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THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

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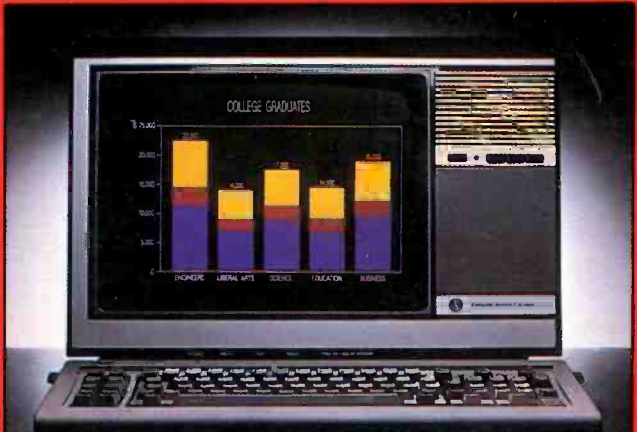
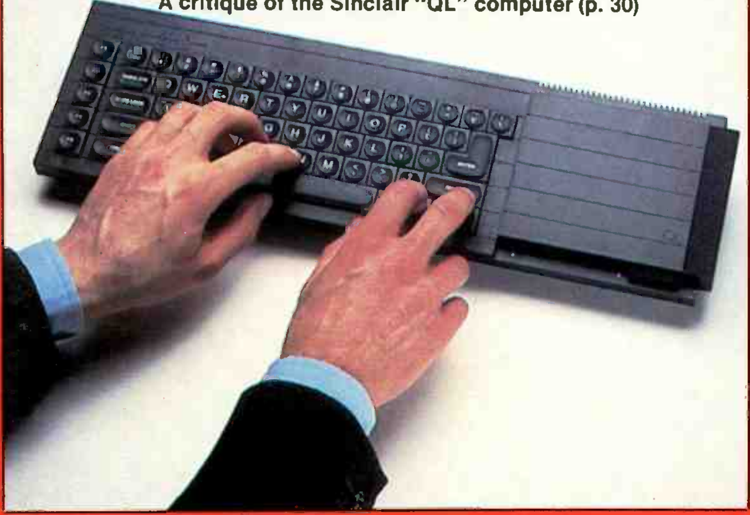
- AUTOMATIC EMERGENCY PHONE DIALER SAFEGUARDS HOME WHEN YOU'RE AWAY



GE color TV receiver/computer monitor (p. 10)

- Sinclair's New $500 "QL" Computer
- Evaluating a Home Satellite TV Receiver
- Build a Low-Cost True-rms Adaptor for Digital Multimeters
- Practical Circuits with a Versatile Audio Amplifier Chip
- Electronic Gadgets—From Smart Watches to Alcohol Breath Indicator

A critique of the Sinclair "QL" computer (p. 30)



Telephone accessory enhances burglar alarms (p. 48)

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Plus—*Equipment Tests:* Carver's New CD Player • GE's TV/Computer Monitor • Beckman's Latest DMM • *Columns:* Forrest Mims' "Electronics Notebook" • Don Lancaster's "Hardware Hacker" • Art Salsberg's "Software Focus" • Glenn Hauser's "Shortwave Communications" . . . and more.

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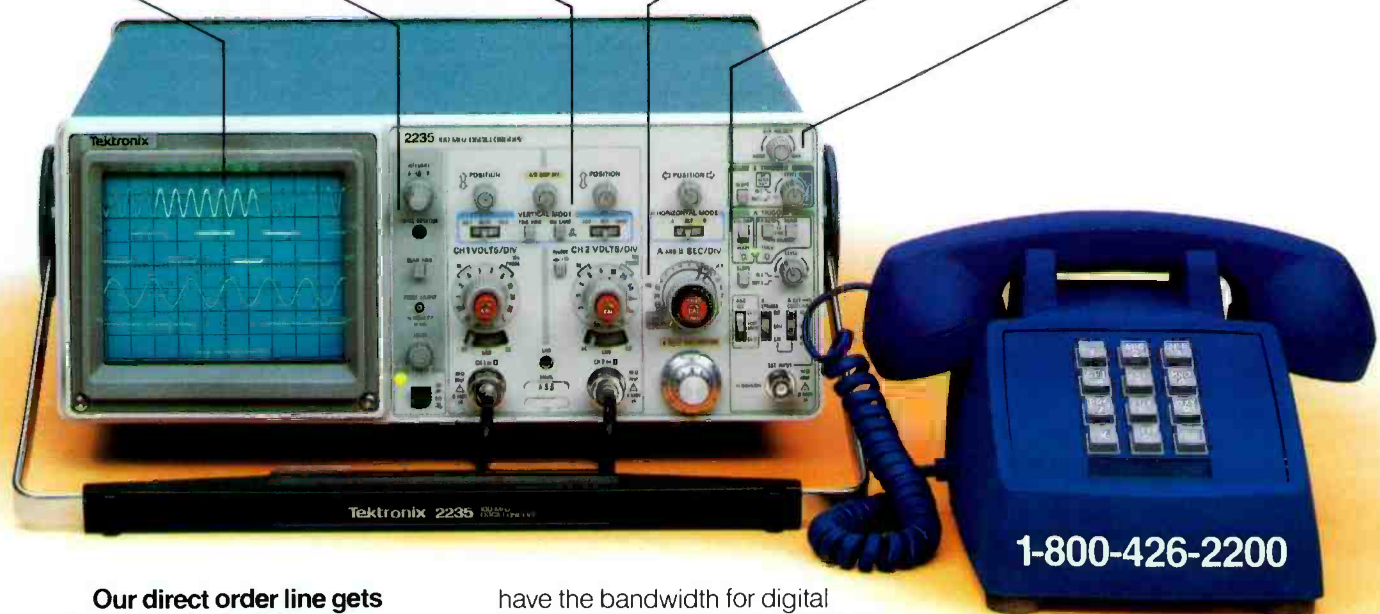

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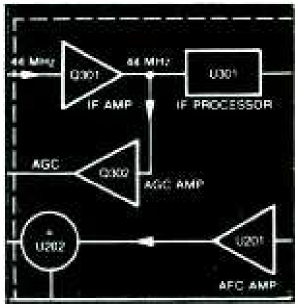
THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

JUNE 1985 **VOLUME 1, NUMBER 9**



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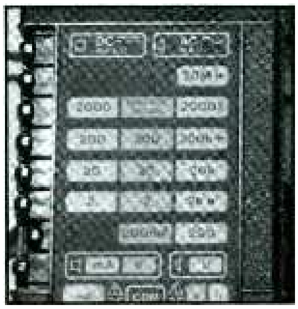

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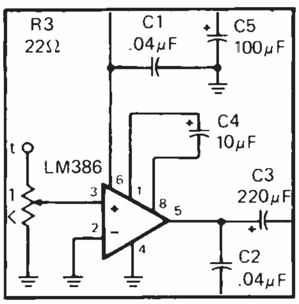

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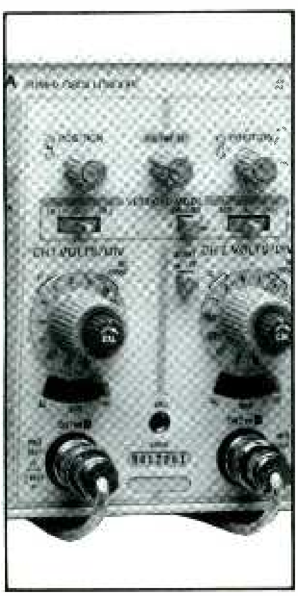

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PRODUCT EVALUATIONS

DEPARTMENTS

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

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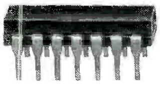

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2.2k	271-1325
3.3k	271-1328
4.7k	271-1330
6.8k	271-1333

Ohms	Cat. No.
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15k	271-1337
22k	271-1339
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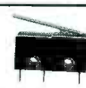

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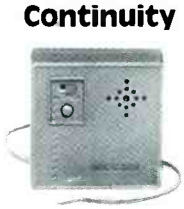

Circuit continuity produces a warbling tone. Possible uses: doorbell, security alarm, moisture sensor, capacitor/diode checker and more. Great experimenter's item at a bargain price! 9V battery extra. **277-1014** . . **1.95**

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EDITORIAL

Silicon's Challenger

Systems are glamorous, but lowly electronic devices are the underpinnings for them. New chips on the horizon will change what systems can do, for instance; even how they're constructed. One in particular, the gallium-arsenide semiconductor (GaAs), promises to do just this.

Though we all think in terms of silicon substrates as the foundation for semiconductors, GaAs has been used for years. It's popularly used with light-emitting diodes, for example, because it emits more light and less heat than silicon. More important for its future prospects, though, is the enormous speed advantage over silicon—4 to 8 times faster, it's said!

If the foregoing is true, you may ask, how come most of the solid-state world is based on silicon instead of gallium-arsenide? It gets down to cost. The material is about 20 times that of silicon. Moreover, manufacturing techniques to increase yields needed improvements. And as with most new products, high-volume production is required to lower overall costs. Nevertheless, industry is moving ahead at an increasingly fast pace to produce GaAs devices. Even governments are pouring money into GaAs research and development, with the U.S., Japan and Europe spending more than $500-million on it in 1984. Private companies such as Texas Instruments, Plessey and Hewlett-Packard, among others, aren't sitting idly by, either.

Discrete GaAs components are being used in the analog area right now, especially for high-frequency purposes, to the tune of some $75-million in annual sales. This isn't earth-shaking, of course, but many manufacturers are looking hungrily at the billion-dollar digital market, where GaAs chip sales have their greatest potential. Here is where speed is a Godsend for number crunching and signal-processing applications.

To this end, the theoretical "ballistic" transistor recently postulated by Lester Eastman, an electrical engineering professor at Cornell University, is expected to be achievable through using gallium arsenide instead of silicon.

The ballistic theory says that if a transistor can be made sufficiently small, electrons can shoot right through the semiconductor material without being slowed down by hitting some of its atoms. Silicon transistors would have to measure about 1/100th of a micron in order for this effect to be achievable, say scientists. They doubt that this is possible since they can barely reduce size to ¾ micron now. Gallium-arsenide, on the other hand, need only measure $^3/_{10}$ micron to achieve ballistic speed, say experts, which *is* in the cards. A gallium-arsenide ballistic transistor would cut switching time to about 1½ picoseconds, says Eastman, which would require architecture changes, like using fiber-optics to take advantage of such high speed.

With the incentive here and the substance in the form of gallium arsenide also available, we may well witness a revolutionary change in electronics and computers in the not-too-distant future. Predictions are that digital GaAs medium-scale ICs will be ready for commercial use in only about a year. But this would be prosaic next to a ballistic transistor. Let's wait and hope.

Art Salsberg

Feedback

•Just to let you know I'm enjoying the new *Modern Electronics* magazine. I particularly like the columns by Forrest Mims and (especially) Don Lancaster.

Warren W. Munro
Aiea, HI

• I like the way you set up the project articles with sections on how it works, construction, testing, installation, etc.

Please keep the electronics aspect as your top priority. I would like you to concentrate on construction articles and information about how things work—technical details—not just generalities. You can include stuff for computers as long as its directly related to electronics, stuff like interface circuits, diagnosing and repairing problems, etc.

Article Bell Ringers

•Please send me a copy of the software described in Don Lancaster's article, "Upgrading Apple IIe's ROM Monitor," February and March *Modern Electroncis*. I've enclosed a large s.a.s.e. for your convenience. The article is a good one—one of many I've enjoyed in the recent issues of your magazine. You've presented a wealth of interesting material. Thanks for the enjoyable and informative reading.

Paul K. Pagel
Enfield, CT

•Thanks to Anthony Caristi on a job well done for his article "The Frustrator," which was just fantastic. A very good construction article. I feel you people are putting out the best electronics magazine. Please send me one year of *Modern Electronics* at your charter membership rate.

Robert P. Loeber
Sunnyvale, CA

• What a wonderful day when I found your magazine. I felt cheated when PE went all computer, missing the build-it-yourself projects.

Harvey Watson
San Antonio, TX

• Your new magazine is excellent. And much needed and appreciated, I might add. May it prosper and grow.

Ken Englert
Los Angeles, CA

The *Penthouse* Alternative?

• I'm glad to see Forrest Mims, et al, helping me. However, if I want pictures of foxy broads I can buy *Penthouse* or *Playboy*.

Robbie Cave
Princeton, TX

Are your referring to the female models holding video cameras in our November issue or the female ice skater on the screen of a color TV set in January? Anyway, "foxy" is in the eyes of the beholder. —Ed.

TVRO A NO-NO says Luxor president Hans Giner. It's only understood by the trade, he believes. So from here on his company will refer to home satellite TV reception systems as "Home STV."

ELECTRONIC FINGERPRINTING. Badges can be stolen; codes can be cracked; security guards can be deceived. But fingerprints are uniquely yours. That's why the FBI, among others, are looking hard at a new electronic scanning terminal developed by Identix (Palo Alto, CA) that verifies a person's identity by their fingerprints. One simply places a forefinger into a slot while the biometric system does the rest.

BACK IN TIME. An unusual club, the Great Circle Shortwave Society, is devoted to shortwave listening in the 1950s and 1960s. It's keeping the period alive with a newsletter covering tube-type equipment, nostalgia, and SWL'ers who were active during this era. For a free sample newsletter, send a SASE to Richard Arland, 2042C Flyer Drive, Bethel Manor, Langley AFB, VA 23665.

A METRIC SHIFT. Hewlett-Packard, who stated a commitment to a metric system, is beginning to phase in metric. Starting early 1985 with its "System II" cabinet, metric-threaded fasteners are used. Rack-mount and front-handle fastener kits will contain both metric-threaded and inch-threaded configurations, so service techs should be aware of this.

DOCUMENT DELIVERY SPEED. There's a small war going on in the document delivery business. Western Union and DHL Worldwide Courier Express recently launched its "Express Document" two-hour and overnight delivery service for documents generated on Western Union's "EasyLink" electronic mail. The two-hour delivery service costs $20 compared to ZapMail's $25; it's $10 less than MCI's four-hour delivery. Initially, 30 U.S. cities will be served.

FILLING OUT FORMS BY VOICE. A new computer software program from Micro Nova System (Winston-Salem, NC) that's based on TI's "Speech Command System" is said to allow complex forms to be filled out by using spoken commands. Called "Multiform Solution," it's designed for use in real-estate, appraisal, mortgage banking, and insurance businesses, where filling in form blanks is a time-consuming, repetitive process. With the software priced from $198 to $395, it's claimed that 80 to 90 percent of forms can be easily filled in using simple vocal commands.

PERSONAL ZAPPERS. A new personal protection device, the Power Zapper, was demonstrated on the video tube recently. A handful of them were purchased by a local police department and one of the officers volunteered to be zapped by the handheld shocker. He virtually collapsed when "bitten" by the probe that generates 46,000 volts, powered by only a standard 9-V battery. (A mini model produces 35,000 V.) Used against an attacker, it causes muscle spasms, disorientation, and loss of balance, while no permanent damage is said to be caused. It's a Viking International (Newhall, CA) product.

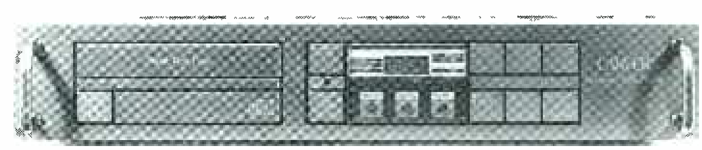
BURNED TWICE. Computer software and hardware makers got burned twice with IBM's PCjr. First when its debut model fouled out quickly due to its poor keyboard, among others shortcomings, and last when IBM pulled the plug on its modified model that addressed many of the original's shortcomings. The machine accounted for much less than 5 percent of the company's sales, so Big Blue's hard-nosed execs, probably observing Tandy's new Model 1000's low price and eying the Junior's slowed sales and bulging inventory, got out of the lower-price personal computer war.

NEW EIA/CEG AUDIO STUDY. A new study on audio ownership and buying patterns was recently completed by the Electronic Industries Association's Consumer Electronics Group. It revealed that 0.2% of U.S. households purchased Compact Disc players during the past two years; 19% bought audio component products in the same period; 41% bought car audio equipment. Last year, the buying rate for personal portable stereos with headphones exceeded 20%.

ZAPPING ON VIDEOTAPE. The dangers of electrostatic discharge on electronic components are emphasized by Motorola in a $75 videotape. The 18-minute VHS- or Beta-format tape, 1/2" or 3/4", details the effects of ESD, how to recognize the dangers, and how to prevent them. Special video effects are used to heighten a viewer's awareness of the problem.

Audio

The Carver CD Player



Bob Carver, an exceptionally creative engineer, often produces products with a design twist. His "Digital Time Lens" is one such device. He developed it to overcome deficiencies rampant in early CD discs, selling it as an outboard model that connects between a Compact Disc player's output and an amplifier's or receiver's input.

Recently entering the Compact Disc player market with its first model, it's not surprising that the unique "Lens" was built into the company's player, distinguishing it from all other CD players.

We'll examine the machine here as a general CD player with and without the Lens activated to give you our measured and personal evaluations, as well as discuss what the lens does. The 10″ W × 3.4″ H × 12.3″ D Carver CD Player, which weighs 10.6 lbs., has a suggested retail price of $650.

Description

The Carver CD player uses 16-bit digital-to-analog conversion with 88.2-kHz oversampling and a three-beam laser pickup. In many respects, it is very much like other CD players currently available.

The player conforms in size and color to several other Carver products. The front panel is equipped with handles, giving it a professional rack-mount appearance. Everything else is flush with the panel except for three small protruding pushbuttons. Finish of the front panel is a subdued charcoal-grey/black color.

The left third of the front is taken up by the CD disc drawer, which is opened by touching a large, square pad at its right. Touching the pad a second time or the drawer itself closes it. Under the pad is an indicator light for the same-size pad beneath it that activates the built-in Digital Time Lens circuitry. The left-bottom corner or the CD drawer has a similar pad for power on-off control.

Near center-panel is an alphanumeric display that alternately displays track number or elapsed time within the track during play. When a disc is loaded into the disc drawer, the display first shows the total number of tracks on that disc and can then be switched to show total time on the disc. During programming, the same display prompts the user to sequentially select tracks for "P1" (Program number 1), "P2," etc., up to "P9," the maximum number of programs that can be "remembered" by the CD player's built-in memory.

Although the display is really a simple numeric one, Carver programs the seven-segment LEDs so that they also provide useful "alpha"-type data. When power is first turned on, the laser pickup does some searching (while the display blinks with a few dashes). If no disc is located, the word "DISC" begins to flash intermittently. When the door is opened, the word "OPEN" appears in the display. After your programmed selections have been played, or programming is completed, the word "END" appears. Below the display are three small pushbuttons, labeled "Display" (for switching between elapsed time and track number), "Program" (for presetting tracks to be played), and "Repeat" (for programming repeat-play of a disc or group of tracks that have been selected).

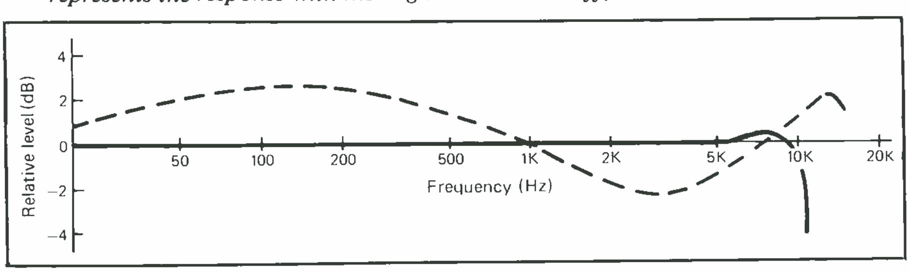
Six more large, square touchpads or buttons to the right of the display initiate play, fast forward and reverse (with muted, but audible cueing), track advance (in track-by-track steps), track reverse, and stop/pause functions.

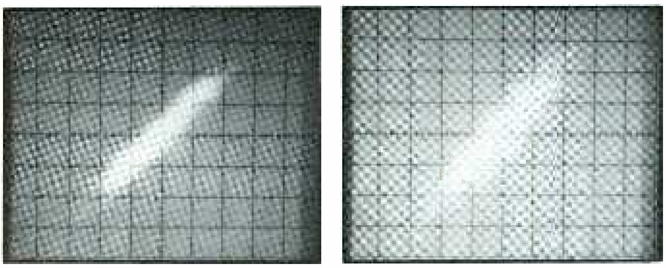
The rear panel of the Carver CD Player is equipped with the usual pair of output jacks. There is no output level control, nor is the player equipped with a headphone jack.

The Digital Time Lens

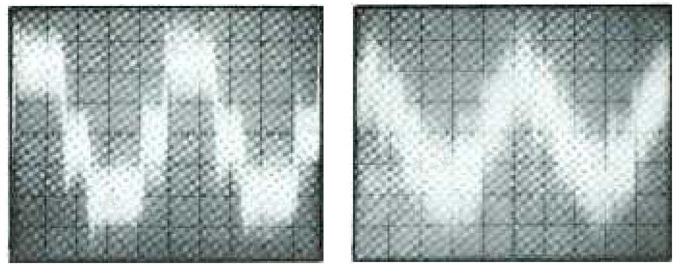
Carver's Digital Time Lens was designed in response to the poor three-dimensional effect he observed with early CD discs. He found that the frequency response

These are the frequency-response curves for the Carver CD player. The solid curve represents the response with the Digital Time Lens off, dashed curve with it on.

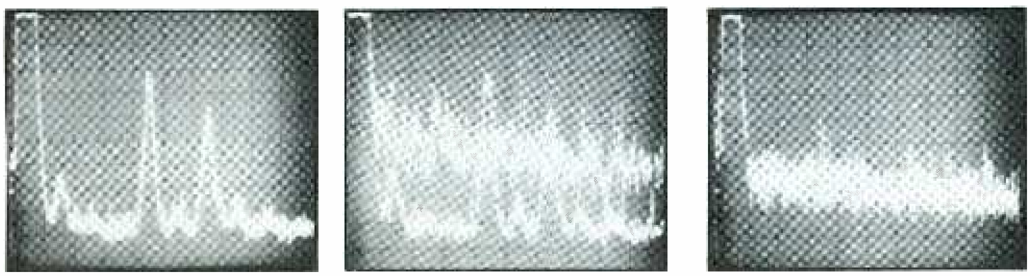




Width of ellipse in these photos indicates amount of L − R signal present. In the left photo, the Digital Time Lens is off, while in the right it is on, demonstrating enhanced stereo effect.



From many CD players, low-level signals often come out distorted (left photo) because of quantizing limitations. Carver solves this by adding some random noise to the signal (right photo).



Distortion in low-level output signal (far-left) is reduced to negligible level (center) in Carver CD player by adding some random noise, equalization and stereo enhancement, but with a bit higher noise (near-left).

was shifted toward more midrange above 400 Hz and that the left-minus-right signal on the CD discs was about 1¼ dB less than the left-plus-right signal as compared to the difference on analog LP discs.

Carver notes that 1¼ dB, though appearing to be a small figure, has a large impact because power increases by the square of voltage. With this tack, and the fact that the L − R signal contains the three-dimensional information, analog records were carrying 33% more ambience information through loudspeakers than digital discs did.

Moreover, he noted that there was a slight boost in mid-bass and a slight cut in mid-treble in LP versions compared to CD versions of the same program.

To counter the foregoing problems, Carver proceeded to design circuitry to allow the user to introduce the converse of these two effects at will. Thus, if there is a deficiency of L − R signal in some CDs, he interposed a form of matrix-dematrix circuitry to put back some extra L − R signal. If there is an overly bright mid-treble and diminished mid-bass in a CD disk, the switchable circuit makes it possible to add a little mid-bass and to attenuate some mid-treble frequencies.

Carver called this special circuit the "Digital Time Lens." Our experiences with the system will be detailed later.

Laboratory Measurements

Due to the presence of the special Digital Time Lens in this CD player, certain measurements had to be taken twice. For example, the normal frequency response of the player without the addition of the special circuit was flat to within better than ± 1.0 dB from 20 Hz to 20,000 Hz. When the "Digital Time Lens" pushbutton on the player is depressed, however, the response exhibited a rise of nearly 2.5 dB at around 150 Hz, and an attenuation of between 2.0 and 2.5 dB at 3 kHz. This is the equalization compensation that Carver inserts to counteract the effects of poor CD recordings.

Harmonic distortion at mid-frequencies, for maximum recorded level, measured 0.0045%, rising insignificantly to around 0.006% at the bass and treble frequency extremes. Output linearity was accurate down to − 60 dB, within 1.0 dB. SMPTE-IM distortion measured 0.0025% at 0 dB (maximum) record level; 0.03% at − 20 dB levels. CCIR-IM (twin-tone) distortion was only 0.0037%. Moreover, we could not detect any in-band distortion components during twin-tone measurements besides the basic 1-kHz beat that constitutes the CCIR IM level.

An analysis of signal-to-noise performance of the CD player, both unweighted and weighted, was made both with and without the Digital Time Lens engaged. Signal-to-noise measured 82.1 dB unweighted; 90.7 dB with an A-weighting filter with the Time Lens feature activated. With the Time Lens feature turned off, signal-to-noise was somewhat better, with readings of 85.4 dB unweighted and 97.5 dB A-weighted. Without the Digital Time Lens activated, at mid-range frequencies, separation was around 80 dB, decreasing to just under 60 dB at the high-frequency extremes.

With the Digital Time Lens switch turned on, we actually measured no more than about 15 dB of *apparent* separation! That's because when L − R content is increased with this circuit, it does so by adding out-of-phase "R" signal content to the "L" channel and out-of-phase "L" signal to the "R" channel. Of course, a simple voltmeter can't reveal that the opposite-channel content is "out of phase," so you get what seems to be a "poor" separation reading. In fact, though, when you listen to music under these conditions, separation (and image depth) actually increases—which is one of the objectives of the Digital Time Lens.

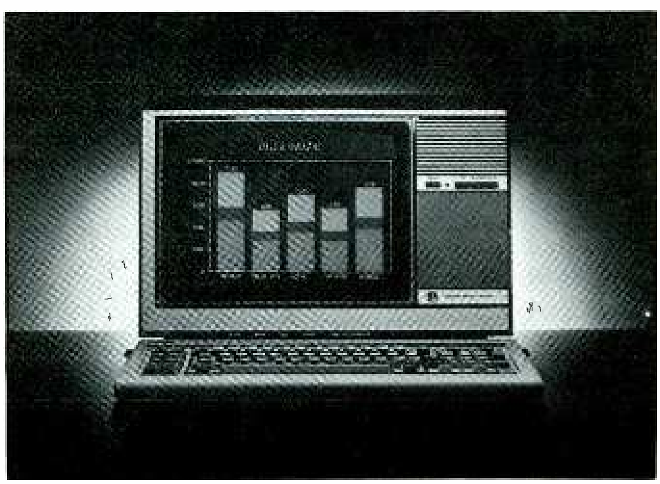
The Carver CD Player was able to track all but the last and greatest width of the opaque wedge on my special-defects disc. That is, it was able to "overlook" dropouts as wide as 800 microns. No problems were encountered in tracking the simulated dust spots, the greatest diameter of which was also 800 microns. Neither were there any mutes or "skips" when the laser pickup traversed the area of the disc that had simulated fingerprint smudges. So, while the player did not do quite as well as some recent ones that can handle all of the defects on this special disc, it is not likely to give you tracking problems unless you really mishandle your discs and get them full of scratches that are too wide for the player to "correct." Resistance to external shock was very good, too. And the motor was quieter than average.

User Comments

Conducting listening tests with the Carver CD player involved two sets of experiments. First, we chose some of our best Compact Discs to audition on this player without turning on the Digital Time Lens feature. The player, like so many current models from a number of manufacturers, employs a technique called oversampling and digital filtering, both of which combine to deliver exemplary sound quality when well-recorded discs are played.

Though satisfied with the results, we deliberately turned on the Digital Time Lens Feature and—just as quickly—turned it off again. For well-recorded CD discs, the "Lens" was clearly not "right." It imparted a rather dull high end and an exaggerated left-right sense of stereo separation.

Next, we selected some of the earliest CDs we had in our collection—specifically those we ourselves had criticized when they were obtained. Sure enough, with



Video

GE's Color TV Receiver/ Computer Monitor

General Electric wants a piece of the personal computer action, at least in the peripherals end of the business. Among a handful of its offerings is its combination 13"-diagonal computer monitor/color TV receiver, Model 13BC5509X.

Designed for people who want to get double-duty from a single video display, the GE model accommodates composite TV input signals, bypassing the tuner in order to produce sharper computer-generated video displays than possible on a conventional TV set which requires using an r-f demodulator at its antenna terminals. Its input jacks also have split "Luma," "Chroma" and "Audio" inputs, too, bypassing some more resolution-reducing elements. At a push of a these discs, depressing the Digital Time Lens button really worked wonders. Abruptly, tonal balance seemed more correct and less strident, and what seemed to be a flat stereo effect "opened up" to some degree, affording missing depth or a more three-dimensional perspective than the musical performances demanded.

Summarizing our findings, the Carver CD player is an extraordinary machine in one respect: its Digital Time Lens. Aside from this, it shares with other CD players a superiority over LP records/players in dynamic range, general distortion, and surface noise, as well as user conveniences, such as random-memory selection, track search, and high-speed scanning.

It does not have a remote control, a feature for which one would pay a premium, naturally. Nor does it quite reach the performance pinnacle that some of the very latest CD players exhibit, such as tracking even with a missing 900-micron-length digital code.

Its Digital Time Lens, though, can be a boon to people who own or expect to buy CD discs that exhibit deficiencies in ambience and/or equalization. A smaller and smaller number of CD discs are expected to have these shortcomings, though.

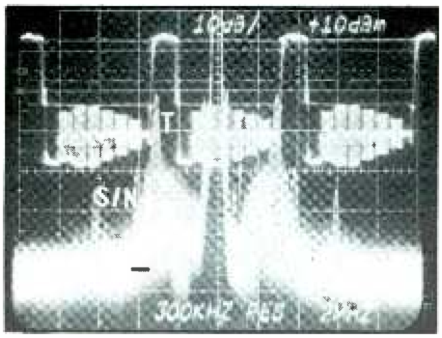
I would have preferred that the L − R signal boost and the equalization counterbalance be put on separate switches, since some discs are deficient in only one of the two areas. In such instances, though, the user can choose whichever option sounds best. With other players, there is no choice, of course. And that's where the strength of the new Carver CD player lies.—*Len Feldman*

CIRCLE NO. 150 ON FREE INFORMATION CARD

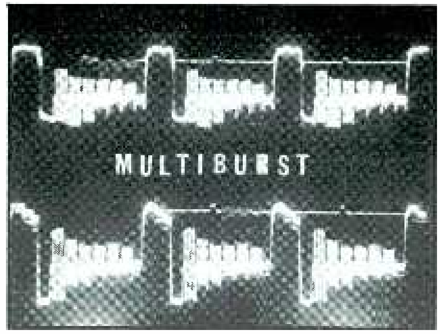
General Electric Model 13BC5509X Laborator Analysis

Ac power drain (120-V input, varies with signal received)	54 watts rms average			
Voltage regulation (with signal input)	source	100V	130V	% Reg
	130V	117.2V	129.9V	90.2
	12V	12.1V	12.2V	99
	22kV	20.3kV	22.3kV	91
Ac input operating range (100-130 V ac)				
Tuner/system sensitivity				
vhf channels 3 and 10	−4 and −2 dBmV			
uhf channels 15 and 20	0 and +7 dBmV			
Agc swing ch. 3 (−4 to +57 dB)	61 dB			
CRT temperature	9000°K			
Luminance/chroma S/N (at CRT)	40 dB			
Dc restoration	82.3%			
Horizontal overscan (normal, restricted)	15%, 5%			
Convergence	98.5%			
Maximum center CRT vertical resolution	380 lines			
Maximum high frequency horizontal resolution	3.5-MHz r-f 4.2-MHz baseband			
Barreling/pincushioning	Slight pincushioning			

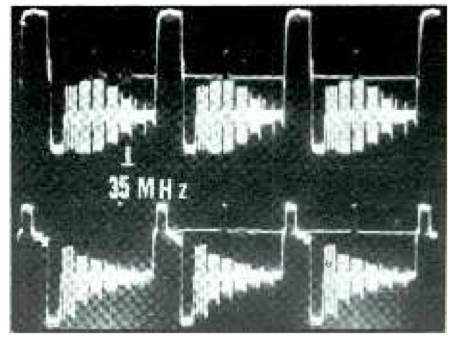
Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Hameg Model 605 oscilloscope; Telequipment (modified) Model D66 oscilloscope; B&K-Precision Models 1260 and 1250 NTSC and 3020 function generators. Sadelco Model FS-3D VU field-strength meter; Data Precision Models 245, 945, 1350 and 1750 multimeters; Sencore Model VA48 (modified) video analyst; Polaroid 667 film and Tektronix C-5C oscilloscope camera; Gossen Luna-Pro light meter; and Commodore 64 computer and 1541 disk drive.



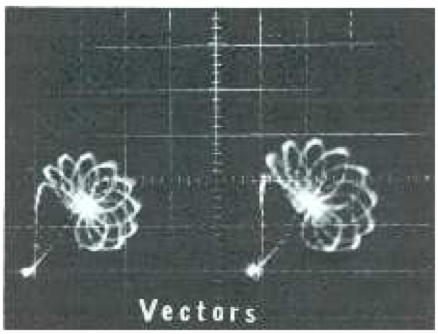
Baseband video and S/N responses of GE's TV receiver/monitor are good.



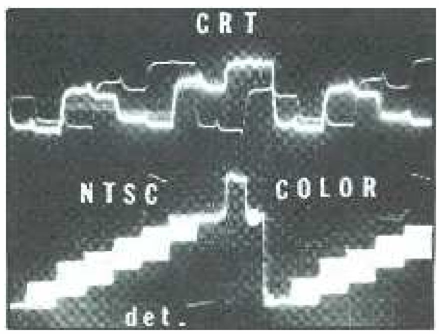
Computer I and II video inputs show full response but slight clipping.



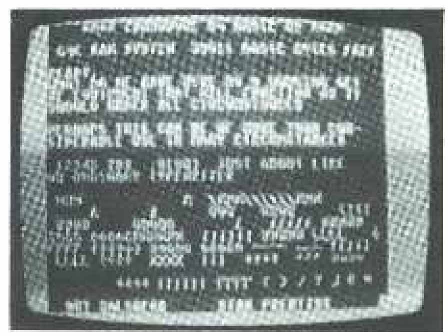
R-f video detector and CRT multiburst responses go out to only 3.5 MHz.



The vectors with (upper) and without (lower) color monitor on look good.



Response of NTSC color is relatively clean at the video detector and CRT.



This is an example of the text display of the GE unit in monitor mode.

front-panel switch, you get standard TV broadcast or cable reception. Outputs from videocassette machines can be used, too, to get improved picture quality.

The compact TV/monitor measures 18½"W × 13¾"H × 16¼"D, and weighs 29 lbs. Suggested retail price is $489.95.

We put the two-in-one unit through its regular TV receiver paces, as well as with a Commodore-64 computer when the model was in computer mode. After outlining its basic features here, we'll examine how the receiver/monitor fared in each of its applications.

Description

Starting with an attractive plastic cabinet that's a neutral gray color with pewter-color trim, GE's TV/Monitor features its new Neo-Vision™ picture tube, a CRT with a bluish faceplate that filters ambient light. It provides a dot pitch (the distance between phosphor stripes or dots) of 0.5 mm. This is sufficient to provide medium resolution for computer work, typifying what many composite color computer monitors offer. This is limited to 40 characters per line, of course. In contrast, standard TV sets have their phosphor elements wider apart at about 0.7 mm, though some of the latest sets are coming out with tighter picture elements, while RGB monitors are 0.5 mm or smaller.

Front controls include Power on-off, Brightness, Picture, Tint, Color, TV, Computer I, Computer II, and Color Monitor. Opening of plastic front-panel hinged door reveals detented vhf and uhf TV tuners and a volume control. A front-facing 3" speaker is behind a grille at the top of the controls, powered by a 1½-W audio amplifier.

Located at the rear is the model's "Jack Pack," which are signal inputs for Computer I (Composite TV), Computer II (separate Luma or brightness and Chroma or color, and Audio). Each has level controls, while the video inputs also have 75-ohm/high-impedance (2k) slide switches. All jacks are phono types.

In addition to the foregoing, there are the traditional 75-ohm vhf and uhf antenna terminals, as well as an unusual width-reduction switch to prevent computer data from spilling past edges.

The main chassis is a one-piece printed-circuit board with six integrated circuits and an SAW (surface wave acoustical) filter input into the i-f amplifiers. You will also find a luminance-chroma-separating comb filter.

The chassis itself is "hot," with return to one side of the line and a full-wave bridge rectifier and IC regulator for the main 130-V supply. This is a tried-and-true chassis design, but does have some more advanced extras such as a separate piggy-back assembly for cold-hot chassis optical signal couplers, an additional transformer-isolated power supply with 5-V regulator, glass delay line, and the aforementioned comb filter and SAW. A rather extensive wire harness between the back pack and main circuit board seems to handle r-f and video inputs acceptably.

Its Color Monitor switch, which GE uses in its better (but not top) receivers, simply amounts to a transistorized current sink that does a good job of handling chroma amplitude and tint control for users who can't bring themselves to do their own tuning-in.

Test Results

For a modestly designed TV receiver, though adding computer-oriented facilities, test results work out fairly well and about as expected. Vhf tuner sensitivity is good, uhf somewhat less. An agc swing of 61 dB is OK. Its dc restoration of 82%, however, is somewhat less than the conventional 86% to 90 % figure we're accustomed to, indicating that the "blacks" won't be quite up to snuff.

Our sample model exhibited slight raster compression on the right and a little pincushioning on the left on our crosshatch test. In real life, though, this was not at all noticeable in the picture. Eyes are forgiving.

The model's 12-V power supply regulation is almost perfect, while high B+ and high voltage exhibit some shortcomings. As an example, at 100 V ac power-line input, the raster begins to pull in slightly from the right CRT side. Luma signal-to-noise at 3 MHz amounts to an acceptable 40 dB. And audio measurements at 8 kHz are what you'd expect them to be: poor, but adequate, which is typical for TV sets that aren't top-of-line models (where you pay for better audio).

Vertical resolution is fair at 380 lines, while a 3.5 MHz high-frequency response via r-f input is not as good as we had hoped for; a 500-kHz improvement would have been welcomed. Using the Computer I and Computer II modes, however, extends the r-f frequency response to a maximum of 4.2 MHz bandwidth as the signal bypasses some circuits. This is better than GE's claimed 4.0 MHz.

In its computer mode, with the Commodore 64 personal computer, all r-f, luma-chroma, and composite results were satisfactory. Alphanumerics were sharply defined. So 40 characters across the screen can be accommodated very well. Luma-chroma inputs produced especially bright and clean displays.

User Comments

As with most dual-purpose systems, the GE TV/Monitor isn't a top performer in either of its modes. Nonetheless, it passes muster fairly well considering everything. This is one of the very few 13-inchers that incorporate a comb filter, which extends r-f frequency response somewhat.

It offers a reasonably bright, fairly contrasty picture for TV viewing, and satisfactory performance for personal computers that require a 40-column by 25-line display. We have one strong criticism here, though. The unit should have included a color-killer switch for easier reading of text that monochrome viewing always offers. On the TV end, we do not like the Korean-made, manual detented tuners and, besides, they're somewhat difficult to operate as they are positioned in a slot behind a plastic door.

So long as you understand that you're not buying a high-definition TV set, with good hi-fi sound, and the very sharpest composite video monitor for computers (nor are you paying anywhere near the price for this), the GE TV/Monitor is a nice unit for a particular purpose—a combination color TV receiver/computer monitor that can serve well in either mode for use in a home environment where space is at a premium. With it, one can take a break from "computing" to watch a favorite TV show or vice-versa at the press of a button.

To buy a separate 13" color TV and a separate composite color monitor that are equivalent in performance would cost around the same as this combination model. The price advantage, however, should have been in GE's favor, so it's not meeting competition—Sears, Panasonic, Sharp, etc—in this respect at $490 before typical discount.—*Stan Prentiss.*

CIRCLE NO. 171 ON FREE INFORMATION CARD

Test Equipment

A DMM for Bench and Field Service

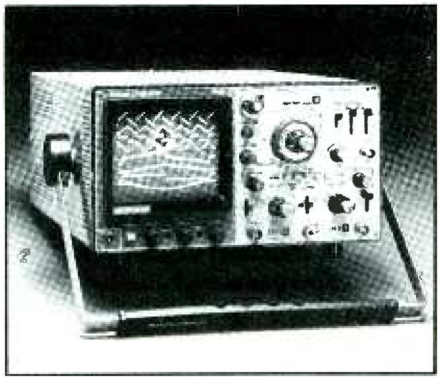
Beckman's Model DM50 Circuitmate

You might reason that one 3½-digit DMM is like any other 3½-digit DMM, regardless of who makes it. Not so! Beckman, it appears, has come up with a handy little package that's likely to be especially appealing to testbench and field-service technicians alike. It's the new Model DM50 Circuitmate, a 3½-digit DMM with a couple of extras you aren't likely to find in competitive instruments.

To begin with, the DM50 provides the full range of voltage, current and resistance measuring capabilities you've come to expect in a general-purpose DMM. To these, Beckman has added an *audible* continuity test function that will be appreciated by almost everyone who might trace circuits and cable runs, and a peak-hold function that operates on all ac and dc voltage and current ranges. The hand-held DM50 is also compact, easy to oper-

(Continued on page 84)

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.



Multi-Channel, Multi-Trace 60-MHz Oscilloscope

A new full-featured professional-grade 60-MHz oscilloscope that features three channels, eight traces and dual timebase with delayed sweep is available from Beckman Industrial Corp. The Model 9060 offers up to 1 mV/division sensitivity at 20 MHz bandwidth with its ×5 magnifier switched on. Its horizontal timebases range from 0.5 s/division to 50 ns/division, and there is a ×10 magnifier to extend the range to 5 ns/division. A 6" (152-mm) rectangular CRT and internal illuminated graticule provide bright, easy-to-read displays free of parallax error.

A unique linear focus control, a trigger level lock control and dynamic bias circuitry are among the innovative features of this scope. Additional functions include a channel-1 output, a TV sync separator, high-frequency reject and vertical mode triggers, and more. The low-silhouette scope comes with a convenient swivel carrying handle that doubles as a tilt stand on the service/lab bench. $1195.

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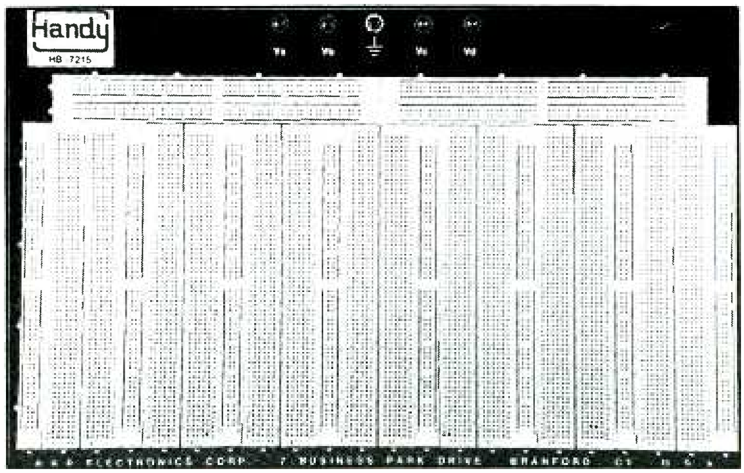


A Really Large Solderless Breadboard

For big prototyping jobs, you need a really large solderless breadboard, like the Titan from Handy. The Titan is so large, in fact, that Handy claims you can assemble a complete computer on it. It features 5680 solderless plug-in tie points, enough to accommodate 63 14-pin DIP ICs on 48 distribution strips. There are also 896 separate five-tie-point terminals on seven socket strips; 32 vertical distribution buses on eight bus strips, each with 25 tie points; and 16 horizontal distribution buses, also with 25 tie points each. Finally, there are five five-way binding posts for convenient connection of power sources. The entire system of plug-in modules is mounted on a 16"W × 10"D × 1½"-thick aluminum plate. Easy-to-read board markings code component positions for easy reference during circuit wiring, troubleshooting and tracing. $129.95.

CIRCLE NO. 104 ON FREE INFORMATION CARD

Parallel Printer Interface & Buffer For Apple IIc

Now you can use just about any parallel printer with your Apple IIc computer with either of two models of U-Print (universal printer) interface/buffers from Digital Devices. Aside from the fact that the Model AP16 offers a 16K buffer and the Model AP64 offers 64K, the two are identical. Both feature a COPY button that allows you to tell your system to print up to 255 copies of the same document, a RESET button for clearing memory, and a Centronics-type parallel interface. Included with the interface/buffer is everything needed to hook up a printer to your Apple IIc, including cables. $139.95 for AP16; $199.95 for AP64.

CIRCLE NO. 105 ON FREE INFORMATION CARD

VCR Anti-Theft Device

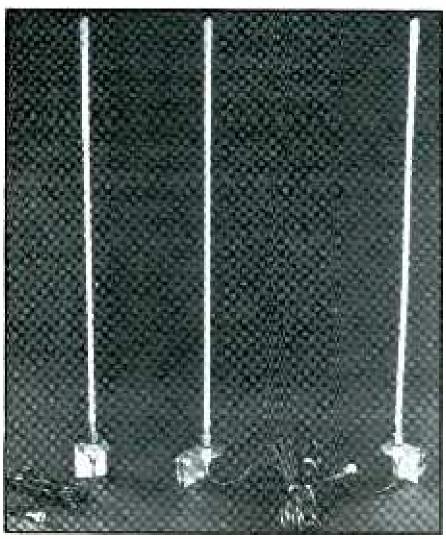
Videolok from Newport Communications International is a patented electronic device designed to protect

against theft of a videocassette recorder. The device can be inserted into any Beta or VHS (different versions for each) top- or front-loading, tabletop or portable VCR's cassette slot. A custom key arms the device. Once installed inside a VCR, a sensitive triggering device inside the Videolok sets off a piercing 98-dB alarm should an attempt be made to tamper with or move the VCR. Only the specific key for the device can disengage the alarm and enable the Videolok to be removed from the VCR. In addition to serving as an anti-theft device, the Videolok can also be used to discourage unauthorized use of a VCR.

CIRCLE NO. 106 ON FREE INFORMATION CARD

Mirror-Mount CB Antennas

Two new CB antennas for use on trucks, vans and other vehicles that require mounting on Hollywood mirrors or other tubular structures have been announced by Antenna Specialists. Their rugged stainless-steel mounts can be used on a vertical mirror support, a horizontal bar or on any flat surface. Sturdy white fiberglass rods (with red safety tips) are 47″ in length.



The single-antenna application Model M-621 Roadmatcher™ antenna comes with 10 ft. of RG-58/U cable with PL-259 connectors on both ends. The dual-mount Model M-622 antenna is provided complete with cable harness terminating in PL-259 connectors on all ends.

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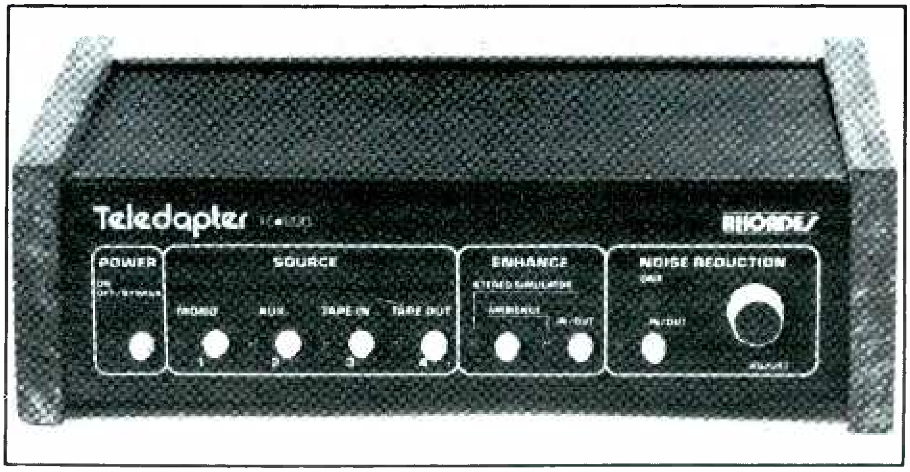


Stereo TV Audio Processor

Rhoades National Corp. has announced availability of the "Teledapter" Model TE-600 stereo TV audio processor designed to enhance the audio quality of all audio and video components. The TE-600 offers dynamic noise reduction (DNR), ambience processing, and four-input audio switching to all stereo or mono inputs. Since most broadcasting and cable signals are in mono format, the Stereo-Plex circuit converts all mono inputs into stereo outputs. A tape-monitor loop lets all features be used with all audio sources, including signals from VCRs.

In operation, a type-four Stereo-Plex synthesizer circuit creates a phase time delay difference between frequency elements of the original signal to create stereo sound. The ambience circuit is designed to create a widened stereo image from *stereo* sources. It detects and reduces common components of the stereo channels and amplifies the difference components to improve stereo imaging and widen the spatial effect.

Electrical specifications include: 20 Hz to 20 kHz frequency response; unity (±1 dB) gain; 48k-ohm input impedance; and 2k-ohm output impedance. The unit measures 8½″W × 7″D × 2½″H and weighs 2 lbs.

CIRCLE NO. 108 ON FREE INFORMATION CARD

Lockable Storage For Audio Compact Disc

The Ring King Model CDT12 is an attractive smoke-tinted plastic lockable storage tray for compact audio discs. It can accommodate up to 12 CDs, each separated by an index divider on which you can write the disc's title. The durable copolymer tray features a hinged lid and two molded-in carrying handles.

CIRCLE NO. 109 ON FREE INFORMATION CARD

Automatic Scanning Radio

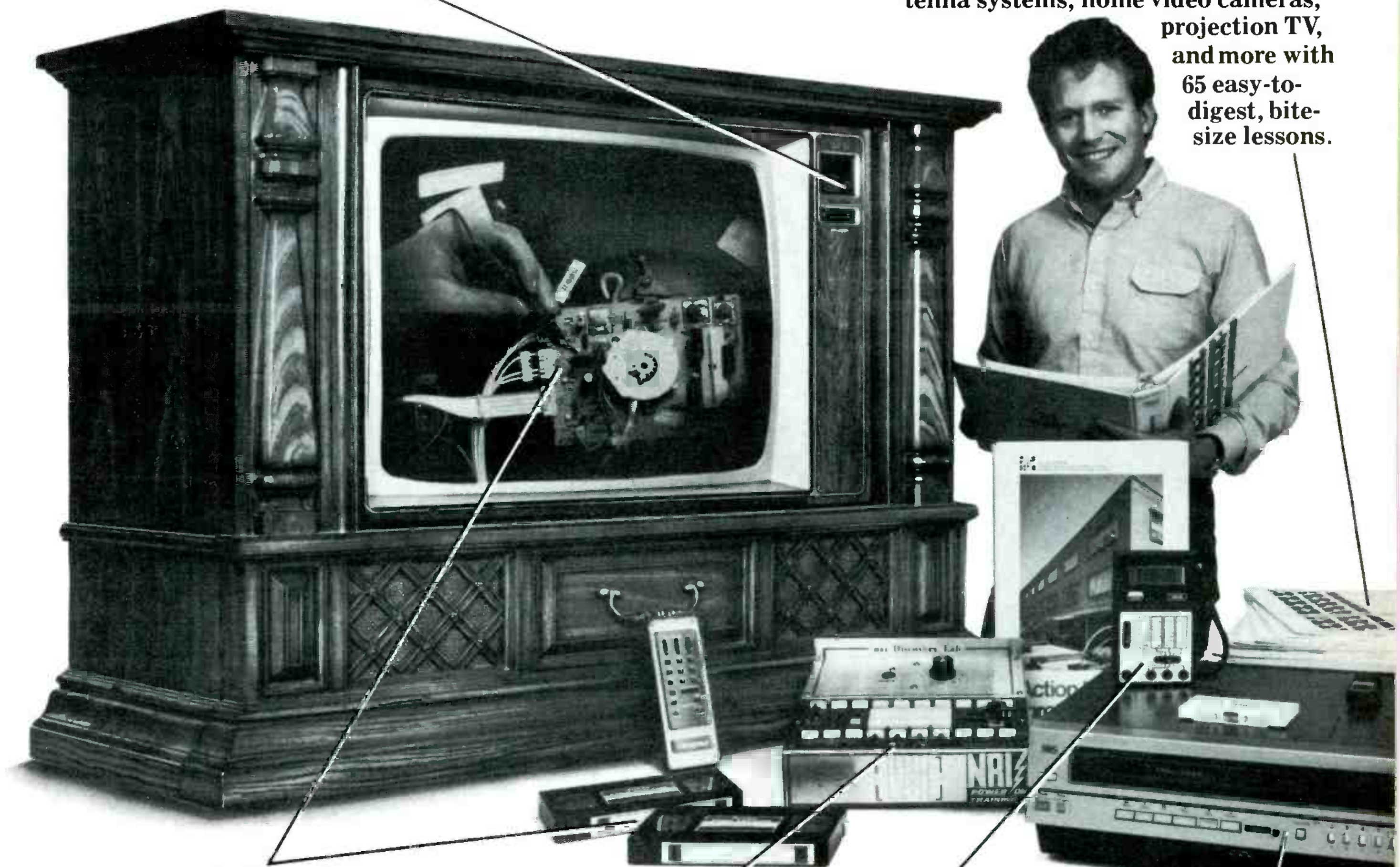
Uniden's Bearcat 180 automatic scanning monitor radio receiver lets you keep tabs on local-area police and fire calls, ham radio transmissions, business and transportation communications, and much more.

(Continued on page 74)

Only NRI Gives You This Kind of Training and Equipment. Only NRI Gives You So Much Professional Preparation For a TV/Audio/Video Servicing Career.

Build this 25" Heath/Zenith Color TV with 112 channel tuning system, infrared remote control, advanced sound system, and in-set space phone.

Get complete, thorough instruction in the theory, servicing, and repair of TV, VCR, video disc players, audio equipment, AM/FM receivers, antenna systems, home video cameras, projection TV, and more with 65 easy-to-digest, bite-size lessons.



See servicing techniques demonstrated in close-up detail. Graphic presentations make theory and systems come alive on NRI Action Videotapes covering VCRs, disc players, and TVs.

Perform challenging state-of-the-art electronic experiments and demonstrations using your NRI Discovery Lab®.

Learn how to diagnose problems using a professional 3½-digit digital multimeter. Exclusive NRI Action Audio instructions talk you through its complete operation and use.

Learn servicing and adjustment techniques with this 6-hour, remote control videocassette recorder you get as part of your training.

Only NRI gives you so much practical training with equipment you learn on and keep. You learn by doing. That's the way to make it interesting, that's the way to make it enjoyable, that's the way to get the hands-on experience and know-how you need.

Hands-On Training For Real Bench Experience and Priceless Confidence

You start with experiments and demonstrations on the unique NRI Discovery Lab. You learn basic circuit wiring and soldering techniques, and then quickly move on to more advanced concepts as you come to understand electronic theory, solid-state devices, digital systems, and microprocessors. You learn by actually building and observing the action of circuitry you'll be working with in real-life situations.

Exclusive NRI Training On Videotape

In addition to profusely illustrated lessons, you get NRI's Action Audio cassette to "talk" you through the use and operation of the professional digital multimeter you receive as part of your equipment. Even more exciting are your NRI Action Videocassettes... videotaped lessons that show you graphic presentations of electronic systems, vivid closeups of servicing techniques and professional "shortcuts" to study and replay as often as you want.

You Get TV, VCR, DMM and More Equipment To Keep

You also build your own 25" Heath/Zenith color TV, a state-of-the-art unit that includes infrared remote control, a Time Control Programmer, and the incredible Advanced Space Phone that lets you telephone from your chair. Using the videocassette recorder that's included as part of your training, you learn how to adjust, service and repair these fast-selling units. Your front-loading VCR features up to 6-hour recording capacity, remote control, and programmable touch-button tuning.

The digital multimeter you receive is a truly professional instrument. You use it in the experiments throughout your course and as a key servicing tool on the job. Using the meter along with the NRI Discovery Lab, you'll learn how to measure voltage, current and resistance and how to diagnose all types of servicing problems.

Advanced Systems Demand Advanced Technicians for Service and Maintenance

The art of TV/Audio/Video servicing has taken quantum leaps into the future. Now, successful technicians must understand advanced concepts like digital control, electronic tuning, laser video discs, microprocessors, and more. NRI gives you the training you need for success... state-of-the-art concepts and practical, hands-on experience working with the kind of equipment you'll encounter on the job.

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Oscilloscope User's Guide

A close-up look at the high-performance general-purpose oscilloscope and how to use it for making tests and measurements

By Vaughn D. Martin

If you recently purchased an oscilloscope (or have had one for some time, for that matter) and want to use it effectively, you will have to become thoroughly familiar with all its controls and how to use them. Failure to do this will short-change you on the sizeable investment you (or your employer) made for this powerful and versatile test instrument.

At the very least, the typical scope is a device that displays visual images of electrical waveforms and, as such, is extremely informative. But the scope is also a very effective measuring instrument as well. For example, depending on how you use it, your scope can serve as a sensitive ac or dc voltmeter or ammeter, a frequency counter, or a phase-difference meter. It can also serve as an indicator of short and open circuits, a component condition tester, or a semiconductor (diode and transistor) junction tester. In fact, the more you learn about your scope, the more you will discover you can do with it.

In this article, we will explore scope controls and functions, suggesting methods to use to make various tests and measurements. Since control layouts and features vary from one manufacturer to another, our procedures will be specific to the Textronix 2200 Series of scopes. This series is representative of modern, relatively low-cost, high-performance scopes. Therefore, the information presented should be readily transferrable to any of a number of different scope brands, whether B&K-Precision, Beckman, Leader, or other makes.

The two models that make up the Tektronix 2200 Series are the 2213 single-timebase delayed and the 2215 dual-timebase delayed scopes. The two differ only slightly, mainly in the triggering section. Note in Fig. 1 how the controls are logically arranged into five groups, each corresponding to a specific function. If you have a scope from a different manufacturer, you should be able to translate the procedures detailed to suit the particular model you have.

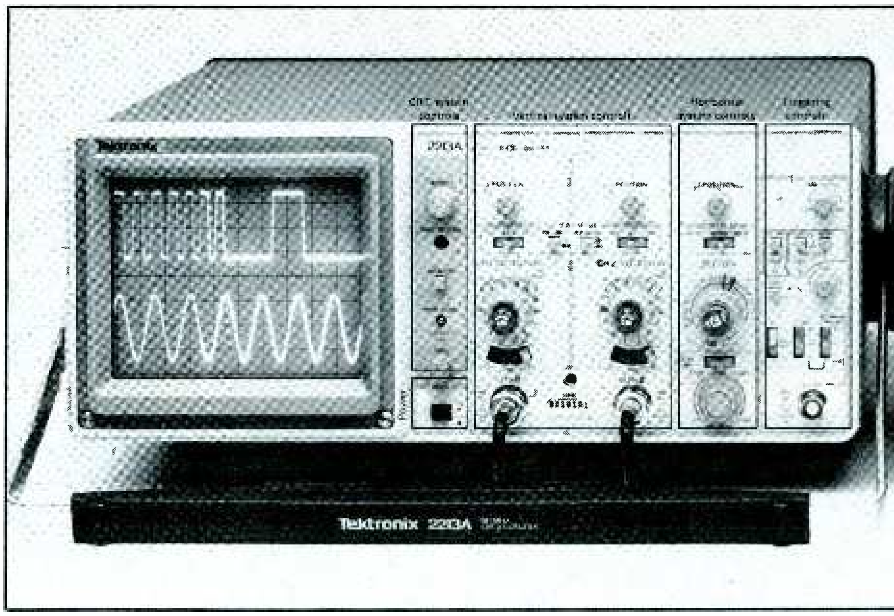


Fig. 1. Controls on front panel of Tektronix 2200 Series oscilloscopes (Model 2213 shown) are logically grouped according to function.

Getting Started

After unpacking your scope—and *before* you begin using it to make tests on your bench—it is important that you familiarize yourself with and check out the operation of all its controls. At the same time, compensate any probes that may have come with the oscilloscope.

Most measurements made with an oscilloscope require use of an attenuator probe (Fig. 2). Such probes usually have a switch on them. In one position, the switch passes the input signal directly to the scope's input. In the other position, the switch diverts the incoming signal to an attenuator network that divides the signal amplitude by 10 before delivery to the scope's input.

Compensation of a probe involves a simple procedure. After plugging the probe's cable into the desired scope input channel, you touch the probe tip to the internal calibrate output on the scope's front panel. Then you turn the tip in both directions while observing the screen. When the trace consists of a series of perfectly symmetrical square waves with no sign of sloping or "ringing," the probe is compensated.

If your scope has more than one channel, each should have a probe specifically compensated for it. With any given input channel, use only the probe compensated for it. (Use some means of identification to keep track of probe/channel combinations.)

Figure 3 illustrates a series of waveforms that might be obtained as you compensate a probe. The two waveforms in the center represent what would be observed with a perfectly compensated probe. The top and bottom waveforms represent an overcompensated and an undercompensated probe, respectively. The photos on the left are the waveforms obtained as a probe was being compensated.

The photos on the right in Fig. 3 represent a 1-MHz square wave obtained with various probe conditions. Before you conclude that all three waveforms are identical, note

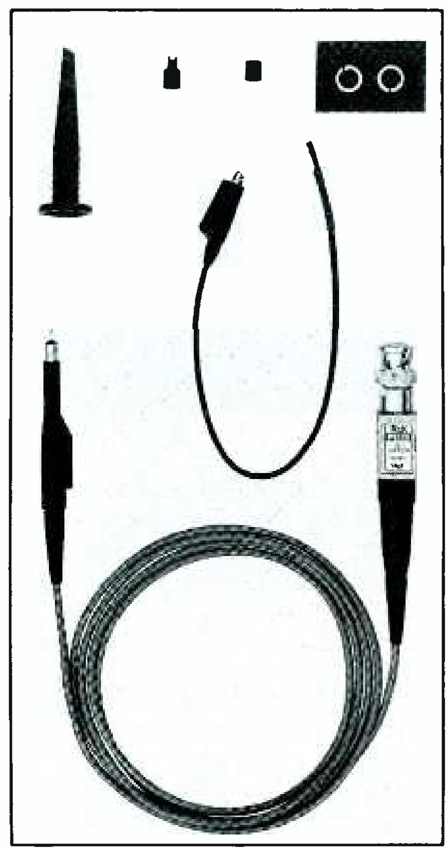


Fig. 2. Most measurements with a scope require use of attenuator probes, like this Tektronix one.

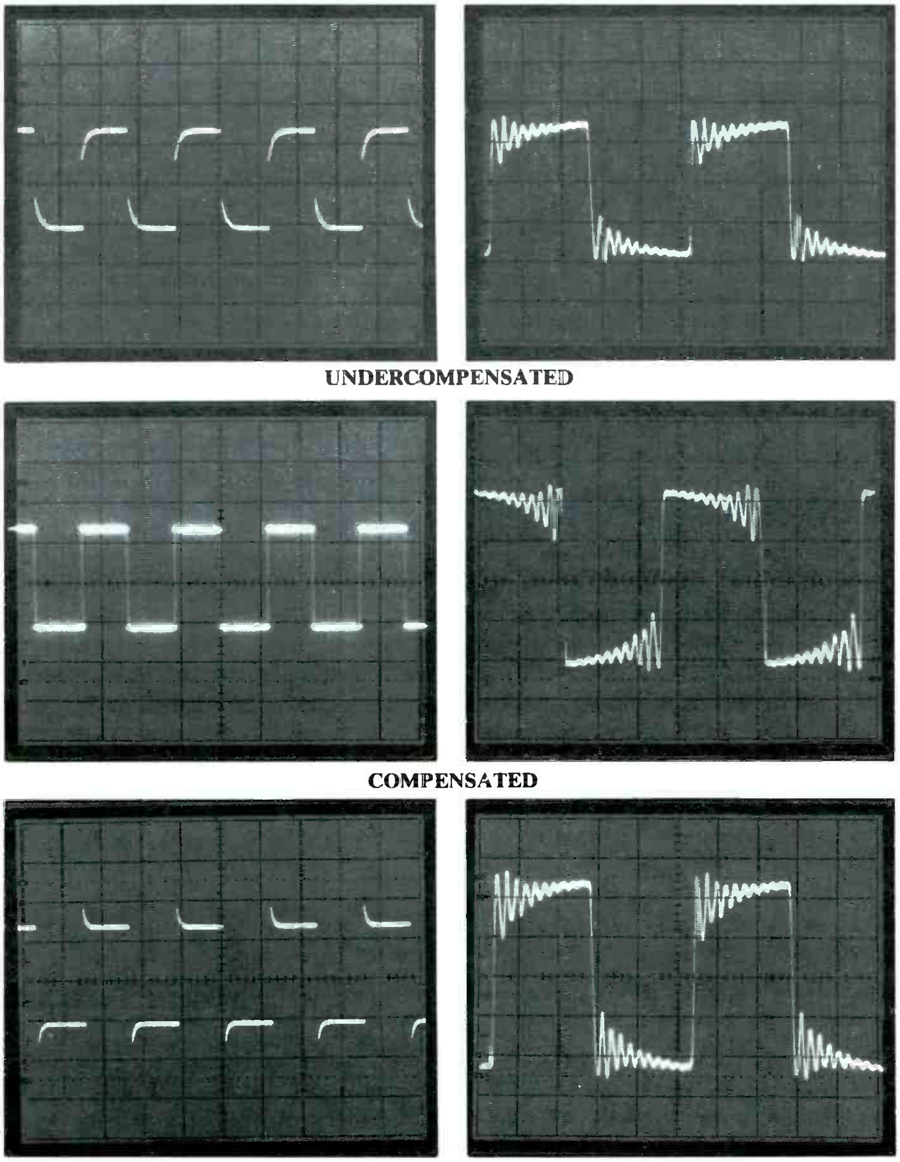


Fig. 3. Improperly compensated probes can distort waveforms displayed on the CRT screen. Shown here are probe-adjustment and 1-MHz square-wave signals as they appear with proper and improper compensation. Note amplitude and ringing on the square wave (right) with different compensation.

carefully how the center trace traverses 4.5 voltage intervals and the 1-MHz square waves with an undercompensated probe has only a 3.5-division peak-to-peak amplitude. With an overcompensated probe, the ringing on the square wave, which represents the probe's ability to settle down and allow the scope to display the actual shape of the square wave, is far greater.

Getting Acquainted

Before you can effectively use your scope, you must become acquainted with its various controls and how to use them to perform a variety of tests and measurements. The following should help you get started.

There are a number of scope calibrators made expressly for checking out the vertical and horizontal controls of a scope. The procedure for using them is as follows:

•Check all vertical controls: Variable controls (CH 1 and CH 2 VOLTS/DIV) should be in their detented calibrated positions. Make sure CH 2 is not inverted, unless you want it to be. Check the vertical mode switches to make sure the signals from the proper channels will be displayed. Check the two vertical VOLTS/DIV switches for correct settings, and do not forget to use the VOLTS/DIV readout that matches the probe setting (×1 or ×10). Check the input coupling switches; use DC for direct coupling or AC for alternate coupling.

•Check the horizontal control settings: Magnification should be off (red CAL knob on the SEC/DIV switch pushed in). Set the SEC/DIV switch to its detented calibrated position. Make sure the horizontal mode switch is set where you want it to be—NO DLY for no delay, INTENS when you want an intensified zone, or DLY'D for delayed sweep (A, ALT or B for the Model 2215).

•Check the trigger system controls to make sure your scope will select the correct slope on the trigger signal. Also, make sure the trigger holdoff control is at its minimum setting.

Amplitude And Time Measurements

These are the two most fundamental measurements made with a scope. All others are derived from them.

Amplitude Measurements. To make these, do the following:

1) Connect the probe to CH 1 input and to the probe adjust jack. Attach the probe's ground strap to the collar of the CH 2 input. Make sure you use the probe compensated for channel 1 and all variable controls are set to their detented positions.

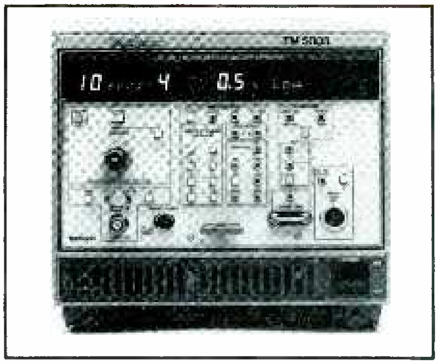
2) Set TRIGGER MODE to NORM for normal triggering and HORIZONTAL MODE to NO DLY (A for the Model 2215). Make sure channel 1 coupling is set to AC, TRIGGER SOURCE is set to INT, INT is set to CH 1, and VERTICAL MODE is on CH 1.

3) Use the TRIGGER LEVEL controls to display a stable trace. Move the VOLTS/DIV switch until the square wave is about five divisions high on the screen's graticule. Now adjust the SEC/DIV switch to obtain a display of two cycles. The settings should be 0.1 V on the VOLTS/DIV switch and 0.2 ms on the SEC/DIV switch.

4) Use the CH 1 VERTICAL POSITION control to move the square wave so that its top is on the second horizontal graticule line from from the top of the screen. Then use the HORIZONTAL POSITION control to move the trace so that the bottom of one cycle intersects the center vertical graticule line.

5) Count the number of major and minor divisions down the center vertical graticule line (assign whole numbers like 1, 2, etc., to major divisions and decimal numbers like .1, .2, etc., to minor divisions) and multiply by the setting of the VOLTS/DIV switch to obtain the value of the measurement. For example, 5.0 divisions times 0.1 volt equals 0.5 volt. (If the voltage of the probe adjust square wave in your scope is different from this example, it is because the signal is not a critical part of your scope and tight tolerances and exact calibration are not required.)

Time Measurements. These measurements are best made against the center horizontal graticule line. Use the instrument settings from above, centering the square wave vertically with the VERTICAL POSITION control. Then use the HORIZONTAL POSITION control to line up one rising edge of the square wave with the second from the left graticule line. Make sure the next rising edge intersects the next horizontal graticule line.



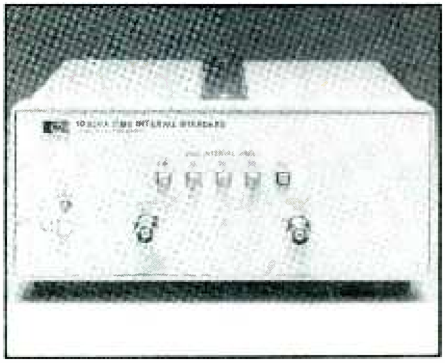


Fig. 4. The CG5001 programmable oscilloscope calibrator from Tektronix offers a wide range of test capabilities (A, left). Hewlett-Packard's 10236A time interval standard (B, right) offers outputs from 5 to 100 ns.

Count the major and minor divisions across the center horizontal graticule line from left to right and multiply by the SEC/DIV switch setting. For example, 5.7 divisions times 0.2 ms equal 1.14 ms. (Again, if the period of the probe adjust square wave in your scope is different from that obtained in this example, the signal is not a critical part of your scope's calibration.)

Derived Measurements

These are the result of calculations made from direct measurements like those previously cited. Frequently, pulse-width, phase and X – Y measurements are examples of derived measurements.

Pulse-Width Measurements. There are time intervals for generating very precise pulse widths (Fig. 4B). To quickly and easily measure the width of the probe adjust square-wave pulse, set your scope to trigger on and display channel 1. (Your probe should still be conntected to the channel 1 input and the probe adjust jack from the previous examples.) Use 0.1 ms/division and the NO DLY horizontal mode (A sweep for the Model 2215). Use AUTO triggering on the positive slope and adjust trigger level to obtain as much of the leading edge as possible on the screen. Switch the coupling on channel 1 to ground and

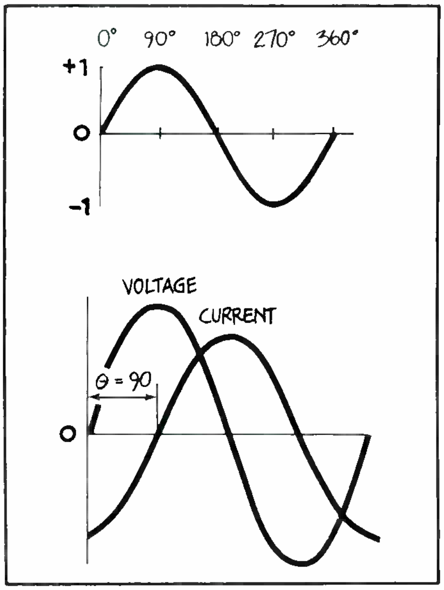


Fig. 5. To determine phase shift between two signals, measure distance between identical points on both, such as at the zero-crossing point.

center the baseline on the center graticule line.

Now use ac coupling to center the signal on the screen as you make pulse measurements at the 50% point of the waveform. Adjust the HORIZONTAL POSITION control to line up the 50% point with the first major vertical graticule line on the left side of the screen. Count the divisions and subdivisions along the center horizontal line. Multiply by the SEC/DIV setting to obtain pulse width.

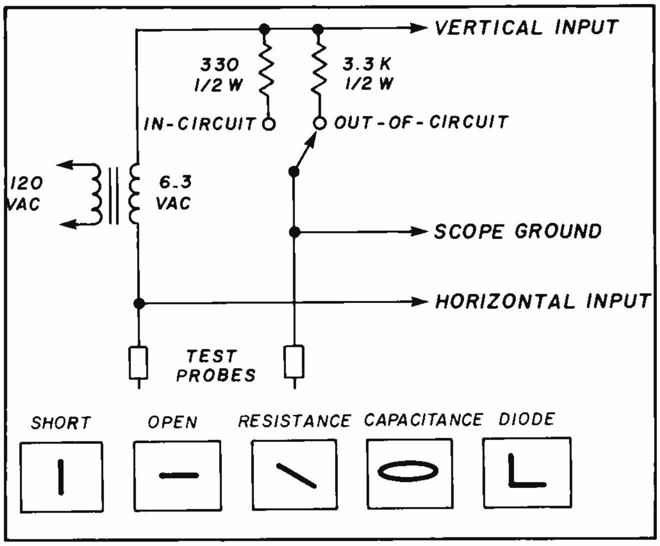


Fig. 6. *Frequency measurements with Lissajous patterns require a sine wave of known frequency on one channel. This allows you to determine the frequency of any other signal applied to the other channel by interpreting the resulting pattern displayed on the scope's CRT screen.*

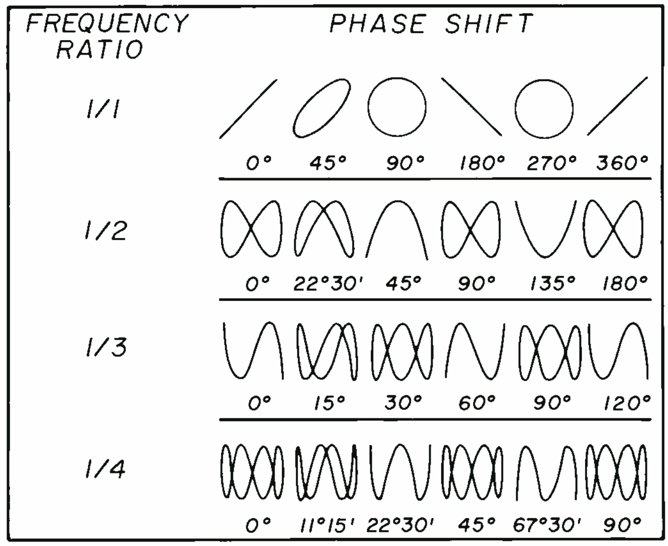


Fig. 7. *X-Y checking requires this transistor test circuit to be connected to a scope set to the X-Y mode. Patterns below schematic indicate the component's out-of-circuit condition. In-circuit patterns will differ because of resistors and capacitors associated with the component.*

Phase Measurements. A waveform has phase, which is the amount of time that elapses since the onset of the cycle to a given point, measured in degrees. There is also a phase relationship that exists between two or more different-frequency waveforms, known as phase shift.

There are two ways to measure phase shift between two waveforms. One is to feed a separate waveform into each input of a dual-channel scope and view the two directly in the chop or alternate mode, with triggering on either channel. If you choose this method, adjust trigger level for a stable display, and measure the period of the waveforms. Then increase sweep speed to display something like the second drawing in Fig. 5. Measure the horizontal distance between the same points on the two waveforms. The phase shift is the difference in time between the two waveforms divided by the period and multiplied by 360 to obtain degrees.

The other method for measuring phase involves use of the scope's X-Y mode. On the front panel of the scope, you will find the vertical channel inputs labeled X and Y and the last position on the SEC/DIV switch labeled XY. When you use the XY position, the scope's time base is bypassed, and the channel 1 input signal becomes the vertical axis and channel 2 signals becomes the horizontal axis of the scope's display. In the X-Y mode, you can input a different sinusoid on each channel to display a Lissajous pattern, whose shape indicates the phase difference between the two signals. Examples of Lissajous patterns are shown in Fig. 6.

Phase measurements using Lissajous patterns are usually limited by the frequency response of the horizontal amplifier, which is typically designed with far less bandwidth than the vertical channels in an ordinary general-purpose scope. Specialized X-Y scopes and monitors, however, have almost identical vertical and horizontal systems and are therefore, more suitable for this measuring application.

X-Y Measurements. In addition to determining the phase shift of two sinusodial signals with a Lissajous pattern, the X-Y capability can also be used for other measurements as well. Lissajous patterns can be used to determine the frequency of an unknown signal when you have a signal of known frequency on the other channel. This frequency measurement can be very accurate, depending on how accurately you know the known signal to be and if both signals are *sine* waves.

Component checking in service and production situations is another X-Y application. It requires only a simple transistor checker, like that shown in Fig. 7.

There are many other applications for X-Y measurements in television servicing, engine analysis, and two-way radio servicing, to mention just a few areas. In fact, any time you have interdependent but not time-dependent physical phenomena, X-Y measurements are the way to go.

Next month, in the conclusion of this article, we'll go even deeper into the use of the oscilloscope for testing and measuring. **ME**

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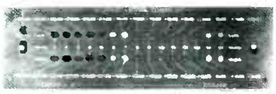
MARK IV — 15 STEP LED POWER LEVEL INDICATOR KIT

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 pre-amp.

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.

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Transformer $4.50 ea.

80W + 80W STEREO AMPLIFIER KIT

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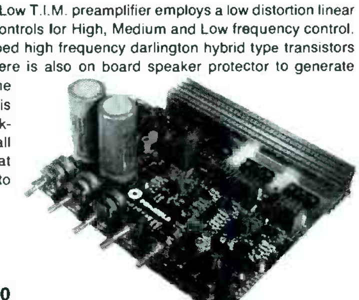
TA-800 is an 80 watts + 80 watts stereo. The Low T.I.M. preamplifier employs a low distortion linear I.C. (LM4558) and three negative type tone controls for High, Medium and Low frequency control. The rear power amplifier uses newly developed high frequency darlington hybrid type transistors (AN7337/AN7338) 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

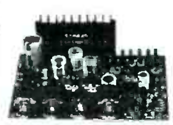
Transformer (52VCT 4A) **$22.50**

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



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Stereo pre-amp + tone control + power amp. All in one unit, fully assembled! Compact in size: 7"x4¾"x2½". Can be fitted into most cabinets. Power transistors using 25C1667 X 4 to give a max output of 60W + 60W (8Ω)

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MODEL: SA-4520

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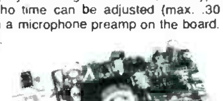

MODEL: MX205
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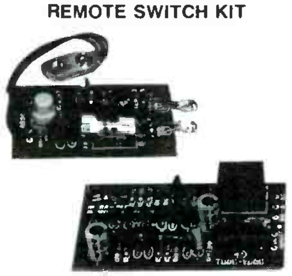
TY-41 INFRA-RED REMOTE SWITCH KIT



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"

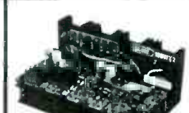
TY-43 DIGITAL PANEL METER KIT $31.50

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**



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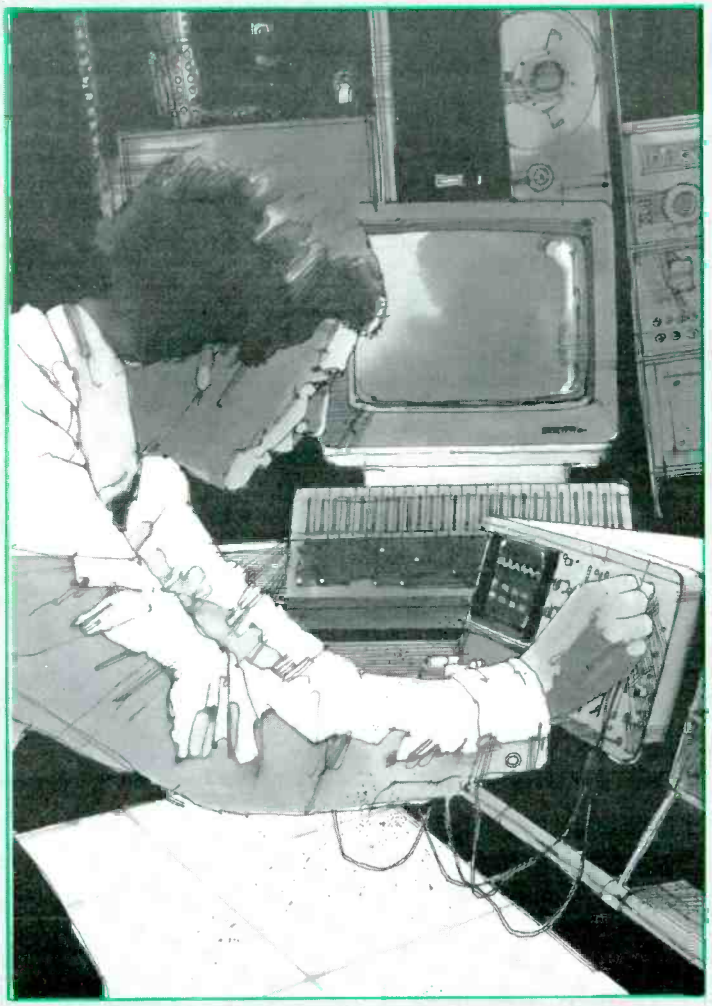

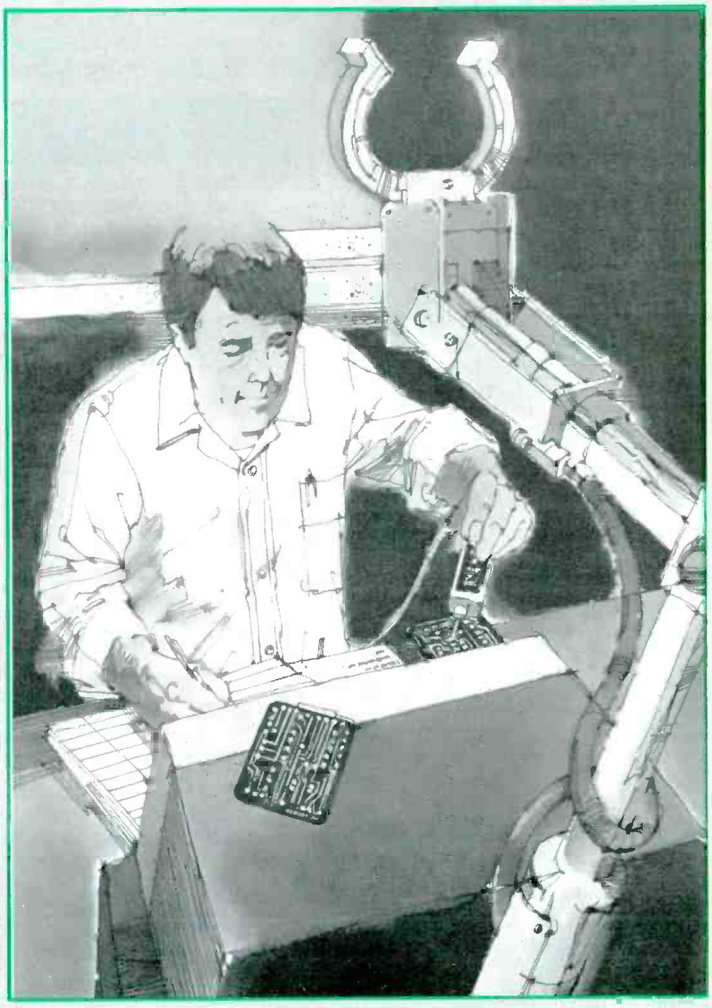

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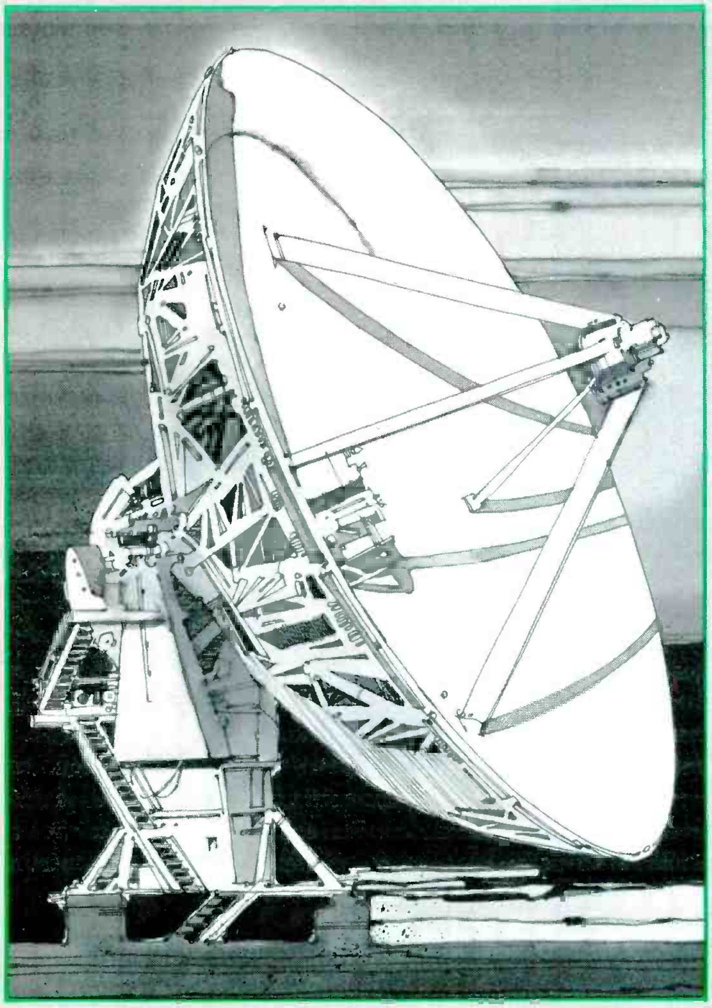

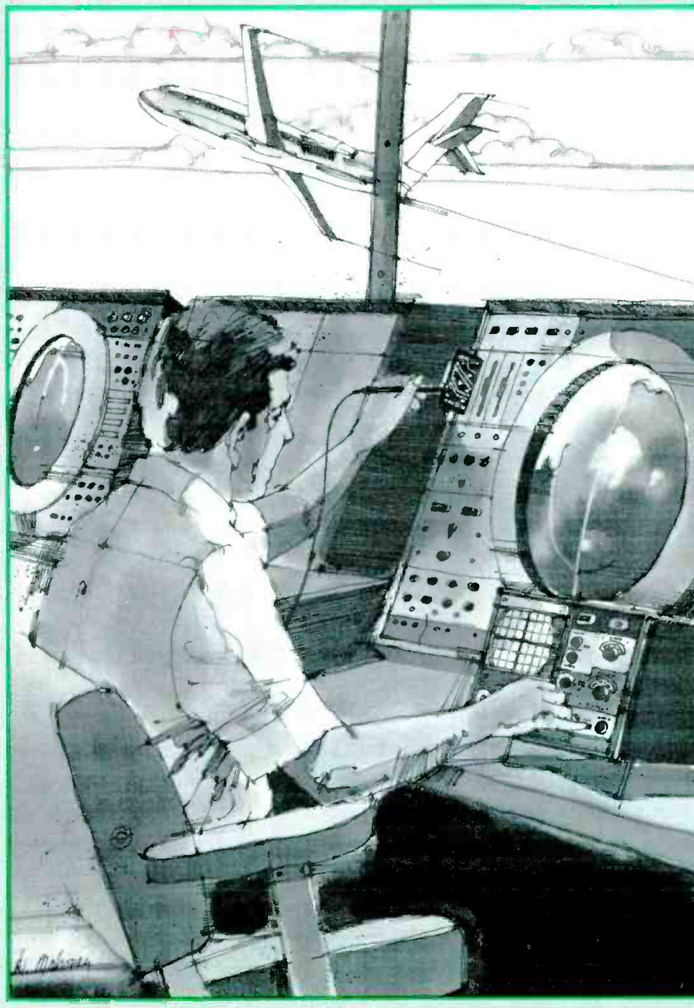

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MO-34

The Sinclair "QL" Computer

Sir Clive's "Quantum Leap" machine is expected to invade U.S. shores

By Fred Blechman

Sinclair was a computer-industry name to be reckoned with in the U.S. during the early 1980s. Its ZX80 model broke the dollar barrier at under $200, followed by an upgraded ZX81 that was marketed here with great success by Timex. New technology and changing public taste caught up with it, though, and after its price dropped to a point where it was virtually a throw-away item, it disappeared from our shores. The company's products, however, did not vanish from the world!

More than 1-million of the company's newer Spectrum computers are said to have been sold in the United Kingdom, Sinclair's headquarters, bolstered by more than 5,000 programs available to be run on it. Sinclair skipped the U.S. on this one, though. Plans are afoot now, however, to enter the personal computer fray with its more advanced "QL" model, a 32/8-bit computer that's not compatible with anything else around. An under-$500 suggested retail price is being advanced for it.

The "QL" will certainly meet a tough marketplace here, facing new Atari, Commodore, and Apple IIc machines, among others, as well as remaining inventory of IBM's PC*jr*, which will no longer be produced as IBM seemingly walks out of the "home" computer market. Nonetheless, the new computer's power, features, United Kingdom sales base, and modest price point could make it a worthy competitor, win or lose.

The unit examined here is the English version since the U.S. model had not yet been finalized, pending compliance with the FCC's RFI (radio interference) requirements.

Description

Sinclair's QL computer is packaged in a sturdy, black unit that's not much larger than a standard full-size keyboard. It measures 18¾"W × 5⅜"D × 1¾"H and weighs about 3 lbs. A provided external power supply that plugs into an ac wall socket supplies the computer with 9 Vdc at 1.8 A and 15.6 Vac at 0.2A.

A video display doesn't come with the system, but internal circuitry makes it capable of driving your choice of a black-and-white or color TV set or a high-resolution RGB or monochrome monitor.

Incorporated into the QL are two "Microdrives," which are tiny tape plug-in cartridges that hold 100K bytes each. There is 128K of internal RAM, with 32K dedicated for screen bit map, leaving 96K to work with. Another 512K can be added externally. In addition, a 32K ROM contains Sinclair's "SuperBASIC" and its "QDOS" operating system, expandable via a ROM cartridge that plugs into a slot at the rear of the machine.

Additionally, there are two standard RS-232C serial ports for printer and modem, two joystick ports, and two local area network ports (LANs) that can link up to 64 QL computers. Included, too, with the QL are four Microdrive cassette programs (word processing, spreadsheet, database management, and graphics), four blank cassettes, and connecting cables and adapters for TV, monitor, and LAN use. A small (about 1" diameter) speaker is built in for use with the QL's SuperBASIC BEEP commands.

The QL uses a Motorola 68008 microprocessor operating at 7.5 MHz. This isn't a full 32-bit CPU, however, since it has only an 8-bit data bus to complement its 32-bit address bus. A second processor, Intel's 8049, controls the keyboard, sound, and other functions, while two custom chips handle its Microdrives and LANs, as well as providing other control.

A Closer Look

Video Display. If you use the QL's TV output to drive a video display, you'll only get a clean picture in its low-resolution mode: about 40 characters or 256 pixels on a line. This mode offers 8 colors, distinguishable as different shades of brightness in monochrome.

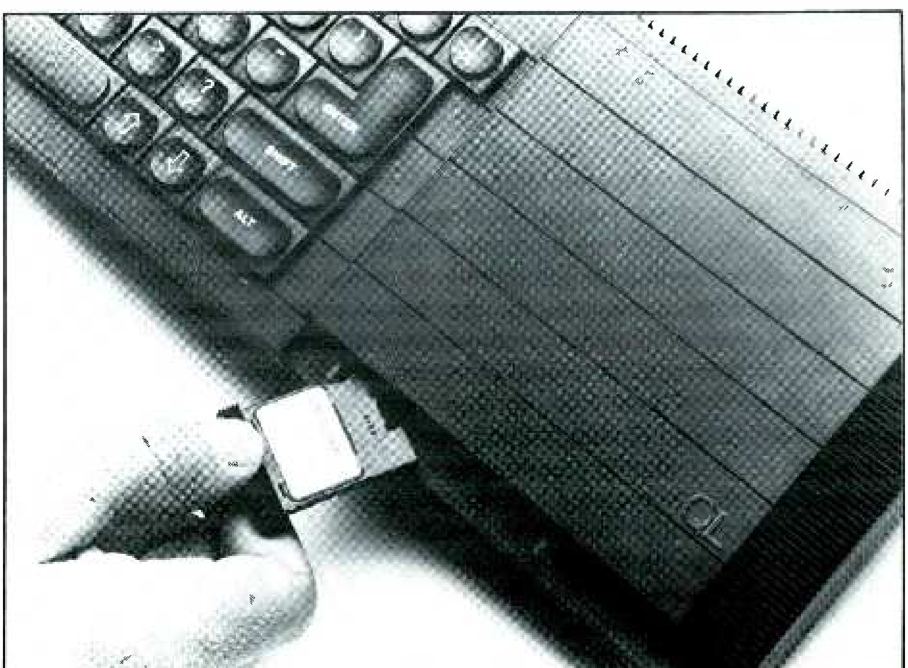
You'll need a high-resolution monochrome or RGB monitor to be able to resolve the full 85-character, 512-pixel lines produced by the QL when using its SuperBASIC. For color, a good RGB TTL monitor should be used. The English QL used for this report produced a non-conventional combination of sync and polarity (positive vertical sync, negative horizontal sync), so I had to use a special sync-inverting cable. Perhaps the U.S. version will make using a special cable unnecessary.

In low-resolution mode, with 256 × 256 pixels, the machine offers 8 colors, each distinguishable as different shades of brightness when used with a monochrome display. The 512 × 256 pixel high-resolution mode provides only 4 colors or shades.

A color-mixing technique using "stipples" (a mixture of two colors in one of four predefined patterns), together with the low-resolution mode's eight solid colors, allows up to 255 different colors and color patterns anywhere on the screen when using "windows."

Actually, a 42½-character line is available for TV use, though with some programs you may use 40, 60, 64 or 80 characters. Maximum with hi-res is up to 85 characters by 25 lines. Four or five lines are normally reserved at the screen's bottom for en-

The QL comes with two Microdrives that accept tiny 1¾" × 1¼" × ¼" tape cartridges, each with a storage capacity of 100K bytes in up to 50 files.



tering, listing and editing programs or for program-status monitoring.

The Keyboard: The QL's keyboard is delightfully simple and straightforward, especially compared to the confusing keyword-oriented keyboard of previous Sinclair computers. Although the keys have a low height above the keyboard surface, they depress well below the surface.

With the shortcuts being taken on keyboard input these days ("Chiclet" keys and membrane keyboards) it's nice to see that Sinclair designed a good-quality QWERTY keyboard for the QL, though it's still not a match to the better keyboards around. The 65 full-travel keys include four cursor-control keys, five function keys, TABULATE, ALTernate, and the usual complement of other keys. There is no screen-dump key, but you can direct the output, uisng a "channel" to a printer instead of the screen.

Most keys auto-repeat when held down more than one-half second, and they have a good "feel," although the keys clatter a bit when pressed. The keys are not tiered, which seasoned typists will prefer, as compared to the QL's flat-plane design, but they are concave shaped, white markings are large and clean on the black background, and control keys are nice and big.

Table I– Key SuperBASIC Words

ABS	DEF FN,	LIST	PRINT
ADATE	END DEF	LOAD	RAD
ARC	DEF PROC,	LOC	RANDOMISE
ARC_R	END DEF	LN	RND
AT	DELETE	LOG10	RECOL
ATAN,ACOS	DIM	LRUN	REM
ACOT,ASIN	DIMN	MRUN	RENUM
AUTO	DIV	MERGE	REP, END REP
BAUD	DIR	MOD	RESPR
BEEP	DLINE	MODE	RET
BEEPING	EDIT	MOVE	RETRY
BLOCK	ELLIPSE	NET	RUN
BORDER	EOF	NEW	SAVE
CALL	EXEC	NEXT	SBYTES
CHR$	EXEC_W	ON...GOTO	SDATE
CIRCLE	EXIT	ON...GOSUB	SDATE$
CIRCLE_R	EXP	OPEN	SIN
CLEAR	FILL	OPEN_IN	SCALE
CLOSE	FILL$	OPEN_NEW	SCROLL
CLS	FLASH	OVER	SEL, END SEL
CODE	FOR, END FOR	PAN	SEXEC
CONTINUE	FORMAT	PAPER	SIN
COPY	GOSUB	PAUSE	SQRT
COPY_N	GOTO	PEEK	STOP
COS	IF, THE, ELSE,	PEEK_W	STRIP
COT	END IF	PEEK_L	TAN
CSIZE	INK	PENUP	TO
CURSOR	INKEY$	PENDOWN	TURN
DATA,READ,	INPUT	PI	TURN TO
RESTORE	INSTR	POINT	UNDER
DATE$	INT	POINT_R	VER
DATE	LET	POKE	WIDTH
DAY$	LINE	POKE_W	WINDOW
DEG	LINE_R	POKE_L	

Included with the QL are three plastic legs that can be inserted into appropriate holes on the keyboard's underside to tilt the keyboard toward you. Actually, only two are needed for this purpose.

Tape Drives. Great Britain is cassette-tape oriented, just now turning to disk drives as prices for them drop. Microdrives were developed as a better alternative to cassettes, introduced as external devices for Sinclair's Spectrum computer. They're now built into the QL in its latest incarnation.

The Microdrives are actually miniature high-speed tape recorder/player machines that use a tape cartridge measuring only 1¼"×1¾"×¼". Now that's tiny! The cartridge contains a 20-ft. length of continuous-loop Mylar tape that's only slightly wider than 1/16". The tape streams past the record head in seven seconds—a speed of more than 34" per second!

Unlike typical cassette recorders, the drives' electronics are designed to handle digital signals. As a result, each cartridge holds up to 50 files with a total of 100K bytes. Typical access time for a designated program is claimed to be 3½ seconds, with loading of data into memory as high as 15K bytes per second. On the surface this is ten times as fast as the late, lamented ADAM computer can accomplish, but programs with overlays require the QL to make multiple tape passes, which slows up performance considerably.

Back Openings. There are ten "ports" on the back of the QL. Among these are two RS-232C serial ports, one for a serial printer and another for connection to a modem for data communications. DB-9 female sockets are supposed to be used on the U.S. model rather than the strange ones my unit had.

Another pair of ports are designed for use with joysticks or other peripheral controllers. These two will have DB-9 sockets in its U.S. version. The remainder of the ports rounding out its full complement are a pair of networking, an 8-pin DIN monitor jack to provide monochrome, composite color or RGB signals, a non-standard 3-pin socket for the QL power supply, an RCA-type socket to provide a modulated TV signal, and a 30-position socket with a pull-out cover that's used for a plug-in 16K ROM software cartridge. The latter is used to replace or expand the QL's SuperBASIC language, and can contain assemblers, compilers, deguggers, applications software, games, special utilities, etc.

The two Microdrives take up about six inches on the right-front side of the keyboard, each having a red LED at the slot's left to indicate when the drives are operating.

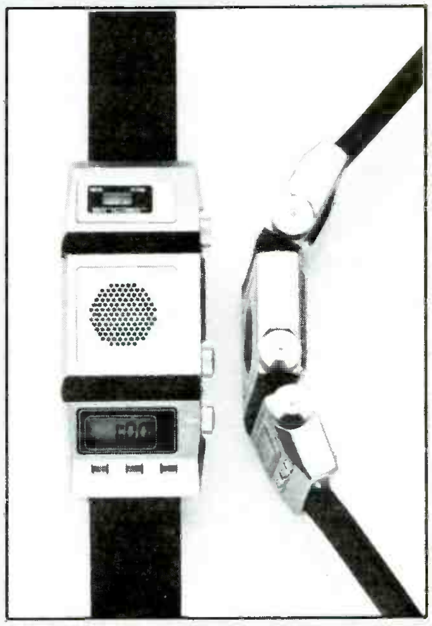
DOS and BASIC

QDOS: The operating system used by the QL is Sinclair's QDOS, probably short for "QL drive operating system." This is a complex operating system, with sophisticated capabilities such as multi-tasking, priority job scheduling, multiple screen windowing and device-independent input-output. For example, you can specify "channels" to link input and output between multiple screens, printer, modem, keyboard, network or either Microdrive.

For the average user, QDOS is "transparent," and you can do just about anything you would normally want to do using QL SuperBASIC commands. Unless otherwise directed, the QL "comes-up" in SuperBASIC.

Furthermore, the software bundled with the QL insulates you even further from the operating system, as it is not necessary for you to learn any QDOS commands. QDOS generally stays in the background, handling display, keyboard, porting and drive functions. This makes the QL easier to use than most of the more conventional—and unfriendlier—operating

Sir Clive



Clive Sinclair, who established and heads Sinclair Research, thinks small. The 45-year-old businessman, who left school at 17 and spent some years as a technical journalist, founded Sinclair Radionics in 1962 to produce mailorder radio and amplifier kits. From this base, he introduced the world's first truly pocket-size calculator in 1972.

Investing heavily in research and development work for other miniaturized products bore fruit in 1975 when he launched his "Black Watch" digital wrist watch kit and a low-cost, small digital multimeter. This was followed by Sinclair's 2"-diagonal "Microvision" pocket TV set, another "first," in January 1977.

By this time he had acquired a reputation as a pioneer in the field of consumer electronics, particularly in miniaturization. No longer having control of the company, he resigned in 1979 and established his present company, Sinclair Research. Less than a year later he astounded the computer world with a small computer, the renowned ZX80, that sold for less than $200, a remarkably low price in those days. A year later came the ZX81 for $150, which became the TMS1000 when Timex took over U.S. distribution.

In early 1983 Clive Sinclair was named both "The Guardian Young Businessman of the Year" and "Computing's Person of the Decade" in Great Britain. This culminated in the bestowal in June 1983 of the major honor of knighthood in the "Queen's Birthday Honours List." Hence, he is now known as Sir Clive Sinclair.

The benighted man's computer wizardy and business acumen resulted in sales nearing 3-million small computers. His efforts to produce Lilliputian electronic equipment did not stop there, though. Sinclair developed and is marketing a flat-screen TV set that measures only 5½"×3½"×1¼", not too much bigger than a pack of cigarettes. Another "first" is his company's recently introduced FM-radio wristwatch that incorporates a miniature loudspeaker and the radio's antenna (built into the wristband), as well as a full-function timepiece.

The absence of academic credits notwithstanding, Sir Clive was the chairman of the British Mensa Society, a high-verified-IQ group that has affiliations worldwide. His interests extend beyond electronics and computers, as you might suspect, to the theatre, poetry, music (he's trustee of the Cambridge Symphony Orchestra), mathematics, and running. Welcome back, Sir Clive.

"*Execution of SuperBASIC's text and graphic commands is fastest I've used.*"

systems, such as CP/M, MS-DOS, ProDOS, and others.

SuperBASIC. Sinclair's SuperBASIC is extremely powerful, with features just not available in other BASICs I've used. For example, SuperBASIC allows procedure structuring, and interpretation speed is independent of program size.

Table I shows the keywords available. Many of them will be very familiar to you if you've done much BASIC programming. However, many keywords are unique to SuperBASIC, and this could lead to difficulty in translating programs from the more common (in this country) Microsoft or Applesoft BASIC.

Sinclair SuperBASIC is a major upgrade of the BASIC used on the Sinclair Spectrum (and Timex Sinclair 2068). However, most of these programs cannot be expected to run on the QL, and Spectrum Microdrive cartridges, though physically compatible, will not load into the QL operating system.

Graphics drawing functions are well supported with LINE, CIRCLE, ARC, POINT, FILL, and SCALE commands. Text can be freely mixed with graphics, although the coordinate systems for text are different from those used for graphics. Somehow the QL sorts them out. Also, text can be displayed in eight different sizes and proportions with a CSIZE command. The execution of the text and graphic commands is the fastest of any of the more than a dozen microcomputers I've used, so long as scrolling is not involved.

Software

Since the QL is incompatible with any other computer, Sinclair was wise to include very powerful software programs with the QL. These programs have their own special names in England, but a trademark conflict in the United States requires that the programs be called here by their generic functions: QL Word Processing, QL Database, QL Spreadsheet, and QL Graphics.

These programs come on four cartridges, and are designed to integrate with each other; that is, information from one can be passed to another. Many of the commands and functions within each program operate in a similar manner, so you don't really have to learn four completely different programs. For example, three of the five QL function keys are used similarly in each program: F1 calls a HELP screen wherever you are in the program, F2 removes the on-screen prompt-block so you have more usable screen space, and F3 puts COMMANDS on the screen, which you can then call with one or more keystrokes.

QL Word Processor. This is a what-you-see-is-what-will-print word processor. Even bold-face, superscript, subscript and underlines are clearly shown on the screen. Bold-face is white, regular lettering is green, and the cursor is red. On a monochrome monitor you see these as different brightness levels. Superscripted characters are actually shown above the normal line, and subscripted characters are displayed below. Underlined characters are shown just that way. And changing the typeface at any point in the document is just a matter of a couple of key strokes.

You can justify left, right or both, and set the margins and tabs wherever you prefer. An 80, 64 or 40-character rule is at the top of the text area (although with a 40-character rule you'll have to scroll sideways to see all the text of a normal-width document.) There is automatic word-wrap and paragraph indenting. Text can be deleted by the character, word, line or block. You can scroll text up or down by the line, or paragraph, or go directly to any page or the beginning or end of the document. You can search and replace words or phrases. Headers and footers, page numbering, and file merging are all supported.

This is, indeed, a sophisticated word processor, and very easy to learn to use. However, screen scrolling is slow, and you can tear your hair out waiting for long documents to LOAD or SAVE on the Microdrives. For example, it took 2 minutes to LOAD a 4925 word file. I then added 75 more words to get up to an even 5000 words, and it took an incredible 4 minutes and 55 seconds to SAVE it!

You'll need a printer with a serial interface to print your document, or a serial-to-parallel converter to use with a Centronics-type parallel printer interface. An installation program allows you to easily insert any ASCII characters into the printer driver routine, so you can accommodate virtually any special printer instructions.

If this is your first exposure to word processing, or you've had some experience with the many low-end word processors that lack features, you'll probably love this one. It is certainly practical for a non-demanding user, it is easy to learn, and it does not cost hundreds of dollars extra, like most do.

QL Database. Database management programs by their nature are very complex, and take considerable study to use effectively. QL Database is no exception. While it provides enormous power and versatility, it also takes a lot of time to learn to use. Despite the excellent on-screen command prompts and the Help screen available throughout, you can get some idea of the complexity of this program by just looking at the proliferation of commands and functions in the User Manual. The 54-page section of the manual that descries QL Database lists 65 command words, 28 function words (each with specific syntax), and 40 different error codes!

Using this program is very much like learning a new programming language. While this "language" bears a great resemblance to SuperBASIC in many ways, it is different in other ways, so you have to be careful. In fact, this program is a good example of how powerful the QL can be. Each record in a file can have up to 256 variable-length fields. You can define relationships, extract and reorganize data, and even do calculations. You can design your own screen and printer reports, and a full text-editor is included. You can even exchange information with QL Word Processor, Spreadsheet and Graphics.

Extensive examples are shown in the manual for a Mailing List Program and a Stock Control Program, detailing each procedure from creating the file to entering and changing data and creating reports.

If you've had the idea that the Sinclair QL is another ho-hum low-end microcomputer with limited capabilities, QL Database should change your opinion. However, of the four programs included with the QL, this is by far the most difficult to learn, and you'll need considerable time, energy and motivation (or need) to master it.

QL Spreadsheet. This is an "intelligent" worksheet that can be used for budgeting, planning, calculation, tabulating data, information storage or just for presenting information. It uses a grid of 64 columns, each with 255 rows, for a total of 16,320 "cells." Each cell can contain text or numbers, and formulas can be used to process numbers in whole rows, columns or blocks of cells without resorting to a complex command structure. Text can be used to refer to the columns and rows instead of just letter/number designations.

Options are clearly shown for the various commands, and suggested values are given. You can ask for HELP at any stage. The detailed documentation is relatively easy to follow for such a sophisticated program.

I found QL Spreadsheet easy to use, and very fast in response. Changing a key value results in changes to all the other figures effected, almost instantly. For example, after changing an initial value that affected all the numbers in 64 columns and 5 rows (with two decimal places in each cell), it took slightly over three seconds for all 320 cells of the spreadsheet to be updated!

One of the optional displays in the QL Graphics package is a pie chart, which is automatically labeled with the values for each section.

QL Spreadsheet is very powerful, yet easy to use. Here, only the value in cell "B" was input; all other values were then calculated from formulas.

This program has many built-in functions for operating on text as well as numbers. Commands are included for joining grids, using multiple windows, varying column widths, justifying text, and displaying different units (monetary, decimal, integer, exponential, percentage).

Detailed examples are shown for cash-flow modeling, multiplication tables, check book reconciliation, standard deviation, household budget, auto-scaling bar chart, mortgage calculator, and Fourier analysis. The data from this program can be "exported" (moved) into the QL Graphics or QL Word Processor programs.

Many powerful spreadsheet programs cost as much as the whole Sinclair QL. If you have a business or investment need for a spreadsheet program, QL Spreadsheet alone can be worth the price of the QL.

QL Graphics. As impressed as I was with the other QL programs, QL Graphics left me in absolute awe! Its performance and versatility is mind-boggling. The options are so extensive in the types, colors and mixtures of graphic capabilities that it will take you hours to investigate them all. Yet, the operation is so "friendly" you can draw simple graphs minutes after LOADing QL Graphics.

The Microdrive operates very efficiently with this program, taking only about 20 seconds to LOAD the program, and only about 15 seconds to SAVE or LOAD a graph you've created.

You can create bars (horizontal or vertical), lines between points, lines with fill under them, pie charts, mixed lines and bars, stacked bars, side-by-side bars, or overlapping bars. With each of these are a variety of colors and styles. With a few keystrokes your data can be replotted in an altogether different format. It's fascinating to watch a complex bar chart replotted as a line chart or pie chart in just a few seconds.

A printer driver is included for an Epson FX80. Hopefully, other printers will be accommodated in the American version. The excellent documentation, which goes through all the variations of each of the many commands, even includes detailed instructions for photographing the screen in color, since most printers only produce the screen in monochrome. Incidentally, while this program will display on a monochrome monitor, the impact in color is much greater. *(Continued on page 86)*

Evaluating a Home Satellite TV Receiver

Attributes of Regency's economically priced Model SR5000 are explored

By Stan Prentiss

This year a few home satellite TV systems are priced much lower than heretofore. Regency Electronic's Model SR5000 satellite TV receiver is in this category at a suggested retail price of $699.95, which includes a block downconverter that gives it multi-set capability with the addition of dividers and perhaps extra signal amplifiers for sharing a system with neighbors.

with the Model SR5000, you can receive any of more than 100 satellite channels by adding an antenna (perhaps with automated Satscan), a good 90° low-noise amplifier (LNA), and a color TV receiver. Additional TV receivers can be tuned to independent channels with sufficient signal drive.

Though it's economically priced, the U.S.-made Model SR5000 isn't lacking in features. It's endowed with dual-microprocessor control, and features built-in dish-drive positioning, automatic memory polarity, and remote control. Add to these skew correction, channel programming, audio muting, nonvolatile channel memory, and a SAW (surface active-wave) resonator with channel 2/3 modulators. Further, the Model SR5000 offers composite output for stereo sound processing, descrambler loop-through, audio and video baseband outputs, and video processing.

On the front panel are a large red LED numeric channel display; pushbuttons for video, audio, and memory adjust; manual polarity invert/adjust; and east/west dish drive control. The receiver accepts Polarotor 1 with skew correction. It also has an audio range between 5 and 8 MHz that is tunable at a bandwidth of 350 kHz. Bandwidth is specified at 24 MHz, threshold at less than 8 dB C/N, (carrier-to-noise) and input between −5 and −50 dBm.

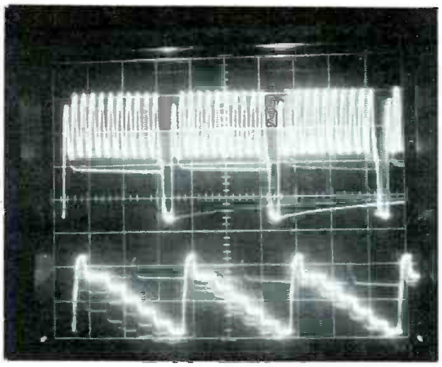
The receiver is housed inside a compact 11″W × 8″D × 3″H walnut and black plastic cabinet. Its companion infrared remote controller measures 6¼″ × 2¾″ × ⅞″.

Theory Of Operation

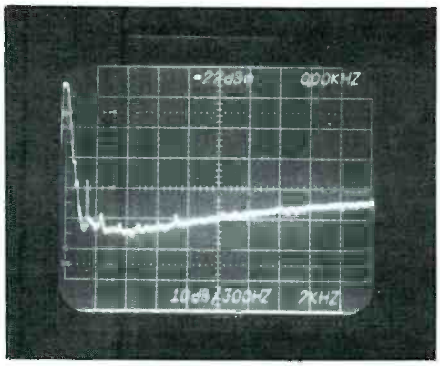
This receiver has 22 integrated circuits and 22 transistors, plus assorted resistors, capacitors and other components—all on four printed-circuit boards (see block diagram).

All FM signals are recovered from a block downconverter (located at the antenna dish) and an i-f between 430 and 930 MHz. A voltage-controlled oscillator (vco) in the tuner mixes this signal with another oscillator signal whose frequency is between 494 and 954 MHz to obtain the standard 44-MHz TV receiver i-f. The resulting 44-MHz signal is then bandpass filtered, amplified, limited and detected to produce composite audio and video carriers within some 8 MHz. These carriers are next routed through buffer *Q401* for delivery to the COMP (composite) phone jack located on the rear panel.

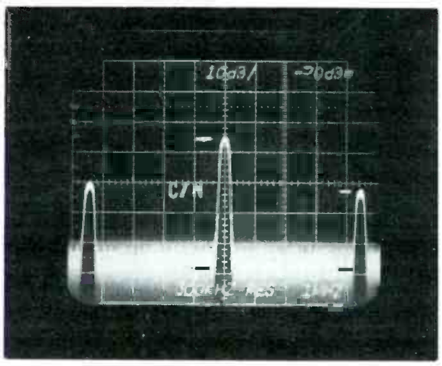
The same information out of the *U301* i-f processor is also routed to afc (automatic frequency control) operational amplifier *U201* and mixer control *U202,* which also receives signals from digital-to-analog converter (DAC) *U703/U704/U705.* Controlled by microprocessor MP1 (*U701*), which is clocked at 4 MHz,



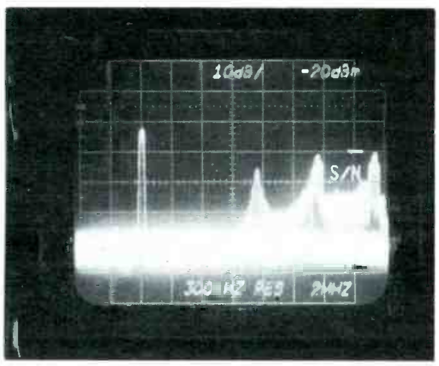
FM modulation response restricts bandwidth, but color bars and staircase steps get through.



As expected, the audio response of Regency's SR5000 satellite TV receiver far exceeds 20 kHz (± 4 dB).

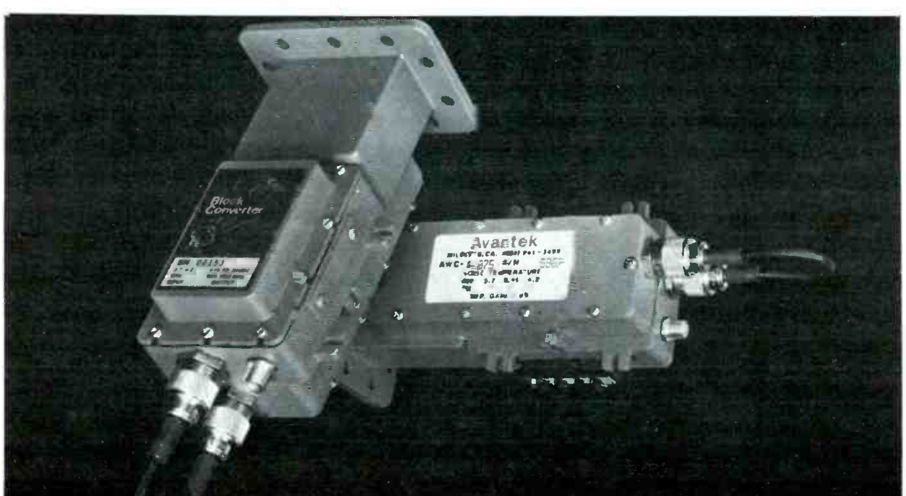


Video and audio carrier-to-noise ratio (C/N) are both good, measuring 28 dB and 11 dB, respectively.



Composite signal modulation and video carrier. Video S/N is considerably better than the 38 dB here.

Avantek's new block downconverter and 3.7-to-4.4-GHz low-noise amplifier companion for C-band satellite downlink reception. Match combination provides 68 dB of gain for any 950-MHz to 1450-GHz receiver.



the *U202* circuit supplies r-f tuning voltages to the tuner, along with digital control from the DAC. Simultaneously, MP1 also controls audio voltages through *U201* and volume gain for the *U101* r-f modulator, r-f switch and baseband audio output. There is an agc voltage to both the tuner and MP1, the latter for signal-strength sampling. Additionally, MP1 controls Polarotor and dish drive interfaces via *U707* (not shown in diagram).

Note also that composite output in the diagram's upper right has a loop-through to accommodate an outboard descrambler (decoder) before continuing on to video clamper *Q305* and baseband video output (BBV). Baseband audio (BBA) also goes to the r-f modulator and r-f switch, joining video for AM/FM remodulation and antenna/TV switching.

Microprocessor MP2 (*U803*) receives signals from the remote-control transmitter through IR (infrared) decoder *U801*. It also controls the LED channel display via *U802* and *U805*, services 64 × 16 electrically addressable read-only memory (EAROM) *U804* for tuning, and the on/off r-f switch. MP2 is crystal-oscillator clocked at 4 MHz.

One board in the receiver is transformer isolated and reserved for the power supply. It has a switched 117-volt ac design and delivers a fused ¼-ampere, +17-volt dc source for the block downconverter and LNA. It also provides regulated +5-, +12- and +24-volt lines for powering the receiver's circuitry.

The receiver delivers a 500-Hz variable-width pulse train for controlling Polarotor polarization, and a 10-Hz pulse output is available for optional dish drive.

Test Results

We examined the Model SR5000 with both the BD-1 and BD-2 block converters to determine maximum and minimum operating results. The

GUIDELINES TO HOME TV SATELLITE SYSTEMS

Satellite TV reception in the home is a budding giant, say industry pundits. Its sales are burgeoning right now in many areas of the U.S. where more traditional TV transmissions by broadcast stations and cable are either not readily available or are too limited.

Typical prices of home satellite TV systems range from that of a good TV receiver/monitor to that of a fine projection TV set, so they are no longer in the relatively outrageous cost class. In the right location with the right equipment, TVRO (TV receive-only) equipment provides access to more than 100 receivable channels.

A satellite's transponder signals are picked up by a large microwave energy reflector/collector, the familiar satellite dish antenna. The dish captures the weak signals and focuses them to a small cone protruding out rather far from the center of the dish. Here's where the feed to a required low-noise amplifier (LNA) at the the antenna location comes from.

The LNA is a key device in any TVRO system, since electrical noise will also be amplified. Its gain in decibels is typically 50 dB, so you won't learn much from this spec about an LNA's worthiness. Its quality can be ball-parked, however, by its noise rating, which is made in Kelvins. The °K rating should be accompanied by the frequency used in gigahertz, of course. The lower the figure, the less the noise.

At this same outdoor location you'll need a downconverter, which is positioned as close as possible to the LNA (and sometimes both are combined). The LNA's output goes to the converter's input. The latter is a voltage-tuned oscillator that makes selection of specific channels possible from the front panel of the satellite receiver in the home. This device also produces the intermediate frequency (i-f) that's sent to the receiver's input through coaxial cable. The plain old downconverter delivers a 70 MHz i-f signal, while the more costly double downconverter or block converter sends the whole 500-MHz downlink band to the receiver, enabling multiple TV receivers to select satellite channels independently. (With the 70-MHz i-f system, all TV receivers can only use the same channel.)

At this point, you have three key elements to consider in setting up a satellite TV receiving system, aside from checking out local ordinances. Each one can strongly affect reception quality. And, naturally, each will influence your cost. If you buy a real big antenna dish to capture a better signal, you'll pay lots more and probably will require a professional to install it. The LNA and downconverter choices will have a major effect on reception quality, too. As an interesting aside, we discovered that Avantek's new block downconverter also provides amplification—another 18 dB, borne out by Stan Prentiss in tests. So a total of 68 dB gain for any i-f 950-to-1450-GHz satellite receiver can be garnered rather than the assumed 50 dB.

Since satellite signals are sent polarized (horizontally and vertically), the home receiver should automatically select the proper polarity for the channel selected. Receivers normally have switch-control for this purpose, too. This is accomplished electronically. It can be done mechanically, too, or by selecting between two differently positioned feeds on the antenna, but the first method cited is best.

Running wiring from the downconverter's output and supply/control sources is the next step in setting up a home TV satellite system. Here, coaxial cable to carry the TV signal and wiring to carry low-voltage dc are routed into PVC lengths, usually ¾" OD and 10-ft. lengths, are buried in the earth. (Combined cables are available with protective outer coverings if you don't want to use PVC pipe, which eliminates water-sealant needs where pipe ends are joined.) Obviously, the wire run should be as short as possible to minimize signal loss and noise pickup. But aesthetics usually demand a fairly long run since most people don't want to have a large antenna right next to the house.

Once the wiring is in the house, simply make the proper connections to the TV satellite receiver you bought. The accompanying article here will give you some insights into gauging your needs. You should keep in mind, though, that you won't be able (or should not because it's illegal) to descramble commercial satellite transmissions that are scrambled. However, you can rent a "box" to do this from the broadcaster or cable company. If you plan to do this, be sure that the receiver you buy enables this to be done externally, with a loop-feed through provision on the back of the receiver.

—Art Salsberg

principal difference between the two LNBs, according to a Regency spokesman, is that one has a ceramic, while the other has a cavity-oscillator resonator. Regency manufactures the BD-2, while Avantek supplies the BD-1. Our tests revealed that both perform well, with no more than 2 to 3 dB difference in gain.

All SR500 channel selections, r-f modulation, sound and video controls operated properly.

On the laboratory testbench, the system provided the following performance results. With modulation, usable receiver range was 485 to 929 MHz. Channels 1 and 24 selectivity measured −52 and −63 dBm, respectively. Effective bandwidth on channel 10 was 617 to 666 MHz. Carrier-to-noise (C/N) video and audio checked out at 28.2 and 11.2 dB, respectively, which are very good figures. Signal-to-noise ratio (S/N) was good at 38 dB, with modulation at a maximum of only 250 kHz.

Color bars (but not color) from a gated-rainbow generator were clean and crisp. Although low-frequency rounded slightly from narrow-band modulation, staircase response was linear. Finally, baseband audio far exceeded 20 kHz ±4 dB across the frequency spectrum display.

User Comment

In testing and working with the Regency Model SR5000 TV satellite receiver, we found it to be a very workable unit in a relatively economical package.

We liked its IR remote control, which includes a "mute" button,

(Continued on page 92)

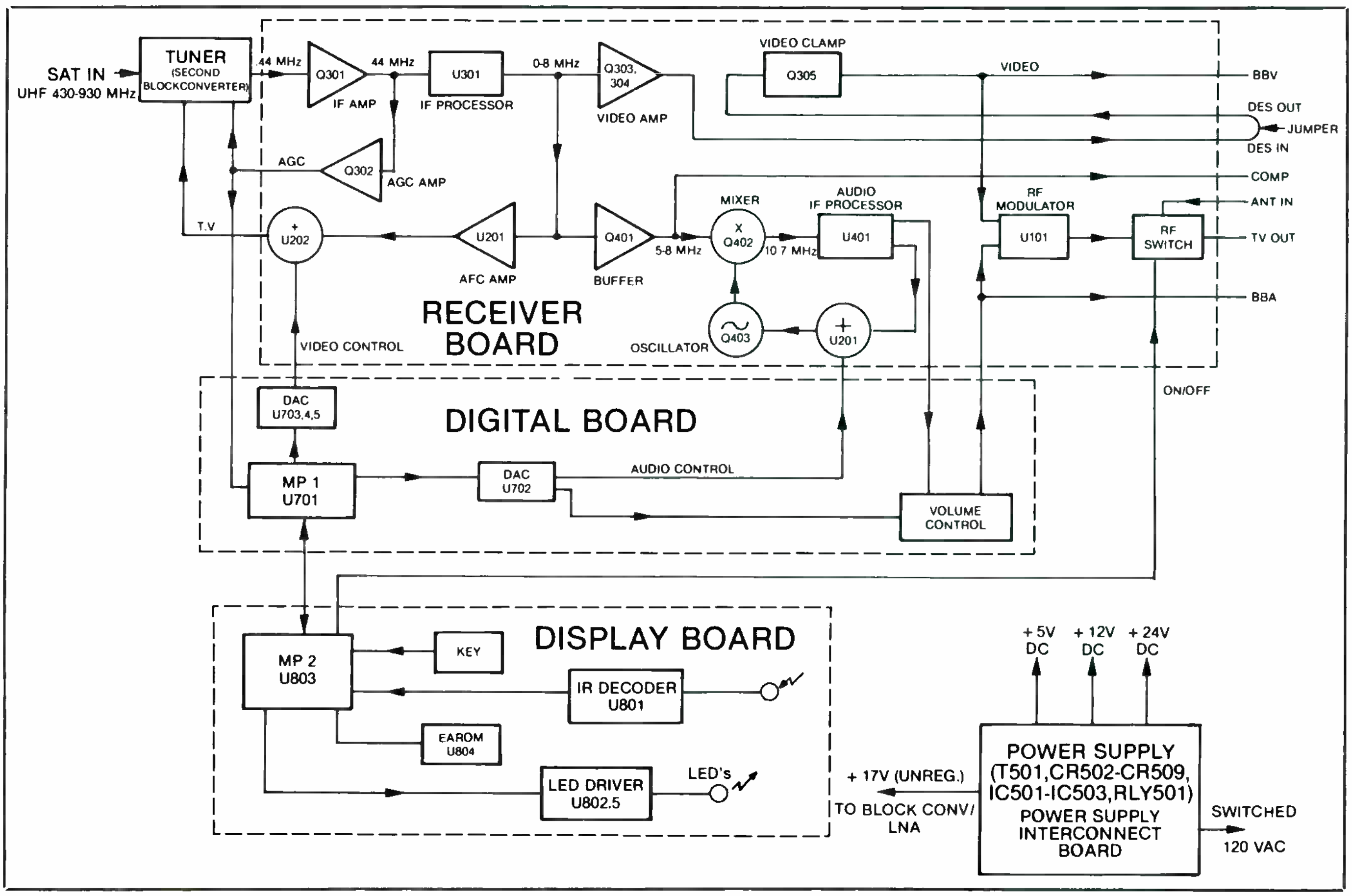
Regency Model SR5000 Laboratory Analysis

Usable frequency range (channel 1 through 24; with modulation)	458 to 929 MHz
Effective bandwidth (channel 10; 617 to 666 MHz)	49 MHz
Sensitivity (channels 1/24; with input signal)	−52/−63 dBm
C/N video/audio (through r-f modulator)	28.2/11.2 dB
S/N (at instrument-restricted bandwidth)	38 dB*
Response with modulation	
BD-1 LNB at −69-dB input showed gains	−55 dB at 4.24 GHz
of 18 and 14 dB, respectively	−51 dB at 3.68 GHZ
BD-2 LNB at −69-dB input showed gains	−57 dB at 4.24 GHz
of 14 and 12 dB, respectively	−55 dB at 3.68 GHz
Color	very good
Differential gain and staircase linearity	very good
Audio response	>>20 kHz; excellent

**Measured figure; S/N with standard bandwidth would actually be 43 dB or greater.*

Test equipment: Tektronix Models 7L12 and 7L5 spectrum analyzers; Wilton Model 6617A programmable sweep and signal generator (10 MHz to 8 GHz); B&K-Precision Models 1260 NTSC and 1248 gated-rainbow color-bar generators and 2030 function generator; Waveline standard gain feed horn; Chaparral Polarotor 1; M.A. Electronics dc block; 15-volt dc power source; Telequipment Model D67A oscilloscope; Sencore Model VA48 (modified) video analyst; Data Precision Model 1750 multimeter.

The SR5000 satellite receiver contains 22 integrated circuits and 22 transistors, only a portion of which are shown in this functional block diagram. Two microprocessors (MP 1 and MP 2) handle all control functions.



Ohm's Law the Easy Way

By Michael A. Covington

The 36-line BASIC program shown here relates voltage, current, resistance, and power. Given any two of these, it computes the others automatically. Unlike most such programs, this one doesn't require you to say in advance which calculation you want it to do or what formula to use; it examines the number you give it and chooses the right formula automatically.

The BASIC statements used here will run correctly on almost any computer. The program is small enough to run on pocket computers and low-end micros such as the Timex-Sinclair 1000. In the interest of brevity, it does not test for erroneous input (for example, fewer than two values given).

The unknown values are identified by giving them as zero (they would never be zero in a real circuit). On some computers, including the IBM PC, you cam simply hit ENTER in response to the question mark for an unknown value, and the computer will behave as if you had typed 0.

The program's strategy is as follows:

1. If voltage was not given, compute it. (Any of three formulas may be used depending on what information is available.)
2. If current was not given, compute it. (Since voltage is now known, there are only two formulas to choose between.)
3. Compute resistance and power (from voltage and current, which are known by now).

```
10 REM  Ohm's law program
20 REM  Michael A. Covington
30 PRINT "This program relates voltage, "
40 PRINT "resistance, current, and power."
50 PRINT
60 PRINT "Specify any two; type 0 for the"
70 PRINT "ones you want calculated."
80 PRINT
90 PRINT "Voltage (volts):",
100 INPUT E
110 PRINT "Current (amps):",
120 INPUT I
130 PRINT "Resistance (ohms):",
140 INPUT R
150 PRINT "Power (watts):",
160 INPUT P
170 IF E<>0 THEN 210
180 IF I=0 THEN E=SQR(P*R)
190 IF R=0 THEN E=P/I
200 IF P=0 THEN E=I*R
210 IF I<>0 THEN 240
220 IF R=0 THEN I=P/E
230 IF R<>0 THEN I=E/R
240 IF R=0 THEN R=E/I
250 IF P=0 THEN P=E*I
260 PRINT
270 PRINT "Voltage (volts):",E
280 PRINT "Current (amps):",I
290 PRINT "Resistance (ohms):",R
300 PRINT "Power (watts):",P
310 PRINT
320 PRINT "Another?  Type 1 for yes, 2 for no..."
330 INPUT R
340 PRINT
350 IF R=1 THEN 90
360 END
```

You can apply the same strategy to any equation that you frequently need to solve for any of several variables. There is no need to rummage through a list of formulas, or even choose one from a menu on the screen. After all, the computer doesn't mind doing the extra work, so why not let it? **ME**

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Hang-On-The-Wall TV

Matsushita previews a 10"-diagonal color TV receiver that's only 4" thin

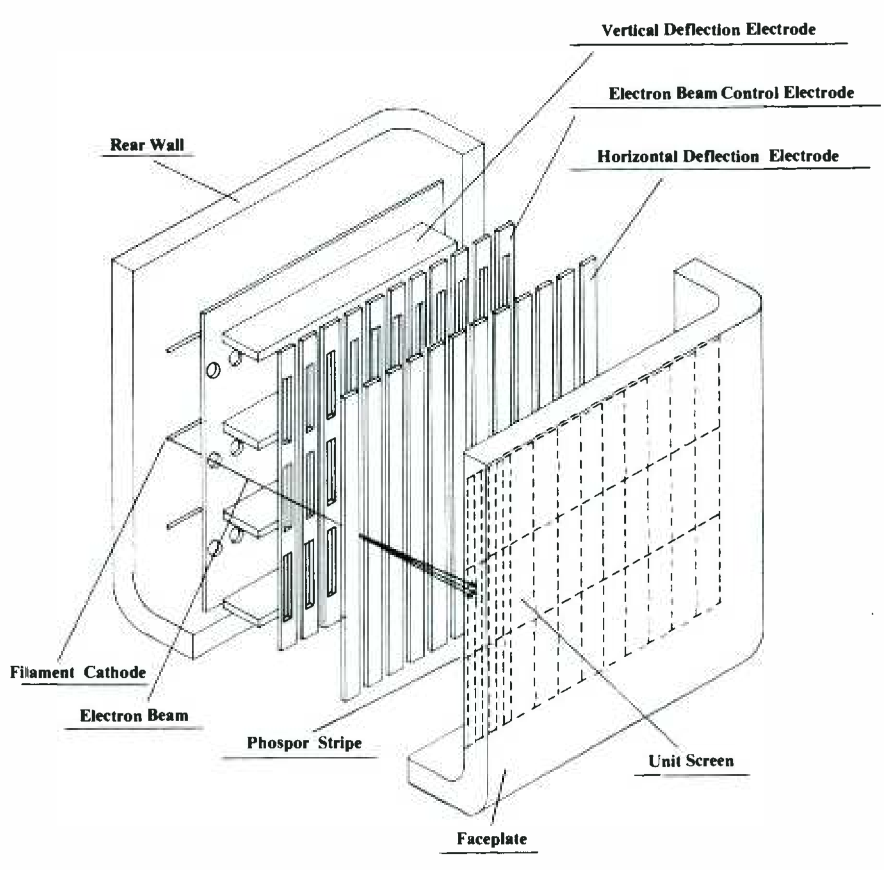
By Alexander W. Burawa

Picture-frame TV receivers that can be hung on a wall or set on a narrow shelf have been a major quest for some time. Until fairly recently, it was only a dream, waiting for technology to catch up. Well, the time for reality may not be very far off if a new prototype Flat Color Television from Matsushita Electric (parent company of Panasonic, Quasar and Technics) is any indication.

Of course, a few very compact black-and-white and color TV receivers, such as Sony's "Watchman" and Epson's "Elf" (see "A New Era Of Go-Anywhere Color TV," October 1984) are being marketed. But these sets are all tiny-screen "personal" portables that aren't suitable for family and group viewing. What sets Matsushita's Flat Color Television apart from them is its 10"-diagonal picture screen that *is* suitable for group viewing, in a package only $3\frac{7}{8}$" thin.

Matsushita's display system breaks with the traditional TV screen's aspect ratio by being truly square. Its flat screen is said to provide a distortion-free image over the entire picture area. Like LC systems, it consists of a matrix array, in this case 3000 picture cells in a 200-horizontal by 15-vertical cell arrangement. Unlike LC displays that don't generate light (they're viewed by reflected or transmitted light coming from an external source), the Matsushita display generates its own light in a manner similar to that used in cathode-ray tubes (CRTs).

Similarity to CRT operation is, in fact, more than skin deep. As each cell is scanned, an electron beam excites red, green and blue phosphor stripes (see drawing) to produce a color image on the screen. The display arrangement, combined with newly-developed matrix and deflection systems, results in a color picture with a resolution of 270 TV lines, a contrast ratio of more than 50, and a brightness of greater than 70 foot-lamperts (fl), according to the manufacturer.



Matsushita's display system employs just 15 cathode filaments and 200 electron beam control electrodes to provide a resolution of 270 TV lines (192,000 picture elements for high-res computer displays). Operationally, the system is similar to the CRT.

Drive And Deflection

Matsushita's Matrix Drive and Deflection System produces 3000 separately controlled electron beams by forming a matrix of 15 filament cathodes and 200 electron-beam control electrodes that cross the cathodes at right angles. Each beam is deflected horizontally in six steps (two sets of RGB) and vertically in 32 steps, including interlace, to form images consisting fo 192,000 picture elements ("pixels" in computer jargon) on the display panel. A complete picture is formed by the line-at-a-time method. This deflection scheme reduces electrode terminals required to approximately one-seventh the number used in conventional matrix driving methods.

Lack of a shadow mask in the display requires that the system develop a fine electron beam width, the same as the phosphor stripe, so that only the desired stripe is excited. To accomplish this task, three-dimensional simulation technology previously developed by Matsushita is used. By separating the horizontal and vertical lens systems, individual focusing control results in improved resolution and color reproducibility.

Signal processing and driving are performed digitally in the system. Picture brightness is controlled by varying the widths of pulses that drive the electron beams. This allows a 64-step grey scale to be generated and, thus, offers a wide range of brightness levels that enhances picture definition. By digitizing the picture signal and alternately driving red, green and blue signals, a full range of colors is reproducible. And to improve resolution, time differences are used in sampling each signal.

Applications

At the present time, Matsushita's Flat Color Television is only in prototype form and is being used to demonstrate the possibility of its development into a consumer product. Taking the long view and assuming that it does indeed become an item available on dealer shelves, it has the potential to eventually challenge CRT-based TV receivers and video monitors and might even put a damper on development of thinner LC panel displays, which require a tremendous increase in complexity when translating from tiny-screen to large-screen group-view format.

A brief review of the system's specifications (see table) reveals that it has almost universal appeal in all video areas, including direct broadcast satellite, high-definition TV reception, cable/pay TV systems, information retrieval from teletext and videotext systems, and as a color monitor for computers that require high-resolution displays. ME

Flat Color TV Specifications

Screen size	10″ diagonal
Brightness	70 fl
Resolution	270 TV lines
Contrast	64-step grey scale
Power	70 watts
Dimensions	14½″ × 14″ × 3⅞″
Weight	30.8 lb.

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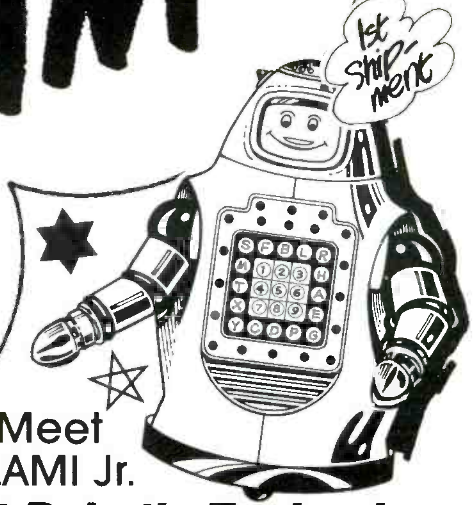

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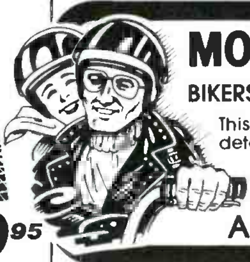

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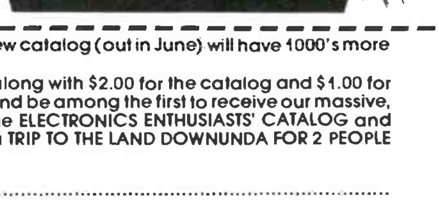

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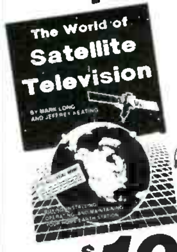

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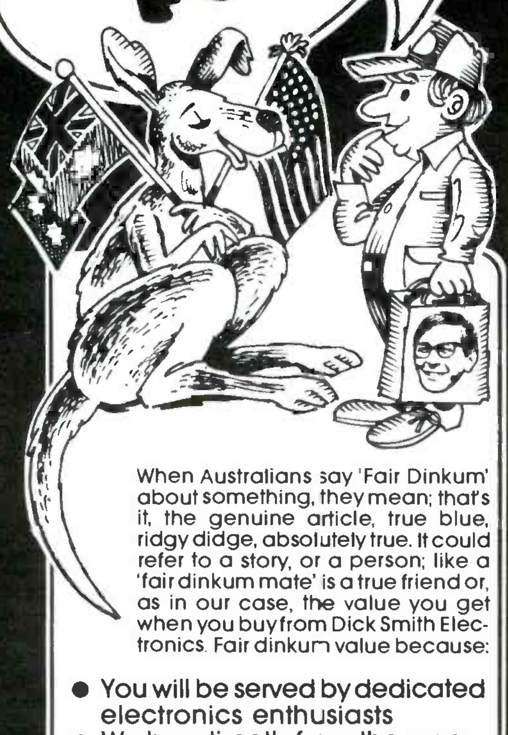

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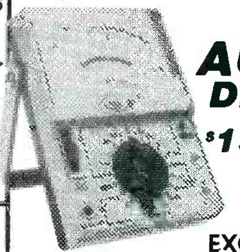

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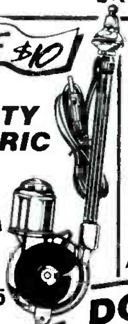

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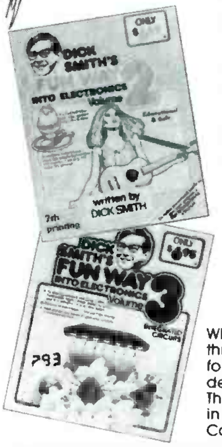

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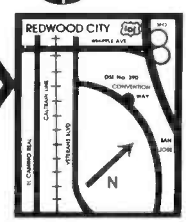

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The Teleguard

Phone accessory automatically calls a preprogrammed telephone number when your burglar/fire alarm or other sensor is tripped

By Anthony J. Caristi

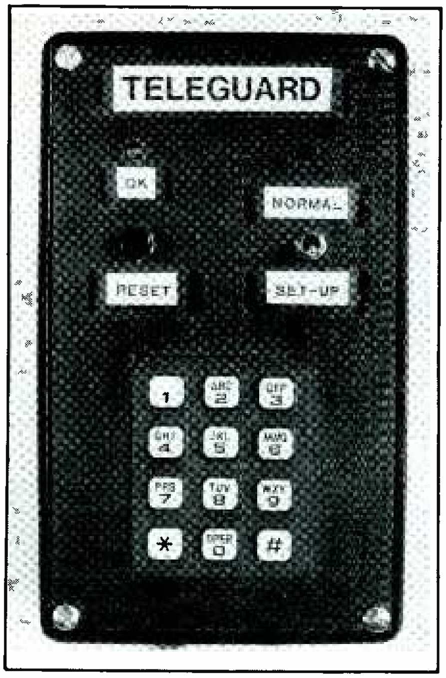
The easy-to-build, low-cost project described here will guard your home or office against a host of emergency situations while you are away—fire, theft, flood, power loss, etc. Upon its activation, it will automatically call a preprogrammed telephone number selected by you and alert the party being called to an emergency with a unique audio tone. The device, called "Teleguard," goes into action whenever a switch is closed. This might be a pushbutton that an invalid presses or the automatic operation of a sensor or thermostat.

Several important features are built into Teleguard to give you peace of mind. For example, the device will repeatedly call the number stored in its memory until it gets an answer, upon which it will transmit its unique "alert" signal. In addition, Teleguard has a power-failure indicator that monitors the ac power line. Should this LED extinguish, you know that power has been interrupted and that you have to reprogram the telephone number into memory to ensure continued protection. (A battery backup supply can be integrated, of course, to maintain operation in case an ac power outage does occur).

Teleguard can be left connected to your telephone line at all times with the assurance that it won't affect normal telephone service. It can also be reprogrammed at any time to dial the number of the location where you or the person you want alerted will be.

About The Circuit

At the heart of Teleguard's circuit (Fig. 1) is *IC3*, a specialized digital integrated circuit that has been designed to replace the standard rotary dial in a telephone. This chip transmits a series of pulses in accordance with a telephone number entered into its on-chip memory bank from a keypad



similar to that found on the familiar pushbutton telephone. Any number, including area code, can be entered.

Once a number is stored in memory, it remains there for as long as power to the circuit is interrupted. However, you can deliberately change it simply by "dialing" in a new telephone number. Doing this replaces any previously entered number. When the circuit is tripped, the number stored in memory is automatically dialed out repeatedly (about every 90 seconds) until Teleguard detects that the party being called has lifted the receiver off the hook at his end.

The timing cycle that controls repeated dialing of the number in memory is provided by *IC1*, an ordinary 555 timer chip operated in its astable mode. When the number is dialed out, the *on* time of the circuit is approximately 60 seconds, while the *off* time is about 30 seconds.

A logic low fed to pin 4 holds *IC1* in the standby (not tripped) mode as long as the protective circuit connected to screw-type terminals, A, B and C of terminal strip *TS1*on Teleguard is intact. (Hookups from the external protective circuits are made from the screw-type terminals selectively, according to whether the circuits are normally-open or normally-closed arrangements. More about the hookups later.) When the external circuit is secure, *IC2* is prevented from oscillating. When the circuit is triggered, by tripping the external protective circuit, *IC1* begins its timing cycle and continues to time out as long as the external circuits tells it an emergency exists.

Taken from pin 3, the output of *IC1* is an inverted pulse that is fed to on/off-hook pin 5 of *IC3*. This pulse tells *IC3* when to begin dialing out its stored number. A logic 0 fed to pin 5 causes *Q1* and *Q2* to switch on and connect *R14* and *LED1* to the telephone lines. The LED lights, indicating that a dialtone is available and outpulsing can begin.

A logic 1 fed simultaneously to pins 1 and 18 of *IC3* starts the outpulsing operation. This logic signal is provided by *IC4B*, *IC4C* and *IC4D*. Delay network *R22/C9* delays the outpulsing signal by one second to allow the telephone line to activate the dialtone when *Q1* switches on. When the 1-second delay time has elapsed, pins 1 and 18 of *IC3* are fed a logic-1 pulse that causes the number in memory to be dialed out. Timer *IC1* holds *IC3* in the operate mode for a total of 60 seconds to permit the dialed number time to ring and the party being called to answer.

When the *on* time of *IC1* ends, *IC3* is returned to the on-hook condition by a logic 1 fed to pin 5. This disconnects the called party. About 30 seconds later, *IC1* returns to the *on* state and the cycle repeats.

Oscillator *IC5* generates the audio signal tone that alerts the called party to an emergency situation at Teleguard's end of the line. With *IC5* enabled only during the *on* time of *IC1*, no tone is generated, so there is no interference with normal telephone operation.

An additional memory circuit is built into Teleguard to provide indication that the telephone number stored in memory is not lost due to a temporary power failure. This is provided by *IC2C* and *IC2D*, which are connected as a bistable or latch circuit. When line power is first applied to Teleguard, pin 10 of *IC2* is held low by means of the delay voltage applied to pin 12, the result of the finite charge time of *C8*. Thus, *Q3* and power-line monitor *LED2* will be off. After programming the desired telephone number into Teleguard's memory bank, you can turn on *LED2* by pressing and releasing RESET switch *S1*. This causes *LED2* to light and indicate an OK condition, meaning that the number is now stored in memory. Should there be an interruption of power to Teleguard at any time thereafer, *LED2* will extingiush and remain off, even if power is restored to the circuit. If you note that *LED2* if off at any time, this tells you that the number held in memory has been lost and must be reprogrammed into *IC3* from the keypad.

The keypad used in this project is a simple 3×4 switch arrangement, as shown in Fig. 2. It contains four row and three column (R1 through R4 and C1 through C3) "output" lines that connect to *IC3* as shown. A common output connection is not required with this arrangement. This type of keypad is the commonest type made. It can be salvaged from an old calculator or Touch Tone telephone or purchased new from any number of electronics parts suppliers.

Pressing any button on the matrix-type keypad shorts one column to one row output line. With the 3×4 matrix shown in Fig. 2, there are 12 possible row/column combinations, 10 for the numerals 1 through 0, one for the * symbol and one for the # symbol. Note that this is the same arrangement used on pushbutton telephones.

Power for Teleguard is supplied by the ac line. Incoming 117 volts ac is stepped down by *T1* to 6.3 volts ac

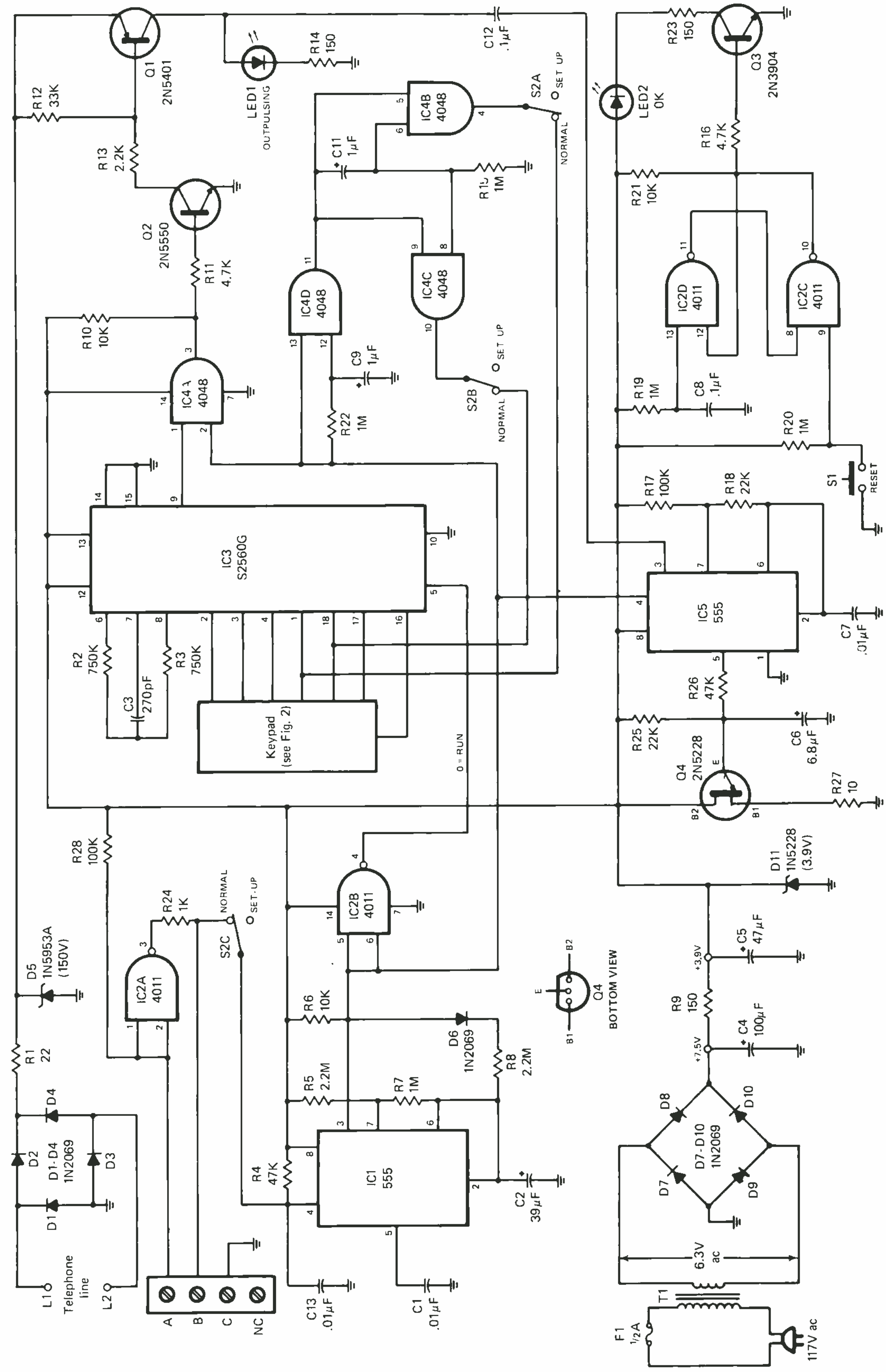


Fig. 1. The heart of Teleguard's circuit is IC3, a specialized digital IC that replaces rotary telephone dial.

PARTS LIST

Semiconductors
D1 thru D4,D6 thru D10—IN2069 or similar silicon diode
D5—1N5953A or similar 150-volt zener diode
D11—1N5228 or similar 3.9-volt zener diode
IC1,IC5—555 timer
IC2—CD4011B quad NAND gate
IC3—S2560G telephone dialer IC (AMI)
IC4—CD4081 quad AND gate
LED1—Red light-emitting diode
LED2—Green light-emitting diode
Q1—2N5401 or similar pnp silicon transistor
Q2—2N5550 or similar npn silicon transistor
Q3—2N3904 or similar npn silicon transistor
Q4—2N4870 or similar unijunction transistor

Capacitors
C1,C7,C10—0.01-μF disc
C2,C5—47-μF, 10-volt electrolytic
C3—270-pF disc
C4—100-μF, 10-volt electrolytic
C6—6.8-μF, 10-volt electrolytic
C8,C12—0.1-μF disc
C9,C11—1-μF, 10-volt electrolytic

Resistors (all ¼-watt, 10%)
R1—22 ohms
R2,R3—750,000 ohms (5% tolerance)
R4,R26—47,000 ohms
R5,R8—2.2 megohms
R6,R10,R21—10,000 ohms
R7,R15,R19,R20,R22—1 megohm
R9,R14,R23—150 ohms
R11, R16—4700 ohms
R12—33,000 ohms
R13—2200 ohms
R17,R28—100,000 ohms
R18,R25—22,000 ohms
R24—1000 ohms
R27—10 ohms

Miscellaneous
F1—½-ampere slow-blow fuse
S1—Spst normally-open, momentary-action pushbutton switch
S2—3pst toggle switch
T1—6.3-volt, 100-mA transformer
TS1—4-lug screw-type terminal strip
Keypad—3×4 matrix (Industrial Electronic Engineers Inc. No. KS 2585 or similar; see text)
Suitable-size plastic utility box; 6′ or longer telephone cord with modular plug at one end; printed-circuit or perforated board and solder posts; sockets for ICs; holder for F1; ac line cord with plug; ½″ plastic spacers (5); insulating plastic tubing; labeling kit; machine hardware; stranded hookup wire; plastic cable ties; solder; etc.

Note: The following are available from A. Caristi, 69 White Pond Rd., Waldwick, NJ 07463; pc board for $7.25; S2560G for $7.50; 2N5401 for $3.00; 2N5550 for $2.75; 2N4870 for $2.95. Add $1.00 to cover shipping and handling.

and is then rectified by the bridge circuit consisting of *D7* through *D10*. The pulsating dc at the output of the bridge is smoothed to dc by *C4* and *C5* and regulated to +3.9 volts by zener diode *D11*.

Connection to the telephone line is through *L1* and *L2* at the upper left of Fig. 1. This signal is passed through the bridge rectifier composed of *D1* through *D4* to assure that the proper polarity is fed to the telephone line.

Construction

The Teleguard circuit can be assembled on a single-sided printed-circuit board. You can fabricate your own pc board, using the actual-size etching-and-drilling guide shown in Fig. 3, or purchase one ready to use from the source given in the Parts List. Alternatively, you can hand-wire the circuit on perforated board, using solder posts. In either case, it is a good idea to use sockets for all ICs, both to protect them against heat and static damage during assembly and to permit easy troubleshooting in case of circuit failure. Also, if you decide to use perforated board, component layout and orientation should be basically the same as for the pc board (see Fig. 3).

Select a plastic box large enough to comfortably accommodate the project's circuitry. Before wiring the board, set it in the bottom of the box, oriented and positioned as it will be when assembly is complete, and mark the five locations where the mounting holes (indicated by asterisks in the component-layout diagram in Fig. 3) are to be drilled. Remove the circuit board and set it aside. Then drill the holes in the marked locations.

Decide which will be the top and bottom walls of the box. In the bottom wall, drill three holes—one for ac line cord entry, a second for telephone line entry and a final one for mounting the fuse holder. Size these holes as needed. On the top wall of the box will be mounted screw-type terminal strip *TS1*. You will have to use a drill, coping saw and file to cut a slot long and wide enough to provide clearance for the solder lugs and screws on the terminal strip and drill a separate pair of holes to permit the terminal strip to be anchored in place with machine hardware. Route the free ends of the ac and telephone line cords from the outside into the box and tie a knot in each to serve as strain reliefs. Then mount the fuse holder and terminal strip in their respective locations.

The keypad, switches and LEDs mount on the lid of the box. Trace the outline of the keypad's *inner* lip on the lid of the box. Then drill a ¼″ hole in each corner of the traced cutout area, using a coping saw to cut away all unwanted material within the outline, and smooth the edges with a file. Avoid removing too much material; you want the keypad to fit snug in the cutout. Drill the holes for the switches and LEDs, sizing the latter to accommodate panel-mount eyelet clips. Then apply a spot of fast-set epoxy cement at all four corners and midway between the corners of the keypad and press the keypad into its cutout. Allow the cement to fully set before handling the lid assembly.

Meanwhile, wire the circuit board according to the component-place-

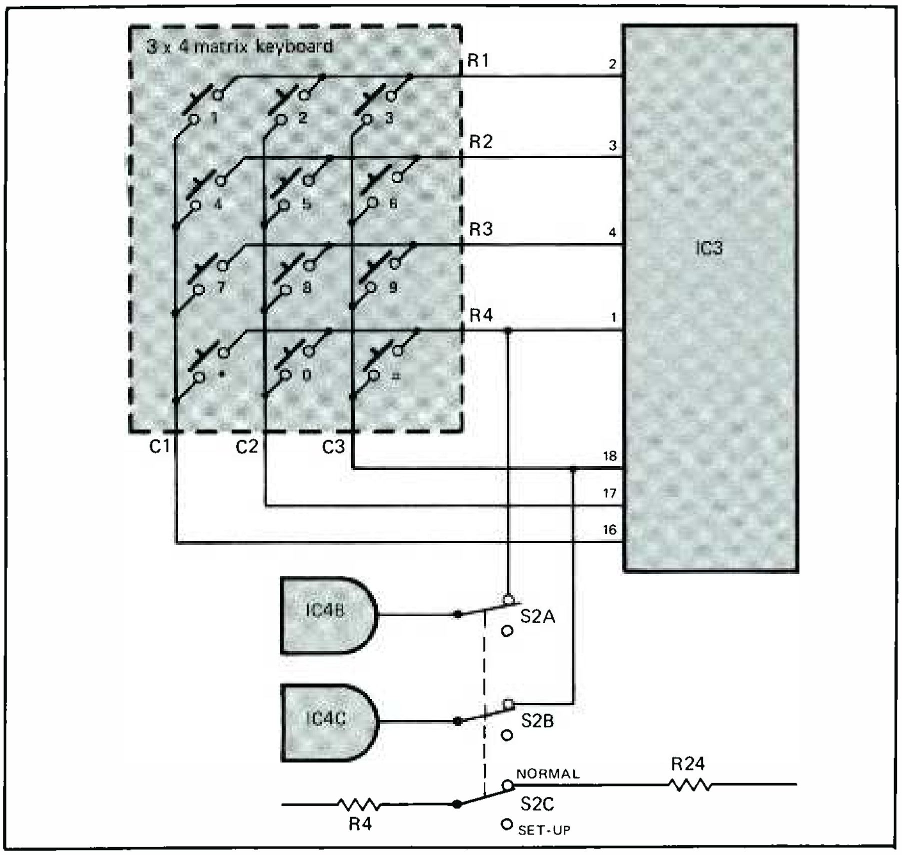


Fig. 2. Calculator-type keypad with 3 × 4 switch matrix connects to IC3 as shown to permit the desired telephone number to be entered into memory.

ment diagram in Fig. 3. Pay strict attention to the orientation of all polarized components (ICs, transistors, diodes and electrolytic capacitors). Also, do *not* install or handle the ICs until all wiring has been completed. Start wiring by installing the resistors on the circuit board, followed by the diodes, IC sockets, capacitors and transistors, in that order. Then loosely mount *T1* in place with machine hardware, plug its primary and secondary leads into the appropriate holes, and solder.

Prepare 19 12″ and three 8″ lengths of stranded hookup wire by stripping ¼″ of insulation from each end. Tightly twist together the fine wires at each end and lightly tin with solder. Install and solder one end of each of the 12″ wires in all holes except those labeled A, B, C, L1, L2 and the unmarked hole between *R17* and *T1* in the Fig. 3 component-placement diagram. Install one end of each of the 8″ wires in holes A, B and C.

Place the circuit board, component side up, to the left of the plastic box. Tightly twist together the fine wires in each conductor of the free end of the ac line cord and lightly tin with solder. Plug one of these wires into the left *T1* primary hole and solder into place. Form a hook in the other wire, slip it into the side lug of the fuse holder, crimp shut and solder. Prepare a 3″ length of heavy-duty standed wire as you did for the 8″ and 12″ wires. Form a hook at one end, slip it into the rear lug of the fuse holder, crimp shut and solder.

Trim away enough insulating outer jacket from the telephone line cord's free end to expose 3″ of insulated conductors. Clip off and discard the black and yellow wires. Strip away ¼″ of insulation from the red and green wires, tightly twist together the fine conductors in each wire, and lightly tin with solder. Plug either wire into the hole labeled *L1* and solder. Plug the other wire into hole *L2* and solder. (The coding of these wires is unimportant, since the *D1* through *D4* bridge in Fig. 1 will deliver the correct polarity signal to the telephone line.)

Finish wiring the project by connecting and soldering the free ends of the remaining wires to the board as follows:

From Board Pad	To
S2A	S2A toggle
S2B	S2B toggle
LED1, K	LED1 cathode
LED1, unmarked	LED1 anode
C1	C1 on keypad
C2	C2 on keypad
C3	C3 on keypad
R3	R3 on keypad
R2	R2 on keypad
R1	R1 on keypad
R4	R4 on keypad
S1	S1, either lug
S1	S1, other lug
LED2, K	LED2 cathode
LED2, unmarked	LED2 anode
A	lug A on TS1
B	lug B on TS1
C	lug C on TS1

Before connecting and soldering any of the wires to the leads of *LED1* and *LED2*, slip a 2″ length of insulating sleeving over the wires. Tack-solder the wires to the leads of the LEDs, and push the sleeving up over the connections and bare wire leads to protect against short circuits. Gently press the LEDs into their eyelet clips.

Plug the free end of the stranded wire attached to the rear lug of the fuse connector into the free *T1* primary hole and solder.

Remove the hardware loosely securing the transformer to the circuit board. Feed five 6-32 × 1″ machine screws through the mounting holes in the bottom of the box from the outside. (Be sure to keep *T1* from swinging free as you do this; otherwise, its leads may tear loose from the board.) Slide a ⅜″ or ½″ plastic spacer over each screw end. Now align the screw ends with the holes in the circuit

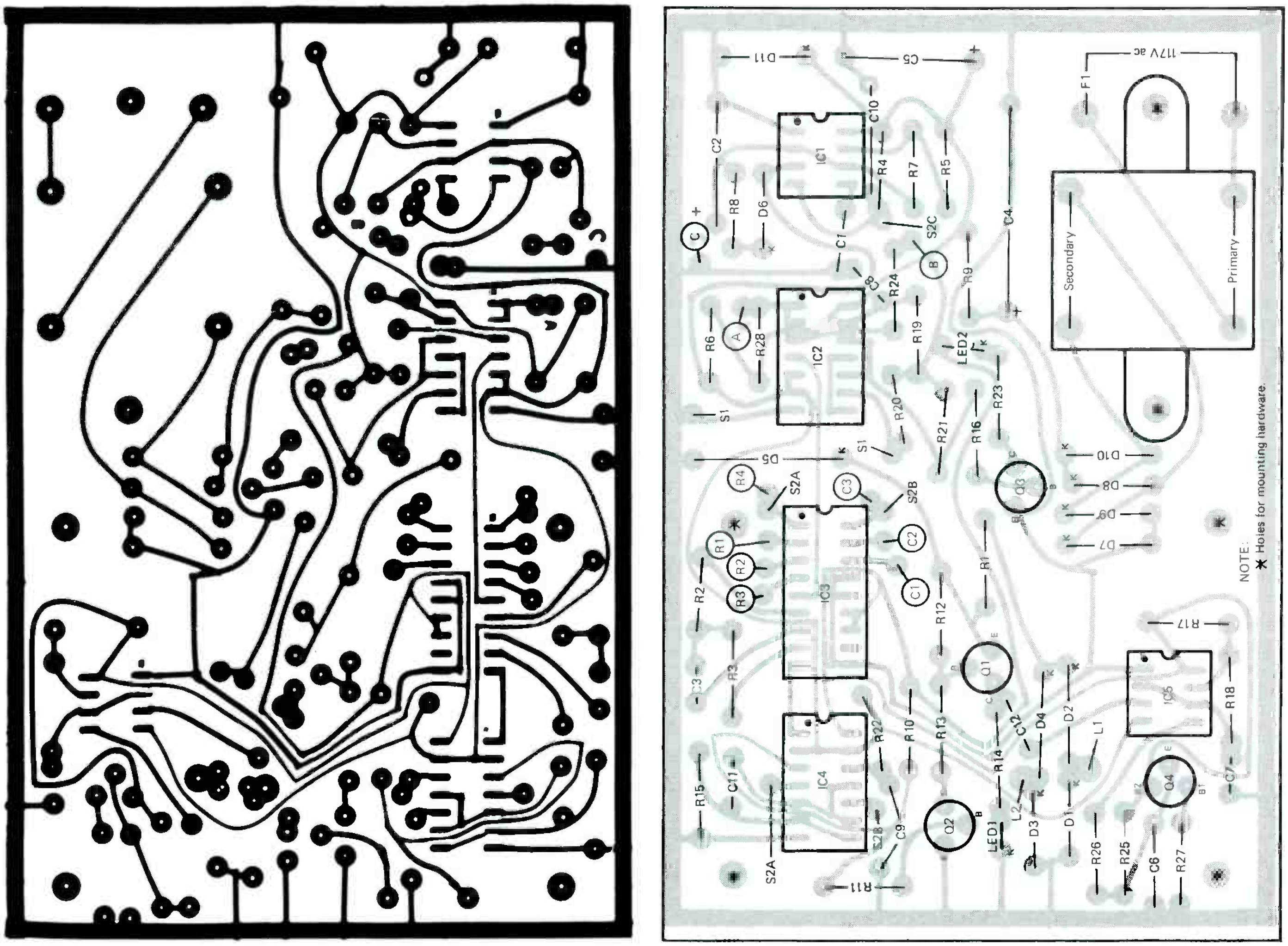


Fig. 3. Shown above is the full-size etching-and-drilling guide for Teleguard's printed-circuit board. The component's placement diagram at right can be used for wiring the pc board or an alternative perforated board.

board and push home. Drop a lockwasher onto each screw end and start a 6-32 nut on each. Gently tighten the hardware.

Checkout

Before you attempt to put Teleguard into service, you should perform some preliminary voltage checks with a dc voltmeter. Plug the line cord into an ac receptacle. Then, being careful to avoid touching any part of *T1*'s primary circuit, measure the voltage across *C4* and *C5*. You should obtain readings of about 7.5 and 3.9 volts, respectively. Clip the meter's common lead to the negative (ground) side of *C2* and measure the voltages at pin 8 of *IC1* and *IC5*, pin 14 of *IC2* and *IC4*, and pins 12 and 13 of *IC3*. In all cases, the readings should be 3.9 volts. If you obtain the proper results, disconnect the meter from the circuit and unplug Teleguard from the ac line.

Allow *C4* and *C5* to fully discharge. Then install the ICs in their respective sockets, referring to Fig. 1 for identifications and the component-placement diagram in Fig. 3 for locations and orientations. Practice the usual safety procedures when handling the ICs, since some of them are CMOS devices that are easily damaged by static electricity discharges. Place the lid assembly on the box and secure it in place with the supplied hardware. Finish assembly by labeling *S1* with the legend RESET, *S2* with the legends NORMAL and SET-UP, *LED1* with the legend OUTPULSING, and *LED2* with the legend OK. Use a dry-transfer lettering kit or a plastic tape labeler for this operation. If you use the dry-transfer method, spray two or three *light* coats of clear lacquer over it to protect the legends from scratching and peeling. Be sure to wait until each coat of lacquer is dry before spraying the next.

This completes part 1. Next month, we'll finish up with checkout and give installation details. **ME**

A True-rms Adapter

This inexpensive accessory lets you use a standard 3½-digit DMM to measure true-rms voltages

By John T. Bailey

Most digital multimeters (DMMs) are dedicated to measuring sine-wave inputs, displaying "average" values. However, it's often important to know the true-rms value of a complex waveform to determine its actual heating effect on a component. After all, square waves, sawtooths, pulses of various duty cycles, distorted shapes from SCRs or flyback transformers, among other waveshapes are non-sinusoidal.

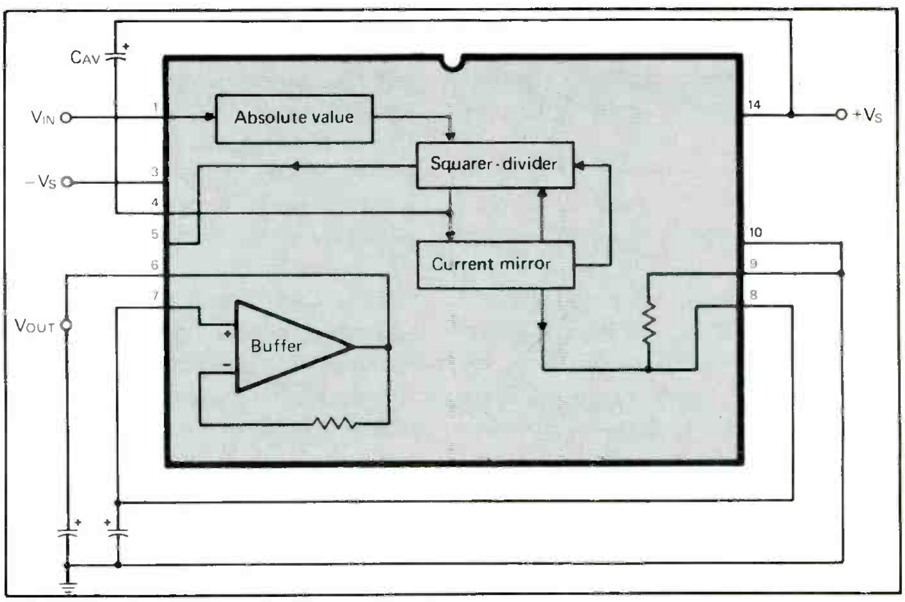
You can indeed buy a costly DMM to read true-rms volts. An alternative is presented here, however, in the form of a modest-cost adapter that will convert your garden-variety DMM into a true-rms-reading meter that offers reasonably good measuring accuracy. About $50 in newly bought parts will do it. Taking this route, here's how to enhance your ordinary 3½-digit DMM.

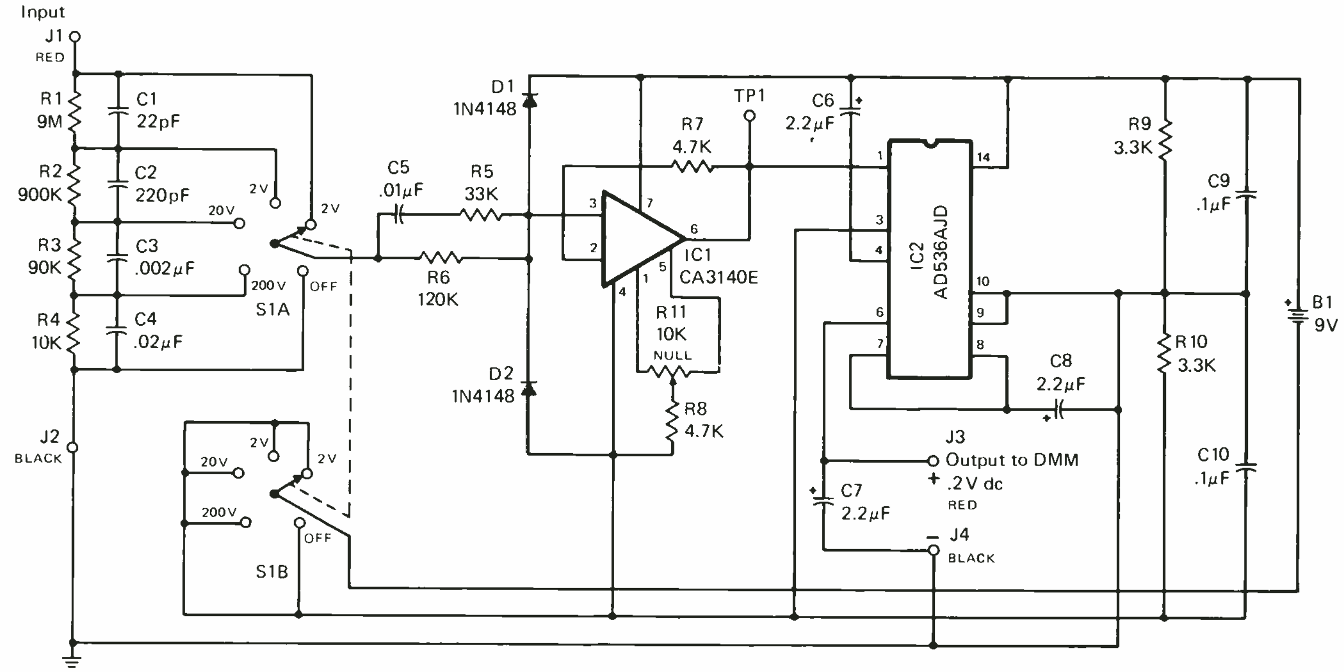
About The Circuit

This adapter is built around an Analog Devices AD536AJD monolithic IC that directly computes the true-rms value of complex and sine waveforms and outputs their dc equivalent values. A simplified block diagram, with pinout information, of this IC is shown in Fig. 1. This diagram shows the IC's internal buffer being used as an output filter.

For this project, a basic design option had to be chosen at the outset. The AD536AJD can be connected, externally, to "read" ac-only or ac-plus-dc inputs, each option having its own advantages and disadvantages. To be most practical for modern electronics needs, it was decided that the

Fig. 1. Block diagram of the AD536AJD IC that computes true-rms voltages.





PARTS LIST

Semiconductors
D1,D2—1N4148 diode
IC1—CA3140E op amp
IC2—AD536AJD (Analog Devices)

Capacitors
C1—22-pF disc
C2—220-pF disc
C3—0.002-μF disc
C4—0.02-μF disc
C5—0.01-μF disc
C6,C7,C8—2.2-μF, 35-volt tantalum
C9,C10—0.1-μF, 50-volt ceramic with radial leads

Resistors
R1—9 megohms, 1%, ¼-watt
R2—900,000 ohms, 1%, ¼-watt
R3—90,000 ohms, 1%, ¼-watt
R4—10,000 ohms, 1%, ¼-watt
R5—33,000 ohms, 5%, ½-watt
R6—120,000 ohms, 5%, 2-watt
R7,R8—4700 ohms, 5%, ¼-watt
R9,R10—3300 ohms, 5%, ¼-watt
R11—10,000-ohm, linear-taper miniature pc-type potentiometer

Miscellaneous
B1—9-volt transistor battery
J1,J2—Banana jack (one red, one black)
J3,J4—Phone jack (one red, one black)
S1—2p6t nonshorting rotary switch (Centralab No. PSA-203 or similar)
Printed-circuit board: one 14- and one 8-pin low-profile IC sockets; connector and holder for B1; ¾"-diameter pointer-type control knob; suitable size metal enclosure; lettering kit; test leads; machine hardware; etc.

Fig. 2. Shown here is the complete schematic diagram of the battery-powered true-rms adapter circuit.

adapter be direct coupled. This allows the adapter to measure ac as well as dc and any combination of ac and dc. Since an rms value, by definition, produces the same heating effect as the same dc value, it was deemed more appropriate for the adapter to provide rms readings that include any dc component.

Shown in Fig. 2 is the full schematic diagram of the adapter. Input resistance is 10 megohms, provided by the voltage divider composed of *R1* through *R4*. This is the same input resistance presented by most 3½-digit DMMs. The adapter's voltage divider is frequency compensated by *C1* through *C4* to enhance bandwidth.

Full-scale output from the adapter is 0.2 volt (200 mV) dc on all ranges. Therefore, the DMM with which the adapter is used should be set to its 200-mV range for all ranges selected on the adpater.

There is a slight problem with decimal point location in the DMM's display when using the adapter. A 3½-digit DMM's 200-mV full-scale display goes to 199.9, with the decimal point fixed as indicated. Consequently, the decimal point is correct only for the adapter's 200-volt range. For the other three ranges, the decimal point must be mentally moved to the left by multiplying by the proper factor pointed to by the adapter's RANGE switch knob (see *S1* in Fig. 2 and lead photo). For example, if the adapter is set to its 2-volt range, an rms input signal of 1.5 volts amplitude will display 150.0 on the DMM. Applying the DMM factor of 0.01 gives the correct reading of 1.500 volts.

From the range divider network, the input signal goes to a filter and protection network. Filtering is provided by the *C5/R5/R6* network. This network limits current through the diodes when input overload occurs. In conjunction with the stray input capacitance of the buffer amplifier, it also serves as a low-pass filter that attenuates frequencies above 100 kHz to prevent input overloading by high frequencies.

An undedicated buffer amplifier is provided internally in the AD-536AJD's chip. This amplifier can be used as a buffer input stage or as an output filter to secure a clean dc output. In our adapter, the latter function is used. Because of this, an additional buffer state is required to present a high impedance to the voltage divider and to buffer *IC2*'s input. A CA3140E op amp (*IC1*) is used for this purpose. Because its input is about 1.5×10^{12} ohms, it presents negligible loading on the 10-megohm input divider. Also, the CA3140E can be nulled without requiring regulated voltage sources.

Averaging time-constant capacitor *C6* (C_{AV} in Fig. 1) determines such things as limits on handling crest factors (C.F.); limits on low-duty-cycle; low-frequency pulse trains; noise spikes; settling time for a step change in input level; and ripple in the output. The 2.2-μF value specified is a compromise that satisfies reasonable trade-offs without seriously sacrificing instrument accuracy.

Power for the project is supplied by a single 9-volt battery (*B1*). Notice in Fig. 3 that *B1* is referenced to ground at midpoint by *R9* and *R10* to provide equal positive and negative supplies for the circuit. Battery output can run down to 6 volts before erratic circuit operations sets in. Current drawn by the circuit is minimal, amounting to only 5 mA. Power to the circuitry is controlled by one section of *S1*, as shown in Fig. 2.

Construction

The true-rms adapter is best assembled on a printed-circuit board (see Fig. 3 for actual-size etching-and-drilling guide and component-placement diagram). It can be housed inside any metal box large enough to accommondate the circuit board, range switch, and 9-volt battery in its holder. The box shown in the photos was custom-made by the author for his prototype.

All components, except *B1* and its holder, mount directly on the board. Sockets are recommended for mounting the ICs on the board. Before installing the sockets, cut off the pins that are not used. These are pin 8 of the *IC1* socket and pins 2, 5, 11, 12 and 13 of the *IC2* socket. (Cut away the specified pin of only the sockets—not the pins on the ICs themselves.)

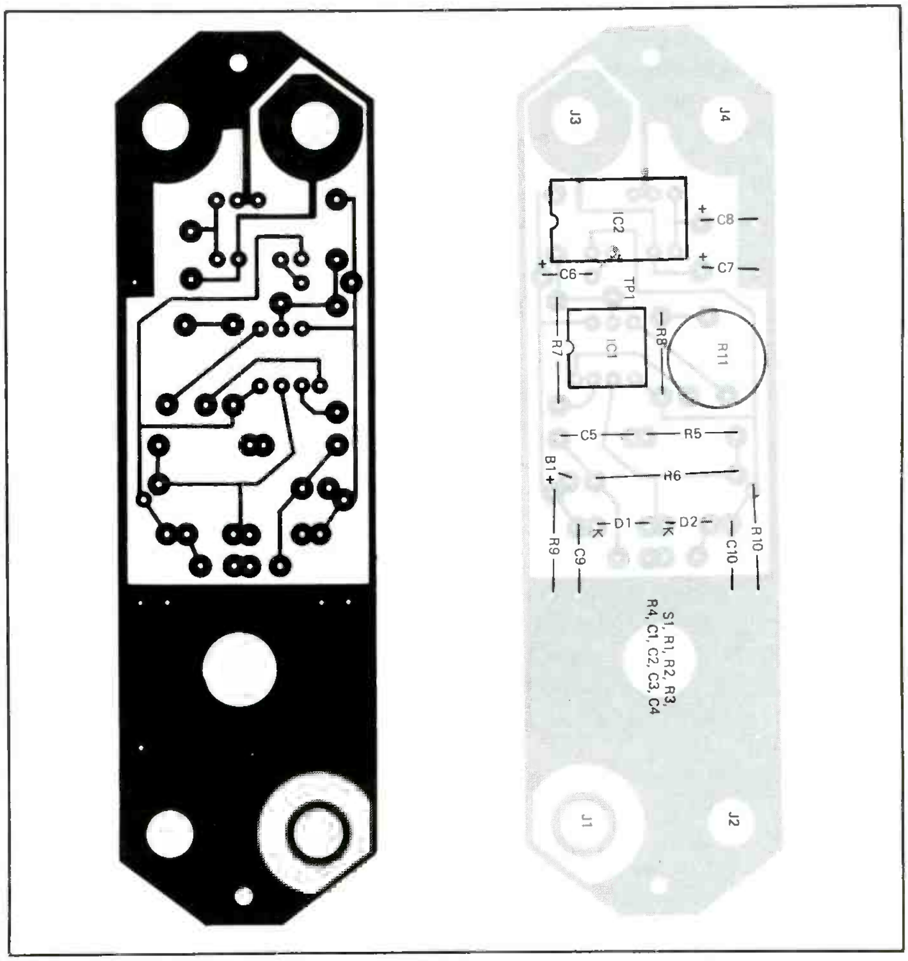
When wiring the board according to Fig. 3, make sure that you install all components in their correct loca-

DELINEATING THE SINE WAVE

There are three significant values for any waveform, whether sinusoid or complex. These are peak, average and rms. For the sine wave, peak is obviously the maximum instantaneous value the waveform reaches; the average value is the average of its absolute values; and the rms value is the square root of the mean of the squares of all instantaneous values. In mathematical terms, the sine wave's values at the three points are 100%, 73.7% and 70.7% of the zero-to-peak value for peak, average and rms.

For an ideal 117-volt ac power-line waveform, with no distortion due to harmonics or noise or spikes, the peak value is 165.5 volts, the average value is 105.3 volts, and the rms value is 117 volts. Peak-to-peak value is two times the peak value, or 331 volts. The ratio of rms to average value is 1.11.

Fig. 3. Etching-and-drilling guide and components-placement diagram.



tions and orientations. Also, when soldering, use heat and solder judiciously. Pay particular attention when soldering to closely spaced pads, such as around the IC leads, to avoid creating solder bridges.

Although the switch specified for *S1* (see Parts List) is a six-position rotary type, it has an adjustable stop for fixing it to five positions, as required in this project. Voltage-divider resistors *R1* through *R4* and capacitors *C1* through *C4* solder directly to the lugs of this switch.

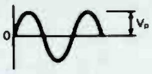
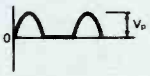
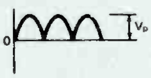
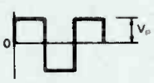
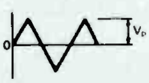
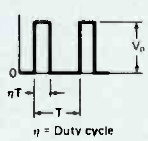
Once the pc-board assembly has been wired, machine the metal box in which it will be installed by drilling the various holes for the jack, rotary switch and mounting hardware for the battery clip. After deburring all holes, spray one or two coats of enamel paint (you choose the color) on all exterior surfaces of the box.

When the paint has completely dried, mount the battery clip on the floor of the box with machine hardware. Set the circuit board assembly into the top of the box and fasten in place with the lockwasher and hex nut that came with the rotary switch. Be careful not to scratch the paint. Place the control knob on the shaft of the switch and tighten. Turn the knob in both directions to establish the pointer's limits from position 1 to position 5. If necessary, loosen the knob and readjust its position so that it points straight up when the switch is set to position 5.

Next, use a dry-transfer lettering kit to carefully letter the identifying legends for the jacks and switch positions. This done, remove the knob from the switch shaft to free the top of the box from the rest of the project. Spray two or three very light coats of clear lacquer over the top of the box to protect the lettering from damage. Let each coat completely dry before spraying the next.

Finally, install the battery in its holder, reattach the top to the shaft of the switch, slide the control knob onto the switch shaft, index it properly and tighten the setscrew. Rotate the knob to OFF at this time.

WAVEFORMS QUALIFIED

Remainder		I V_{avg}	II V_{rms}	III C.F. = (V_p/II)	IV II/I	V (I × 1.111)/II
		half cycle =0.637 V_p full cycle =0	0.707 V_p	1.414	1.111	1
		0.318 V_p	0.5 V_p	2	1.571	0.707
		0.637 V_p	0.707 V_p	1.414	1.111	1
		half cycle =0 V_p full cycle =0	V_p	1	1	1.111
		0.5 V_p	0.707 V_p	1.414	1.414	0.786
		half cycle =0.5 V_p	0.577 V_p	1.733	1.154	0.936
		full cycle =0	0.577 V_p	1.733	1.154	0.936
		0.5 V_p	0.577 V_p	1.733	1.154	0.936
	η	ηV_p	$\sqrt{\eta}$ V_p	C.F. = V_p/II	II/I	(I × 1.111)/II
	1	V_p	V_p	1	1	1.111
	0.5	0.5 V_p	0.707 V_p	1.414	1.414	0.786
	0.25	0.25 V_p	0.5 V_p	2	2	0.556
	0.0625	0.0625 V_p	0.25 V_p	4	4	0.278
	0.0156	0.0156 V_p	0.125 V_p	8	8	0.139
	0.01	0.01 V_p	0.1 V_p	10	10	0.111

This chart shows the tabulation of the average, rms and crest factor (C.F.) values of commonly encounterd values and the ratios of readings of average-responding, rms-calibrated VOMs, VTVMs and DMMs to true-rms-reading meters (column V).

Significant is the column that shows the ratio of rms to average values. Of even more significance is column V, which reveals the errors that occur when an average-responding, rms-calibrated (garden-variety) VOM, VTVM or DMM is used to measure the rms values of various waveforms.

Of the 13 waveforms listed, only two are without error. Using ratios, the reading errors vary between 1.111 and 0.111. Such diversity clearly substantiates the need for true-rms readings, especially if they can be accomplished accurately, simply and inexpensively.

Using The Adapter

Only one adjustment must be made before you can use the adapter with your DMM. That is to null the CA3140E op amp (*IC1*). To do this, set the RANGE switch (*S1*) to the 0.2-volt position, short the input jacks, connect your DMM (set to the

DEMONSTRATION TESTS

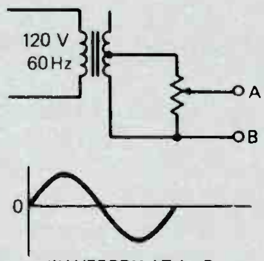
Several simple tests can be made to demonstrate the performance of the true-rms adapter. To peform them, no test equipment beyond your DMM itself is required. Results obtained from these tests reflect minor errors due chiefly to less-than-ideal waveforms used.

Basically, these tests are of several of the waveforms listed in the table shown elsewhere in this article. You will be using your DMM on its dc range (except in Test 2, which uses the DMM's ac range) to measure the magnitude parameters of the waveforms at the adaptor's input. With such measurements, true-rms values can be determined from the relationships given in the table and then the adapter's true-rms readings can be compared with the anticipated figures to reveal any deviations.

In spite of the less-than-ideal waveforms used for the tests, accuracy of the adapter is remarkably good. Tests on the other waveforms in the table were not included here because they require use of an oscilloscope, which may not be available to you at this time.

Test 1. This is a direct-current measuring test. Set the adapter's range switch to 2 volts. Connect a nominal 1.5-volt dry cell to the input. The reading obtained on your DMM, when connected directly across the cell, might be 1.514 volts. Transferring the DMM on its 0.2-volt dc range to the adapter's output might now provide a reading of 151.1 which, after applying the range factor of 0.01 would give a reading of 1.511 volts (regardless of polarity of the cell at the input, the DMM reading at the output of the adapter will always be positive). The 3-mV discrepancy in this test represents an error of −0.2%.

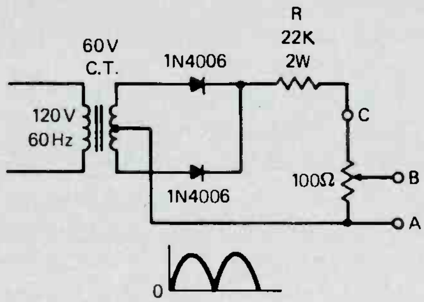
Test 2. In this test you will measure the true-rms value of a sine wave taken from the ac line, as shown in the drawing. Connect a 1000-ohm potentiometer across half the secondary winding of a 6.3-volt transformer and the test probes of your meter to points A and B. Make sure the meter's range switch is on 2 volts ac. Adjust the pot for a meter reading of about 1.8 volts. Select a reading of 1.801 volts.



WAVEFORM AT A−B

Set the adapter's range switch to 2 volts and the range switch of your DMM to the 0.2-volt dc range. Now, without disturbing the setting of the pot, plug the adapter into your DMM and touch the adapter's test probes to points A and B in the circuit. The meter might now read 1.792 volts (179.2×0.01), which calculates out to an error of −0.5%. This error is probably due mostly to inaccuracy of the DMM's ac function.

Test 3. In this test, you will be measuring the full-sine voltage from the full-wave rectifier circuit shown. Select a combination of *R* and transformer



WAVEFORM AT A−B

secondary voltage that will provide a drop of about 0.25 volt across the pot, as measured by your DMM when set to its 2-volt dc range and measuring between points B and C. The values shown are for example only.

Set your DMM to its 0.2-volt dc range and connect the test probes to points A and B. Adjust the pot for a meter reading of 170 mV. Set the adapter's range switch to 0.2 volt. Now connect the adapter's input to points A and B in the circuit and the meter's input to the output of the adapter. In our test, we obtained a reading of 189.8×0.001, or 0.1898 volt, as the rms value of the full-sine waveform's amplitude. The average value of the waveform is the 170-mV measurement taken at the start of the test. For an ideal full-sine waveform, the rms value is 1.111 times the average value. In this case, the ratio was 0.1898 to 0.1700, or 1.1165.

Test 4. For our final test, you will be measuring the half-square and square waveform, as shown in the drawing. Begin by connecting a 555 timer in its astable configuration as shown. With

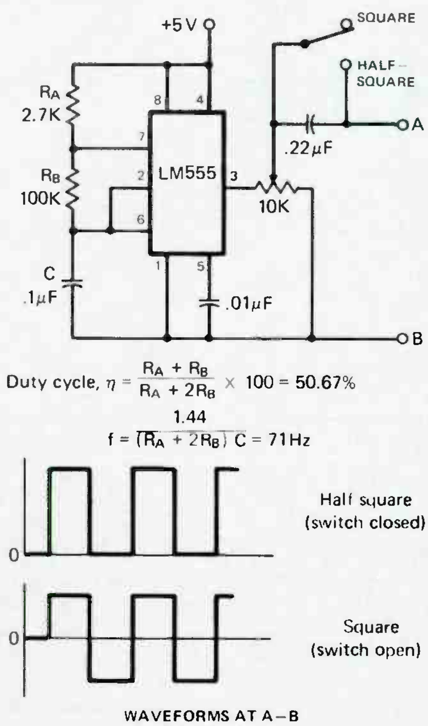
0.2-volt dc range) to *TP1* (see Fig. 3) and ground, and adjust *R11* for a zero reading on your meter.

Measuring rms values with the adapter is relatively simple, but certain limitations must be understood at the outset. One of these is that bandwidth is proportional to signal input. That is, greater bandwidths are achieved with higher-amplitude inputs. The manufacturer's curves for frequency-versus-input for the AD536AJD IC show the following:

input	−3 dB	10%	1%
0.2 V	600 kHz	350 kHz	60 kHz
0.1 V	300 kHz	200 kHz	40 kHz
0.01 V	45 kHz	30 kHz	6 kHz

This data pertains to the AD536ADJ itself, without regard to the effects of associated circuitry. For this adapter, these effects were minimized but were not measured for lack of suitable instruments.

Another performance error pertains to the crest factor (C.F.), which is defined as the ratio of the peak to the rms values. It is never less than 1

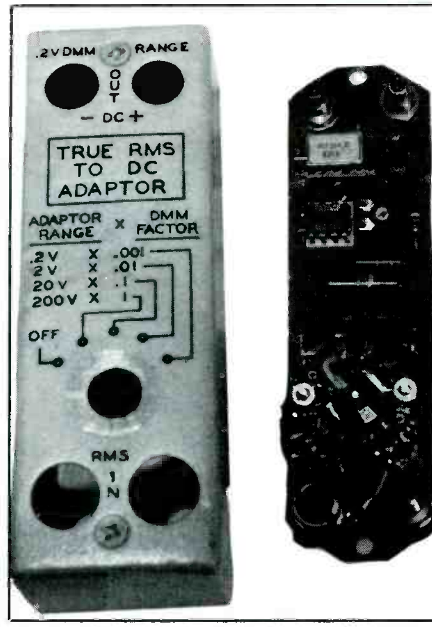


this arrangement and the component values shown, duty cycle of the circuit will be close to 50%, frequency will be about 70 Hz, and zero-to-peak voltage at pin 3 of the 555 will be close to the 5 volts of the supply.

For a half-square waveform demonstration, close the switch across the 0.22-μF capacitor. Connect your DMM, set to its 0.2-volt dc range, to points A and B and adjust the pot for a reading of 140.0 mV. Then transfer the DMM, without changing its range setting, to the output of the adapter, the latter set to its 0.2-volt range. In our test, the reading obtained at this point was 197.3 × 0.001, or 0.1973 volt as the rms value of the half-square waveform. For an ideal half-square wave of 50% duty cycle, the ratio of rms to average values is 1.414. Here, the ratio was 0.1973 to 0.1400, or 1.409 average.

For the square waveform test, leave the pot setting as it was above and open the switch. The waveform will not be symmetrical about the zero baseline and its zero-to-peak voltage at pin 3 of the 555 will be close to half the supply voltage, or 2.5 volts. With the DMM and adapter both set to their 0.2-volt ranges (the DMM on the dc function), we obtained a reading of 139.7 × 0.001, or 0.1397 volt for the rms value of the square wave. From the table's relationships, the rms value of a square wave is equal to the zero-to-peak value. In this case, it was 0.1397 versus 0.1400, which calculates to an error of −0.2%.

The Test 4 circuit also provides the basis for demonstrating how a true-rms measurement of a nonsymmetrical waveform is made when using an ac-coupled true-rms DMM. With such an instrument, ac and dc values must be measured separately and be entered into a formula. In the Test 4 circuit, when the switch is open, you have the equivalent of a true-rms ac-coupled DMM. The reading would be the ac component (0.1397 volt in this case). To obtain the dc component, you close the switch and read the dc voltage at points A and B with the DMM set to 0.2 volt dc. This reading would be 0.1400 volt dc. Using the formula $V_{rms} = \sqrt{ac^2 + dc^2}$, the result would be $\sqrt{0.1397^2 + 0.1400^2}$ = 0.19777 volt rms, which is very close to the 0.2000 ideal value.



Suggested panel legends for switch and jacks are shown at left. At right is the fully wired pc-board assembly.

and, for commonly encountered complex waveforms, may be as high as 10. For example, a rectagular pulse train with duty cycle η of 1%, C.F. is 10 (C.F. = $1/\sqrt{\eta}$). The AD536ADJ will handle crest factors of about 3 or less with little error. For a C.F. of 7, the error is −3%, subject to increases as input and duty cycle are reduced.

Another error in measuring high-C.F. waveforms has to do with the fact that the waveform must not be clipped in the measuring process. Since all energy in a pulse train is in the pulses, any clipping will produce a decreased rms reading. This can be avoided merely by switching *S1* to the 2-volt range, thus lowering the crest value by a factor of 10. However, since the adapter is designed for a 0.1-volt full-scale input, clipping is not likely to occur.

Input resistance to the adapter, being 10 megohms on all ranges, is relatively high but will create substantial errors due to loading when source resistance is relatively high. On dc, the error formula is $\%_{error} = [(R_{source} \times 100)/(R_{source} + 10\text{ megohms})]$. For a source resistance of 10,000 ohms, the error is only −0.1%, while for a source resistance of 100,000 ohms, the error will be −1%.

On ac, input impedance is frequency dependent. This error is in addition to frequency errors in the rest of the adapter circuitry. Because the 10-megohm input resistive divider has about 50 pF of capacitance across it, input impedance at 60 Hz is about 9.8 megohms. At 1000 Hz, impedance is about 3 megohms, and at 10,000 Hz, it is only about 300,000 ohms. Obviously, unless source resistance is low, say, less than 1000 ohms, the error for frequencies beyond 10,000 Hz will be considerable. **ME**

A Versatile Audio Amplifier Chip

How to use the popular LM386 IC in a variety of applications

By Michael A. Covington

National Semiconductor's LM386 integrated circuit is an easy-to-use audio amplifier that delivers as much as 0.4 watt into an 8-ohm speaker load. You can use this 8-pin chip in such projects as receivers, intercoms, alarms, and all types of battery-operated audio equipment. In this article we'll explore how to use the LM386 effectively.

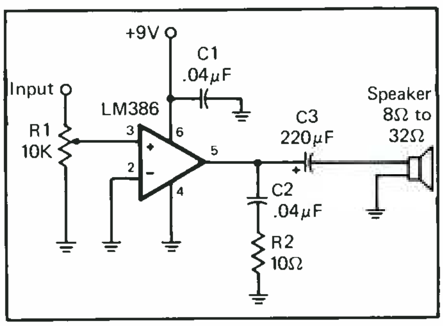


Fig. 1. Basic LM386 amplifier circuit. Place C1 as close as possible to the LM386 integrated circuit.

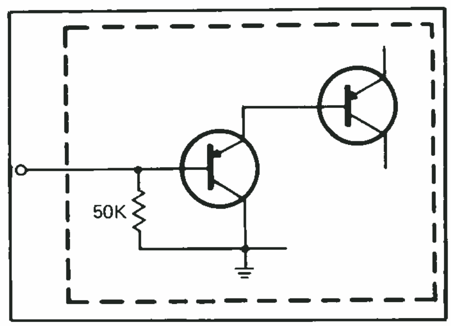


Fig. 2. An LM386 input's upside-down emitter-follower stage allows input voltage to swing below ground.

Low-Gain Amplifier

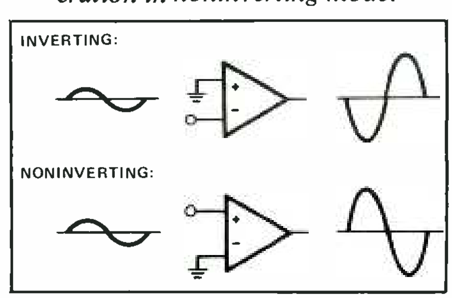
Figure 1 shows the simplest LM386 circuit, an amplifier with a voltage gain of 20. Its input can come from a tuner, a tape deck, or a crystal phono cartridge. (If you wish to drive this circuit from a magnetic cartridge, the LM386 circuit will have to be preceded by a preamplifier.) An output signal of about 400 millivolts peak-to-peak is sufficient to drive the speaker to full volume. This circuit is exactly what you need to use a speaker with a Sony Walkman or the like. Stereo sound, of course, requires two such amplifiers, one for each channel. Harmonic distortion in this circuit is well below 0.5% almost up to maximum volume.

In the circuit shown, potentiometer *R1* serves as a volume control. Its value determines the input impedance, which can be anything from 500 to 20,000 ohms. The value of *C3* can range from about 50 microfarads (which gives rather poor bass response) up to 1000 microfarads or more. Capacitors *C1 and C2* and resistor *R2* are needed to prevent high-frequency oscillation that would result in garbled sound. Although the manufacturer's literature states that these last three components are optional, I've found that trying to do without them is a very risky proposition. During assembly, be sure to keep all leads short and adequately isolate the input from the output.

If you use a 16-ohm or greater impedance speaker, supply voltage can be anywhere between 4 and 14 volts. With an 8-ohm speaker, however, keep supply voltage to less than 10 volts to prevent overheating the LM386. With a 4-ohm speaker, the supply should not exceed 7 volts.

It usually isn't practical to drive more than one speaker from a single LM386. However, if you must do so, connect the speakers in series rather than in parallel with each other to maintain a relatively high total impedance. The LM386 consumes very little power. The only significant power drawn by the circuit is what is

Fig. 3. In low-gain mode, LM386 can be used as noninverter (upper) or inverter (lower); high gain requires operation in noninverting mode.



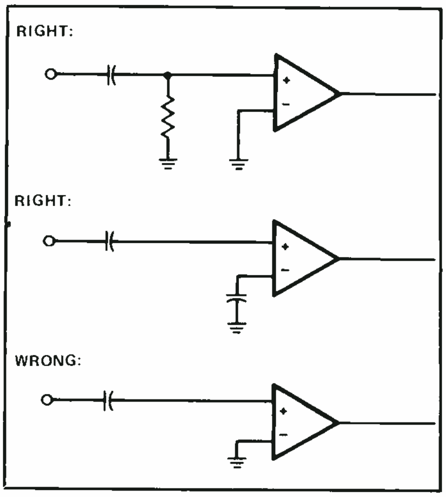


Fig. 4. For best results, provide a dc path from both inputs or neither.

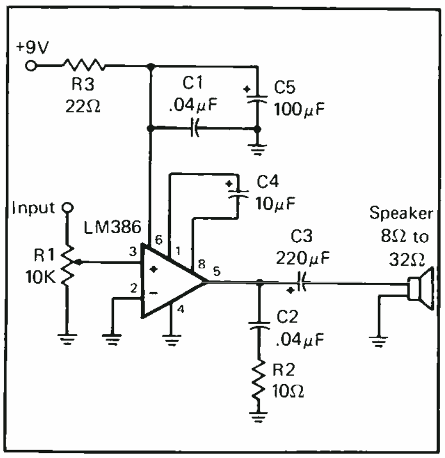


Fig. 5. In the high-gain mode, be sure to place C1 as close as possible to the IC, isolate input from output.

actually delivered to the speaker. With no input, current consumption is typically 2 mA. At moderate volume this increases to 15 mA and can go as high as 70 mA at high volume or when driving a large speaker.

The LM386 looks a lot like an operational amplifier, but there are some important differences to keep in mind. For example, unlike an op amp, the LM386 requires only a single positive supply voltage. Also the output at pin 5 is automatically biased to a dc level halfway between the supply voltage and ground, with *C3* preventing dc from flowing through the speaker.

In an operational amplifier, the inputs would normally be at the same dc level as the output. But the inputs of the LM386 operate at ground level, and the input signal can swing to either side of ground. Figure 2 shows how this is achieved—the input stage is an emitter-follower whose "ground" is actually the positive supply voltage. The internal 50,000-ohm resistor sets maximum input impedance.

Like an op-amp, the LM386 has both inverting and noninverting inputs (Fig. 3). In the low-gain circuit shown in Figure 1, you can apply the signal to either input, depending on whether or not you want it to come out inverted. Inversion has no effect on sound quality, and there is little reason to prefer one configuration over the other. For other applications, such as higher-gain amplifiers and oscillators, only the noninverting configuration will work.

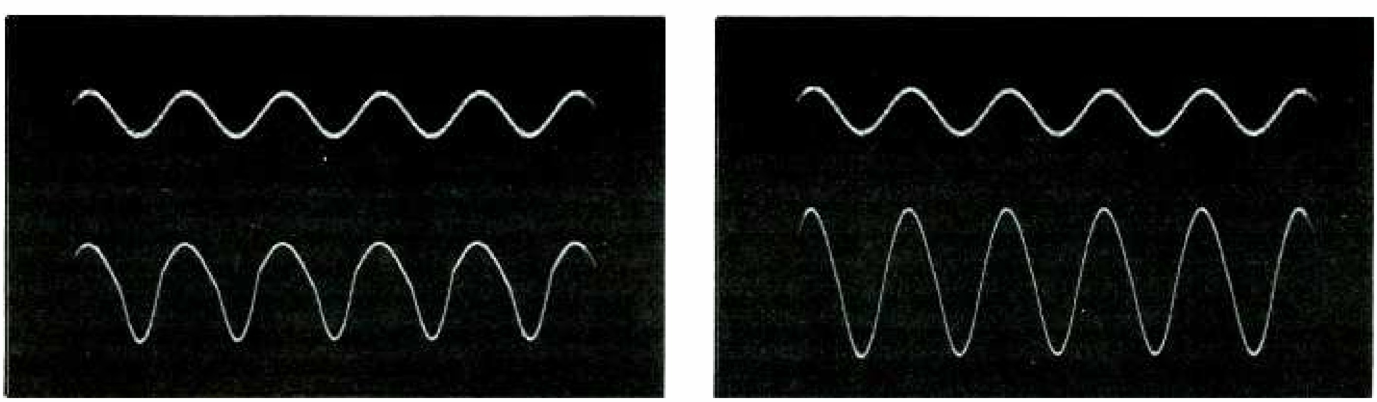
The LM386 performs best if the dc resistance to ground from both inputs is roughly the same ("roughly" here means within 10,000 ohms or so). If you ground one input, you should provide a path from the other one to ground through a resistor (Fig. 4). If the input signal is coupled to the LM386 through a capacitor, so that there is no dc path to ground, the other input should be grounded through a capacitor or simply left unconnected.

High-Gain Amplifier

Figure 5 shows the LM386 configured as a high-gain amplifier, with a voltage gain of 200. The main change here is that *C4* has been added to bypass an internal feedback resistor. Resistor *R3* and capacitor *C5* change the dynamic characteristics of the power supply.

Figure 6 shows why *R3* and *C5* are necessary. Without them, the LM386 suffers from noticeable distortion when driving a low-impedance (8- or 16-ohm) load. The distortion isn't affected by the signal level or the impedance of the signal source, nor by bypassing pin 7 to ground through a capacitor as suggested in the manufacturer's literature. In fact, the distortion surprised me so much that I

Fig. 6. Distortion in high-gain mode (left) is cured (right) by using R3 and C5 in Fig. 5. Top traces are input.



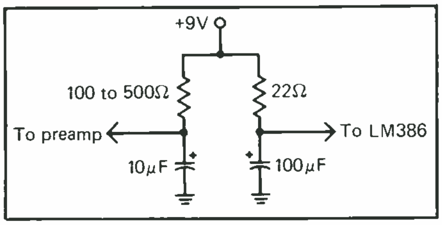


Fig. 7. Split power supply prevents feedback when using a preamplifier.

tried two LM386s from different manufacturing lots, just to make sure I wasn't dealing with a defective IC.

Apparently, the explanation is that the LM386 is designed to be battery powered, and the internal resistance of the battery is figured into its feedback network. The internal resistance of a 9-volt battery is between 10 and 100 ohms, whereas the resistance of a well-regulated power supply is nearly zero. So *R3* takes the place of the resistance of the battery, and *C5* is the bypass capacitor that would normally be used with battery-powered equipment. If the power supply is in fact a battery, or if the load impedance is more than 32 ohms, *R3* can be omitted.

Even a gain of 200 isn't quite enough to drive a speaker with the signal from a microphone, tape head, or magnetic phono cartridge. As mentioned earlier for the Fig. 1 circuit, an extra stage of preamplification is required. If the LM286 and the premaplifier are connected to the same power supply, feedback may cause oscillation—usually an audio-frequency squeal or a low putt-putt sound ("motorboating"). Figure 7 shows how to prevent this. The resistors and capacitors send the incoming power down two paths that are isolated from each other.

Figure 8 shows a complete amplifier for microphone-level input. Total voltage gain is about 4000. The transistor in the first stage can be any small-signal npn transistor with a beta (h_{fe}) of at least 50. For experiments, you can use a second 8-ohm speaker as a microphone; by doing this and adding a switch to interchange the two speakers, you have an intercom. In a high-gain circuit like this, it is doubly important to keep leads short and isolate the input from the output.

Oscillator Configuration

Finally, Fig. 9 shows how to use the LM386 as an oscillator. The output is a square wave with a frequency (in Hertz) of $2.5/(R_tC_t)$, where R_t is between 10,000 and 100,000 ohms. Because the circuit is designed to oscillate, the anti-oscillation measures used in the amplifier circuits aren't needed here, and the power supply voltage isn't critical. Also, since linear amplification isn't required, pins 1 and 8 can be joined by a direct connection, rather than through a capacitor.

If you connect a speaker in place of *R3* in this circuit, the output is no longer a square wave. Instead, what you hear will be a loud, piercing squeal that makes a good alarm sounder. The LM386 is an efficient noisemaker. It delivers a lot of sound for a small amount of battery power. To reduce the volume of the sound, connect a 10- to 300-ohm resistor in series with the speaker.

Going Further

Once you've mastered the LM386, you'll want to look at several of its relatives in the National Semiconductor line. The LM389 consists of an LM386 plus three individual npn transistors, all on one chip. This IC is often used to save space in radio receivers. The popular LM380 is a 2.5-watt power amplifier that requires a 12-to-15 volt supply and delivers a voltage gain of 50. Stepping up to the LM380's big brother, you come to the its big LM384, which delivers a hefty 5 watts of output from a 20-volt supply. You can begin immediately experimenting with the LM380 and LM384, since their external circuitry differs only in minor details from that of the LM386. **ME**

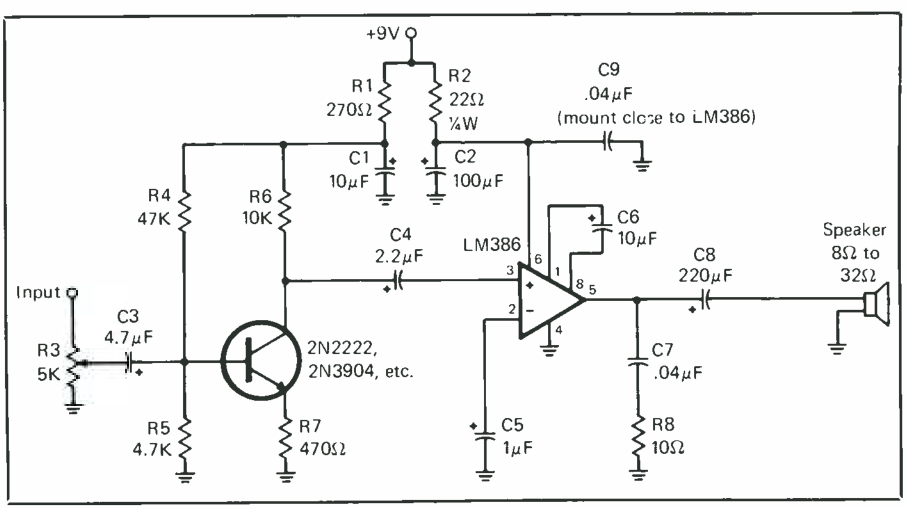
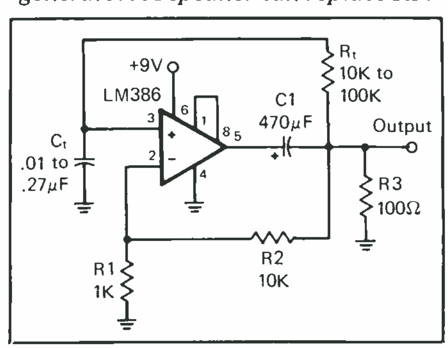


Fig. 8. A microphone amplifier circuit with total gain of about 4000.

Fig. 9. This is an LM386 square-wave generator. A speaker can replace R3.



ELECTRONICS NOTEBOOK

An Infrared Temperature Transmitter

By Forrest M. Mims III

The subject of this month's column may at first seem rather specialized. But even if your interests lie elsewhere, you may find some of the design principles and tips that follow applicable to subjects and projects more to your liking. With that in mind, let's now explore a solid-state method of transmitting temperature measurements over a beam of near-infrared radiation.

Why an Infrared Temperature Transmitter?

Obviously, an ordinary thermometer provides the simplest way to measure temperature. For remote temperature measurements, a solid-state sensor can be connected to a monitoring station by means of a wire cable. Suitable sensors include thermocouples, thermistors and silicon chips.

In some special applications, it's not practical or safe to connect a remote sensor to a monitoring station by means of a wire cable. For example, if the sensor is to be mounted on a moving fixture, adjacent to moving parts or near high-voltage circuits, a wire cable may get in the way or pose a shock hazard. Moreover, outdoor wires and cables are susceptible to lightning strikes.

Another special application is the measurement of temperature at various elevations in the earth's atmosphere. A temperature inversion occurs when a layer of cool air is trapped near the earth's surface by an overlying blanket of warm air. If the inversion persists over a few days, the trapped air can become heavily contaminated with automobile exhaust and other pollutants.

The measurement of temperatures at different altitudes is the application which led directly to the development of the system to be described. For this application, a radio or optical-fiber link is preferred, since it's not safe to connect a balloon- or kite-borne system to a ground station by means of electrically conductive wires. Lightning from thunderstorms is the obvious hazard. But it's important to remember that potentials as high as 50,000 volts have been measured on the lines of wire-tethered kites flown on perfectly clear days!

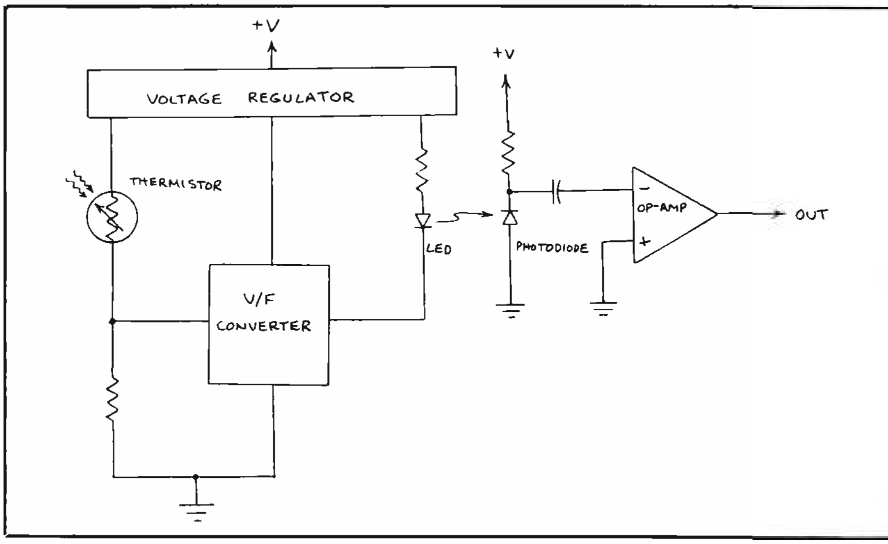


Fig. 1. Block diagram of an infrared temperature-sensing transmitter.

An IR Sensor System

Several circuit arrangements can be used to transmit temperature by means of an infrared (IR) beam. Figure 1 is a block diagram of the method I selected. Notice that the temperature-sensing element is a thermistor, a type of temperature-dependent resistor. Temperature-sensing integrated circuits like the LM334 and LM335 can also be used. They provide highly linear output with respect to temperature. Though thermistors are nonlinear, they provide a faster response time.

In Fig. 1, the thermistor is in series with a resistor to form a voltage divider. As the thermistor's resistance changes with temperature, the voltage at the junction of the thermistor and resistor changes. The resistance of thermistors is typically inversely proportional to temperature (resistance decreases as temperature rises). Therefore, the output from the thermistor-resistor voltage divider in Fig. 1 increases as the temperature of the thermistor increases.

The temperature-dependent voltage from the thermistor-resistor divider is applied to the input of a voltage-to-frequency (v/f) converter. The v/f converter generates a pulse train whose frequency is dependent upon the temperature of the thermistor. The output from the converter drives a LED. Note that both the thermistor and v/f converter are powered by a voltage regulator, which guarantees that the circuit will provide repeatable performance until the battery voltage falls below a usable point.

The infrared signal from the LED is detected by a receiver circuit, amplified, and coupled into a frequency meter. A calibration chart is then used to determine the temperature of the thermistor.

The receiver's detector can be a photodiode, phototransistor, solar cell or a LED that is identical to the one in the transmitter. The IR signal can be coupled to the detector directly through the air or via a fiber-optic cable. If free-space coupling is employed, a lens at both the transmitter and receiver can increase transmission range from a few feet to hundreds of feet. Using an optical fiber will provide a high degree of reliability and the signal will be unaffected by sunlight.

The IR Transmitter

Figure 2 shows a working infrared transmitter circuit based upon the block diagram in Fig. 1. I've built and tested several versions of this circuit. The final working version of the circuit is housed in a 2.3" × 1.2" × 0.6" plastic enclosure. The entire circuit, including battery, weighs less than an ounce.

Referring to Fig. 2, the thermistor and *R3* form the temperature-dependent voltage divider. Many kinds of thermistors will work with the circuit. I used an unmarked glass bead thermistor that has a room temperature resistance of 2500 ohms. Pages 202 and 203 of the current Newark Electronics catalog (No. 107) lists Fenwall Electronics glass bead and Yellow Springs Instruments Teflon™ coated thermistors with this and similar values. They range in price from about $3.60 to $10.00. However, since Newark has a $25 minimum order requirement, you might be better off to try to obtain the thermistor from a local electronics parts distributor first.

The v/f converter is a National Semiconductor LM311 chip, which can also function as a frequency-to-voltage (f/v) converter. Potentiometer *R8* provides the means to vary the output frequency of the LM311. It therefore serves as a calibration control.

Note that the LM311 directly drives the LED through *R10*. Almost any standard LED can be used. However, for best results, select a red or near-infrared AlGaAs or GaAs:Si device. I used a General Electronic GaAs:Si GLOE1A1 fiber-optic emitter. This device is housed in a plastic package equipped with a threaded coupler that mates with AMP Optimate™ fiber-optic connectors.

Referring back to Fig. 2, note that an LM350T serves as the circuit's voltage regulator. The circuit I built is powered by a miniature 7-volt mercury battery (Duracell™ TR175 or equivalent). The LM311 will function at a power supply voltage as low as 4 volts, which is the approximate output provided by the LM350T when *R1* and *R2* have the values shown. The regulator will provide a steady output until battery voltage falls to about 5.5 volts. Output voltage from the LM350T can be changed by altering the value of *R1*. For details, see the data sheet for this chip.

The IR Receiver

A suitable receiver for the near-infrared signal from the transmitter can be fashioned from any op amp and a photodetector. I tried a GFOE1A1 emitter identical to the one in the transmitter, a miniature solar cell and a photodiode. This arrangement worked well.

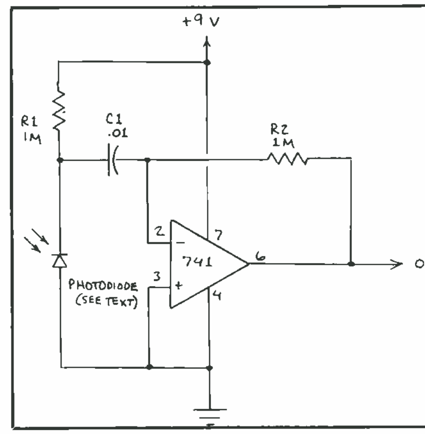
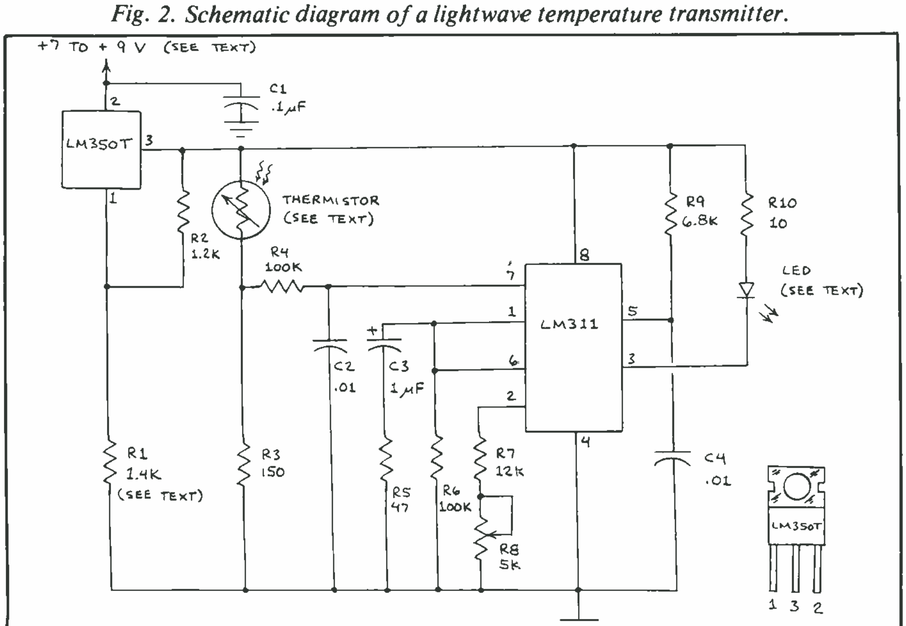


Fig. 3. Schematic diagram of a lightwave receiver for Fig. 2 circuit.

The output from the receiver can be coupled directly into a standard frequency counter or oscilloscope. If you don't have either of these instruments, you can make a simple but effective frequency meter from an LM311 or a 555. For details about an LM311 frequency meter, see the December 1984 installment of this column. A frequency meter designed around a 7555 (CMOS version of the 555) is given in *Engineer's Notebook II* (Radio Shack, 1982, p. 104). A 555 version of this circuit can be found in *Engineer's Mini-Notebook* (Radio Shack, 1984, p. 17).

Fig. 2. Schematic diagram of a lightwave temperature transmitter.



Calibrating the System

If your thermistor is the glass-bead type, you'll need half a cup of boiling water, a full cup of ice water and a thermometer to calibrate the temperture transmitter.

Begin by recording both the temperature of the hot water and the frequency produced by the transmitter when the thermistor is immersed in the water. Be sure to avoid immersing the leads from the thermistor in the water. Then add some ice water to the hot water and repeat the measurements. Continue adding cold water and making measurements until the cup is full. Then start making measurements of the cup of ice water.

For reliable measurements, the water should be stirred after water with a different temperature is added. Also, the thermometer should be allowed to stabilize for 30 seconds or so before the readings are made. You'll probably find that the thermistor settles down much faster than the thermometer. Incidentally, avoid suddenly transferring the thermometer from the hot water to the ice water or vice versa. The sudden temperature change might fracture its glass housing.

Here are the results of the calibration procedure for the temperature transmitter I assembled:

Temperature (°C)	Frequency (Hz)
2	103
4	114
13	166
21	217
28	285
35	369
39	421
45	510
53	649
60	795
78	1180

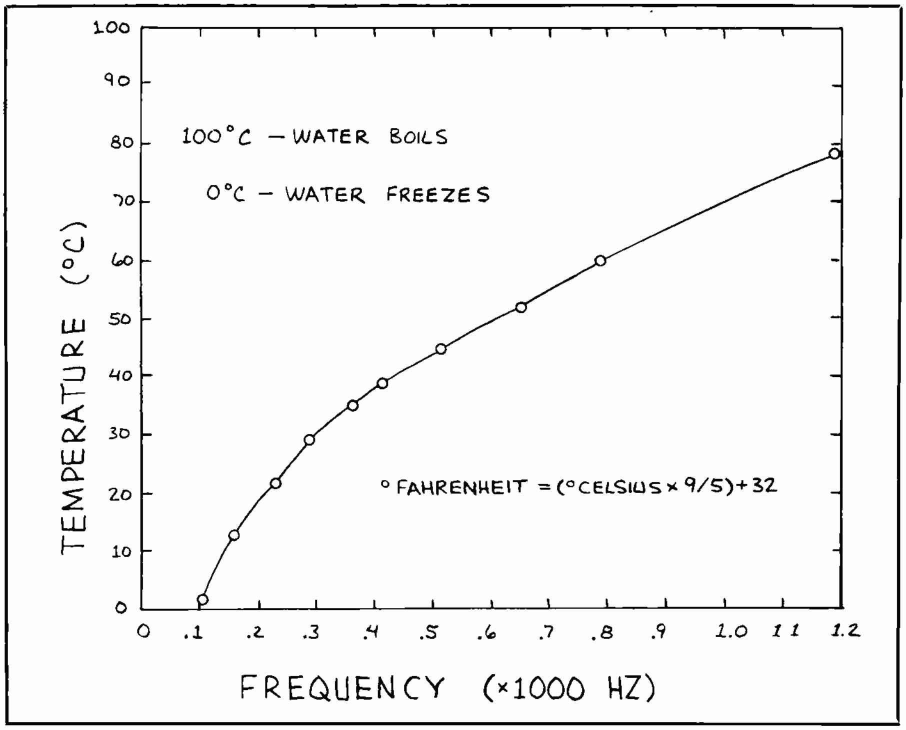


Fig. 4. Plot shows typical calibration curve for temperature sensor circuit.

Figure 4 is a graph of these measurements. Since the transmitter uses a thermistor as a temperature sensor, the curve is nonlinear over its entire range. Keep in mind that other thermistors will provide different curves.

You will have to modify the calibration procedure if your thermistor is uninsulated. Since you will be unable to immerse the thermistor into a fluid, one approach is to simply measure the temperature of the air at different times of the day. Then record the results and plot them on a graph. This method will not provide the range of the immersion method, but it will work.

Using the System

I designed this system to make temperature measurements from a helium-filled balloon flown to an altitude of up to 500 feet. For these tests, the temperature transmitter was dubbed the "Fibersonde." It was connected to the receiver by means of a 200-meter length of 200-micron ITT silica optical fiber wound on a kite spool. The receiver was coupled to a tape recorder so the data could be saved and read back later. For details about saving analog data on cassette tape, see the December 1984 installment of this column.

For previous experiments with airborne, remote-controlled cameras, I used commercial balloons. Unfortunately, such balloons are expensive and a good quality 4-feet diameter balloon costs as much as $18. Worse, such balloons are easily burst by inadvertent encounters with trees. Therefore, for flight tests with the Fibersonde, I used a cheap and rugged BPTB (Black Plastic Trash Bag) balloon. You can purchase a dozen BPTB balloons at any grocery store for under $2.00.

One cubic foot of helium lifts about 1.1 ounces. Allowing a 15% excess lift margin and assuming a total airborne package weight (balloon, Fibersonde and fiber) of 4 oz., then only about 3.6 cu-ft. of helium is needed to fly the system. This is equivalent to 26.9 gallons which means a 30-gallon trash bag will suffice.

Helium can be purchased from some welding shops and party supply stores. You'll need to borrow a regulator to attach to the gas cylinder. Expect to pay about a quarter per cubic foot for the gas plus a deposit for the cylinder and regulator. Be sure to handle the heavy gas cylinder with care.

The optical fiber I used for flight tests has a breaking strength of 10 pounds and could easily have doubled as a tether line. Because of nearby trees, however, I attached a nylon tether line to the balloon. That proved to be a wise move since a slight breeze caused the balloon to drift into the top of a tree. The trash bag was so rugged that it could be pulled from the branches without a puncture.

Figure 5 is a photograph of the Fibersonde suspended from a flying trash bag. Unfortunately, the system can be flown only when the air is almost perfectly still. Otherwise, the balloon drifts downwind and fails to reach a high altitude. An aerodynamically shaped balloon is required for flights when the wind is blowing. Unfortunately, such balloons cost hundreds of dollars.

Here are a few flying tips that will prove helpful when flying a balloon. Use only helium to inflate a balloon. Tie the free

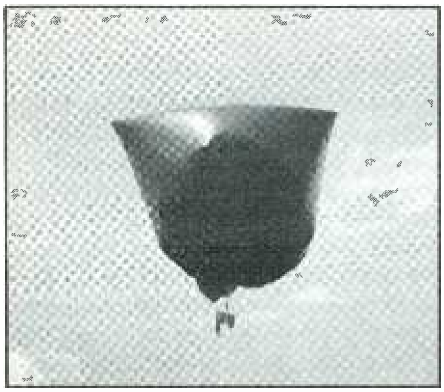


Fig. 5. Fibersonde suspended from a helium-filled black plastic trash bag.

end of the tether to an object on the ground so, if necessary, you can release the line and run toward the balloon. Avoid jerking on the tether when the balloon is flying low over trees or a building. Both the tether and the balloon may be pulled into the obstacle below. Never fly a balloon near an airport, power lines or high buildings. Finally, never use an electrically-conductive wire between the balloon and the ground.

Going Further

If you're interested in flying instrumented packages from helium-filled balloons or kites, you will want to refer to my "Experimenter's Corner" (*Computers & Electronics*, January 1983, pp. 28, 33, and 104 through 107). This article describes how to fly a radio-controlled Kodak disc camera, but the principles involved apply to any instrumented package.

If you want to transmit the infrared beam from the temperature transmitter directly through the atmosphere, you'll need to use a lens at both the transmitter and receiver. I briefly covered this subject in *Getting Started In Electronics* (Radio Shack, 1983, p. 65). **ME**

HARDWARE HACKER

Self-focusing photodiodes, where to get an EPROM burned, how Apple software tells one machine from another

By Don Lancaster

Some questions are asked more than others. This month, we'll answer three of the more frequently asked questions. So, without further adieu, let's get right to it!

The first is the *Scan-A-Matic* S27301, shown in Fig. 1. This looks like a miniature TO-18 metal transistor, except it has four leads and a plastic dome. Down the middle of the plastic dome is a fiber-optic light pipe. Cost is around $20.

Inside the package is an infrared light-emitting diode that shines through the entire plastic focusing dome, illuminating the object being sensed. The fiber-optic light pipe then transmits any reflected infrared light that it captures into the photodetector.

Operation is best when nearly touching whatever image you are scanning. A spacing of 10 mils or so gives you the highest resolution. One way to handle this is to put a clear and tough piece of plastic between the document and your scanner. This also protects the document from scuffing.

While fairly cheap and fun to use, the best resolution isn't quite good enough for serious scanning. In addition, certain inks will reflect infrared light nearly as good as white paper will, and some inks and ink colors just will not work at all.

Still, though, this is a great little device for such things as edge detection, robotics, sheet sensing, and stuff like this. It is also a cheap way to develop ideas and software, since the resolution can come later.

Our second self-scanner is the *Hewlett Packard* HEDS-1000, and is shown in Fig. 2. While not tiny and certainly not cheap at $45, HEDS-1000 offers your usual HP high quality.

This dude is packaged in an oversize round 8-pin package, like were once used for op-amps and military ICs. Sockets remain available, but once again, not at jellybean pricing.

The HEDS-1000 uses visible light, which greatly eases color and ink hassles. Besides, you can actually see it in action.

A totally different imaging means is also used. Instead of a fiber-optic light pipe, the LED and photodetector sit side by side inside the case. Each is focused with a plastic lens to form a tight sensing spot with excellent resolution. The optimum focus point is some $\frac{3}{16}$" from the case end. Usually, you will have a hollow plastic cap of some sort to hold this spacing for you. Something like a shortened penlight cap should work.

You can also get these as ready-to-use bar-code wands and readers at hoo-boy prices. Check into HP's *Optoelectronics Designers Catalog 1985* for details. Be sure to ask for a separate price list.

I've found a third source of self-focused photodetectors. But, judging from the stainless-steel case, the all-glass optics, and their snotty and elitist ads, the *Welch-Allyn* SS1D series products seem well beyond a hacker's budget.

There are zillions of possible new uses for sanely priced optically focused inputs to microcomputer. What new uses can you think of?

Where can I get an EPROM burned?

Any "old-line" electronics distributor will be happy to program an EPROM for you. All it takes is $300, and either an exact working and debugged EPROM for them to copy, or else the code submitted on punched paper tape.

They will alternatively accept your duodecimal code written in cuniform on fired clay tablets. Provided, of course, that you sort them properly and then pack them with a 0.03 cubit spacing of papyrus needs. Arrgh . . .

Probably the cheapest local way of getting an EPROM burned is to check your nearest hacker club, or leave a message on a regional electronic bulletin board. A complete list of most clubs and bulletin boards appears in *Computer Shopper.* Most clubs and bulletin boards have an up-to-date list of all the others in your neighborhood, so find one, and you have found them all.

I know of only one hacker EPROM burning service, and it is an excellent one. It's called *E-Tech Services* out of Everett, Washington, and they do good work. For input, they want a hex image stored on a binary file on an Apple disk. Presumably, they will eventually have a direct modem burn process, as well as a way to convert whats-their-name diskettes as well.

Cost is unbelieveably low, and varies with chip size—EPROM or theirs. Yes, they can handle anything up to the 27128 (16K × 8) EPROM you need for IIc monitor rework.

Where do I find a self-focusing photodetector?

There are very new uses for a combination lamp and photocell that focuses on a very small spot and sense black or white at that point. Naturally, these are essential for bar-code readers and product-identification code processing.

Above and beyond the totally obvious, you can put one of these into a plotter pen casing, and then use the plotter to scan artwork to "capture" it to computer files, either by tracing the image outline or by raster scanning it one line at a time. One obvious use of this is to copy a "cheat book" of typography fonts to capture complete large-type alphabets to disk with minimum fuss and bother.

Or, you can bolt a self-focusing scanner onto the side of the ribbon on a printer. This can give you a facsimile sending transmitter at a tiny fraction of the usual cost. The scanner converts white and black on the page into ones and zeros for your microcomputer. Once captured as a binary image on disk, you can send it over a modem to a stock printer anywhere in the world.

The really mind-blowing use of printed-document scanning is that you can capture the text message without having to hand key it! To do this, you scan the document into a bit-mapped image, and then use some elaborate machine-language software to figure out which characters go where. You will have the most luck if you teach your code a particular font first, and then stick with that font.

While considerably slower than a $100,000 document reader, this approach

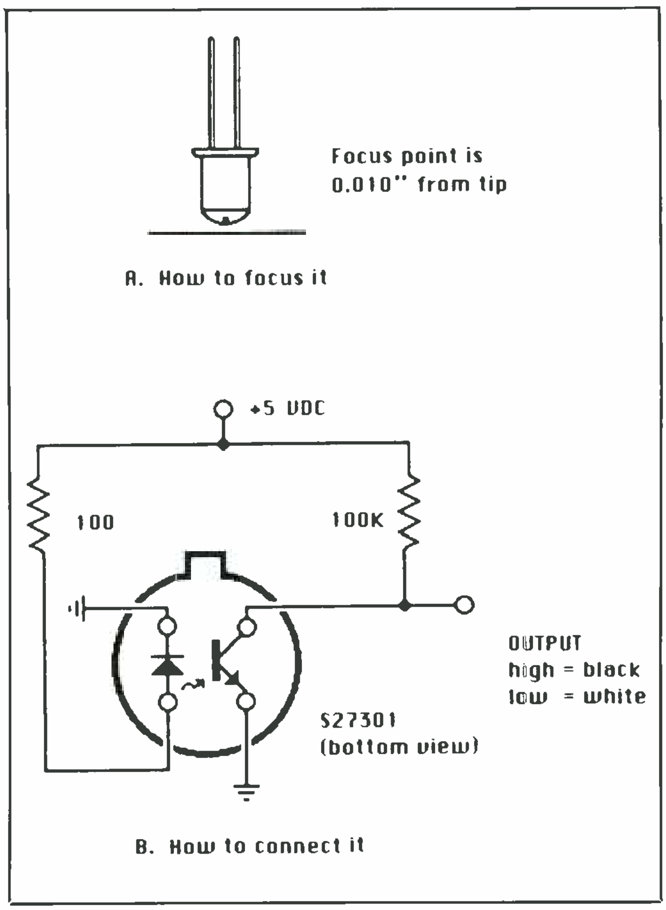


Fig. 1. The S27301 contains an infrared LED, fiber-optic light pipe, and phototransistor in a single package. Possible uses include barcode reading, artwork scanning, etc.

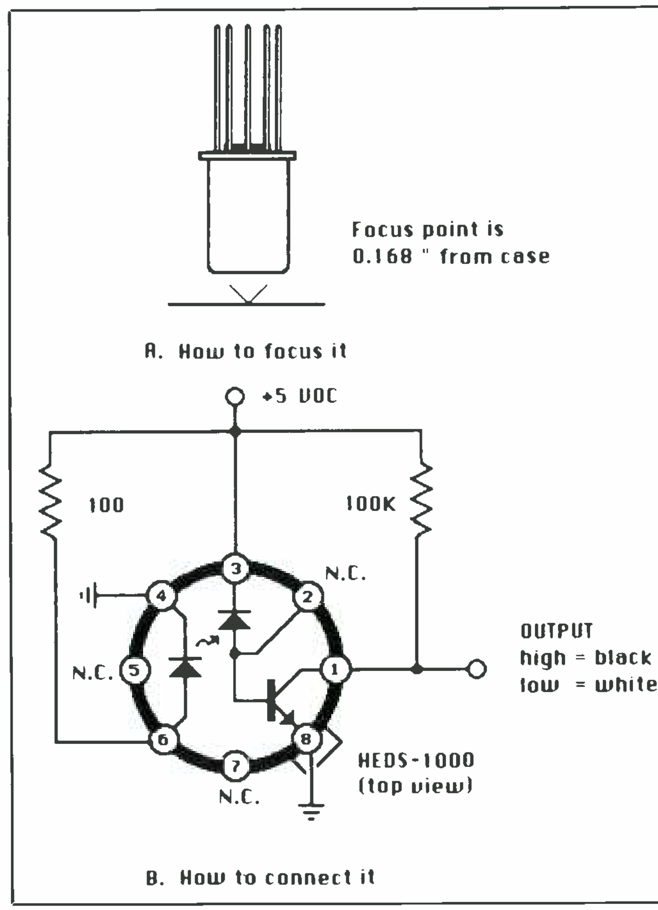


Fig. 2. The Hewlett-Packard HEDS-1000 is a larger and costs more than the S27301, but it has sharper focus, uses visible light, and readily handles color images.

is also $99,960 cheaper. A hundred thousand here, a hundred thousand there, it eventually adds up.

You can try taking any old LED or semiconductor laser and any old photodetector and working up your own optics. But, according to Hornschnable's first law of optics design, "If you design your own optics, all the light you want will disappear, and all the interfering light you don't want will completely swamp whatever it is you thought you were trying to accomplish."

How can Apple software tell one machine from another?

There are now bunches of "Apple Forever" machines. There are the Apple II, II+, III emulation mode, IIe "old" ROM version, IIe "new" ROM version, and IIc. Speculating, since both 16-bit *pin-compatible* 6502 enhancements and 256K RAMs are now being shipped in quantity, we can someday expect to see a few "IIx" enhanced variations here and there.

If you are writing Apple software, and if it is going to do its task well, you must test for each machine and then optimize your program for what is or is not available. Important things to check for are how much memory is present, 40 versus 80 columns, and whether a clock/calendar card is present.

There are two methods to find which machine the code has just been booted into. One method that always works is to read certain magic monitor locations. Another method that works only when ProDOS is in use is to read a magic ProDOS location. The ProDOS check will also tell you about memory size, eighty columns, and clock cards.

Here are the Apple monitor locations:

Machine	$FBB3	$FB1E	$FBC0
Apple II	$38		
Apple II +	$EA	$AD	
Apple III emulation	$EA	$8A	
Apple IIe, "old" ROM	$06		$EA
Apple IIe, "new" ROM	$06		$E0
Apple IIc	$06		$00

And here's the same thing out of Apple ProDOS:
Read location $BF98 and convert it to binary.

Apple II	00..	.0..
Apple II +	01..	.0..
Apple III emulation	11..	.0..
Apple IIe, "old" ROM	10..	.0..
Apple IIe, "new" ROM	00..	.1..
Apple IIc	10..	.1..
48K of memory	..01	....
64K of memory	..10	....
128K of memory	..11	....
80 columns ability	....	..1.
40 columns only	....	..0.
Clock card absent	....	...0
Clock card present	....	...1

Each dot in the above listing means "don't care." Thus bit zero is involved with compatible clock cards. Bit one handles 80 versus 40 columns. Bits four and five tell you how much memory is present. Bits two, six, and seven handle the machine ID. Bit 3 is reserved for another use.

The machine-language BIT command is one easy way to isolate single bits for analysis. For instance, an LDA $#01 followed by a BIT $BF98 followed by a BEQ GOTCLOCK will take the branch if a clock card is present. More details on such funny goings-on appear in my *Assembly Cookbook for the Apple IIe* (SAMS 22331).

More useful information on ProDOS appears in the *ProDOS Technical Reference Manual* (Apple Workbench #030-0360A) or in *Beneath Apple ProDOS* by Quality Software.

You can tell and "old" IIe from a "new" one in that the "new" version displays "APPLE IIe" on bootup, has a faster and smoother screen scroll, includes a mouse nest, a 65C02 CPU, and accepts lower-case BASIC commands. Reasonably priced upgrade kits should be available from your Apple dealer by the time you read this.

Names and Numbers

E-Tech Services
Box 2061
Everett, WA 98203
(206) 337-2370

Quality Software
21601 Marilla St.
Chatsworth, CA 91311
(818) 709-1721

Hewlett-Packard Co.
1820 Embarcadero Rd.
Palo Alto, CA 94303
(415) 857-8000

Scan-A-Matic
Box S
Elbridge, NY 13060
(315) 689-3961

Welch Allyn
Jordan Rd.
Skaneateies Falls, NY 13153
(315) 685-8351

Need Help?
Phone or write your hardware hacker questions and comments directly to:
Don Lancaster
Synergetics
Box 809
Thatcher, AZ 85552
(602) 428-4073

NEW PRODUCTS ...

(from page 15)

Loaded with features, the new receiver offers eight-band coverage in 16 preprogrammable channels, including: low-vhf (30 to 50 MHz), high-vhf (148 to 174 MHz), uhf (450 to 470 MHz) and uhf-T (470 to 512 MHz) Public Service bands; 2-meter (144 to 148 MHz) and 70-cm (420 to 450 MHz) Amateur radio bands; and military land mobile (138 to 144 MHz) and federal government land mobile (406 to 420 MHz) bands. Rated sensitivity is 0.8 μV on the vhf and 1.0 μV on the uhf bands.

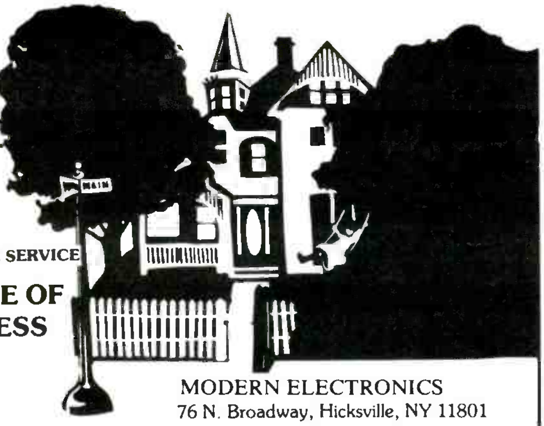
Among the Bearcat 180's features, you will find: adjustable VOLUME and SQUELCH controls; a 0 through 9, plus decimal point and ENTER programming keypad; a nine-key OPERATION keypad; flourescent numeric channel/frequency display; and a telescoping whip antenna. Functions include: a 16-channel programmable memory; patented Track Tuning for optimum reception; automatic and manual up/down scanning; priority channel select; automatic lockout; direct channel address; auto search; and selective scan rate (5 to 15 channels/second). The ac-powered unit measures 9½"D × 9"W × 3"H and weighs 3.5 lbs. $249.95.

CIRCLE NO. 103 ON FREE INFORMATION CARD

Probe-Type Auto-Range DMM

A compact probe-type digital multimeter that features auto-ranging on all functions, audible continuity test, data hold and rfi/emi shielding has been introduced by B&K-Precision. The Model 2802 DMM has a 3½-digit liquid-crystal display (LCD), with annunciators for function, polarity, low-battery condition, and over-range indication. It measures dc voltage in five ranges from 200 mV to 500 volts, ac voltages in four ranges from 2000 mV to 500 volts, and resistance in six ranges from 200 ohms to 20 megohms full-scale. Basic dc voltage accuracy is rated at ±0.7%, and all functions are overload protected.

When a DATA HOLD switch is pressed, the meter "freezes" the displayed reading and allows the probe



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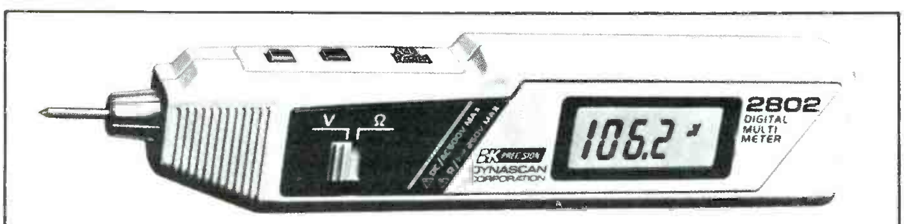


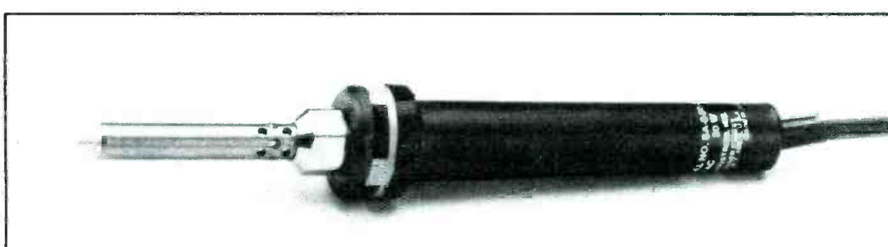
tip to be removed from the point of measurement for easier reading. Data hold is selectable for all measurements. In the continuity test function, an audible tone is sounded for resistance below a threshold of approximately 150 ohms. Supplied with the DMM are interchangeable short and long probe tips (the latter for convenient use when a measurement point is in a tight or difficult-to-reach location), ground lead and alligator clip, two 1.5 volt cells, and instruction manual. $55.

CIRCLE NO. 101 ON FREE INFORMATION CARD

Lightweight Soldering Irons

Two compact, lightweight soldering irons that feature heavy-duty ceramic heaters for maximum thermal efficiency and reliability have been announced by OK Industries Inc. Designated the Series SA-8, these industrial-grade irons quickly come to working temperature and provide rapid heat recovery after use. High insulation resistance (100 megohms) makes then ideal for soldering static-sensitive components without the need for grounding. The 15-watt Model SA-8-15 offers a maximum tip temperature of 698° F (370° C), while the 20-watt Model SA-8-20 of-

(Continued on page 92)



Desktop Accessories

By Art Salsberg

Once upon a computer time—like about a year or so ago—a software gem called "Sidekick" startled the computer fraternity. It contained a handful of neat utilities that could be stored in a computer's memory while a main program like a word processor was being used, and brought to the screen at any time for use at the press of a key. Like a calculator or a notepad or an appointment book or a phone book whose telephone numbers may be chosen for automatic dialing. Another key press and you're back to your main program. For $49.95 (now five bucks more), it was an instant hit.

A bevy of other software makers introduced similar products with some enhancements . . . at higher prices. Here are some comments about "Sidekick" and a costlier popular desktop utility, "Spotlight," for contrast.

Sidekick by Borland International. For IBM PC and compatibles. Single disk. $54.95 ($84.95 unprotected).

This program provides a group of pop-up windows that can be chosen at will while in the middle of another program or as a stand-alone program. They're designed as substitutes for devices or material that you otherwise might have to keep at hand on your desk, such as a calculator, appointment scheduler, calendar, notepad, phone dialer, and ASCII table that gives hexadecimal and decimal values.

The program is called up by pressing the control and alternate keys at the same time, then choosing the accessory you want by selecting it from a menu, pressing the appropriate function key or alternate key and an accessory's reference letter (C for calculator, for example).

Additional window accessories can be called up, whereupon they sit to a side one atop the other. To get back to an earlier accessory, one simply eliminates windows in succession by pressing the escape key for each accessory discarded. Windows can be moved anywhere on screen.

The calculator promises to be a workhorse for everyone, displaying up to 18 digits and four decimal places that appear in the screen drawing's calculator display window. It also features a calc memory, and hex/binary modes. Moreover, you can insert the results right into the work you were doing on the main program.

Another sure-to-be-used accessory is the Notepad. This is a full-screen editor with some WordStar-like commands. With it you can search, replace, sort, insert, save, time stamp, input data, etc. A nice touch, too, is being able to change the width of the notepad to the full width of the video display. A number of function keys line the bottom for quick and easy reference.

An appointment calendar is a handy tool to have, too. Sidekick's is set up in half-hour slots. You can pop up a month's calendar, too, to complement what you are planning.

The telephone directory and automatic phone dialing provision are useful features, as well. You must have a Hayes-compatible modem, though, for dialing automatically.

A help file can be popped up, too, by pressing the F1 function key. Assistance is very friendly. An installation file gives you some flexibility in terms of colors used, size of windows, etc.

Sidekick worked without a hitch with WordStar, dBase II, and Lotus 1-2-3 programs. I hear tell, though, that it doesn't work with *every* program. You should also keep in mind that Sidekick (and similar programs) resides in RAM, so have plenty of memory to spare, since it takes up around 64K by itself.

Summarizing, Sidekick is a very useful, bargain-priced package.

Spotlight (Version 1.1) by Software Arts. For IBM PC, XT, AT, and compatibles. Single disk. $149.95.

Like Sidekick, Spotlight has a bunch of fine desktop accessories in computer soft-

Sidekick with two accessories.

Spotlight's Appointment Book.

ware form. It costs almost three times as much as Sidekick, so let's see what it does for the extra money.

For starters, some of Spotlight's windows are bigger. The program also has some refinements on basic accessories. For instance, its appointment book can be divided into 15-minute increments, there's an audible alarm signal that can be programmed to be triggered according to the time set no matter what accessory you're using, guide marks indicate overlapping appointments, weekly meetings can be automatically posted to daily schedules, and date and time are always displayed on the video screen.

An index-card file is an added, very welcome accessory that allows you to set up 500 "cards" with up to 36 different categories. It has convenient sort, goto, and search provisions.

Its phone book can store up to 18,000 phone numbers, which are automatically sorted, as well as accommodating notes such as addresses. You can view individual "cards" that include phone number, address, contact person, and other notes or whole listings of first lines that contain name and phone numbers. Auto dialing is included, which was not incorporated in the earlier version (1.0) of Spotlight. As with Sidekick, a Hayes or compatible modem is required to take advantage of the auto-dial feature.

Also added to this latest version is Kaleidoscope, which allows you to select and save a different set of colors for each accessory; foregrounds, backgrounds, window frame, etc. Sixteen foreground and eight background colors are available to choose from. Not using a color monitor, this was not tried out.

Other new upgrades expand Spotlight's utility. These are IBM AT support, operation with 80-track high-capacity diskettes, printing or filing of multiple pages in the appointment book, and a snow/no-snow option for users of non-IBM color card with an IBM Personal Computer or vice-versa.

Spotlight's calculator is a neat, uncluttered one that offers paste and quit functions, the latter obviously transferring the numbers to a program you're working with prior to calling up Spotlight. The 12-digit display isn't as great as Sidekick's 18-digit one, nor is there a binary/hex mode that programmers will love, but for most purposes it does its job very well indeed.

The note pad is just what the name says it is. With more limited memory capacity than Sidekick's, however, it might rightly be called a memo pad. It's a nice accessory, though not as powerful as its less costly competitor's is.

Finally, Spotlight has a DOS filer to allow users to manage their disk files, with move, copy, rename, delete, disk formatting, and other functions—all without leaving the program to get into the DOS command level. Nice!

Accessories are called up by holding down the Shift and Alternate keys and typing a key letter for the utility you want, such as "N" for note pad. Accessories can be moved on screen, too, and multiple ones can be brought up one atop another. On-screen help is readily available whether using or not using an accessory by pressing the F1 function key.

Like other RAM-based desk organizers, substantial memory is used. In this instance about 10K more than Sidekick. Moreover, Spotlight is half protected, if there is such a thing. To explain, the core program has to be loaded into memory, while accessory programs must reside on a disk, which could be your program disk, for calling them up. You can make copies of the accessories, but Spotlight permits making only two backup copies of the core program, after which copy protection goes into effect.

Spotlight worked perfectly with the major applications programs previously cited. Like Sidekick, though, it won't work with all programs, with the software maker observing that Spotlight uses keyboard and timer interrupts; so it won't be compatible with programs that eliminate these, such as the XYWrite word-processing program. Nor will it work with nonstandard screen modes.

This desktop organizer program is without doubt a fine, slick one. Coming from the house that developed the venerable VisiCalc spreadsheet, we're not surprised that this is a powerful tool.

Which to Buy?

Given a choice of one or the other desktop organizer examined here (there are a handful of others now on the market, too, one might consider), which one is the better buy, you may wonder.

Comparing the two, Spotlight is slicker. If you've got an IBM AT or equivalent, this is the way to go. Should you need lots and lots of phone number listings with accompanying notes or value a mini-data base highly, I'd say the same. On the other hand, if you're a programmer or want very much to have the capability of making considerable notes on a note pad, Sidekick looks like the best bet. It is, too, if you simply don't have the extra loot. ME

"Hands-On" Look At Useful New Consumer Electronic Products

By Eric Grevstad

In 1973, Roger Moore wore one of the first digital watches (an LED-equipped Hamilton Pulsar) in *Live and Let Die;* the same year, my dad paid $100 for a four-function claculator. Today, watches and calculators have liquid crystal displays (LCDs), and cost $5 and up. What Q gave 007, John Q. Public can get at K Mart.

Desktop computers and laser discs are dazzling, but some of today's best things come in smaller packages: electronic gadgets with serious uses. This might be smart typewriters, super-calculators, home and health monitors, talking watches, etc. I'll also look, from time to time, at above- and below-average entries from the growing pile of electronics mail-order catalog offerings.

I want to stress the part about serious uses. A good gadget starts as a gimmick to impress your friends, and then becomes indispensable. Digital watches are good examples, and a good way to start this column, I think, is with two watches that store names and numbers, letting you carry your phone book on your wrist.

One is from Japan's watch wizards, Casio; the other (though made in Hong Kong) carries the trusty Radio Shack label. Radio Shack's is cheaper, narrowly better as a phone directory, and includes a calculator. Casio's is a superior, immaculately engineered timepiece.

Five Alarms, 50 Numbers

Casio's Data Bank watch comes in either black plastic (Model DB-50, $44.95) or handsomer, heavier chrome (Model DB-500, $59.95). Its display shows the hours, minutes, seconds, day, date, month, and year; the touch of a button gives a light for convenient night viewing, and another switches between 12- and 24-hour formats.

The Casio's also a 1/100-second stopwatch, with a lap feature to freeze the display while timing continues. Another timer sounds a countdown alarm after one to 60 minutes, useful for reminding you that your laundry's finished or that it's time to feed your parking meter or your nap's over.

Casio "Data Bank" digital wristwatch.

Alarms, in fact, are the Data Bank's specialty. Besides a daily alarm and optional hourly chime (the worst feature of the digital watch age, the curse of theatergoers from 8:55 to 9:05), you can set up to four more alarms for specific times and dates. Each of these bears a six-letter message (for instance, an alarm and the word DOCTOR for 2:45 on July 17).

The appointment alarms and memos foreshadow the watch's data capabilities: it stores up to 50 "pages," each containing up to six letters and 12 numbers. Pages are filed alphabetically, and scanned with the forward and reverse keys beneath the LCD.

Filling pages is a painstaking process; you enter data one character at a time, scanning backwards and forwards through A-Z or 0-9. For example, to type SMITH, you hold down the forward button until the first character reads S, then press another button to move to the next space, then reverse a few times to change from S to M, and so on.

The Casio's letters, formed from a 5 × 5 LCD matrix, are wonderfully sharp. Numbers are laid out less elegantly—six small spaces, four large ones (the first of which, where the 1 in times like 12:46 appears, is rather skinny), then two more small ones. Still, the phone list's quite readable, though paging back and forth through 50 entries can mean a few second's delay in finding one.

What's best about the Casio is how smoothly it operates; compared to older watches, it's more convenient despite having more functions. Being able to set the time in either direction, back one hour instead of forward 23, is a godsend; besides the usual beeps as you cycle through various modes, there's a higher-pitched one when you return to the time display (letting you complete the cycle without looking). Such small touches make the Casio most impressive.

Different Features, One Flaw

If the Casio is a slick businessman's aid, the Micronta memory watch (Radio Shack catalog #63-5060, $29.95) is an engineer's tool—and not just because, like all calculator watches, it's ugly. (Wear this watch, and you might as well dress for dinner with a plastic pocket to carry your pens: not only are there 16 buttons to push, but it has a metal band that needs a screwdriver, instead of a buckle, for adjustment.)

The Micronta offers 12- or 24-hour timekeeping of hours, minutes, and seconds; various buttons show the month, date, and daily alarm setting. Press the mode button and you have an eight-digit, four-function calculator; the buttons are fairly easy to push with your fingernail or a pencil, and there are negative and error/overflow indicators.

There's no light, no hourly signal, and you can only set the time forward, but those are minor flaws compared to the Micronta's LCD window: its LCD characters are thin, faint, and hard to read. It's difficult to see the time at a glance, and the phone directory is a poor try at forming letters from the familiar digital-watch (tiny diagonal strokes fill out the usual rectangle).

Something like the Casio's dot matrix display would be welcome because the Micronta *is* an ingenious and efficient data device. Rather than making you flip through the alphabet, it lets you pick a letter by pressing two buttons: four keys summon the series A-H, I-P, Q-X, and Y-Z respectively, then the numbers 1 through 8 select corresponding letters. (To get E, you press the A-H button followed by 5; for Q, press Q-X and 1.)

This process makes entering data, and retrieving specific names, quicker. The watch stores up to 40 sets of seven letters and 10 numbers; finding a name is as easy as choosing its first letter (if there are several names under that letter, pressing the button repeatedly rotates among them).

Once a name's on screen, press the equals button and its number's cleverly displayed, with the first three digits (area code) shown for several seconds before the last seven.

This precision, plus the convenience of figuring my bank balance or restaurant tips on my wrist, made me wish the Micronta was more readable. Except for the faint LCD, it's an appealing alternate to the fancier Casio—and, if you have a jeweler's screwdriver, you can change its battery yourself, instead of needing a Casio dealer with Case Opener B.

Micronta memory digital wristwatch.

Radio Shack's Micronta alcohol breath analyzer is meant for party-goers who wonder if they have had one too many drinks.

Casio, ads tell me, makes a memory watch that's also a calculator (plastic CD-40, $39.95; chrome CD-401, $49.95). It looks nice, but it only stores 10 sets of names and numbers. So Micronta is the winner here with 40 sets.

Huff, Puff, Drunk

Finally, to get away from watches, Radio Shack sent another gadget: an alcohol breath tester (catalog #63-665, $34.95), also with the Micronta label though I've seen it elsewhere under the name Blotron. It's a pocket version of your police department's breathanalyzer; as the box (showing a champagne glass, confetti, and car keys) implies, it's meant for party-goers who wonder whether they've had one too many for the road.

After the battery-powered unit warms, waving its needle and blinking its red, yellow, and green lights, all you do is blow into it. The device measures the amount of alcohol in your breath, and therefore in your blood; a reading of 0.1 percent, the legal limit in most states, lights the red light.

The analyzer works as advertised, and the instruction booklet has some useful information about alcohol and its effects on the body. Should you spend $34.95 on it? I've got mixed feelings because anyone in a condition to consider using it is already in no condition to drive.

At 0.1 percent you are seriously, dangerously smashed, one-quarter of the way to death from alcohol poisoning. Some states, more wisely, set the drunk driving limit at 0.05 percent.

That's probably where I was the night I tested the unit, swilling seven glasses of wine with a beer chaser; I was stumbling around the apartment in no shape to drive an armchair, but I rated only a yellow light ("We recommend you do not drive") from the Micronta. I lit the red light by having a slug of gin and blowing immediately, my mouth still wet. I couldn't make myself drink enough to light it honestly.

The indicator's an interesting piece of hardware, but anything that might make anyone think it's safe to drink and drive raises my hackles. It's certainly a conversation piece, though, especially at a party.
ME

Shortwave-Station News And Listening Tips

By Glenn Hauser

Shortwave broadcasting, still little known to the American public, is a vital and growing medium worlwide, and even in the U.S. itself, as a look at the major developments since our last column will bear out. All times and days mentioned are UTC— subtract 4 hours for EDT, 5 for CDT, 6 for MDT, 7 for PDT, etc.

Brasil. Though the AM and FM bands are clogged by many hundreds of stations, there's still a great deal of interest in duplicating programming on shortwave, to reach every remote corner of this vast country. In order to accommodate 49-meter-band stations as well as possible, almost all of them are changing frequency. Here's the new plan, approved by the International Frequency Registration Board, and supplied by Claudio R. Moraes. It's not clear when all these changes will be complete:

5955 R. Gazeta, Sao Paulo
5965 R. Pampas, Porto Alegre
5970 R. Itatiaia, Belo Horizonte
5975 Ceara R. Clube, Fortaleza
5980 R. Guaruja, Florianopolis
5990 R. MEC, Rio de Janeiro
6000 R. Guaiba, Porto Alegre
6000 R. Cultura da Bahia, Salvador
6010 R. Inconfidencia, Belo Horizonte
6020 R. Educadora da Bahia, Salvador
6020 R. Gaucha, Porto Alegre
6030 R. Tupi, Rio de Janeiro
6040 R. Clube Paranaense, Curitiba
6050 R. Guarani, Belo Horizonte
6060 R. Universo, Curitiba
6070 R. Capital, Rio de Janeiro
6080 R. Jornal do Comercio, Recife
6080 R. Cultura, Foz de Iguacu
6090 R. Bandeirantes, Sao Paulo
6105 R. Globo, Rio de Janeiro
6120 R. Globo, Sao Paulo
6135 R. Aparecida, Aparecida
6150 R. Record, Sao Paulo
6165 R. Cultura, Sao Paulo
6175 R. Nacional, Brasilia

Powers range between 1 and 25 kW except for 6175, 250 kW. This will cause a terrible interference problem with BBC via Antigua if it actually goes into effect.

Canada. Here's how the dust settled at RCI following budget cuts. Weekend programming, formerly largely localized for different target areas, is now consolidated. *Canada a la Carte,* the Saturday magazine program, can be heard at 1805 on 17820, 15260; 0005 Sunday on 9755, 5960. *Listeners' Corner* is at the same times on Sundays, plus 1905 on 17875, 15325. *SWL Digest* is now heard Saturdays at 1935 on the same; 2135 on the same plus 17820, 15150, 11945; Sundays 2305 on 11710, 9755; Mondays 0305 on 9755, 5960.

China. Radio Beijing has released a new schedule showing exact times of programs within its 55-minute broadcasts. *Daily* 00-15 World, domestic, sports news. 16-21 Commentary. *Sun.* 22-31 China Anthology, 31-44 Music Album, 44-55 Listeners' Letterbox. *Mon.* 22-31 Across the Land, 31-38 Economic Horizons, 38-48 Music Feature, 48-55 Learn to Speak Chinese. *Tue.* 22-34 Travel Talk, 34-41 General Feature, 41-44 Music, 44-55 Listeners' Letterbox (repeat). *Wed.* 22-32 In the Third World, 32-37 General Feature, 37-43 Martha [an American] in Beijing, (biweekly), 43-48 Music, 48-55 Learn to Speak Chinese (repeat). *Thu.* 22-33 China in Construction, 33-39 General Feature, 39-55 Culture in China. *Fri.* 22-31 Profile, 31-39 The Land and the People, 39-48 Cultural Interchange, 48-55 Listeners Calling (biweekly). *Sat.* 22-31 Chinese Folktales, 31-39 China Scrapbook, 39-55 Music from China. Radio Beijing has also been distributing some marvelous multicolored and delicate paper cuts commemorating the Year of the Ox.

Curacao. Though it has never transmitted from here, Radio Earth originated its programming from this southern Caribbean island when it began two years ago. It has used the facilities of Radio Clarin, Dominician Republic; WRNO, New Orleans; Radio Clarin again; considered trying WINB in Pennsylvania, and plans to use NDXE in Alabama (see U.S.A.). Its long term goal, however, has been to establish its own transmitter. Earlier this year, a plan was announced to raise $750,000 by selling stock to listeners, to set up a transmitter on Curacao. If this succeeds, Radio Earth would become the first (partially) listener-owned international shortwave station.

Mexico. After 24 years of silence, XEQQ has been reactivated on 9680.3 kHz, relaying XEQ from mediumwave. The weak signal seems to operate between 1300 and 2400 UTC; it was first reported by Mike Shockley in Oklahoma.

Netherlands. A new complex of 500-kilowatt transmitters in Flevoland went into full operation March 31, and Radio Netherlands reorganized its schedule, increasing the number of daily English broadcasts. Not all of these are beamed to North America, but they should be audible in some parts of the continent. (B = Bonaire relay, M = Madagascar relay). 0430 on F11720, F9895. 0730 on B9630, B9715. 1030 on B9650, B6020. 1130 on F17605, F15560, M21480, M17575. 1430 on F17605, F15560, M17575, M11740. 1630 on M9515. 1830 on B21685, B17605. 2030 on F11740, F11730, M9715, M9540. 0130 on F9895, F6020. 0230 on B9590, B6165. 0530 on B9715, B6165. Programming includes a Documentary on Monday; *Dutch Cultural Magazine* and *Dutch by Radio* on Tuesday; *Media Network* on Thursday; *Shortwave Feedback* on Saturday; *Happy Station* on Sunday.

Suriname [non]. An alliance seems to have developed between the anti-Castro forces of La Voz del CID, and the movement to overthrow Suriname's revolutionary government. CID has turned over a quarter hour daily of airtime to Radio Free Suriname, around 2030-2045 UTC on Radio Camilo Cienfuegos, 11680 and 9940 kHz; in Dutch and Sranan-Tongo.

Switzerland. If you've been searching in vain for SRI's morning edition of *Dateline,* or its weekend features like *SW Merry Go Round,* Saturdays at 1315 UTC, here's why: for reasons unknown, the single North American frequency for this transmission, 17765, was to be dropped after May 4. Listeners who want this transmission back should write SRI.

United Nations. UN Radio is making slow progress in expanding operations. English at 1900-1930 has remained Mon.-Fri., instead of Fridays only as is the case with other transmissions and with this one in the past during the off-season when the General Assembly is not in session. Listen on Greenville 21710 and 15120 AM transmissions; or 18782.5, 15650, 10454 LSB.

U.S.A. It always takes longer than expected to put a new shortwave station on the air. June is now the target month for NDXE in Opelika, Alabama, mentioned in previous columns. The 100-kW transmitter (with an ERP of 4.5 megawatts) is located on a farm off I-85 which has been in entrepreneur Dickson Norman's family for a hundred years; the main building features Southern Colonial style architecture. Initial languages will be English, Spanish and Portuguese; NDXE claims a potential worldwide audience of between 400 and 800 million, and thus a very low cost-per-thousand of 25¢, for ads costing between $2000 and $5000 per 30-second spot (a great many times higher than WRNO, for example, which has a transmitter of the same power). Norman expects to attract major multi-national advertisers, even tobacco companies which are not prevented from advertising on U.S. shortwave stations. But the major source of income is to result from direct mailorder offers; everything from bluejeans to large appliances shipped through the Port of Mobile—something akin to the "World's Largest Store" concept of the original WLS, Chicago. A wide variety of programming is planned, in AM stereo, from sports to Grand Ole Opry to disaster fundraisers to kidshows, but no politics. Also worldwide weather, stock market reports, features on science, art, religion, humor. Program schedules are to be published in 'major newspapers of the world.' An initial staff of about 30 is to be expanded to 300 as the station grows with additional higher powered transmitters. Norman says President Reagan is expected to throw the power switch putting "In Dixie" on the air sometime in June.

Salt Lake City is the site of another commercial shortwave station under construction, KRSP Worldwide; Carlson Communications already operates AM & FM there. The shortwave outlet seems to be envisaged as a way to allow western culture and advertising to reach Europe, on a schedule between 1700 and 0600 ranging between 16 and 49 meters.

George Otis of High Adventure Ministries in California not only plans to put KVOH on this summer from Simi Valley, California, but also set up equally powered stations on a 10 kiloton freighter in the South China Sea by Easter 1986, and in Lebanon by Thanksgiving 1985 (where he already operates a lower-powered station), which together could blanket the world with Otis' version of the gospel.

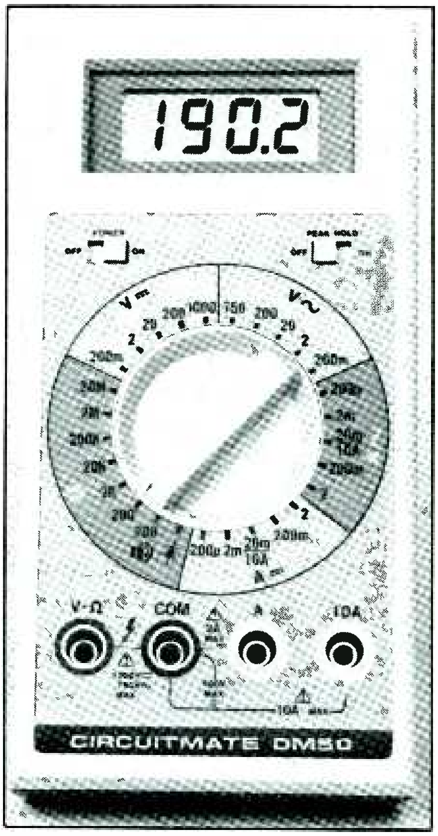
Other slow-starters, which may be on the air by now, are KCBI in Dallas, profiled previously, and WMLK in Bethel, Pennsylvania, both of which first tested on the air some six months ago. Kenneth Vito Zichi has looked into the ideology of the Assemblies of Yahweh, operator of WMLK. Though Christian, unlike other evangelical organizations, Yahweh does not emphasize Jesus, but instead the fine points of Biblical interpretation and dietary laws akin to Judaism.

Still more private shortwave stations, commercial or religious, are in various stages of planning for San Francisco, Louisville, Louisiana, Atlanta, Guam, Puerto Rico. WRNO is reportedly thinking about adding a second transmitter.

They all might well envy the Voice of America, which, with President Reagan's blessing, has embarked on a billion-dollar improvement program. Ground has been broken and construction is underway at new sites in Morocco and Sri Lanka. Israel finally approved a new VOA site there, but it could take five years before it's ready to go on the air. VOA is considering direct satellite SW broadcasting, for another gigadollar. The antenna would be the largest object ever orbited. **ME**

PRODUCT EVALUATIONS . . .

Beckman's Model DM50 continued . . . (from page 13)



ate, and rugged enough to survive the rigors of the field-service kit. And it's reasonably priced at only $99.95.

General Description

Designed along traditional VOM lines, the DM50 has only three controls, all of them switches. One is a large, easy-to-grip bar-type rotary switch that simultaneously selects function and range. Arranged around the perimeter of this 28-position switch are range legends on light and dark grey backgrounds, grouped according to function. Five major groupings cover dc volts, ac volts, dc current, ac current and resistance. In the resistance group there are two special positions, one for making diode/transistor junction tests and the other for making continuity tests with both meter display and audible indication. The remaining switches, both slide types, are for turning on and off power and switching in and out a peak-hold function.

Numeric values of parameters being measured appear in seven-segment format in a recessed liquid-crystal display (LCD) consisting of 3½ decades of ½"-high numerals. The display is a high-contrast type, with numerals appearing in dense black on a silvery background for easy reading under almost any ambient lighting conditions. The DMM's electronics automatically causes a minus sign to be displayed for negative values of dc voltages and currents. Overrange is indicated by a "1" or "−1" (no trailing zeros) at the left side of the display, while "LO BAT" tells you that it's time to replace the battery.

Along the bottom of the DMM's front panel is a horizontal row of four color-coded jacks into which the instrument's lest leads plug. Coding is as follows: red for the "hot" input jack for the voltage and resistance functions, white for the two "hot" input jacks for the current function, and black for reference.

All four inputs jacks are recessed well below the front surface of the instrument and are designed to accept hooded test-lead plugs. This arrangement is designed to provide operator safety when working in high-voltage circuits and protection for the instrument from contamination and other hazards during operation. Operator safety is further enhanced at the other end of the cables. Here you'll find plastic probe handles with anti-skid ridges and molded-on guards to prevent fingers from slipping and coming into contact with the metal of the probe tips.

On the back of the DMM's case is a fold-flat plastic bail that, when deployed, serves as a convenient tilt stand. With the bail folded flat, a pair of positive-grip plastic strips on the back of the case come into play to prevent the DMM from being easily swept off the work surface.

The DM50 is powered by a single 9-V transistor battery, located in a user-accessible well in the lower-rear section of the case. Depending on the type of battery used (carbon-zinc or alkaline), you can expect 150 or more hours of operating time before replacement is necessary.

Size and weight of the DM50 are about average for a hand-held DMM. The instrument measures 6.85"H × 3.55"W × 1.4"D and weights 9 oz., including battery but not test cables.

Technical Details

As do most other modern DMMs, the DM50 provides a full complement of voltage, current and resistance measuring functions, as well as a now common diode/transistor junction-condition test function. Unlike most DMMs its price class, however, the DM50 also offers a continuity test feature that sounds a high-frequency audio tone when it detects a continuity of less than 100 ohms and provides a numeric display of values up to 200 ohms, regardless of whether or not there's a tone. This is a handy feature to have if your work involves checking out long cable runs, and the like.

Another handy feature is the peak-hold function previously cited. Selecting this function gives you displays of peak values of ac and dc voltages and currents. (With peak-hold disabled, the DM50 displays average values.) Peak-hold captures voltage and current peaks of as short as 6 ms in duration. The reading is updated, rather than being merely "frozen" as in data-hold systems.

Electrical specifications for the DM50 are quite comprehensive. A brief rundown of them will give you a good idea of the versatility of this instrument. Leading off with dc voltage, you'll find five ranges that go from 200 mV to 1000 volts full-scale. Accuracy is specified at ±0.5% of reading + 1 digit. Overload protection is to 500 volts dc and 350 volts ac on the 200-mV range and to 1200 volts dc and 850 volts ac on all other ranges.

On ac, there are also five ranges, with the same full-scale capabilities as on dc volts, except for the highest range, which goes to 750 volts. Accuracy on ac is specified at ±1.25% of reading + 3 digits. Overload protection is to 500 volts dc and 350 volts ac (both for 15 seconds maximum) on the 200-mV range and to 1200 volts dc and 850 volts ac on all other ranges. Rated frequency response is 40 to

1000 Hz up to the 750-volt range and 40 to 400 Hz on the highest range.

Input impedance on all ac and dc voltage ranges is the industry-common 10 megohms. Resolution in both cases is 100 μV.

Full-scale ac and dc current ranges are identical at 200 μA, 2 mA, 200 mA and 2 amperes, with a 10-ampere range selected by setting the range/function switch to the 20m/10A position and plugging the hot test lead into the 10A jack. On dc, accuracy is rated at ±1.0% of reading + 1 digit from 200 μA to 200 mA and ±2.0% + 2 digits on 2 and 10 amperes. On ac, accuracy is ±1.5% + 3 digits between 200 μA and 200 mA at 40 to 1000 Hz and ±2.5% + 4 digits on 2 and 10 amperes at 40 to 400 Hz.

On all ac and dc current ranges, overload protection is provided by a 2-ampere, 250-volt fuse, except for the 10-ampere range, which is unfused. Voltage burdens are also identical on both ac and dc, rated at 250 and 700 mV on the 2- and 10-ampere ranges, respectively. Ditto for resolution, which is 100 nA.

The resistance cluster is busiest, because there are more ranges and this is where you'll find positions for the diode-test and continuity functions. There are six basic resistance ranges, in decade steps that go from 200 ohms to 20 megohms full-scale. Accuracy ranges from ±0.75% of reading + 1 digit on the 2-k to 2-M ohm ranges to ±2.0% + 5 digits on the 20-megohm range. Maximum test current ranges from 50 nA on the 20-megohm range to 2 mA on the 200-ohm range. Overload protection is to 250 volts dc and ac.

Test voltage in the diode/transistor-junction test function is 3.2 volts, enough to assure forward conduction of silicon junctions in- and out-of-circuit but not to cause reverse breakdown.

Peak-hold accuracy is rated at ±5% of reading + 10 digits on dc volts and amperes and ±10% + 12 digits on ac volts and amperes.

How It Performed

To test the DM50, we used a number of precision-tolerance (1% and better) resistors and both a fixed precision voltage reference source and variable 0.5-to-50-volt dc power supply. Additionally, we performed comparisons between the DM50 and Beckman's Model HD110T hand-held 3½-digit DMM (see "Product Evaluations," November 1984) and a 4½-digit "laboratory-grade" DMM.

Without belaboring the point, we can report that the DM50's accuracy checked out well within Beckman's published specifications in all areas in which we were able to conduct definitive tests. We assumed that the 4½-digit DMM, because of its higher-resolution display and better electrical specifications, was the most accurate of the three DMMs and, therefore, used it as a "standard" against which we compared the DM50.

Ac voltage tests revealed what some people might term "significant" differences between the readings obtained with the DM50 and the 4½-digit DMM. At ac-line levels, the discrepancy amounted to about 7 volts. However, the significance of this discrepancy must be tempered by the fact that the 4½-digit instrument, priced at more than $500 in current catalogs, uses more expensive circuitry to provide compensation that yields a truer rms value than is possible with the DM50's average-value-calibrated circuitry. At the much lower ac voltages normally encountered in modern solid-state circuits, measured differences with all three DMMs weren't anywhere near as great as at ac-line levels. Here, the DM50's accuracy was more than sufficient for all but critical laboratory work.

For the type of work we do, we find no urgent need for the peak-hold function, though we can well appreciate its inclusion in the DM50 for those people who do need it. More to our liking is the continuity test function, if only because we have a more than occasional need for it. It eliminates the need for an extra piece of test gear on the workbench and lets you focus your full attention on circuit tracing, rather than having to keep one eye on the display. It worked well, especially when used to trace the conductor runs on densely packed printed-circuit assemblies. However, this function may not be exactly what the doctor ordered if you happen to be one of those people whose high-frequency hearing is very limited. The pitch of the audio tone is quite high, higher than it need be.

User Comment

While the Beckman Model DM50 may not deliver the stellar performance of laboratory-quality 4½-digit DMMs, it's at least worthy of a good supporting role in any service facility, whether on a test-bench or in the field. What it does, it does well, reliably and accurately. Nor is it lacking in bells and whistles. The pluses here, which include the audible continuity tester and peak-hold functions, should be given careful consideration if you're in the market for a new DMM, not to mention its full complement of measuring capabilities.—*Alexander W. Burawa*

CIRCLE NO. 149 ON FREE INFORMATION CARD

"There are separate manual sections for each of the four programs supplied."

Sinclair "QL" Computer

(from page 35)

Since no screen scrolling is involved, this program is fast, and a high-resolution graphics screen allows you to display an enormous amount of information. Text is added to the graph using a cross-wire cursor that allows you to easily cruise around the screen and place text wherever you please. A "Key Box" shows the meaning of your different colors. You can even use several common math and trig functions to calculate, evaluate, manipulate and then display your data.

If I had to use one word to describe QL Graphics, I'd choose the word "incredible!"

Up and Running

Getting the QL up and running is very straighforward. After you connect all peripherals, you plug the power supply into the QL and into the ac outlet to turn it on (there's no switch on the power supply).

I used a monochrome monitor initially, then a good RGB monitor later to check the colors. When you apply power to the QL, the screen comes up with a message directing you to press F1 for Monitor or F2 for TV. In so doing, you're actually determining if you'll initially be displaying 42½- or 85-character lines.

The big surprise here is that, regardless of whether you press F1 or F2, you get a three-window screen display. A large window on the left side is white, the same size window on the right side is red, and there's a black section at the bottom. If you pressed F1, the cursor and characters are small. With F2 you get large characters.

Actually you're in SuperBASIC at this point, without even using a cartridge. The left screen is for program listings, the right side for program display. The bottom is for program entry and editing. Unless you've used Sinclair computers before, this is weird!

In this mode, you can have 42½ characters on a line in each window. Opening the screen to a full-width window takes the command WINDOW 512,256,0,0 (which took considerable hunting through the manual to find!) Then you can get a single full-width screen with up to 85 characters on a line.

Just to compare operating speed, I wrote this simple BASIC program loop to count to 1000 on the screen:

```
10 FOR X = 1 TO 1000
20 PRINT X,
30 NEXT X
```

The comma at the end of line 20 provides for "zone printing"—automatic spacing on a screen line. I tried this program on six different micros. The little Radio Shack MC-10 was the fastest at 14 seconds, using two zones on a line. Next was the TRS-80 Model III at 23 seconds, with four zones on a line. The QL printed ten zones on a line and took 28 seconds. The Sanyo MBC 550 took 32 seconds, using five zones on a line. The Coleco ADAM, with two zones on a line, took 42 seconds, and the Timex 2068 Color Computer, with two zones on a line, required 55 seconds.

Although the QL printed ten numbers on a line very quickly, the screen scrolling slowed it down. Comparatively slow screen scrolling appears to be a QL characteristic, in fact.

The BAUD command, typed at the keyboard, changes the QL baud rate to match your printer setting. I used BAUD 9600. In addition, it was necessary to address the printer with PRINT #5 after using OPEN #5, SER1 to open that channel. LIST #5 provided a means of printing a LISTing on the printer. I had to do some digging in the User Manual to figure this out, but otherwise the printer connection was less trouble than usual with serial interfacing.

Documentation. The three-ring notebook QL User Guide is impressive in size and content. Tabbed dividers separate 10 sections, with a total of 400 pages overall. The printing is clear, and there are many illustrations and screen prints.

There are separate manual sections for each of the four programs supplied with the QL. These are well-illustrated with screen displays, and run from 27 to 54 pages for each.

The documentation I had was for the English QL, and it was considerably better than the user manuals I've gotten with most other computers. One section (The Concepts) goes into considerable hardware and software details, right down to pinouts for the various connectors.

I found that I had to refer to all three of these sections at times to grasp the use of some advanced commands. This, coupled with many errors and omissions in the manual, caused some frustration and loss of time. However, I understand the manual is being rewritten for the American market, so it should benefit from the exposure to scrutiny and criticism in England.

Conclusions

Decidedly, Sinclair's QL computer is "different." In its modest price class, it's much more powerful than any of its prospective competitors, combining 128K of main memory that's expandable externally to 640K and a 32-bit (internal) microprocessor.

Considering that the QL also comes with the most powerful BASIC language I've ever seen, a built-in sophisticated operating system, and four free software packages, as well as two built-in data storage drives, one certainly gets a lot for his money with this machine.

Color capability, networking provisions, ROM/cartridge slot, joystick and dual serial ports, et al, only add to the QL's value.

Many people in the U.S., however, may not find its "stringy floppies," the Microdriven cartridges, an en-

"Dual disk drives are already available in England."

dearing feature. Much better than conventional cassette drives, it is no match at all for disk drives in access speed. Nonetheless, it does indeed work well and gives a user immediate accessibility to convenient dual-storage-devices. At the QL's moderate price, this is quite an accomplishment.

The cartridges themselves are exquisitely small and easy to use and store. Moreover, I was impressed at how quickly and easily short programs written in SuperBASIC could be SAVEd and LOADed using Microdrives. However, when the programs supplied with the QL were employed—especially the Word Processor—times were not much better than an audio cassette's.

Sinclair Research Managing Director, Nigel Searle, advises that single and dual disk drives (up to 800K storage) are already available in England, so QL upgrade provisions are on the horizon. Even a 7.5-M Winchester drive is said to be available! These peripherals simply plug into the QL.

Searle also says that a host of other QL peripherals are being sold in England, namely a Centronics parallel interface; IEEE-488 interface; memory expansion boards to a half-megabyte; software such as assemblers, Forth interpreter, Pascal compiler, a 68K CP/M; and various programs such as the World Microcomputer Chess Championship joint winner, 3-D Chess.

Furthermore, other QL-oriented equipment and software is under development by Sinclair and third parties, including a modem, an analog-to-digital converter, a C compiler, a 68000 assembler, and a terminal emulator to tie the QL into a mainframe. Sinclair will distribute various QL peripherals in the U.S. market, he says, and expects third-party vendors active in England to follow the QL to the U.S.

So what we have here is not quite a start-up situation since the established Sinclair Research Company has already shipped 50,000 QLs in England in 1984. How quickly and what types of peripherals will enter the U.S. is a question mark, of course, with much depending on the success of the basic QL machine here.

In Great Britain, our information indicates that the QL is viewed as a computer for experimenters and hobbyists who want a machine at an affordable price that has real utility. A QL Users Bureau is being set up to give QL owners access to program updates and the latest technology developments and applications. Club dues are $50, for which one will get six newsletters and software support.

Certainly, the QL is probably too hot to handle for a beginner who is not dedicated to taking advantage of all that the QL has to offer, especially since it's not compatible with any software in the U.S. So the market in the U.S. would seem to exclude the novice who isn't serious about learning the ins and outs of computers and the larger businesses. Experimenters and hobbyists may well love this machine, however, since one can hook any variety of peripherals to a choice of many external connections, and spend many hours mining the power of its superior BASIC and challenging applications software.

Whether a window of opportunity exists for a computer of this type in the U.S., where it is not suitable for larger businesses or the first-time computer dilletante, is an open question. We'll find out soon enough when Sinclair starts shipping its QL, which will be sold by mail, as they indicate they will by the month of May.

IF YOU OWN A

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(from page 77)

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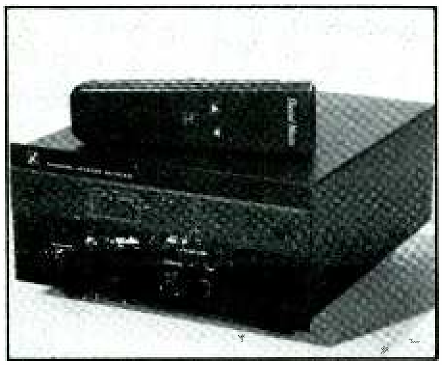

Satellite Antenna Motor Drives

Two new motor drives, both stressing simplicity of operation and reliable performance, have been added to Channel Master's Satscan line of satellite TV antenna positioners. The basic Model 6253 features pushbutton controls for simple up/down operation, while the more sophisticated Model 6252 builds on this by adding an infrared remote-control system with hand-held transmitter. As a user pushes either button to move the dish antenna, he compares the LED readout with satellite locations recorded by the installer on a permanent satellite locator card.

Both models use solid-state circuitry (instead of mechanical relays) to eliminate motor-drive "hang-up." Power is provided by a 36-volt dc source. Featured are nonvolatile memory, heavy-duty ball-screw linear-actuator drives, and protective weatherproof expandable jack bellows and motor boot. $395 for Model 6153; $495 for Model 6251.

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Satellite TV Receiver

(from page 39)

and the host of various features such as channel memory and antenna positioning control, as well as its modest price.

You do give up some things, though. For example, the receiver isn't designed to drive video and audio inputs of a high-definition color TV receiver/monitor. (Actually, changing a couple of resistors would enable you to do this, but you need an excellent, strong signal coming in due to severely lowered sensitivity when this modulation is done.)

Though stereo-capable with its composite video outputs, you'd have to buy a separate stereophonic audio processor to drive your audio system. Nor is the receiver equipped with Dolby noise-reduction facilities and it's missing channel-scanning control, as well.

But the foregoing are luxuries. Our only real reservation might be with regard to the 430-to-930-MHz i-f receiver frequencies Regency selected. A 950-to-1450-MHz range is preferred to avoid interference from local uhf TV stations. If this is a problem in your area, you might try a notch filter to get rid of the offending interference. Otherwise, you'll have to pay the higher price that a higher-frequency receiver demands.

In sum, then, the Regency home TV satellite receiver is a fine unit and a good value so long as you're not looking for every conceivable frill and you don't need great freedom from signal interference. And if you can share the cost with others or need independent channel tuning in an apartment or motel installation, the Regency's independent-channel-selection versatility is an important feature as compared to the single-channel reception provisions of satellite receivers with typical 70-MHz electronics instead of a block downconverter's very broad range that brings all channels to all TV receivers simultaneously. **ME**

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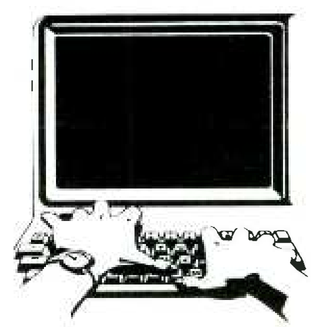

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