we'll grant you: a modest 8-line, 40-column display, 32K RAM maximum, and clumsy cassette tapes for mass storage. But third-party products have fixed the latter two problems, and Tandy's price cuts have created a bargain—$599 with 24K RAM, a first-rate keyboard, a text editor, and built-in modem that make the 100 a fine note-taking and telecommunications machine. Also, this computer is compactly built, unlike later models that feature adjustable displays.

Tandy's latest portable, the *Model 200,* corrects some shortcomings exhibited by the 100, such as having more RAM, ROM, and a 16-line display. It's also bigger, due to its hinged display and, of course, pricier. Complain all you want about the limitations of 40-character lines: bigger characters are easier to read.

Epson's Geneva/PX-8 is a big improvement over its pioneer HX-20 portable. Besides a fairly legible 8 × 80-character LCD, the $995 machine offers a slow-but-useful microcassette drive, a versatile operating menu, and CP/M 2.2, BASIC, and Micropro's full-featured Portable WordStar and Portable Calc. A drawback of this computer is that there are only two sockets for the four ROM software capsules.

Too bad, though, that the PX-8 doesn't have a built-in modem or a parallel printer interface. Even so, the under-$1000 laptop's on-board mass storage makes it worth a try, though its keyboard travel is a bit shallow and stiff for comfortable typing.

If you're willing to give up BASIC, *NEC*'s *PC-8401A Starlet* offers similar software (plus a filer program), a full set of input/output ports that include parallel and serial interfaces, a built-in modem, and a 16-line screen. It's a neat package, though like others of its kind not as compact as the Tandy 100 . . . nor as easy to read, tiltable display or no.

Sharp's PC-5000 is a novel portable with its bubble memory. The unit worked nicely, though there is some question as to the future of this type of user memory. For its $1695 price you also get MS-DOS and a slew of software.

Next up in price is *Data General/One,* a $2895 package that's also supplied with MS-DOS, word processing, and communications software . . . and a 3½" disk drive. Its 25-line × 80-column screen emulates what the conventional business computers feature. But legibility of characters on its LCD screen leaves much to be desired.

It's $2995 price needs cutting, but otherwise the *Hewlett-Packard HP-110* has few faults: a skimpy word processor (HP's MemoMaker) and poor success at sharing IBM PC programs (though a $150 interface card makes swapping data files easy).

Past that, HP's is one of the best-engineered portables around: a fairly readable 16 × 80 screen, 272K of user memory, and the best menu or operating system shell I've seen: Personal Applications Manager (PAM), which controls everything from setting up RAM disks to keeping tabs on battery charge. Thanks to the 110's mighty ROM and 80C86 chip, Lotus 1-2-3 loads and runs faster in your lap than on a desktop.

Fast typists will find the keyboard a bit stiff, and I found myself preferring the HP's program menu and built-in software to its limited MS-DOS talents —which is why I call it the ultimate Model 100, rather than a laptop PC. That doesn't make it any less desirable, though I wish I'd had Hewlett Packard's external disk drive and the chance to try some other software.

The *Osborne 3*, by contrast, is defi-

Hewlett-Packard's 9-lb. The Portable comes with three built-in software packages and an 80 × 16 LCD screen.

NEC's Model PC-8401A offers full 64K of RAM, built-in business software, 300-baud modem, 80 × 16 LCD screen.

nitely a would-be desktop: awkward in your lap, but ready to run standard 5¼-inch floppy disks. I spent a week with an early production model, which impressed me as a reasonably handy traveler, and ran about half of my MS-DOS library (flunking with graphics programs and software written specially for IBM hardware).

The keyboard was crowded by responsive, and the 16 × 80 screen's world map, desk clock, and calculator distracted me from its incredibly noisy disk drives. But the $2595 Osborne's slow screen response dropped half the characters I typed. Without more debugging, I doubt the 3 will pull its own in the marketplace.

And finally there's the *Grid Compass,* the highest priced portable of the lot at $4995. Everything else aside (like mucho RAM, a 300/1200-baud modem, and so on), my reaction to it is much the same as anyone else's: "I can see, I can see!" Any LCD screen literally pales next to an ELD, which is the computer's hallmark.

We'll have to wait on the newly announced portables: Morrow's "Super Pivot" glow-in-the-dark screen and Grid Systems' new gas-plasma-screen portable, among the offerings.

—Eric Grevstad.

Counterpoint

While I agree with Eric's comments, there's more to portable computers than meets the eye. In fact, what meets the eye is a major consideration.

Using the Tandy/Radio Shack Model 100 when it debuted, I was struck by the limitations of the LCD screen, the 40-column by 8-line display, the absence of on-board mass storage, and its low memory capacity. Nonetheless, it could be a handy machine, I felt, especially if there was a home or office computer system that could provide download and upload facilities. Carrying along a small portable cassette recorder would solve a need for more memory, too.

My reservations about the 100 were soon countered by more advanced portables reaching the market. Now I could use a portable that featured a full 80 characters, just like I'd see on 8½"-wide paper, as well as many more lines. You know what? I have to twist and turn to read the smaller characters displayed, and even with a tilt screen, you can keep your 80-character format with current LCD screens! Tandy/Radio Shack was smart to retain only 40 characters per line.

Then came models with more RAM power, more built-in programs, and now floppy-disk provisions. Real operating systems like CP/M and MS-DOS, too. You know what, again? The machines are no longer little portables to be tucked into one's attache case. They're cases unto themselves. This reminds me of the evolution of portable TV receivers, which quickly became 19"-screen, very heavy models, with a handle stuck on its top. Portable?

Given what I see to date, at the price, I just don't like 'em . . . at all. Given my druthers, I'll take a "transportable" any day and forego inputting data while on the fly. A Compaq or Zenith transportable would do just fine, thank you, or some equivalent to them. I haven't seen George Morrow's new Pivot or Zenith's version of it, so comments here don't apply. The new Tandy 200 is okay by me, with mixed emotions on 40 columns (I can read it, but what you see is not what you get).

Oh, for the good old days! Come to think of it, they're still here since the original TRS-100 is still around at a massive discount now. So I take back my three wishes when I first worked with the 100. If I want truly portable computing and easier-to-read display, at a modest price, I'd take the 100 at this point in time.—*Art Salsberg.*

LCD), 32K RAM, a modem, and word-processing, spreadsheet, database, communications, and appointment software in 96K of ROM. The machine should be Commodore 64 compatible; I hope, however, that the built-in software isn't the awful stuff from the Plus/4.

Big Disks & Backlighting

While CP/M and Commodore invade one end of the market, MS-DOS tightens its grip on the other. The DG/One and its IBM ghost rival may make 3½" microfloppies a standard, but three new portables aim for PC compatibility by running off-the-shelf 5¼" disks.

The slickest is the Datavue 25, sold by Quadram Corp. ($2195 with 128K RAM and one drive). The Datavue resembles a lunchbox with a 25 × 80-character screen; like the DG/One, it's built around Intel's 80C88, the CMOS version of the PC's microprocessor. There's also a PC*jr*-style cordless infrared keyboard.

At 14 pounds, the Datavue is better slung over your shoulder than put in your briefcase. With a nondetachable keyboard and nine fewer display lines, it would be a triplet for two 16 × 80-character models, the Osborne 3 and Morrow Pivot (each $2595 with 128K and two drives).

Both models, designed by a California subcontractor, feature an 80C86 CPU, skinny one-third-height floppy drives, and ROM software that includes a calculator, phone dialer, and deluxe world map and desk clock. Osborne offers expansion to 512K and two drives ($3395).

Morrow, which goes up to 640K and two drives ($2795), promises superior readability, thanks to a "secret" backlighting technique, turning its LCD into bright characters on a black background. Chairman George Morrow boasts that the trick costs far less than an electro-

(Continued on page 86)

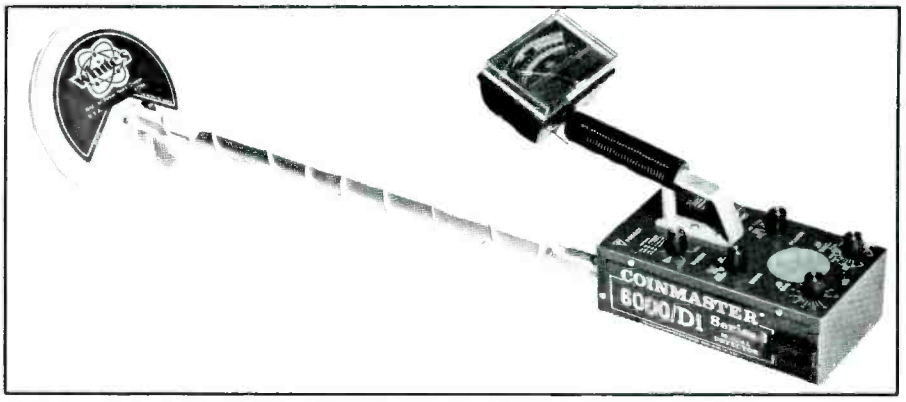
Metal Detecting For Fun & Profit

Part 2 (Conclusion)

Tips on treasure hunting and purchasing

By Gerald S. Pattee

As we pointed out last month, metal detecting—commonly referred to as "treasure hunting"—has gone through a number of stages to arrive at its present level of sophistication. Now that you know what a metal detector is and generally how it does what it does, we will tell you what to look for when planning to buy a detector. Of particular importance is the Buying Guide listing we have prepared, which will help you make comparisons between the various makes and models on dealer shelves.



White's Model 6000/Di offers four operating modes, visual discrimination.

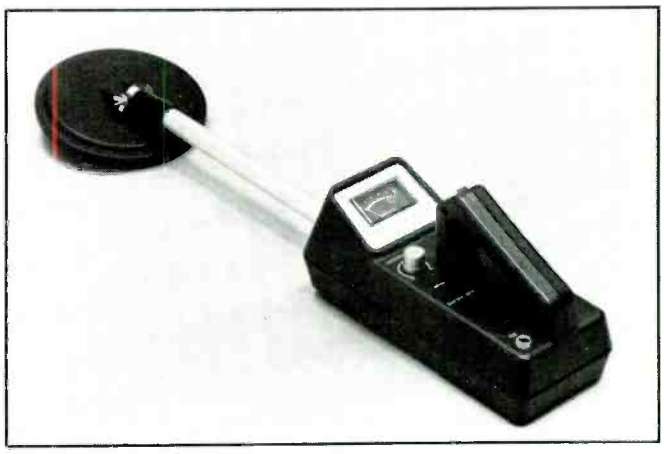
Buying a Metal Detector

Metal detectors, as a glance at the Price column in the Buying Guide table will reveal, can be expensive, depending on their degree of sophistication. An average price is in the neighborhood of $400. Some 40% of the models listed in the Buying Guide cost $500 or more. With only four exceptions, you can figure you will have to lay out a minimum of $150 for one of today's sophisticated detectors, minus any options and accessories you might want. Obviously, then, metal detection is a serious hobby, and for some a business, requiring a sizeable monetary commitment.

Which make or model metal detector you ultimately decide to buy should be arrived at only after seriously considering your needs and carefully comparing features of the various offerings. Do not make the error of letting price sway you toward a model that will not meet your needs. If you plan on using a metal detector professionally, you will undoubtedly want the best there is, even if it proves to be the costliest or nearly so. On the other hand, if you want to make metal detection a hobby or to have something different to do at the beach, a less costly model may be all you need.

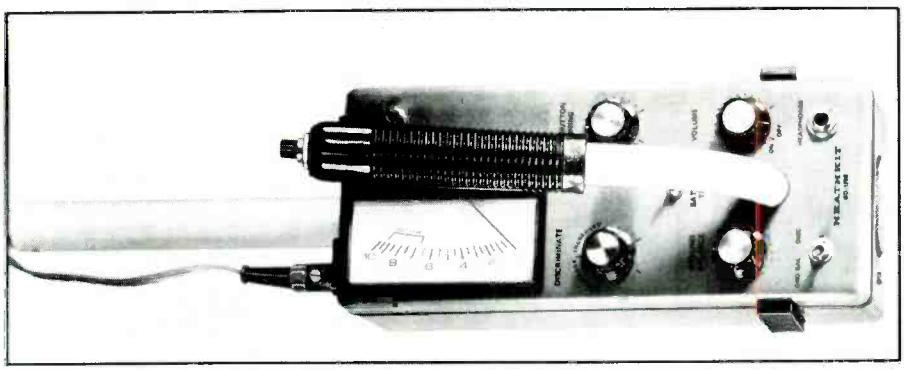
It can almost be said that there is a metal detector for every need. There are the general-purpose detectors most people use at the beach and in public parks for locating small items like coins and jewelry; there are others designed for deep-water (up to 200 feet) salvage work; and still others for locating large objects buried deep in the ground, like pipes and metal conduits, and tiny pocket-size models for locating small items inside walls and sampling ores. For the purposes of this article, we have limited the listings in the Buying Guide to general-purpose and submersible detectors.

If you are not yet into treasure hunting but have more than a passing interest in it, Radio Shack has three economy-priced models that might appeal to you. The low-end Catalog No. 60-3003, which sells for $19.95, is hardly in the same league with the sophisticated detectors offered by other manufacturers, but it can serve as an excellent educational toy that will keep youngsters occupied for



Radio Shack's low-cost discriminator detector.

Teknetics' Model 9000 is technologically perhaps the most advanced multi-mode metal detector on the market.



Heath's Model GD-1290 discriminator comes in money-saving kit.

hours on end. Stepping up in price, and adding a little more sophistication, you can spend $39.95 for the Catalog No. 63-3001, which adds a meter to the built-in speaker. However, if you want a taste of sophistication, the Catalog No. 63-3002 detector with discriminator circuitry will give you a taste of what you can expect in modern detection equipment.

Heath is another company that offers an economically priced detector. Its Model GD-1290 is a build-it-yourself kit, whose $219.95 price is deceiving because it represents what you pay for the kit, which would be considerably more than if it were factory assembled.

Variations among metal detectors is mainly in the search modes offered. Some models offer only one search mode, others two or more, each selectable according to conditions in the area being examined.

Another area in which different models differ is in how they alert you to the presence of metal. All offer audible alert, either through a built-in speaker or plug-in headphones or both. Most also offer visual meter indication, with the meters set up to indicate signal strength, target identification, and target depth or any one or combination of the three. White's Model PI 1000 underwater metal detector has an unique alert system that provides a choice of phone, vibrator or LED display alerter.

(Continued on page 36)

Metal Detector Terminology

As with just about every other specialty area in modern electronics, the metal detector field has its own unique terminology. Much of it is characterized by letter codes that can be totally meaningless to the uninitiated. To understand a manufacturer's descriptive product literature, you must be able to interpret these abbreviations. The following is only a partial list, but it should be sufficient to take the mystery out of the literature and to converse with other metal detector users.

ADS—Automatic detection system
AGC—Automatic ground cancel
ATI—Audio target identification
BFO—Beat-frequency oscillator
DISC—Discriminator
DS—Deep seeker
GBD—Ground-balancing discriminator
GC—Ground cancel
GCD—Ground-canceling discriminator
GEB—Ground-exclusion balance
GNC—Ground-neutralizing circuit
PI—Pulse induction
SPD—Synchronous phase discrimination
TR—Transmitter/receiver
TR-DISC—Transmitter/receiver-type discriminator
VDI—Visual discrimination indicator
VLF—Very-low frequency
VLF-TR—Very-low-frequency transmitter/receiver
VTI—Visual target identification

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The world of computers is constantly expanding. Applications have spread from business to manufacturing, from industry to medical and scientific fields. Computer-aided design, engineering, and production have revolutionized drafting, graphics, and prototyping. Computer sales figures point to a continuing need for service technicians as well as installation and maintenance specialists. The type of training you receive will largely determine your ability to take advantage of these opportunities .... and nothing beats the practical, down-to-earth training you get from NTS.

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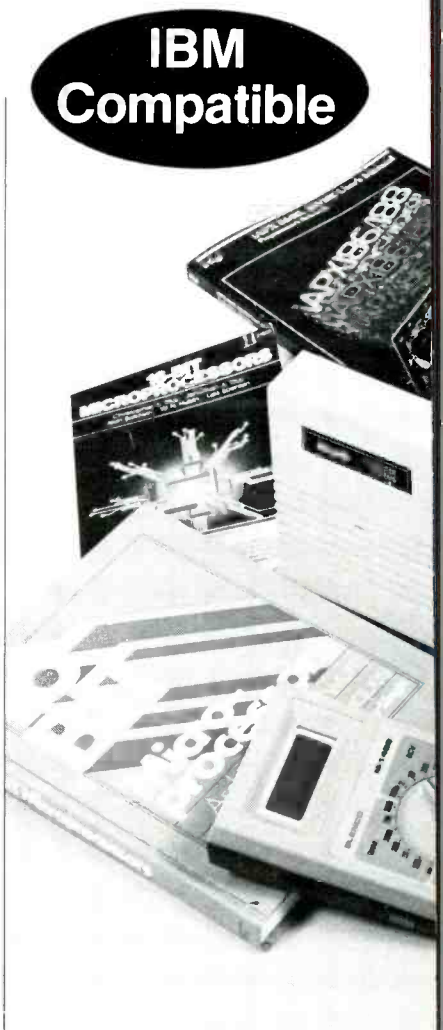
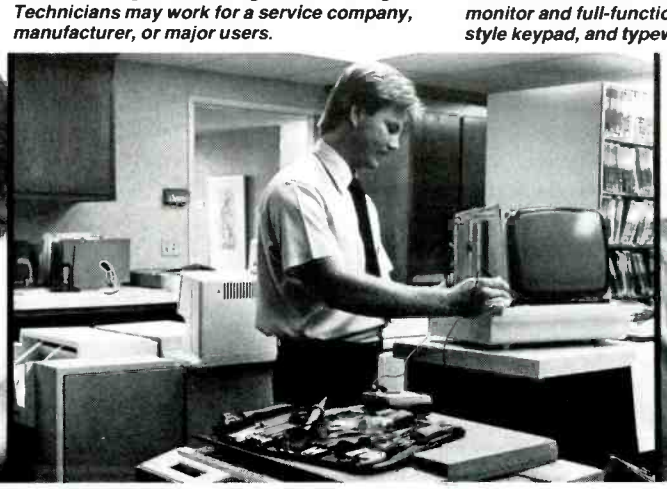
Your NTS training course will teach you to program on this outstanding PC, using lessons, texts, and diagrams to make full use of its capabilities. Catalog contains complete details.



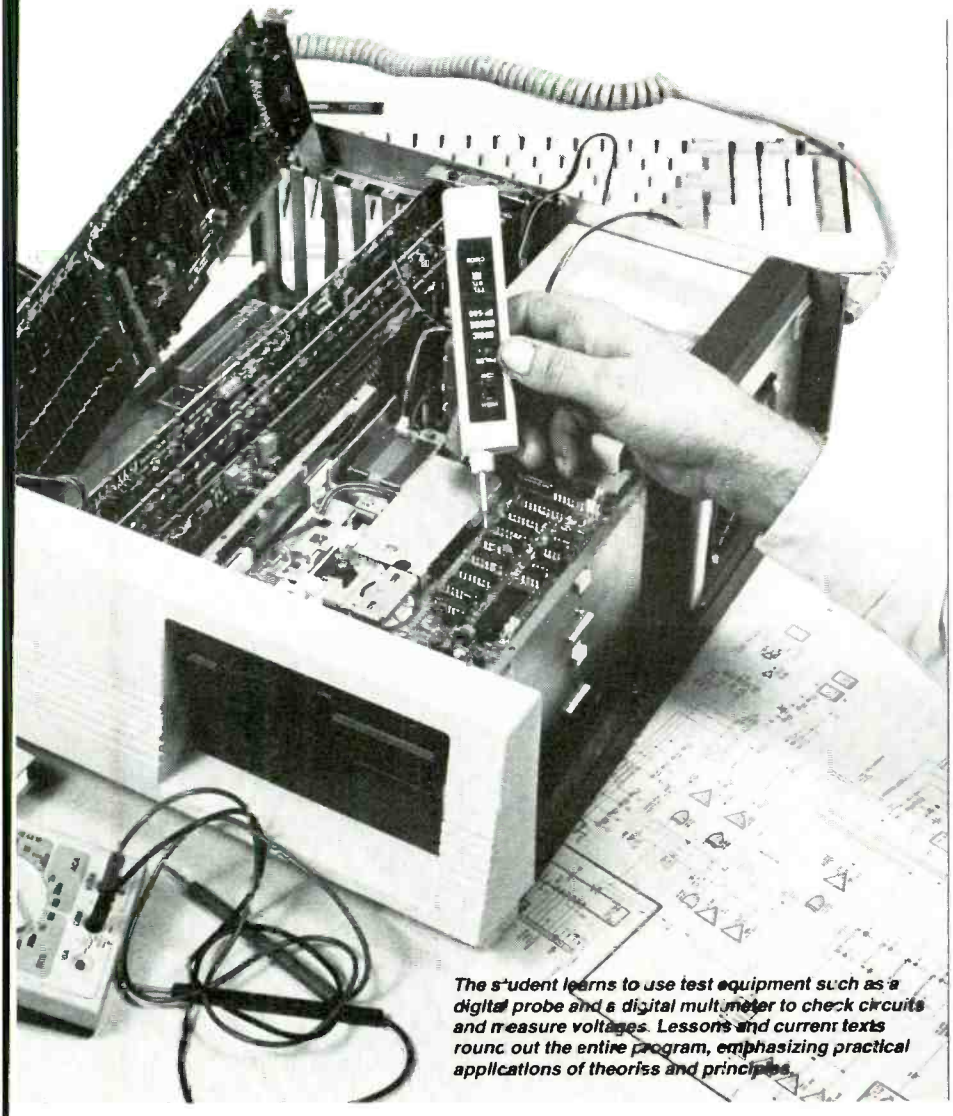
Learning circuitry through the construction of this equipment offers practical training for which there is no substitute. Test equipment is included.

Field servicing is interesting and rewarding. Technicians may work for a service company, manufacturer, or major users.



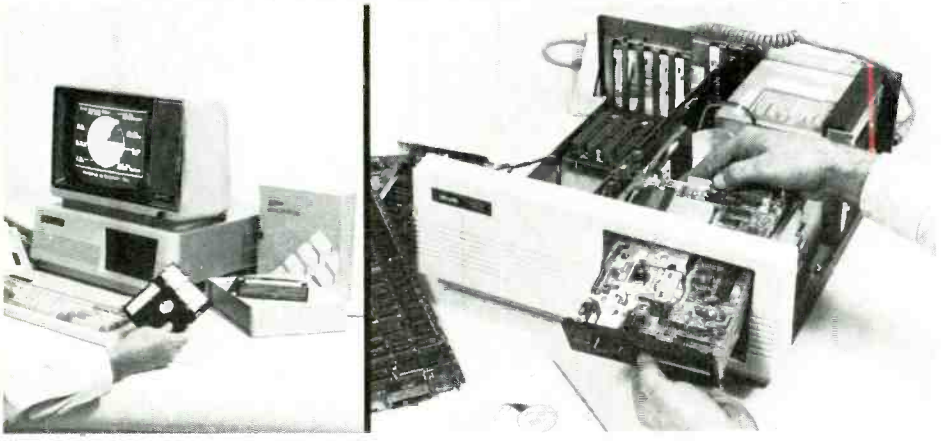
The NTS/HEATH HS-151 PC completed, includes monitor and full-function keyboard with calculato style keypad, and typewriter format.

INTO PC SERVICING A MICROCOMPUTER



The student learns to use test equipment such as a digital probe and a digital multimeter to check circuits and measure voltages. Lessons and current texts round out the entire program, emphasizing practical applications of theories and principles.

Installing the disk-drive in the PC is one of the final stages in the assembly of the microcomputer. Learning the use of test equipment to check circuits is an integral part of the training which, with field experience, develops invaluable career skills.



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Metal Detector Buying Guide

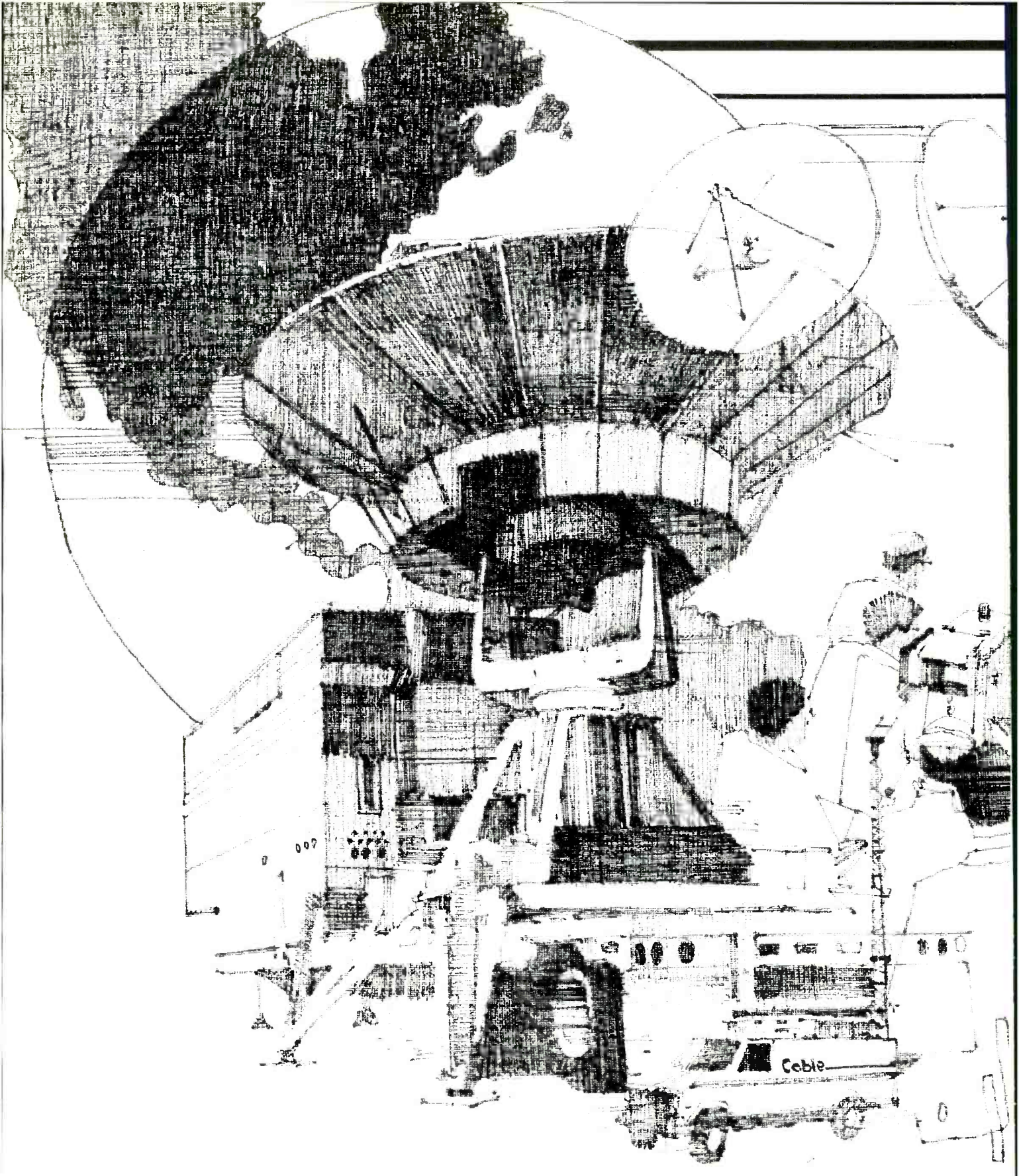
Model	Price	Search Modes*	Coil Size	Indicator	Controls	Weight	Remarks
Compass Electronics Corp., P.O. Box 366, 3700 24 Ave., Forest Grove, OR 97116 (Tel. 503-357-2111)							
X-80 X-70	$649.95 589.95	GB, GB DISC, TR DISC, GB DISC Target Tone Identification (X-80 only)	8″	spkr meter	variable auto tuning; audio tone frequency & volume, sensitivity, discriminate controls; metered target ID	5 lb	3-section telescoping arm-rest stem; options: 1″, 3″, 12″, 16″ search heads; hip-mount platform; backlighted meter
Fisher Research Laboratory, 1005 I St., Los Banos, CA 93635 (Tel. 209-826-3292)							
1260-X	$499.95	VLF-DISC, VLF-all metal (motion)	8″	spkr	trigger mode change; dual discriminator, sensitivity, volume controls	4 lb	battery-recharge circuitry built in; auto tuning; auto ground reject; no-threshold operation
1220-X	$299.95	VLF-DISC, VLF-all metal (motion)	8″	spkr	discriminate, sensitivity controls	3.5 lb	toggle mode change on hand grip; auto ground rejection, auto tuning; no threshold operation
1220-X-PRO	359.95	same as 1220-X	8″	spkr	same as 1220-X, plus frequency shift control	3.8 lb	same as 1220-X, except mode-change switch is on panel
1210-X	199.95	VLF-DISC, VLF-all metal (motion)	8″	spkr	discriminate control	2.8 lb	auto ground reject; auto tuning; no-threshold operation
VLF-441	299.95	VLF-all metal	8″	spkr	tuner, discriminate, volume, sensitivity controls	4.4 lb	optional 11″ deep-search, 3½″ nugget coils
VLF-660	279.95	VLF-all metal; VLF-MAX-all metal	8″	spkr	tuner, ground-reject, volume, sensitivity controls	4.5 lb	optional 11″ deep-search, 3½″ nugget coils
VLF-660-PRO	299.95	same as VLF-660	8″	spkr	same as VLF-660	5.1 lb	same as VLF-660, plus body mount
VLF-930-D	179.95	VLF-TR DISC	8″	spkr	mode, retuner switch; discriminate, ground-reject, volume controls	3.2 lb	ultra-slow auto tune; optional 11″ deep-search, 3½″ nugget coils
VLF-920	149.95	VLF-all metal	8″	spkr	retuner button, ground-reject control	3 lb	optional 11″ deep-search coil
Garret Electronics Inc., 2814 National Dr., Garland, TX 75041 (Tel. 1-800-527-4011)							
XL500	$799.95	Pulse DISC	7½″	phones meter	volume, detection depth, discriminate controls		designed for beach, fresh/salt water to 200-ft depth, including headphones; optional 3½″, 11″ search coils
XS500	799.95	same as XL500	7½″	phones meter	same as XL500		same as XL500, except designed specifically for underwater use
XL500 VLF	799.95	manually tuned VLF DISC	7½″	phones meter	function switch; elimination, volume controls		same as XS500, except designed specifically for fresh-water use
7 A.D.S.	599.95	VLF-DISC, VLF-all metal	7½″	spkr meter	master control, audio selector, ground/trash eliminator switches; audio adjust, tone, depth controls	5 lb 3 oz	submersible search coil for salt/fresh water; slow scanning speed detection; automatic ground elimination; adjustable detection depth
XL200	599.95	pulse DISC	7½″	phones meter	tuning, eliminator controls		auto ground eliminator; auto threshold adjust/operate; rechargeable battery and recharger; belt mount; usable to 200-ft depth with optional headphones
6 A.D.S.	579.95	VLF-DISC, VLF-all metal	7½″	spkr meter	ground/trash-eliminator, master control switches; audio threshold, tone controls	5 lb 3 oz	auto ground elimination; adjustable target elimination; salt-water operation (search coil only); adjustable detection depth
Freedom 2	499.95	DISC	7½″	spkr meter	master control, depth-detection switches; audio threshold, ground eliminator, dual target eliminator controls	4 lb	automatic ground elimination; arm rest; silent or threshold operation; salt-water operation (search coil only)
5 A.D.S.	399.95	VLF-DISC, VLF-all metal	7½″	spkr meter	same as 6 A.D.S.	5 lb 3 oz	same as 6 A.D.S., except meter is not elevated, no visual target classification on meter
4 A.D.S.	299.95	VLF, VLF-DISC	7½″	phones	master control switch; depth, audio threshold, tone-adjust, ground eliminate, trash eliminate controls	4 lb 11 oz	submersible search coil; depth meter scale
Freedom 1	299.95	VLF-DISC	7½″	phones	dual trash eliminate switch; audio threshold, depth, trash eliminate controls	4 lb 6 oz	automatic ground elimination; submersible search coil; electronic pinpointing

Model	Price	Search Modes*	Coil Size	Indicator	Controls	Weight	Remarks
AM-2	199.95	VLF	7½"	phones meter	mode-select/retune switch; audio adjust, ground eliminate, trash eliminate controls	3 lb 7 oz	initial control settings; depth scale on meter; submersible search coil
AM-1	139.95	VLF	7½"	phones meter	retune, depth switches; audio level, ground/trash eliminate controls	3 lb 6 oz	initial control settings; depth scale on meter; submersible search coil
Note: Most Garret detectors can be fitted with optional search coils in different sizes							
Heath Company, Benton Harbor, MI 49022 (Tel. 616-982-3496)							
GD-1290	$219.95	VLF-DISC, GB	6"	spkr meter	mode-select, battery-test switches; volume, ground balance, discriminate, tuning controls	3 lb 5 oz	build-it-yourself kit; submersible search coil; meter mountable for right- or left-hand operation
Radio Shack, 1800 One Tandy Center, Fort Worth, TX 76102 (see local store for details)							
63-3002	$ 59.95	DISC	6"	spkr meter	volume, discriminate, auto-tune controls		can discriminate between desired target and unwanted junk
Teknetics, Inc., 300 Market Dr., Lebanon, OR 97355 (Tel. 503-451-1238)							
9000	$869.99	TR-DISC, GB, GB max., GB-DISC	7¼"	spkr meter	mode, target ID, display switches; tuner, volume, ground-balance, discriminate controls	4 lb 11 oz.	unique liquid-crystal display with coin ID, depth scales, operating mode legends; built-in battery and recharger
8500	679.99	same as 9000	7¼"	spkr meter	same as 9000	4 lb 12 oz	pointer-type meter with target-ID, conductivity, depth scales
8000	589.99	same as 9000	7¼"	spkr meter	same as 9000	4 lb 12 oz	similar to 8500, except has less informative meter scales
7700	479.99	GB, GB-DISC	7¼"	spkr meter	mode, power switches	4 lb 4 oz	no tuning; automatic ground adjust; automatic pinpointing; simplified meter scales
7500	399.99	same as 9000	7¼"	spkr meter	same as 9000	4 lb 10 oz	coin depth, conductivity scales
6500	299.99	GB, GB-DISC	7¼"	spkr meter	mode switch; discriminate-adjust control	4 lb 4 oz	no tuning; automatic ground adjust; automatic pinpointing
Mark I	699.99	GB-all-metal, GB-DISC	7¼"	spkr meter	tuner, tone, sensitivity, ground balance, volume controls; power, target-select switches	4 lb 12 oz	automatic retuning; ultra-slow sweep; target-select programming; very-deep detection; multiple meter scales
Mark III	499.99	GB-all-metal, GB-DISC	7¼"	spkr meter	sensitivity, ground balance, discriminate-adjust controls; mode, power switches	4 lb 12 oz	ultra-slow sweep; very-deep detection; multiple meter scales; automatic battery alert
White's Electronics Inc., 1011 Pleasant Valley Rd., Sweet Home, OR 97386 (Tel. 503-367-6121)							
6000/Di	$679.95	GEB-NORM, DEG-DISC, GEB-max., TR-DISC	8"	spkr meter	power, mode switches; volume, tune, discriminate, GEB controls		stem or hip mount; target ID/depth meter; preset controls; self-adjusting threshold; submersible search coil; trigger/meter
6000/D	499.95	same as 6000/Di	8"	spkr meter	same as 6000/Di		signal-strength/depth meter; trigger switch; self-adjusting threshold; preset controls
PI 1000	499.95	pulse induction	10"	phones vibration LED	single tune/detect/battery-check control		surf/underwater (to 200-ft depth) detector for fresh, salt water; balances out salt, minerals
5000/D	399.95	GEB-norm, GEB-DISC, TR-DISC, GEB-max	8"	spkr meter	trigger, mode switches; tune, ground-adjust, volume, GEB, discriminate controls		self-adjusting threshold; signal-strength meter; preset controls; trigger switch
4000/D	289.95	GEB, DISC	8"	spkr meter	same as 5000/D		trigger switch; self-adjusting theshold; low-battery alert
3000/D	199.95	TR-DISC	8"	spkr meter	retune switch; tune, volume, ground-adjust, discriminate controls		pushbutton retuning; low-battery alert
2000/D	139.95	TR-DISC	8"	spkr meter	retune switch; tune, discriminate, volume controls		pushbutton retuning; low-battery alert
1000	99.95	TR	8"	spkr meter	tune control		auto ground cancel; single-control operation; low-battery alert

Note: Most White's detectors can be fitted with optional search coils in different sizes

*Abbreviations in this column are explained in the "Metal Detector Terminology" box elsewhere in this article.

(Continued on page 96)

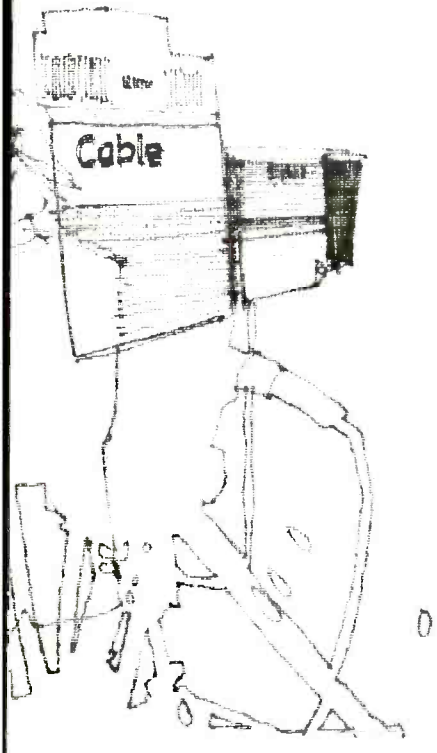

Cable

TVRO Satellite News

The home satellite TV beat goes on as new equipment and industry happenings continue

By Stan Prentiss

The satellite receiving industry is booming as summer installations and dealer showings set records for the continental United States. Manufacturers and distributors now estimate more than 1.3-million privately-owned television receive-only (TVRO) installations are now in operation, with sales during warmer weather exceeding the record-breaking market rate of 60,000 per month established in mid-winter.



Furthermore, the list of geosynchronous satellites on station keeps growing as new launches occur with fair regularity from the U.S. and abroad.

As with any dynamic, new industry, however, there are always tidings of gloom and jubilation. The worst occurred on March 31 with the failure of USCI as it went off the air. The good news is that consumer satellite engineering is progressing by leaps and bounds, and some excellent systems are now appearing at moderate prices that should satisfy almost all requirements, including the ever-present threats of 2° C band satellite spacing and special program audio-video "scrambling" encryption.

SPACE, the Society for Private and Commercial Earth Stations, is now actively negotiating with Home Box Office (HBO) and other would-be scramblers to make available its shows and movies if Harry Homeowner wants to pick up a $395 check for a descrambler and moderate programming and access fees. At the same time, SPACE is also upgrading dealer and technical personnel in an extensive Dealer Certification Program that includes receiver design, terrestrial interference, installations,

zoning and legal, and troubleshooting. Written tests and a final examination covering all seven required courses are part of the curriculum.

Industry Trends

Latest TVRO movements are toward smaller receptors (dishes), lower-noise LNAs (low-noise amplifiers), and higher frequency outputs from block-down converters that deliver the entire 500-MHz C or Ku satellite bands. Formerly a mere 70 MHz with a single LNA, they've risen to between 900 and 1450 MHz, many with dual LNAs for both vertical and horizontal transponder (satellite channel) polarities so several TV receivers may tune any channel on a single satellite without interaction by another. Even 6-ft.-diameter antennas with much lower-cost 80° Kelvin noise temperature LNAs instead of 120° LNAs are penetrating markets that either need less-obtrusive dishes or are satisfied with a couple of high-powered satellites and a few dozen channels, rather than the hundreds often available.

Whether mesh, perforated, or fiberglass, the same size receptor usually produces equivalent gain, although there are tradeoffs for each category. The mesh dish is often made up of sectional panels, supported by a fairly rigid frame—all aluminum. The better *perforated* dishes come in a solid piece or large steel panels and are usually the larger 8-to-12-ft. variety of receptors with holes punched through the sheeting. As for solid antennas, they may be fabricated of spun aluminum, steel, or fiberglass, with compression molding, sheet molded composition, or resin transfer molding.

Among steel and aluminum antennas, surface coatings of hot mix black zinc or electrostatically-bonded powder coatings are preferable, with as little aluminum-to-steel contact as possible since this can result in metal-deteriorating galvanic action.

Pico's new rectangular satellite antenna handles both C and Ku bands.

Stainless steel is good, but expensive, and should have a flat matte surface to diffuse heat-creating IR/UV light waves. In fiberglass, undersurface reflecting mediums of either sprayed metal film or continuous metal foil are preferred, since "chicken wire" with large holes produces carrier phase distortion and image problems. As for wind velocity, after speeds of 30-40 mph, perforated and mesh antennas behave like any other closed surface, and probably have the tendency to retain ice and snow longer than solid receptors because of their holes. Weights are relative, depending on size.

Antenna Wrinkles

The newest wrinkles among TVRO antennas are the rectangular variety, which are claimed to easily meet the FCC's (transmit) antenna requirements. Occupying less space vertically but more horizontally than some ordinary parabolics, these latest receptors have both specially designed feedhorns and offset (lower) feeds, and at least two manufacturers claim they're more than adequate for both the 11.7-to-12.2-GHz Ku band as well as the 3.4-to-4.2-GHz C band. With dual feeds, they may even be able to accommodate both Ku and C band transmissions across the States and beyond with reasonable gain and narrow enough beamwidths to avoid undue carrier-to-interference problems.

Comtech Antenna Corp. of Florida has the larger of these two rectangular receptors, measuring 8-ft. high by 18-ft. wide, guaranteed to *exceed* all "FCC specifications for 2° spacings," and available for both transmit and receive in AZ/EL, polar mounts or mobile configurations. Of probably greater interest to homeowners is the very new little Pico kid™ with its specially designed dual feed horn that operates equally in horizontal and vertical polarities. It can serve both Ku and C bands with the proper LNAs, meeting most if not all requirements for 2° spacing. Weighing but 39 lbs. and formed from high impact, UV-stablized plastic, it is said to be designed to reject mild-to-moderate terrestrial microwave interference in either of the two bands. The two LNBs and their feeds serve 950- to 1450-MHz satellite receivers.

In the more conventional satellite receive-only dishes, General Instrument Corp. (Canadian Div.), offers 8- and 10-ft. mesh antennas with ribs and rims precision-formed from tempered aluminum extrusions for excellent surface accuracy and high efficiency. Pre-galvanized steel forms with polar mount for these units and spherical bearings allow friction-free horizon-to-horizon travel, all fully adjustable for azimuth, elevation, and declination.

Janiel is another distributor of products with solid and perforated antennas from Alcoa Aluminum and receivers from General Corp. of Japan. Its small antennas have 25% perforation and consist of 6 panels—all UPS shippable. Big antennas are made of 40-thousandths steel with baked-on powder coatings and up to 42-dB gains and high efficiencies. The company also introduced a brand new rack-and-pinion mount with metal screw (worm) and transmission and gears that's driven by a 36-Vdc motor using but 1.5-2.8 amps of current. A highly accurate inclinometer, built especially for this mount, caps the package.

Uniden Corp. of America showcased a host of new satellite antenna products. Among them was its UST-110 antenna, a 10-ft. 7-in. diameter design that can be shipped by UPS and takes only about 1½ hours to assemble. The model uses expanded aluminum mesh panels and 18 extruded aluminum arms. A five-step, baked-on painting process gives it a weather-resistant coating. It's designed for the proposed 2° satellite spacing.

The Newest Feeds

Chapparral has both a new Sierra receiver and special plastic antenna mount accommodating both its Ku and C band feeds without further sighting or special support arrangement. Boman Industries is manufacturing a brand new, one-piece *dual* feed for both C and Ku spectrum that aligns as a single unit. Seavey Engineering offers a pair of prime focus feeds for standard or deep dishes with polarity rotations for all transponders in either 3-wire pulse or 2-wire dc types. And Gillaspie Communications has a new GCI-100 C band Polarizer™ that's said to deliver 10° K better noise-temperature performance than the competition. Meahwhile, Uniden brought out new block downconverters to complement its equally new home satellite TV receivers, led by top-of-line UST 7000, which features programmable antenna control that handles up to 81 satellite positions in memory.

Much of the foregoing was introduced and exhibited at midyear meetings of the Society for Private and Commercial Earth Stations (SPACE) and Satellite Television Technology, Inc. (STTI). Almost a traveling road show, such meetings are held at least four times a year, primarily in Las Vegas, Nevada, and Nashville, Tenn., with other sites such as Dallas, TX and Tulsa, OK in between. SPACE has become a force and spokesman for the home satellite industry and is working hard on such rights as viewing, zoning, and training, as well as battling signal-scrambling threats, supporting a two-year moratorium on scrambling introduced in the House of Representatives in late March by Rep. Judd Gregg of Hew Hampshire.

Signal Scrambling

Like it or not, sound and sight scrambling has already begun its move as specialized movieland programs encipher outputs for public pay TV. Furthermore, since the system is addressable with a unique 56-bit key for each descrambler, the degree of difficulty in pirating access is said to be 72,057,590,000,000,000 possible key combinations, or $72,057,590 \times 10^9$ permutations or trial-and-error search possibilities.

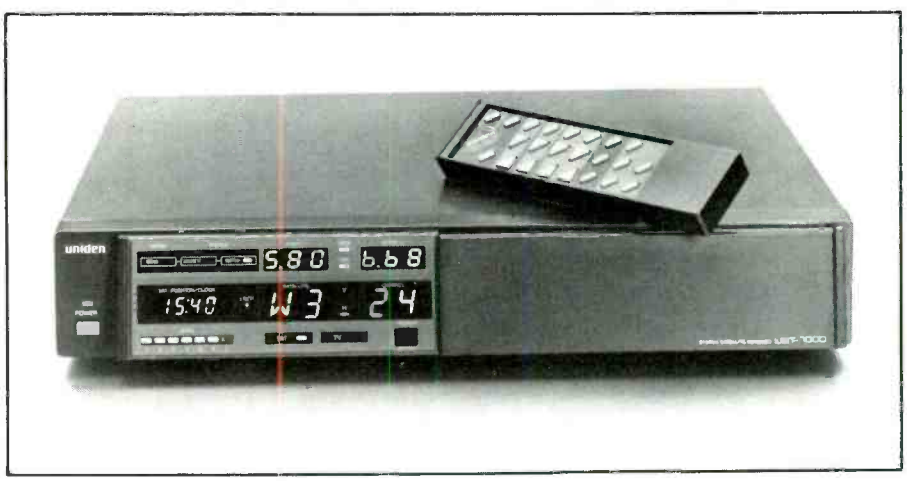
Designed and built by satellite and microwave giant M/A-COM and its Linkabit™, Inc. division, VideoCipher™ uses a Data Encryption Standard (DES) algorithm of the National Bureau of Standards, reportedly producing a descrambled signal equal to or better than the plain-language original even in relatively noisy environments. System applications are CATV, SMATV, satellite DBS, and private networks, with up to 56 tiers of independent programming that can be altered on command, depending on system operation and/or customer billing intervals.

Video has sync removed and a portion inverted, plus the centering of 3.58-MHz color burst at some nonstandard line position, while audio is transmitted as a pair of digital channels during horizontal blanking. The audio is encrypted and combined with error coding bits for extremely high security and quality.

There are actually three VideoCipher versions available, with VideoCipher IV, a modification of VideoCipher II, scheduled for reliable cable and terrestrial consumer applications. Most of our information, however, concerns VideoCipher II.

It transmits secure address and control information to the various descramblers as part of the video signal, providing complete control at points of origination. Organized in related program categories, descramblers will respond up to 56 independent tiers and can pass only programs specifically authorized. Individually addressed control messages may be received at the rate of 250,000 per hour, along with a 56-bit

Uniden's top-of-line model UST-7000 downconversion satellite TV receiver features infrared handheld remote control, programmable antenna position control, stereo capabilities and dynamic noise reduction.



authorization word and a monthly access key. A 56-bit program mask word is also sent, and if the mask and descrambler's authorizations have common 1s digits, program viewing is permitted.

The service is further broken down into DBS (direct broadcast service) commands and CATV commands, so that all DBS channels may be activated by separate program masks, while another 56-bit program mask controls descramblers for separate service elements on each CATV channel, independent of DBS.

Addressing and control data transmits as 63 kilobits during the nominal 11-microsecond horizontal blanking interval in the form of multilevel key structures. Each subscriber has a special unit address with certain keys, while secure retention of critical descrambler information stored in non-volatile memory, permits rapid restoration of service after interruptions or power outages.

Each descrambler is preloaded with its X-Y coordinates based on your local post office zip code. If descramblers are not affected by up to 32 imposed and independent blackout regions, they then permit the showing of scheduled programs, all else being in order.

You may also receive personal messages such as electronic birthday cards, personal stock exchange quotations, etc., and view up to 256 pages of text information per channel. These may show program guides, headline news, sports, and so forth, and even notices of unauthorized ongoing or coming events.

While all this percolates, the descrambler keeps track of your available credit for impulse purchasing of programs, which may either be increased or decreased, depending on how the account is handled. Then there's infrared remote control that will permit impulse pay-per-view selections as well as on-screen program displays for ratings, cost, and your present line of credit, in addition to second language programming. **ME**

U.S. Domestic Satellite System*

Satellite Name	Locations °W. Longitude	Band (GHz)	Date Launched	# of Xpdrs/ BW (MHZ)
SATCOM V	143°	4/6	Oct. 1982	24/36
SATCOM I-R	139°	4/6	Apr. 1983	24/36
GALAXY I	134°	4/6	June 1983	24/36
SATCOM III-R	131°	4/4	Nov. 1981	24/36
COMSTAR IV	127°	4/6	Feb. 1981	24/36
SPACENET I	120°	4/6; 12/14	May 1984	12/36 & 6/72
WESTAR V	122.5°	4/6	June 1982	24/36
SBS IV	101° (temp.)	12/14	Sept. 1984	10/43
SBS I	99°	12/14	Nov. 1980	10/43
WESTAR IV	99°	4/6	Feb. 1982	24/36
SBS II	97°	12/14	Oct. 1981	10/43
TELSTAR 301	96°	4/6	July 1983	24/36
SBS III	95°	12/14	Nov. 1982	10/43
GALAXY III	93.5°	4/6	Sept. 1984	24/36
WESTAR III	91°	4/6	Aug. 1979	12/36
TELSTAR 302	86°	4/6	Sept. 1984	24/36
SATCOM IV	84°	4/6	Jan. 1982	24/36
WESTAR II	79°	4/6	June 1974	12/36
COMSTAR III & D_2	76°	4/6	Sept. 1978 & Sept. 1976	24/36 24/36
GALAXY II	74°	4/6	Sept. 1983	24/36
SATCOM II-R	72°	4/6	Sept. 1983	24/36
SPACENET II	69°	4/6; 12/14	Nov. 1984	12/36 & 6/72
WESTAR I	retired (8/83)	4/6	April 1974	12/36
SATCOM I	retired (5/84)	4/6	Dec. 1975	24/36
COMSTAR D_1	retired (9/84)	4/6	July 1976	24/36
SATCOM II	retired (2/85)	4/6	March 1976	24/36

*In Orbit as of February 5, 1985

SATCOM: RCA American Communications, Inc.
WESTAR: Western Union Telegraph Co.
SBS: Satellite Business Systems
GALAXY: Hughes Communications Galaxy, Inc.
COMSTAR: owned—Comsat General Corp.
operated—American Telephone & Telegraph Co.
TELSTAR: American Telephone & Telegraph Co.
SPACENET: GTE Spacenet Corp.

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Stereo Tape Deck Performance Specs

How tape recorder performance specifications are determined by using recognized measurement standards

By Leonard Feldman

If you're interested in buying a good-quality stereo tape deck or service such equipment, you'll want to know how well a model should perform when it's brand new. To do this you can check out the manufacturer's published performance specifications for the deck. Chances are that the figures were derived from a measurement standard recognized by the Electronic Industries Association (interim standard No. IS-12-CP). Thus, most of the better tape decks have their performance attributes defined with the same reference points, so that you can make comparisons meaningful.

There are 13 separate performance parameters that are considered primary specifications for a tape deck that both records and plays back. All must be published by any manufacturer who wants to conform to the EIA standard. Furthermore, there are some 11 additional performance characteristics that are considered to be of secondary importance. These may or may not be reported, as each manufacturer sees fit. In this discussion we'll examine only primary specs and how they are measured. (For a listing of secondary specifications with a brief description of what they mean, see "Secondary Specs.")

Here are details on what these specifications mean and the methods used to obtain these specifications.

Record/Play Frequency Response

Frequency response—the ability of an audio component to reproduce all audio frequencies at correct relative amplitudes—is, of course, a primary specification to be measured. In the case of a tape recorder, however, the level at which a recording is made has

Fig. 1. A typical record/play frequency response, graphed for both left and right channels. Notations below the graph show relative response (referenced to "0 dB" at 1 kHz) at 18.5 kHz. The vertical scale in this graphed illustration is calibrated in 10-dB per division increments.

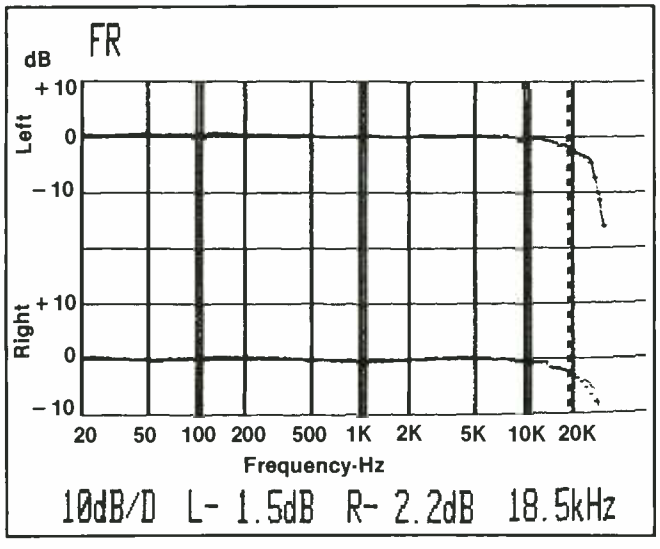
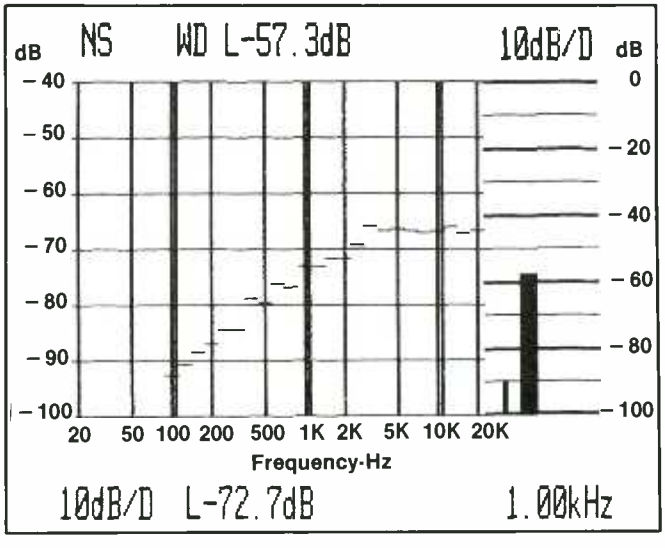


Fig. 2. A-weighted signal-to-noise ratio analysis of a tape deck, using a specified tape. Bar graph at right shows overall S/N figure for left channel (57.3 dB, at top of graph); figure beneath graph (72.7 dB) is noise contribution of the third-octave frequency segment centered at 1 kHz.



a lot to do with the way the measured frequency response will appear.

When you try to record very high levels of high frequencies onto magnetic tape—particularly onto cassette tapes—the tape tends to become "saturated." This causes response at those high frequencies to be lowered or attenuated instead of remaining constant or flat. To avoid this problem, the measurement standard allow us to test the frequency response of cassette decks at 25-dB below "reference level." This is rationalized by observing that high frequencies in music are seldom as great in amplitude as low and mid-frequencies are.)

But what is "reference level"? To begin with, it is not the level at which a given cassette deck's recording level meters read "0 dB." The 0-dB meter readings on most recorders are arbitrary, and not the same from one model to another. Magnetization level can be described in absolute terms, however, by a quantity called nanowebers-per-meter (abbreviated as nWb/m). For cassette recorders, the reference level has been established as 400 nWb/m. As long as all manufacturers regard that level as the reference level and back down to −25 dB from that point when measuring record/playback frequency response, consumers will get a fair comparison of the frequency-response capabilities of one recorder against those of another. Ideally, a manufacturer should furnish a graph, or curve of frequency response, such as that shown in Fig. 1.

If such a curve is not supplied, the manufacturer may state the response in verbal terms, such as:

R/P Response, (using) XYZ Type Q Tape: 35 Hz to 15 kHz, +0 dB, −3 dB

Notice that the tape type and brand used in making the measurement must be stated, as must the plus and minus deviation from flat or uniform response throughout the frequency range be stated.

If the tape recorder is equipped with a noise reduction system, such as Dolby or dbx, record/play response must also be stated for the deck with its noise-reduction circuitry activated. Playback-only frequency response must also be stated. For this purpose, standard prerecorded test tapes are used. If the tape deck has provisions for different basic

More Tape-Recorder Specifications

In addition to the primary specifications described in detail, a manufacturer of home tape recorders has the option of supplying as many as 14 additional specifications, several of which represent multiple sets of information. Many of these additional specifications are self-explanatory, and are simply listed below without any details concerning them. A few may seem strange to you if you are not very familiar with tape recorder technology, and these are briefly defined.

Secondary Specifications

1. Tape Speed Error.
2. Fast Forward and Fast Rewind times.
3. Playback Frequency Response with Noise Reduction Activated.
4. Headphone Output Level.
5. Loudspeaker Output Level (if built-in speaker is present).
6. Line Output Impedance (helpful in matching with other components).
7. Record/Playback Channel Separation and Cross-talk (for stereo units).
8. Maximum Line Input Level.
9. Line and Microphone Input Impedance.
10. Erasure (completeness of erasure of tape, stated in dB)

In addition to the above secondary specifications, the following additional performance specifications are listed and described in the new tape measurement standard: Indicator Response Time and MPX Attenuation.

While many audio tape recorders now employ fast-acting electronic recording level indicators such as LEDs or flourescent bar graphs, others continue to use mechanical level meters. Regardless of the type of metering system used, it is worthwhile to know just how quickly the meters or indicators respond to an actual change of signal level.

A complex toneburst signal is used to determine the ballistics of the metering system and duration of the tone burst required to cause the meter system to read "0 dB" when a signal level of +2 dB is applied to the system. This is considered to be the indicator response time of the metering system. If quoted at all in a manufacturer's published specifications, it is to be given in milliseconds.

In a somewhat similar way, it is possible to measure the indicator decay time: the time it takes for the indicator to recede from its steady state reading by 20 dB. The test of this decay time is done by steadily increasing the interval between one-second-long tone bursts and observing the meter reading. When it reaches −20 dB just prior to the beginning of the ensuring tone burst, the time between tone bursts is listed as the decay time of the particular indicator or metering system.

Another secondary specification having to do with the tape deck's metering system is called Indicator Calibration Error. Specified in dB, it is the greatest deviation observed between the actual input level and the meter reading from nominal 0 dB recording level down to a −10 dB recording level.

The last of the optionally reportable secondary specifications that a tape deck manufacturer may want to list is called: MPX Attenuation.

If a tape recorder has an MPX (multiplex) filter in its circuitry to eliminate the 19-kHz pilot signal present in FM-stereo transmissions, it will attenuate any 19-kHz input to the recorder. Thus, any filter that does a good job of attenuating 19 kHz is also likely to attenuate (albeit to a lesser degree) other *wanted* audio frequencies. A statement of the MPX Attenuation characteristics of a recorder having such a filter should therefore include the amount of attenuation that will take place for 15-kHz signals as well as for 19-kHz signals when the filter is turned on.

Tape Makes The Difference

You may have noticed that some specifications discussed require that the manufacturer list the brand and type of tape used to make the measurement that determined the specification. When it comes to tape recorders, the tape you use in them can influence the performance of the recorder fully as much as (if not more than) the recorder's circuitry. To begin with, there are differences between tapes made by one manufacturer and those made by another. Beyond that, there are also basic or generic types of audio tape.

The International Electrotechnical Commission (IEC), a world standard-making body of scientists, has divided audio tape into four basic types. They are numbered, appropriately: Types I, II, III and IV. Furthermore, the IEC has selected certain batches of tapes, made by specific manufacturers, as the "reference" tapes for these four types.

Type I tape is basically a tape that uses ferric-oxide magnetic particles as the magentic medium. Such tapes require a specific amount of high-frequency "bias" applied to them during recording. They also require frequency tailoring known as equalization during playback. The equalization is defined as a time constant, in this case 120 microseconds. The time constant defines the rate at which high frequencies are rolled off or attenuated by the playback electronics, thereby compensating for a rising response at high frequencies during recording.

While the amount of equalization is fixed for each tape type, the amount of bias will vary slightly even within one tape category. That's why some tape recorders haver vernier bias controls in addition to the basic switch positions for each tape type. But if a recorder has only fixed bias settings, those settings are supposed to be optimized for the standard "batches" which the IEC selected as "reference" tapes for each tape type. Tape manufacturers, in turn, are supposed to make their tapes so that they, too, will operate optimally when bias is set for the "standard" tapes. Of course, some variation can be expected, even from one batch to the next and between different tape manufacturers. That's why serious recording enthusiasts who own tape recorders that only have fixed tape selector switches try to find out what tape a manufacturer used when calibrating his products. The "officially recognized" IEC reference tape for Type I tape was made by BASF, as was the "reference" for Type II tape.

Type II tape uses either chromium dioxide particles or cobalt-treated ferric oxide particles. Tapes using either of these magnetic particles require a higher bias than does tape using ferric-oxide particles. Type II tapes are generally preferred by serious recordists for their somewhat better frequency response

types of tape requiring different settings of the deck's equalization switch, then playback response must be given for each such setting and type of tape. For example, a deck that can handle ferric-oxide, chromium-dioxide (or equal) and metal-particle tape would have to have three separate playback responses quoted for it.

Record/Play Signal-to-Noise Level

This measurement gives you an idea of how much residual tape noise or hiss you will hear when using a given tape with the tape deck being described. The measurement is adjusted by "A-weighting" it to take into account the fact that not all noise frequencies are equally annoying to human ears. Of course, the term signal-to-noise ratio means that we not only have to measure noise level, but that we must have a signal level against which to compare the noise. As before, that signal level is the newly established magnetization reference level of 400 nWb/m (for cassette tape decks). An example of a properly stated A-weighted S/N ratio would be:

A-weighted S/N, Record/Play, using X tape with (or without) Y noise reduction: 57.5 dB.

In my own tests of signal/to noise, I generally go a step further and provide an analysis graph that also shows frequency distribution of that noise, as illustrated in Fig. 2.

Distortion

Harmonic distortion is measured by first recording a midfrequency tone onto a defined type and brand of tape. Then, during playback of the recording, distortion is measured using a distortion of *total* distortion, many manufacturers measure only third-harmonic or second- and third-harmonic distortion, since these two distortion components constitute the major forms that occur when using a tape recorder. The distortion rating is supposed to be quoted in the following form:

Distortion at reference level (400 nWb/meter, for cassette decks), X brand tape, at 1 kHz (the usual frequency used): Y%

In the above, X is the brand and type of tape used for the test and Y is expressed as a percentage.

The plots in Figs. 3A and 3B show how distortion rises as a function of recorded level. For both graphs (3A is 3rd harmonic distortion; 3B is 2nd harmonic distortion), the dotted line cursor has been set to "0 dB." This, in turn, represents the required 400 nWb/m reference level. The percentages appearing at the top of each graph are the measured distortion level at reference level—in this case

characteristics and for their slightly superior signal-to-noise ratio capabilities.

Type III tape is no longer used very much for cassette tape. It is known as Ferri-Chrome tape and is made by applying two separate layers of magnetizing material: ferric oxide and chromium dioxide. The idea, originally, was to make a tape that exhibited the best characteristics of both Types I and II. In recent years, however, most makers of cassette tape recorders have not bothered to include a separate tape selector switch position for Ferri-Chrome tape. Therefore, very few manufacturers continue to make this type of tape. The IEC recognizes a particular batch of Type III tape made by Sony Corp. as the "official" reference tape for this tape type.

Type IV tape employs pure metal-particle magnetization material and is the most expensive recording tape available. In return for that extra cost, however, the user of metal particle cassette tape enjoys a much better high-frequency response, especially for program material where treble-recorded content is fairly loud. With the other types of tape, recording treble tones at high levels tends to "saturate" the tape. As a result, such high levels of high frequencies don't sound right when played back. Metal-particle tape is especially useful when you need a tape that can handle wider dynamic range recording chores. Type IV tape requires a much higher recording bias level than do any of the other three types, however, although its standard equalization setting during playback is the same as that of Type II tape: 70 microseconds. Thus, metal-particle tape should not be used on a tape deck that does not have a specific switch setting for metal tape.

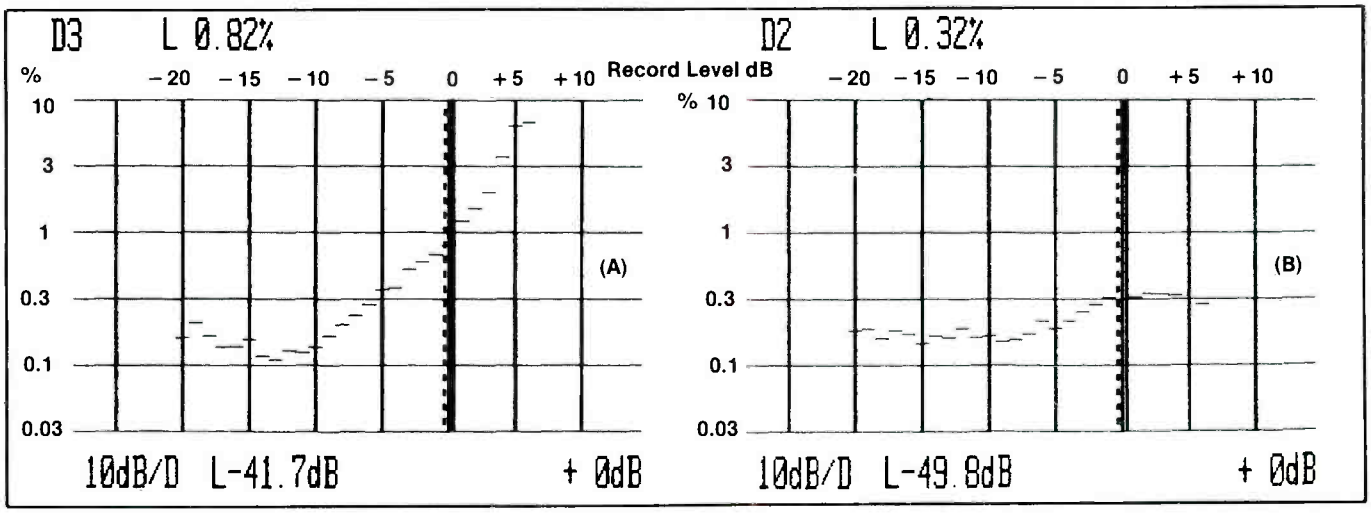
Regardless of whether you use Type I, II, III or IV tape with your cassette recorder, you should choose a high-quality of tape if you intend to record music for future listening. Within each of these categories are a great many brands and grades of tapes. The lowest grades are suitable only for recording of speech or for dictating notes to be transcribed later. Some are not even suitable for that low-fi purpose. Ideally, choose the tape your tape deck maker recommends. If the tape deck manufacturer doesn't tell you which tape is best for his machine, choose a tape, or tapes made by one of the leading manufacturers of cassette tape. These include such well known brands as BASF, FUJI, Maxell, Memorex, PD Magnetics, Sony, TDK, and 3M (Scotch), among others. If the manufacturer of a tape deck offers a tape under its own name (such as JVC, Denon, Nakamichi and TEAC, to name a few) such tape will be a good choice, too. More often than not, these manufacuters are simply buying the tape from one of the above makers who are labeling it with their brand names.

0.82% for 3rd and 0.32% for 2nd harmonic distortion.

Maximum Recorded Level

Maximum recorded level is defined in the Standard as that level at which playback of the recorded test tone yields a third-harmonic distortion level of 3%. That level of distortion is regarded as the highest that anyone would want to tolerate during playback of a recorded tape. In my lab, I can use the plot of Fig. 3A to determine how much above reference level the recording level can be pushed before that 3% distortion point. I simply move the electronic "cursor" on my display to the level at which the

Fig. 3. Numbers at top of each graph show third-order (left) and second-order (right) distortion at reference (0 dB = 400 nWb/m) recording level.



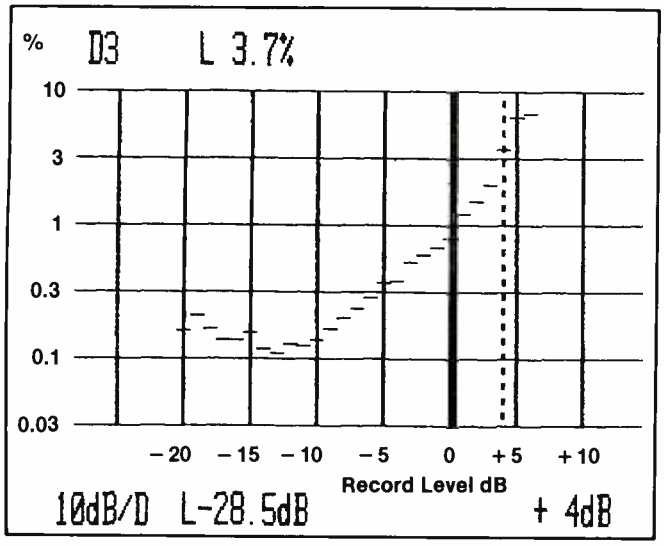


Fig. 4. By moving the dotted line "cursor" of Fig. 3A above the "0 dB" mark in our test instrument, we can determine the maximum record level for the recorder under test—the level at which third-order distortion reaches 3%, here it occurred at about 4 dB above reference recorded level. (Distortion was already at 3.7% at + 14 dB.)

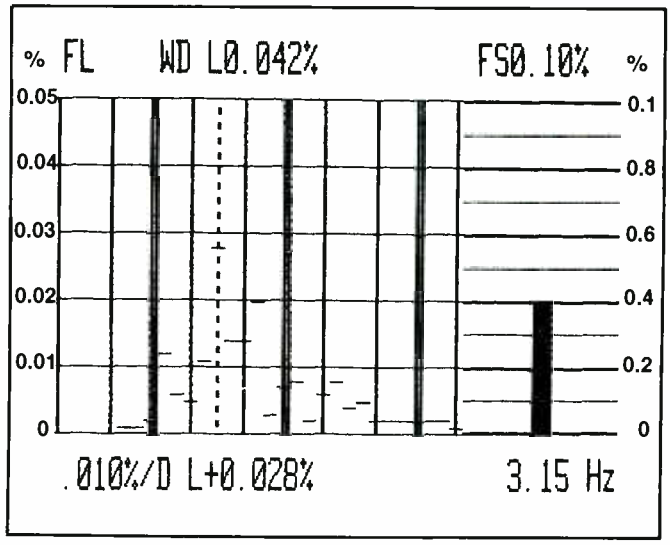


Fig. 5. Bar graph at right shows overall weighted peak wow-and-flutter percentage for recorder under test. Figure appears at top of graph (0.42%). Figure below graph (0.028%) denotes wow-and-flutter contribution at a frequency of 3.15%—in this case the worst component of wow-and-flutter for this particular deck.

distortion readout comes close to the 3% mark. Figure 4 shows the appearance of the graph after the cursor has been moved—in this instance to a level that's +4.0 dB above the reference level established earlier. A statement by the manufacturer regarding maximum recording level would take the following form:

Maximum Recording Level, using X tape, at 1000 Hz, Y dB referred to 400 nWb/meter.

Recording Level Readings

A mentioned earlier, recording level meters or indicators on tape decks aren't always calibrated to the same reference level. One deck's "0 dB" point may not equal the "0-dB" point of another deck. Still, to use a tape deck intelligently, given some of the other specifications we've already discussed, it would be extremely useful to know what your deck's meters (or indicators) read when you are at maximum recording level. That way, you could avoid exceeding that maximum recording level and always get recordings that are not overly distorted. Of course, this specification can be measured at the same time that Maximum Recording level is being checked. The equipment tester or manufacturer simply has to observe the reading on the deck's own level indicators (meters, LEDs or whatever) and note those readings when Maximum Recording Level (MRL) is reached. This specification should be reported as follows:

Indicator Reading for MRL: Y dB using ABC type Q Tape.

Weighted Peak Flutter

This specification is often called wow-and-flutter. One of the sometimes audible defects in any tape deck is wavering of tape speed. This gives rise to a sort of undulating pitch. Rapid fluctuations in pitch are described as wow (because of the wow-wow-wow sound caused by erratic tape speed) while rapid fluctuations of tape speed are called—appropriately enough—flutter.

Special test instruments are used to measure these speed fluctuations in a general tape deck, and the results are expressed as a percentage. The measurement is made several times on a given deck and, in general terms, the highest level of flutter observed during each measurement is recorded. The several values observed in this way are then averaged and the result is reported as the Weighted Peak Flutter. The graph of Fig. 5 goes a step further since it not only reports a single, overall wow-and-flutter figure, but also plots the frequencies of the wow or the flutter.

Wow is generally considered to consist of fluctuations in tape speed

(Continued on page 86)

AKIHABARA
An Electronics Shopper's Paradise

By David A. Wolf

Every special interest has its "capital." Beer lovers may think of Milwaukee. Art lovers may consider Paris as the center of their universe. Today's consumer electronics enthusiasts must certainly consider modern Tokyo as their Mecca. In your lifetime, if you are fortunate enough to find yourself in Tokyo for business or pleasure, you must make a pilgrimage to a most wonderful place, Akihabara. For this is where the most modern electronic equipment may be found. All manner of products may be found in this three-block area in south-central Tokyo. If it runs on batteries, solar cells or plugs into a wall outlet, you'll likely find it in Akihabara.

The famous name, Akihabara, should rolls off the tongue very quickly, like "abracadadra" since no syllables are stressed; in Japanese, every one has equal weight. Akihabara got its start as a locus of electronics shopping right after World War II. Much of Tokyo had been bombed during the war, of course, so the first electronics merchants literally set up tents to sell military surplus. As Japan began developing its infant electronics industry, surplus electronic components began to appear.

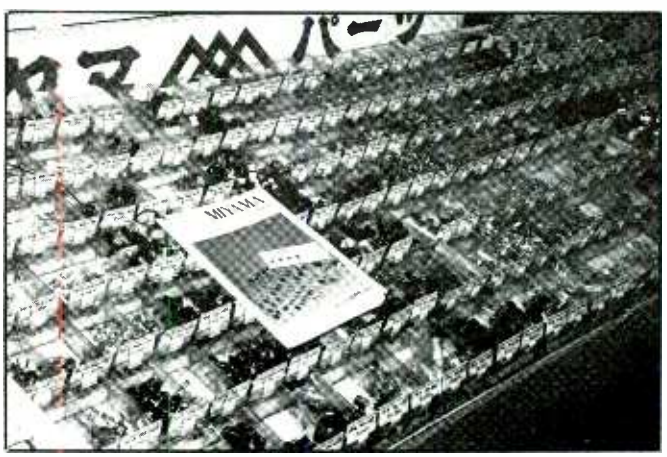
It is curious to note that many of the shops in Akihabara are owned by Chinese immigrants to Japan. Eventually, as Japan was rebuilt, tents gave way to multistory buildings. As Japan's economy recovered, Akihabara merchants began offering finished products along with the component parts.

Without a doubt, the best way to reach Akihabara from wherever you are staying is by the Japan National Railway (Yamanote Line). Japan boasts of having the most efficient rail system in the world. Take the time to plan your route in advance (not at the station) and you will have no problem negotiating the city. If you travel during morning or evening rush hour, be sure and allow plenty of extra transit time. Each station sign is in both English and Japanese. Should you be sightseeing without a local guide and feel lost, write your desired destination on a piece of paper. Most Japanese have a good command of written English, but have little chance to practice the spoken language. Be sure and take your passport along with you, too.

From Akihabara Station, head in a generally northerly direction toward

A busy side street just north of Chuo Dori. The stores are filled with bargains on electronic parts and equipment.

Sometimes, an entire display area is dedicated to the wares of one manufacturer, such as switch maker Miyama.



Most items for sale are out in the open, where prospective buyers have an opportunity to examine before buying.

One of the many multi-story parts outlets at Akihabara. Shopping is shoulder-to-shoulder seven days every week.

the boulevard named Chuo Dori. There are two mandatory stops in your first visit: Yamagiwa Department Store and Kakuta Musen. Stop by the Yamagiwa on the *south* side of Chuo Dori. (The Yamagiwa on the north side of the street is an annex selling duty-free items mainly to tourists, and you're not the average tourist, now!)

Yamagiwa started as a lighting store, and they have not forsaken their roots. There are several floors of lamps and electrical applicances. Make your way up the narrow escalators to the real "goodies." You will find VCRs in every color of the rainbow, display case after display case of the latest in personal stereos, calculators, watches, shortwave receivers, tape recorders, etc. Several soundrooms house the latest and loudest audio equipment with every brand name represented, even esoteric "imported" audio gear (from the U.S.) with names like Macintosh.

Every piece of equipment is marked with neat, colorful, hand-lettered signs showing the value in yen. After a fashion, you can perform the necessary exchange-rate conversions in your head. If you are interested in making a purchase, make a note of the item and its asking price. Do some comparison shopping. There are, literally, scores of shops, all selling much of the same heavily-discounted merchandise. It is fair to play one shop off against the other for a better deal!

Your other mandatory visit is across the street and a few doors to the east of the Yamagiwa annex. Kakuta Musen is among the oldest of the stores in the area. Its ground floor has more conventional consumer-oriented radios, tape recorders and small electronics than you could

The ham-radio sales floor of Kakuta Musen, one of the oldest shops in Akihabara. Other floors are just as crowded.

A salesman placed down his ticket book just long enough to pose. Notice the tape decks, TV receivers and refrigerators.

dream possible. The next several floors contain computers, video games, electronic components, radio-control models and ham radio gear. The components are sold primarily from bins, as they used to be sold in the U.S. Very little merchandise is blister-packaged. There are small plastic dishes in which you may collect just the part necessary for your project. Many times, an entire section is dedicated to the products of one manufacturer.

If you can't find the right part at Kakuta, there are several large, multi-floored complexes of booths specializing in particular types of components. Don't let the austerity of the booths fool you. Some of the proprietors of these booths are very wealthy. The top two floors of Kakuta house the radio-controlled models and ham radio departments. The prices of this equipment are the lowest I've ever seen! Before making a purchase, make sure that your newfound bargain is compatible with U.S. line voltage (115 Vac) and frequency assignments. Japan's line voltage is 100 Vac and the broadcast bands are a little different.

Okay, you've visited the two landmarks in Akihabara, and made your way off the street, away from the bulk of the tourists. If you find something you really like, I encourage you to do some comparison shopping. Find out who has the lowest price and try a little bargaining. The Japanese are polite but skillful negotiators. Depending on the shop and the salesperson, you might end up saving a little more, especially if you pay in cash (expect to pay a 3 to 4% premium if you use a credit card).

Since you will be taking your treasure out of the country, show your passport, so that the Japanese federal tax will be subtracted from the selling price. The salesperson will attach a form to your passport that will be collected as you leave Japan. A successful deal is always concluded with smiles, a bow and, maybe, a handshake. Save your receipts to make the U.S. Customs check as trouble-free as possible. Even the most well-organized person will have a little trouble filling out the customs declaration form after the all-night flight from Tokyo.

If you are a camera buff, as many electronics enthusiasts are, you must travel across town to Yodobashi Camera in the Shinjuku area. Yodobashi has become so well-known, that it is now a stop on many sightseeing tours. Prices are definitely higher than they were just a few years ago. Frequently you will find similar prices on basic camera bodies in the U.S., but Yodobashi can't be beat for prices on lenses and other accessories. I would even suggest making Yodobashi your first stop so that you can document your travels with photos taken with your new camera!

You now have a head start on your own shopping adventure in the most exciting collection of electronics specialty shops in the world—Akihabara. Even the most jaded electronics professional will marvel at what he will find. Like other visitors, you will wish you had brought more money and had more room in your luggage.

Solid-State Sensing Modules For Teleguard

Low-cost circuits you build to enhance the operation of the Teleguard security system

By Anthony J. Caristi

If you built the Teleguard security system described in the May and June issues, you will almost certainly want to build and use the solid-state sensing modules described here with it. The modules presented here have been specifically designed to be used with Teleguard to enhance system operation.

The sensing circuits will respond to such parameters as temperature, light and the presence of fluid (specifically water) to detect fire, thieves, water seepage, and heating system and refrigeration failure. Each circuit is low in cost, easy to build from readily available components, and provides state-of-the-art protection.

Teleguard's Sensing Circuit

In Fig. 1 is shown a simplified schematic diagram of the sensing circuit and controlling oscillator inside Teleguard that uses the normally open protective circuit connected between terminals A and C of terminal strip *TS1*. With the external sensing switch open, the logic-0 fed to pin 4 of *IC1* holds the voltage at this point to zero by the inverting action of

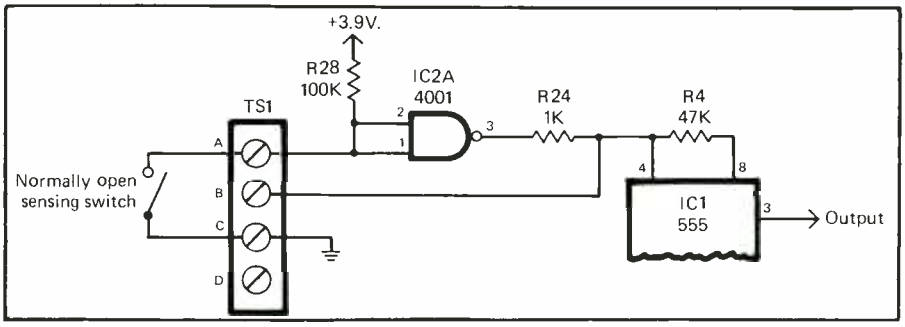


Fig. 1. Simplified schematic diagram of sensing circuit and controlling oscillator inside Teleguard, using a normally open protective circuit.

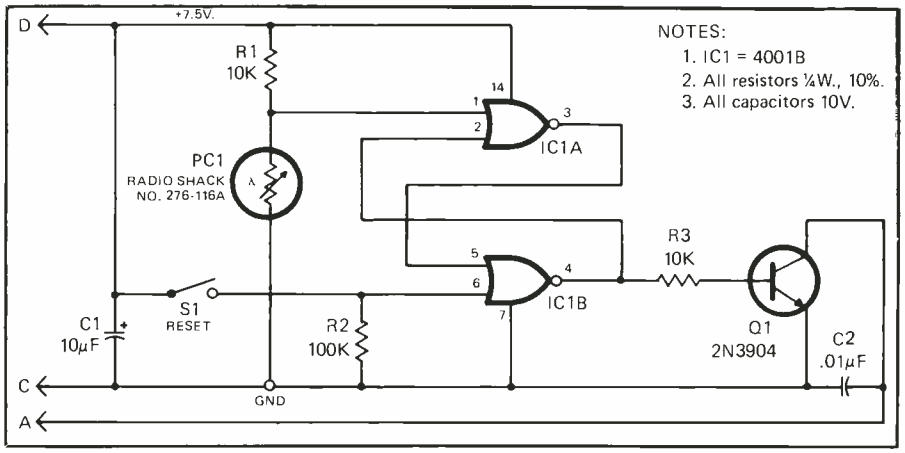


Fig. 2. This latching-type light-activated sensing module uses a photocell and light beam to monitor doorways and passageways to detect intruders.

IC2A. This prevents *IC1* from oscillating and maintains Teleguard in its standby mode. When the sensing switch closes, 3.9 volts appears at pin 4 of *IC1*, allowing oscillation to occur and teleguard to dial out its stored telephone number.

Control of Teleguard can be accomplished with ordinary passive switches, thermostats, etc. However,

a more reliable—if not more elegant—way to do this is to use solid-state circuitry to control the logic level at terminal A of *TS1*.

When triggering of Teleguard is to occur, the sensing modules described below will control the logic level by shorting terminal A to ground through a switching transistor. When the circuit is in standby, the transistor will be cut off, allowing terminal A to rise to logic 1 by means of pull-up resistor *R28* in Teleguard's circuitry.

To power the sensing modules, it is necessary to provide a source of dc power. This can be obtained from Teleguard itself, rather than from a separate supply. The Parts List for Teleguard specified a four-contact terminal strip for *TS1*, though in implementing the circuit only three contacts were used (labeled A, B and C). The fourth contact, which we identify as D, can be used to provide 7.5 volts dc to the sensing modules. Simply connect a wire from the positive end of *C4* to the unused lug on *TS1*. Thereafter, whenever you run wires from Teleguard to the sensor modules, simply include an extra one for the power line.

Since Teleguard's input sensing circuit has a high impedance, you should use two-conductor shielded cable to make connections between it and any sensing modules that are more than about 2 feet away. Connect the shield to terminal C. Also, since Teleguard's ground connection is not isolated from the telephone line, be sure to use an insulated shielded wire so that terminal C does not become accidentally grounded to anything else.

Light-Activated Sensing Modules

A latching-type light-activated sensing module is shown schematically in Fig. 2. This module will cause Teleguard to transmit an emergency call to the preprogrammed telephone number when light to photocell *PC1* is interrupted for even a fraction of a second. When this occurs, the logic level fed to terminal A on Teleguard's terminal strip is set to transmit and will remain so even if the light beam to *PC1* is restored.

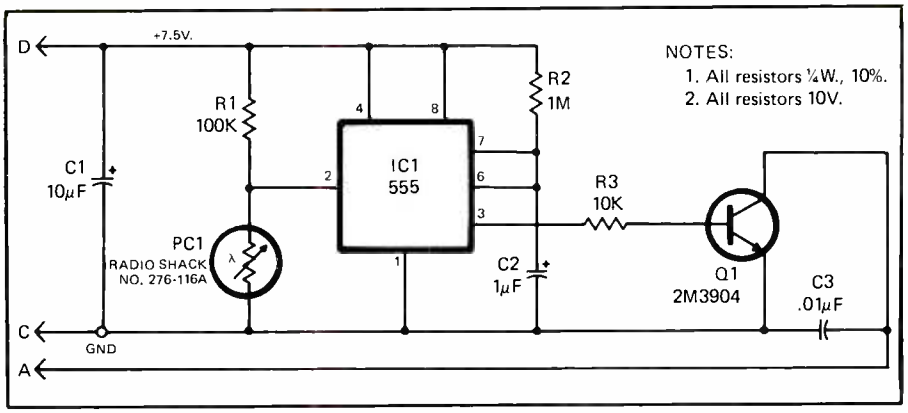


Fig. 3. This nonlatching light-activated sensing module is designed to monitor a normally closed and dark room, such as a storeroom or a vault.

A practical application of the Fig. 2 circuit would be to sense the passage of an intruder through a doorway or a passageway. The sensing module would be located on one side of the doorway or passageway, the light source on the other side and aimed so that it illuminates the sensitive surface of *PC1*. An unauthorized person passing through the protected portal will then break the beam and trigger the circuit.

Operation of the circuit in Fig. 2 is as follows: *IC1A* and *IC1B* NOR gates are wired in a bistable (latching) multivibrator configuration. This circuit can assume either of two logic states, depending upon the last logic-1 level placed on either of the input terminals at pin 1 of *IC1A* or pin 6 of *IC1B*.

When the circuit is in standby and light is directed onto *PC1*, the voltage at pin 1 of *IC1A* is near zero (logic 0). Similarly, the voltage at pin 6 of *IC1B* is also at logic 0, the result of the open contacts of RESET switch *S1* and *R2*. You preset the logic state of the output terminal at pin 4 of *IC1B* after power is applied to the circuit when you press and release momentary-action switch *S1*. This sets the circuit to its inactive mode. At this point, pin 4 of *IC1B* is at logic 0, cutting off *Q1* and putting Teleguard in its standby mode.

As long as light falls on *PC1*, the circuit will be armed and in standby. Interrupting the light beam causes pin 4 of *IC1B* to go to logic 1, turning on *Q1* and activating Teleguard. Should the light beam be restored, pin 4's logic level will remain high and Teleguard will continue to transmit its emergency call. Only when *S1* is operated will the circuit return to standby and cancel the call.

A simple modification can reverse the Fig. 2 circuit's operation such that it holds Teleguard in standby with no light falling on *PC1* and triggers it when light is detected. To obtain this method of operation, simply connect *R3* to pin 3 of *IC1A* instead of to pin 4 of *IC1B*. This operating scheme is possible because the outputs of the latch circuit at pins 3 and 4 are always at opposite logic states. To put the modified circuit in the standby mode, you simply press and release *S1* as before.

A nonlatching light-activated sensing module is shown schematically in

Fig. 3. With this circuit, the transmit signal is produced by Teleguard only when light falls on *PC1*. Should *PC1* go dark after some light has been detected, the transmit signal will be canceled and Teleguard will return to standby. With the circuit shown, light must continuously fall on *PC1* for at least 30 seconds for Teleguard to dial out its stored telephone number and the call to be answered.

A practical application of the Fig. 3 circuit is protection of a normally closed and dark room. Should a thief break in and turn on a light, the transmit signal will trigger Teleguard into making its telephone call.

A common 555 timer, connected as a monostable (one-shot) multivibrator is used in the Fig. 3 circuit. The pin-2 trigger input of *IC1* is held to about 7 volts when *PC1* is dark. This inhibits *IC1* from operating and maintains the pin-3 output at 0 volt. It also keeps *Q1* in cutoff and places a logic 1 on terminal A of *TS1*.

When light strikes *PC1*, *IC1* is triggered into operation with a one-shot period of about 1 second. Since *IC1* is a retriggerable multivibrator, light continuing to fall on *PC1* causes the pin-3 output to remain at about 7 volts. This forward-biases *Q1* and shorts terminal A of *TS1* to ground to initiate the telephone call.

Since the Fig. 3 circuit is nonlatching, the emergency call will be made only if light shines on *PC1* long enough for Teleguard to outpulse the number. If desired, you can increase the time constant of the circuit to about 45 seconds by changing the value of *C2* to 47 microfarads. This will assure that at least one telephone call will be made by Teleguard should light strike *PC1*, even if only momentarily.

Temperature-Activated Sensing Modules

Monitoring the temperature of your home or office—or a refrigeration system—is a practical way to alert you that an emergency exists in your absence. With temperature used as the sensing parameter, you can have Teleguard detect fire and heating system, refrigeration, air-conditioning or freezer failure. You could even use such a detector in a greenhouse to warn you when delicate plants might be ruined by a killing frost.

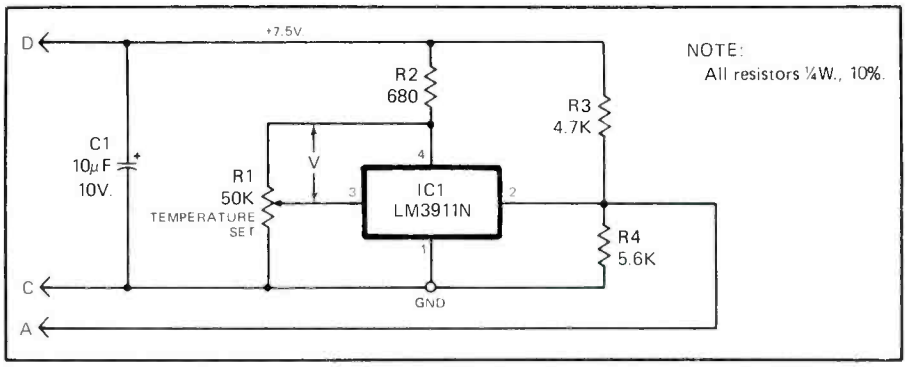


Fig. 4. This temperature-sensing module triggers Teleguard when a rise in temperature is detected. Use it as a fire or refrigeration failure monitor.

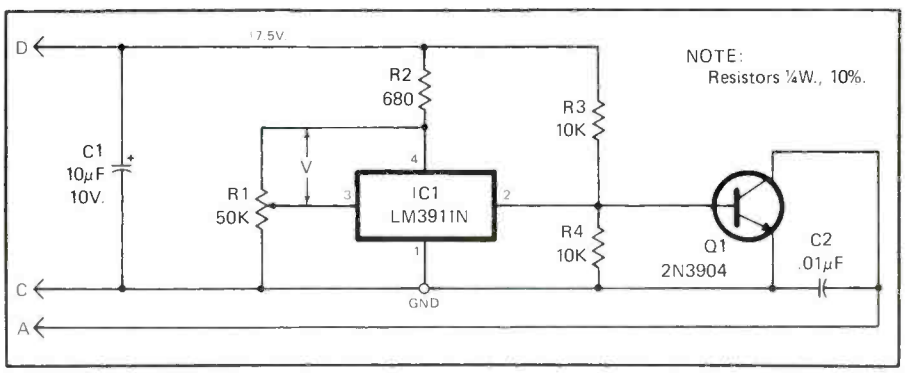


Fig. 5. This temperature-sensing circuit detects a fall in temperature. Use it to monitor for heating system failure or danger of frost damage.

At the heart of the temperature-sensing modules shown schematically in Figs. 4 and 5 is a low-cost specialized IC that reacts to changes in temperature. This precisely calibrated IC can be used to set the desired temperature switching point, using a simple dc voltage measurement between pins 3 and 4 of the LM3911N used for *IC1* in both circuits.

Since a heat emergency, such as a fire, requires opposite logic from a sensor designed for heating system failure, two slightly different circuits are required to monitor the two different conditions. The Fig. 4 circuit will cause Teleguard to transmit its emergency call when a rise in temperature is detected and would be used to protect against fire or refrigeration failure. The Fig. 5 circuit, on the other hand, detects a fall in temperature and can be used to alert you when a heating system fails or when there is a threat of frost. Both circuits are provided with potentiometer controls (*R1*) to let you set the switching point to that temperature that is correct for your application.

The circuits in Figs. 4 and 5 operate in much the same manner. Sensor *IC1* contains a 6.8-volt reference circuit, an operational amplifier and a switching transistor. The last con-

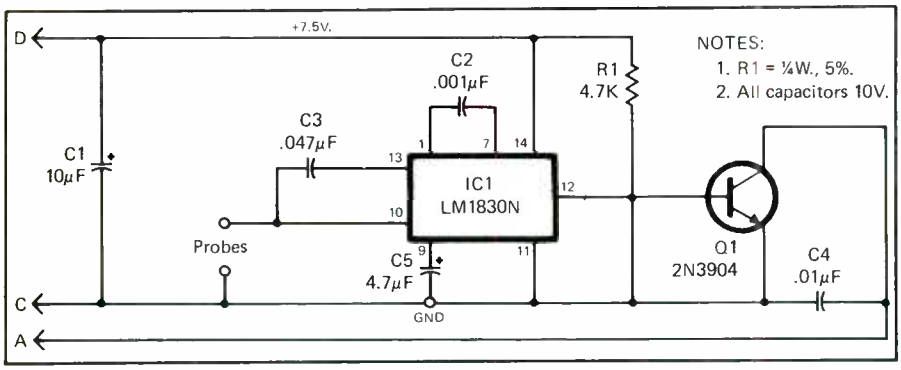


Fig. 6. Use this fluid-detecting module with Teleguard to alert you to take remedial action when water seepage threatens to damage your home or business.

ducts when temperature rises above the trigger point set by *R1*. The temperature at which the on-chip transistor turns on is defined by a simple equation that relates voltage to degrees centigrade.

The output transistor in *IC1* serves as a switching control for terminal A on Teleguard for any application that requires the emergency call to be transmitted when temperature rises in the monitored area. The circuit for this mode of operation is shown in Fig. 4. If you wish the system to respond to a fall in temperature, an additional transistor external to *IC1 (Q1)* must be used to invert the output signal.

The voltage between pins 3 and 4 at which *IC1* switches can easily be calculated for the desired temperature in °C as follows: volts = 2.73 + (0.01 × °C). If you do not know the °C equivalent for any temperature expressed in °F, simply convert as follows: °C = [5(°F − 32)/9].

Suppose you wanted to build a sensor that will alert you when a fire breaks out. You would use the Fig. 4 circuit. Now assume you want Teleguard to make its call when the temperature in the protected area rises above 105 °F (40.6 °F). Using the voltage formula, you would determine that 3.14 volts would be required between pins 3 and 4 of *IC1*. Should you wish to be alerted in the event of a heating system failure, you would use the Fig. 5 circuit and set the circuit to trigger at, say, 50 °F (10 °C), which requires a potential between pins 3 and 4 of *IC1* of 2.83 volts.

Connect the temperature-sensing module to Teleguard using terminals A, C and D of *TS1* (do not use terminal B). Connect a dc voltmeter between terminals 3 (negative) and 4 (positive) of *IC1*. Apply power to Teleguard and adjust *R1* for the desired voltage. Use a fairly accurate (20,000 ohms/volt or greater) voltmeter when making this measurement to ensure that switchover temperature is as accurate as possible.

Fluid-Activated Sensing Module

Water seepage as the result of a heavy rainfall or spring thaw can cause a lot of damage if it is not caught in time to take remedial action. Using a solid-state fluid detector to trigger Teleguard is an ideal way to guard against water damage. Such a sensor is shown schematically in Fig. 6.

At the heart of the Fig. 6 circuit is a low-cost LM1830N IC that can detect the presence or absence of a conductive fluid bridging two metallic probes connected to its input. Any *conductive* fluid can be detected with this arrangement.

Inside the LM1830N used for *IC1* in the Fig. 6 circuit is an oscillator, a detector and an on-chip output transistor. This circuitry triggers on when the resistance between the probes is greater than the built-in reference resistor. Since the normal condition for the Fig. 6 circuit is an absence of fluid, the on-chip transistor normally conducts. Therefore, pin 12 of *IC1* will be at ground potential and *Q1* will be off.

When a fluid bridges the probes, the potential at pin 12 of *IC1* rises to the 7.5-volt supply level and forward-biases *Q1*, shorting terminal A on Teleguard to ground and causing Teleguard to start the dialing sequence.

Note in Fig. 6 that one of the sensing probes is connected to circuit common (ground) and is not isolated from the telephone line. *Under no circumstances should either probe be allowed to contact any conductive object.* To prevent this from happening, mount the probes on an insulated base, such as perforated board, to maintain good isolation between them. Secure the assembly so that the probes touch nothing but the fluid being monitored.

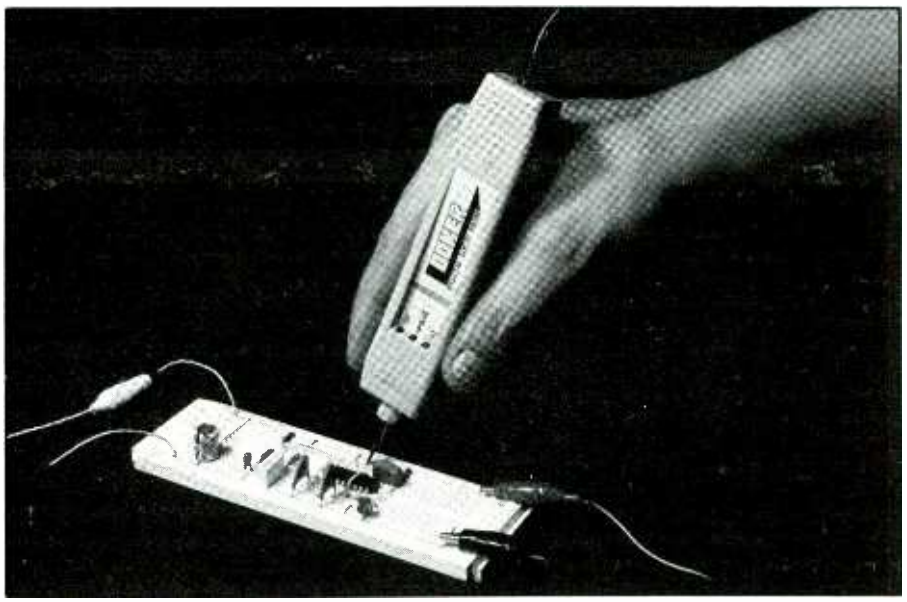
In Summary

Once you have installed your Teleguard security system, you will find that it requires very little attention. Your only real concern will be to perodically check to make sure that the OK LED is on. The security provided by the system will give you peace of mind that your home and/or business is protected from intruders, fire, water damage, etc.—even while you are away. You will also discover that the solid-state sensing modules described here greatly expand upon the type of monitoring provided by the usual switch- and tape-type sensors used in other surveillance systems. In fact, if you wish, you can supplement the solid-state sensors with those passive sensors to achieve both local-area and full-perimeter monitoring with Teleguard. **ME**

The Looker

A low-cost digital logic probe you build

By J. Daniel Gifford



Though everyone regularly acknowledges that a digital logic probe is a very useful tool to have around any electronics bench, many people still don't own one. This is surprising since a logic probe offers a fast, powerful way to check out digital circuits and devices with easy-to-use go/no-go indicators.

If you don't yet have a logic probe, here is a low-cost project that will give you a good taste of what it can do for you in tracing digital circuits and isolating defects. I call this probe the "Looker" because it lets you "look into" a circuit.

When completed, this probe offers good, professional performance. It uses the universal 30%/70% thresholds, has a high 2-megohm input impedance, 3.5-to-16-volt supply range, and low standby current of about 1.5 mA at 15 V. It easily handles multi-family logic, such as CMOS and TTL devices. If the probe has any shortcomings it is in its limited input-frequency response, which is up to 800 Hz. Also, the shortest pulse handled is 300 ns. However, a simple design option extends these specifications, though trading away other advantages.

The finished probe shouldn't cost you more than $20 and could cost much less. At the higher price there's a probe case kit available.

Circuit Description

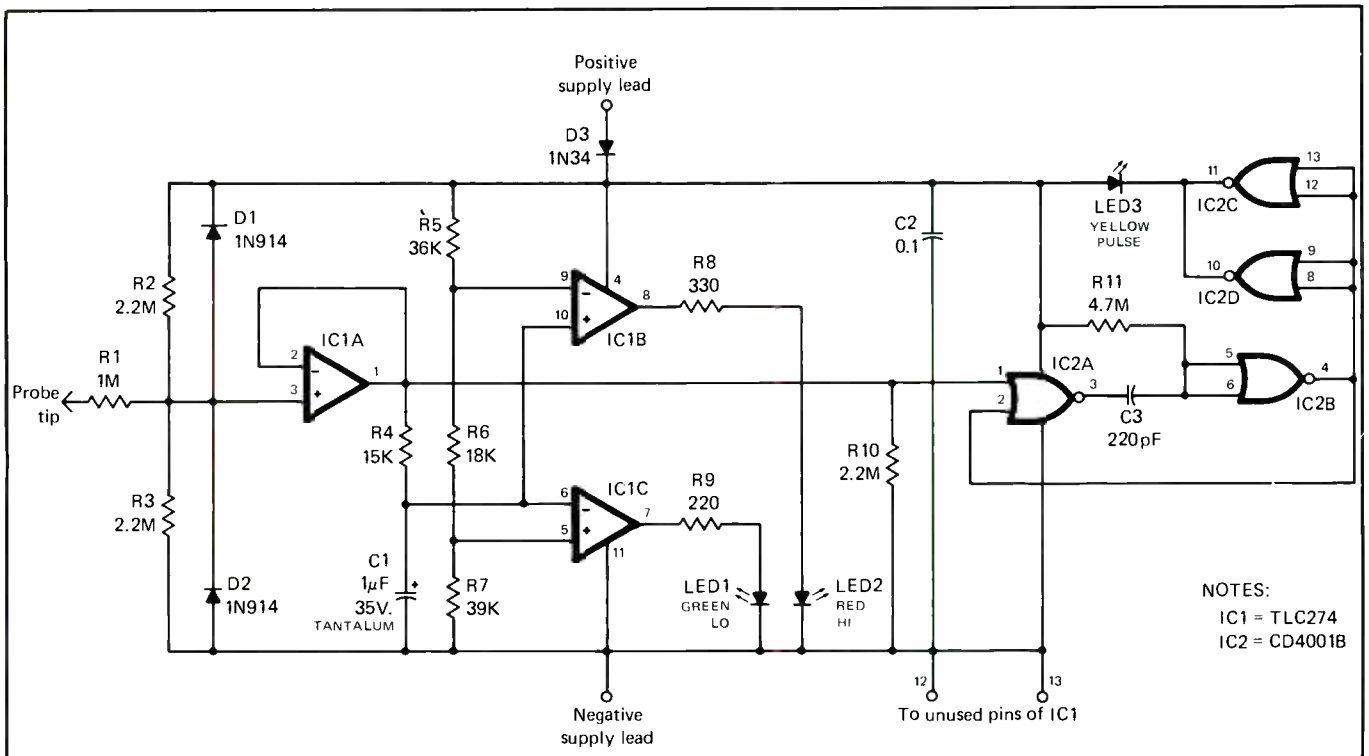
At the heart of the Looker (Fig. 1) are two ICs, a TLC274 quad CMOS operational amplifier (*IC1*) and a CD4001B quad CMOS NOR gate (*IC2*). Though the TLC274 is a pin-for-pin replacement for the common LM234 quad op amp, it offers vastly improved performance, most notably very low supply current and very high input impedance (10^{12} ohms).

Only three of the four op amps in the TLC274 are used. The fourth must be disabled by tying its inputs to ground. The first op amp, *IC1A*, is used as a voltage follower to decouple the input from the rest of the probe circuit. The output of *IC1A* is always equal, within a few millivolts, to the input voltage. Resistors *R2* and *R3* bias the input at about 50% of the supply voltage when no signal is applied to the probe tip. Diodes *D1* and *D2* protect the input against over- and under-voltages, and resistor *R1* limits input current to a safe level.

The other two op amps in *IC1* are used as an offset comparator string, with the inverting (–) inputs of *IC1B* connected to the junctions between *R5* and *R6* and of *IC1C* to the junction between *R6* and *R7*. The values of *R5*, *R6* and *R7* were chosen so that comparator *IC1B* switches on when input voltage rises past 70% of supply voltage, and comparator *IC1C* switches on when input voltage drops below 30% of the supply. HI/LO visual indication is provided by *LED2* (red), driven by *IC1B*, and *LED1* (green), driven by *IC1C*.

A low-pass filter, composed of *R4* and *C1*, deliver the switching signal from the output of *IC1A* to the inverting inputs of *IC1B* and *IC1C*. The filter keeps the HI and LO LEDs from flashing or lighting up at input frequencies beyond about 15 Hz.

To detect fast pulses that might not



PARTS LIST

Semiconductors

D1,D2—1N914 or 1N4148 signal diode
D3—1N34A germanium signal diode
IC1—TLC274 quad CMOS op amp (Radio Shack No. 276-1750) or TL084 quad JFET op amp (Radio Shack No. 276-1714) or LM324 quad op amp (Radio Shack No. 276-1711) (see text)
IC2—CD4001B quad CMOS NOR gate
LED1 thru LED3—T-1 light-emitting diode (one each red, green, yellow/amber)

Capacitors

C1—1-μF, 35-volt dipped tantalum
C2—0.1-μF, 50-volt Mylar
C3—2200-pF, 50-volt Mylar

Resistors (¼-watt, 5% carbon-film)

R1—1 megohm (or 100,000 ohms; see text)
R2,R3,R10—2.2 megohms
R4—15,000 ohms
R5—36,000 ohms
R6—18,000 ohms (or 47,000 ohms; see text)
R7—39,000 ohms
R8—220 ohms
R9—330 ohms
R11—4.7 megohms

Miscellaneous

Global Specialties No. CTP-1 probe case kit with perforated board and test leads/clips (available from Global dealers locally or from some mail-order houses); printed-circuit or perforated board and solder posts; gold-contact, low-profile 14-pin DIP IC sockets (2); one red, one black alligator test clips with attached leads; rubber cement; ¾"-wide clear tape or clear spray acrylic; hookup wire; solder; etc.

Fig. 1. Note in this overall schematic diagram of the Looker digital logic probe that only three of the four operational amplifiers in IC1 *are used. The fourth op amp is disabled by having its inputs grounded. Also,* IC2C *and* IC2D *are tied together in parallel to form a high-current buffer/driver for* LED3.

otherwise be captured by the Looker, the circuit also contains a pulse stretcher consisting of *IC2* and PULSE indicator *LED3* (yellow). Two of the NOR gates (*IC2A* and *IC2B*) are used as a positive edge-triggered monostable multivibrator with an output period of about 0.01 second. The other two gates are wired together as a high current buffer/driver, with their inputs connected to the monostable's output and their outputs driving *LED3*. The input of the monostable is connected directly to the output of *IC1A*. A brief positive or negative pulse at the probe tip will cause *LED3* to flash, while a pulse train at the input will continually retrigger the monostable and hold *LED3* on at a steady brightness.

Like all logic probes, the Looker is powered by the circuit it is testing via a cable terminated in a pair of alligator clips. Diode *D3* is inserted into the

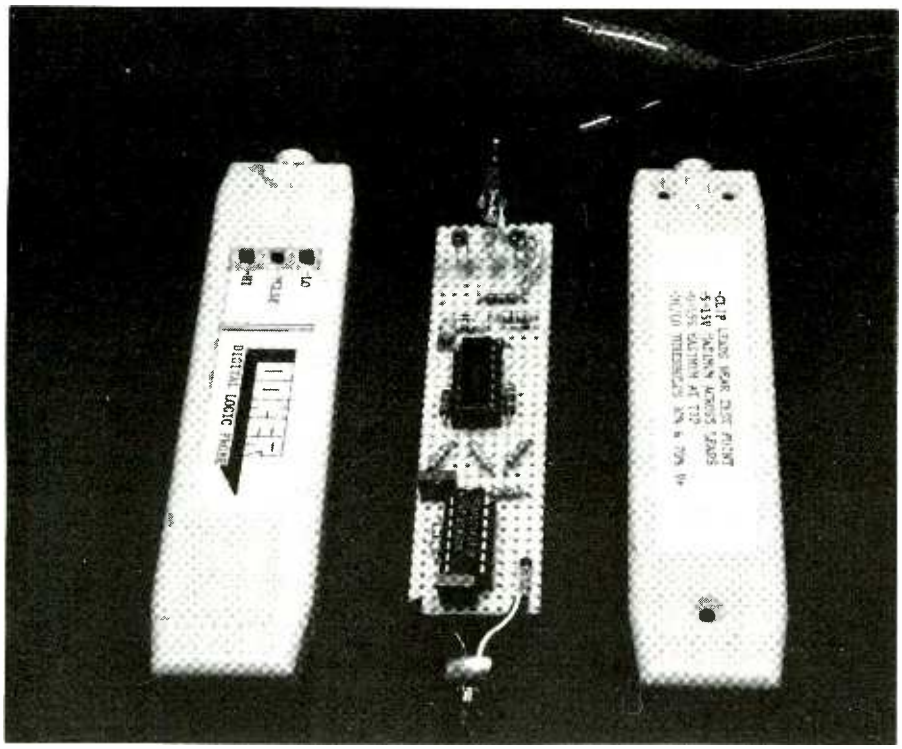


Fig. 2. Shown here is the probe case kit described in the text. Note the threaded removable tip; replacement and specialty tips are available.

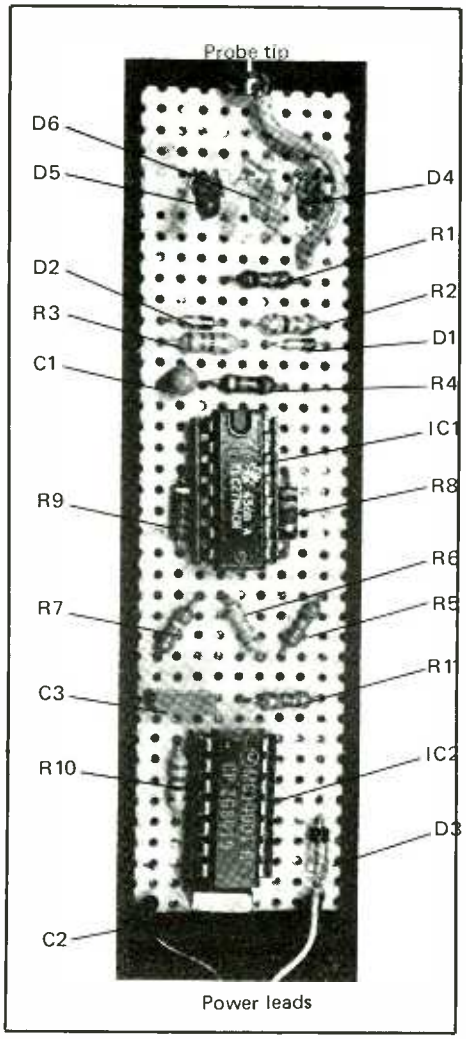


Fig. 3. This is the recommended layout for the parts on the perforated board supplied with the probe case kit. Note the unusual mounting of the LEDs. Use sockets for the ICs.

positive supply lead to protect the probe against damage from reversed connections. A germanium diode is used here, rather than a silicon diode, because of its lower voltage drop—0.3 vs. 0.7 volt for silicon. The lower voltage drop means less interference with the probe's thresholds at lower supply voltages. (The *R5/R6/R7* resistor divider string is also offset upwards slightly to compensate for the unavoidable drop across *D3* and to give true 30%/70% thresholds.) Capacitor *C2* filters out transients and stray frequencies that may interfere with the Looker's operation.

Construction

For a professional appearance, as well as comfortable handling, the Looker is best built into a molded-plastic housing designed specifically for probes. In this case, the No. CTP-1, logic probe kit from Global Specialties is ideal (Fig. 2). The kit is composed of the two shell halves, perfboard, tip holder and tip (replacement tips are available), LED support and lead set with preattached clips and molded strain relief. If you make your own case, follow the general layout shown in the photos.

As mentioned earlier, with only one design change you can extend the Looker's frequency range to about 3.5 MHz, pulse sensing to about 100 ns, and voltage range to 18 volts. You do this by replacing the CMOS TLC274 with a pin-for-pin-compatible JFET-input TL084. However, there's a penalty to be paid. The TL084 will cause the Looker to draw more standby current (about 10 mA at 15 volts). More importantly, it will not permit full operation when connected to a power source that delivers less than 6 volts.

The TL084 version will indicate HI logic levels as well as frequencies and pulses at the 5-volt level, but because the JFET voltage follower cannot swing its output below the LO threshold at 5 volts, it cannot indicate LO logic levels correctly. If you're willing to accept these shortcomings to obtain a greatly extended frequency range, the TL084 version may be the better choice.

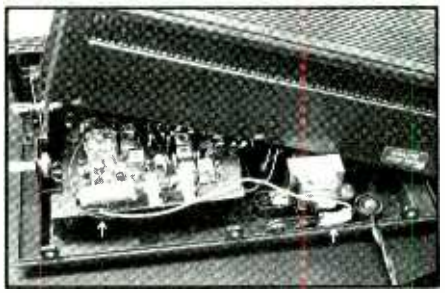
A second design option, suitable only for very-low-performance use, is to use the original LM324 quad op amp in place of the TLC274. The

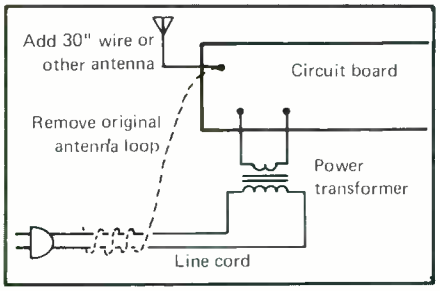
(Continued on page 90)

Tips & Techniques

Better FM Reception From Your Clock Radio. The FM antenna in most clock radios consists of a piece of wire wrapped tightly around the power cord, but not electrically connected to it, as pictured. Its purpose is to pick up FM signals through the power cord and the house wiring. This is adequate for nearby FM stations, but not for fringe areas.

Fortunately, it is easy to add an external antenna. Just remove the wire that wraps around the power cord, noting where it was connected to the circuit board. Then connect your new antenna line to the circuit board in the same place, as illustrated.





As an antnena, try a piece of wire about 30″ long. Start with it oriented straight up and down, but experiment to find the position that gives the strongest signal. Althcugh 30″ is the correct length for a quarter-wave vertical antenna at 98 MHz, a longer wire antenna may work better under some conditions. Alternatively, you can use a telescoping antenna from a junked portable radio or TV set.

—Michael A. Covington, Athens, GA

Measuring the Flow of Air

By Forrest M. Mims III

There are various applications for devices that detect the movement of air. This month's column will discuss some of them and describe two simple devices you can build to measure the movement of air. One device is a cup anemometer patterned after those meteorologists use to measure windspeed. The other is a hot-wire anemometer capable of detecting minute movements of air.

Applications for Air Movement Sensors

The most obvious application for devices that detect the movement of air is the measurement of windspeed. A closely related application is the measurement of the speed of a vehicle or aircraft. Airspeed indicators are also used to measure the velocity of air in a wind tunnel.

Air-movement detectors and sensors are sometimes used to monitor the blower in a heating or cooling system. The detector triggers a warning signal or shuts down the system when the air flow falls below a preset level. This same principle can be used to monitor the air flow in a clean-room environment.

Air-flow detectors can be used to count objects on an assembly line or detect the edge of a nearby object. This application is accomplished by directing a jet of air toward the sensor. Objects passing between the jet and the sensor block the flow of air and actuate the sensor.

Finally, air-flow detectors have many uses in science and medicine. They can be used to monitor respiration and the flow of oxygen. Air-pressure switches can be used by disabled people to trigger electrical circuits and to operate computers. The operator simply puffs into (or sips from) a plastic tube to close the switch.

Hot-Wire Anemometer

The electrical resistance of a conductor changes with temperature. For example, a platinum wire that has a resistance of 2 ohms at 0 degree C has a resistance of 2.5 ohms at 100 degrees C. In this case, the temperature coefficient of the wire is 0.002/degree C (0.5 ohm/2 ohm/100).

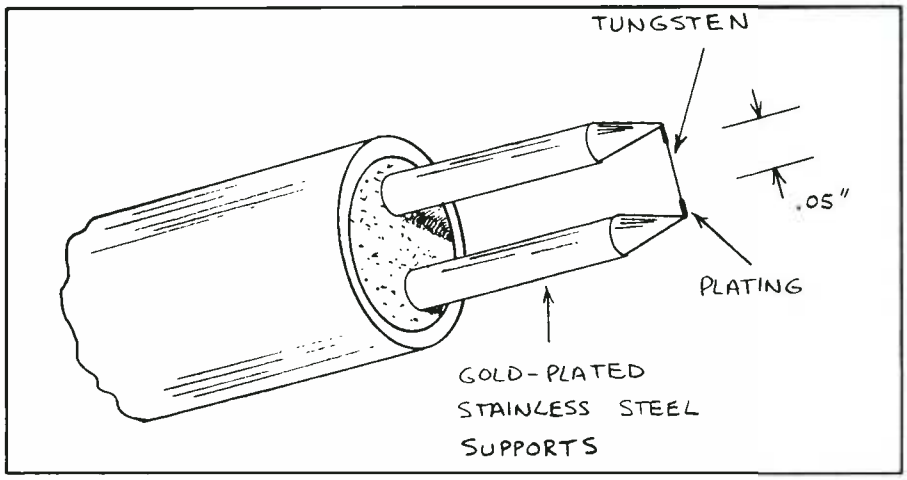


Fig. 1. A typical commercial hot-wire sensing element.

Air flowing past a heated wire tends to cool the wire, thereby lowering its resistance. By monitoring the resistance of the heated wire and taking the temperature of the surrounding air into account, it's possible to measure the speed of the air past the wire. A sensor designed for this specific purpose is commonly called a hot-wire anemometer.

Hot-wire anemometers can be used to measure very small changes in air movement. Since the active surface area of the device can be quite small, hot-wire anemometers are very useful for accurately portraying the flow of air and the turbulence around wind tunnel models. They can even be used to detect the movement of air created by the vibrating wings of a small insect.

Among the materials best suited for making hot wire-anemometers are tungsten, platinum and an alloy of platinum and iridium. Tungsten has a higher temperature coefficient of resistance than platinum (0.004/degree C). When heated, however, tungsten tends to oxidize much more rapidly than platinum.

Figure 1 shows one kind of commercial hot-wire anemometer. Notice that the active area of the probe is determined by the plating applied to either end of the tungsten wire. In recent years the sensing element of this basic probe has in many cases been replaced by a tiny quartz rod coated with a thin film of platinum. This sensor, which is called a hot-film anemometer, responds more quickly to variations in air flow, since a much smaller mass of metal is heated and cooled.

It's easy to experiment with hot-wire anemometry, since an ordinary flashlight bulb makes an effective hot wire sensor. All that's necessary is to remove the glass envelope from the bulb and monitor the current flowing through the filament. A change in the air flowing past the heated filament will change the resistance of the filament and, hence, the current flowing through it.

Of course the current flowing through the filament of the exposed light bulb must be much *lower* than that applied when the unbroken bulb functions as a light generator. Otherwise, the filament will quickly burn up. Figure 2 shows a simple circuit I've devised that both applies a safe current and permits the monitoring of the current through the filament for this purpose.

In operation, a 7805 voltage regulator supplies a constant voltage that is applied to an incandescent flashlight lamp in series with 50-ohm, 5-watt resistor *R1*. Variations in the air flowing past the filament cause fluctuations in the resistance

of the filament and, hence, the current through both the filament and *R1*.

The filament of *L1* and *R1* form a voltage divider. As the resistance of *L1* changes in response to the air flow past its heated filament, the voltage applied to the inverting input of the 741 op amp varies accordingly. The 741 amplifies the voltage fluctuations and sends them to a voltmeter.

Potentiometer *R5* controls the gain of the op amp [gain = −(R5/R2)]. Potentiometer *R4* permits the output of the 741 to be zeroed when a measurement session is begun. Note: Unless the battery leads are short, it's important to bypass all power-supply connections with 0.1-microfarad capacitors. Connect the capacitors close to the two ICs.

A common PR13 flashlight bulb can be used for *L1*. Unless you want to use a lamp socket, solder a pair of insulated wire leads to *L1*. You must use care when removing the glass envelope from the lamp, because of the hazard presented by the sharp glass and the possibility of breaking the fragile filament. I wrap several layers of masking tape around the envelope, squeezing the tape at the top of the bulb so that no glass is visible. Then I place the taped envelope between the jaws of a C-clamp or a vise and very slowly tighten until the bulb's glass envelope pops. If the tape is pressed around the entire envelope, all the broken glass will usually lift away with the tape. With needle-nosepliers, I carefully remove any small shards of glass protruding from the metal base of the bulb.

Caution: A flashlight bulb may propel glass fragments a considerable distance if it is broken without appropriate protection. Therefore, it's imperative that you wear safety glasses or a face shield when breaking a flashlight bulb. Avoid using pliers or a hammer to break a bulb, since the filament may be damaged, and sharp shards of glass will fly all over the place.

The chief drawback of the circuit in Fig. 2 is the high current required by the 7805/*R1*/*L1* combination (about 250 milliamperes). While this is only about half the current required by a 6-volt lantern light, it's much too high for powering the circuit with the 9-volt transistor radio battery used to power the amplifier. Therefore, it's best to power this portion of the circuit with a pair of 6-volt lantern batteries connected in series.

The 7805/*R1*/*L1* combination dissipates about 3 watts of power. Therefore, if the circuit is to be operated for more than a few tens of seconds, the 7805 should be fitted with a suitable heat sink. Likewise, *R1* should be a 5- or 10-watt resistor. Too small a power rating will cause *R1* to be destroyed.

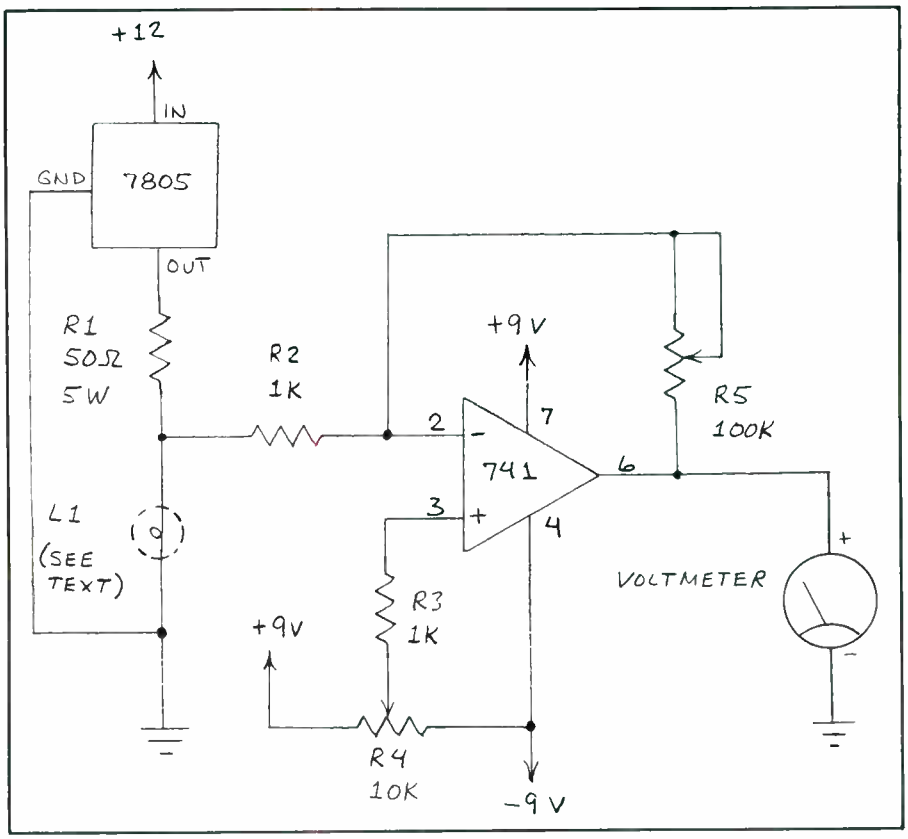
The basic circuit in Fig. 2 is amazingly sensitive. While testing it, I found that slowly passing a hand by *L1* caused an increase of about 1.5 volts in the output when *R5* was a 100,000-ohm resistor. Gently exhaling and inhaling near the exposed filament of *L1* caused the output voltage to swing even more.

It's important to note that when the gain of the circuit in Fig. 2 is made very high, setting the output to 0 by means of *R4* can be very difficult, since *L1* is so sensitive. You might want to try placing a small cover or container over *L1* while adjusting *R4*. Also, you can simplify calibration by operating the circuit at lower sensitivity levels.

Because *L1*'s filament is very fragile, you may want to devise a housing to protect it. A length of plastic tubing placed over the metal socket is one possibility. Holes can be cut in the plastic to permit the flow of air. The filament should be kept dry, since even a small drop of water will cause the filament to be quickly destroyed if the circuit is activated.

The hot wire anemometer in Fig. 2 is much too sensitive to monitor more than the gentlest breeze. But it can be used to detect drafts sneaking into a house

Fig. 2. A basic hot-wire anemometer circuit.



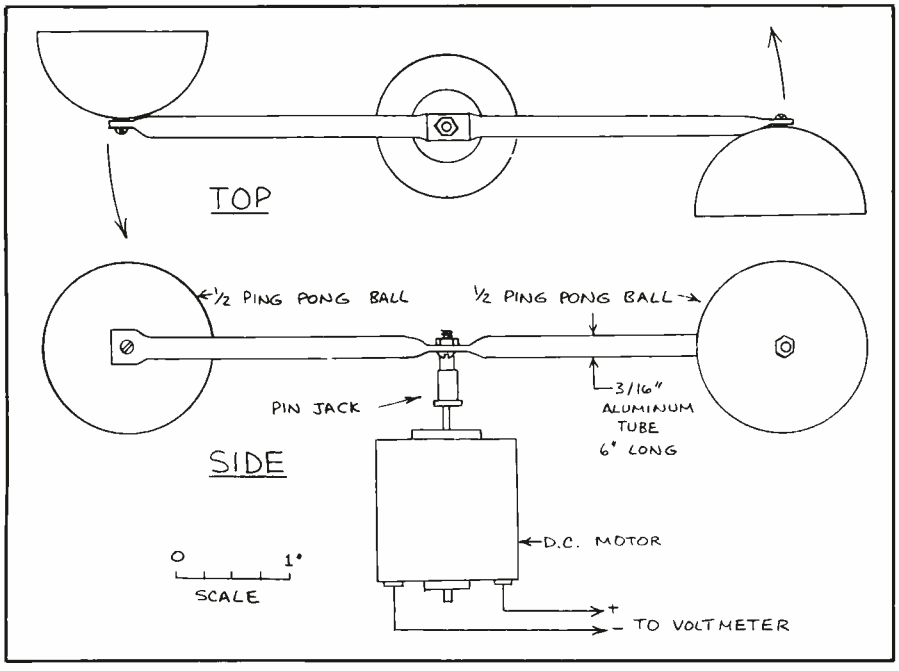
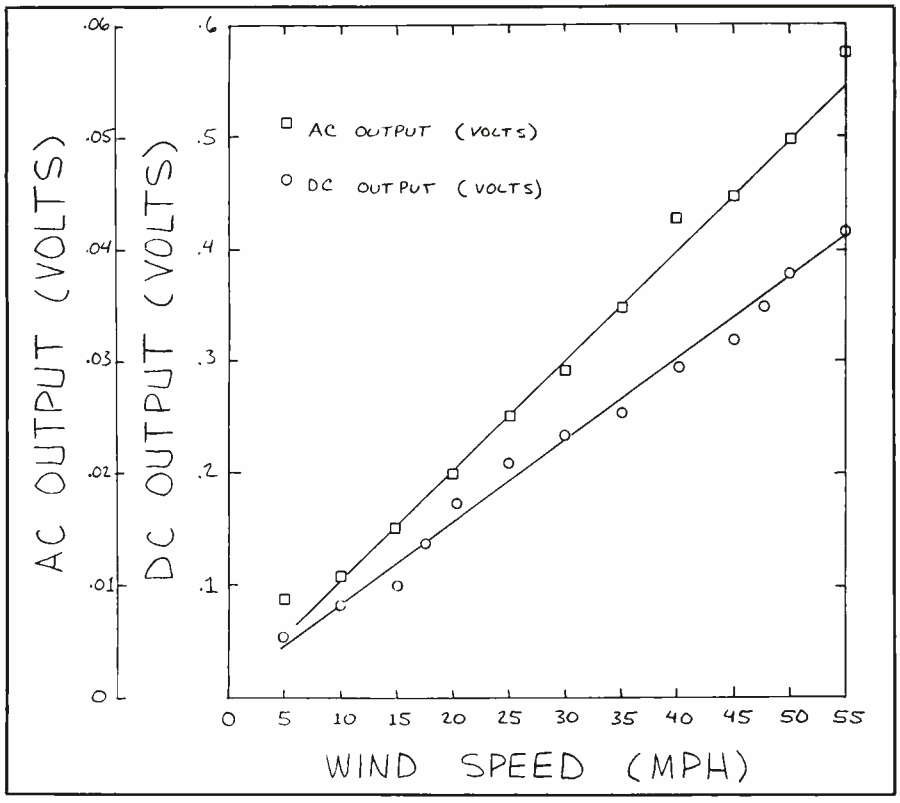


Fig. 3. A make-it-yourself cup anemometer.

Fig. 4. Calibration curve for cup anemometer.



through doors, windows and electrical outlets. It can also be used in experiments that detect respiration. A comparator can be connected to the output of the 741 so the circuit can indicate when the air flow exceeds a desired level.

Cup Anemometer

A dc motor functions as a generator when its shaft is rotated by an external force. Therefore, a dc motor can be used to make a very simple anemometer. I once applied this principle to make a miniature anemometer that measured the air speed of a wind tunnel. The wind tunnel, which was strapped onto the passenger side of a car, was used to test a miniature guided rocket. The anemometer was made by attaching a small balsa cone to the shaft of a dc motor. Four blades fashioned from the lid of a tin can were inserted into the balsa to form a propeller.

There are many ways to fashion a cup anemometer based on this principle. Figure 3 shows construction details of a simple cup anemometer that I recently assembled. The two cups are halves from split ping-pong balls. They are attached with 4-40 hardware to the ends of a 6" × 3/16" hollow aluminum tube (available from hobby shops).

The ends of the tube are flattened with pliers and then drilled to receive the mounting screws. The center of the tube is flattened at a 90 degree angle to the flattened ends and drilled. The solder lug from a pin jack is bent at a right angle and secured to the center of the tube with 4-40 hardware. The receptacle end of the pin jack is then pressed onto the shaft of a small dc motor.

Use care when slicing the ping-pong balls in half. I used a sharp hobby knife and wore heavy gloves. Ping-pong balls are tough, so you must be careful.

To test the anemometer, I used a length of flexible metal strap (available in hardware stores) to secure the motor to one end of a sturdy aluminum rod. I then mounted the rod to the side mirror on the passenger side of a pickup truck and connected the motor's leads to a voltmeter. My son Eric then drove the truck at vari-

ous speeds on a still day, while I recorded voltage readings.

Figure 4 is a graph that shows the ac and dc readings Eric and I obtained during the test session. The cups begin to rotate when the wind speed reaches 3 to 4 mph. The speed at which your anemometer begins to rotate and the slope of the calibration curve is dependent upon the motor you use. The output from the motor is reasonably linear. This corresponds nicely with results I obtained with the wind tunnel anemometer described above.

During the tests, I noted some fluctuations of the voltage output at certain speeds. When this occurred, the voltage reading would jump back and forth over a range of a few tens of millivolts. Therefore, I recorded what appeared to be the average voltage.

The anemometer in Fig. 3 can be improved by adding another pair of cups. In its present configuration, the cups don't always turn when the wind is below 10 mph unless they are perpendicular to the oncoming wind. The motor must be protected from rain should this anemometer be installed outdoors. One possibility would be to install a split ping-pong ball over the top of the motor. It could be mounted to the 4-40 hardware that holds the pin jack in place. The split ball should rotate with the cups and keep rain from entering the top of the motor.

Going Further

You can find much more information about devices that detect and measure the flow of air at any good library. An excellent article on hot-wire anemometry is "Hot Wire and Hot Film Anemometry" by Eric Nelson (*Sensors*, September 1984, Pp. 17 through 22).

The Sharper Image (680 Davis St., San Francisco, CA and other stores in Houston, Denver and Los Angeles) sells the TurboMeter™, a compact anemometer with a shrouded fan and a digital readout. This unit, which measures winds up to 100 mph, sells for $79 (plus $3.50 postage). The TurboMeter and other anemometers are sold also by Edmund Scientific (101 E. Gloucester Pike, Barrington, NJ 08007).

For more information about Honeywell's ultra-sensitive air pressure switch, see "The Forrest Mims Circuit Scrapbook" (McGraw-Hill, 1983, Pp. 138-140). Included in this reference are experimental circuits that permit disabled people to control external devices by puffing into or sipping from a plastic tube. Also included is an experimental respiration detector circuit. The wind tunnel anemometer mentioned above is also described in this book (Pp. 133 to 134). **ME**

Getting computer and peripheral schematics, a first look at the Laserwriter, innermost secrets of power supply design, methods of video sync separation and combination.

By Don Lancaster

There's been a lot of reader feedback on the low-pressure pneumatics we looked at a few columns back. It seems that a lot of *other* hobbyists in wildly different fields also have dibs on air pressure as a substitute for electromechanical stuff. For instance, a player piano is nothing but a bunch of low-pressure pneumatics, and there are lots of enthusiasts around who rebuild or restore these instruments. There's an outfit called, of all things, the *Player Piano Company*. In its catalog, you will find all sorts of low-pressure pneumatic goodies and ideas.

Great stuff.

Seems the largest of the radio-controlled model planes are also going pneumatic for such things as landing-gear controls. *Bryon Originals* is one source. These systems tend to run at much higher pressures than you can handle with one of those 25 cent EGR valves. Since the EGR valve is really intended for vacuum use, when you reverse it for low-pressure robotics, the valve will "crack" around 11 psi or so. The model-plane people often run their equipment at 100 psi.

A very few model-railroad people also use medium-pressure air for such things as turnout switches and roundhouse doors that slowly and smoothly open. One company involved with these products is *Del-Aire Products*. This time, the pressure is up to around 50 psi, mostly because they insist on the tiniest cylinders possible. For instance, at 5 psi, you can get 5 pounds of force with a cylinder that is 1 inch square. Go to 50 psi, and you only need an area of 0.1 square inch. This can be done with a square cylinder only 0.33 inch on a side.

On to this months goodies . . .

Where do I get a schematic for a computer or printer?

The first and most obvious place to look is in the technical or repair manuals for the microcomputer or printer in which you are interested. Normally, the technical stuff is held back, and you get charged extra to access this information.

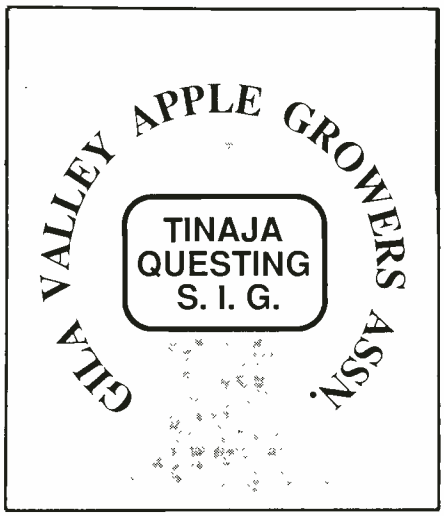


Fig. 1. A snappy Laserwriter image done with Applewriter on an Apple IIe. Print time was 17 seconds and materials cost was less than four cents. Though shown in black and white, the original was done in two colors.

Some computer stores do not want you to know these manuals even exist because they cut dearly into their service profits. The trick is to call the manufacturer directly. Should they try to shuttle you off on a local dealer, tell them you are from Littlefield, Arizona, or some similiar "non-urban" area. If that fails to get results, get on a modem line or a club SIG and holler for help.

As examples, Apple has its *IIe Technical Reference Manual* (#A2L2005) and separately available pair of *IIc Technical Reference Manuals* (#A2L4030). Getting hold of these has loosened up bunches, and they should now be available at most technical bookstores, newly reprinted by *Addison Wesley*.

One of the best-kept secrets around is the *Sams* series of *Computerfacts*. These are similar to the older *Photofacts* that are essential for radio and television repair. A typical Computerfact packet contains a complete, large and well-organized schematic, disassembly instructions, parts lists, troubleshooting guides, the whole bit.

There are 43 of these packets available so far. As typical ferinstances, the *Apple IIe* version is #8920 and the original *Imagewriter* printer is #8941. The brand-new *Imagewriter II* packet is in the works and should be available by the time you read this. Cost is around $20 each.

Sadly, there is not an *Apple III* packet available. I sure have gotten a lot of help line calls from orphaned III people, who are desperately clawing at anything at all they can get their hands on. The *Macintosh* packet is not yet ready.

What's the real word on the Laserwriter?

I've had mine for only a week or so. But, my, oh my, what a machine!

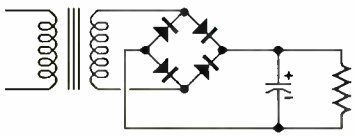
Kiddies, the price of typesetting with full graphics has just dropped below a dollar a page. Not one red cent more.

Where to even begin.

The *Laserwriter* sets *any* size type you like, mixed with *any* style of graphics in *any* size you can imagine in *any* configuration. You can easily do such things as homecoming posters and sidewalk-to-sidewalk centenial banners. Signs of any size and shape are trivial. There's even a neat *Postscript* procedure that will automatically chop up the sign or poster into as many 8½″×11″ pieces required. Later, you tape the pages back together to get up to whatever size you need.

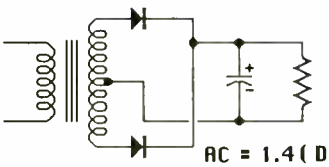
It is trivially easy to move, spin, repeat or stretch an image every which way. You can have any shade of gray you want, and even four colors with repeated passes are possible. Variable size and slant text along a circular or even an aribtrary path is easily done.

One thing not well known (guess why?) is that *Applewriter* on an *Apple IIe* does as good, if not better, a job than the *Mac-*



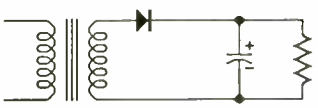
AC = 0.7 (DC + 2)
DC = (1.4 AC) - 2

(A) Full-wave bridge; use magic rule.



AC = 1.4 (DC + 1)
DC = (0.7 AC) - 1

(B) Full-wave, center-tapped; use magic rule.



AC = 0.7 (DC + 1)
DC = (1.4 AC) - 1

(C) Half-wave; use double the magic rule.

Fig. 2. Shown here are the three most popularly used power supply circuits.

A 10,000 Microfarad Capacitor will give one volt of ripple under a one ampere load.

Fig. 3. The magic "10k" rule for power supply filter capacitor design. Use this rule only when designing a 50- or 60-hertz full-wave power supply. When designing a half-wave power supply, double the capacitance.

Intosh does in driving the *Laserwriter*, including graphics so fancy that they are not available out of any of the common Mac programs.

We'll note in passing that *MacPaint* has no way to handle the high-resolution alphabets, *MacWrite* isn't good at larger or integrated graphics, and *MacDraw* is a cruel joke at best.

HIRES dumps or any other bit-mapped graphics are done by converting them to hex ASCII character pairs that are easily handled by *Applewriter* and its *WPL* supervisory language.

The *Appletalk* network stuff is also not needed. In fact, it can severely limit what you can do with the *Laserwriter*. Among other things, it excludes you from using the so-called *Diablo* emulation mode.

And yes, I'll put my money where my mouth is.

I have five *Laserwriter* images created with *Applewriter* on a *IIe*. I'll be glad to send you free copies of them. I'll also gladly give a free *Sams* book to anyone who can show me *any way at all to do these on a Mac* that is even remotely as cheap, as easy, as powerful, and as convenient as using *Applewriter* on a *IIe*.

Figure 1 shows a typical image. This was done on a *IIe* under *Applewriter*. Once you know exactly what you are doing and have built up a library of goodies, this complex an image should take you around 10 minutes to program and 17 seconds to print. Materials cost is under four cents for a single color, and under seven for two.

One neat thing that is not at all obvious is that it does not matter what order you put the image onto the Laserwriter's bit-map. You are free to, say, do your backgrounds first, artwork second, your headlines third, and your fine print last. More importantly, you do a form letter by putting the letter *in* the *printer* and changing only the name and address for each repeated pass. A *IIe*, again with *Applewriter*, can process hundreds, or even thousands, of letters at a whack.

Watching customized form lettrs quietly pour out of a machine at an eight-copy-per-minute rate is a joy to behold. Yes, I have automatic software for both form letters and envelopes—call or write.

There are some problems though. The quality is not quite what a print house would call "typeset," since the resolution is "only" 300 dots per inch. A printer might call this "tabloid" quality. One way to beat this is to work double or triple size and then photo-reduce the result.

Another way is to find one of the many "real" typesetting machines that speak the same *Postscript* language the *Laserwriter* does. Once you have exactly what you want, the *same* software on the *same* machine can give you good typeset quality, say to 2400 dpi and beyond.

A second obvious problem is that there is no way to tractor feed anything, so things like envelopes, labels, or business cards have to be hand fed. And hand feeding requires custom programming.

Turning to nit picking, the laser engine itself shows some truly bizarre human engineering. You need continuous access to all four sides and the top of the printer, including the ability to simultaneously observe status lights at *both* the front and the back of the machine. An unreachable and often-used selector switch requires that you add a shaft extender before you can even put a knob on it, let alone use it.

The paper tray is far too shallow to the point of being a joke. An unnecessary "U" turn in the paper path adds to the

jam potential and limits paper weight, but accomplishes nothing else useful. And while ridiculously quieter than most other printers, a laminar fan redesign could make the silence totally eerie.

That eight-pages-per-minute rating is the absolute maximum speed on repeat copies, and then only after you custom flip a magic "prefeed" software switch that ups the wear and tear on the laser engine. It is very easy for a complex image to take several minutes or more to finally get any output. Nonetheless, the print speed is impressive—awsome, even.

Print quality is surprisingly good on a *very* wide range of different papers. Gray images tend to blotch a little on high-rag papers. Giant black areas aren't quite solid either, but they are certainly usable.

You aren't supposed to use thermal "raised print" letterheads, but I suspect you can get away with it by always changing back to an older cleaning pad while you use them.

Yet another problem is that the *Diablo* emulation mode, like everyone else's, just flat out does not emulate a *Diablo* printer. I found out how to fix this so that you can easily do a true wall-to-wall microjustification and proportionally space in this mode. Pick up details by calling the Synergetics telephone number in the box and asking about the patches and utility package I have available.

And one thing that is absolutely infuriating. The toner cartridges are *not* the same as the stock *Canon* photocopier cartridges. In fact, through the use of special *Torx* "tamperproof" screws, missing notches, brackets that are slightly different, etc., they went to an awful lot of trouble to make darn sure you would not casually interchange the two. Thus, printer cartridges will cost you more and will be harder to get, particularly in colors. The toner cartridges also look like they will be more than a little tricky to refill on your own.

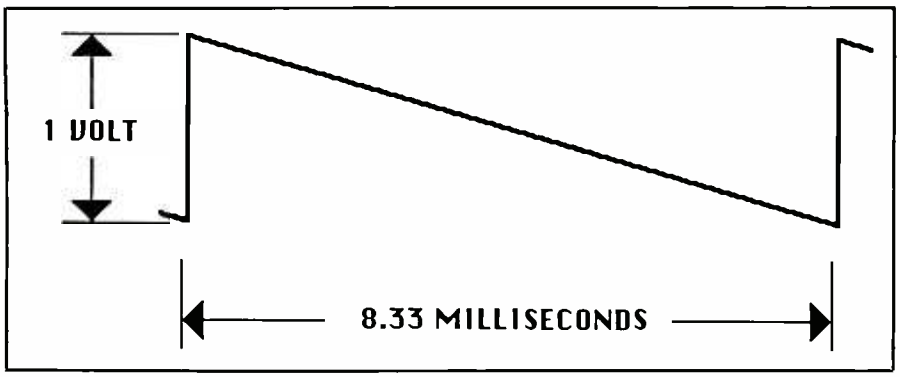
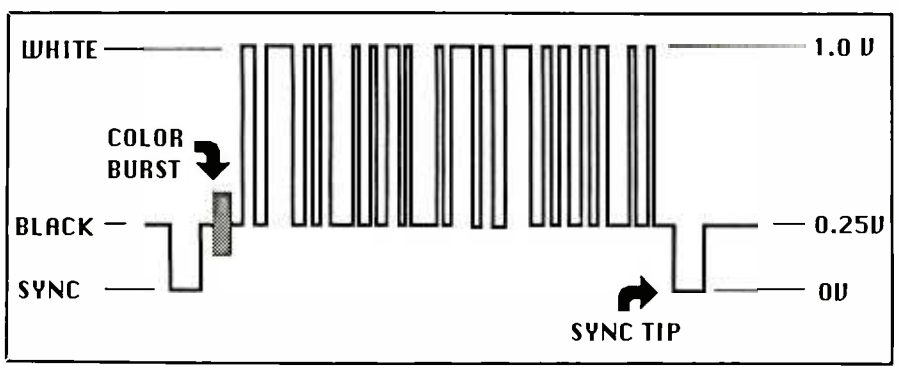


Fig. 4. This is the approximate waveform across an 8300-microfarad filter capacitor in a full-wave 60-Hz, 1-ampere supply. To simplify scaling, figure an even 10,000 microfarads.

Fig. 5. A typical data monitor composite-video signal.



How do you design a power supply filter capacitor?

It never ceases to amaze me how many people do not know how to design a filter capacitor for a power supply. Thanks to an obscure and little known magic rule, the process takes all of five seconds and can easily be done in your head without pencil or paper.

Let's review.

Figure 2 shows the three most common power supply arrangements used today. These are the half wave, the full-wave center tapped, and the full wave bridge circuits. Also shown is how to spec the secondary voltage you need for a given dc output voltage, and vice-versa.

Practically all power supplies today use capacitor input filters and allow fairly high values of ripple voltage. The ripple is then taken out and the output voltage is dropped by a integrated-circuit voltage regulator that follows the "brute force" supply.

Now for the rule. Check out Fig. 3. A 10,000 microfarad capacitor gives you 1 volt of ripple for 1 ampere of current. Just scale from there. A 1000-microfarad capacitor will give you 1 volt of ripple for 100 mils of current; 2500 microfarads should be a safe value for 1 volt ripple at 250 mils; and so on.

All you have to remember, then, is the "10k rule." There are two minor gotaches, however: The rule works only at 60 Hertz, but you can scale from there; and you have to double the rule for half-wave supplies.

Just why does the 10k rule work? Nor-

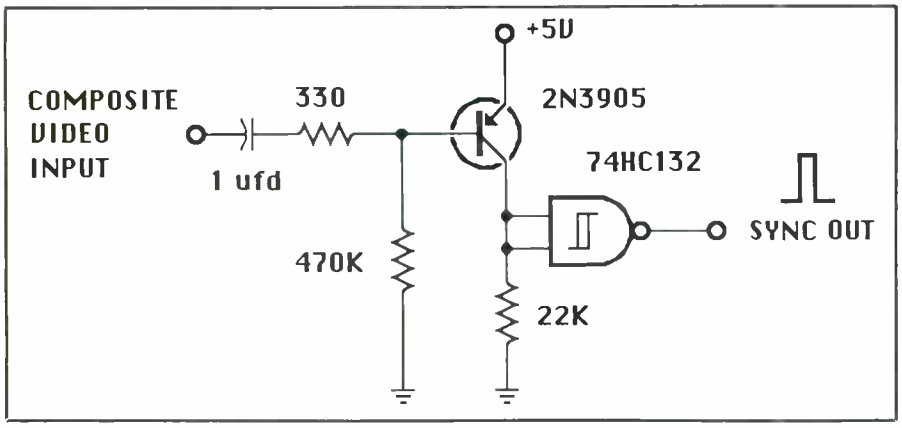
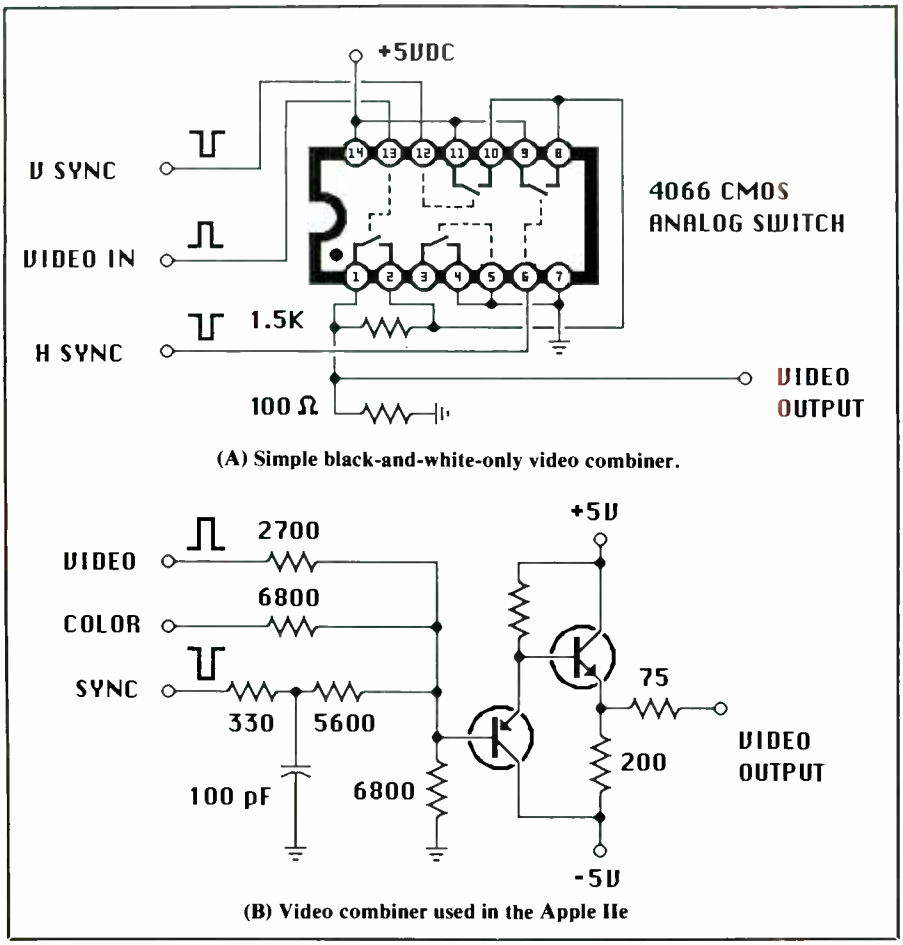


Fig. 6. This simple sync stripper extracts sync pulses from composite video.

Fig. 7. Either of these two simple circuits can be used to combine sync, video and color burst signals into a single composite-video signal.



(A) Simple black-and-white-only video combiner.

(B) Video combiner used in the Apple IIe

mally, ripple is only a tiny fraction of the total output voltage; so the waveform at the capacitor looks almost like a sawtooth. The waveform briefly charges the capacitor only during the very peak of the input ac cycle. Then the capacitor discharges into the load for the rest of the cycle. (Note that the diodes conduct very breifly for only a very small portion of each line cycle.)

Now, the capacitor waveform isn't *quite* a sawtooth, since the diode conducts for a while and the decay is really exponential. Let's make the conservative and useful assumption that there's a true sawtooth waveform at the capacitor, as shown in Fig. 4. The operating rule of a sawtooth applied to a capacitor states that the current equals the capacitance times the voltage change divided by the time interval [$I = (C\Delta V/t)$]. To normalize things, let I be 1 ampere and ΔV be 1 volt. A full-wave rectifier generates a 120-Hz sawtooth, which has an 8300-microsecond ($\frac{1}{120}$) time interval.

In solving the equation, you see it takes 8300 microfarads to allow only a 1-volt drop for a 1-amp current in 8.33 milliseconds. Since 8300 isn't a stock value, we conservatively round things out to an even 10,000 microfarads.

And there's our magic rule.

How do I strip video sync signals?

Thanks to all the bargain video monitors and orphaned microcomputers on sale these days, there's been an awful lot of help line requests for either combining sync and video signals or else taking them back apart again.

If the video dots and the synchronizing signals are together on one wire, this is called "composite video." If the video dots are one one wire and the synchronizing signals are on one or more separate wires, this is called "split sync."

Needless to say, you need a sync stripper to get from composite video to split sync and a sync combiner to get from split sync to composite video. Which you need

depends on which bargain parts you happen to be using.

If you are interested in only black-and-white video directly cabled to a monitor, sync stripping or combination is no big deal. It's only when you need noise-free over-the-air transmission, color or gray-scale that things get messy.

Figure 5 shows a "typical" combined video signal. Normally, the signal is 1 volt high. Sync pulses are at 0 volt, with the horizontal sync pulses being around five microseconds wide, and the vertical sync pulses being a fancy waveform that lasts around 200 microseconds. Video black is around 0.25 volt, and full white is at 1 volt. Gray is between white and black.

The time between horizontal sync pulses is usually around 63 microseconds (15.735 kHz) for standard video, but can be much less for high-resolution monitors that run at higher sweep frequencies. The vertical sync pulse rate is usually 16.7 milliseconds (59.95 or 60 Hz). The time between vertical pulses is called a field.

Sometimes, two fields are interlaced into a single frame. Interlace does not work well with dot-matrix characters; so most micro uses of video do *not* involve the interlace technique.

Should color be used, there is a color burst tacked onto the back porch of the horizontal sync pulse. This is an 8-cycle burst of 3.579545 MHz that is used to synchronize the color circuits of the display or monitor if it is using NTSC (never the same color) stock video.

NTSC video is limited in bandwidth and color resolution, so you cannot normally get more than 40 dot-matrix characters across a color TV screen. To beat this limit, fancy monitors use RGB video in which individual signals are sent directly to the red, green, and blue guns. Each gun then behaves as if it is really receiving high-bandwidth B&W video. Only at the screen is the color sorted out.

Figure 6 shows a simple sync stripper that will split the sync pulse from a composite-video signal. The transistor and input coupling capacitor act as a "leaky dc restorer" and only the very sync tips get highly amplified. The output Schmitt trigger then further cleans up the signal and inverts it to positive-going sync.

Note that the value of the bias resistor on the transistor is much higher than normal. You want the transistor to amplify *only* the negative-most sync tips. This resistor's value can be adjusted for the best operation.

Note also that you can use the other Schmitt triggers in the quad package to seperate the vertical from the horizontal sync. Just how you do this depends on what polarity signals you want, but the key is to stall half a horizontal time and then check for a high level. If high, you have vertical sync.

Much more information on simple video interface appears in my *TV Typewriter Cookbook (Sams #21313)*.

Combining sync is just about as easy as stripping sync. Usually, you will have a video signal, a horizontal sync signal, a vertical sync signal, and an optional color burst on seperate lines, and you want to merge them into a single output line.

Figure 7 shows two circuits for doing this. The first uses a single CMOS analog switch to combine everything. This one may be slightly low in bandwidth and is black-and-white only, but is sure is simple. The second is the sync combiner used in later versions of the Apple IIe.

If you have to get fancier, Motorola is now second sourcing some very interesting and very complicated integrated circuits that do all sorts of neat video things "by the rules." Be sure to check out their MC1374, MC1377, TDA3301, TDA3303, TDA3330, and TDA3333 in particular.

NAMES AND NUMBERS

Addison Wesley
General Books Div.
Reading, MA 01867
(617) 894-3700

Byron Originals
Hiways 59 and 75
Ida Grove, IA 51445
(712) 364-3164

Del Aire Products
407 North 7th Street
Allentown, PA 18102
(215) 432-9975

Inside Laserwriter
467 Saratoga Road S621
San Jose, CA 951129
(408) 966-1010

Motorola Semiconductor
Box 20912
Phoenix, AZ 85018
(602) 244-6900

Postscript (Adobe)
1870 Embarcadero Road S120
Palo Alto, CA 94303
(415) 852-0271

Player Piano Company
704 East Douglas
Wichita, KS 67202
(316) 263-3241

Howard W. Sams
4300 West 62nd Street
Indianapolis, IN 46206
(800) 428-SAMS

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

BOOKS

The latest technical books and literature in the electronics and computer field.

Guide To Local Area Networks by TJ Byers. (Prentice-Hall; 182 pages; $14.95 soft cover, $24.95 hard cover.)

What is a local area network (LAN)? Who needs or can benefit by it? How is one set up? If you (or your employer) have more than one microcomputer in a given location and would like them to link together to communicate with each other and/or to share hardware and software resources, this book will provide the answers to these and many more questions. Written to help the businessman who has decided to join the computer revolution (and to entice those who have not yet made the commitment), this book will step you through the ins and outs of local area networking. It assumes no prior knowledge of LANs and, thus, starts from square one by introducing at the outset the concept of networking. Written in a brisk style, it gets right down to cases, stepping quickly through each topic and introducing each successive thought only after prior groundwork has been set.

This is a relatively nontechnical overview of local area networking, but it does manage to impart quite a bit of technical detail, though without dry prose and cluttering theories. The major value of this book is that is provides practical guidance on which you can base intelligent decisions. Not only does it tell you what types of LANs are available and their weak and strong points, it also gives an extensive listing of LAN vendors.

Tricks Of The Burglar Alarm Trade. (Mentor Publications; soft cover; 91 pages; $14.95.)

Most books about burglar alarms go heavy on electronics theory and construction and pay only lip service to the practical considerations of sensor selection and system installation. This large-format (8½″ × 11″) book addresses the weak areas in such books and, therefore, should be considered in addition to them. It focuses on sensor selection to suit various needs and conditions, installation procedures, and the special tools required to do the job. Detailed instructions are provided for applying window foil, installing locks, running wiring from sensors to the control unit, and more—all from the professional's point of view.

Virtually every type of sensor is described, along with its strong and weak points. Additionally, the book gives details on how to run hidden wiring. An important topic is coverage of a common weakness (and how to eliminate it) of typical alarm systems that make them vulnerable to bypassing. Since this book is meant for the nontechnical installer, very basic instructions for using a meter and troubleshooting a system are provided.

The book is heavily illustrated with informative drawings that both support and clarify information given in the text. Type is apparently set by a near-letter-quality dot-matrix printer, which is not as classy as that of typical books, though it is still easily readable.

NEW LITERATURE

Video Accessories Catalog. This new 38-page catalog from RCA is printed in full color and provides illustrations and explanations of nearly 180 products for use with VCRs, video cameras and TV receivers. The listed accessories are designed to simplify installation, improve operation, expand usage and protect video equipment. New entries include updated VCR cases, video camera cases, stereo microphones, broadcast stereo adapters, accessory kits, replacement and extension cables for RCA's "Dimensia" system, as well as numerous hardware items. For a free copy of Form No. 1J7674, write to: RCA Distributor and Special Products Div., Deptford, NJ 08096, Attn.: Sales Promotion Services.

Test Instrument Catalog. Nineteen new products are featured in Leader Instrument's new 1985 catalog. The 80-page catalog details complete features, specifications and applications on more than 100 products in the Leader line. Among the new products highlighted are a 35-MHz two-channel oscilloscope and an economically priced 100-MHz three-channel dual-timebase scope. Other new products include a programmable video generator system designed for testing monochrome and color CRT monitors normally associated with computer systems and workstations and a new line of signal and sweep generators. For a free copy of the catalog, write to: Leader Instruments Corp., 389 Oser Ave., Hauppauge, NY 11788.

Holding Device/Work Positioner Catalog. Holding devices/work positioners, presses, and accessories are the subjects of a new 12-page, two-color catalog (No. 182) from PanaVise. The fully illustrated catalog breaks down the company's products by phases. Each of the four phases keynotes the selection of heads, bases, base mounts and accessories recommended for different needs. A "roadmap" inside the front cover shows the number of different combinations that are available. Products listed and described are for all types of hobbies, though there are a number that are of specific interest to the electronic hobbyist and technician. Among these are circuit board holders that serve as "third hands" and a new "Chassis Mount" that handles large items weighing up to 100 lbs. For a copy of Catalog No. 182, write to: PanaVise Products Inc., 2850 E. 29 St., Long Beach, CA 90806.

Printed Circuit Manual/Catalog. Bishop Graphics' No. 107A Printed Circuit Technical Manual & Catalog contains a wealth of pc-board design and drafting techniques, tips, reference tables, charts and practical theories in an easy-to-follow, fully illustrated format. Listed and fully described are the company's full line artwork patterns for creating artwork masters, detailed specifications and prices on a wide selection of new Bishop patterns designed to increase pc board design efficiency, and more than 20,000 printed circuit aids. For a free copy of publication No. 107A, write to: Bishop Graphics, Inc., 5388 Sterling Center Dr., P.O. Box 5007, Westlake Village, CA 91359.

Two Electronic Typewriters & a Time-Saver Voice Recorder

By Eric Grevstad

Since this won't see print till late midsummer, I could almost call this a back-to-school column, reviewing useful gadgets for returning students. More generally, this month's products illustrate an issue common to all high-tech items: that of innovation versus usefulness, a gadget's gee-whiz appeal compared to its day-to-day value.

In this case, I could state the issue as efficiency in reproducing words. I examined two portable typewriters that put sophisticated functions into lap-sized packages, but lack the print quality of full-size electrics like Smith-Coronas or Selectrics. I also tried a tape recorder that lets you listen to lectures at double speed, without turning the speaker into Professor Alvin of Chipmunk College.

Almost Word Processors

Both the Sharp PA-1000 Intelliwriter and Canon Typestar 5 are battery-powered, lightweight typewriters (four D cells apiece; eight and six pounds, respectively) that use thermal-transfer printing. Like the cheap thermal printers sold with home computers some years ago, thermal transfer units have a dot-matrix printhead with heated pins. However, instead of forming an image on tacky silver-coated paper, transfer pins melt waxy ink from a ribbon onto plain paper.

Compared to regular typewriters or dot-matrix printers, transfer units are much quieter. For instance, the Canon's only sound is the whir of its carriage return and paper advance, though the Sharp emits a stiff squeak at the beginning and end of each line as the printhead moves toward and away from the ribbon. Their disadvantage is that nonimpact printing doesn't make an impression on textured bond paper; the smoother and thinner your stationery, the better.

Both typewriters can work in the normal way, printing a character as soon as you press a key and moving to the next line when you press the return key. But

Sharp PA-1000 Intelliwriter portable.

both work best with lines instead of characters—letting you type an entire line, changing a word or fixing mistakes, before putting it on paper. The previous line is printed as you begin the next, either by pressing RETURN or by computer-style word wrap (starting a new line automatically as you end a word and type a space or hyphen near the right margin).

To let you see a line before it's printed, each unit has an LCD screen (with a dial to adjust contrast). The Typestar 5 scrolls text through a 15-character display; the Sharp shows a superior 70 characters of text plus 10 of system information, such as a constantly updated number to show the cursor position.

Neither portable qualifies as a word processor (no search functions or block moves or anything like that) but both have cursor arrow and delete keys for backing up and changing text, and relocate keys to jump to where you were before backing up.

Besides regular text in single, 1½, or double line spacing, both typewriters let you switch to bold double-width or underlined characters, or center a line. The Sharp can make lines flush with the right margin, too, and its command keys make options easier—Code-P for boldface and Code-I for underlining, compared to pressing the MODE and RETURN keys and cursor arrows to change the Canon's tiny LCD format menu. It can also handle fast typing; more than moderate speeds make the Canon beep and lock up in protest.

Canon Typestar 5 portable typewriter.

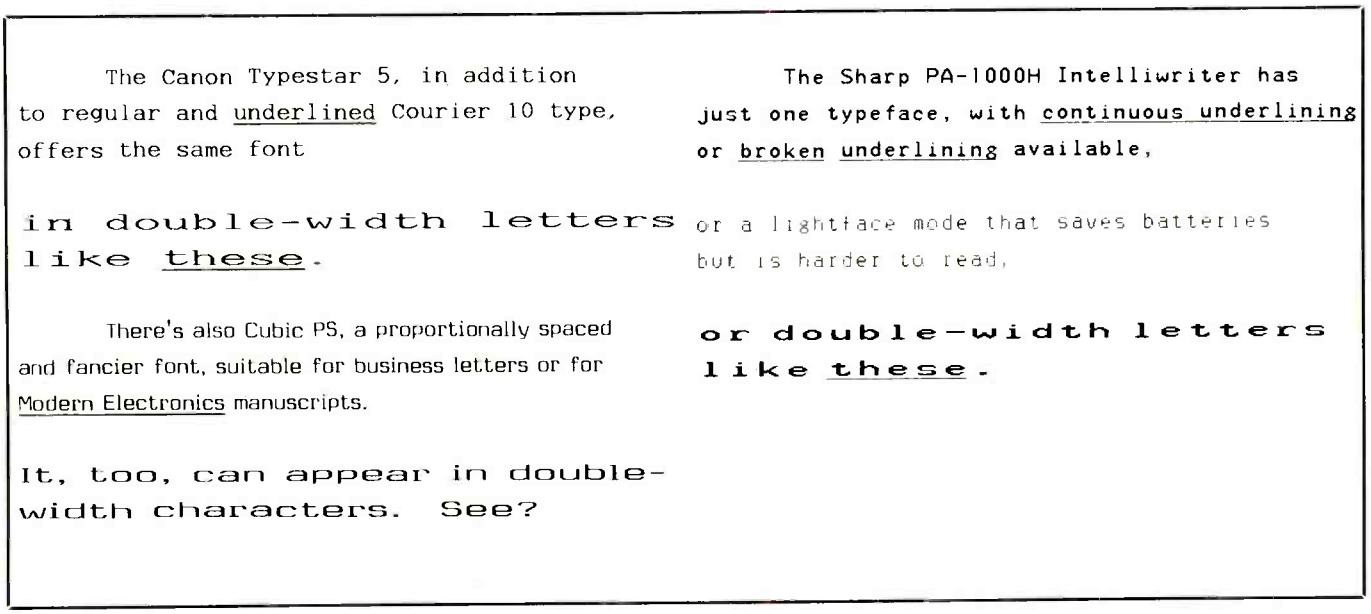
Better Text, Stock Phrases

Against the Sharp's bigger LCD and ease of use, the Canon offers a lower price—$249.95 versus $349.95—and some advantages when it comes to putting words on paper. The Typestar's KB key switches between two keyboards, giving extra characters ranging from square brackets and French accents to the British pound and paragraph signs. Better yet, one of the MODE functions switches to a second typeface, the proportionally spaced Cubic PS. This is a slim, elegant alternative to both units' regular fonts, which are spaced in 1/10-inch increments whether the character's a skinny *i* or a wide *m*. (See samples reproduced.)

And the Canon's printhead, with its 32- by 26-pin matrix, delivers far better quality: excellent on smooth, lightweight paper; decent even on heavier stock such as copier paper. The Sharp's printouts (16 by 10 matrix) look passable on thin paper, frankly bad on anything else.

Finally, if you don't mind the extra cost ($329.95), Canon has an upscale competitor among its models (not tested here). Called the Typestar 6, it comes with only one typeface, but a cartridge slot that lets you choose among half a dozen others, from 1/12-inch and italic to three different proportional fonts ($30 apiece). And it has a wider 32-character LCD.

The Typestar 6 also shares a feature with the PA-1000: the ability to store up to 26 frequently used words or phrases in memory, so pressing one key plus "A" can type your return address and one key plus "B" types "Sincerely yours" automatically. Canon allows a total of 2000 characters to be stored; Sharp allows



Canon Typestar's 32 × 26-pin matrix printhead delivers far better print quality (left) than does Sharp Intelliwriter's printhead (right). Canon's quality is excellent on smooth, lightweight paper, and is decent even on heavier paper.

2200, including a 27th memory space. Thus, a whole document can be created and saved for later printing. The function works like a charm, though it's no fun to edit a two-page letter or report for only 70 characters at a time. Conclusions: The small, "smart" typewriters aren't smart enough to justify their rather immodest prices. Some are better (and costlier) than others, but us guys always wind up too frustrated when you can't go all the way. And that, sadly, is the case here.

Easy Listening

This month's other product comes from JS&A (One JS&A Plaza, Northbrook, IL 60062, 312-564-7000), where Joseph Sugarman remains the king of witty, wordy ads about little-known products and the trials of the mail-order business. Sugarman's "Products That Think" catalogs have veered heavily toward health and fitness items lately, but my favorite headline is still the one about JS&A's first impression of the Magic Stat programmable thermostat: "Magic Baloney . . . . It has no digital readout, an ugly case, and a stupid name. It almost made us sick."

My first reaction to JS&A's Time Cruncher was less violent but still skeptical, because $239 will buy not one but eight voice recorders at Radio Shack. But if you listen to many lectures, your time might be worth crunching.

Besides playing tapes at normal speed (or 80-percent speed if you're learning a language or taking notes), the JS&A recorder lets you accelerate up to double speed, hearing a tape in half the time. The trick to keeping such talk intelligible is an adjustable pitch control; slide the speed lever alone and your lecturer turns into a chipmunk, but move the pitch lever into alignment and he sounds like himself.

Well, almost. Even at normal speed, switching on the variable speed control produces a slightly filtered sound; at high speed, voices are surprisingly understandable, but not always recognizable. I found a particularly dull member of a conference panel to be intelligible at double speed, but lost most of his colleagues at the one and three-quarters mark. (As for music, don't even try it.)

Even so, the Cruncher can save considerable time—and tape. Pushing a switch halves the recording speed from the standard 1⅞ inches to 1⅞₆ inch per second (though it disables auto stop at the end of tapes). Another switch, once you've recorded sides A and B and flipped the cassette to side A again, minutely shifts the recording head to accommodate four tracks instead of two.

This means that you can buy a one-hour cassette, record four hours' worth of material on it (if you're vigilant about turning it over), and listen to them in two hours. That may be pushing your luck; traces of other tracks showed up as background noise when I listened at moderate volume, but the 1⅞₆ speed worked fine when I settled for two tracks.

My college lecture-hall days are over, but I'll be sorry to give the Time Cruncher back. I've held it at the ready while watching TV, but never caught a fast-talking Federal Express commercial that I could record and then hear at double speed. **ME**

International Shortwave Broadcast Listings

Programs in English Audible in North America

By Glenn Hauser

Reception Quality:
Quality ratings are a rough subjective comparative guide only.
A = Strong and reliable
B = Regular
C = Occasional/unreliable
D = Seldom

General notes:
(+) = one hour later after DST
NAE = Not all English
R = Radio
V = Voice
v = Varies/variable

Time Conversion:
Subtract 2½ hours for NDT, 3 ADT, 3½ NST, 4 AST/EDT, 5 EST/CDT, 6 CST/MDT, 7 MST/PDT, 8 PST/ADT, 9 AST/YST, 10 HST

Afghanistan *R. Afghanistan*
1900-1930 C 11805, 9665

Alaska *KNLS*
0700-0930 C 11850

Albania *R. Tirana*
2200-2230 B 9480
0000-0030 A 9760, 7065
0130-0200 A 9760, 7120
0230-0300 A 9760, 7120
0330-0400 A 7300, 6200

Algeria *R. Algiers*
2000-2030 C 17745, 15160, 9640, 9510

Argentina *RAE*
1200-1300 C 15345
0100-0200 C 11710, 9690
0400-0500 C 11710, 9690

Australia *R. Australia*
2100-0100 C 17795, 15160
0100-0200 C 17715
0200-0730 C 17795
0300-0700 C 15320
0600-0840 C 11910
0730-0930 B 11720
0800-1600 B 9580
1100-fade C 5995
1200-fade C 6060

R. Australia International
1230-1255 B 15320 (Sun 1200-)
0130-0155 B 6000, 9635
0330-0355 B 5945, 6000 (Sun 0305-)
0430-0455 B 6000, 9635

Belgium *BRT*
1800+1820 C 15590 Sun
2100+2155 C 11980, 5895
0030-0125 B 5910, 9925
0800-0855 C 9880 Mon-Fri
0910-0930 C 9880 Sat
1300-1355 C 15590 Mon-Sat

Brasil *R. Nacional, Brasilia*
1750-1850 C 15155
0200-0300 B 11745 (time v)

Bulgaria *R. Sofia*
0630+0700 C 9700
1830+1900 C 11720, 9700
2030+2100 B 11720, 9700
2130+2230 A 11720, 9700
2300+2400 A 11720, 9700
0300+0400 C 11720

Cameroon *R. Nationale*
0530-0540 C 4795, 4850, 5010
2100-2115 C 9745 (sometimes 2045-)

Canada *CFRX Toronto*
24 hours C 6070

CFCX, Montreal
24 hours C 6005

R. Canada International
0615-0630, 0645-0700 B 11960, 11825, 9760, 6140 Mon-Fri
1200+1225 A 9650, 11955, 15440, 17820 Mon-Fri
1300+1600 A 17820, 11955, Sun
1537-1545 A 15325, 17820 = not Sun
1645-1700 A 17820, 15325
1800-1830 A 17820, 15260 (Sat/Sun-1900)
1900-1930 A 17875, 15325, 11945, 9555, 7130 (Sat/Sun-2000)
1900-1930 A 17820, 15260 Mon-Fri
2000-2030 A 17875, 17820, 15325, 11945 Mon-Fri
2130-2200 A 17820, 15150, 11945 (Sat/Sun also 17875, 15325)
2200-2230 A 9755, 5960
2200-2300 A 15325, 11960 Mon-Fri
2300-2330 A 11710, 9755
2330+2400 A 9755, 5960 (except Sat)
0000+0030 A 9755, 5960 (Sun/Mon-0100)
0100-0130 A 17820, 15190, 11940
0100+0200 A 9755, 5960 Tue-Sat
0200+0230 A 9755, 5960 Tue-Sat
0300+0330 A 9755, 5960

CBC Northern Quebec SW Svc NAE
1058+1259 C 6065, 9625
1300+2300 B 11720, 9625
2300+0509 C 6195, 9625

China *R. Beijing*
1100-1155 B 11860
1200-1255 B 11860, 11655, 9535
1300-1355 B 9730, 9550
1400-1455 B 9730, 9550
0000-0055 C 15520, 15385
0300-0355 C 15520
0400-0455 C 15385, 17795

Cuba *R. Habana Cuba*
2010-2140 B 17855
2050-2140 B 17750, 15300
0100-0600 C 11725
0100-0450 A 6140
0330-0600 B 6090?
0630-0800 B 9525 or 11725

Czechoslovakia *R. Prague*
0100-0155, 0300-0355 B 11990, 9740, 9540, 7345, 5930

Ecuador *HCJB, V of Andes*
1200-1430 B 11740
1200-1530 A 17890, 15115
1900-2000 B 21477½, 17790, 15295
2130-2200 B 17790, 15295
0030-0130 A 11910
0030-0200 A 15155
0030-0700 A 9745
0200-0700 A 6095
0500-0700 A 11910
0645-0830 B 9870, 9655 (Sat/Sun 0700-)
0700-1000 B 9745
0700-1100 B 11925, 6130

Egypt *R. Cairo*
1215-1330 C 17675
2115-2245 C 9805
0200-0330 B 9475, 9675

Finland *R. Finland*
1100+1130 C 15400, 17800
1200+1230 C 15400, 17800

1300 + 1330 C 15400, 17800 (Sun -1400)
1400 + 1430 C 15400, 17785

France *R. France Internationale*
1600-1655 C 17620, 17795, 11705
0315-0330, 0345-0355 A 11995, 9800, 9550, 9535, 7135
0415-0430, 0445-0455 A 9800, 9790, 9550, 7135

Germany *East R. Berlin Int'l*
2215 + 2300 B 6125
2315 + 2400 C 9730, 11975
0000 + 0045 C 9730, 11975
0130 + 0215 C 9730, 11975
0230 + 0315 C 9560, 9620, 11970
0200 + 0245 B 6125
0530 + 0615 C 9690, 11970

Germany West *Deutsche Welle*
0930-1020 A 9650
1230-1315 B 17800
2100-2150 C 9765
0100-0150 A 6040, 6085, 6145, 9545, 9565, 11785
0430-0515 B 7150
0500-0550 A 5960, 6130, 9545, 9690, 11705

Ghana *GBC-2*
0530-fade C 3366

Greece *V of Greece*
1240-1250 C 17565 (not Sun)
1540-1550 C 17565, 15630 (not Sun)
2335-2345 B 7395, 9860 (not Sat)
0130-0140 B 7395, 9420, 9905 (not Sun)
0340-0350 B 7395, 9420, 9905 (not Sun)

Guatemala *TGNA, R. Cultural*
0330-0430 B 3300

Guinea *R. Guinea*
1830-1930 C 15310v (Sun irregular)

Guyana *GBC-2*
0730-fade C 5950

Haiti *4VEH*
2300 + 2330 B 4930

Honduras *HRVC*
0300-0400 B 4820 Mon

Hungary *R. Budapest*
2000 + 2030 C 11910, 9835
0030 + 0100 C 12000 Tue-Sat
B
0100 + 0130 C 9835 except Mon
B
0200 + 0230 C 11910 daily
B
0300 + 0312 C 9520 Tue/Sat
B
0300 + 0330 C 6110, 6025 Mon
B

India *All India Radio*
1330-1500 C 9545, 11810, 15335
1845-2230 C 11620, 9665
2000-2230 C 9910

Indonesia *V of Indonesia/RRI*
1500-1600 C 11790
RRI Yogyakarta
1130-1137 C 5046.3

Iran *V of Islamic Republic*
1930-2030 D 9022, 9770 or 11930

Iraq *R. Baghdad International*
2030 + 2130 C 9610

Israel *Kol Israel*
0400 + 0415 B 9815, 9440½, 9009
1700 + 1715 C 13720, 11585, 9920
1900 + 1930 C 15585, 12025, 11655
2130 + 2200 B 9440
2300 + 2330 A 11655, 9815, 9440
0000 + 0025 A 11655, 9815, 9440
0100 + 0125 A 9815, 9440, 7410

Italy *RAI*
0100-0120 B 9575, 11800

Korea North *R. P'yongyang*
1100-1250 B 9977, 9745
2300-2450 C 15230, 9745

Korea South *R. Korea*
0815-0830 C 9570
0845-0900 C 9570
0915-0930 C 7275
1015-1030 C 7275
1045-1100 C 7275
1100-1200 C 15575, 7275
1215-1230 C 7275
1245-1300 C 11805, 7275
1345-1400 C 15575
1400-1500 C 15575, 9750, 9570
1445-1500 C 11805, 7275
1600-1700 C 11810, 9870
1715-1730 C 15575
1745-1800 C 15575
2200-2300 C 15575, 7550
2345-2400 C 15575, 7550
0145-0245 C 15575, 11810
0330-0430 C 15575, 11820, 9570

Kuwait *R. Kuwait*
1800-2100 C 11675

Libya *R. Jamaheriyah*
2130 + 2300 B 11815 (time varies)

Luxembourg *RTL*
2300 + 0100 B 6090

Malaysia *V of Malaysia*
0555-0825 C 15295, 12350, 9750

Monaco *TWR Monte Carlo*
0625 + 0720 B 7160
0731 + 0910 B 9495 (Tue/Sat/Sun-0940, Sun-1000)

Mongolia *R. Ulan Bator* (not Sun)
1200-1235 D 9615, 12015 (freqs. v)
1255-1330 D 15305, 7235 (freqs. v)
1445-1520 D 9615, 12015 (freqs. v)
1940-2015 D 15305, 7235 (freqs. v)

Netherlands *R. Netherlands*
0430-0525 C 11720, 9895
0730-0825 B 9770, 9630
1030-1125 A 9650, 6020
1130-1225 C 17575, 17605, 15560
1430-1525 C 17605, 17575, 15560, 11740
1630-1725 C 9515
1830-1925 B 21685, 17605
2030-2125 C 11740, 11730, 9715, 9540
0130-0225 B 9895, 6020
0230-0325 A 9590, 6165
0530-0625 A 9715, 6165

Netherlands Antilles *TWR*
1110 = 1242 A 11815 (Sat-1405, Sun-1337)
0400-0455 A 9535, 800 (not daily, time and language v)

New Zealand *RNZ International*
2345-0145 C 17705, 15150
0345-0730 C 15150, 11780
1030-1215 C 11780, 9600

Nicaragua *V of Nicaragua*
0100-0200 A 6015 irregular
0400-0500 A 6015 irregular
R Zinica, Bluefields
1700-1800 C 6121 weekdays

1830-? C 6121 Sats
1300-1330 C 6121 Suns

Nigeria *V of Nigeria*
0455-0800 C 7255, 11770
0500-0600 C 15119v

Norway *R. Norway Int'l.*
1300-1330 C 15305, 17770 Sun
1400-1430 C 15305, 15225 Sun
1600-1630 C 17840, 15305, 11925 Sun
1700-1730 C 15305, 17850, 11925 Sun
1900-1930 B 15305, 15205, 11860 Sun
2000-2030 B 15305, 15265, 17830 Sun
2200-2230 C 15180, 11925 Sun
0000-0030 C 9605, 9580 Mon
0400-0430 C 9645, 11870, 15180 Mon
0500-0530 C 15165, 15180 Mon

Pakistan *R. Pakistan*
1645-1740 C 9465, 11810

Philippines *FEBC R. International*
2300-2400 C 15445
2300-1000 D 21475
0000-0500 C 11725
0230-0500 C 15315
0500-1000 C 11890
1300-1400 C 11840, 11725
1400-1600 C 11850, 9730

Poland *R. Polonia*
2230-2400 B 7270, 7125
0200-0355 C 7270, 7145

Portugal *R. Portugal*
1600-1630 C 15190 Mon-Fri
1800-1830 C 15250 Mon-Fri
2030-2100 C 9605, 7155 Mon-Fri
0030-0100 B 6095 Tue-Sat
0300-0330 B 6095 Tue-Sat

AWR-Europe
0800+0830 C 9670

Romania *R. Bucharest*
0200-0300, 0400-0430 C 11940, 11810, 9570, 9510, 6155, 5990

Sa'udi Arabia *BSKSA*
1700-2100 C 11855 or 11840

South Africa *Radio RSA*
1300-1556 C 21535, 15220, 9585
2100-2156 B 11900, 9585
0200-0256 B 9615, 6010, 5980
0300-0426 C 9585, 7270, 5980, 4990, 3230

Spain *Spanish Foreign Radio*
2200+2300 C 7105
0000-0100 A 9630, 11880
0500-0600 A 9630, 6125

Sri Lanka *SLBC*
1030-1130 C 11835, 15120, 17850 NAE

Surinam *R. Suriname International*
1810-1815 B 17755 (via Brasil) Mon/Wed/Fri

Sweden *R. Sweden International*
1400-1430 C 15345
2300-2330 C 11705, 9695
0230-0300 C 11705, 9695, 17840=SSB
0330-0400 C 11705

Switzerland *Swiss R. International*
0630-0700 C 9535, 6165
0830-0900 C 9560, 15305, 15570
1000-1030 C 9560, 15305, 15570
1200-1230 C 12030
1330-1400 C 11955, 15570, 15585, 17785, 17830
1530-1600 C 17570, 17830, 21770
1830-1900 C 11955, 9885
2100-2130 B 9885, 12035, 15570
0200-0230 A 6135, 9735, 9885, 11925, 12035
0400-0430 A 6135, 9725, 12035, 15305

Red Cross Broadcasting Service
Mon and Thu following last Sun of month at 0740, 1310; Tue and Fri at 0340 on above frequencies 20 min. later; other weeks: musical prelude

Syria *R. Damascus*
1200-1300 C 17840?
2005-2105 C 12085, 17825

Taiwan *V of Free China via WYFR*
0100+0200 A 5985, 6065 or 9680
0200+0300 A 5985, 11740
0500+0600 A 5985

Thailand *R. Thailand*
1130-1230 C 9655/9650, 11905

Turkey *V of Turkey, Sunshine R*
2200+2250 A 9560
0300+0350 A 9560

U A E *UAE Radio, Dubai*
1330-1415 C 11955, 17775, 21605, 21695
1600-1700 C 15300, 15320, 21605
0330-0415 B 9565, 11730, 15435, 17775

UKOGBANI *BBC World Service*
5975 B 2245-0545
6120 B 2200+0330 (S)
6175 A 2000-0730 (W)
6195 A 0900-0915, 1100-1330 (W)
7105 B 0400-0430, 0445-0515, 0600-0630 (A)
7150 B 0545-0730
7160 B 0300-0545 (A)(a)
7325 B 2300-0330
9410 B 0200-2430 C
9510 A 1100-1330 (S) A 0430-0915 (W)
9515 B 0030-0330 (K)
9590 A 2200-2430 (S) C 0030-0230 (C)
9600 B 0300-0430, 0445-0515, 0545-0815 (A)(a)
9640 C 0545-0915
9740 C 0900-1745 (F) /(f)
9915 B 2200-0330, Tu/F 2130-2200
11750 A 2300-0230 (A) C 0900-1615 (F)
11775 A 1100-1330 (W) A 1600-1709 (Sat/Sun 1500-1745) (S)
11820 B Tu/F 2130-2200 (A)(f)
11860 A 0600-0915 (A)(a)
11955 C 0600-0915
12040 C Tu/F 2130-2200 (f)
12095 C 0300-2430 (Sat/Sun only during 0730-0900)
15070 B 0300-2315 (as above) C
15215 C 1100-1330
15260 A 1600-1709 (Sat/Sun 1500-1745) (S) A 2000-2330 (A)
15390 A Tu/F 2130-2200 (A)(f)
15400 C 0715-1130, 1430-2000 (A)(a)
17705 C 0600-0730, 0900-1745

17790 C 0600-1445
17880 B 1600-1745 (A)(a)
17885 B 1400-1600 (A)
18080 C 1500-1530, 1700-1745 (a)
21470 C 0900-1615
21550 C 1100-1330
21660 B 1030-1745 (A)(a)
21710 C 0900-1745
25650 D 1100-1330

(A) Ascension; (C) Cyprus; (F) Singapore; (K) Greenville; (S) Sackville; (W) Antigua relays; (a) includes African alternative; (f) Falklands programme; no indicator = UK site. These codes apply to only UKOGBANI listings.

United Nations

1830-1840 A 21710, 18782.5 = LSB,15650 = LSB, 15360, 15120, 10454 = LSB Fri
1900-1935 A as above, Mon-Fri
2100-2145 A 17730, 15120 Fri
0215-0230 B 11780, 10869 = USB,10454 = LSB Sat
0545-0600 B 11740, 9540 Sat
0710-0715 B 9565, 7651 = USB, 6873 = USB Sat
0815-0830 B 11825, 11740, 9680 Sat
1000-1030 B 15250, 9565, 8110 = LSB Sat

USA *AFRTS*

0900-1100 B 9590, 9530
0900-1300 A 6030
1000-1700 B 11805
1000-1800 B 9700
1100-1700 A 15330
1100-0100 B 15430
1300-0200 A 15330
1700-2300 B 15345
1800-0700 B 17765
2200-0430 C 21570
2300-0700 B 11790
0100-0700 A 6030
0430-0700 C 15330

WRNO Worldwide, New Orleans NAE

1500-1700 A 11965
1700-2200 A 15420
2200-2400 A 11890
0000-0300 A 7355
0300-0500 A 6185
0500-1100 A 6185 Sun
1100-1330 A 9715 Sun
1330-1500 A 11965

Voice of America

0300-0430 B 11720
0300-0500 B 6035, 11835
0300-0600 C 9550
0300-0700 B 6140, 7170, 7200
0400-0700 B 11925, 15205, 9770
0500-0700 A 9670, 7170, 5995
0500-0800 B 6040
0600-0800 B 6080, 6125, 9530, 9540, 9550, 11915
1100-1330 C 11715
1100-1400 C 6110
1100-1500 C 9760, 7230, 15425, 15160
1300-1700 C 9760, 15205
1500-2200 C 9700
1600-1800 B 15600
1600-2200 A 15410
1600-2300 A 17870, 17800, 17785, 15580, 15445
1700-1800 A 21840, 21590, 21545, 17640 (first Sun)
1700-2200 B 9760, 11760, 15205
1800-2300 B 21485
2000-2300 C 17715
2200-2215 A 17775, 15160, 11740 Mon-Fri
0000-0200 A 11740
0000-0400 A 5995, 6130, 9455, 9650, 11582½ = SSB, 11675, 15205, 15375, 17730, 5747½ = SSB

Uruguay *SODRE*

2330-2400, 0030-0100, 0130-0200, 0230-0300 D 15273v, 9620

USSR *R. Moscow World Service*

1100-2200 B 11840 (Cuba)
1100-? B 15135
2100-2200 B 9490
0300-0400 A 9610, 9600 = (Cuba)
0400-0500 B 9765

R. Moscow North American Service

2200 + 2300 A 15425, 15240, 12065,
B 12060, 12050, 11850,
C 11780, 11770, 11750, 11735, 11710, 9880, 9820, 9720, 9685, 9610
2300 + 2400 A as above, except add
B 9765; drop 11850, 11780,
C 9880; add 9530 at 2330
0000-0100 as above, except add 9600 (Cuba)
0100 + 0200 as above, except drop 9685; add 9700 at 0130
0200 + 0300 A 15425, 15240, 12060,
B 12050, 11770, 11750,
C 11735, 11710, 9765, 9720, 9700, 9610, 9600, 9530
0300 + 0330 B 15425, 13605, 12050, 11790, 11770, 11710
0330 + 0400 as above, except add 12030
0400 + 0430 as above, except drop 11710
0430 + 0530 as above, except add 9580
0530 + 0600 as above, except add 11710
0600 + 0700 as above, except drop 11790

R. Kiev

2330 + 2400 B 9800, 11720, 11790, 11960, 13605, 15180
0200 + 0230 C 9820, 11720, 11790, 13505, 15180

R. Vilnius

2200 + 2230 C 15180, 13605, 11960, 11790, 11720, 9800

R. Tashkent

1200-1230, 1330-1400 C 15115, 11785, 9715, 9650, 7340

Vatican *Vatican Radio*

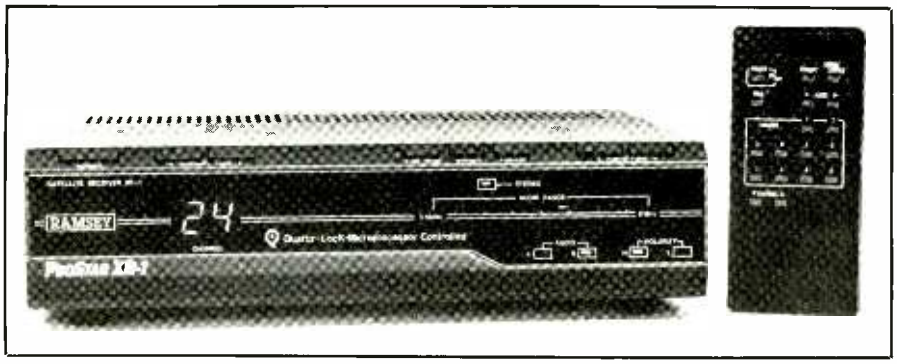
2045-2100 C 9625, 11700, 11760, 15120
2205-2225 C 11830, 9615, 6015
0050-0110 A 11845, 9605, 6015
0200-0215 C 7125, 9650, 11865
0500 + 0520 B 6185, 9645

Vietnam *V of Vietnam*

1100-1130 C 9840, 12035
1330-1400 C 15012, 10040

Yugoslavia *R. Yugoslavia*

2215 + 2130 B 9620



tions; full channel memory that stores all channel information, including audio format, frequency and fine-tune offset; and convenience ac outlet on rear panel. A crystal-controlled r-f modulator for output on channel 3 or 4 is built in.

I-f input is 440 to 940 MHz at 75 ohms, while i-f bandwidth is 27 MHz. The XR-1 measures 11¾ "W × 10"D × 3¼ "H and weighs 7 lb.

CIRCLE NO. 114 ON FREE INFORMATION CARD

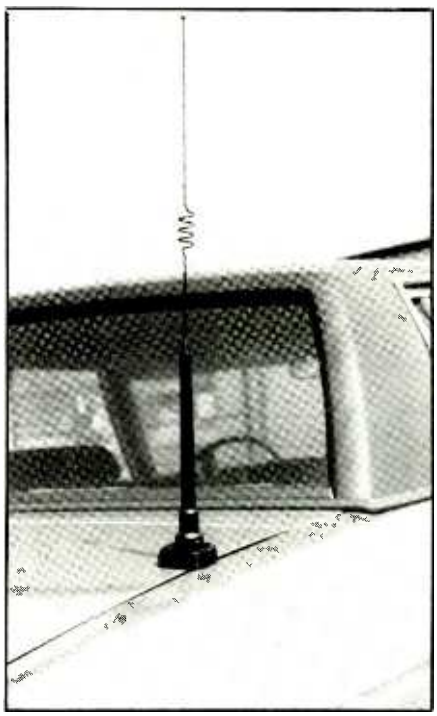
Automatic Cleaner For Soldering Tips

Elvo Electronics' "clean-o-point"® appliance is a soldering iron tip cleaning aid that is claimed to provide a better quality cleaning action than other tip cleaners. Designed for bench use, clean-o-point contains a motorized pair of sponge rollers that wipe tin-alloy, liquid and residue off the soldering tip and deposits them in a receptacle designed exclusively to retain used solder. Since the heating element of the soldering iron does not contact the damp sponge rollers, the soldering tip retains an even temperature. $44.50.

CIRCLE NO. 115 ON FREE INFORMATION CARD

"No-Holes" Antenna For Cellular Phones

The Model ASPD912 is a "no-holes" elevated-feed antenna from Antenna Specialists for special vehicle applications or the cellular telephone frequencies. The new antenna provides 3 dB of gain. It offers a "Quick-Grip"™ trunk lip mount that permits fast, simple installation with no hole drilling required and completely concealed connecting cable. Because the antenna is designed to provide superior omnidirectional performance when mounted on the lip of a trunk lid, it requires no ground plane. It also permits the shortest possible run to the cellular transceiver, using the furnished RG-58/U cable.



CIRCLE NO. 116 ON FREE INFORMATION CARD

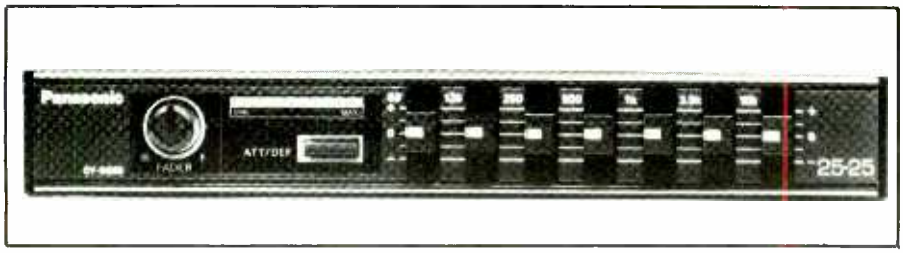
Hand Nibbling Tool

The Model K-88 hand nibbling tool from Davle Tech cuts sheet metal like a punch and die for making templates, cutouts for radio chassis and panels, and making model parts. The easy-to-use tool produces no strain or distortion to the original form. It cuts mild steel up to 0.023" (0.6-mm) or soft aluminum sheet up to 1/16" (1.6-mm) thick. Replacement cutting blades, No. K-881, are available.

CIRCLE NO. 117 ON FREE INFORMATION CARD

7-Band Equalizer/Amplifier

Panasonic has a new car audio seven-band combination graphic equalizer/booster that measures a slim 1" in



height. The Model CY-SG60 is thin enough to fit snugly into the dashboard of many US-manufactured cars when teamed with the company's compact-chassis car audio units. Dual inputs allow the CY-SG60 to be connected to car audio units with preamplifier outputs as well as to units with speaker-only outputs.

Rated maximum output power is 50 watts, with less than 1% THD at 12 watts per channel. A tone-defeat/attenuator switch reduces volume by 20 dB to mute sound without changing volume control setting. A remote power switch feature permits the CY-SG60 to be automatically turned on with the main car audio unit. The seven frequency control sliders, tone-defeat/attenuator switch and fader knob are all illuminated in soft orange. $119.95.

CIRCLE NO. 118 ON FREE INFORMATION CARD

Remote-Control Transmitter Tester

Philips ECG's new Model RCT 5501 tester verifies all remote-control transmitting functions for both infrared and ultransonic units used with TV receivers, videocassette recorders and cable converters. The compact, self-contained tester also provides a rapid determination of the transmitter's useful operating range.

Designed around highly sensitive hybrid circuitry, the RCT 5501 is rugged, lightweight and powered by a single 9-volt transistor battery. A

built-in battery-test function is featured. The tester measures less than 5″ long by 3″ wide by less than 1″ thick and weighs just over 4 ounces.

CIRCLE NO. 119 ON FREE INFORMATION CARD

900-MHz Scanner Converter

A new converter for scanner radios that covers the 900-MHz land mobile band, the Model CVR-900, is available from Hamtronics. It provides coverage of new services now being assigned or proposed for the 880-to-996-MHz range, including such additional land mobile services as police and fire departments; government and nongovernment fixed stations; industrial, scientific and medical services; and the proposed 902-to-928-MHz amateur band. Also included are proposed new cellular telephone and paging services and existing and new broadcast studio-to-transmitter communications links.

The CVR-900 converts all frequencies in the 880-to-960-MHz band down to the 430-to-510-MHz uhf band. To make the conversion in dial frequency on your scanner or other uhf receiver, you simply subract 450.000 MHz from the frequency you want to listen to. The converter is equipped with Motorola type connectors for simple installation in the coaxial line between antenna and scanner/receiver. Dc power for the converter is supplied by many scanners, though if you wish, you can power it from an optional ac adapter. $88 + $3 S&H.

CIRCLE NO. 120 ON FREE INFORMATION CARD

Portable Computers '85 *(from page 29)*

luminescent display, but solves the problem of LCD legibility in any lighting conditions.

The glow-in-the-dark screen, whieh apparently consists of a reverse-video LCD (all other pixels darkened, leaving light characters) backlit by a plain electroluminescent panel, is attracting wide attention. Not only are companies such as Zenith reportedly buying Morrow's technology, but it should produce a major market contender in a 25-line, fully IBM-compatible super-Pivot due this summer for $2995.

Unconfirmed Rumors

Besides the phantom IBM, two other important portables are expected between this writing and your reading. One is Kaypro's DG/One imitation, dubbed the Kaypro 2000 in an early spec sheet: a 25 × 80-character LCD display from Japan's Citizen, a 3½" disk drive, 256K of RAM, and the PC's 8088 processor and 8087 math co-processor socket—all in an 11-lb. package priced at an impressive $1995, or $1500 below a comparably equipped Data General. Reportedly, the keyboard will be detachable. There's already a Tandy 2000 and a WordStar 2000, but this expected new "2000" low-priced clone might be a bargain in keeping with the original Kaypro II's market thrust.

The other newcomer might prove even more important, the fourth landmark laptop (or the first of the hybrid notebook/XT machines I mentioned at the beginning). It's reportedly coming from Zenith, called the PAL (Portable Advanced Laptop) or Satellite, and said to have a 16 × 80-character display and 32K of RAM. Those specifications don't sound impressive (though memory might be expandable to 416K), but the Zenith is rumored to use the high-speed ROMs discussed earlier and have a bundle of high-class software in them. Zenith declined to comment on this when I phoned, and rumors also surfaced that the design, created by giant Mitsui, was shelved.

Such power, though, pre-loaded into a $2000 Zenith, might hold its own against the notebook-sized "Flat Mac" expected from the Apple MacIntosh team in 1986. There's already a Japanese portable, the Ampere, with Mac's 68000 CPU and the scientific language APL in ROM, and Hewlett-Packard has put AT&T's multitasking Unix operating system into ROM for its new 68000-based transportable, the Integral. Plainly, there's no limit to ROM's possibilities.

In fact, if portables haven't yet replaced desktop computers, it's clear we can't blame their software or compatibility. We can't point a finger at their mass storage or communications abilities, either, and we're no longer able to complain about high prices. All we have left to blame are their LCD screens, and we shouldn't be able to blame them too much longer. **ME**

Stereo Tape Deck *(from page 50)*

that occur at a rate of 10 Hz or less, while flutter consists of speed fluctuations that occur at a rate of between 10 Hz and 200 Hz. The frequency range included in the graph of Fig. 5 extends from 0.5 to 200 Hz.

Line and Microphone Input Sensitivities

These specifications, usually given in millivolts, simply tell the user how large an input signal must be applied to the line or microphone inputs to produce a tape recording at reference level (a magnetization level of 400 nWb/m). Unlike the other specifications discussed so far, the input sensitivity specifications are not an indication of performance quality. They are merely needed for proper interfacing between the recorder and the signal sources.

Microphone Maximum Input

Since microphone output levels vary greatly, depending upon the type of microphone used, those manufacturers who want to comply with the new tape measurement specifications are required to state just how much input voltage their recorders can handle via its microphone inputs before severe clipping or 5% distortion of the recorded signal occurs. This maximum is stated in millivolts.

Line Output

The last primary specification that manufacturers are supposed to supply in order to meet the requirements of the EIA Standard is called Line Output. It is a statement of the voltage level that will be present at the line (high-level) output terminals of the recorder when a tape that was recorded at reference magnetization level is played back. Line output level is stated in volts.

The well-defined primary specifications that manufacturers of home tape recorders are being asked to state in their published specifications sheets are, perhaps, more than many tape deck manufacturers have been accustomed to supplying. Nevertheless, makers of high-quality tape recorders are expected to supply all of this data to their prospective customers, and many offer even more detailed information about their products. Having standard methods of measuring and reporting the performance of a tape deck should make it easier for prospective purchasers to pick the right recorder to suit their specific requirements and to compare the performance of one machine against another. **ME**

general-purpose oscilloscope with a minimum bandwidth of 1 MHz.

The alignment procedure is as follows. Adjust the slug in *L6* while using an oscilloscope to monitor the local oscillator signal at pin 2 of *IC2*. As you adjust *L6,* you will note that signal amplitude increases, reaches a peak and then abruptly falls off. For proper alignment, adjust the coil's slug in the opposite direction from the drop-off point, just below peak.

To adjust *L3, L4* and *L5,* use the r-f signal from the transmitter. Before proceding to adjust these coils, however, it is necessary to defeat the agc by temporarily grounding pin 16 of *IC2*. Use the amplitude of the i-f signal at pin 15 to guide in alignment. It is sometimes advantageous to monitor this signal on the unused output of *L4* to prevent the i-f from shifting as you touch pin 15.

Place the transmitter at a sufficient distance from the receiver so that the measured voltage on pin 15 of *IC2* is less than 400 mV (less than 50 mV if you are monitoring *L4's* secondary). Adjust *L5, L3* and *L4* for maximum signal strength. Repeat adjusting these coils until you observe no further increase in amplitude.

Applications Suggestions

The Experimenter's Radio-Control System described here consists of a basic encoder/transmitter and receiver/decoder sans interfacing to the outside world. Since this is conceptually an *experimenter's* R/C system, we have left applications implementation to your ingenuity.

The system described is excellent for remote radio control of the usual model airplanes, boats, cars, etc. By adding some very minor interface circuitry at the decoder outputs of *IC3* and *IC4*, it is possible to remotely control lights, appliances, heating systems, automatic sprinkler systems and much more. For such applications, no modification of the transmitter is necessary.

For more ambitious—and knowledgeable—experimenters, other applications might include simple robot control; complex robot control (tie the transmitter into a personal computer and program the floorplan of your home, for example); conversion of video games to eliminate the cable attached to the joysticks; a carrier-current digital local-area network (FSK or on/off carrier modulation) communications link using local house ac wiring; remote temperature monitoring with associated heater/air-conditioning control; etc.

Some simple interfaces to help you get started are given in circuits A through D in the "Interfacing to the Outside World" box. If your primary interest is to adapt the system for motor drive (as needed for model airplanes, boats and cars), important information is given in the "Motor Drive Notes" box.

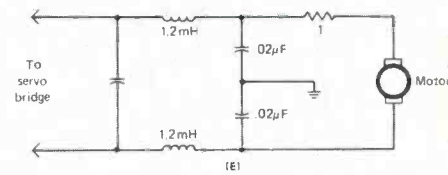
Whichever way you decide to use the Experimenter's Radio-Control System, you will find it both highly flexible and eminently adaptable. **ME**

Motor Drive Notes

For applications in which motors are used, the receiver and drive motors are powered by the same battery. Because of high current drain, alkaline cells are preferred. An alkaline C cell can deliver 400 mA, a D cell 700 mA, for 10 continuous hours. Comparable carbon-zinc cells will last only one or two hours.

Since dc motors generate wide-spectrum noise, this can have an adverse effect on the receiver's r-f and i-f sections. Also, high peak-current demands by a motor under heavy load can affect battery terminal voltage. This can be critical as cell voltage drops toward its end-of-life 0.9-volt level. Fortunately, sensitive circuit elements in the receiver are referenced to the supply line, and the LM1872 has good common-mode rejection characteristics.

Most notable problems will occur with very inexpensive motors in which a metal stamping is used for commutator brushes. The brushes have very-light, single-point contacts that cause a great deal of arcing and, hence, electrical noise. If a motor is located several inches from the receiver, you may have to use a noise-suppression network like that shown here. In projects where space considerations force close proximity between motor and receiver, use low-noise motors with wire or carbon brushes. Various types of small dc servo motors are available from local hobby dealers and mail-order houses.



LM324 will operate from 5 to 18 volts, but has a very-low input impedance and a maximum frequency response under 50 kHz.

If either the TL084 or LM324 are used, the values of *R1* and *R6* must be changed to 100,000 and 47,000 ohms, respectively. No other changes are necessary, and all three devices have identical pinouts.

Since space on the kit's perfboard is limited, it's necessary that you carefully follow the layout shown in Fig. 3. Use low-profile gold-contact sockets for the two ICs. Sockets will allow you to exchange ICs easily in the event you change your mind about the op amp you wish to use.

All resistors are ¼-watt, 5% tolerance carbon-film types—avoid carbon-composition devices here. Tantalum and Mylar are specified for the capacitors, as much for their small size as for their performance characteristics. Other types can be substituted for *C1* and *C2*, space permitting, but only a Mylar or polystyrene capacitor should be used for timing capacitor *C3*.

Connections from the probe tip holder to *R1*, *R1* to the voltage follower input, and the voltage follower output to the input of *IC2A* at pin 1 should be at least 22-gauge wire to ensure a low-impedance path for high frequencies. The supply bus wires should also be at least 22 gauge, but the rest of the connections are not critical and may even be made with wire wrap.

One tricky part of building the Looker is properly positioning the three LEDs. They must be raised above the perfboard and angled to fit into the three holes in the top half of the case. The kit includes a support that was useful for aligning the LEDs but was discarded from the prototype as it tended to interfere with assembly of the two case halves.

The only other tricky part of building the Looker is properly applying the two case labels shown in Fig. 4.

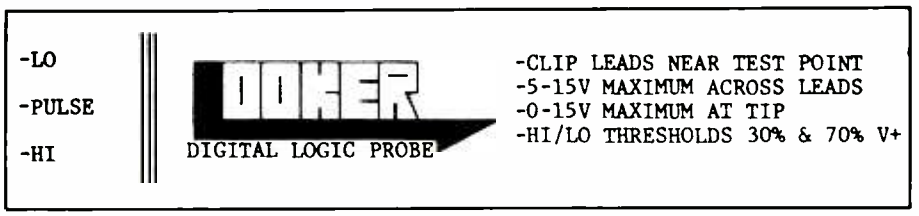


Fig. 4. These are actual-size labels for the Looker's case. The left label goes on the top of the case, with the LO, PULSE *and* HI *legends aligned with the LEDs. The right label goes on the bottom of the case. Photocopy both labels and protect them with clear tape or several coats of acrylic.*

These can be cut from the page or photocopied on a good-quality plain-paper copier and cut from the copier sheet. (The copier method is recommended, since there will be no bleed-through from backside images, lets you use color bond paper, and allows room for mistakes).

Use either rubber cement or a artist's stick adhesive (Glue Stic, UHU, etc.) to fix the labels in place. Also, to protect the labels from smearing and/or wearing away, it's a very good idea to cover them with a strip of ¾ *" clear* tape or spray several thin coats of clear acrylic over them.

Using the Probe

The Looker can be used to test any circuit or device with a minimum supply of 3.5 volts (6 volts for the TL084; 5 volts with the LM324) and a maximum supply of 16 volts (18 volts with the other two ICs.) Since the Looker is partly or wholly CMOS, performance varies with the supply voltage (one of CMOS's quirks). For this reason, the Looker will respond to a maximum frequency of 800 kHz at 15 volts, 500 kHz at 10 volts, and 150 kHz at 5 volts. Pulse sensing is correspondingly voltage related, but the HI and LO indicators operate the same regardless of supply voltage.

The Looker can be used to test almost any logic family, including regular and LS TTL, CMOS, NMOS and even PMOS and ECL, if the supply voltage is within range of the probe. With regard to the last, it is important that you first use a voltmeter to measure the supply voltage of the circuit to be tested to make certain that it is within the supply range of the probe. Be especially alert for negative voltages; application of a voltage that is lower than the probe's supply ground can damage the instrument.

Once the supply voltage is determined to be safe, connect the probe's power leads to the most positive and most negative supply rails in the circuit being tested. Unless unavoidable, the power leads should not be more than about 6" from the test area. If necessary, a pair of mini-hooks, such as Radio Shack's No. 270-334, can be added to the alligator clips to facilitate hookup on crowded circuit boards.

Before touching the probe tip to any test point, touch it briefly to the two supply clips to confirm proper operation. You should obtain a HI indication from the positive clip, a LO from the negative clip. If you obtain neither indication, you have a bad or reversed connection. This test should always be repeated each time the clips are moved; it takes only a moment and it may save you from damaging the probe, the circuit or both.

Once the probe is connected and tested, all you need do is touch the tip to any point in the circuit to see what's happening there. Be careful to avoid shorting together IC pins and other closely spaced component leads. Most probes, like the Looker,

have very high input impedance and will disturb the circuit under test only minimally, if at all.

Although you can't determine frequency with a logic probe, you can trace a waveform through a circuit to see where it goes, disappears or goes awry. A common indication is to have the probe indicate all HI or all LO conditions for every point in a circuit or pins on an IC. This means that the circuit or IC is lacking a ground or positive supply voltage.

There are seven basic responses a probe can give. With a schematic diagram or other documentation and a little practice, you'll soon learn to interpret them:

(1) *No indication at all*—the point being tested is dead or is at a voltage level between the two thresholds (see 7 below).

(2) *Steady* HI *indication*—the point under test is at a voltage level greater than 70% of the supply (logic-1 for most circuits).

(3) *Steady* LO *indication*—the point under test is at a voltage level less than 30% of the supply (logic-0 for most circuits).

(4) *Steady* HI *with flashing* PULSE *indication*—the presence of a negative pulse or pulses at that point.

(5) *Steady* LO *with flashing* PULSE *indication*—the presence of a positive pulse or pulses at that point.

[Note: The probe point must be held firmly against the test point to eliminate the chance of false pulse indications. Many probes—including the Looker—may flash the PULSE indicator when the tip is touched to or removed from the test point.]

(6) *Steady* PULSE *indication*—the presence of a frequency between 0 Hz and maximum range of the probe at that point. The presence of a steady HI or LO simultaneously may mean a frequency that's slightly out of range for the probe, a frequency with a strong dc component, a very high or very low duty cycle, or a waveform with its amplitude biased toward one end of the supply.

(7) *Flickering* PULSE *indication*—may indicate a frequency that's out of range of a voltage that's between the thesholds. This shouldn't be interpreted as a valid state. Use a voltmeter or frequency counter to check.

Conclusions

If you've never used a logic probe before, you will be surprised how quickly and easily it can give a comprehensive look at the operation of a digital circuit. With a schematic diagram or a timing chart of a circuit and a logic pulser for signal injection, you will find that a logic probe is particularly useful in design/experiment work as well as for troubleshooting.

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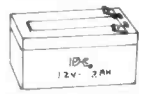

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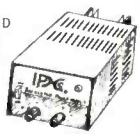

THESE ARE SOLID STATE FULLY REGULATED 13.8 VDC POWER SUPPLIES. ALL FEATURE 100% SOLID STATE CONSTRUCTION, FUSE PROTECTION, L.E.D. POWER INDICATOR.

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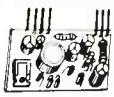

DESIGNED TO PROVIDE A STEADY ±5 VDC @ 240 MA FROM A BATTERY SUPPLY OF 3.5 TO 6.25 V.

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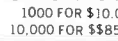

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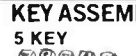
6 KEY **$1.25 EACH**



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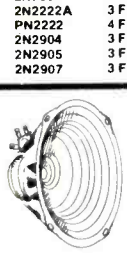
8" P.A. SPEAKERS



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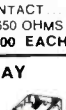

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For further information on products, dealers, or literature in this issue, circle the appropriate numbers below. Be sure to include your name and address before mailing.

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Metal Detecting *(from page 37)*

Whether or not a meter is supplied appears to depend upon the manufacturer's philosophy. With one exception, all manufacturers whose products appear in the Buying Guide table offer some type of metering on most of their products. Fisher, the exception, does not. This is not to say that Fisher's metal detectors are inferior to the others; they are not.

The information supplied in the Buying Guide table is necessarily limited. However, it should be sufficient to launch any preliminary comparisons. If you wish much more detailed information, you are urged to call or write to the various manufacturers and request their latest catalogs and/or descriptive brochures. If possible, before making a final decision, you should visit dealers who handle metal locators for hands-on comparisons.

Options and Accessories

As the metal-detection industry has matured, product manufacturers have heeded the requests of equipment users by making available optional items that can greatly enhance the operation of the basic detector. Hot on the list of options are different-size search coils. While not all models permit substitution of different coils (those that do not are usually indicated in the catalogs), most general-purpose ones do. With a series of different-size search coils, you can tackle a wide range of search tasks that would not otherwise be possible with the standard 6″ to 8″ coil supplied.

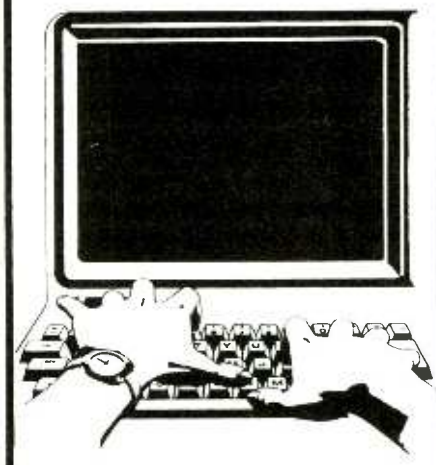
Another useful option that manufacturers offer are conversion kits that allow you to dismount the electronics package from the stem and transfer it to your waist, shoulder or neck. This way, you can use either the standard cane-like stem or one of the new arm-rest stems for the search coil and, thus, reduce fatigue.

Nickel-cadmium (NiCd) battery packs and rechargers are also high-interest optional accessories with most detector models, as are protective plastic covers for delicate search coils and rigid cases and zipper pouches for the detectors.

In Closing

This summer and fall, you can add a lot of fun to your outdoor activities by getting involved in metal detection. When you dig up your first ring or coin, the treasure-hunting bug might just bite deep enough to keep you at it and make you want to come back for more early next spring. You might want to visit a library to learn about treasure hunting areas aside from local beaches. For U.S. treasure guide information, write to Carson Enterprises, Deming, NM 88031; for worldwide treasure maps, Treasure, Box 1355, LaCrosse, WI 54601. Good hunting. **ME**

ADVERTISERS' INDEX



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CLASSIC TUBE LAMP COLLECTION

#357A: World War II era
W.E. Transmitting Triode.
Lamp is 19" high.

#5J29 Type: World War II Radar Tube
classified as 'secret'.
Lamp is 17" high.

#808: Circa 1934 Transmitting Triode
Lamp is 17" high.

A unique, limited edition, of strikingly beautiful desk and table lamps, crafted from rare, old, genuine radio transmitting tubes.

In the pioneer broadcasting days of the 1920's and 1930's, these tubes powered the commercial and amateur radio transmitters that linked the nation and the world. Today, these same tubes are considered by many to be some of the most beautiful industrial artifacts ever created.

For many years, the A.B.C. Guild has collected whatever quantities of these old tubes that were available. Each is carefully inspected, cleaned, and painstakingly surface-restored. The bases are constructed of solid acrylic and polished to a jewel-like clear lustre which compliment the clean, sweeping lines of the glass tube. The final result is a functional lamp of great beauty as well as a valuable genuine collectible from a long-gone age.

The Classic Tube Lamp in your home or office becomes an attractive heirloom with inherent investment potential. The "high-tech" design of both the tube and the attractive acrylic base is in keeping with today's design trends and makes the lamp a unique, decorative focal point of any room.

For the hobbyist, ham, computer enthusiast, or anyone with ties to the electronic industry, these lamps have an extra meaning and importance. For the homeowner or decorator who seeks accessories of classical beauty, they make a one-of-a-kind impact wherever they are used and must be seen to be truly appreciated.

The available quantity of each of the lamp styles is extremely limited. Each lamp is numbered as one of a limited edition series and comes with individual certification papers that summarize the history, manufacturer, and establish authenticity of the tube in your lamp.

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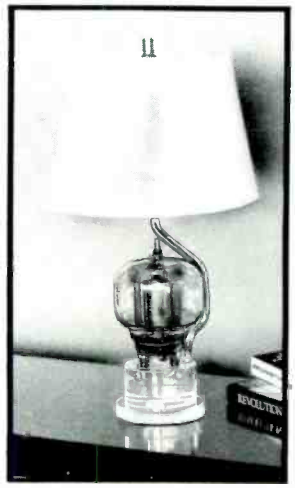

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