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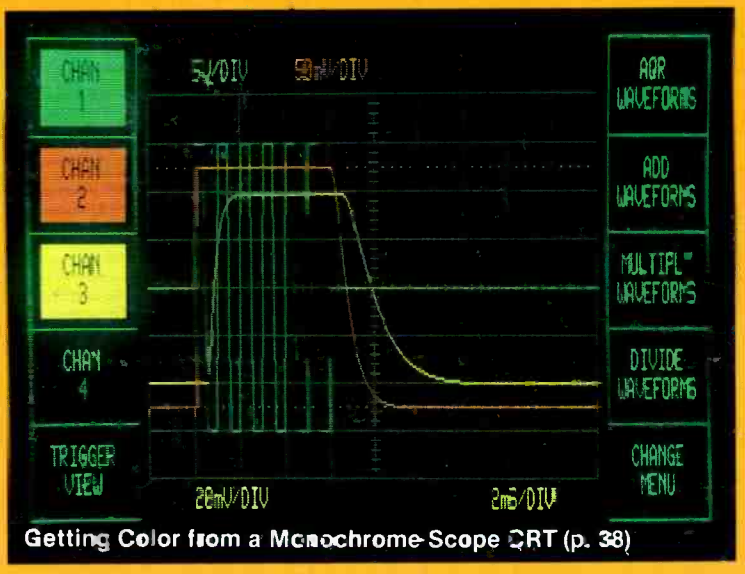
THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

- **ME Tests Latest Color-TV Receivers**
- **Build A Digital Humidity Controller For Greater Warmth & Economy**

Evaluating Magnavox's TV Monitor/Audio System (p. 48)

- ***Starting This Issue: Don Lancaster Answers Technical Questions From Readers***
- **Timebase Circuits For Experimenters**
- **Heath/Zenith's New IBM-Compatible Transportable PC**
- **Spectacular Colorgraphics With BASIC**

Zenith's Computer with [illegible]



Getting Color from a Monochrome Scope CRT (p. 38)

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Plus: ● Testing Yamaha's New T-80 AM/FM-Stereo Tuner & Kodak's 8-mm Video Camcorder ● Glenn Hauser's SW Listings ● Forrest Mims' Electronics Notebook ● Technical Book Reviews

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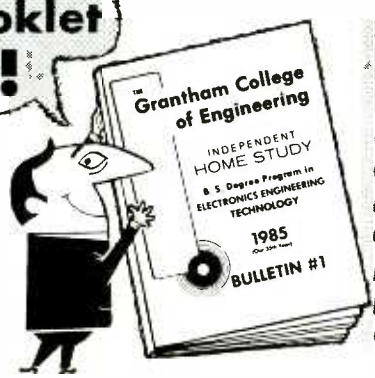

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K-7000-AC	550 MHz	5.24288	±1 PPM-RTXO	15 mV −24 DBM	N/A	(2) .1, 1 SEC	10 Hz			100 Hz		No	No	Yes	No
7010-S	1 GHz 600 MHz	10.0 MHz	±1 PPM-TCXO *±0.1 PPM-TCXO	10 mV −27 DBM	20 mV −21 DBM	(3) .1, 1, 10 SEC	.1 Hz	1 Hz		10 Hz		Yes	No	Yes	No
8007-S	700 MHz														
8010-S	1 GHz		±1 PPM-TCXO *±0.1 PPM-TCXO *±0.05 PPM-OCXO	10 mV −27 DBM	20 mV −21 DBM	(4) .01, .1, 1, 10 SEC	.1 Hz	1 Hz		10 Hz		Yes	Yes	Yes	Yes
8013-S	1.3 GHz														

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MODERN ELECTRONICS

THE MAGAZINE FOR ELECTRONICS & COMPUTER ENTHUSIASTS

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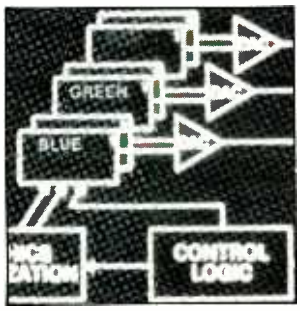

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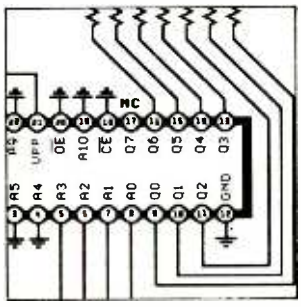

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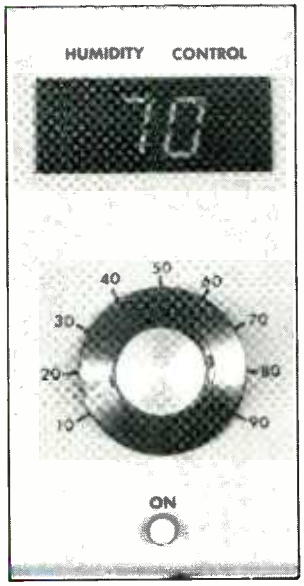

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FEATURES

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DEPARTMENTS

EDITORIAL

Author! Author!

Many readers have expressed interest in writing articles for *Modern Electronics,* while some have submitted manuscripts for our review. It's likely, too, that more of you have the same thought. Here, then, are guidelines for submitting editorial matter to enhance your chances of acceptance and also make our job easier.

First, it is best not to write an article before inquiring whether or not we're interested in the subject to be covered. Therefore, it makes sense to contact the editor or managing editor at *Modern Electronics,* 76 N. Broadway, Hicksville, New York 11801, with a brief summary of your proposed article and some information concerning your technical background. If the proposal is a construction project, you should also include a schematic or block diagram and an estimated cost to build the device.

The rewards for authoring an article can be great. They include money, ego satisfaction, a sense of fulfillment in sharing your knowledge and experience, and advancing one's career.

The Manuscript

If you don't want to be struck by lightning, do not send a manuscript to more than one magazine at a time. Our usual turnaround time is only a few weeks. If a manuscript is rejected, then you're free to send it to another magazine. Be sure to include a stamped, self-addressed envelope to ensure safe return of your material should the article not be accepted.

A manuscript must be typed on white 8½″ × 11″ paper, and *double-spaced,* of course, with *at least* one-inch margins all around. Computer printer type is fine so long as a coarse dot-matrix is not used and a fresh ribbon is employed.

The article's title, subhead, and the author's byline name should start about one-third down the first page. Accordingly, the main body of the article would start around the middle of the first page. Paragraphs should be indented with four or five spaces.

The first page should have your full name, address, telephone number, and social security number (needed by Federal law in order for us to make payments) at the top-left corner. Pages should be numbered consecutively, too, whether at the bottom or top of each page. It's best to identify each succeeding page of the manuscript with an abbreviated title or last name at the top-left corner of the sheet.

Construction projects should include a parts list, as well as a source of supply for uncommon components, if any.

Article Length

Typically, three full pages of typed material fill one printed page in the magazine, without illustrations. There is no specific length required for an article, though shorter articles —two to three printed pages—are in greater demand. So the size of an article is up to you, the writer. One should write tightly, though, without extraneous thoughts, and material should be interesting, to the point, and, naturally, accurate.

Illustrations

Photographs and drawings are especially welcome adjuncts to a manuscript. (They also earn extra payment.)

We'll accept glossy black-and-white prints as well as color slides or transparencies. In any event, pictures should be sharply focused and not have irrelevant objects detracting from the subject. Keep in mind that manufacturers are good sources for photographs of their products.

Drawings should be neat and easy to read. *Modern Electronics* has drawings and schematics redone to its specifications. Foil patterns and component-side drawings should be supplied with construction projects. It would be helpful if key voltages were noted on construction-project schematics.

A working model of a construction project must be sent to us for inspection and possible photography. It will be returned to the author as soon as we're through with it.

Captions should be keyed to photographs and drawings. A separate captions page is suggested. Where drawings and schematics are discussed in the text, the illustrations should be keyed with figure numbers. In general, figure numbers are not applied to photographs.

Avoid using felt-tip pens to write on backs of photographs. They sometimes "bleed" through. Ballpoint pens should not be used, either, since impressions often go through the print and mar the picture. Also, don't write on a piece of paper while it is atop a photograph. A grease pencil can be used for marking purposes, though typing information on a piece of paper and taping it to the back of a photograph is best.

Finally, photographs should be protected by flat cardboard when mailing. Additionally, the envelope should be marked "Photographs—Do Not Bend!" as a hopeful caution to postal workers.

Editorial Approach

Since *Modern Electronics* covers the consumer electronics and personal computer gamut, there's a wide choice of subjects to write about: audio, video, computers, communications, circuitry, electronic devices, and general home/auto electronic products. Article categories break down to feature, tutorial, equipment review, and construction project.

As a technically oriented publication, we are interested in technical insights to circuits and equipment, na-

turally. How it works is of primary importance. This includes tracing circuit operation, and lucid descriptions on theory and practice. Put yourself in the reader's place and don't assume he knows all the fundamentals; some may, some may not, so cover it all with as little jargon and math as possible.

"Hands-on" experiences that will help readers are very desirable, especially those little tricks that can reduce component count or enhance the utility of a piece of equipment, practical work with new test instruments or other equipment, etc.

Writing should be as clear and grammatically correct as possible, of course, but technical knowledge, depth, and shared experience are more important. Our editors are more than willing to clean up copy.

Looking forward to working with you budding writers out there.

Art Salsberg

LETTERS

Vincula Trouble

You made some mistakes on equations in my article, "Circuit Design From Scratch" (Nov. 1984). On page 60, the lower equation in column 1 should read "$C = A\overline{B} + \overline{A}B + \overline{A}\overline{B}$." In column 2 of the same page, replace the formulas labeled 1 through 6 with the following:

1. $\overline{X} + X\overline{Y} = \overline{X} + \overline{Y}$
2. $\overline{XY} = \overline{X} + \overline{Y}$
3. $X(Y + Z) = XY + XZ$
4. $X + \overline{X} = 1$
5. $X + \overline{X}Y = X + Y$
6. $X + Y = \overline{\overline{X}\,\overline{Y}}$

and change the immediately following equation in the same colum to read "$C = A\overline{B} + \overline{A}B + \overline{A}\overline{B}$." In columns 3, change the second equation to read "$D = B(A\overline{C} + AC + \overline{A}\overline{C} + \overline{A}C) + A\overline{B}C$." On page 61, column 1, change the last equation to read "$D = \overline{\overline{B}\overline{A}\overline{C}}$." Finally, in Fig. 7 (page 60), there should be a NOT gate in the lowest A input line; the last gate should be an OR gate; and the first line of the caption for this drawing should read "Fig. 7. By using a combination of AND and OR gates and inverters . . ."

Jules Gilder
Brooklyn, NY

Profile Fits

• It's astonishing that your profile of typical readers was a perfect example of myself. My age is 38; my business, a small-business owner doing about 50% electronic service for the photographic arts industry; my education level, college level and technical schools; and my serious interest, electronics. Thank you for including Forrest Mims III. My interest in computers is only for my business. Plug in, use for accounting and other records, and turn if off. My subscription to PE is close to running out or I would have cancelled it. Enclosed is my check for a 2-year subscription.

George Bloom
Dayton, OH

Political/Geography Lesson

• I would like to make a complaint about a mistake on your October issue. In the "Communications" column by Glenn Hauser on "50 Countries For Shortwave Listening," right after Radio Pyongyang, which is in North Korea, you put Radio Korean and you listed Korea, North, which is very WRONG. It should have said Korea, South. And also, the name of the broadcaster is not Radio Korean, but Radio Korea.

ME lover
Worcester, MA

Columnist Glenn Hauser observed some mistakes in his column that slipped by us in our rush to meet the first editorial deadline. We'll be sending galleys for his inspection from here on.—Ed.

Ballots Are In

• I've just read your first edition of *Modern Electronics* and enclosed is my subscription along with my sincere appreciation for what promises to be a great magazine! In my 39 years I have never felt moved enough to send a comment to a magazine until now. I'm an active Amateur Radio op and avid general electronics buff including computers. My disappointment over the content of today's computer magazines had been paralleled by my frustration over the lack of publications equal to the "old" *Popular Electronics.*

Jim Moore, K2CTY
Byron, NY

• My sentiments concerning the "change in editorial policy" of the former *Popular Electronics* magazine echo those of many other people. As a longtime subscriber to PE I was worried when it ocurred and when my subscription expires in two more months I will allow it to lapse. This is in spite of the fact that I am an avid TRS-80 Model III user in addition to being an electronics hobbyist. There are already tons of computer magazines on the market that satisfy my needs and I don't need another! I look forward to many years of progressive education and enjoyment with your format.

Ken Stover
Springfield, IL

• I too am glad you did it! Have missed the old format and contents of *Popular Electronics.* Nothing beats a change of pace. Thanks a lot for adding projects and reading that is entertaining and educational in more ways than one: computers.

Charlie Booker
Evanston, IL

• Enclosed is a check for a 1-year subscription to your most welcome magazine. I consider *Popular Electronics* a traitor to all of us electronics enthusiasts and am glad to see another magazine on the market to replace it.

Robert W. Council
Las Vegas, NV

IBM PC-COMPATIBLE PRINTERS are now being offerred by Star Micronics, following in the footsteps of Okidata's very successful "Plug-N-Play" printer line. These "PC printers" will be added to the company's Gemini, Delta and Radix models in both 10" and 15" versions, Current versions, which will be continued, are designed for use with Apple, Commodore, and Atari computers.

A QUARTER-CENTURY AGO Matsushita Electric Corporation of America opened a U.S. office with three employees selling four radio models. Now, with such brand names as Panasonic, Technics and Quasar, there are more than 7,000 employees. In commemoration of its anniversary, the company set up a $10-million foundation to fund educational programs in the U.S., where 1983 annual revenues was $2.8-billion.

TAKING A TIP from automobile makers, Texas Instruments offers an extended warranty-for-pay period for five years, up from one year. The program, called "Pro Pack," extends the standard 90-day hardware warranty that's included in the purchase price of one of its computers. The program includes a toll-free, 24-hour customer support line. Prices vary according to the system purchased and the length of the warranty extension. As an example of costs, a one-year extension agreement for a TI Professional Computer with 128K of memory, one floppy disk drive, and a monochrome video monitor costs $192.50, which includes the company's a 50% introductory discount.

KODAK ENTERS COMPUTER FIELD. From disk camera to floppy disk is how far Eastman Kodak now ranges. The compnay launched a full line of flexible diskettes, from 3½" plastic-encased ones to 8" disks in jackets. Its 5¼" disks will be packaged in two-packs as well as five- and ten-diskette boxes. In addition, Kodak is producing high-density 5¼" disks at 192 tracks-per-inch with as high a formatted capacity as 3.3 Mb. Further, Kodak is in the disk-drive business, producing the high-density floppy-disk drive, which is marketed by Data Technology Corp.

RECREATIONAL VIDEOTEX NETWORK. American People/Link is a new videotex service by American Home Network, Inc. that's being planned for non-professional home-computer users. With promises that it will become operational at the end of 1984, it will focus on interactive games and "conversation," as well as some educational and informational features. Among offerrings planned are tele-conferencing, club meetings, a nationwide electronic bulletin board, an electronic mail service, and interactive agames in which subscribers can pit their skills against each other. The subscriber fee structure is touted as being many times lower than other similar services, and without surcharges for special features, though no price was cited.

A DIGITAL TV MODEL was announced by Toshiba. The $1,199 set processes chominance, video and deflection signals digitally. A picture-withing-picture can be obtained with a second signal source. With the set's memory, the inset can be enlarged from 1/16 to 1/4 of full screen.

DO-IT-YOURSELF VIDEO EDITING STORES. A video editing center in Fort Lauderdale, FL provides professional video editing equipment, both VHS and Beta formats, for use by customers on a walk-in-basis. Users are charged $12.50 per hour editing time on state-of-art equipment, supported by music mixing, voice recording, titling, duplicating and film-to-tape capabilities. The developers plan to set up a nationwide network of franchised centers, which include a two-hour interactive training tape for franchisees and their staffs. Startup cost is $90M plus $10-20M for store costs, says franchiser, Video Workshop Franchises, Inc. (305-537-7940).

COUNTER-SPY STORE. James Bond would love it! A new Washington, D.C. store, Counter Spy Shop, displays a host of 007-type electronic gadgets, such as anti-kidnapping, anti-terrorist, super-long-range cordless phones, bug detectors, and similar everyday needs for diplomats and others. The company, located at 1801 "K" St., will unveil the world's first computer--controlled, bullet-proof car, the "Dallion X." The car's self-monitoring and functions and malfunction checks are stored on computer disks. Other features of the super-luxury car include a bullet-proof exterior that protects against machine guns and grenades, and a sophisticated private communications system.

BBC-BROADCAST RECEIVER. The Liniplex Fl is an unusual type of shortwave receiver. It's specially designed to receive Britain's BBC Overseas Service broadcasts, which are diversified programs in English that range from news to concerts to radio theatre. The receiver doesn't use continuous tuning. Instead, a switch knob is moved to one of nine selected stations. Weighing four lbs., it can be powered by a rechargeable battery or standard ac power. Radio West in Escondido, CA is the U.S. agent.

256K CHIPS ARE "IN." A host of IC makers are now producing 256K-bit chips in volume. Producers from Japan for the awaited RAM include Hitachi, Fujitsu, NEC, Toshiba, Oki, and Matsushita, among others. U.S. manufacturers have joined the act, with IBM and AT&T also pumping them out, and Texas Instruments, Motorola, and Mostek revving up for its production. Such chips are already being used to upgrade the 128K-byte user memory of McIntosh computers to 512K. But Mac owners have to trade in their machine's unsocketed pc boards in order to get the enhanced board. Moreover, early buyers of Apple Computer's McIntosh computer are threatening to give Apple a fat lip owing to the high-than-anticipated price of the replacement board needed to change their computers into a 512K-RAM "Fat Mac."

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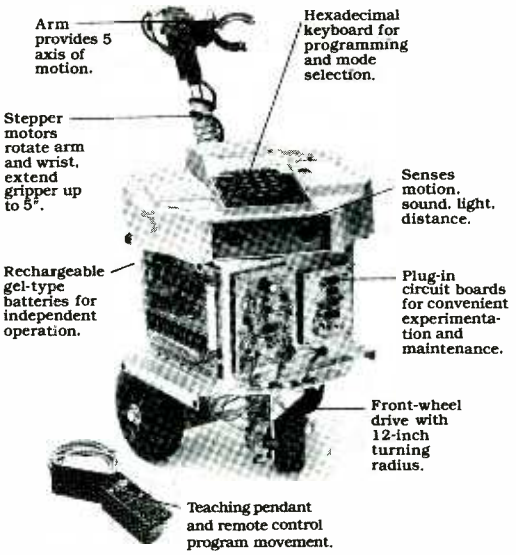

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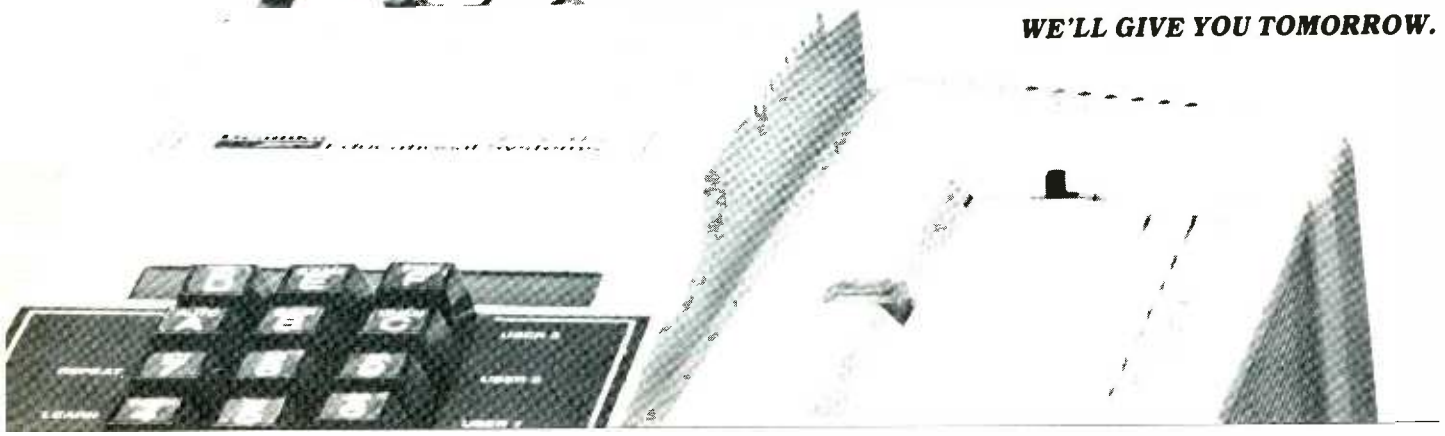


For more information on products described, please circle the appropriate number on the Free Information Card bound into this issue or write to the manufacturer.

Pocket-Size Electronic Dictionary

How would you like to travel through a foreign country accompanied by your own personal translator? Sound too expensive to even consider? Actually, though, it's not—if your "translator" is a compact, pocket-size electronic device like the Langenscheidt Translator 8000 pocket electronic dictionary. Resembling a pocket calculator with its LCD panel and matrix of keys, the Translator 8000 lets you access the translations for some 4000 words and phrases. It even gives you instant translations for such phrases as "I am sick" and "Thank you very much."

Currently, the Translator 8000 is available in the U.S. in Spanish, French and German versions. Translation is bidirectional, from English to the foreign language and vice-versa. Other language versions are slated for release during the latter part of this year. Language students should find this translator ideal for studying. Besides being a handy dictionary, it can drill them on thousands of words. Additionally, the Translator 8000 can store problem words for practice (an irregular verb, for example). And travelers can store an important word or phrase. Finally, the device also doubles as a full-function electronic calculator with memory function. $69.95.

CIRCLE 155 ON FREE INFORMATION CARD

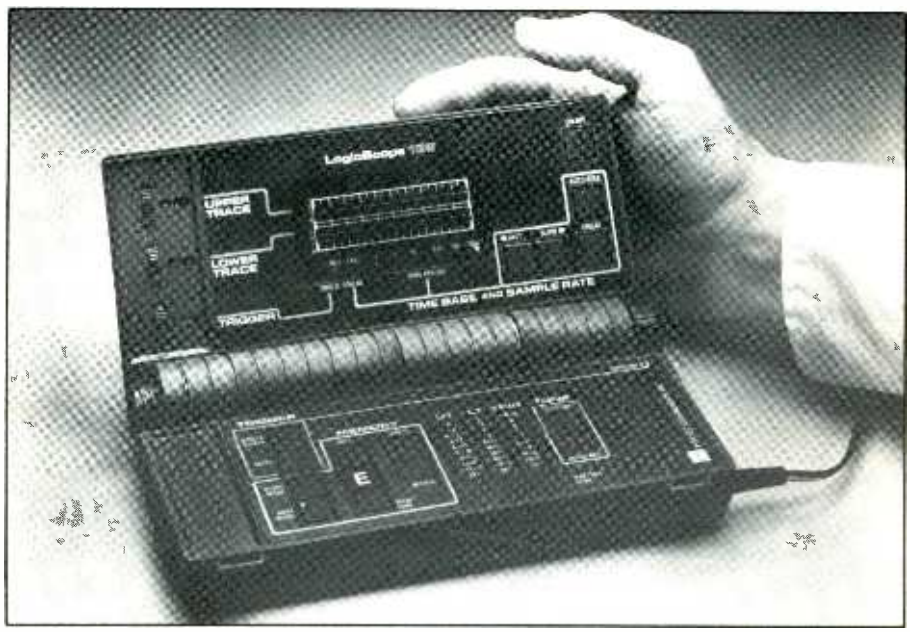
Miniature Oscilloscope/ Logic Analyzer

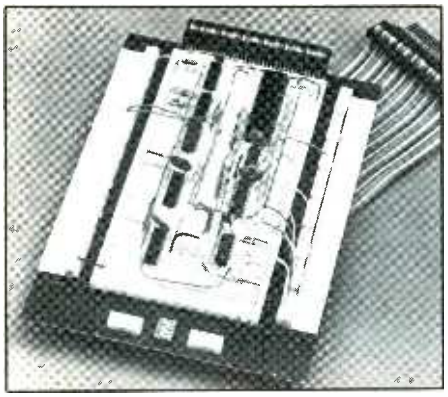
Pocket Technology's LogicScope™ 136 offers many of the capabilities of a logic analyzer and a dual-trace oscilloscope in a compact instrument that fits into a large pocket. With a bandwidth of 10 MHz, LogicScope can measure pulse widths down to 100 ns and detect 50- to 100-ns glitches. Storage oscilloscope features include trigger, single sweep, free run, variable timebase, store, and recall. Logic functions permit comparison of two waveforms with logic compare, AND, OR and exclusive-OR functions.

The instrument has a patented high-resolution LED matrix display consisting of four parallel rows with 100 LEDs per row. CMOS memories store and recall waveforms and can hold them for several months. Waveforms in memory can be compared or linked with each other to provide one continuous waveform. An I/O port allows waveforms to be sent to external systems for display and analysis. The I/O port will also be used as the interface for future options.

Its features include Auto-Seek, which automatically adjusts timing to fill the display with one complete waveform; Audo Trak, which lets you hear logic states by sounding a low or a high tone for a logic 0 or logic 1; and a setting to capture a single event and sound an alert when it occurs, eliminating the need to constantly monitor the display. $495; $125 for optional triple 1×/10× probe assembly.

CIRCLE 157 ON FREE INFORMATION CARD





Solderless Breadboard For Computers

From Jensen Tools Inc. comes "eZ Board," a solderless breadboarding device designed to connect to an IBM PC, Apple, Commodore or any other computer that has the same bus arrangement. Plugged into the computer's expansion slot via an integral 18" ribbon cable, eZ Board provides a fast, convenient way for designers, engineers and experimenters to build their own developmental circuits and test fixtures.

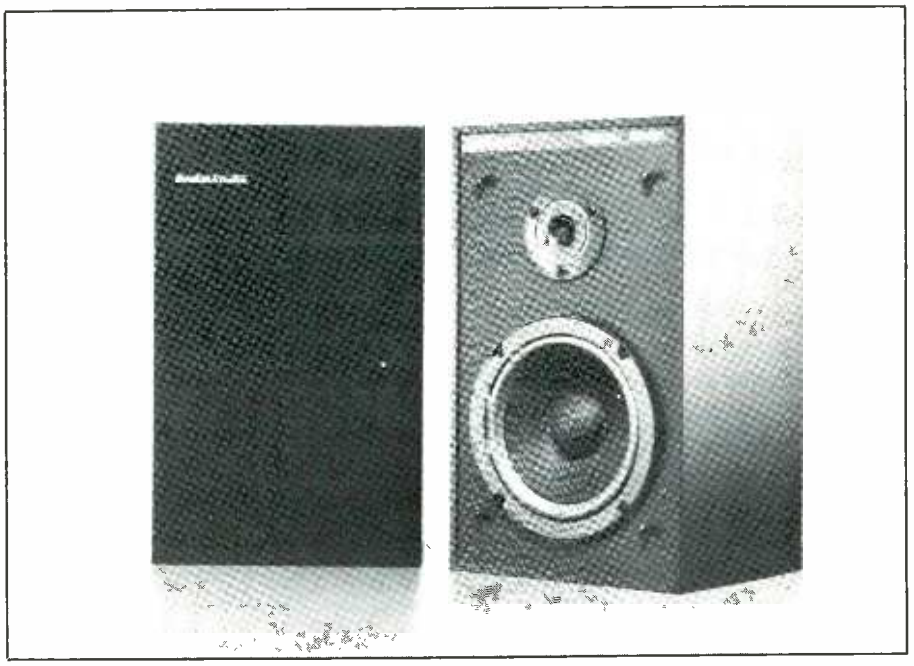
Facilities on the glass-epoxy printed-circuit board include an array of solderless blocks that provide access to each of the signals available on the computer's bus. Signal and power identification, the same as used by the manufacturer, are clearly and permanently marked adjacent to each pair of terminals.

The solderless breadboarding sockets accommodate DIP devices with up to 24 pins, as well as discrete component leads and wires with up to 0.032" diameters. An idea/instruction booklet is packaged with each eZ Board.

CIRCLE NO. 152 ON FREE INFORMATION CARD

Video Monitor Speaker System

A major problem with most speaker systems is that their magnetic fields can adversely affect some modern electronic devices, such as video monitors and computers. One manufacturer that is doing something to rectify this situation is Boston Acoustics, which recently introduced a magnetically shielded speaker system for use with video monitors, color TV receivers, and computers. The Model A40V is a new version of the company's strictly hi-fi Model A40 two-way system. The new Model A40V features a ¾" tweeter with ferrofluid and a magnetically shielded 6½" long-throw acoustic-suspension woofer. Recommended amplifier power for the new speaker system is 5 to 40 watts. The compact speaker system measures 13½" × 8¼" × 7¾" deep. $165 per pair.



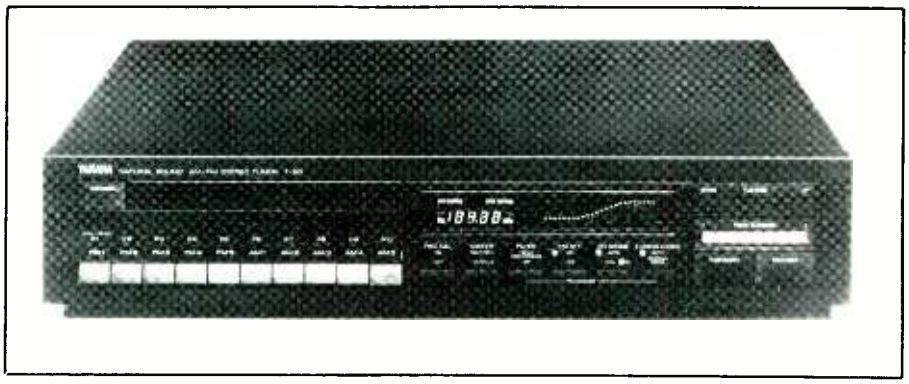
CIRCLE 156 ON FREE INFORMATION CARD

Hand-Held Digital Multimeter

Two switches are all that are needed in Sperry Instruments' new Model DM-8010 digital multimeter to measure ac and dc voltages and currents and resistance. A three-position slide switch can be set to OFF, DC/Ω, or AC, while a large, bar-handle rotary switch is used to select the desired range and function. In addition to providing the usual voltage, current, and resistance measuring capabilities, the new 3½-digit DMM offers a diode/transistor test function and a built-in buzzer for making continuity

(Continued on page 80)

A Tuner For These Times: The Yamaha T-80



When Major Edwin Armstrong invented FM radio transmission and reception as we now know it, I doubt very much if he could foresee the day when FM radio would be more popular than its predecessor, AM broadcasting. Yet, that is exactly the case today!

However, the popularity of FM has been accompanied by overcrowding of the FM band in this country, with stations occupying just about every available space on the dial in major metropolitan areas. Such a proliferation of FM stations has resulted in increasing interference from stations operating on adjacent channels. Even though the FCC is careful in allocating station frequencies to minimize this, increasingly sensitive FM tuners and receivers, which can pull in more distant stations, compound the interference problems.

Manufacturers of FM tuners have been steadily improving their art to take into account such matters, not to mention improvements in stereo multiplex decoding, all-electronic tuning, and other advances. An outstanding example of good, yet not overly expensive, FM tuner design is Yamaha's flagship tuner, the Model T-80. Carrying a suggested retail price of $395, this tuner incorporates a great number of circuit innovations that are worth noting.

Digital Fine Tuning

Most electronic digitally tuned FM tuners can resolve frequencies down to 200 kHz or, in some cases, 100 kHz. In theory, that degree of resolution should be good enough, since FCC frequency assignments in the U.S. are in 200-kHz increments. For example, the first possible channel frequency on the U.S. FM dial is 88.1 MHz; the next one is 88.3 MHz; etc. Yet Yamaha's "Computer Servo Lock Tuning" system permits digital fine tuning in 0.01-MHz (10-kHz) increments. It does this with two unique tuning subsystems: an infinite-resolution FM servo-tuning circuit and a 10-times precision phase lock loop (PLL) circuit. Why such small steps if station frequencies are 200 kHz apart? For a couple of good reasons, as follows.

First, if you are bothered by adjacent channel interference, you can slightly detune your desired station and, if the i-f bandwidth of the tuner is wide enough (as it is with the Yamaha T-80) you will reduce interference from the adjacent signal without adding distortion to the desired signal. Secondly, many cable TV stations offer FM radio as part of their service. Often, these FM signals are not delivered at the same frequencies as over-the-air FM signals. To properly receive them, you must be able to tune "between" officially designated FM frequencies. The Yamaha T-80 allows you to do this easily.

You can preset up to ten favorite stations frequencies (any combination of FM and AM stations) in the "tuning memory" circuitry of this tuner. In addition to preset tuning, "auto-search" and manual tuning modes are also provided. In auto-search mode, the tuner scans the band in the specified up or down direction until a strong signal is found. In manual tuning mode, single-step tuning enables tuning to a station's exact frequency (or to any 0.01-MHz increment in the FM tuning dial range).

When using the presets to find favorite stations, reception conditions can also be entered into the memory when presetting the station. Thus, if the station is tuned in with the fine-tuning mode, that fact will also be "memorized." Settings of the local-distance switch, the FM attenuator switch, an FM filter switch, and the Mono/Stereo switch will also be memorized. Therefore, when that station is recalled again, all of those reception-condition circuits will be switched to their preset settings.

Whenever power is turned on, the same station can be automatically tuned in. Alternatively, the last station listened to before the set was turned off can be selected automatically. The T-80 incorporates a combination signal quality/multipath meter that aids in tuning for the best possible signal and in orienting your FM antenna for minimum multipath interference from reflected signals. Other features include a record calibration signal which, when activated, allows you to set up correct recording levels on your tape recorder *before* you begin taping an FM program. Two levels of output voltage are provided to suit the optimum requirements of just about any asso-

ciated preamplifier or integrated amplifier with which the tuner is likely to be used.

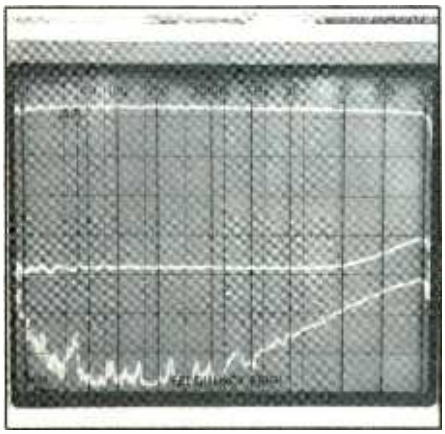
Control Layout

The left section of the T-80 front panel is equipped with the 10 preset stations pushbuttons and the unit's power on/off switch. Small areas above the preset buttons are all illuminated in red, with the color changing to white when a particular button is touched. These illuminated areas can be filled with actual frequencies of your favorite stations, which are supplied on a separate card for easy punch out and insertion.

The frequency display area near the center of the panel shows FM and AM frequencies and, if the manual mode is selected, two-digit resolution after the decimal point appears (e.g., 99.2 changes to 99.20), so that you can resolve down to 0.01 MHz, as described earlier. The dual-purpose signal-quality/multipath meter is located to the right of the frequency display. Below these display areas are five touch buttons. These are used for turning on the record calibration tone, changing the meter's function, turning on an FM noise reduction of an AM-emphasis circuit, turning on an FM-input attenuator (used with overly strong FM signals), selecting local or distant reception (or having the tuner automatically select which of these is best) and choosing the automatic or manual tuning mode. In the manual tuning mode, circuitry is automatically switched to monophonic reception.

Controls at the extreme right of the front panel include an up/down tuning bar. This rocker bar is used for manual or automatic search tuning. A fine-tune up/down bar just below it is used for the 0.01 MHz incremental tuning when necessary. A memory button and an AM/FM selector button complete the front-panel layout.

The rear panel is equipped with both 75-ohm coaxial and 300-ohm (twin lead) balanced antenna input terminals, as well as with a pivotable AM loopstick antenna. Low and high level output jacks are located near the center of the rear panel; just to their right is a slide switch that's used to determine whether the "initial station" (first preset button frequency) or the last tuned-to station should come on when power is applied to the tuner.



Shown top to bottom are: frequency response (20 Hz to 20 kHz), separation under normal conditions, and somewhat reduced separation with noise reduction on. Vertical scale is in increments of 10 dB/division.

Tuner Measurements and Performance

With strong FM signals applied, the FM tuner section of this tuner offered very good signal-to-noise performance: 88 dB in mono and an almost-as-good 86 dB in stereo. The local-distance switch actually alters i-f bandwidth. We found that in the local setting, distortion in mono for a 1 kHz modulating signal, was an incredibly low 0.032% (0.05% in stereo). When it becomes necessary to switch to the "distant" setting (narrow bandwidth), harmonic distortion in mono rises to around 0.2%, while in stereo it increases to 0.4%. This is the usual trade-off expected between maximum sensitivity and selectivity versus distortion.

The 50-dB quieting in mono was obtained with only 15 dBf (3.1 μV) of signal at the 300-ohm antenna terminals, while in stereo it took 37 dBf to reach the same quieting level. These are extremely good performance figures for these specifications. With the noise-reduction switch activated, the figures in stereo improved to 32 dBf (about 10 μV) for 50 dB quieting. This switch, while reducing noise in stereo, also decreases separation somewhat. Without the switch activated, we measured an impressively high separation of 62 dB at a test frequency of 1 kHz. At 100 Hz, separation was still amazingly high with readings of 57 dB, while at 10 kHz it was 44 dB. Using the noise-reduction feature, separation remained adequate, decreasing to 39 dB at mid-frequencies, 38 dB at 100 Hz, and 34 dB at 10 kHz.

Though FM frequency response was virtually flat all the way up to the highest broadcast frequency of 15 kHz, AM response, although far poorer, was still better than that obtained with most AM tuner sections. It was reasonably flat out to 5 kHz. We noted the incorporation of a 10-kHz filter to eliminate those annoying "whistles" from adjacent AM signals that are so often present with better AM tuners, especially during nighttime listening.

Listening To The T-80

The Yamaha T-80 tuner proved to be an excellent performer in my listening room as well as on the test bench. It was certainly as sensitive as any tuner I have ever listened to and pick-

ed up at least 50 usable signals when connected to my rotating outdoor antenna located some 17 air miles from New York City. I found the multipath indicator to be especially useful since it enabled me to rotate the antenna for minimum multipath distortion easily and without a lot of back-and-forth checking and re-checking.

I had some reservations about the need for 0.01 MHz incremental tuning when the unit was being tested in the lab. My doubts all vanished when I found it necessary to use that feature with at least three of the stations to which I listened during my brief use of this tuner. I can easily envision situations and listening locations where the fine-tune feature will be even more welcome.

Assigning frequencies to the ten presets is very easily accomplished, and I liked the idea of not having to set up those other operating choices, such as local/distant, fine tuning or not, and so forth for each of those stations every time I wanted to tune to one of them. It wasn't too long ago that tuners with this level of performance and convenient features, if available at all, cost well over $1000. The fact that this state-of-the-art tuner can be had for well under half that amount today, makes it all the more appealing. *—Len Feldman*

CIRCLE 64 ON FREE INFORMATION CARD

Kodak Cracks The 8-mm Camcorder Market

Introduction of the 2200 and 2400 series of 8-mm video camera/recorder combinations by Eastman Kodak marks a radical departure from Sony's and JVC's approach in which ¾" tape is the star performer. (For details on the camcorder revolution see Modern Electronic's "Camcorders—A Revolution In Home Movie Making" in the November 1984 issue.) The 8-mm tape is substantially narrower than its ¾" competition, but new recording/processing/playback technology make it a worthy competitor to existing video recording formats.

Close up, Kodak's so-called "camcorders" are a marvel. They weigh just 5 lbs., are housed inside compact 14.3"W × 7.4"H × 7.2"D enclosures, and are nicely balanced and easily fit onto narrow or broad shoulders. The enclosures are of molded grey and black plastic.

With softly whirring drive motors, these compact machines offer an impressive array of features and functions. Entry into the compact camcorder scene isn't inexpensive, though. The deluxe Model 2400 carries a retail price tag of $1899, while its less sophisticated brother, the Model 2200, is priced at $1599.

General Decription

These camcorders have some impressive specifications. For example, stop/record times average just 1.5 seconds, while play engagement takes 2 seconds. In addition, a fast f/1.2 lens is teamed with a power-zoom capability. Recording can be successfully performed with ambient light levels of only 20 lux. With all this, these Kodak camcorders are highly responsive to both action and still photography. But this isn't all.

A blue cast "filter" adjustment is provided for indoor operation. This

allows both camcorders to do a good job of capturing broad scenes with fine detail, using only window or incandescent lighting. Colors, of course, always improve in daylight. And somewhat better results can be obtained by using ME metal-evaporated tape, rather than MP metal-particle tape cassettes, according to Kodak. This was advice we followed when making our laboratory tests.

Features And Differences

Since we analyzed the deluxe Model 2400 Kodak camcorder, we'll detail its features and functions first and include at the end a run-down of the differences between it and the less deluxe Model 2200.

Contained inside the "business" end of the Model 2400 camcorder is a ⅓" Newvicon tube with some fair specifications. A fully automatic white balance circuit is included, as are automatic and manual focus (the latter preferred) and a Newvicon-on standby switch. The latter, when switched to the standby position, allows the camcorder to draw only 2 watts of power from the battery.

Among the standard features offered are visual search, an electronic counter with memory, 4-second record review and equivalent forward recovery (very handy), and a 1-hour rechargeable battery (extras are available for $29.99 apiece). Also included are an omnidirectional (surround-sound microphone), listen-in earphone, month/day/date record, fade in/out capability, negative/positive image switch, blacklight, electronic monochrome viewfinder that doubles as a playback viewer, and other displays that indicate illumination levels, dates, counter numbers, dew condition, recording (green), indoor/outdoor setting (orange), and low battery (red).

The Model 2400 also has three heads. It offers still-frame (pause), single-frame advance, and a flashing red "tally" light on the camera's front end when recording.

The Model 2200 camcorder has general specifications that are similar to its more sophisticated brother. However, it has only two heads and, therefore, doesn't provide as good special effects. Also, it lacks automatic focusing, which isn't essential in any case. Other features the Model 2200 lacks include white balance override, negative/positive image switch, date set, backlight switch, and fade in/out capability.

Buying the Model 2200 saves you $300, but eliminates some features which may or may not be essential to you. However, if you're willing to shell out $1599 for the Model 2200, it makes good sense to throw in the extra $300 and go first class with the deluxe Model 2400. Even if you don't plan to use the extra features now, as you become familiar with them, you're likely to find that you really "need" them.

Kodak Model 2400 Camcorder Laboratory Analysis

Tuner/system sensitivity	
vhf channels 3 and 13	−2 and −6 dBmV
uhf channel 30	−0.5 dBmV
Power drain (at 117 volts ac)	
converter/charger	5 watts
cradle/tuner	13.8 watts
Ac operating range (tuner/timer and cradle/tuner)	from < 100 to > 130 volts ac
Record/play (Using E6-30, 30-minute cassette)	30 minutes
Fast-forward time (E6-30 cassette)	1 minute 10 seconds
Rewind time (E6-30 cassette)	1 minute 3 seconds
Play start-up time (E6-30 cassette)	2 seconds
Stop time	⅓ second
Record enable time	⅓ second
Apparent video C/N (less than 2.5 dB)	39.5 dB
Apparent audio C/N (less 2.4 dB)	24 dB
Measured luminance S/N (1 to 3.58 MHz)	40 to 25 dB
Vertical/horizontal resolution (at baseband)	≤400 lines/3 MHz
Grey-scale linearity	reasonable
Color reproduction	good
Maximum continuous record/play time with fresh battery	57.8 to 60 minutes
Audio response (at −14 dB)	12 kHz
Wow/flutter (NAB at 3 kHz)	0.0035%/0.005%

Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Hameg Model 605 oscilloscope; Sadelco Model FS-3D VU field-strength meter; B&K-Precision 1260 NTSC and 3020 function generators, 1035 wow-and-flutter meter and 1653 power supply; Kodak E6-30 metal-evaporated tape; RCA Model VGM2023S TV receiver/monitor; and precision registration charts from WAPB-TV and Telemeasurements, Inc.

Auxiliary Equipment

If you want ac power and battery chargers, as well as additional recording capabilities, you'll have to add to your shopping list a cradle for $239 and its tuner/timer for $300 or the converter/charger for $179.95 and a VCR connector cable for $39.99. The optional carrying case for $69.99 and negative/positive adapter for $49.99 are not expecially important options. Extra tapes range in price from $12.00 for the MP-30 to $23.95 for the ME-90 30- and 90-minute 8-mm cassettes.

The cradle contains a battery charger, power source, input and output connectors and external con-

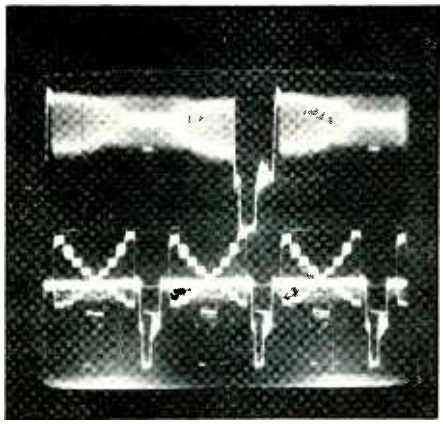


Fig. 1. Oscilloscope displays of vertical and grey-scale resolution during tape playback.

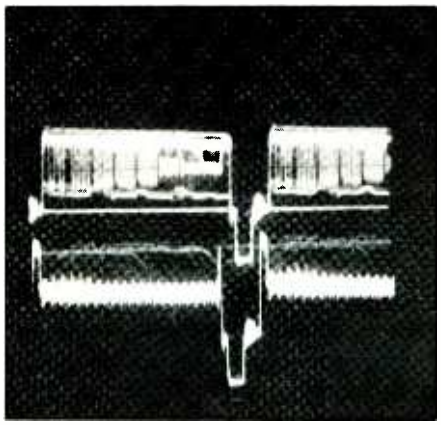


Fig. 2. This photo shows the camcorder's multiburst horizontal frequency and chroma waveforms.

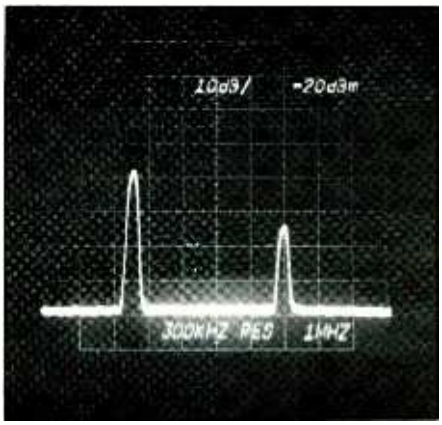


Fig. 3. Very clean video (left) and audio (right) carriers out of converter/charger on channel 3.

trols. When combined with the Model 2000 tuner/timer (the two work with both Kodak camcorder models), it permits timed recordings of two programs per day over a two-week period. Recordings can be as long as 120 minutes. Any 12 of 107 vhf/uhf/CATV channels can be selected and programmed, with their sequence and duration registered in a flourescent front-panel display.

The top cover of the cradle folds down to reveal a storage compartment for tapes and other items.

A wired controller permits remote selection of the record, play, pause/still, frame-advance, rewind/search, fast-forward/search, and stop functions to be enabled. Channel-selection and volume-adjustment contols, however, are not as yet built into the remote controller.

From our point of view, the most valuable of all accessories is the smallish Model 150 converter/charger. Unlike the bulky 17″W × 10″D × 6″H cradle, the converter/charger measures only 7″D × 4¾″W × 3″H. It can be adjusted to accomodate 100-, 120-, 220- and 240-volt ac line sources and provides a user-selectable r-f output to a TV receiver on either channel 3 or 4. R-f inputs and outputs and baseband video and audio inputs and outputs are all located on the rear apron.

On the front panel of the converter/charger are TV/camcorder and power switches and charge and power indicators. On the top of the Model 150 is a small plastic door and charge compartment for the 2½″ × 2⅛″ × 1¾″ battery.

Combine the Model 150 converter/charger with a VCR connector cable, and you can do almost anything but accept a timed program off the air.

Using The Camcorder

Unfortunately, the VCR multiconnector cable wasn't shipped with the rest of the equipment. So we had to do a bit of cabling of our own, using the converter/charger as both signal processor and power source. The result was good, although we would have liked to be able to record baseband audio and video directly from the monitor portion of our RCA TV receiver/monitor. Nevertheless, a little adroit cabling and signal splitting enabled us to attach the RCA monitor, an oscilloscope, and a spectrum analyzer so they could do their collective jobs. Of course, signal and channel measurements from outside were performed with the tuner cradle.

After installing a charged battery in the camcorder, we set the selector for indoors recording with automatic white balance, positive imaging, and fade off. Checking the rocker zoom control for location and inserting an E6-30 tape, we switched on power and, from the shoulder position, adjusted manual in/out focus for best overall zoom lens reproduction. Thereafter, it was simply a matter of thumbing the record button to record whatever we wanted.

As sound was recorded, we monitored the level and intelligibility as processed by the camcorder, using the supplied earpiece. By doing so, we had both video viewfinder and audio checks as shooting progressed, along with quick review video for good measure.

Indicator lights in the viewfinder proved to be more than a mere convenience. They were a necessity, since recording is fairly quiet and visual signals are required as constant reminders.

Playback without color through

(Continued on page 78)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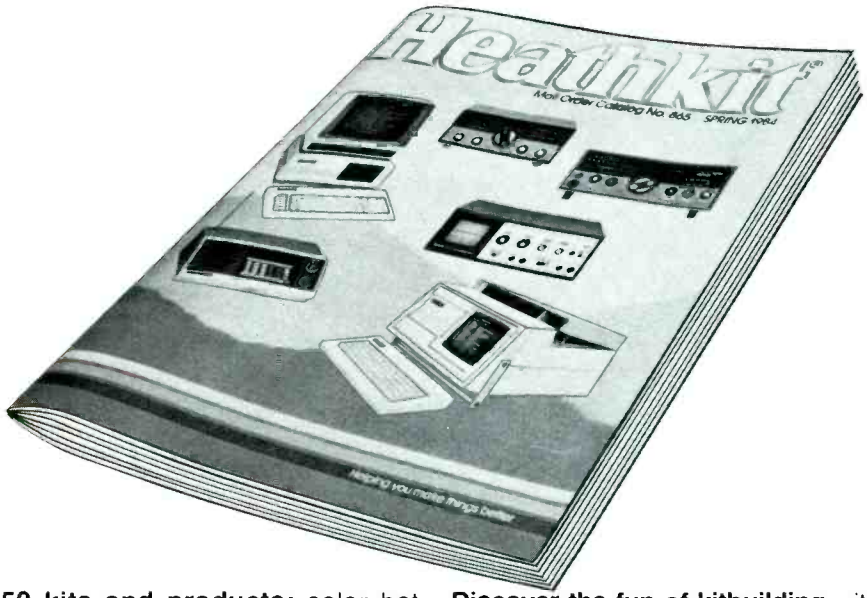
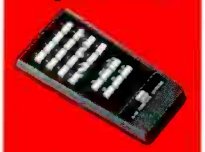
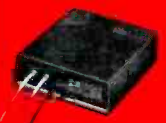



Fully Portable Test Instruments


Hand-held Digital Multimeter


Home Control Systems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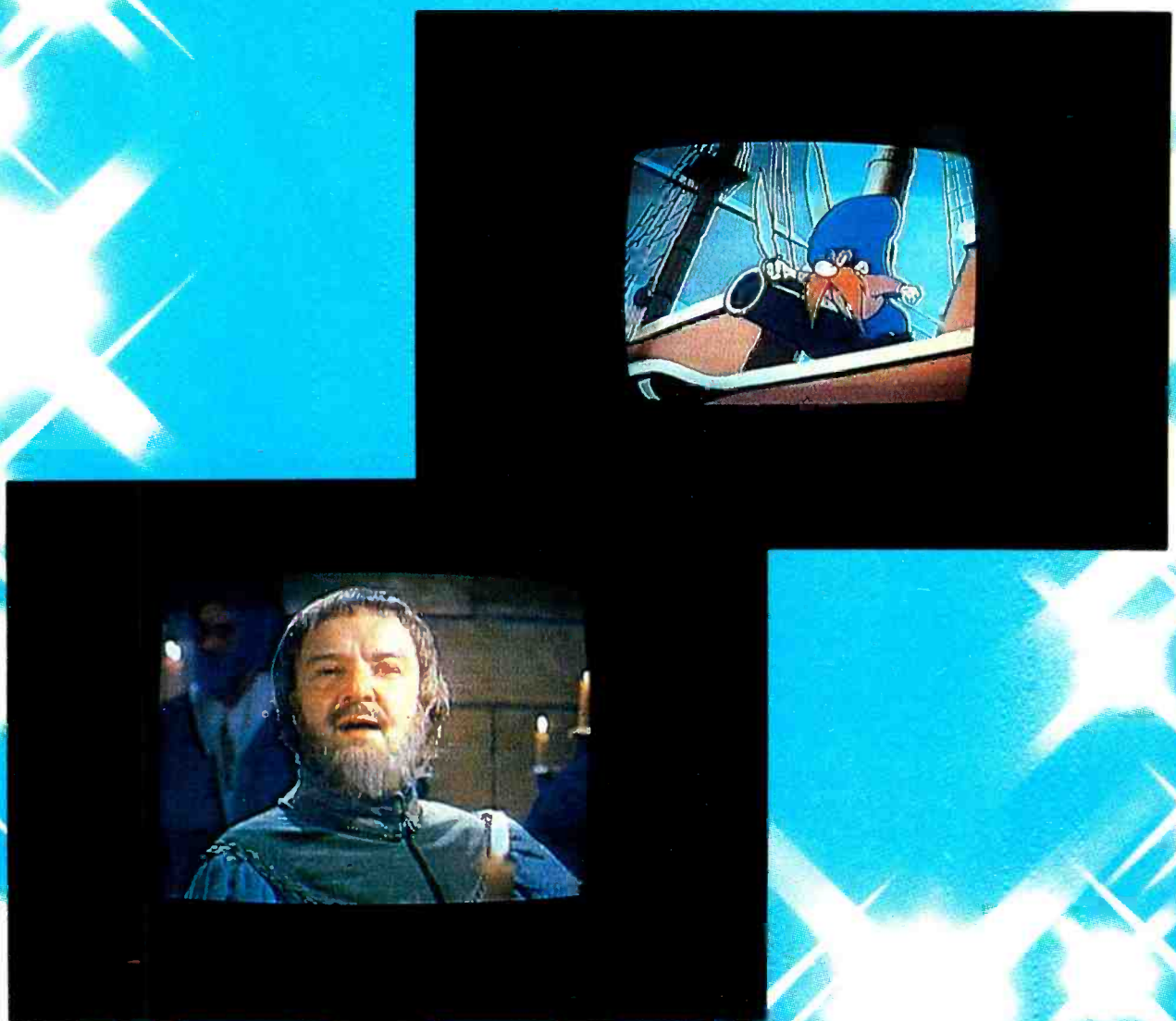
A Showcase of Color TV Receivers For 1985

Here's a close, critical look at a half-dozen offerings for the new model year



By Stan Prentiss

It's that time of year again, folks, and you videophiles have in store for you a bountiful crop. More and better remote controls, excellent luminance- and chroma-separating comb filters, beautiful TV receiver/monitor combinations, improved power supply and high-voltage regulation, better IC chips, new picture tubes, a couple of sizzling projection receivers, and real honest-to-goodness multichannel TV sound. But you'll have to keep a sharp lookout for the new products and a firm grip on your pocketbook.

As you'll shortly see, you usually get what you pay for and little else, proving that it's never cheap to go first class. Although we can't possibly cover all the new consumer video products in one relatively short article, we can take a close, hard look at a half-dozen TV receivers and receiver/monitor combinations as a warm-up. So let's see what the market has to offer through descriptions of features and functions, laboratory test analyses and results, and some frank user comments.

Magnavox Star System

If you have no problem dealing with a 3- to 4- ampere turn-on current and a 32"-wide cabinet, Magnavox's Model RS4278WA super-deluxe 19" monitor/receiver may be just what you've been looking for. It gives you the works for a mere $829. Featuring one very clean five-module, high-serviceablilty chassis, this set is housed inside a real wood (walnut solids and veneers) cabinet that measures 32½"W × 18"H × 19¾"D.

This beauty has a built-in TV-stereo/SAP decoder, and its amplifier will deliver 7 watts minimum power per channel at 8 ohms, with a frequency response of from 50 to 20,000 Hz and a THD (total harmonic distortion) of no greater than 0.5%.

Two built-in 4½" woofers and two 2" tweeters deliver sound from inside the cabinet, while larger outboard 8-ohm speaker systems (you supply these) can sit to the left and right of the cabinet and be switched in to provide "better" sound.

On the rear panel, you will find video and audio input and output jacks with separate potentiometer level controls for standard monitor applications.

With the tuner inputs accommodating 125 vhf/uhf/CATV channels, on-screen time and channel display, microprocessor-controlled STAR system remote tuning, and automatic correction for black, white and color/tint levels, this receiver is loaded. In addition, a new dark-faced, negative guard-band picture tube with small spot size, conical field focus, self convergence, and stop-and-go velocity-scan modulation system to highlight black-white transitions offer a remarkably well-defined image.

Of course, there's a comb filter (after all, Magnavox was the first to introduce it) for maximum luminance and chroma bandpass and separation. A Videomatic circuit monitors ambient light levels and adjusts picture brightness accordingly. A three-position MONO/STEREO/SAP selector switch is provided for setting the sound to your preference. Also included are LED multichannel sound indicators and an r-f switcher (built into the receiver or remotely controlled) for independent connection of two accessory video sources.

For stereo sound, there are also bass, treble, and balance controls that allow you to adjust the sound as you like it.

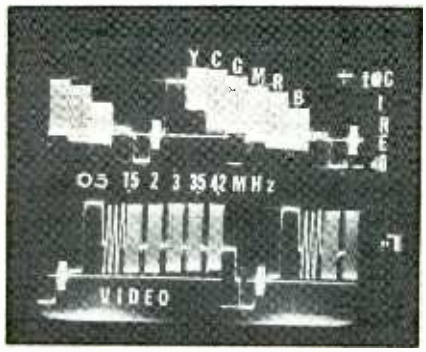
Measurement Interpretations. With so many available functions, a 117-volt SCR regulator, and a pair of heavy-duty stereo IC outouts, this receiver is bound to draw a slug of start-up current—as would any receiver with similar goodies. So don't put it on an already overloaded home/of-

Magnavox Model RS4278WA Laboratory Analysis

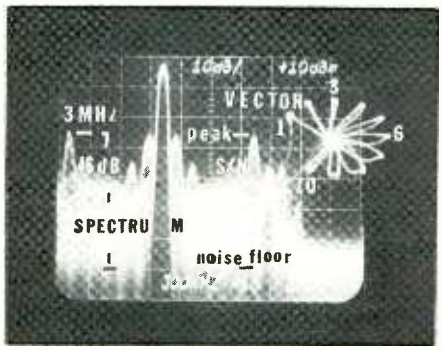
Ac power drain (100 to 130V ac; varies with video input)	172 watts average			
Voltage regulation (with signal input)	source	100V	130V	%
	110V	101.3V	109.3V	92.7
	24V	21.88V	23.77V	92
	27kV	24.2kV	27.3kV	88.6
Tuner/system sensitivity				
vhf channels 2 and 12	−2 and −5 dBmV			
uhf channels 15 and 60	−0.5 and −2 dBmV			
Agc swing (−2 to +56 dB)	58 dB			
Luminance/chroma S/N	42/42 dB			
CRT temperature	7200° K			
Dc restoration	85.4%			
Horizontal overscan	11%			
Convergence	99.8%			
Maximum center CRT vertical resolution (apparent)	390 lines			
Horizontal resolution				
r-f input	4.2 MHz			
video input	4.6 MHz			
Audio response				
internal speakers	11 kHz at −6 dB			
at baseband	>>20 kHz			

Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Telequipment Model D66 (modified) and Hameg Model 605 oscilloscopes; B&K-Precision Model 1260 NTSC and Model 3020 function generators; Data Precision Models 245, 258, 945, 1350 and 1750 multimeters; Sencore Model VA48 video generator, Model CG169 color-bar generator, and Model PR57 Powerite power supply; Sadelco Model FS-3D VU field-strength meter; Gossen Luna-Pro light meter.

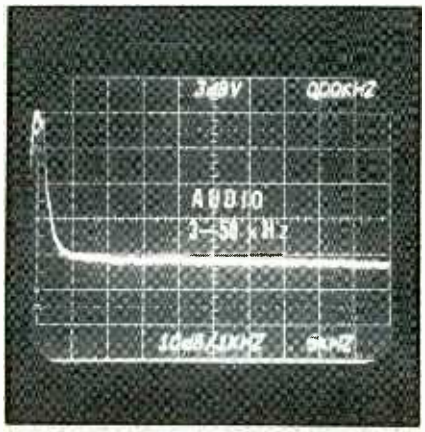
How To Interpret The Waveforms



1. NTSC color bars and six cycles of multiburst from 0.5 to 4.2 MHz.



2. Spectrum display of S/N and "telltale" vector superimposed.



3. What the "perfect" audio processor should reveal.

Probably the easiest way to interpret the waveforms for the six TV receivers discussed in this article is to show "perfect" examples initially and then explain any deviations as we go along. In this way, you can reasonably judge dissimilarities between signal-generated information and receiver-processed results. As you might expect, there are always some differences, but usually only certain variations are significant. Therefore, these waveforms and the laboratory instrument readouts tell the entire operational story without the necessity of having to guess.

For simplicity, illustrative waveforms in the three photos in this box should suffice. The first is a composite of the usual six NTSC color bars, beginning with yellow, proceeding through cyan, green, magenta and red, ending with blue. The second part of the waveform shows a series of six multibursts, ranging from 0.5 to 5.2 MHz. Both occupy −40 to +100 IRE (Institute of Radio Engineers) units of amplitude. Some color distortion is inevitable in both TV receivers and videocassette recorders but is not nearly as apparent to the eye as lack of picture (luminance) definition that's due partially or severely to restricted video information reaching the cathode-ray tube.

The second compound photo consists of a spectrum-analyzer display that illustrates signal-to-noise (S/N) ratio at 3 MHz, with a pretty fair, very clean 10-petal gated-rainbow vector superimposed. The vector shows even 30° petal spacing, no inductively induced crossovers or tuner problems, classic 90° R−B demodulation, and substantial tint control. We'd prefer a little less petal width at the sides and bottom. The first spoke of this vector wheel represents yellow-orange, the third red, the sixth blue, and the tenth green. This is a highly significant waveform for those people who can successfully generate and interpret it.

The third photo shows a theoretically perfect peak-detected spectrum-analyzer display of audio frequencies from approximately 3 kHz to 50 kHz, which is certainly beyond hearing range on the high end but gratifyingly apparent to the analyzer.

fice circuit and expect not to replace fuses or reset ciruit breakers.

Chassis voltage supply regulation between 88.6% and 92.7% isn't perfect. However, it will do nicely for 100-to-130-volt ac operation wherever you are.

R-f input and video output waveforms are generally excellent, with only a few transient spikes, possibly due to transition-enhancing velocity-scan modulation. Regardless, you obtain a full 4.2-MHz bandwidth, through the r-f section and out to the picture tube's cathode, and 4.46-MHz bandwidth at the base-band video output. These two specifications should satisfy anyone.

Signal-to-noise (abbreviated S/N hereafter) at 3 MHz is normal, with the usual dropoff occurring at around 4 MHz. We would have preferred a more symmetrical vector with even 30° spacing between the petals, but some expansion between green at 300° and orange at 30° seems to have occurred electrically, even though NTSC color bars (done with a different generator) are unaffected. So this may be more our problem than Magnavox's.

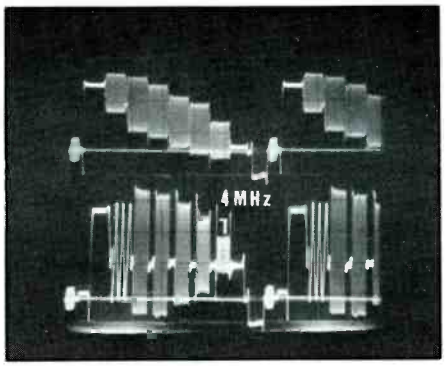
Audio seems fairly constant in the right- and left-channel outputs out to 100 kHz, which is normal for stereo response. However, mono dropoff is obvious beyond 10.7 kHz when depending on the four internal speakers serenading a microphone pickup.

User Comment. If you want a complete audio/TV/monitor package in a handsome wood cabinet and with modulator serviceability, the Model RS4278WA is it! Assembling them in Greenville, TN, North American Philips has done well with its Magnavox, Sylvania, and Philco acquisitions, and the Phoenix 19C4 deluxe chassis is a credit to all wherever used with good CRTs and tuners.

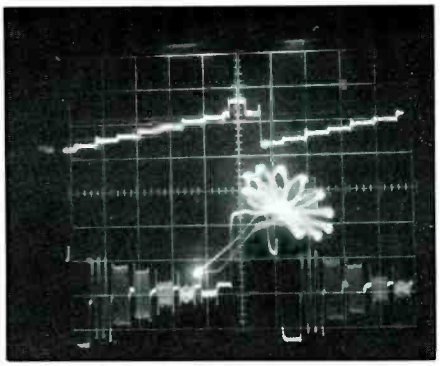
Panasonic—Japan's Best

Obviously, we can neither declare

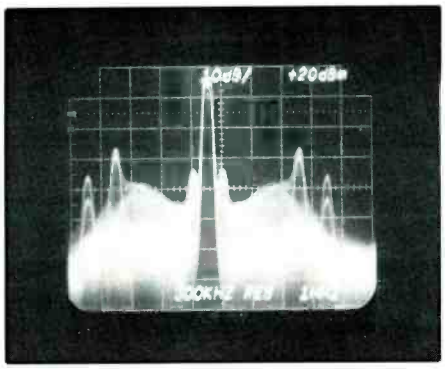
Magnavox



Color bars and multiburst at audio output jack.



Staircase, vector and multiburst during general signal processing.



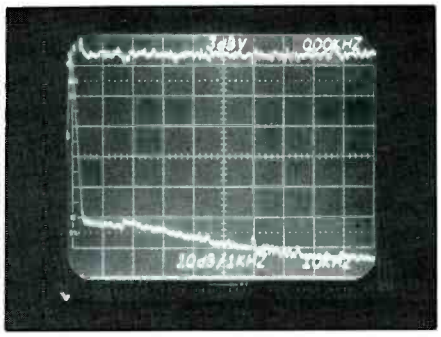
Display shows a 42-dB S/N at the cathode-ray tube.

nor prove that all Matsushita (Panasonic) TV receivers are forever Japan's best. But we *can* positively state that the 20″ Model CTF-2075 TV receiver/monitor checks out as a remarkable TV receiver and the best we've *ever* tested from an off-shore manufacturer.

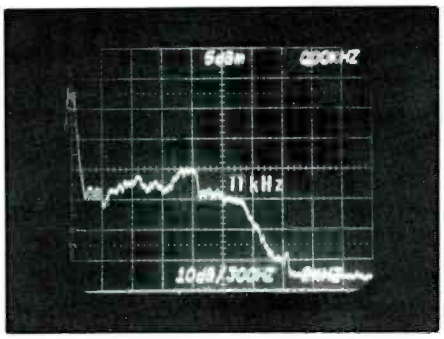
Beginning with a 70% light-emissive picture tube and removeable dark glass face plate, this set goes on to deliver 192 sq. in. of viewing area and has a 129-channel vhf/uhf/CATV tuning range. By the time you compile a list of everything this set has to offer, you may be amazed, confused, or ecstatic, depending on how familiar you are with the technical aspects of video. The plethora of outstanding features may even soundly convince you that you've hit the video jackpot with this receiver. Then, if you're prepared to pay the price, are happy with a 20″ picture, and like the unusual flexibility this set has to offer, your in for a real treat.

Flex Features. A data-grade picture tube with fine-pitch dot phosphors and shadow mask lets you put on-screen graphics, computer text (2000 characters in an 80-character line by 24-line format), and high-resolution TV pictures. Corner resolution and focus are excellent, thanks to the tube's true rectangular shape.

On-screen displays for time, channel 1 or 2 input, sleep, and channel number first appear as large blue



Audio inputs and R/L channel outputs to external speakers.



Peak-detected audio through internal speakers at 2 kHz/division.

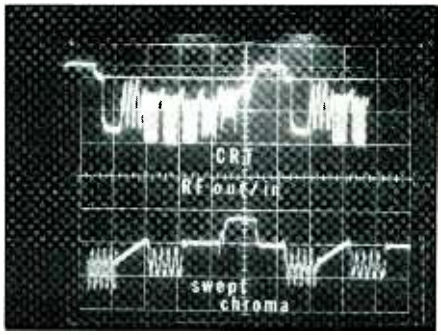
Panasonic Model CTF-2075R Laboratory Analysis

Ac power drain (100 to 130V ac; varies with video input)	115 watts average			
Voltage regulation (with signal input)	source	100V	130V	%
	115V	115V	115V	100
	5V	4.9V	4.9V	99+
	27kV	26.9kV	27.1kV	99+
Tuner/system sensitivity				
vhf channels 3 and 8	−2 and −3.5 dBmV			
uhf channels 15 and 30	0 and −1.5 dBmV			
Agc swing (−2 to +53 dB)	55 dB			
Luminance/chroma S/N	42/42 dB			
CRT temperature	9000° K			
Dc restoration	84.5%			
Horizontal overscan	10%			
Convergence	98%			
Maximum center CRT vertical resolution (apparent)	470 lines			
Horizontal resolution				
r-f input	4.2 MHz			
video input	>8 MHz			
Audio response				
internal speakers	8 kHz at −6 dB			
at baseband	>>20 kHz			

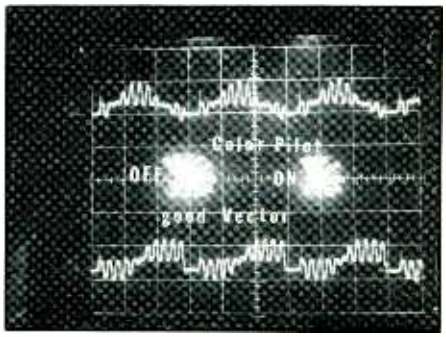
Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Telequipment Model D66 (modified) and Hameg Model 605 oscilloscopes; B&K-Precision Model 1260 NTSC and Model 3020 function generators; Data Precision Models 245, 258, 945, 1350 and 1750 multimeters; Sencore Model VA48 video generator, Model CG169 color-bar generator, and Model PR57 Powerite power supply; B&K-Precision Model 1653 variac power supply; Sadelco Model FS-3D VU field-strength meter; Gossen Luna-Pro light meter.

Panasonic

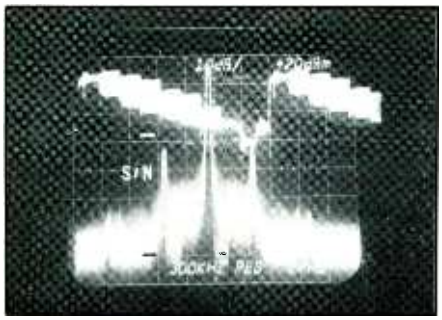
Multiburst and color bars through baseband video input/output.



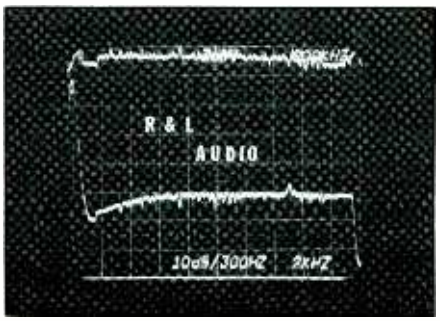
Multiburst and swept chroma via r-f to the cathode-ray tube.



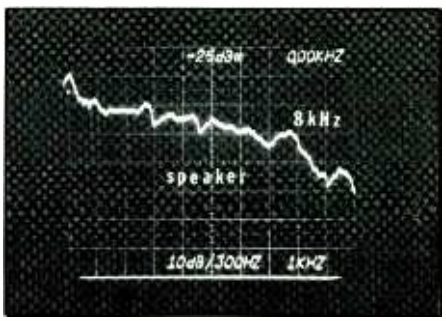
Excellent chroma vector pattern in open and color pilot modes.



CRT inputs are loaded by spectrum analyzer, but S/N is 42 dB.



Right and left audio response to sine inputs; separation is 46 dB.



Peak-detected audio response at speaker shows 10-kHz high end.

numerals in the center of the CRT. The numerals move upward and to the right in three steps as they decrease in size until they merge same-size with allied information being displayed.

When the receiver operates on baseband pure audio/video/data, the displayed numbers turn green and identify video 1, 2 and 3 modes. There are also special vertical size, contrast, and horizontal controls.

Naturally, programmable up/down channel scan, dual antenna inputs, bass and treble tone and balance controls, ambience (expanded) sound, double 4-watt stereo amplifiers, electronic Color Pilot luminance, and automatic color control sharpness tuning are featured. Also included are 8-watt external-speaker outputs, a special CompuFocus video system with both surface-wave (SAW) filter and color/luminance-separating comb filter. All of these features work like a charm.

You might also fancy the dual types of RGB (red/green/blue) inputs for teletext (with adapter) and video displays from computers and other sources. Three groups of video and audio inputs and program outputs should prove appealing for use with video monitors, VCRs and video games. Should you wish outputs directly from this receiver/monitor's tuner, there are audio and video jacks available—if you have a means for detecting (demodulating) these sight and sound signals and put them to good use. Panasonic says nothing about this last being a BTSC-dbx multichannel TV sound output. Perhaps it isn't. But if you want the genuine built-in article in this Omni series, you might wait a little while and try the Model CTF-2077R, which will be available later this year and has everything!

This receiver/monitor has dual 4" speakers and is housed inside a silver and black cabinet with built-in handholds. It measures 20⅜"D × 19 13/16"W × 18 15/16"H and weights 66 lbs.

Remote Control. The 7¼" × 2½" color-coded remote-control transmitter supplied with this receiver/monitor has a throw switch for TV and VCR. In the TV position, it controls power, sound level (volume), up/down channel scanning, direct channel address, rapid tune, recall, 30/60/90-minute sleep intervals, sound muting, antenna, TV video, and ambience. In the VCR position, TV/VCR can be switched, in addition to operating the record, stop, play, rewind, fast-forward, pause and frame-advance functions of a videocassette recorder.

Numerals 1 through 0 permit direct channel access for either the TV receiver or the VCR. Because of the discrete switching system, there is *no* interaction or signal pickup between the receiver or recorder commands and execution. When sound is silenced, the word MUTE is displayed on the screen.

User Comment. Probably enough

has already been said in praise of this receiver/monitor, but a note about serviceability is still in order. Since printed-circuit boards are located on three sides and the bottom of the BMX-GXD chassis, one may need cable extenders to tackle tough jobs. But with a few test points and superior component identification *facing* the service technician, even complex repairs shouldn't prove to be too difficult to perform.

RCA—America's Best

Wanna buy the best TV receiver made in America? If so, try some of the ColorTrak 2000 series sets from RCA. What you'll get is both tremendous pictures and sound. Frankly, we've never seen anything like the ColorTrak 2000 series—even to pretty good serviceability!

Taken directly off the bench from a service seminar, the picture and audio from the 25" Model FKC2022 TV receiver/monitor we used for this report looked and sounded unusual, even to our educated eyes and ears. Back in the lab, test equipment substantiated what we saw and heard.

What You see Is What You Get. Our usual procedure is to give a rundown on the features and functions of a product before we give details of test results. But since our sample's test results really represent the entire 2000 series line (so any single unit is characteristic of all, with the exception of cabinet and added or deleted features), we decided to switch things around for this report.

First off, the Model FKC2022 accepts audio and video inputs and has three auxiliary inputs and outputs, including one set for text and graphics. It also has red, green, blue and "enable" inputs for direct video entry, separate TV and audio input and output, and right and left driver outputs for external speakers. The external-speaker outputs have 220-μF coupling capacitors, which should enable this receiver/monitor to handle 16-ohm speakers when equipped with 20-watt amplifiers.

Let's first take a look at some video bandpass measurements. It isn't difficult to see in the first photo that 4.2 MHz is present at both the video detector (upper display) and red cathode (lower display) of the picture tube. There's some hint of CRT driver clipping, but this is probably due more to the the somewhat nonsymmetrical signal generator used than to the receiver.

Using two gated-rainbow generators, instead of an NTSC color-bar generator, we next looked at both the video detector and CRT input again for swept-chroma response, as well as a vector test pattern. Although high-frequency chroma reveals reduced amplitude at around 4 MHz, it is still sufficient. The 10-petal vector pattern indicates relatively good bandpass tuning, appropriate 30° petal separation, only one obvious crossover, and much better than average color demodulation. In auto-color, the orange-reds close up a little to help with fleshtones.

NTSC color patterns were so good that they're not included in the photos. S/N at 1 MHz per division is as shown, with a very conservative measurement of 42 dB (some might even say 43 dB). Video input and output surpassed the 8-MHz mark.

With 18 models having TV multichannel stereo/SAP (second audio probram "B") built-in sound with additional dynamic noise reduction extra, what more can we say? The photos show that the left and right chanel outputs through auxiliary 1 and the hi-fi jacks are just as linear as can be out to 20 kHz and beyond, including the presence of a 15,734-Hz stereo signal. Doubling the stereo signal, you obtain the 31-kHz stereo subcarrier, and multiplying it by 5, you get the SAP carrier.

Receiver Description. In addition to providing 4.2-MHz video and better than 20-kHz audio responses, this receiver/monitor is also the first of its kind to process and deliver 2-MHz I and Q chroma. *That's* why it's called "full-spectrum television."

The digital command remote tunes both the receiver/monitor and VCR

(Continued on page 30)

RCA Model FKC2022T Laboratory Analysis

Ac power drain (100 to 130V ac; varies with video input)	150 watts			
Voltage regulation (with signal input)	source	100V	130V	%
	129V	127.9V	128.6V	99.5
	11V	11.1V	11.2V	99.1
	27kV	27.5kV	27.8kV	98.9
Tuner/system sensitivity				
vhf channels 3 and 8	−6 and −8 dBmV			
uhf channel 20	−1.5 dBmV			
Agc swing (−2 to +58 dB)	66 dB			
Luminance/chroma S/N at CRT)	42/42 dB			
CRT temperature	7000° K			
Dc restoration	82%			
Convergence	95%			
Maximum center CRT vertical resolution (apparent)	446 lines			
Horizontal resolution	4.2 MHz			
Audio response	20 kHz			
Stereo separation	23 dB typical			
L and R separation (without stereo)	60 dB			

Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Hameg Model 605 oscilloscope; B&K-Precision Model 1260 NTSC color-bar and Model 3020 function generators; Sencore Model VA48 video generator, Model PR57 Powerite power supply; and Model CG169 color-bar generator; Data Precision Models 245, 1350 and 1750 multimeters; Sadelco Model FS-3D VU field-strength meter; Gossen Luna-Pro light meter.

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NTS offers three programs in computer electronics. You will receive training covering solid-state devices, digital logic circuitry, and the fundamentals of the computer itself. Instruction includes micro-control technology and detailed operation of microcomputers. These courses will prepare you for entry-level in many facets of the computer industry such as field service and customer engineering as well as programming. In addition to written texts your course includes the NTS/HEATH disc-drive computer which you assemble as part of the training process. The assembly and use of the computer will serve to reinforce practical application of principles.

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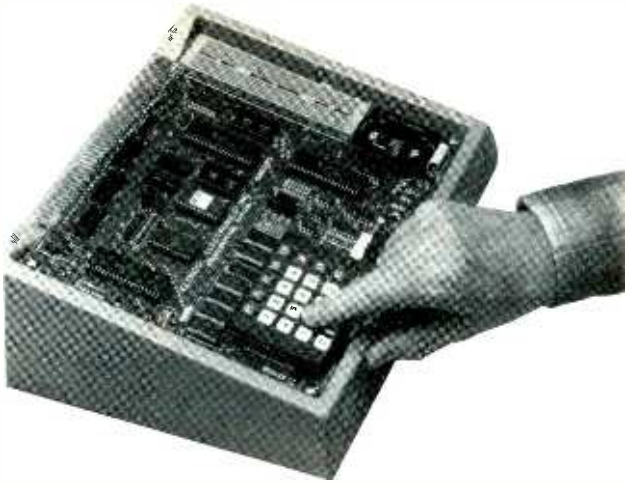

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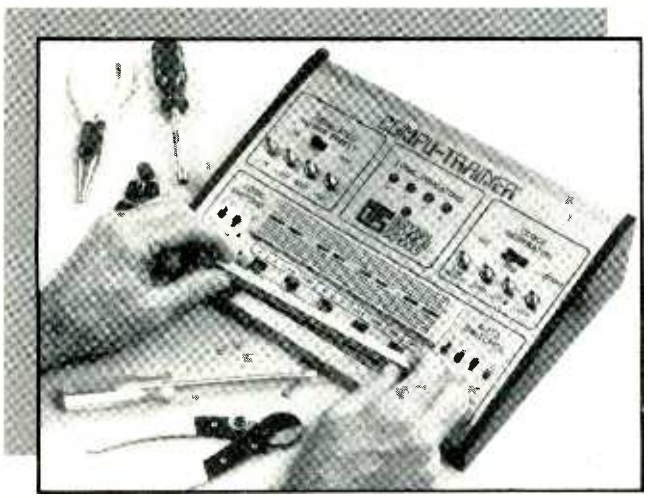
ROBOTICS & VIDEO TECHNOLOGY

Other NTS courses cover a wide range of specialization. In Robotics, the NTS/Heath Hero I is included to train you in robotic applications in manufacturing processes. In Video technology, a new course features the advanced NTS/Heath Z Chassis "Smart Set" color TV with computer space command remote control and space phone. This is an excellent program for those interested in a career in video servicing with microcomputer basics.



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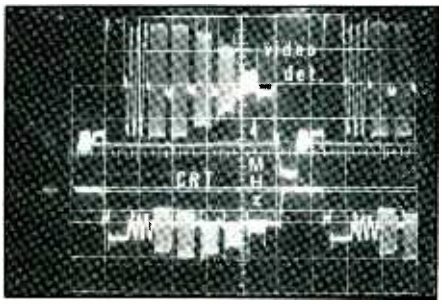
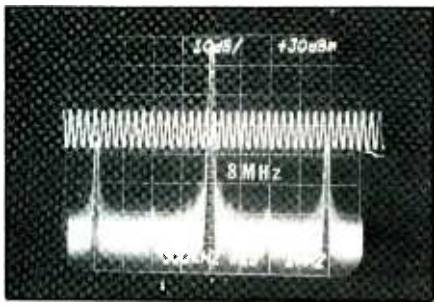
4000 So. Figueroa St., Los Angeles, CA 90037

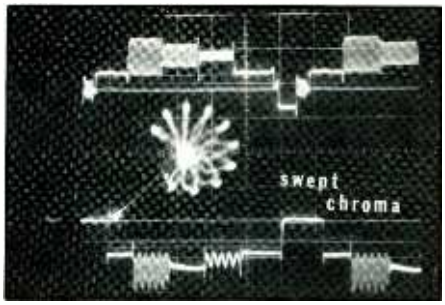
RCA



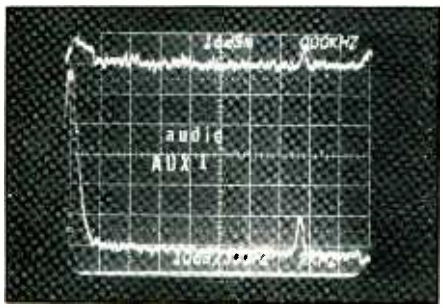
Multiburst showing bandwidths at the video detector and CRT.



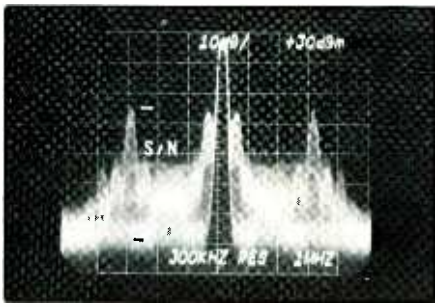
Video input and output characteristics at 8 MHz.



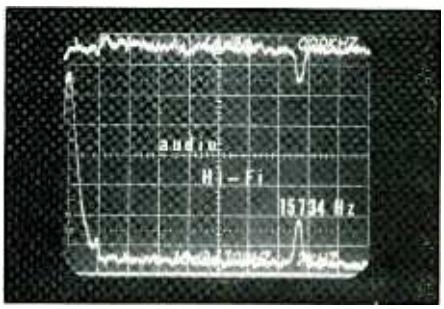
Swept-chroma response and superimposed vector petal pattern.



Scope photo shows audio response through AUX 1.



Trace photo shows a 42-dB S/N from this top-of-the-line receiver.



Audio response through the hi-fi outputs extends out to 20 kHz.

through a 127-channel vhf/uhf/CATV range directly or by up/down scanning, preprogrammed recall, or previous-channel recall. It also lets you monitor inputs 1, 2 and 3.

Inside the receiver, there's a very good comb filter for maximum luminance and chroma separation, a new computer-matched tube/yoke combination, continuous automatic color balance, automatic color control, fleshtone correction, contrast/color tracking, automatic sharpness control, black-lock contrast level control, and a 110° picture tube. There are also two high-compliance 5″ woofers and a pair of 2″ tweeters with separate amplifiers.

Hidden behind a front-panel door on the receiver/monitor are switches that permit you to select speakers or outputs, audio B, stereo or mono mode, DNR/off, automatic color/off, and the usual picture, sound, and direct address channel potentiometers and keys.

User Comment. One word describes this RCA receiver/monitor—marvelous! It's not "perfect," of course. For example, it would be nice if we could have a little better edge focus on the CRT, an approach to automated troubleshooting, and a less-bulky remote-control transmitter. But considering what you get, these complaints are just nit-picking.

Samsung—A Relatively New Name From Korea

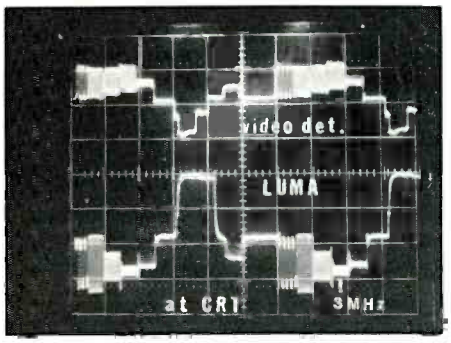
Japan isn't the only Far Eastern country doing a brisk business in the U.S. video marketplace. From Korea come TV receivers under the brand name Samsung, which you'll find mostly in discount stores, where they're priced to appeal to the budget-minded consumer.

For this report, we chose the 19″ Samsung Model C9510CA color receiver that, at a suggested retail price of only $429.95, sells for roughly half the price of its deluxe counterparts. Though this is definitely a low-budget color set, don't judge it too harshly until you've had to look at your bank balance and the performance and features it has to offer. You might just find that the Model C9510CA has all the features and performance you want or need for a fraction of what you thought you might have had to pay.

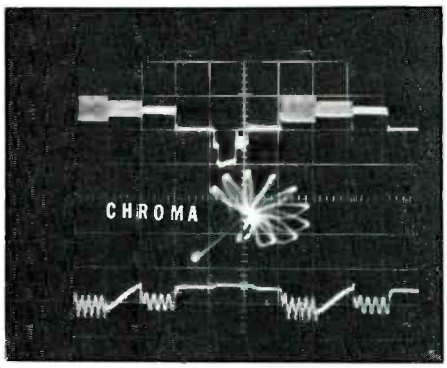
At any rate, this receiver does have a frequency-synthesized infrared remote-control system that offers up/down channel search, up/down volume control, power on/off, audio mute, and direct-address channel selection. The receiver also features automatic and manual channel search, CATV/normal tuning, automatic color control, and a master power switch behind a small door on the front panel. Above this door are larger buttons for controlling volume, up/down channel scanning, and turning on and off initial power.

The operating portion of the receiver consists of two pull-out and detachable printed-circuit boards, a separate vhf/uhf/CATV tuner, a 4″ speaker, and an in-line, slotted-mask, black-matrix picture tube.

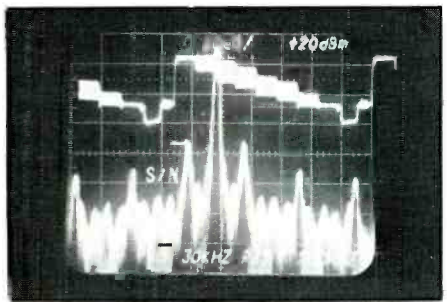
Samsung



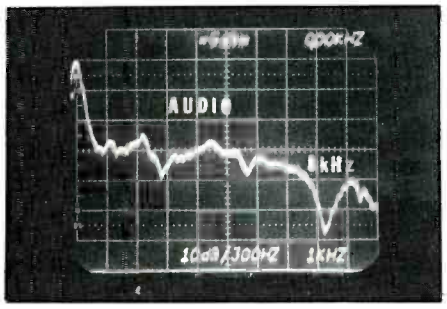
Multiburst at video detector (top) and red gun of CRT (bottom).



Swept chroma and reasonably well-formed vector pattern.



S/N is not the best, but it is passable for the noncritical viewer.



Scope trace shows audio response from 600 Hz to 10 kHz.

Samsung Model C9510CA Laboratory Analysis

Ac power drain (100 to 130V ac; varies with video input)	87 watts			
Voltage regulation (with signal input)	source	100V	130V	%
	125V	108.6V	124.7V	87
	16.5V	13.6V	16.2V	84
	21kV	17.4kV	21.2kV	82
Tuner/system sensitivity				
vhf channels 3 and 8	−3 and −2.5 dBmV			
uhf channels 15 and 60	+3 and +7 dBmV			
Agc swing (−3 to +43 dB)	46 dB			
Luminance/chroma S/N (at CRT)	35 dB			
CRT temperature	9200° K			
Dc restoration	81.6%			
Horizontal overscan	11%			
Convergence	97%			
Maximum center CRT vertical resolution	427 lines			
Audio response (from 4" speaker)	7 kHz at −6 dB			
Barrelling/pincushioning/flagwaving	slight barrelling			
Horizontal resolution	3 MHz			

Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Telequipment Model D66 (modified) and Hameg Model 605 oscilloscopes; B&K-Precision Model 1260 NTSC and 3020 function generators; Data Precision Models 245, 945, 1350 and 1750 multimeters; Sencore Model VA48 video generator, Model CG169 color-bar generator, B&K-Precision Model 1653 variac power supply; Sadelco Model FS-3D VU field-strength meter; Gossen Luna-Pro light meter.

On one circuit board are the 42-pin microprocessor tuner control, 4.5-MHz clock, and driver IC. The second and larger board contains five additional ICs for: video i-f, agc and video detection; sound; color/luminance processing, sync and chroma demodulation; voltage regulation; and flyback pulse generation. Except for the tuner control, there are only 11 discrete transistors on the chassis. ICs are made by Samsung, Toshiba and NEC (Nippon Electric Corp).

The TV receiver is housed inside a walnut-grain plastic cabinet with pewter-colored front and accents. It measures 17⅞"W × 14⅛"D × 12⅞"H and weighs 31 lbs.

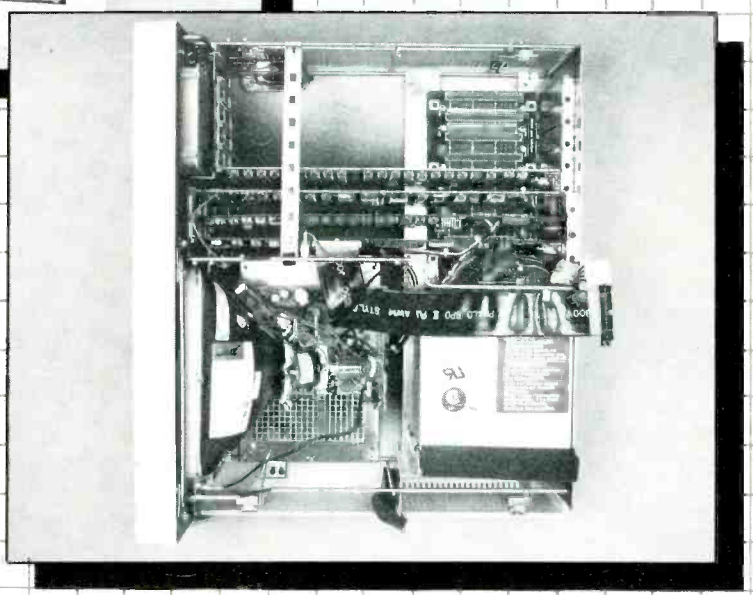
How It Operates. The K20 chassis used in this receiver does exactly what it is designed to do—provides a viewable picture for nonexacting people and fair quality sound at modest cost. Its 21-kV high-voltage supply generates sufficient potential to accelerate electrons in the picture tube, and its 82% to 87% voltage regulation offers a reasonable operating variance for a receiver in this price range. Vhf tuner sensitivities on channels 3 and 8 are passable at −3 and −2.5 dBmV, although uhf sensitivity on channel 60 becomes a bit sloppy at +7 dBmV.

The agc (automatic gain control) range is fair at 46 dB, while dc restoration of 81.6% isn't bad at all. The slight barrelling noted on the left side may be due to setup and would be noticeable only when the receiver is excited by a color-bar generator or with a crosshatch (or just vertical lines) pattern being displayed.

At only 11%, horizontal overscan can certainly be classed as good, and maximum vertical center resolution of 427 lines isn't shabby, either. This resolution figure, by the way, doesn't mean that you're going to see 427 lines of a possible 484, but they're there if horizontal sweep, good vertical interlace, and small spot size video can use them.

User Comment. The Model C9510-CA is certainly a better color TV receiver than many competing Korean video products. It also projects a reasonably good service record, judging

(Continued on page 81)



Heath/Zenith's New IBM-Compatible Personal Computer

Focusing on Zenith Data Systems' new 9"-screen transportable personal computer, M-E examines its capabilities, performance, and competitiveness

"Both text and graphics display capabilities are provided."

By Charles P. Rubenstein

Adam Osborne popularized the suitcase-like computer that could be lugged around by its carrying handle. Compaq, in turn, elevated the design's success to new heights with a (trans)portable that emulated IBM's popular personal computer, astonishing the computer world with a reported $110-million sales in its very first year.

Since then, a host of other lug-along computers have been introduced. Among the latest issues is Zenith Data Systems' Model Z161, examined here, which is also available in kit form by Heath/ Zenith. A desktop version, Model Z151, is being marketed, too.

More importantly, these computers are said to be IBM-compatible. Coming from a company that traditionally went its own design way, this marks a new turn for Zenith. Now that Zenith is meeting some competition head on, let's explore what its Z161 transportable has to offer.

General Description

Like all transportables, Zenith's detachable keyboard latches to the front of the computer, showing its back as it protects the CRT inside, and converts the machine into a neat carrying package. The cream- and beige-color plastic case measures about 19″ square by 8¼″ deep, weighing in at 42 lbs. with two disk drives. Storage compartments are included for the detachable ac power cord (on the right side of the disk drives) and for the coiled keyboard cable (behind a slide-open "hidden" compartment at the left of the CRT, which also cloaks the brightness control).

Setting up the transportable, one is quickly struck by its different "look." Whereas other transportables use half-height drives one atop the other, Zenith's employs a pop-up section at the top of the case to accommodate its drives in a horizontal layout, as one can see in an accompanying photograph.

A basic Z-161 comes with one 5¼″ disk drive and 128K of user memory. Disks are IBM formatted for 360K bytes of data storage. The unit we examined came with two drives and 256K of RAM. The basic machine is priced at $2,399 ($1,699 in kit form), and $2,999 with a second drive ($1,999 as a Heathkit). Each 64K RAM expansion set costs $100, so the model we tested would cost $3,199. Included with the machine are the operating system (MS-DOS Version 2) and a diagnostic disk, representing $278 if purchased separately. Other software, such as BASIC ($100), are sold separately.

Though not merchandised as having bundled software, the latest Heath retail catalog (Christmas 1984) notes that $725 worth of software will be issued free with purchase of an assembled or kit version of the model (Microsoft's Multiplan, Word, and Windows).

The assembled ZDS model comes with a non-glare 9″-diagonal amber-phosphor CRT, while Heathkit models present the buyer with a choice of amber or green (same price). The basic model has four internal card slots available for expansion purposes, and includes two RS-232 serial I/O ports and Centronics-type parallel I/O port. There's also an output port for an RGB color monitor and a composite monochrome output should one wish to use a larger mono video screen. Both text and graphics display capabilities are provided.

Inside the Z-161

It's easy to expose the guts of this machine. Simply unlatch the top-loading drive section, unplug a few clearly marked connections, remove the four Phillips-head screws, and slide the cabinet cover off from the rear. You'll then see the backplane with four circuit boards (CPU, memory, video, and disk controller) and four empty 64-pin IBM bus slots for adding more boards, a large shielded power supply, and the CRT. The layout is airy as a result of separating the disk drives from the computer's body. There's also a small coupling fan at the rear of the power supply as well as a 2″ speaker to output software-generated tones. The 168-watt switched supply has impressive power, producing 16.4A dc for the +5 volts line, 5.4A dc for +12V, 0.25A dc for −12V, and 1.5A dc for +12V regulated supply. This more than doubles what's available with an IBM PC.

The CPU Board. With the thought that this computer is also purchasable as a kit, it is not surprising to find that all 42 ICs on the CPU board are in sockets. In addition to the 8088 microprocessor running at 4.77 MHz, the same as an IBM PC, and a socketed provision for an 8087 math co-processor (optional at $225), the board has a pair of 16K EPROMS to manage disk operating system BOOT, the monitor, and a myriad of diagnostic routines. Additionally, the keyboard interface with an attached five-pin DIN connector and several VLSI circuit chips reside on this board.

These Zenith machines take a back seat to none when it comes to diagnostics. In addition to having diagnostics done automatically on power up—accomplished so fast you don't even notice it, in contrast to IBM's more than half-minute pause for the same purpose—menu-driven diagnostics in ROM are callable by the user for on-screen examination.

In addition to the foregoing, there are diagnostic LEDs on the CPU board to aid in troubleshooting. Six red LEDs located here monitor the "health" of the CPU, ROM, RAM, INT, DSK, and RDY functions of the system. On the initial turn-on, they all light. As each ROM-based diagnostic program is completed correctly, they turn off one by one. Furthermore, five green LEDs monitor the

backplane's power-supply voltages. They remain lighted whenever the appropriate voltages are present.

Furthermore, a diagnostic disk, included with each machine (our sample model did not come with one) contains a series of routines that allow the user to test various functions, sounding an "alarm," it's said, when a defect is discovered.

The Memory Board

Mimicking the design parameters of the IBM PC, the memory of the Z-161 is made up of several 64K banks of 9-bit (parity checked) dynamic RAM. The standard Heath memory board comes equipped with at least two banks or 128K of RAM, as cited earlier, and is upgradable to five banks or 320K per board (at $100 per bank). Two 320K boards can be supported by the system, which can therefore have an impressive 640K of *internal* RAM. The RAM chips and support ICs (including the omnipresent PAL device) are, again, all socketed. As part of this board, and at no extra charge, is a Centronics-type parallel printer interface with a DB-25 connector.

The Video Board

As implied earlier, the Z-161 has the equivalent of an enhanced IBM color graphics board, producing text and graphics on the same screen, and shades of amber to represent programmed colors. The video board, which has a DB-9 connector with RGBI (Red, Green, Blue and Intensity) video output as well as a phono plug for external monochrome monitor use, is composed of 61 socketed ICs. This includes an Hitachi HD46505 (a Motorola 6845 equivalent) CRT Controller, a 4K character generator ROM, two banks of 16K video RAMs, and six special PAL-type ICs. These join forces to enable the user to create four text-graphics modes, including 40- and 80-character IBM font, 25-line text displays, with 8 background and 16 foreground colors or 8 levels of "grey" on monochrome displays. Further, there are three color graphics modes, which include 320×200 pixel, 4-color Med-Res, or 640×200 pixel Hi-Res color graphic displays.

The ROM has four 256-character fonts that are hardware (and purportedly software) switchable. They're displayed on a 7×7 grid within an 8×8 grid box. In addition to the standard alphanumerics, the default character set includes Greek mathematical symbols, foreign-language characters, a block graphic characters, and even word processing edit characters.

The dual 16K video RAM banks can hold 8 pages of 40 characters/line or 4 pages of 80 characters/line of text. Used in the graphics mode, and

The Kit

by Al Burawa

Although we did not have an opportunity to assemble the Heath/Zenith version of Zenith Data Systems' assembled Z-161, my experiences with assembling its desktop counterpart, the Model HS-151, should carry over to the transportable kit.

It was easy! For one, there was virtually no chassis work that had to be done. Furthermore, Heath changed its parts packaging system for the better. Instead of supplying bags with all parts thrown in, all resistors, capacitors, and other small parts are arranged in required order of installation on taped-together strips. In addition, the central processing unit and video printed-circuit boards came preassembled, as does the power-supply system. Just set 'em into place. Captive hardware simplifies the work further.

This leaves two of the four plug-in boards for the user to assemble: the memory board and the disk-drive controller board. Add the "IBM" bus board (backplane), and that's what virtually all the soldering is about. For the transportable, which has a built-in CRT you'll have to add some more solder work, of course. This consists largely of a small pc board that sits at the socket end of the CRT tube.

There's more than 3,000 solder points in total, so one cannot dismiss the assembly effort too lightly. I spent about 10½ hours wiring the two boards and the backplane, with another 4½ hours assembling metal and plastic sections, making tests, and for drive-controller adjustments. Add about two hours more for the transportable's CRT and accompanying circuits, I guess, and I'd say that the H-161 should take an experienced kit builder about 17 to 18 hours or so to completely assemble.

Heath's instruction manual is extraordinarily simple to follow. Clear instructions and superb illustrations lead you by the hand. Nonetheless, an inexperienced kit builder, without the confidence of a seasoned builder, would likely require a few hours more than myself to do the job. Even so, you'd be paying yourself about $40 per hour tax-free if you elect to go the kit route, which is very appealing, don't you agree?

A Heathkit buyer also has technical counsel literally at his fingertips. Just phone Heath's technical department and pose whatever questions you have concerning their product.

Another benefit picked up when you roll your own is an intimate knowledge of the computer's hardware, which can come in mighty handy should you ever have to repair it or elect to modify the machine.

Heath supplies the buyer with most of the essentials needed to put together the kit, including solder and an inspection magnifying glass. The builder has to supply a solder iron, diagonal cutters, long-nose pliers, and a high-impedance multimeter for resistance and voltage checks. But any electronics enthusiast worth his salt should already own these.

Just add some patience and care while building such a kit, and you'll also gain a sense of fulfillment and impress your friends and business acquaintances.

with an RGBI monitor, 16 colors are possible (8 on RGB only), as are reverse video, blinking, highlighting, and 8 levels of "grey" when using a monochrome display. Although color is not supported in the HiRes mode, an assembled graphics board is available for $499 that yields 8-color 640×225 pixel-mapped graphics.

The Disk Controller

The disk-controller board, as with all the Z-161 boards, provides extra functions. Here we find two DTE (data terminal equipment) RS-232C serial ports; one for a serial printer, the other for a serial asynchronous modem or other serial devices such as graphics tablets, plotters or a mouse, with operation at up to 19.2K baud. (The modem socket was covered on the unit we reviewed. Two chips—U535 and U536—were missing.) The 30 socketed ICs on this board will also support up to four double-sided, double-density, 4¼", 48-TPI drives (360K of storage per disk using IBM PC MS-DOS version 2-compatible 40-track disks).

The Z-160 transportable employs the Mitsubishi Model M4851 half-height Mini Flexible Disk Drive, which is whisper-quiet.

With drives in the collapsed stored position, an unsuspecting observer might even think you have a built-in hard-disk unit. (A Winchester hard disk is available for the Z-150 desktop for $1500, but not suggested for the Z-161 portable.)

The Keyboard

The Z-161's three-pound detached keyboard, doubling as the system monitor cover in its transporting mode, is 19" wide, 7½" deep, and slopes from ¾" to 1½" from front to back. For users who want the standard 15-degree slope, there are two fold-down tabs at the back that raise the keyboard's rear another inch.

The keyboard has 84 keys. Fifty-seven are laid out in a Selectric-compatible manner, unlike IBM's, which should please typists. Clustered at the right are 17 keypad keys which double as numeric keys when the numeric lock key is depressed. Ten IBM PC-compatible Function keys are lined up in two rows at the left side of the keyboard in the same manner as that of an IBM PC. Alphanumeric keys and the XY cursor/numeric keys are cream-colored, while other keys are beige.

Unlike IBM's PC, Zenith had the foresight to include LED lights for the NUM LCK and CAPS LCK, enabling a user to know which mode he's in. Another improvement is the use of a large, backward-L-shaped RETURN key, as well as large-size SHIFT and CONTROL keys. All keys are well sculpted, feature auto-repeat, and possess tactile feedback.

The Z-161's detached keyboard is controlled by a dedicated microcomputer chip. The 8048 is used with a half-dozen other ICs for keyboard encoding and communication with the serial CPU interface through a five-pin DIN socket. Connected here is a very thick, heavily shielded, three-ft. coiled cable that is extendable to twice its length.

Software/Hardware Compatibility

I tried my best, but was unable to find any commercially available applications software designed for an IBM PC that could not run without a hitch on the Z-161 computer. Of course, I could not run IBM ROM-specific programs such as IBM BASIC and IBM BASICA, but could operate with all the IBM "sample.BAS" programs using Heath/Zenith's Microsoft GW BASIC.

Among IBM programs that ran flawlessly on the Zenith machine were LOTUS 1-2-3, Supercalc³, IBM Typing Tutor, Condor Data Base, and even an Advanced Space Graphics IBM PC Demo that required using the IBM color graphics board. I'd have to say, then, that the Z-160 is certainly compatible with software written for an IBM PC unless direct calls are made to IBM's ROM BASIC input/output system, which is rarely used by software writers.

Hardware, too, did not present any sort of problems. I tried out an AST Research multifunction board that was pulled out of an IBM PC, and it worked perfectly.

User Comments

Firstly, the Z-161 transportable computer definitely earns the right to be called "IBM PC compatible," being virtually a 100% clone. This out of the way, let's look at the new machine from a "hits and errors" view. Errors first.

The coiled cable that connects the keyboard to the main computer is impressively thick and has a lot of force within its coil. So much, though, that the keyboard connection is sometimes jarred a bit when the board is extended and sometimes shifted. What Heath/Zenith needs here, perhaps, is an audio-type professional connector with a catch or a threaded ring that secures it to the keyboard.

Do you like amber-color screens or do you prefer the color green. With a Heathkit you have a choice; with a Zenith Data Systems model, it's amber all the way, the preferred phosphor in Europe. I haven't made up my mind on this yet.

The text display on screen is nice and sharp, as 8×8 characters go. However, it suffers from the same deficiency that an IBM PC with a color graphics adapter has, as well as other IBM clones using the same system—lower descenders on one line meet with ascenders on the line below when they coincide. That is, the bottom of the letter "p" will touch the top of the letter "l" if the latter is directly below it. Moreover, some characters are not as well formed as I would like them to be. The letter "m," for instance, has much more height than other lower-case letters.

Picky? Perhaps. But if word processing is your main use with a computer, every improvement is welcome. People who have not worked with a few different computers or terminals might not notice. Even if they have, this may not be immediately observed. I had one person spend considerable time with the Z-161, and he loved the text display. Switching him to an IBM PC with a monochrome adapter and IBM's monochrome video monitor, however, he quickly commented on how much better the 14″ mono screen (which does not produce graphics on the same screen without a very costly board addition) is as compared to the 9″-screen Zenith machine. But, then, the same could be said for IBM's own transportable! The Compaq transportable, in contrast, does produce better text as well as supporting IBM graphics programs. It's not just alphanumeric display size that makes the difference, of course.

The Z-161's case does not appear to be as rugged as one could wish. In particular, when the drive section is closed down for carrying purposes, there's a small gap between it and the front panel. This is closed by pushing two slides that moves a plastic cover across this opening. It's this top-front area, a sheath, where the plastic has some physical "give."

For whatever reason, initial graphics display has a slight bounce when brought up on screen, much as a photographic slide that's repositioning itself. It happens quickly only the first time graphics is called, but it does occur. This is likely due to a not quite fast enough reprogramming for the graphics mode, where there's a delay in latching on to a sync pulse.

Do I like the pop-up drive setup? It's different. And working with the Z-161, I have to say that I do indeed like the drives side by side rather than on top of each other, and I even prefer the drives in their higher location, which avoids bumping the heel of one's hand when inserting or removing a disk in a lower drive. Furthermore, this design allows more storage area for the keyboard cable and the line cord, and the closed sliding panel in the front gives the machine a sleeker look. I guess that Zenith designers took a cue from their parent company's TV sets, which hide controls behind flap doors, etc. I also like the automatic loading of a disk when the drive "cover" is closed.

The keys have a nice feel to them. Zenith did a good job here. Especially welcome is moving the dreaded backlash key so that hitting the SHIFT isn't a challenge, as well as using larger SHIFT and CONTROL keys that one gropes for with a pinkie finger. Visually separating alphanumeric and keypad keys from other keys with two colors is a good ergonomic move, too.

Screen height on this portable is especially fine, with the carrying handle tucked under the main body. On many other transportables, such as IBM's, the screen rests too low for a user's comfortable eye level.

Heath/Zenith equips the Z-160 transportable with hardware extras that would cost nice bucks to add with most other machines. Two serial ports and a parallel port, for example, are standard features. Diagnostic provisions are superb, which should make troubleshooting the computer in the event of a breakdown a relative breeze.

Moving the disk drives outside the body of the Zenith computer doubtlessly reduces heat problems. This also enabled Zenith to provide four long-card expansion provisions on its IBM bus, giving the Z-161 the capacity to have 640K of user memory inside its enclosure. Moreover, the widest choice of third-party expansion boards is with the long-card format. An IBM transportable, for example, uses four *short* boards and one long one, while a Compaq has three long slots.

Kudos go to Zenith, too, for its powerful power supply, which should be able to handle any form of internal expansion without a problem. This cannot be said for IBM PC's much-underpowered supply.

This machine operates more quietly than any I ever used. You have to strain your ears to hear this disk drive operate and internal fan noise is totally absent. This is great for late-hour computerists.

Obtaining high-resolution, dot addressable graphics on the built-in mono screen is a boon. Also, the absence of video flickering as experienced with IBM's PC is appreciated, as is Zenith's very-smooth scrolling capability. Furthermore, the speed at which text is displayed is appreciably faster than with an IBM PC.

At 42 lbs. with dual disk drives, Heath/Zenith's transportable is heavier than most of its competitors. But, then, a large, rugged power supply adds weight, as does heavy metal internal chassis and struts. It would have been nice if the carrying handle were thicker and had some padding on it. But anyone planning to move a transportable a considerable distance always learns than an inexpensive foldup luggage cart with wheels is the way to go!

Conclusions

The Zenith Data Systems Z-161 is a fine IBM-compatible transportable machine. It competes with familiar computers in the higher-price category, with gives and takes that have to be weighed by prospective buyers.

This is an auspicious opening hand by Zenith, which has bowed to the dominance of IBM PC computer software and hardware. In doing so, it has added computers—a desktop and a transportable—to its line that emulates IBM's lower-priced computers that will likely appeal to people not visibly aware of Heath/Zenith's strong presence in the personal computer field, as well as to its regular customers. Equally important to the company is its corporate and military sales, of course, where Zenith

The Genealogical Tree

By Art Salsberg

The Heath Company started life as a maker/seller of flying-machine kits—real airplanes that one built—more than fifty years ago. Its founder and namesake, in fact, was ironically killed in an airplane crash. As electronics grew, Heath entered the electronic kit business, molding its fine reputation with test instruments.

After a time, it was purchased by Schlumberger, a conglomerate whose mainstay was oil drilling. The Zenith connection took place in 1979, when the TV giant purchased Heath and established Zenith Data Systems, now a force in the computer industry.

Heath was urged to enter the computer field when the MITS "Altair" computer kit was introduced at year-end 1974. I recall proudly showing the Altair in operation to its visiting advertising manager, Earl Broihier, who relayed the information to Heath officials. It wasn't until 1977 when Heath introduced its first computer, the H-8 kit, however. It had a set of programming buttons on its front panel, a necessity since major software programs for it were not widely available then.

At the same time, Heath debuted its H-11 computer, a 16-bit CPU machine that availed itself of Digital Equipment Corporation (DEC) technology.

Not long after, Heath developed the H-9 video terminal to go along with the H-8 computer. This "glass Teletypewriter" had all sorts of shortcomings, and was quickly set up for a redesign. By this time, fast changes were occurring in the microcomputer field. A better CPU than Intel's 8080 was introduced—the Zilog Z-80; Shugart was marketing 5¼" floppy-disk drives.

The prototype of a new, "real" video terminal, the H-19, was completed in 1978. It was compatible with some popular DEC computers. Heath design engineers then developed the concept of combining the terminal and a newly designed computer, each using a Z-80 microprocessor, and dual-disk drives. When it was introduced at the 1979 National Computer Conference, however, the all-in-one computer had only a single drive. This computer, the H-89, attracted a large following, and is still in Heath/Zenith's latest catalog.

Heath's early H-89 model used its in-house-developed disk operating systems—HDOS ("Hdoss"). This powerful operating system didn't have sufficient software backing from third-party producers, however, and Heath capitulated to software needs by adopting CP/M for the H-89 in order to tap a horde of application programs.

The H-89 was being bypassed in technology after a time. It used a disk-drive/controller that employed hard-sector disks, whereas soft-sector disks became ascendant in the industry. As a result, an H-89 floppy disk could store only up to 100K bytes, whereas soft-sectored ones had a storage capacity of 320K bytes, with high-capacity floppies (96 tracks per inch) soon to come with 640 bytes. Replacement controllers were offered then, and upgraded H-89s with soft-sector controllers were added to Heath's computer line as Model H-90, and assembled machines as Model Z-90.

Evidently observing IBM's success with a personal computer, Zenith Data Systems followed the star with one foot still in its past. It announced its Z/H-100 line of desktop computers in late 1982. These machines employ dual microprocessors, the 16-bit 8088 CPU (the same one used by the IBM PC) and an 8-bit 8085 CPU. The best of both worlds—almost. Though using the same CPU as IBM's, the new Zenith computers were not compatible with IBM PC software or hardware. Furthermore, the 8085 CPU cannot handle all 8-bit CP/M software. It's a beautiful, flexible machine, though, that includes an S-100/IEEE-966 expansion bus and super color graphics capability.

Now Zenith has moved itself into the open market with IBM-compatible computers that will enable users to avail themselves to more fine applications software than they could ever use with its Z/H-151 and 161 personal computers, the latter examined in this article.

What can we expect from Zenith Data Systems next? I'd guess that more powerful IBM-compatible models will be introduced since ZDS focuses more and more on the enormous office-equipment market. Heath, in turn, which is the manufacturing arm of ZDS, will likely be the recipient of its design aims by continuing to market kit versions of its assembled computers. It's interesting to observe, too, that Veritechnology Electronics Corp., the subsidiary that heads Heathkit Electronic Centers, which at last count number 65 stores around the country, is testing a new name for the centers: Heath/Zenith Computers & Electronics Center.

Data Systems is growing stronger and stronger. A case in point is the company's recent $100-million military contract for its desktop version of the Z-161 transportable, the Z-151 with special r-f radiation shielding.

Zenith has done much to enhance its IBM-compatible computers, though there are obvious constraints in doing so. Its H-100 8-bit/16-bit computers are more versatile, and provide higher-resolution displays (though a $499 plug-in board from Heath/Zenith upgrades the Z-161 and Z-151 from 320 × 200 in color mode to equal H-100's 640 × 225 pixels).

Nonetheless, Zenith has broadened its computer-line appeal with these new IBM-like machines. If you really need a transportable, and want 99.9% software and hardware compatibility, the ZDS Z-161 should be in the running as a choice. Its higher-end price is bolstered by the staying power of a company like Zenith, and—very important—on-site repair service that is said to be super-quick as a result of built-in diagnostics and diagnostic software.

There's stiff competition out there, though, and I don't consider the Z-161 (or the Z-151, for that matter) a great buy. On the other hand, the Heath/Zenith kit versions—with their $1,000 lower price—is! **ME**

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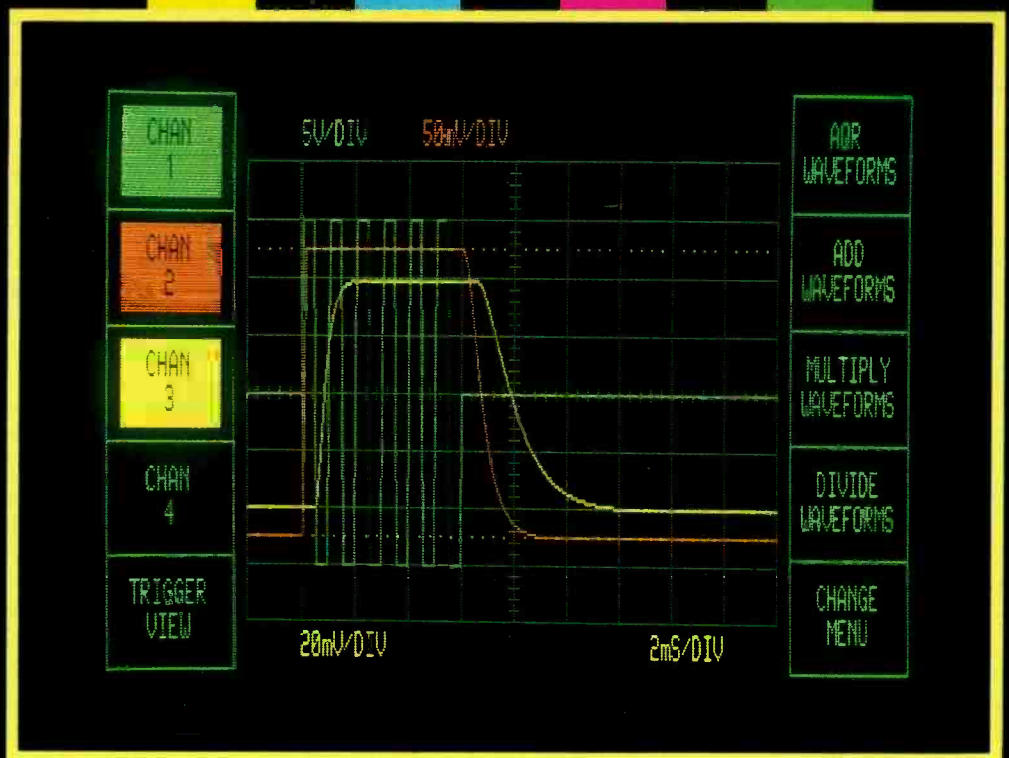


Fig. 1. An oscilloscope trace with the liquid-crystal shutter displays three separate colors with a monochrome cathode-ray tube for backlighting.

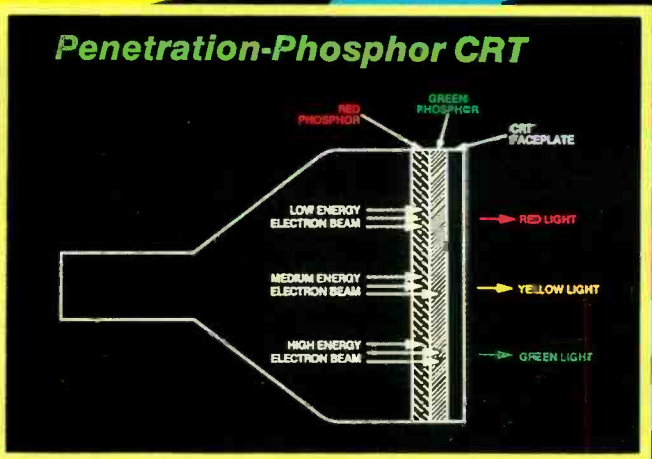


Fig. 2A. This is an example of a penetron-phosphor CRT with beam energies causing activation of different-color phosphors on the face of the CRT.

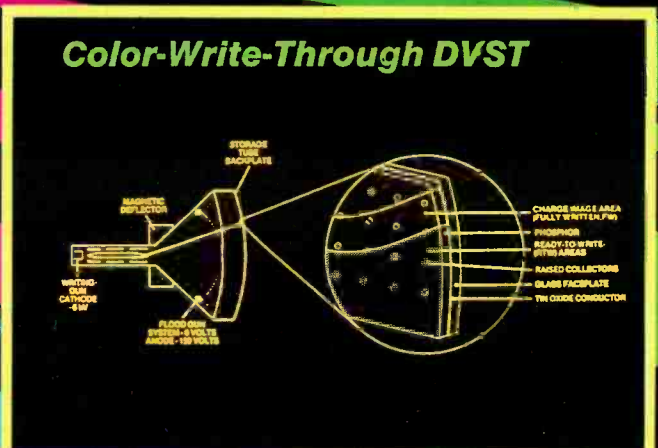


Fig. 2B. Here, the color write-through cathode-ray tube uses two electron guns and the penetron principle to write images on the screen.

Color From A Monochrome CRT

The world's first liquid-crystal shutter to extract color from a new monochrome cathode-ray-tube storage oscilloscope

By Vaughn D. Martin

Tektronix has developed a new liquid-crystal shutter that yields both blue-green (cyan) and orange color from a monochrome CRT (cathode ray tube). This shutter is used with its 5116 mainframe oscilloscope to form the world's first liquid crystal shutter color display digital storage oscilloscope. It's capable of storing transient events up to 100 kHz for single-channel acquisition (50 kHz for dual channel). The oscilliscope is intended mainly for low-frequency applications such as in bio-engineering or electromechanical analysis.

The immediate benefits of the new development are as follows:

- Much higher resolution, limited only by CRT spot size and contrast ratio (20:1 or better), than with other color displays.
- The shorter, more rugged monochrome CRT is used in place of the longer, more delicate traditional color CRT.
- No color convergence or focus problems exist with this scheme because of using only one electron gun.
- A larger usable viewing area.
- Color purity is greater than that obtainable with more traditional color displays.
- The most beneficial characteristic of this new technology is its impact on human-factors engineering. Specifically, the multiple color capability allows separation and emphasis of information on the CRT, along with enhanced pattern recognition capabilities.

Examples of this attention to color ergonomics are: The channel-1 data are displayed in blue-green (cyan); channel-2 data are displayed in orange. Alphanumeric readouts are color coded per channel, and X-Y axis are plus time (period) measurements are in neutral (white). These three colors (blue-green, orange, and neutral) were selected because they were spectrally separated enough to be distinguishable, while still being close enough to minimize the eye's

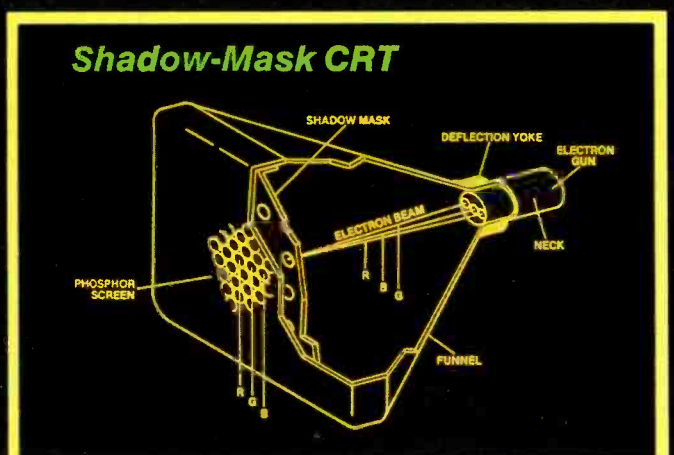


Fig. 2C. This drawing illustrates the design of the shadow-mask CRT. Red, green, and blue phosphors are excited to make any possible color.

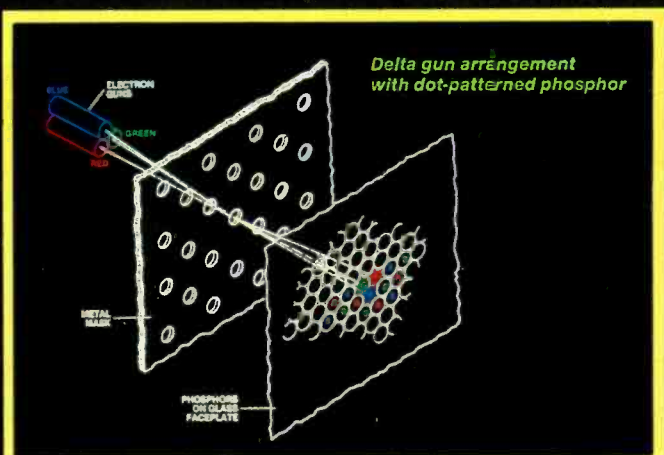


Fig. 3A. One of the two gun/phosphor arrangements used in shadow-mask CRTs, this is the delta-gun arrangement with dot-patterned phosphors.

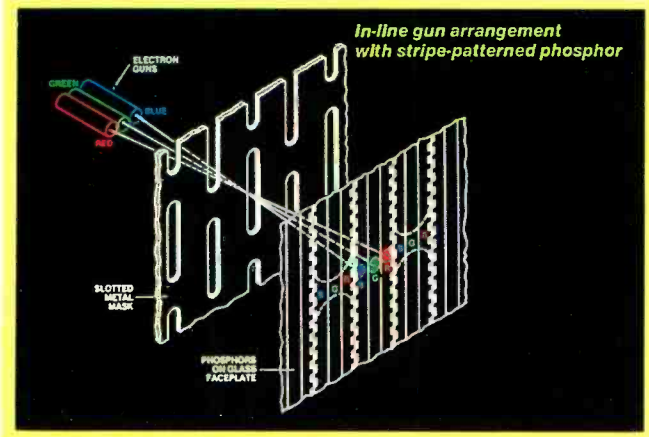


Fig. 3B. The other gun/phosphor arrangement uses an in-line gun and has the phosphor deposited on the CRT screen in a stripe arrangement.

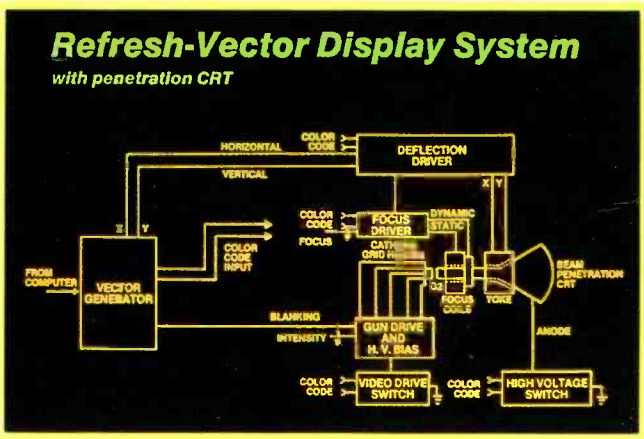


Fig. 4A. This is a typical penetration CRT refresh-raster system with deflection drives changing for each color in a field sequential manner.

need to refocus. (The human eye is subject to chromatic aberration. That is, it cannot focus red and blue light in the same plane.) The display's black background also provides a maximum visual contract, even under high ambient lighting conditions.

Color CRTs

Before the advent of this new LCD shutter technology (Fig. 1), three types of color CRTs predominated. These were: (1) the penetron, (2) the color write through, and (3) the shadow-mask types.

The Penetron CRT technique uses two phosphors in separate layers. Each layer requires a certain voltage threshold to "break through" or penetrate—thus its name. Referring to Fig. 2A, note how a 6-kV potential allows red phosphors to be activated. However, this voltage is insufficient to reach the green phosphors, which are stopped by the dead layer and only activated by 12-kV potentials.

This type color CRT typically uses two electron beam guns, each employed at a different potential. This unfortunately requires circuitry to deflect the two beams to a particular spot on the CRT. Obviously, here is where mislignment or poor registration can result if these two circuits are not working perfectly in unison.

The Color Write Through CRT technique uses the penetration effect, as described, in a color storage CRT. The CRT operates at a 6-kV negative potential with respect to the target, while the tube itself is characterized by an array of low-energy (several hundred volts) flood guns and a special phosphor target. (Fig. 2B).

The phosphor is separated from a transparent conductor by an insulating layer pierced with a number of conductive "dots." Like the pene-

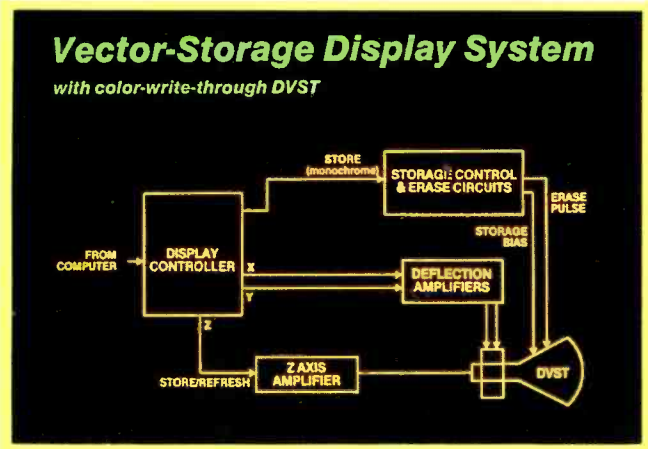


Fig. 4B. In this block diagram, the vector storage display system illustrated has color write-through capabilities for display of generated images.

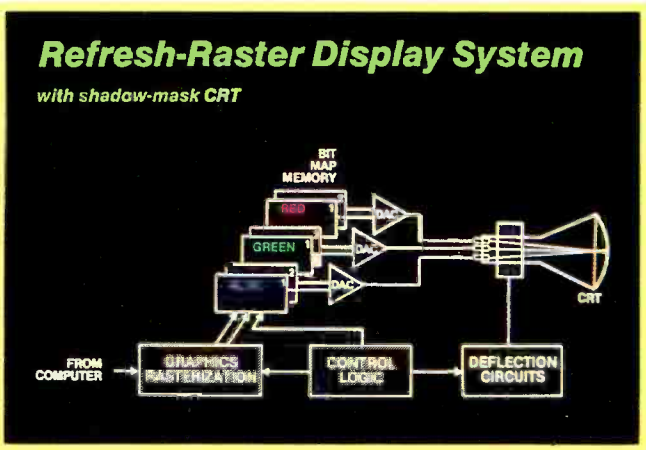


Fig. 4C. This is the block diagram of a typical refresh-raster color display system. It uses a shadow-mask CRT and displays a full spectrum of colors.

tron CRT, this phosphor is also made up of two phosphors. Small particles of each phosphor are mixed together. The normal green phosphor for storage is mixed with red phosphor particles surrounded by a dead layer.

When the flood electrons strike the written target areas, they naturally cause the phosphor to luminesce. The unwritten areas, which are maintained at near ground potential by the flood electrons, do not luminesce.

To prepare the screen for writing new information on it, the written areas are erased by pulsing the conductive backplane and resetting the phosphor potential to its lower bistable state.

If the writing-beam current is lowered below some threshold, whereby no information is stored, the phosphor still briefly luminesces as a result of the writing gun's high energy. This phenomenon is called "write through." With the penetration phosphor in place, the writing beam's high-energy electrons penetrate the red phosphor's dead layer, exciting both phosphors. This causes a yellowish green trace, and the process is commonly known as "color write through."

Shadow Mask CRTs are the last type of commonly used color CRTs. They yield the best performance, but are in some respects the most complex of the three technologies. This type of tube dominates the color CRT market today and is most notably characterized by the presence of three electron guns that are used to address either three primary-color phosphor dots or three primary-color phosphor stripes. The dots and stripes are collectively assembled in groups called triads. They are so closely "packed" together that they appear as one to the eye. Color results from the proportional mixing of these colors. The shadow mask, shown in Figs. 3A and 3B, ensures that each beam addresses only its assigned color dot or stripe. The primary-color beams (red, green, and blue) must be angled properly to pass through the mask openings to strike just their corresponding color phosphor. All other phosphor dots on the screen are "shadowed."

Dots instead of stripes are used when maximum resolution is required because the dot pattern permits smaller horizontal spacing between the triads. Therefore, the guns are typically configured into deltas or triangles for dots and in-line for stripes, although in-line guns can still handle phosphor dots. The trade-off here is that the in-line guns require less convergence circuitry. A lack of convergence typically occurs when the three beams pass through the deflection yoke at slightly different angles and locations. As a result, they are deflected to slightly different points on the screen. Compensation circuitry partially helps in this re-registration of the three primary colors.

A technique to effectively combat this problem is to display the three colors sequentially rather than simultaneously. This is how Tektronix solves this problem with its color red, green, and yellow special CRT.

Color Display Systems

Now that we've examined the three dominant types of color CRTs, let's look at how they are used in various color systems.

The three most widely used color systems are: (1) vector storage, (2) refresh vector, and (3) raster refresh. Theoretically, both the refresh-vector and and refresh-raster displays could use either penetration CRT or shadow-mask CRT technology. In practice, however, certain restraints lend themselves to use with the penetration-type CRT. The refresh raster type of color system almost exclusively uses the shadow-mask CRT.

Refresh Vectors. A typical refresh-vector display system is shown in Fig. 4A. Vectors are drawn by deflecting the beam between two specified end points. An image is formed, in turn, from a combination of vectors and can be rapidly changed by merely changing the vector end points. Since there are relatively few end points required for images consisting mostly of lines, the dynamic capabilities of this type of display system are excellent. However, in order for the viewer's eye to perceive a constant luminance, the complete image must be frequently refreshed. This limits deflection speed and the number of vectors that can be drawn before flicker becomes a problem.

A penetron requires a different deflection-amplifier gain for each of the two colors. Therefore, a so-called "field sequential" operation is used. This means that the red information is written in the first field, then the deflection gain is changed before the green information is written in the second field. Producing a third color as the result of registering (placing one color over another one) is difficult for alignment reasons. Therefore, this third color is usually produced by an intermediate acceleration voltage in the third field.

Vector Storage. Using the vector storage color display system helps overcome the flicker problem. A typical vector storage display system using a DVST (direct view storage tube) with color write-through is shown in Fig. 4B. When the DVST is set to the storage mode, green vectors are stored on the screen. Deflection speed therefore affects only the time required to draw a complete graphics image. There is no flicker regardless of how many vectors are drawn. This characteristic particularly lends itself to the display of complex intricate images. By employing the unique capabilities of the DVST with CWT (color write-through), images with another color can be added to the display. When the write beam is operated with reduced current to prevent storage, a yellow-orange spot is produced on the screen. This non-stored spot can be deflected to produce refreshed vectors. The number of vec-

LCD Shutter Theory

Instead of relying on dual-frequency liquid-crystal materials, as earlier liquid-crystal color switches have, Tektronix's proprietary process uses a single-frequency material in a new optical-switch device called a "π-cell." The π-cell offers millisecond switching rates and excellent viewing angle.

Early attempts to create a suitable fast switch relied upon two-frequency switching of a normal, twisted nematic liquid crystal cell. The π-cell eliminates the need for higher power and complicated drive circuitry. It also eliminates undesirable temperature effects and successfully deals with the problem of poor viewing angle of the two-frequency switches.

The system is constructed by mounting a fast liquid crystal color shutter in front of a monochrome CRT. The phosphor in the monochrome CRT has an emission spectrum that includes an orange peak and a blue-green peak. The color shutter consists of a fast liquid crystal polarization switch (the π-cell), which is sandwiched between two orthogonal (mutually perpendicular) color polarizers and a neutral polarizer, as previously shown.

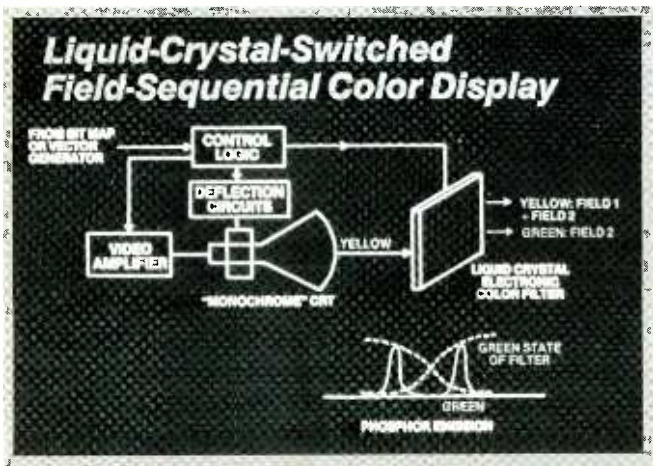
Depending upon the polarization state of the switch, one or the other of the primary phosphor peaks is transmitted through the shutter. Information is fed to the CRT in two sequential fields, synchronized with the color shutter. Information in each field appears as a primary color. Information fed to both fields is integrated by the eye and appears as a combination of the two primary colors (neutral in the 5116 color oscilloscope).

Since an entire color image consisting of two primary fields must be presented at a 60-Hz rate (to prevent flicker), the field rate must be 120 Hz. In the 5116 Color scope, the color shutter must switch in less than 3 milliseconds to allow a reasonable amount of active display time for each primary color.

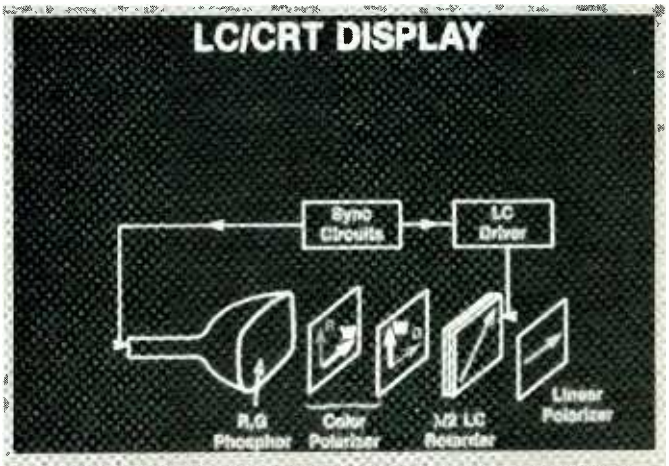
The π-cell. The new "π-cell" achieves its fast switching time by arranging the liquid-crystal molecules so that when the applied electric field is removed (turned off), its small, necessary liquid flow is in harmony with the elastically induced rotation of those molecules. This alignment and thin cell spacing result in a fast cell switching (between ½ and 3 ms). The π-cell must have highly accurate spacing because it functions as a half-wave retarder, tuned for the wavelength region of interest.

Tektronix has developed techniques for spacing cells in the 5- to 6-micrometer range with tolerances and uniformities of 300 nanometers. These cell spacing techniques have been applied to cell sizes ranging from 5- to 40-cm diagonally. Actual viewing area is about 90% of the cell size due to the surface area needed for mounting. The use of the thin π-cells allows a large viewing angle for the color display.

Color and Viewability. A desirable feature of the new display system is



Note in this block diagram of a liquid-crystal switched field sequential color system that three colors—red, yellow and green—can be displayed.



Here is a detailed look at the various elements that make up the liquid-crystal display system's cathode-ray tube filter—a multilayer "sandwich."

its high contrast ratio. The combination of color polarizers and either a diffusing or an anti-reflection coated linear-polarizer permits high contrast ratios (greater than 20:1). The high contrast gives the 5116 oscilloscope display excellent viewability, even in high ambient light, with less CRT brightness.

Brightness. The system is field sequential. By their nature, field sequential displays have implications for system brightness and bandwidth requirements. Any given color's brightness is, in theory, reduced to 25% of the brightness of a continuously refreshed CRT without the color filter. This is caused by the field sequential operations (50% duty factor for any given color) and by the transmission characteristics of the color polarizer (50% for an ideal device). But the application of theory always presents new complications. For this technology in an oscilloscope, the duty factor must take into account horizontal retrace times. Realistic numbers must also account for polarizer and phosphor mistuning, as well as non-ideal polarizer transmission. When these are considered, the resulting brightness is 24 to 28% (50% duty factor for dual trace) of the continually refreshed brightness without a color shutter. Although this is a rather substantial reduction in the original (monochrome) brightness, it's mostly compensated for by the system's high contrast ratio, which improves viewability in high ambient light.

Conclusion. If the proof is in the pudding, take another look at the photo in Fig. 1 to see what the true capabilities of this innovation are. You'll surely agree that this actual oscilloscope trace with a liquid crystal color CRT is truly impressive.

tors in this second color, however, is limited by maximum deflection speed and flicker.

A third color can be obtained by writing the refresh vector on top of an identical, stored vector. This mode produces a greenish-yellow. Unlike the penetron, no misregistrations are encountered since the same writing-beam potential is used to write in all modes.

Refresh Raster. This is the most common of the three color graphic display systems. A shadow-mask CRT using this system is shown in Fig. 4C. This system uses three beams deflected together over the phosphor screen in a prearranged raster pattern. A bit-map semiconductor memory determines when each of the three guns receives current and how much it receives. Thus, it is capable of controlling how much of each color is produced at each pixel or addressable point on the screen.

The data must be dumped or read out repeatedly to the screen as fast enough to avoid problems associated with flicker. However, the time required to change images on the screen is determined by how fast the scan conversion can relocate the bit map. There is a tradeoff condition encountered here: the larger the bit map, the slower the process. Therefore, raster images with many pixels (picture elements) must endure diminished speed of interaction and cannot produce dynamic images. The two controlling parameters to note in specifying this are the deflection speed of the CRT beam and the bandwidth of the video amplifier.

Image-Quality Characteristics. Resolution, or the display's ability to resolve or separate two closely matched points or lines, is the prime consideration in image quality. Resolution gives an image its sharpness and is independent of display size; however, the smaller the display, the higher the resolution to resolve an equal number of lines or pixels.

The resolution of vector displays is primarily a function of the electron-beam spot size because vector-generated images inherently consist of lines equal in width spacing to that of the spot. The current distribution in an electron beam usually is Gaussian and circularly symmetrical.

Another feature critical to the eye is the number of colors the system is capable of showing. The penetron CRT is limited to a maximum of three distinguishable colors; the DVST with CWT is also limited to three. Only the shadow-mask CRT is capable of a panoply of colors.

Future Color Displays

There are two developments on the horizon that appear to be the most promising for color CRTs. The first is a current-switched CRT, where the dependence on two or more voltage sources of different potentials has been eliminated. The principal used here is two phosphors, each producing different colors. These phosphors differ in current saturation tendencies, so that an increase of beam current causes a change from red to green. After the red phosphor saturates, all further light comes from the green phosphor. Sony is reported to be investigating this system, which is attractive because no registration is required here.

The second alternative to the penetron is the subject of this article, the liquid crystal shutter CRT. This also uses a monochrome CRT in a field sequential color display and a liquid-crystal color switch.

A monochrome CRT with an unpatterned multicolored phosphor is placed behind an electrically controlled color filter. By synchronizing the red information written on the CRT during field number one with a color switch set to pass only red light, and green information in field number two with the switch passing green

(Continued on page 92)

Stereo and Mono Together

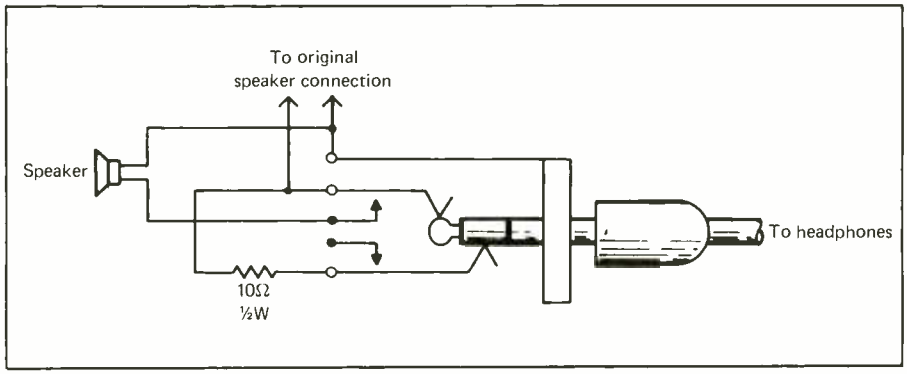
Modifying a mono headphone jack to properly accept either stereo or mono phones

By Michael A. Covington

Here is a way to wire a headphone jack so that either stereo or mono headphones can be plugged into it. The problem to be solved is as follows: If you plug stereo phones into a mono phone jack, sound can be heard only in one ear; if you plug mono phones into a stereo jack, there is a short across one channel, which can damage the output transformer.

This circuit assumes that the signal source is monophonic (that is, the speaker output of a radio). Plugging in either type of headphone cuts out the speaker. If the phones are stereophonic, one channel receives the signal directly, and the other receives it through a 10-ohm resistor. With mono headphones, the resistor prevents the signal from being shorted to ground. (Many closed-circuit stereo phone jacks have one more switch contact than is shown in the diagram; the extra contact can be ignored.)

Most stereo headphones have an impedance of 100 to 200 ohms, so the resistor does not produce a noticeable difference in sound level between one ear and the other. Even with 40-ohm lightweight headphones, the loss due to the resistor is only 2 dB, which is usually not perceptible. With 8-ohm phones, the loss is 6 dB, which is noticeable, but won't be serious when listening to a monophonic signal. ME



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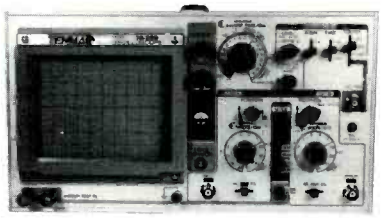

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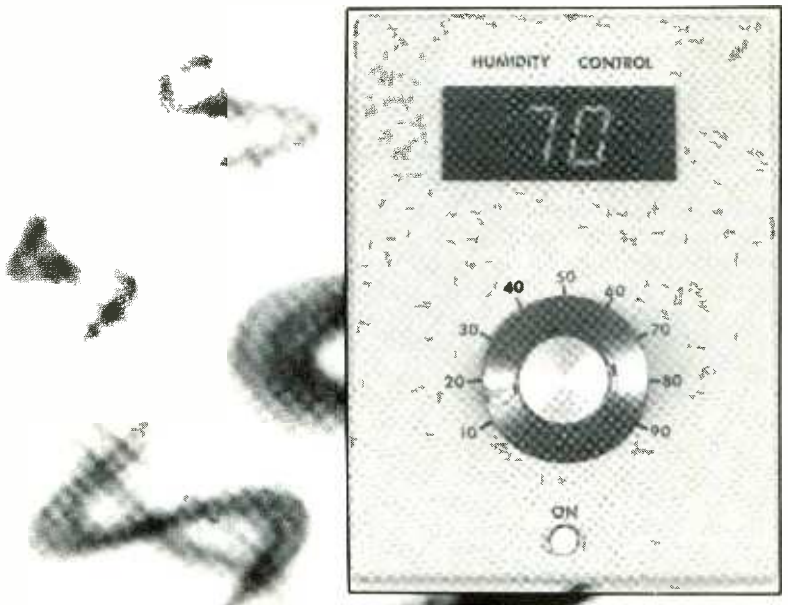
A Digital Humidity Control

Interfacing this digital controller with a humidifier provides accurate readings of relative humidity and maintains indoor air moisture at its optimum point

By Eugene Weber, WB9WWI



Winter is here, with its dry air and high heating bills! To help in both areas, many people turn to humidifiers to add moisture to their heated environment. This makes breathing more comfortable, provides a feeling of greater warmth for a given temperature and, consequently, lowers energy costs.

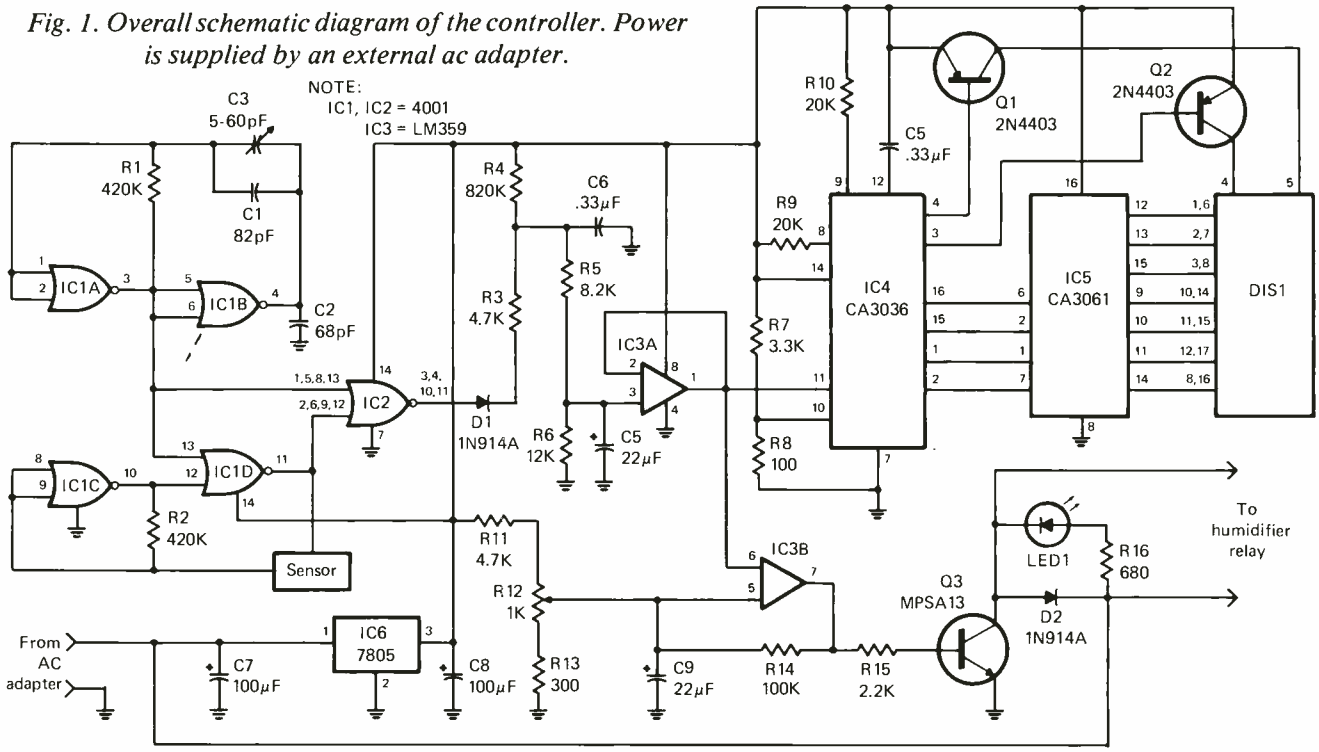
To get the most from a typical humidifier, whether it's attached to a central system or simply a room unit, you need an accurate controller and relative-humidity display. The digital device discussed in this article is both, and it will maintain household humidity at the desired level.

Circuit Description

The heart of the digital humidity control presented here is its capacitive humidity sensor (see Fig. 1). This sensor consists of a special membrane with a thin deposit of gold on each side. The membrane's dielectric constant is a function of ambient relative humidity. As the humidity changes, so does the sensor's capacitance.

In the Fig. 1 schematic diagram, *IC1* forms a dual synchronized multivibrator. The free-running frequency of the first multivibrator is determined by resistor *R1* and capacitors *C1*

Fig. 1. Overall schematic diagram of the controller. Power is supplied by an external ac adapter.



PARTS LIST

Semiconductors
D1, D2—1N914A diode
DIS1—2-digit 7-segment common-anode LED display
HS1—Humidity sensor (Phillips No. 5X38H122R)
IC1, IC2—4001 quad NOR gate
IC3—LM358 dual op amp
IC4—CA3062 A/D converter
IC5—CA3061 BCD decoder/driver
IC6—7805CT 5-volt regulator
LED1—Red light-emitting diode
Q1, Q2—2N4403 transistor
Q3—MPSA13 transistor

Capacitors
C1—82 pF
C2—68 pF
C3—5-to-60-pF trimmer
C4—0.15 μF
C5, C9—22-μF, 6.3-volt electrolytic
C6—0.33 μF
C7—100-μF, 16-volt electrolytic
C8—100-μF, 6.3-volt electrolytic

Resistors (all ¼-watt, 5%)
R1, R2—420,000 ohms
R3—4700 ohms
R4—820,000 ohms
R5—8200 ohms
R6—12,000 ohms
R7—3300 ohms
R8—100 ohms
R9, R10—20,000 ohms
R11—4700 ohms
R13—300 ohms
R14—100,000 ohms
R15—2200 ohms
R16—680 ohms
R12—1000-ohms linear-taper potentiometer

Miscellaneous: Suitable enclosure; 12-volt ac (at least 300-mA) ac adapter; printed-circuit board; control knob with pointer; sockets for ICs (optional); hookup wire; machine hardware; solder; etc.

Note: The following items are available from GTC Industries, PO Box 443, Hinsdale, IL 60521: etched and drilled pc board for $12.50; HS1 humidity sensor for $14.75; complete kit of all board-mounted parts, less enclosure and dc adapter, for $54.00. Please add $2.50 SH for each order. Illinois residents, please add state sales tax.

and *C2*. The second multivibrator's frequency is controlled by *R2* and the sensor.

The outputs of the two multivibrators are gated through *IC2*. The output of *IC2* is a pulse of approximately 10 kHz and a width proportional to the capacitance of the sensor. Contained in *IC2* are four NOR gates that are wired in parallel to provide a lower output impedance. The output of *IC2* is fed through diode *D1* to a network consisting of *R3, R4, R5, R6* and *C4*. The function of this RC network is to integrate the output pulse from *IC2* and provide linearization of the signal.

The integrated pulse, which is now an analog voltage proportional to humidity, is buffered by voltage-follower *IC3A* and is fed to the inverting input of voltage comparator *IC3B*.

The noninverting input of *IC3B* is derived from voltage divider *R11, R12* and *R13*. Note that *R12* is a panel-mounted potentiometer and is used to select the desired humidity set

Recommended Indoor Humidity Vs. Outdoor Temperature

Outdoor Temperature	Indoor Humidity
−30 °F	10% R.H.
−20 °F	15% R.H.
−10 °F	20% R.H.
0 °F	25% R.H.
10 °F	30% R.H.
20 °F	25% R.H.
30 °F	40% R.H.
40 °F	45% R.H.
50 °F	50% R.H.

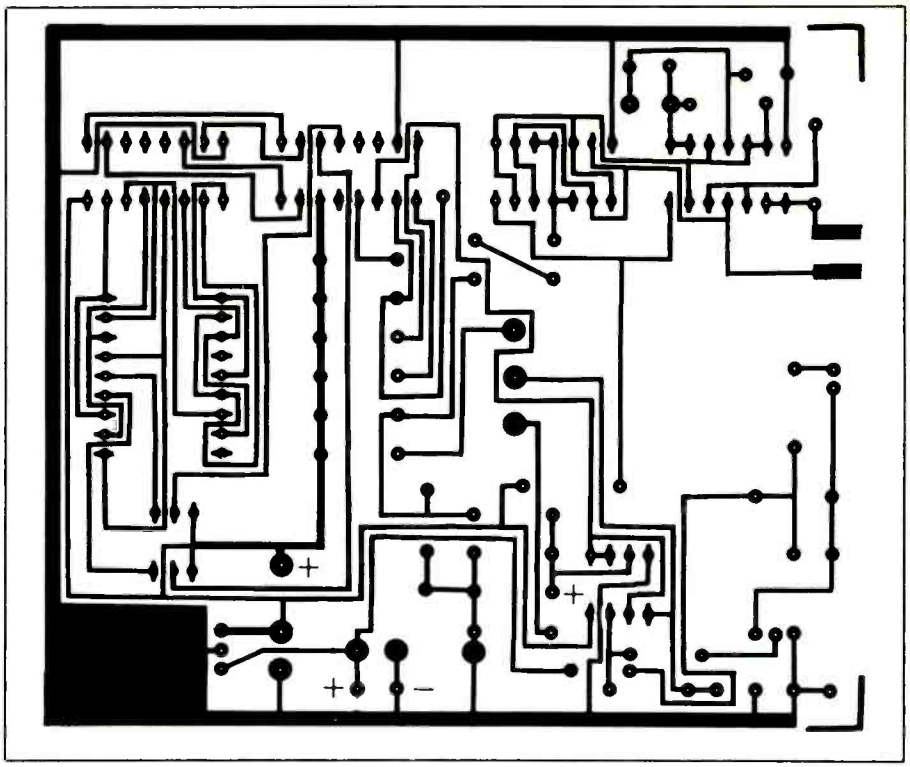


Fig. 2. Actual-size etching-and-drilling guide to use when fabricating your own printed-circuit board.

point. Resistor *R14* provides a differential between turn-on and turn-off of about 5% relative humidity.

The output of *IC3B* turns on transistor *Q3* which, in turn, turns on *LED1* and provides a 12-volt control signal to turn on the humidifier. (The humidifier interface will be discussed later.)

The output of *IC3A* is also fed to the positive input of *IC4,* an analog-to-digital (A/D) converter with multiplexed BCD outputs. The outputs of *IC4* drive *IC5*, a BCD-to-seven-segment decoder-driver. Transistors *Q1* and *Q2* are digit-select drivers. Integrated circuit *IC5* turns on the individual display segments.

Power for the circuit is supplied by a standard 12-volt dc plug-in ac adapter. The adapter should be able to supply at least 300 mA of current. The 12 volts from the adapter is reduced to +5 volts by the *IC6* voltage regulator.

Construction

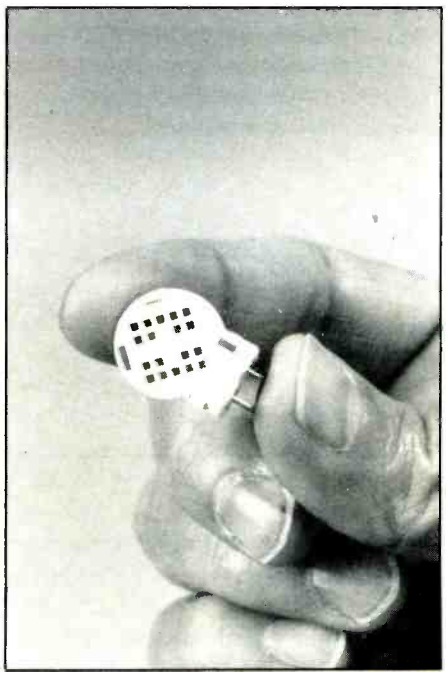
All components, with the exception of *R12*, mount directly on a single-sided printed-circuit board. If you plan to fabricate your own pc board, use the etching-and-drilling guide in Fig. 2. Otherwise, you can obtain a ready-to-use pc board from the source given in the Parts List.

Parts placement and orientation are shown in the drawing in Fig. 3. Though there is nothing critical about assembly, it is important that you observe the orientations and polarities of the ICs, transistors, diodes, and electrolytic capacitors. Also, you can install the ICs directly on the pc board or use optional sockets for them.

The leads of the humidity sensor should be kept as short as possible to minimize the effects of stray capacitance. For best results, the sensor should be mounted outside the enclosure in which you house the rest of the circuit, but no more than 3″ from the pc board.

If space limitations require the sensor be mounted inside the enclosure, be certain to provide adequate ventilation for it so that ambient air can circulate around the sensor. Any type of enclosure can be used, so long as it is large enough to accommodate the pc board assembly and potentiometer control.

Shown in Fig. 4 is the calibrated scale to use for the humidity control



In this photo is shown the special capacitive-type humidity sensor around which the project is designed.

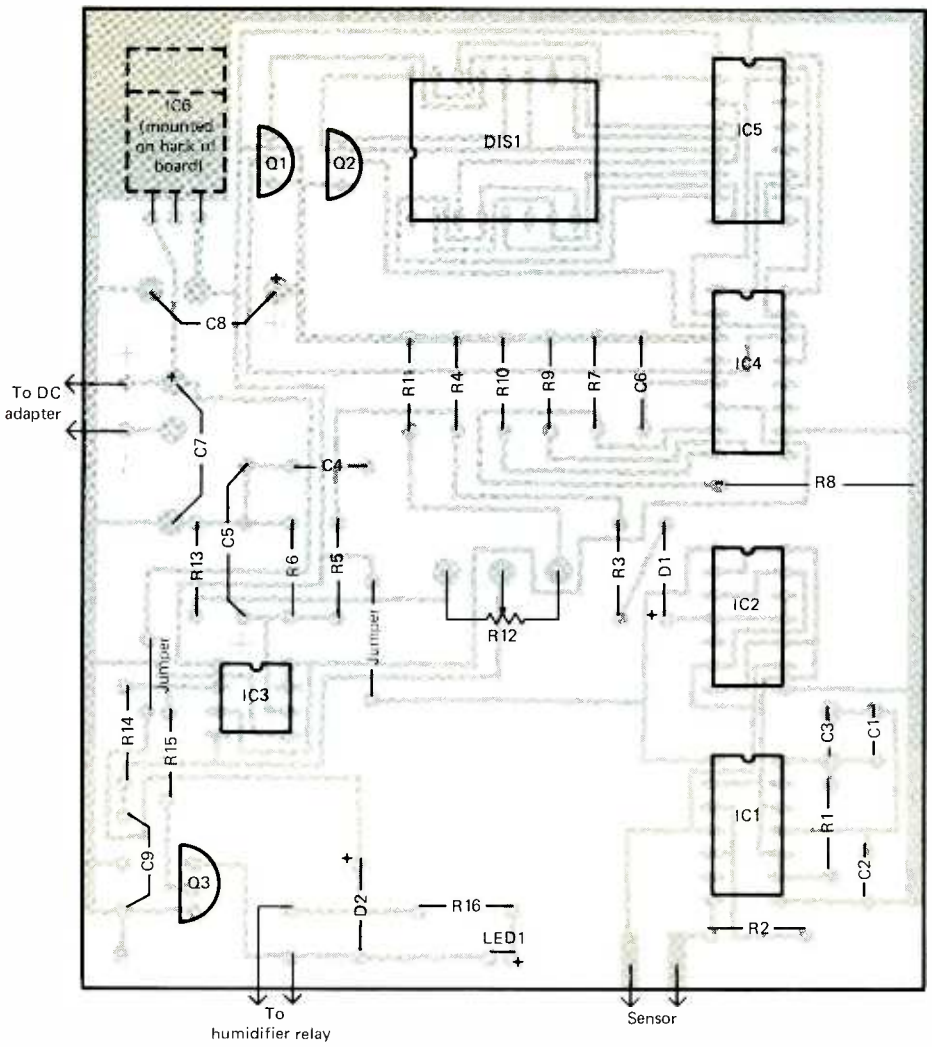


Fig. 3. Component-placement guide for pc board. Note that components are shown from foil side of board. You must *mount these components on the* opposite *side of the board.*

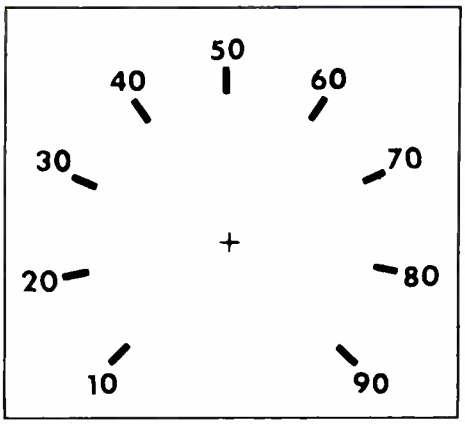


Fig. 4. This is the actual-size calibrated dial plate to use behind R12's control knob. See text for further details.

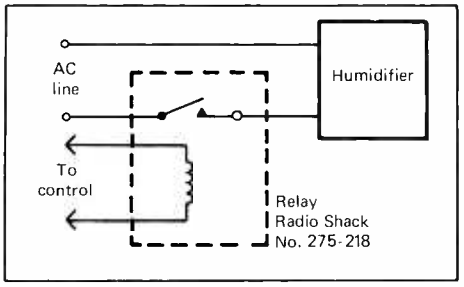


Fig. 5. Interface circuit for connecting controller to humidifier.

knob that mounts on *R12*. You can cut this scale from the page and glue it to the front panel of your project, or you can photographically copy it onto film and use that instead. Alternatively, you can use the scale as a guide to dry-transfer label your project's front panel.

Calibration & Interfacing

The project is very easy to calibrate. You simply connect the calibration reference capacitor that comes with the sensor in place of the sensor itself. After powering up for the project with the reference capacitor in place, you adjust trimmer capacitor *C3* for a display of the value specified on the reference capacitor. This done, you turn off the power, remove the reference capacitor, and replace the sensor.

When you once again power up the project, the display will indicate the actual relative humidity of the surrounding (ambient) air.

A 12-volt dc relay can be used to interface the humidity control to the humidifier, as shown in Fig. 5. If the humidifier is a line-operated 117-volt ac model, mount the relay as close to the humidifier as possible.

Operation

To use the digital humidity control, simply set the knob on *R12* to the desired relative-humidity (R.H.) level. The Table (shown elsewhere in this article) indicates the recommended indoor humidity based on outdoor temperature. Setting the humidity control too high may result in excessive condensation (or ice) forming on windows and outside walls.

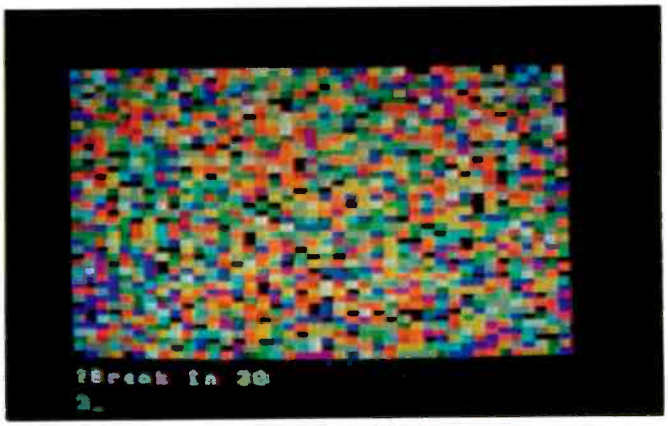
The digital humidity control will not only indicate relative humidity levels in your home, it should also provide much more comfortable living this winter. **ME**

SmartBASIC Color Graphics

Authors illustrate how the ADAM computer creates full color patterns with its version of BASIC

"Color Bar Generator"

"Mosaic Dazzler"



By Forrest M. Mims III
and Eric Mims

My 15-year-old son, Eric, who is also my co-author here, were among the pioneer buyers of Coleco's ADAM computer system last year. After all, it represented a major breakthrough in value. Our problems with the computer system were minuscule, thankfully, though I did read reports about reliability problems that other purchasers experienced.

We were favorably impressed by the computer system's professional keyboard and letter-quality printing. Combined with ADAM's built-in word-processing, cartridge slot, and color capability, it functions well as an excellent electronic typewriter and video game machine. ADAM also comes with SmartBASIC, Coleco's name for its version of BASIC that closely resembles Apple BASIC. You can't fully appreciate ADAM's capabilities until you actually try your hand at SmartBASIC.

Working with SmartBASIC

Virtually all home computers use various versions or dialects of the popular programming language, BASIC. Among the two leading versions are Microsoft BASIC and Applesoft BASIC. Even these forms of BASIC have variations.

For instance, various versions of Microsoft BASIC are used by Radio Shack for its line of TRS-80 computers and IBM for its PC and PC*jr*. So-called IBM look-alike computers also use Microsoft BASIC. Applesoft BASIC is used by the famous Apple II as well as its descendants. It's also used with several Apple clones.

Though ADAM is certainly not an Apple "look-alike," it uses a version of Applesoft BASIC. Why? Certainly, Microsoft BASIC has its advantages. But there are believed to be in existence more programs for the Apple than for any other computer. Hundreds have been published in computer books and magazines, many of which can be typed without modification into ADAM, though some may need minor revisions. Taking advantage of ADAM's fine graphics capability, anyone can use SmartBASIC to create complex and beautiful color patterns in both low and high resolution.

In the *low-resolution* mode, ADAM divides the TV or monitor screen into an invisible grid of 40 columns and 40 rows. A solid block of any of 16 colors can be placed at the intersection of any row and column. (The SmartBASIC statement for low resolution is GR.)

In the *high-resolution* mode, ADAM partitions the screen into a grid of 256 columns and 192 rows. A small point of color can be placed at any column-row intersection. (The SmartBASIC statement for high resolution is HGR.)

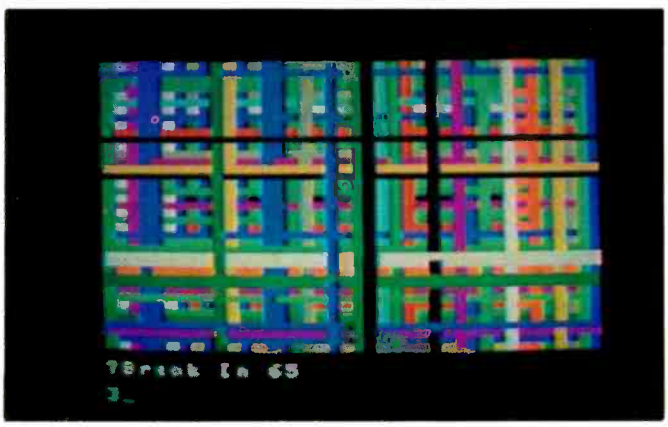
A simple number code is used to select the color painted on the screen. In the low-resolution mode the color is selected by the statement COLOR = n. In the high-resolution mode the color is selected by the statement HCOLOR = n. In both cases, *n* denotes the code of the selected color as specified in the following table:

Code	Low Resolution	High Resolution
0	black	black
1	magenta (purple)	green
2	dark blue	dark red
3	dark red	white
4	dark green	black
5	grey	medium red
6	medium green	medium blue
7	light blue	white
8	dark yellow/orange	dark yellow/orange
9	medium red	dark blue
10	grey	grey
11	light red	light red
12	light green	dark green
13	light yellow	light yellow
14	cyan (aqua)	cyan (aqua)
15	white	magenta (purple)

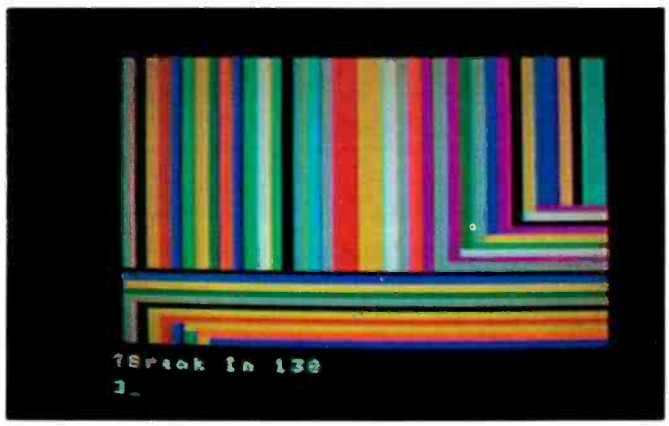
These color codes are given in the revised edition of the "ADAM SmartBASIC Programming Manual." We've defined them here so you can better understand the graphics portions of the programs that are given below.

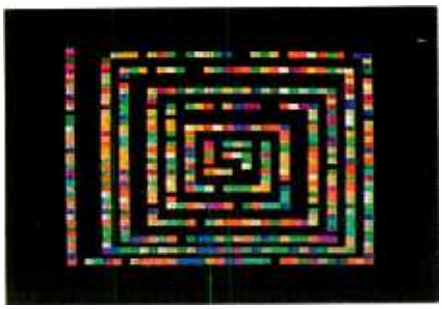
With the exception of "Color Bar

Typical screen display of "Weaving Rainbows."

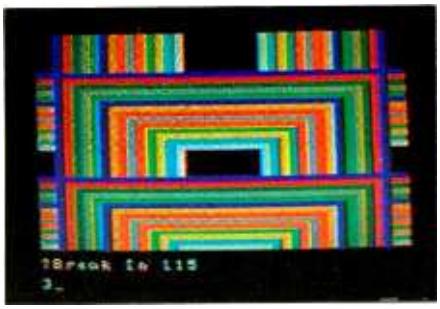


Typical screen display from "Paddle Plaid."

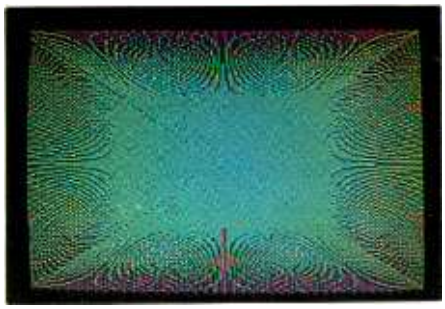




One of the limitless possibilities provided by "Rainbow Scribbler."



Typical screen display from "Rainbow Tunnels" (low-res graphics).



The final result of "Pinwheel" (high-resolution graphics).

Generator," all the programs produce a variety of continually changing color patterns. The accompanying color photos will give you some idea of what to expect.

To use these programs, one first loads the SmartBASIC tape and actuates the computer reset switch. After the tape has loaded, it can be removed and be replaced in its plastic holder.

After typing each program line into the keyboard as shown, and then typing RUN, entering everything with the RETURN key as usual, you'll see some eye-dazzling results. (Typing TEXT removes ADAM from the graphics mode so you can enter a new program or modify the one in memory).

Color Bar Generator. Want to adjust the color of your video monitor or TV receiver for the best possible color combinations? This simple program paints 16 broad stripes of color across the screen of ADAM's TV or monitor:

```
10 GR
20 c = 0
30 FOR v = 3 to 34 STEP 2
40 COLOR = c
59 VLIN 0,39 AT v
60 VLIN 0,39 AT v + 1
70 COLOR = c + 1
80 NEXT v
90 PRINT " "
100 PRINT "      COLOR BAR TEST "
```

Note that the accompanying screen photo shows only 15 color bars. That's because the first bar is black and, therefore, merges with the screen's black background. You can modify the program to show 15 narrow color bars separated from one another by black bars if line 70 is omitted from the program.

Mosiac Dazzler. Here's a short but clever program given in the "ADAM SmartBASIC Programming Manual."

```
10 GR
20 COLOR = INT(RND(1)*16)
30 x = INT(RND(1)*40)
40 y = (RND(1)*40)
50 PLOT x, y
60 GOTO 20
```

This program produces a colorful mosiac of 160 squares, some of which are always switching colors. The program is important because it illustrates the use of SmartBASIC's ability to generate *random* numbers.

Look at line 20. RND(1) tells ADAM to "think" of a random number between 0 and 1. ADAM then multiplies the number times 16 (*16). INT (INTeger) tells ADAM to ignore anything after the resulting number's decimal point. This gives a number between 0 and 15. Finally, COLOR = orders ADAM to use the number as the code for the 16 low-resolution colors. In short, line 20 randomly assigns one of the available 16 low-resolution colors to the square designated by the PLOT statement in line 50.

Using the same random-number method of line 20, lines 30 and 40 determine the X and Y coordinates for the PLOT statement. The random number is multiplied times 40 since that is the maximum value for both the X and Y axes in low resolution.

So far, the program has instructed ADAM to fill with one of 16 randomly selected colors one of 1600 randomly selected boxes. Line 60 tells ADAM to return to the beginning of the program and repeat the cycle. Now *two* colored squares appear on the screen. Eventually, the entire graphics portion of the screen is filled with a colorful mosaic of squares, some of which are continuously changing colors.

Weaving Rainbows. This programs converts ADAM's screen into a magical weaving machine.

```
10 GR
20 COLOR = INT(RND(1)*16)
30 x = INT(RND(1)*40)
40 y = INT(RND(1)*40)
50 HLIN 0,39 AT x
60 VLIN 0,39 ATy
70 GOTO 20
```

Compare this program with "Mosaic Dazzler" and you'll find that the first four lines of each are identical. Intead of producing colored squares, however, this program produces randomly colored vertical and horizontal stripes.

The stripes are positioned randomly according to the instructions in lines 50 and 60. After the first pair of vertical and horizontal stripes is painted on the screen, line 70 tells ADAM to repeat the process. Soon the screen becomes an interwoven pattern of stripes which continually and randomly change color.

Paddle Plaid. The previous two

(Continued on page 86)

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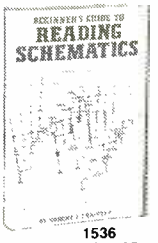

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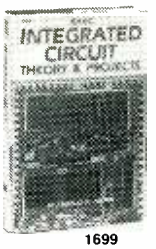

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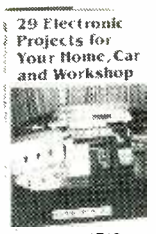

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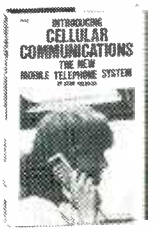

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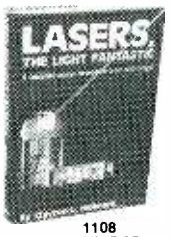

1108
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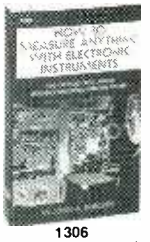

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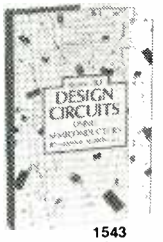

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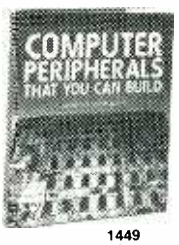

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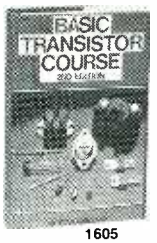

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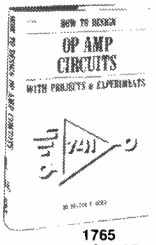

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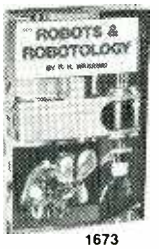

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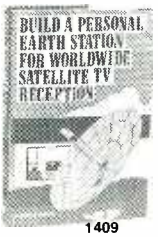

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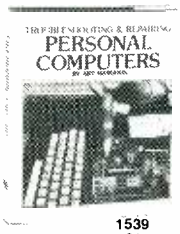

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Programmable Timebase/Dividers

Use them in clocks, computers, and other digital circuits, or as additions to your test-equipment lineup.

By C.R. Ball, Jr.

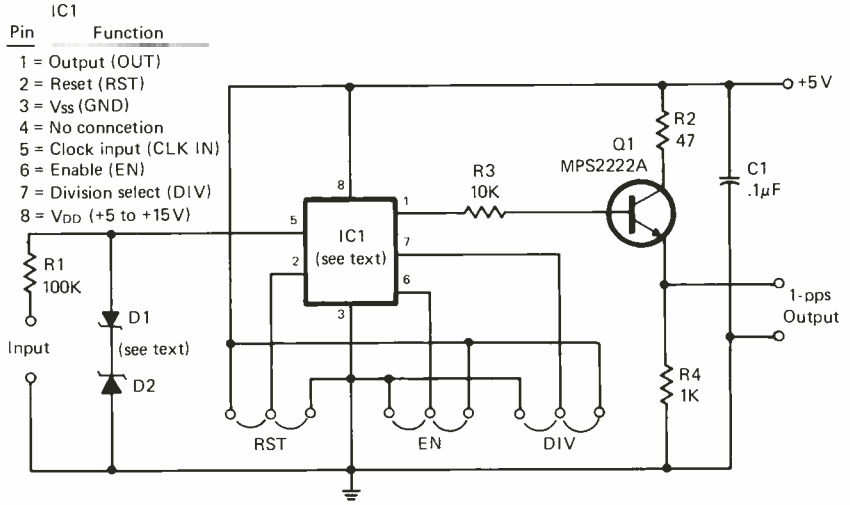
Computers, clocks and many other electronic devices require accurate timing signals that must be derived from existing sources. Common among these sources are the 50/60-Hz power-line frequency, quartz crystals, and ceramic resonators. Traditionally, to derive these signals, several ICs and associated components have been required to achieve the desired frequency. Recently, however, several timebase/divider ICs have come on the market that greatly simplify the task of building timebase circuits while, at the same time, providing a versatility absent in earlier designs.

In this article, we will discuss two timebase/divider circuits you can build and use. Designed around two of the recently introduced ICs, these circuits will satisfy many, if not most, of your clock and computer requirements and/or make a handy addition to your test equipment lineup.

One circuit, which we call Timebase I, is designed to provide an output of 1 pulse per second (1 Hz) from a 50- or 60-Hz source. The other, Timebase II, provides a 1-pps output from a 1-MHz crystal source.

About The ICs

Timebase I is built around the RED series of ICs, which consists of five different devices, each of which provides two divide ratios. These ICs allow you to obtain 10 pps (pulses per second), 1 pps, 0.1 pps, 0.1 ppm (pulse per minute) or 1 ppm from any 50- or 60-Hz line-power source, depending on the specific device used. In addition, the count can be started, stopped or reset using enable and reset inputs. Because the cost of the IC is so low and the fact that few external parts are needed to make a working circuit, a 50/60-Hz-to-1-pps (1-Hz) timebase can be built for a cost of about $12.

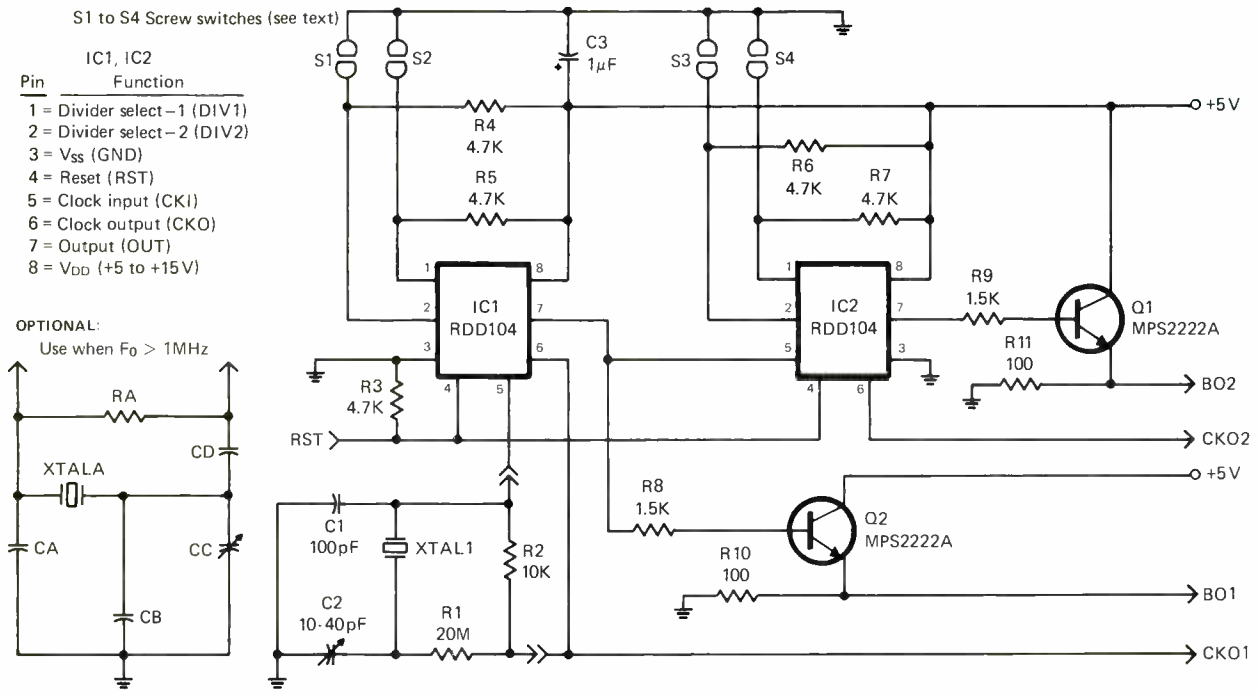


PARTS LIST (Timebase I)

C1—0.1-μF, 25-volt disc capacitor
D1,D2—Zener diode (optional—see text)
IC1—See Table I for part number
Q1—MPS2222A or equivalent transistor
All resistors are ¼-watt, 5%:
R1—100,000 ohms
R2—47 ohms
R3—10,000 ohms
R4—1000 ohms
Misc.—Printed-circuit board; 3 dpst switches (optional—see text); 8-pin DIP IC socket; hookup wire; solder; etc.

Note: The following items are available from BALL, PO Box 1022, Snellville, GA 30278: No. U1A for IC1 (specify 6, 60 or 120) for $3.75; No. U2A for IC1 (specify 360 or 3600) for $4.50; No. TBI silk-screened glass-epoxy pc board for $6.00; complete No. U1A kit (specify IC) for $12.95; complete No. U1B kit (specify IC) for $13.50. Add $2.50 P&H for each order.

Fig. 1. Schematic diagram of Timebase I. Note strapping options for RST, DIV and EN. Zener diodes D1 and D2 are required only if input signal level is expected to exceed 6 volts. Pinout table for IC1 is shown at upper-left.



PARTS LIST (Timebase II)

C1—100-pF, 250-volt mica or polystyrene capacitor
C2—10-to-40-pF pc-mount ceramic trimmer capacitor
C3—1-μF, 15-volt tantalum capacitor
D1, D2—7.5-volt zener diode (see text)
IC1,IC2—RDD104 timebase/divider IC
Q1,Q2—MPS2222A or equivalent transistor
All resitors are ¼-watt, 5%:
R1—20 megohms (two 10-megohm resistors in series—see text)
R2—10,000 ohms
R3 through R7—4700 ohms
R8, R9—1500 ohms
R10, R11—100 ohms
Misc.—Printed-circuit board; 2 8-pin DIP IC sockets; 4 6-32 × ¼" binder-head machine screws or 4 spst switches (see text); hookup wire; solder; etc.

Note: The following items are available from BALL, PO Box 1022, Snellville, GA 30278: RDD104 IC for $3.50 each; No. TBII silk-screened glass-epoxy pc board for $7.95; complete kit No. TBIIK (less crystal) for $19.95. Add $2.50 P&H per order.

Note: Crystals are available from Delta Electronics, 5151 Buford Hwy., Atlanta, GA 30340.

Fig. 2. Schematic diagram of Timebase II. Switches S1 through S4 can be screw-type (see text) or actual spst switches. Optional cirlcuit for using greater than 1-MHz crystals is shown at lower-left, below IC pinout table.

Another IC device, the RDD104, is used in pairs in Timebase II. This device is a selectable four-decade divider that is capable of dividing an input signal (crystal or logic) by 10, 100, 1000 or 10,000. In Timebase II, the two cascaded RDD104s can provide a divide ratio of 10^1 to 10^8. Therefore, a 1-MHz crystal can be divided down to 1 pps for less than $20. An optional network can be built to allow you to use crystal frequencies beyond 1 MHz. Reset inputs are provided for zeroing the counters, and on-board switches are provided for division programming.

Theory Of Operation

Timebase I uses the RED series ICs, which consists of five devices that provide a choice of 10 different division factors (Table 1). All RED devices have square-wave outputs, except the divide-by-5 portion of RED 5/6. All also operate from +5 to +15 volts and have TTL-compatible outputs when operated at +5 volts.

The counter inside the RED series devices advances one count with each negative transition of the input signal as long as the ENABLE input is high and RESET input is low (see Fig. 1).

When the ENABLE input goes low, the input pulses will be inhibited and the counter will be held in the state it has assumed prior to the initiation of a low condition on the ENABLE input. A high on the RESET line clears the counter to zero. A low on the DIVISION SELECT input will effect a divide-by-6, -60, -120, -360 or -3600,

Table I. RED Series Device Types	
RED 5/6	divide by 5 or 6
RED 50/60	divide by 50 or 60
RED 100/120	divide by 100 or 120
RED 300/360	divide by 300 or 360
RED 3000/3600	divide by 300 or 3600

depending on the device used. Similarly, a high on the DIVISION SELECT input will cause a divide-by-5, -50, -100, -300 or -3000 (see Table II).

An output buffer is provided to boost the output drive capability to 10 mA. Nominal input signal level is 6 volts, but higher voltages can be used if the optional 7.5-volt zener diodes are installed at *D1* and *D2*. The input signal can have any waveshape.

Programming is achieved by using jumper wires on the circuit board, or by using external switches for the ENA (enable), RST (reset), and DIV (divide) functions.

The Timebase II circuit (Fig. 2) uses two RDD104s. Each RDD104 contains a 4-decade divider circuit and three-stage amplifier network, with the output made available. In *IC1*, this output allows the amplifier network to be used with an external crystal to form a stable oscillator, using a minimum of external components. In *IC2*, the amplifier network is used as an input buffer and shaper.

Refer to Fig. 3 for the following description. The count circuit advances by one with each negative transition of the input signal. When the RESET input goes high, the counters are reset to zero. The SELECT inputs program the RDD104s for divide-by-10, -100, -1000 or -10,000 (see Table III). All inputs and outputs are TTL-compatible when the circuit is operated on +5 volts.

For the circuit in Fig. 2, two RDD104s are cascaded to make a versatile selectable timebase/divider with a division range of 10^1 to 10^8. The clock outputs are made available at CKO1 and CKP2, while buffered outputs are available at BO1 and BO2. By making the several outputs available, different timing and dividing combinations are possible. The two RDD104s can be programmed independently, using screw switches on the circuit board.

For the truth table for the Timebase II circuit, refer to Table IV.

Construction

Timebase I assembly is relatively simple and straightforward if printed-circuit board construction is used. The etching-and-drilling guide for this circuit's pc board is shown in Fig.

Table II. Truth Table For Timebase I			
Enable	Reset	Division Select	Result
1	0	D	Counter advances by one with each negative transition of clock input.
0	0	D	Input pulses inhibited and count held.
D	1	D	Counter reset to zero.
D	D	1	Circuit divides by 5, 50, 100, 300 or 3000, depending on device.
D	D	0	Circuit divides by 6, 60, 120, 360 or 3600, depending on device.

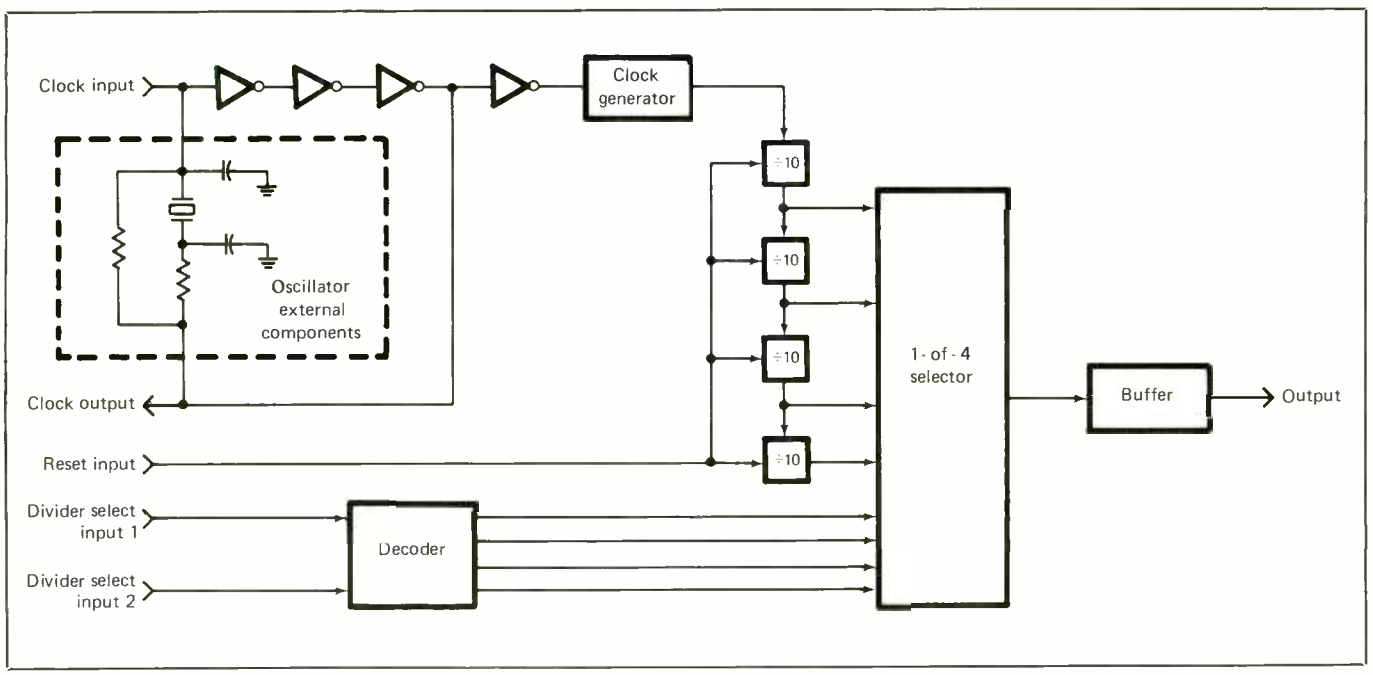


Fig. 3. Block diagram illustrates function blocks contained inside the RDD104 timebase/divider IC. Major elements are the ÷10 chain, decoder and 1-of-4 selector. Clock input can be supplied by logic circuitry, crystal, or ceramic resonator.

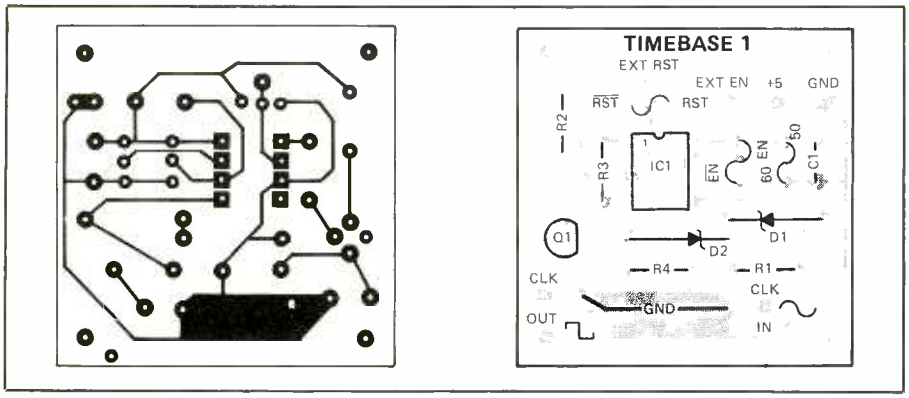


Fig. 4. These are the actual-size etching-and-drilling guide and component-placement diagram for the Timebase I project.

Table III. RDD104 Truth Table

Divider Select Inputs		
Select 2 (pin 2)	Select (pin 1)	Output Division
0	0	10,000
0	1	1000
1	0	100
1	1	10

Table IV. Truth Table For Timebase II

Switch Setting				Outputs		
S1	S2	S3	S4	CKO1	CKO2 BO1	BO2
1	1	1	1	f_o	10^1	10^2
0	1	1	1	f_o	10^2	10^3
1	0	1	1	f_o	10^3	10^4
0	0	1	1	f_o	10^4	10^5
1	1	0	1	f_o	10^1	10^3
1	1	1	0	f_o	10^1	10^4
1	1	0	0	f_o	10^1	10^5
0	1	0	1	f_o	10^2	10^4
0	1	1	0	f_o	10^2	10^5
0	1	0	0	f_o	10^2	10^6
1	0	0	1	f_o	10^3	10^5
1	0	1	0	f_o	10^3	10^6
1	0	0	0	f_o	10^3	10^7
0	0	0	1	f_o	10^4	10^6
0	0	1	0	f_o	10^4	10^7
0	0	0	0	f_o	10^4	10^8

f_o = Fundamental frequency of crystal.

4, along with its components-placement diagram. When mounting components on this board, make certain that you observe the proper orientations for *Q1* and *IC1*.

Zener diodes *D1* and *D2* should be installed for protection if inputs in excess of 6 volts are anticipated. The three programming options (RST, EN and DIV) can be strapped on the board or wired to external switches.

A bank of five Timebase I boards would make a dandy line-frequency timebase for the shop. In this case, each board would have a different RED IC, and all would have their options and outputs wired to terminals, switches, and jacks.

Timebase II is a bit more difficult to build than Timebase I, owing to some unique construction techniques required. The etching-and-drilling guide for this circuit's pc board and the components-placement diagram are shown in Fig. 5.

When assembling Timebase II, note that *R1*, a 20-megohm resistor, actually consists of two 10-megohm resistors mounted on-end and series connected by tying and soldering together the free leads. Also, programming switches *S1* through *S4* are made up with 6-32 × ¼ binder-head machine screws that are self-threaded into the pc board on the *foil* side. When completely screwed in, they close their respective "switches" and effect an electrical zero; backed out slightly, they lose contact with the foil patterns and effect an electrical one through pull-up resistors *R4* through *R7*.

For versatility, a socket can be added for crystal *XTAL1*, as the circuit is designed to operate with crystal frequencies up to 1 MHz. A modification circuit (see option in Fig. 2) permits the circuit to operate at frequencies beyond 1 MHz. For servicing, sockets are suggested for install-

(Continued on page 92)

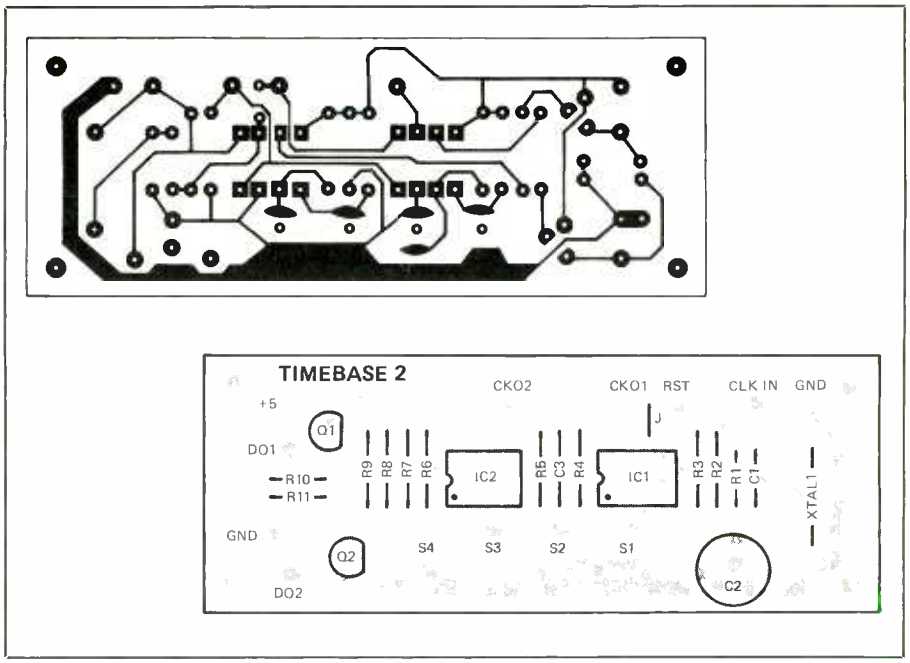


Fig. 5. These are the actual-size etching-and-drilling guide and component-placement diagram for the Timebase II project.

Experimenting with a Touch-Tone DTMF Receiver

By Forrest M. Mims III

In recent years, semiconductor companies have introduced various integrated circuits capable of generating and decoding the Touch-Tone™ signals used in pushbutton telephones. Since Touch-Tone signals can be easily transmitted over wires, radio waves, beams of light, and through the air as sound waves, the new chips permit the signals to be used in many kinds of remote-control applications.

For example, ICs that decode Touch-Tone signals make possible receivers capable of responding to signals sent over the telephone line. Lights or appliances at any location equipped with a telephone and such a receiver can be switched on or off by pressing buttons on a second telephone equipped with a Touch-Tone keypad. If the second telephone is not equipped with a Touch-Tone pad, then the signals can be transmitted by means of a commercial or homemade Touch-Tone circuit placed next to the telephone's handset microphone.

The dual-tone principle of a Touch-Tone system requires that two specified tones be simultaneously present before an output signal is generated at the receiver. This greatly reduces the impact of interfering signals and means Touch-Tone encoders and decoders can be used in non-telephone applications which might be subject to interference from externally induced signals.

Several years ago experimenters and hobbyists who wished to experiment with Touch-Tone signals were forced to assemble the required circuits from scratch. Integrated circuits capable of generating Touch-Tone signals, such as the crystal-controlled MC14410 tone encoder, greatly simplified the assembly of such circuits.

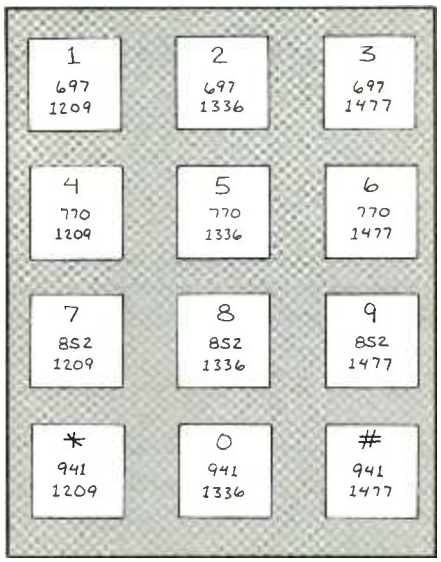


Fig. 1. Each key of the Touch Tone keypad selects two tone frequencies as shown. Selections are made from seven available frequencies.

Today, it's possible to buy preassembled, pocket-size Touch-Tone encoders for less than the cost of assembling a do-it-yourself unit. For example, Radio Shack sells a compact Touch-Tone generator complete with batteries for less than $20. More expensive units include such features as memory, digital display and crystal controlled clock.

Commercial Touch-Tone decoder systems are not as widely available or as economical as encoder units. At least not yet. Therefore, the emphasis here will be upon the operation of a particularly versatile decoder chip suitable for do-it-yourself circuits, the Teletone Corp. M-957. Before looking at this chip in some detail, however, let's quickly review the basics of the Touch-Tone system.

Touch-Tone Basis

The Bell System invented the Touch-Tone system specifically for pushbutton telephones. The keypad on a typical pushbutton phone includes 12 buttons, 10 labeled 0 through 9 and two special functions keys, known as spares, labeled * and #. The system can be expanded to include four additional keys.

Pressing a Touch-Tone button generates two simultaneous audio-frequency tones. Figure 1 shows the frequency pair assigned to each button. The four additional keys would control an eighth tone having a frequency of 1633 Hz.

The technical term for the various Touch-Tone frequencies is *Dual-Tone Multifrequency* (DTMF) signals. If you refer to Fig. 1, you'll observe that the seven frequencies seem arbitrary and rather oddly distributed. Actually, the frequencies were very carefully selected to reduce to a minimum interference from voice, the dial tone, and the harmonics from alternating current power lines.

The frequencies are divided into a low group (697 to 941 Hz) and a high group (1209 to 1477 Hz). Pressing any button simultaneously selects one frequency from each group. Since both tones must occur simultaneously, the possibility of a false signal is negligible. This is why a DTMF system should be considered for remote-control applications that might be subject to false triggering from noise or interfering signals.

For instance, a few years ago I designed a radio-controlled camera system for making aerial photographs from kites and balloons. (See the "Experimenter's Corner" in the November and December 1982 and January 1983 issues of *Computers & Electronics.*) This system was triggered by single-frequency audio tone superimposed on the carrier of a low-cost radio-control transmitter.

With this system, I have obtained many good-quality aerial photos. Unfortunately, the system is very vulnerable to false triggering, as have been most remote-control systems I

have built that use a single-frequency. In other words, it can sometimes be triggered by ship-to-shore radios and CB units in passing cars and trucks. Now that I have experimented with DTMF circuits, I plan to modify my aerial photography system for Touch-Tone operation. The system should be virtually immune to false triggering and it will provide the added bonus of up to 16 channels.

IC DTMF Receivers

Several companies make chips that receive and decode DTMF signals. Among them are Mitel Semiconductor (2321 Morena Blvd., Suite M, San Diego, CA 92110); Silicon Systems, Inc. (14351 Myford Rd., Tustin, CA 92680); and Teltone Corp. (P.O. Box 657, Kirkland, WA 98033).

The DTMF receiver chips made by these companies all incorporate switched-capacitor filters to detect the transmitted tones. The filter stages are followed by various kinds of amplitude detection circuitry and logic that determines when two detected tones are present. Each chip includes an output decoder that transforms the detected tone into a binary bit pattern. CMOS IC circuitry is generally used to provide low-power operation.

Teltone DTMF Receiver

Teltone has for several years made available to hobbyists and experimenters a line of reasonably priced DTMF receiver kits. The latest is the TRK-957 DTMF Receiver Kit, which sells for $24.75. It includes an M-957 CMOS DTMF receiver, a 3.58-MHz crystal, a 1-megohm resistor and a 22-pin DIP socket. You can order the kit by writing the company at the address given above or by calling (800) 227-3800, extension 1130. (Inside California, call 800-792-0990.)

Figure 2A is a photo of the plastic version of the 22-pin M-957. A more expensive version of the chip is available in a ceramic package (CERDIP), while Fig. 2B is its pinout diagram. Pin placements are similiar, though not identical, to those of the M-947, an earlier DTMF receiver which was once sold in a Teltone kit. The M-957 is very easy to use so long as operating requirements and precautions given in the manufacturer's data sheet are followed. Since the M-957 is a CMOS chip, it's important to observe proper handling procedures to avoid damaging the chip with high-voltage static electricity.

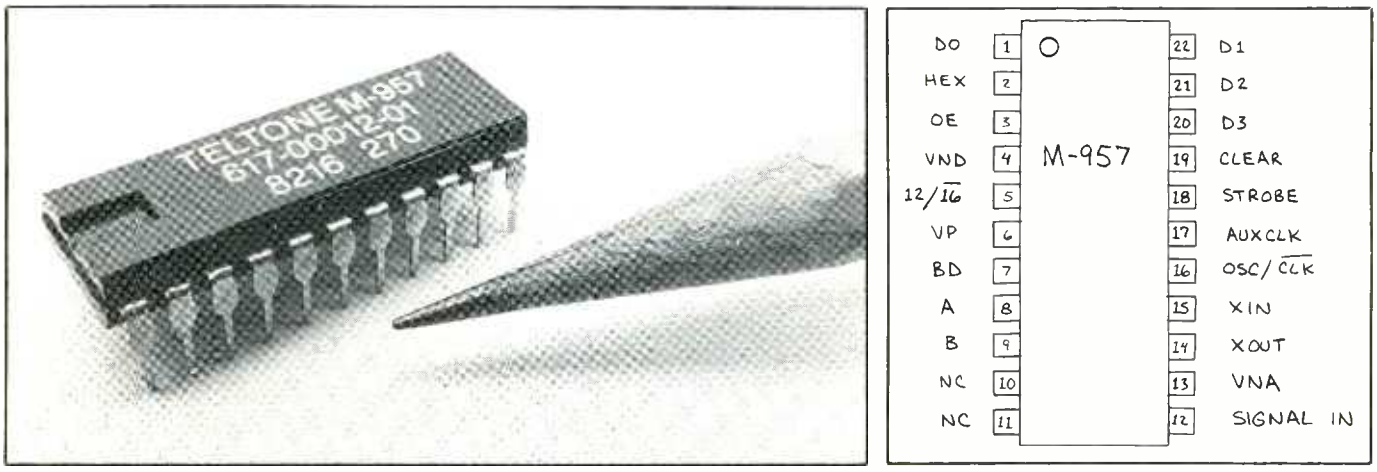
Referring to the pin diagram in Fig. 2B, the positive supply, which should be from +5 volts to an absolute maximum of +16 volts, is applied to the M-957 at pin 6 (VP). Pins 4 (VND) and 13 (VNA) should be at ground potential.

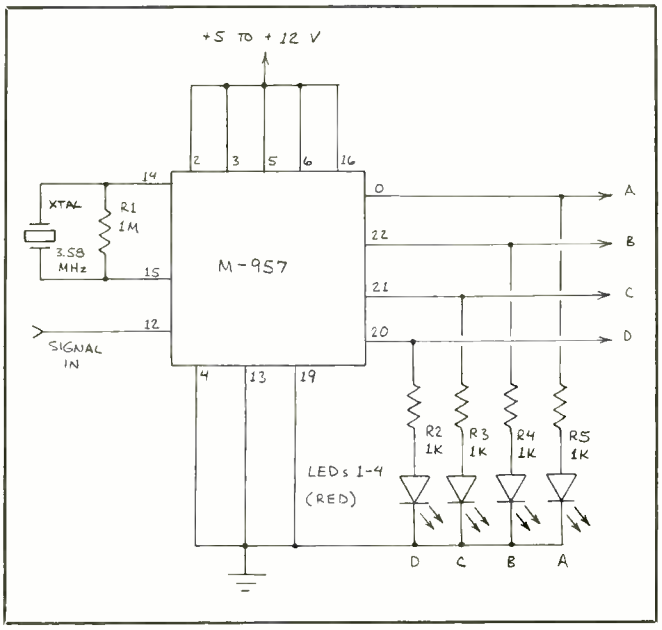
The DTMF signal is applied to the M-957 at pin 12 (SIGNAL IN). The input signal may be ac coupled through a capacitor. If the signal is dc coupled, the peak signal voltage must not exceed the positive supply voltage. Therefore, the input signal should always be removed *before* power to the M-957 is switched off.

A 3.58-MHz crystal and a 1-megohm resistor are both connected across pins 15 (XIN) and 14 (XOUT) to provide a precise timebase for the chip's internal oscillator. If the internal oscillator is not used, pin 15 should be tied to logic 1.

Pin 16 (OSC/CLK) is the timebase control. When pin 16 is at logic 1, the internal oscillator is selected. When pin 16 is at logic 0 (and pin 15 is at logic 1), a signal applied to AUXCLK is selected as the timebase. Pin 17 (AUXCLK) should be left open when the internal timebase is selected (pin 16 at

Fig. 2. At the left is a photograph of the Teltone M-957 DTMF receiver integrated circuit, while at the right is a drawing that shows the IC's pin function designations.





SIGNAL	LOW TONE	HIGH TONE	BINARY OUTPUT	2-OF-8 OUTPUT
1	697	1209	0001	0000
2	697	1336	0010	0001
3	697	1477	0011	0010
4	770	1209	0100	0100
5	770	1336	0101	0101
6	770	1477	0110	0110
7	852	1209	0111	1000
8	852	1336	1000	1001
9	852	1477	1001	1010
0	941	1336	1010	1101
*	941	1209	1011	1100
#	941	1477	1100	1110
A	697	1633	1101	0011
B	770	1633	1110	0111
C	852	1633	1111	1011
D	941	1633	0000	1111

Fig. 3. This is the schematic diagram of the M-957 Touch Tone decoder test circuit in which LEDs give visual indication of the circuit's operation.

logic 1). If an external signal is used for a timebase, its frequency must be 3.58 MHz divided by 8 or the M-957 integrated circuit will not decode signals properly.

The M-957 has four output pins (1, 22, 21 and 20) conveniently grouped at one end of the chip. As explained below, these pins provide two kinds of binary bit patterns that correspond to the detected DTMF signal.

Several control and output pins add to the M-957's versatility. The 12/16 input (pin 5) determines which range of DTMF signals will be detected. When pin 5 is at logic 1, the standard 12 DTMF signals of the pushbutton telephone will be detected. When pin 5 is at logic 0, all 16 DTMF signals are detected.

The A and B inputs (pins 8 and 9) control the sensitivity of the M-957 to the input signal. Applying various combinations of logic states to these two pins adjusts the sensitivity in steps to a maximum of −31 dBm.

The OE input (pin 3) is controlled whether the output pins are enabled or placed in the high-impedance or so-called third state. When pin 3 is at logic 1, the output pins are enabled and represent the contents of the M-957's output register. When pin 3 is at logic 0, the output pins are placed in the high-impedance third state.

The HEX input (pin 2) controls the format of the four output pins. When pin 2 is at logic 1, the output pins provide a standard 4-bit binary bit pattern. When pin 2 is at logic 0, the output pins provide a 2-of-8 binary code. The table summarizes the two output modes of the M-957.

The STROBE input (pin 18) indicates when a valid frequency pair is present at the input. Normally, pin 18 is at logic 0. When a valid frequency pair has been detected, pin 18 goes to logic 1 until the signal ends or the CLEAR input (pin 19) is placed at logic 1. If the CLEAR input is not used, it should be tied to ground (VNA or VND) to prevent stray signals from causing inadvertent clear operations.

Output BD (pin 7) provides an early indication of a possibly valid DTMF signal at the input pin. Normally BD is at logic 0, but it goes to logic 1 when a signal has been received and is being validated. The BD output responds to an input signal within about 18 milliseconds while the STROBE output requires about 40 milliseconds to verify a correct signal.

Using the M-957

Figure 3 is a straightforward test circuit for the M-957. The input signal may be supplied directly from a Touch-Tone keypad, a tape recorder, an amplifier, or a radio receiver so long as the signal amplitude does not exceed the positive supply applied to the M-957. The signal may be coupled directly (dc) or through a 0.01-μF capacitor (ac).

The circuit in Fig. 4 includes four optional LEDs connected to the outputs to provide a visual indication of the received signal. Indicator LEDs can also be connected to other outputs of the M-957.

Generally, it's desirable to decode the binary output from the M-957 into a 1-of-16 format. Figure 4 shows how to connect a 74C154 4-line to

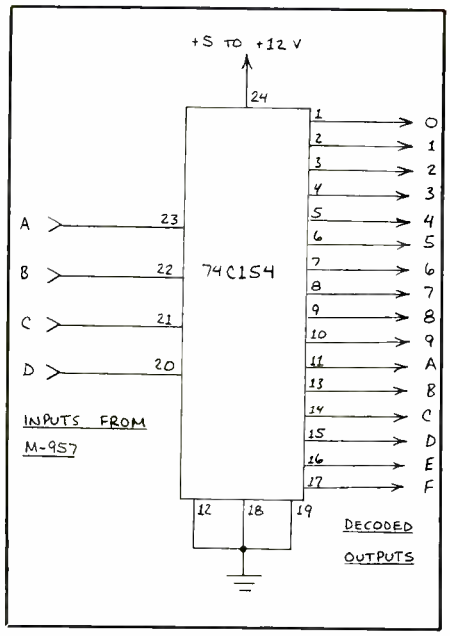


Fig. 4. This is a 74C154 1-of-6 decoder for use with the M-957 Touch Tone decoder integrated circuit.

16-line decoder to the outputs of the M-957 to achieve this purpose. Keep in mind that the 74C154 is a CMOS chip and should be handled accordingly. Other CMOS decoder chips can also be used.

Figure 5 shows how to drive a relay from one of the outputs from the 74C154 or a similar decoder. Diode *D1* absorbs reverse voltage generated by the collapsing field in the relay's coil when the relay is switched off. The relay is normally deenergized. When the base of *Q1* is placed at logic 0, the relay is energized. If the circuit doesn't switch consistently, try making slight changes in the value of *R2*.

I have had excellent results experimenting with the M-957 in a variety of non-telephone remote-control applications. Those readers wishing to connect the chip directly to a telephone line will want to first carefully review the M-957 data sheet. Figure 6 is adapted from a suggested telephone line interface circuit given in the M-957 data sheet. If this single-supply circuit doesn't work properly, try using a dual-polarity supply. In other words, connect pin 4 to the negative counterpart of the positive supply instead of to ground.

It's very important that you understand the interfacing requirements imposed by your local telephone company before connecting a do-it-yourself circuit to their lines. The Federal Communications Commission allows customer-provided equipment to be connected to telephone lines if the equipment meets FCC guidelines. In every case, the equipment must be connected to the lines with standard four-prong or modular telephone plugs and jacks. Check your telephone directory for guidelines and call the company if necessary.

Going Further

As you can see by now, the familiar Touch-Tone DTMF signals have far more applications than merely dialing telephone numbers. For more information, write the manufacturers whose addresses are given above and request data sheets and application notes. Also, look for articles on DTMF applications and new encoder and receiver chips in the various electronics and communications magazines available at most good university libraries.

If your primary interest is connecting circuits to the telephone line, be sure to thoroughly research the topic and proceed with caution. An excellent book for hobbyists is "Electronic Telephone Projects" by Anthony J. Caristi (1979, No. 21618, Howard W. Sams & Co.). **ME**

Fig. 5. Relay driver circuit for the decoder IC chip.

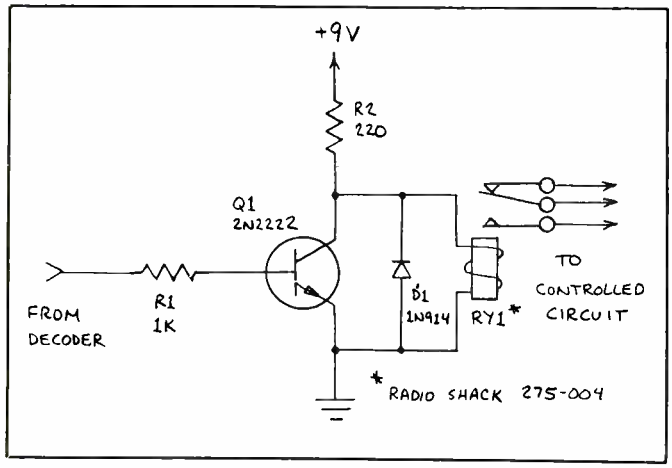
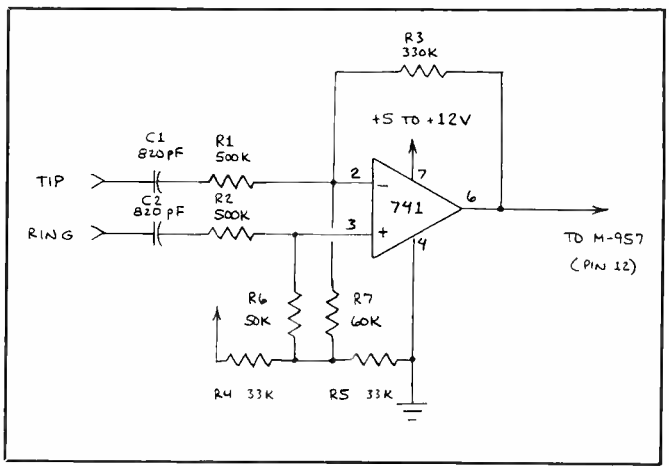


Fig. 6. Tone-decoder telephone-line interface circuit.



HARDWARE HACKER

A new monthly column devoted to answering hardware questions posed by readers

By Don Lancaster

This new column is designed to be *your* column. That is, it will develop into an interactive column in which I'll try to answer most any hardware (and inescapable software) questions readers pose to me, look at some neat hacker-type stuff, and maybe explore a few off-the-wall things along the way.

To join in the fun, write or phone me directly (see "Need Help?" box). Frankly, I'm not so great at answering letters, so the telephone is your better choice. Best hours are 8 to 5 weekdays, Mountain Standard Time. (Someday, we'll even add a bulletin board on-line. To anyone who responds, I'll send a free book list and product list relating to my very special wares.

Now, for Column #1 . . .

How can I do a Hexadecimal LED Display?

There are lots of different integrated circuits available that will let you display the digits from 0 to 9 on a light-emitting diode (LED) display. Unfortunately, most of them treat codes decimal 10 through 15 or hexadecimal A through F as invalid codes, and will blank, or turn off, the display. This is fine for a digital instrument. But for a computer or trainer display, you need all 16 hex digits displayable and readable.

A circuit that will display all hex digits in response to all 16 possible $0 through $F code inputs is shown in Fig. 1. (Note: from here on, the $ prefix refers to hexadecimal notations.) As a bonus, it takes only a single integrated circuit, a *Motorola* MC14495, which even has the seven current-limiting resistors demanded by all seven-segment LED displays built right in.

Essentially, all you need for the circuit is the chip and an LED display. One gotcha: This takes a *common-cathode* 7-segment display. These are less common than the usual *common-anode* displays, but they are findable if you look around for them.

There are four data inputs, which I have labeled 8-4-2-1, and a clock input. You put the binary code for the letter you want to display on the 8-4-2-1 inputs. For instance, for a $6, you input a 0-1-1-0, or low-high-high-low, code. For a $B, you input a 1-0-1-1 combination. (By the way, you can tell the $6 from the $B since the six has a top bar, while the $B is shown in lower case.)

The MC14495 also has a memory feature. There is a hold-follow latch built into the chip. If you make the store input high, you will *hold* the old data. If you ground the store input, you will instead *follow* the new data as it arrives. Thus, for an "instant" display, ground the store input. For a

Fig. 1. A decoder/driver circuit for a 7-segment LED display that will show all 16 hex states.

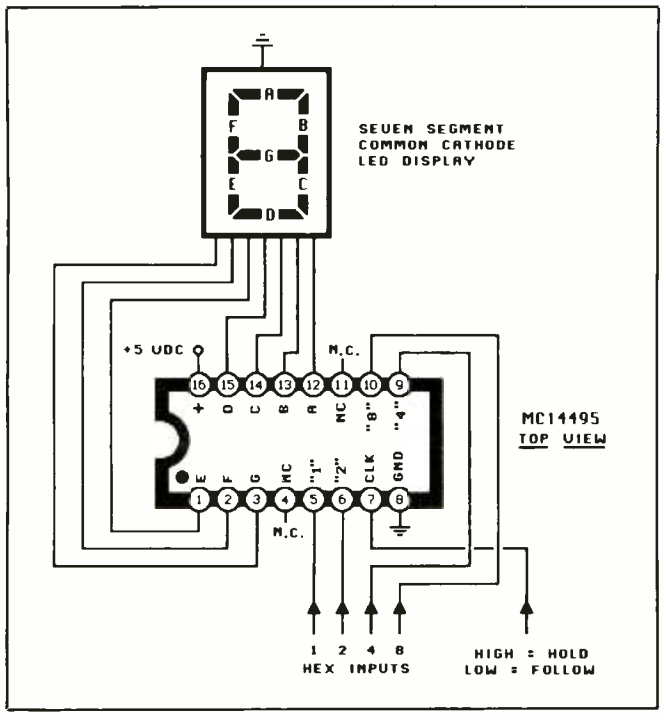
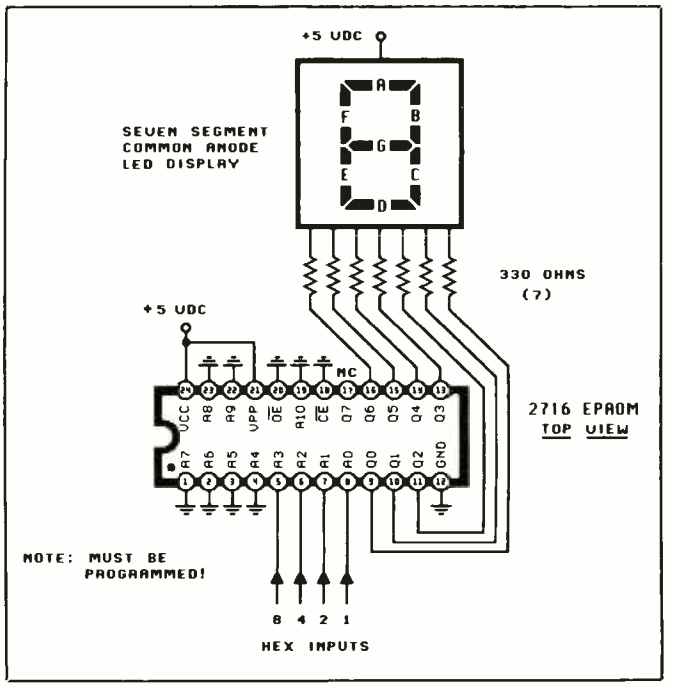


Fig. 2. When you can't find the circuit you need, a 2716 EPROM can often be used as a "sledgehammer" solution to your needs.



"memory" display, connect the store input to a signal that is normally high but goes low any time you want to update.

Since this is a CMOS device, be sure to connect all of the inputs at all times. The two pins I have marked "NC" are outputs intended for specialized and rare uses.

Though the chip works best off a +5-volt supply, you can use any supply from 4.5 to 16 volts. For LSTTL (low-power Schottky transistor-transistor logic) compatibility, use a +5-volt supply and add 4.7K pull-up resistors to all five inputs.

Besides this chip, there are apparently a Mitel MD4311B and a related Plessey MV4311 available. Either one will also drive a hex LED display. I haven't had a chance to look into these further, though.

There is also a sledgehammer solution to driving any code into any display. Just burn the pattern you need into a 2716 EPROM. A 2716 would normally use a +5-volt supply, a common-anode LED display, and seven 330-ohm current-limiting resistors. Use a truth table that pulls outputs *low* when you want to *light* the display. Figure 2 shows details.

How can I do a cross references to a disk file?

An *intelligent disassembler* is a routine that lets you tear apart a machine-language computer program so that you can "capture" it to your own source code, including the usual features such as labels, comments, operands, and so on. A *cross reference* is a listing of who does what to whom. Cross references are particularly useful using the "avalanche effect" to tear into unknown code.

I'm an Apple person, so I use a program called "*DISASM IIE*" by RAK-WARE. This is the best one I have found, and it performs admirably, even though it is a tad on the user-vicious side. The normal cross reference listing on DISASM IIe is done to the screen or a printer. Many times, I have wanted to do a listing to a text file on disk. Once on disk, you can transfer the listing to a work processor and you'll be able to do all sorts of fancy things with it.

Bob Kovaks, the author of DISASM IIe, advises me that you can make a simple patch to capture a cross reference to disk. Locations $09A1 through $09A2 should be $20 -$E0 - $0C. Change this to $20 - $F1 -$0A, and your cross reference will be printed to disk. It works like a charm, except for a minor bug. Use this routine only once and then reboot, for a location or two gets clobbered in the X-REF disk access.

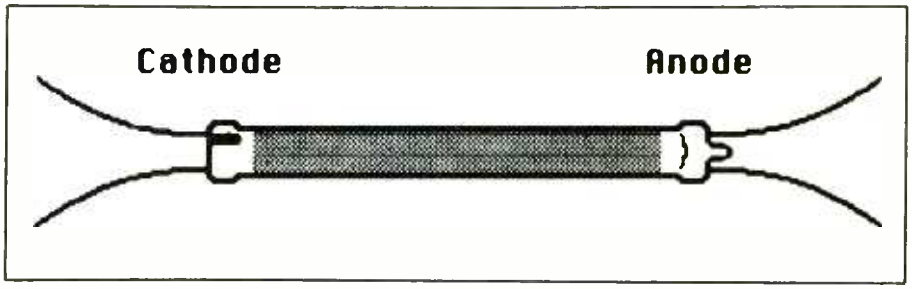


Fig. 3. The JKL BF659 lamp is only 2½" long and comes in several colors. It is very easy to power, from the ac line or transistor oscillator. Take careful note of polarity.

Where can I obtain small cases with built-in battery compartments?

I've found several sources on these. *Global Specialties* has a CTH-1 "Handheld" light-grey case that includes a built-in 9-volt battery compartment, input jacks, and provision for a keyboard and LED display. *Jameco* stocks it.

The ones I really like, though, are made by *Vero*. Check into this company's Series II case boxes, Types I, II and III. Type I is cute as a bug, and includes a front panel and a 9-volt battery compartment. Types II and III are slightly larger and are provided with a molded-in compartment for four penlight cells. *Dyna Service* is one distributor. Cost is well under $10 for most sizes.

The Type I box requires some cramming to get things to fit. I've found that you can hang circuit boards *upside-down* from the plastic bosses, to use normally wasted space. Much as I hate to solder ICs into place, instead of socketing them, this is one package where socket bulk may be intolerable. Even thinner pc boards may be of help. (We are working on a whiz-bang project using one of these neat little guys.)

Vero also has just the snap-in 9-volt battery compartment that you can pop into a rectangular hole in the case of your choosing. Their part number is 75-2859, and cost is under $3 in onesies. A battery connector is included.

Where can I get some Hacker's microcomputer books?

Funny you should ask that. By the most astounding coincidence, I have written two of them that treat microcomputer fundamentals from the point of view of a hacker-type person with a mostly hardware background.

There are my *Micro Cookbooks,* Volumes I and II, and are available as SAMS #21828 and #21829. Volume I is on bare-beginning fundamentals, while Volume II is on machine-language programming. You can get these books through your local com-

puter store or directly from the SAMS order hotline by dialing 1-800-428-SAMS.

Are there miniature flourescent lamps available?

There sure are, and they are as cheap as $1.62 each. *JKL Components* has bunches of sizes and colors of these. They range from 2" to 5" long, and are available in white, red, green, blue, orange, yellow and pink. Figure 3 shows a typical example. It is JKL's Model BF659.

An ac line-operated test circuit is shown in Figure 4. There are some very subtle things happening in this circuit, so be extra careful to observe polarity of everything and do not rearrange the parts.

The bulb itself has a cathode end and an anode end. There is no filament and, thus, no filament to burn out. At the cathode end is a cup-shaped cathode that is marked with a black line. The anode end has a bulb evacuation tip on it, which also may have a black mark on its extreme end. Centered at the cathode end is a starting electrode. At the anode end are two starting electrodes, one of which acts as an anode when the lamp is running.

There are three operating modes for the Fig. 4 circuit: power up, start, and run. On power up, there is no lamp current, so you simply have a half-wave rectifier where the power diode charges the capacitor to some −200 volts. Note that the capacitor must have a rating of 200 volts dc or higher. While an electrolytic is shown, I prefer to use a good-quality 1-microfarad, 400-volt mylar capacitor instead.

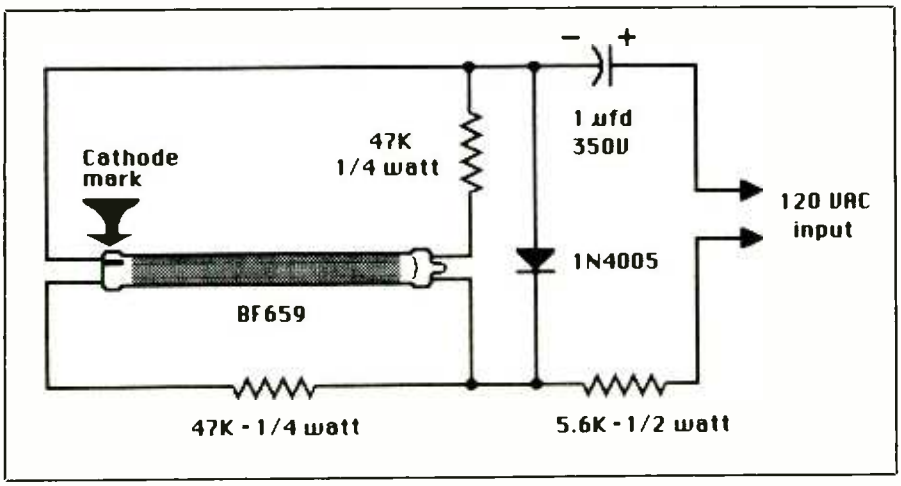
As with any ac line-operated circuit, this one has a stinger in its tail, so be careful! There's 400 volts here waiting to nail you.

Applying power charges the capacitor to −200 volts. On the positive line cycle, the potential across the "off" diode is some 400 volts, taking the difference between the positive peak line cycle and the negative capacitor voltage. So you have 400-volt pulses appearing across the diode.

Now for the startup. The object of the game is to get an ionized path from cathode to anode inside the bulb. This ionized gas will then whap the phosphor coating inside the tube and light the blub. The trouble is that it would normally take thousands of volts to ionize that long a path. So we get sneaky.

At the anode end of the bulb is a pair of pins spaced similarly to a common neon lamp. A pulse of 400 volts is more than enough to fire a localized ion path between these two pins. The localized current is limited by the 47K resistor.

Fig. 4. Circuit to power a BF659 fluorescent lamp from the ac power line. The polarities of the lamp, capacitor and diode must be observed.



Names & Numbers

Dyna Services
1020 S. Atlantic Blvd.
Los Angeles, CA 90022
(213) 268-8531

Global Specialties
70 Fulton Terrace
New Haven, CT 06509
(203) 624-3103

Jameco Electronics
1355 Shoreway Rd.
Belmont, CA 94002
(415) 592-8097

JKL Components
13343 Paxton St.
Pacoima, CA 91331
(800) 421-7244

3M Graphic Prep Systems
3M Center
St. Paul, MN 55144
(612) 733-3712

Mitel
360G Leggett Dr.
Kanata, Ontario K2K 1X5, Canada
(613) 592-5630

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

Plessey
1674 McGraw Ave.
Santa Ana, CA 92705
(714) 540-9945

Rak-Ware
41 Ralph Rd.
West Orange, NJ 07052
(201) 325-1885

Howard W. Sams & Co.
4300 W. 65 St.
Indianapolis, IN 46206
(800)428-SAMS

Vero Electronics
171 Bridge Rd.
Hauppauge, NY 11788
(516) 227-8890

Webril/Kendall
One Federal Way
Boston, MA 02101
(617) 423-2000

At the cathode end is a cathode cup and a pin that is similarly spaced. It also will fire when 400 volts is placed across it. Eventually, some ions drift down the tube and a conduction path is established. At that time, the main lamp "fires," and the electron path is through the current-limiting input resistor, into the cathode, into the ionized path, out the anode and back to the supply via the large capacitor. The whole process takes only a few line cycles, so the bulb appears to "instantly" light.

Colors are produced by changing the phosphor chemistry. JKL also has an ultraviolet version. I have not tried this one for erasing EPROMs, but it is probably the usual "poster" low-energy UV, rather than the high-energy "rockhound" UV style needed to blast an EPROM.

Let me know if you have any luck on this, since most EPROM erasers are obscenely priced.

Brightness can be controlled over a reasonable range, from a lamp current of, say, 3 to 15 mA. You can also build a simple transistor oscillator to battery power the lamp. Efficiency can be quite high. Several cavers are even experimenting with these as underground light sources.

If you really want to get wild, JKL will custom-bend almost any shape or size lamp you want. But not on a hacker's budget.

Is there some simple way to handle 1:1 photographic reversals?

Getting from black-on-white artwork to clear-on-black film can be a real hassle. Yet it is often needed for printed circuits, silk screens, dialplates, overlays, and the like.

If you are able to work 1:1, you can eliminate both the camera and the darkroom, by using 3M's *Color Key* materials. These are intended for use by printers to do "prepress" color proofing, and are available in a wide variety of colors. Chances are the plain old black-over-transparent will work for you. 3M's #77-9801-6648-0 is typical in the 9″×12″ size. The packages tend to be expensive, but the cost per square-inch is fairly low.

The stuff is only moderately light sensitive, so you can work in subdued light if you are reasonably quick and make sure that all long-term storage is done in a light-tight package.

Here's all you do: Rig up a contact printing frame. Put whatever you want reversed in contact with the color-key sheet. Emulsion to emulsion is sharpest. To find the emulsion side, use the old darkroom stunt of touching the film to your lips. Whichever side sticks to your lips is the emulsion side.

Next, you expose. If you do not have an exposure box, try direct sunlight for three minutes. Then adjust for best results.

After exposure, pour some #77-9800-7992-3 developer over the sheet and gently rub the sheet with some non-woven fabric or soft paper. The same place that sells you the Color Key materials should stock *Webril* Proof Pads, which are ideal for this purpose. After a half a minute or so of gentle wiping, the part of the image that did not receive any light should literally fall off the sheet, leaving it clear where no light got through, and solid black where it did.

Unfortunately, this material is much too slow for use in any reduction or imaging camera, no matter how bright the lights or how long the exposure. It works only at 1:1 and then only when directly contact printed.

There are some related 3M products that let you do dialplates, either on aluminum or a polyester base material. These are available in several colors, and are ideal for dialplates and panels, particularly when you need only one or two of them but demand a professional result. The same developer is used.

3M, a huge corporation with many divisions, is monumentally hard to deal with as a company, so your best bet usually involves calling your local printer or lithography supply house.

These materials are easy and fun to use and have lots of hacker potential. Let us know what new uses you find for them. **ME**

Need Help?

Phone or write hardware hacker questions and comments directly to:

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Thatcher, AZ 85552
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BOOK REVIEWS

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

Assembly Cookbook For The Apple II/IIe. By Don Lancaster. (Howard W. Sams & Co., Inc.; soft cover; 408 pages; $21.95.)

A lot of books on assembly-language programming are either so shallow or so advanced they turn off the reader for good. Making matters worse, their writing styles are frequently so dry that they can't maintain reader interest. None of these deficiencies are in the *Assembly Cookbook* For The Apple II/IIe. This book is a rare gem that's actually *fun* to read while being very informative and hilariously amusing. If you really want to learn assembly programming on the Apple, this is the book for you. It sets the stage by telling you why you should program in assembly language and then moves on to defining what an assembler is, how it works, and the ins and outs of using it. Throughout, the text is easy to read and so witty that it's almost guaranteed to hold your attention and make you come back for more and more. In terms of coverage, this book deserves high marks, but so do other books on assembly-language programming. What sets this one apart is its readability and the manner in which it holds reader interest right through to the last page.

DOS Primer For The IBM PC & XT. By M. Waite, J. Angermeyer and M. Noble. (New American Library; soft cover; 197 pages; $14.95.)

If you use the disk operating system in your IBM PC or XT for only routine everyday operations, you're taking advantage of only a small portion of PC-DOS's power. To really understand what you can do with PC-DOS, you must go beyond the supplied DOS manual. This is where the DOS Primer comes into play. Written to appeal to both the beginner and advanced user, this book uses an intensive interactive approach to teaching PC-DOS. To obtain maximum benefit from the learning experience, *DOS Primer* is designed to be used right at the computer's keyboard to hammer home what you're reading. The writing style is light and easy to absorb, though in no way lacking in very useful information. Each of the nine chapters into which the books is divided builds upon previously presented material, taking the reader logically from beginning concepts right on through advanced concepts. Along the way, there are extensive exercises to be performed at the keyboard, and each chapter closes with a series of review questions, answers for which immediately follow. The book covers versions of PC-DOS from 2.0 on backward. It covers both floppy and fixed-disk systems and details use of the EDLIN editor and CONFIG.SYS utilities.

Introducing Cellular Communications. By Stan Prentiss. (TAB Books; soft cover; 216 pages; $8.95.)

You've probably read or heard about "cellular communications," the hot new technology that expands the usefulness of mobile telephone communications. If you want to know a great deal more about it, this is the book for you. *Introducing Cellular Communications* is an authoritative one-stop source that offers both a general overview of cellular communications and all the technical details you'll ever want or need. It tells you what cellular communications is and why it's important to you. The author then gets into a technical, but by no means pedantic, discussion of the terrestrial and satellite carriers that make it all possible. For the technically inclined, there are 38 pages packed with technical specifications information, including dozens of tables and drawings that detail every part of the cellular-communications system. Current equipment, both at the user's and the base-station ends, also come in for thorough examination.

Much of the material presented in this book is of a technical nature. But it's not presented in a manner that will turn off the casual reader whose only interest is in learning what cellular communications is and how it will directly affect him.

NEW LITERATURE

Scanner Converter Catalog. A catalog of scanner converters designed for people who want to receive the new vhf and uhf bands recently put into service can be obtained from Hamtronics, Inc. Though these new and scattered frequency ranges are generally not available yet on scanners, the converters described can be used to receive them through virtually and crystal-controlled or programmable scanner. Described are models for receiving radio-control and low-power industrial broadcasts on 72 to 76 MHz; weather and geophysical research satellite broadcasts on 135 to 144 MHz; Navy/Air Force fleet satellite broadcasts on 240 to 270 MHz; Federal government and FBI broadcasts on 400 to 420 MHz; and the new metropolitan land mobile band broadcasts on 806 to 894 MHz. For a copy of the catalog, send $1 to cover postage and handling to Hamtronics, Inc., 65-F Moul Rd., Hilton, NY 14468.

Portable Antenna Catalog. A new eight-page catalog from Centurion International, covering the company's line of "Tuf Duck" portable antennas, lists more than 20 antenna models, including new 800-MHz antennas for cellular-radio applications. Included in the listing is Centurion's full line of connector styles to fit virtually any portable radio on the market. Other new additions include a ⅝-wave gain antenna, a new ¼-wave flexible whip for uhf, a ½-wave flexible cable antenna for uhf, and the Tuf Duck "Slim Mini" 3" antenna for 118 to 225 MHz. Rounding out the listing are entries for the company's special-application antennas for scanner, pager, and emergency use. For a free copy, write to: Marketing Dept., Centurion Int'l., Inc., PO Box 82846, Lincoln, NB 68501.

Microwave Filter Catalog. A 24-page, illustrated catalog from Racom Corp. features microwave filters, multiplexers, switches, and integrated components. Address: Racom Corp., 165 Topaz St., Milpitas, CA 95035. ME

Shortwave-Station News And Listening Tips

By Glenn Hauser

Here's a selection of station news and practical listening tips to help you get the most out of your shortwave—and in some cases mediumwave—radio; unless otherwise specified, times and days are UTC.

Antarctica. Midsummer activity is at its peak. In *SPEEDX,* Mike Chabak recommends 8997- and 13251-kHz USB for air-ground communications, best between 0400 and 1000. A station-to-station frequency is 11582 USB around 0100-0400. US Navy MARS uses 13974 USB between 2300 and 0300. Propagation conditions vary greatly, so if you don't succeed at first in monitoring Antarctica, keep trying.

Argentina. Radio Belgrano has been doing some strange things. In *Latinoamerica DX,* Emilio Pedro Povrzenic notes they've started including IDs in Quechua after 1200, presumably for Bolivians in Argentina. Saturdays at 1100 there's an anti-Paraguayan program; Saturday or Sunday at 0030 and 0130 respectively, anti-Uruguayan and anti-Chilean programs so far noted on mediumwave only. Juan Carlos Codina in Peru says Belgrano's main frequency, 6090, is covered by Ecuador, but Belgrano can be heard there on a spurious emission around 6221 kHz until 0200. Beware—Central American clandestines also transmit in this area.

Austria. Further to the information in our October column: Austrian Radio has an additional weekly program in English, "Austrian Coffeetable," with a variety of music and cultural items, Suns. 0305-0330 on 5945 and 9770; 1205-1230 on 15320 (alternate: 17860).

Belgium. BRT has been using 5910 for North America, 9925 for South America, in English at 0030-0115, but changes usually take place Jan. 1. Kraig W. Krist in Virginia says BRT planned to change its whole program layout on that date; they've already been experimenting in the news with several longer items instead of short ones.

Canada. "Ideas," one of CBC's most outstanding series, is not carried on shortwave (except for low-powered 6160 in Nfld. and B.C.), but if you're within two or three states of the border, you may be able to hear it on mediumwave, Sun.-Thu. at 9:05 p.m. local time. Main frequencies from N.S. to B.C. at 860, 1070, 940, 920, 740, 1550, 800, 990, 540, 1010, 740, 690. Subjects during the first 3 or 4 weeks of January are: Suns., "The Circle of Knowledge," about the rise and fall of the encyclopedia. Mons., "Journey Through the Volcano: Central America in Turmoil." Tues., "Finding Out—the Rise of Citizen Science." Weds., "Kazantzakis," about the Greek author, pacifist and revolutionary. Thurs., "Alexis de Tocqueville's *Democracy in America* 150 Years Later."

Cuba. Radio Havana holds an essay contest each year, the prizes being five all-expense-paid trips to Cuba for two weeks including July 26. Maximum length is 500 words, deadline April 30, on the topic "What do you consider Cuba's main achievement in 25 years of revolutionary power?" *Non-Cuba:* The Voice of America, which never wanted to be associated with Radio Marti, kept stalling its activation on 1180 kHz from Florida until after the election. But if there are any shortwave radios in Cuba capable of tuning strange frequencies, such as 10040 (variable), a 24-hour anti-Castro station already exists courtesy of La Voz del CID (Cuba Independiente y Democratica), Radio Camilo Cienfuegos. The location of this transmitter is unknown, but since we've heard in south Florida a weak and fading signal skipping in on its third harmonic, 30118, it seems likely to be at least a few-hundred kilometers from Fort Lauderdale.

Dominican Republic. Radio Earth, mentioned in our last column, left WRNO because of irreconcilable differences, resuming broadcasts Sept. 24 via Radio Clarin, its original

home. The transmission at 0300-0400 suffered fadeouts on 11700 kHz, and a move to an earlier hour such as 2300 or 0000 was contemplated. For the latest information on Radio Earth, write them at 1724 Sherman Ave., Evanston, IL 60201.

Easter Island. You'll not hear broadcasts from this exotic spot, but it is possible to monitor radiotelephone traffic with Santiago, Chile. Gary Hickerson in Arkansas heard contacts in English and Spanish at 1654 on 18665.1 USB.

Ecuador. HCJB has started scheduling listener call-ins irregularly during some of its more popular programs, such as Passport, DX Party Line, Musical Mailbag; and another one was expected for Christmas. The phone number is 593-2-241-560. A new station in Ecuador is La Voz del Upano, Macas, on 5040, initially scheduled only at 2300-0030 (weekends until 0200), discovered by Steve Reinstein and David Potter in DX South Florida.

El Salvador. The official government station, Radio El Salvador, gets much less attention than clandestines like Radio Venceremos, since it's seldom active on shortwave—and at times has even been missing from its distinctive mediumwave channel, 655 kHz. Radio El Salvador unexpectedly carries out brief tests on 5992 and its second harmonic, 11984; one evening, Don Hosmer in Michigan found a good signal with test announcements on 9587. Robert Horvitz in Rhode Island monitored election returns from remote areas on 6284 SSB, well worth checking the next time El Salvador has an election.

Malaysia. A seldom-heard external service comes from the Voice of Malaysia, in English at 0555-0825 on 15295 and 9750. One of these may be a 500-kilowatt transmitter, and late-evening listeners on the West Coast have a better shot at it once audio problems are solved. Gerry Bishop in the Philippines says it's very undermodulated. There's news at 0600 and 0800, and a good variety of music and other features in between; for example, Mon. 0703-0730 "Movie Magazine"; Tue. 0745-0800 "Latin Quarter"; Wed. 0645-0700 "Just Jazz"; Fri, 0610-0630 "Pop Songs from Malaysia"; 0745-0800 "Talk on Islam"; Sat. 0730-0800 "Malaysian Theatre"; Sun. 0700-0745 "The Classics." Thanks to Christopher Bagge, Jr. in Massachusetts for this schedule.

Mexico. That "Borderblaster," XERF on 1570, has been broadening its programming away from just gospel-huckstering. If you tune in at 0500 (perhaps 0600 now), you might think you've caught a British pop pirate. "Wonderful Radio London," complete with its own jingles, bought the time on XERF, but hoped to resume its own broadcasts on Christmas Eve.

Non-Nicaragua. Yet another anti-Sandinista clandestine was born Sept. 16, this time with a big AM signal on 6229.9, and a softer tone with lots of music. Almost daily one-hour broadcasts in Spanish start at 0000, 0200 and 1300, from Radio Monimbo. Juan Carlos Codina, who discovered it, says it's named for an heroic town where the Indians fought Somoza. Steve Reinstein in DX South Florida notes that *Monimbo* is also the name of a current novel about a fictitious race war in Miami instigated by Castro in that Nicaraguan town.

Papua New Guinea. "Good PNG Mornings" are much sought after by avid DX listeners—those occasions around sunrise when most or all of the provincial stations on the tropical bands come in at once. In the limited time, it's tempting to "list log" them, assuming a PNG-sounding station on a certain frequency is the one listed there. But last summer, NBC began moving several stations to new frequencies, mainly from the 120- to the 90-meter band. That means reception for us will be a bit more likely. Radio Manus is on 3315; Radio Northern Districts, Popondetta on 3345; Radio West New Britain on 3235; Radio Western Highlands on 3375; and Radio North Solomons shifted from 3322.5 to 3325, per Richard Jary in Australian DX News. On Oct. 2, Craig Wicks of Independent New Watch in Michigan monitored the central station at Port Moresby on 4890 with a news item at 1200 that some transmitters in the "Karai Service" had been sabotaged.

Peru. There's a hot bed of radio activity in certain regions, especially San Martin and Cajamarca. Almost every week, Juan Carlos Codina in Lima has monitored a new shortwave station; many of them have technical faults, operate outside the broadcast bands (such as between 3.9 and 4.7 MHz, 5.1-5.9, 6.2-7.1, 7.3-7.5), and are unlicensed. One of them, Radio Continente, Juanjui, even chose to vary around 8900 kHz, a flight weather channel.

Spain. Spanish Foreign Radio has been on 9630 and 11880 for many years during its English hours at 0000, 0100 and 0500, but monitor George Poppin has been informed of plans to replace 11880 with 6065 during the winter. It was already used in the fall for Spanish.

Surinam. Lacking powerful transmitters of its own, but desiring to get its point of view across to former colonial power Holland, the government obtained transmitter time from Radio Nacional, Brasilia. Initially in August, broadcasts in Dutch were on 17755 Suns. 1430-1520; Wed. & Fri. 1700-1750, and we were able to monitor this in North America. More recently, transmissions have started at 1730, various days of the week.

Syria. After a long absence from shortwave broadcasting, SBS, Damascus returned in 1984 with Arabic transmissions on 12085 and 7425 kHz; also check 9505 and 7365.

United Arab Emirates. A new shortwave station, Voice of the UAE in Abu Dhabi, planned to activate four 500-kW transmitters by October, but had not been monitored at press time. Tentative schedule registered with the ITU was: 1000-1200 on 17820, 1200-1400 on 11715, 11915, 15230, 15275; 1400-1600 on 11815, 15115, 15330; 1600-1800 on 11915; 1800-2000 on 9630, 9655; 2000-2200 on 6155, 7235; 2000-2100 on 5960, 2100-2200 on 6185. Alternates: 7145, 7225, 9595, 11890; according to the *World Radio TV Handbook Newsletter.* Don't confuse this station with UAE Radio, Dubai.

United Kingdom. We're glad to report that the BBC World Service has restructured its programming so that now, with very few exceptions, there is always news on the hour, every hour—but in some cases, just headlines. This also puts an end to its former inconvenient practise of allowing 30- or 45-minute programs to span the top of the hour. Audio quality from the Antigua and Ascension relays should now be much improved, with the implementation of a long-delayed low-priority plan to feed those sites by satellite rather than relays off shortwave.

USA. Some programming developments at the Voice of America: "Talk to America," a new monthly call-in show hosted by Larry King, began Oct. 7 with Gerald Ford as the guest. It's on the first Sunday at 1710-1800 on 17785, 15600 and many other frequencies, ironically conflicting at first with the BBC program which inspired it. Subsequent guests were to be astronaut Guy Gardner and Isaac Asimov.

After a great many years of refusing to consider the subject, VOA started in September a weekly segment for shortwave listeners; it was expected to be kept on an elementary level, not getting so esoteric as to broadcast DX tips. The feature appears during part of the Magazine Show, which starts UTC Fridays at 0230 on 15205, 11675, 11580, 9650, 9455, 6130 and 5995.

A highly-regarded public radio program, "A Note to You" with Roland Nadeau in Boston, is now being carried on VOA, a bit more often than once a month, during Concert Hall, Suns. 1415, 2015 and Mons. 0310.

Lots of money is being pumped into the USIA to upgrade VOA facilities over the next several years—almost a billion dollars! There'll be new shortwave relay sites in Thailand and Puerto Rico; great improvements in existing sites such as Sri Lanka. A devious deal with a Costa Rican front organization will soon result in a VOA mediumwave relay there on 930 kHz, to serve Nicaragua. There has also been press reports of three powerful television transmitters being set up in northern Costa Rica for the same purpose.

VOA will soon have more company, as several new private U.S. shortwave stations near completion go on the air. KVOH, the Voice of Hope, in Rancho Simi, California, set up by High Adventure Ministries, has this tentative winter schedule: 1400-1600 on 9525, 1600-2200 on 17755, 2200-2400 on 15115, 0000-0400 on 11930, 0400-0600 on 9525, 0600-0800 on 6005. WMLK, Assemblies of Yahweh, Bethel, PA, kept delaying its debut from August to September to October, to . . . ? perhaps at 1700-1900 on 15110, 2200-2400 on 15250, 0400-0600 on 15160.

KCBI, at the Southern Baptist Criswell Bible Institute in Dallas, hoped to be on the air by November, but refused to give us its frequency schedule, saying it "does not depend on listener support." Beams toward Europe and Latin America are expected.

But the most grandiose plans are for NDXE, "In Dixie," transmitting from a high spot near Opelika, Alabama. Studios should be in Daytona Beach, and perhaps elsewhere. There would be lots of sports coverage, especially auto racing; and AM stereo applied to shortwave. In an interview with Jeff White of Radio Earth, NDXE claimed to have enough advertising committed to enable purchase of 500-kilowatt transmitters, even before the initial 100-kW unit was ready to go on the air. A March airdate was envisioned.

AFRTS made a number of changes for its winter schedule since our last column: 0900-1100 on 9590, 1100-0100 on 15430, 0100-0700 on 6030 toward Newfoundland. 0900-1100 on 9530, 1100-1700 on 15330, 1700-2300 on 15345, 2300-0700 on 11790 toward Europe. 0900-1300 on 6030, 1300-2200 on 15330, 2200-0700 on 6030, toward the Caribbean. 1000-1600 on 6140, 1600-2200 on 11805, 2200-0200 on 17765, 0200-0700 on 11730, toward the Far East. 1000-2100 on 9700 and 2100-0700 on 15335, also toward Far East. From Munich toward the Middle East, 0800-1100 on 15400, 1100-1400 on 15265. From Philippines to Southeast Asia, 0100-0245 and 0300-1400 on 21670, 1400-2100 on 11890, 2100-0100 on 9590.

If you're a movie buff, you'll love a midnight talk show on WCAU, 1210, Philadelphia, hosted by Steve Friedman, "Mr. Movie," Sunday mornings. He's often on Saturday and other mornings in addition. Despite encroachments by new stations on 1210, WCAU can still be heard widely in the eastern half of North America.

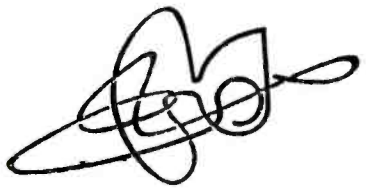
BELGISCHE RADIO EN TELEVISIE
(BRT)

ADRES/ADDRESS/DIRECCION

B R T

P.B. 26

B-1000 BRUSSEL (BELGIE)



KORTEGOLFPROGRAMMA'S

SHORTWAVE PROGRAMMES

PROGRAMAS EN ONDA CORTA

N° 32 30/09/84 - 31/12/84

Receiver shorts: Heathkit has re-entered the shortwave receiver market with the SW-7800. *Review of International Broadcasting's* Radio Equipment Forum editor, David Newkirk, points out that the new Kenwood TS-670 transceiver can also function as a general-coverage receiver with the addition of an optional module. Features include 80 memories, scanning, R.I.T., voice synthesis readout.

If you have trouble getting a correct impedance match with conventional gray patch cords from receiver to tape recorder, Radio Shack has come up with a nice solution: an attenuating patch cord with a built-in resistor. It's black with red moldings.

For a source list of additional reading about shortwave listening, send a self-addrressed stamped envelope, and enclose another stamp, to Glenn Hauser, Box 490756, Ft. Lauderdale, FL 33349. ME

PRODUCT EVALUATIONS . . .

The 8-mm Camcorder continued *(from page 18)*

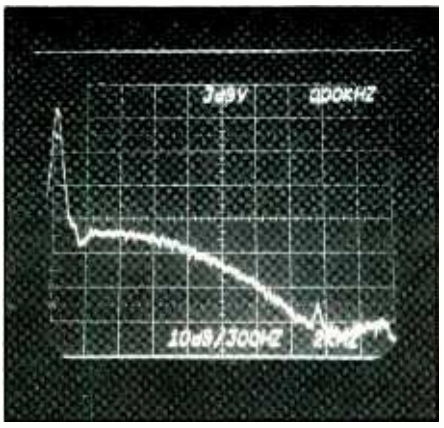


Fig. 4. Spectrum peak-detected audio response (r-f output, channel 3 input) is 14 dB down at 12 kHz.

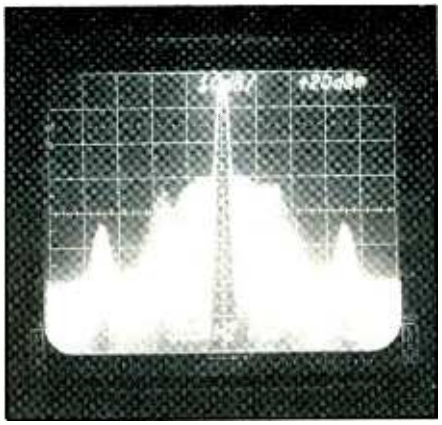


Fig. 5. Camera S/N begins at a comfortable 40 dB but trails off to 26 dB at 3.58 MHz.

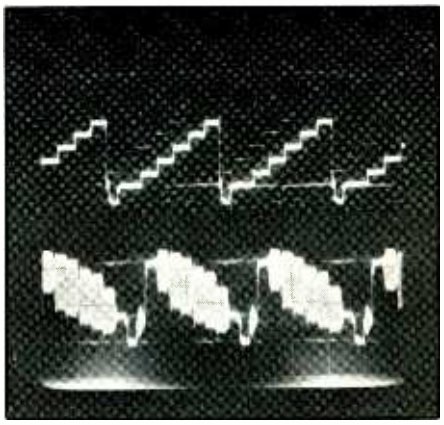


Fig. 6. Photo shows good staircase grey scale (top) and NTSC color bars (bottom) through cradle.

the viewfinder wasn't exactly exhilirating. So we connected the converter/charger for both r-f and baseband and set up the various test charts generously provided by WAPB channel 22 and Telemeasurements, Inc. With this arrangement, we found that not only could we play back through the RCA monitor, but we could also record a program off the air by focusing the camcorder on the screen of a TV receiver. It didn't produce the best picture possible, but it did prove that camera and broadcast sync are right on the money.

Test Results

Casual indoor and outdoor testing produced better-than-expected results. There was little or no lag, and colors were reasonable, while resolution and definition were fair. Sound from the omnidirectional capacitor microphone was surprisingly clean. Sensitivity of the mike was good enough to pick up bird songs and modulated room conversations fore and aft of the camera.

For qualitiative testing, the camera was attached to an indoor tripod in a location with appropriate "daylight" lighting and was aimed at precision broadcast-standard test cards. The results are illustrated by the double-exposures in Figs. 1 and 2.

In Fig. 1, are the results from a Tektronix radial-resolution diagram, resulting in camera reproduction of approximately 400 vertical lines. Beneath this is the Electronic Industries Association (EIA) logarithmic grey-scale that crosses satisfactorily in the center. The slight sag and amplitude loss in the lower portion of this pattern may be to flare and blackstretch (gamma) settings. Channels, however, have identical waveform and crossover points, which is most important, even though there may be slight differences between chroma and luminance.

In Fig. 2 is shown baseband horizontal multiburst resolution approaching a weak 3 MHz, but it's there. Below this is the oscilloscope version of Tektronix's chroma-evaluation diagram. A little noise jitter in the left-hand portion could be our slight magenta and lighter-blue shading, or it may be just processing recorder jitter. The latter is more likely, since multiburst suffers from more of the same. It's definitely not the result of wow or flutter.

Very clean video (on the left in Fig. 3) and audio carriers out of the converter/charger on channel 3 are illustrated. You can see that they're separated by precisely 4.5 MHz, as they should be. And since our analyzer's filter caused no reduction in carrier amplitude (and was only 300 Hz wide, anyway), its effect is negligible. Therefore, all we need to "subtract" from the apparent waveform is the routine 2.5 dB to correct for the analyzer's logarithmic amplifier and detector to accurately measure C/N (carrier-to-noise ratio).

Figure 4 illustrates the spectrum peak-detected audio response. At 2 kHz per division, this audio is down about 15 dB at 12 kHz but only 8 dB at 10 kHz. This is sufficient to capture bass and alto, and possibly a little colortura on occasion.

By using the cradle, we could measure camera S/N (signal-to-noise ratio) between approximately 1 and 3.5 MHz. Note that the S/N dropped from 40 to 26 dB at 3.58 MHz in Fig. 5. This isn't very significant, since it can't be seen, owing to the fact that it's beyond the camera's bandpass.

Finally, staircase (top) and color bars (bottom) register in Fig. 6 as

processed by camera playback in the cradle. They're all pretty linear, exhibiting just a little overshoot. This is probably due to the recorder's luminance processing.

User Comment

As a general comment, Kodak's Model 2400 is a very compact, responsive camera/recorder that provides reasonably good handling balance, good low-light-level response for indoors and out-of-doors recording, and competitive horizontal and vertical resolution. It also offers good color reproduction, responsive controls, satisfactory black-and-white viewfinder, good lens, and fairly quiet operation.

The small 1-ampere-hour battery that supplies power to the camcorder provides a reasonable operating time. If accompanied by a spare battery pack, there should be no reason why a Model 2400 owner can't capture almost an entire 2-to-3-hour session on tape.

Manual focus is very good throughout the 6:1 zoom range, and the see-through viewfinder indicators are a blessing. Only time will tell if heads and tapes will bear up over the long haul, but a great deal of experience went into their design, giving us reason to suspect that they will.

About the only things we would like to see added to later versions of the Model 2400 would be indicator lights that come on when the play, record and pause functions are activated, since we found that some controls require firm pressure to provide positive operation.

The converter/charger option provides r-f, video and audio inputs and outputs, as well as a battery charger. All worked nicely. In fact, r-f carrier-to-noise (C/N) signals with suppressed (vestigial) sideband for video and audio checked out quite good. This optional accessory is relatively inexpensive and, with the $39.95 VCR connector cable, will really do everything except record programs directly off the air.

The tuner/timer/cradle option has been carefully planned for those people who want the works. It's contained in two sturdy plastic boxes. In operation, vhf tuning was relatively easy to accomplish.

There are a couple of shortcomings with this option, though. For example, there are no function indicators to help the user to operate the device. Also, uhf tuning is rather difficult to accomplish, and tuning in cable channels may prove even rougher. As for tuner sensitivities, though they're about par for the type of channel selector used here, frequency synthesis and phase-locked-loop (PLL) tuning beats it by a nautical mile.

On the bottom line, the Model 2400 camcorder and its optional converter/charger accessory deserve at least an 8.5 of a possible 10 rating. Congratulations to Kodak for marketing a highly useful product. You can expect more video products out of Rochester (the home of Kodak) in the coming months, even though their origin may be in Matsuhita's or TDK's plants in Japan. **ME**

—Stan Prentiss

CIRCLE 70 ON FREE INFORMATION CARD

NEW PRODUCTS . . .

(from page 13)

tests. Values measured are read from a liquid-crystal display panel.

Among the standard features of this hand-held DMM are: a built-in tilt stand, automatic zeroing, automatic polarity indication, overload protection on all ranges, 500-volt ac/dc protection on all resistance ranges, recessed input probe jacks, and basic dc accuracy of 0.25% of reading. Full-scale ranges are 200 mV, 2 V, 20 V and 1000 V on dc; the same for ac, except that the highest range goes to a maximum of 750 V; 20 μA, 200 μA, 2 mA, 200 mA and 10 A for ac and dc; and 20, 200, 2 k, 20 k, 2 M and 20 M ohms. Available as options for the Model DM-8010 are: carrying case, ac current jaw adapter, high-voltage probe, and transistor/diode test adapter.

CIRCLE 159 ON FREE INFORMATION CARD

Disk-Drive Head Cleaner

Clean Runner is a new interactive cleaner for floppy-disk drive heads from Discwasher. It is designed to safely and efficiently clean drive heads of oxide build-up as well as other contaminants. Clean Runner uses a lint-free cleaning surface bonded to a programmed diskette. The exclusive software program on the diskette guides the user through a step-by-step cleaning procedure as it directs the drive heads to a different contamination-free track for each cleaning operation.

Clean Runner is a dry system. It uses no chemicals that can prove harmful in themselves or give off vapors harmful to the internal components of disk drives. The kit is programmed for 20 cleaning operations and works with both single- and double-sided drives. Cleaning takes less than 30 seconds to complete. $24.95.

CIRCLE 158 ON FREE INFORMATION CARD

by its immediate predecessors. Although the chroma demodulation vector seems rather good, all things considered, some 3.58-MHz chroma still leaks into the video channel, slightly affecting both color and luminance, and there's a little residual sync buzz in the audio.

It would be nice to have a good comb filter working in this set, instead of the usual LC bandpass-restrictive chroma trap, as well as a S/N of better than the minimum 35 dB. Of course, if Samsung had gone this route in the first place, this receiver might have had to cost another $100 or so, perhaps defeating its attractiveness to the consumer.

Ubiquitous Sony

They're everywhere! Assembled in San Diego in May of 1984, Sony's 26" Model KV-2670R emerges as a multifaceted receiver with an ingenious remote-control system, accompanied by better-than-average picture resolution and definition and a stereo adapter jack. Although not a true receiver/monitor, it does have a special channel 2-through-6 "Hit" input for video games and/or computers. The receiver is housed inside a 26½"W × 25⅛"H × 23"D handsome rosewood-color vinyl veneer on wood cabinet and weights a hefty 114 lbs. Suggested retail price is $945.95.

The receiver is built around a 110° Trinitron picture tube and features a 4⅜" × 2⅜" internal speaker. Under its front panel are controls for adjusting sharpness, brightness, color, hue (also known as tint), and for selecting normal or CATV input. Out in the open are picture up/down, volume up/down, channel up/down, and power controls, plus a light-sensor port and a sleep timer indicator.

Located on the rear of the receiver, you'll find a jack for multiplex TV sound output and a *single* vhf/uhf/CATV 75-ohm coaxial cable input for accessing all broadcast and cable channels 1 through 125.

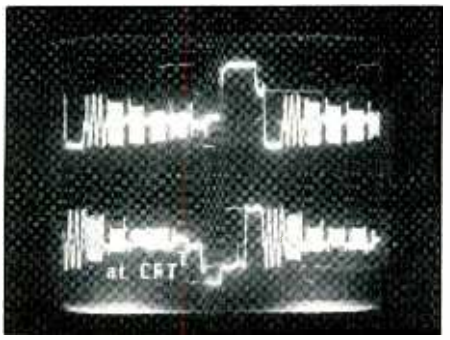
Internally, there's velocity modulation for sharper black-white transitions, dynamic "natural" color and focus, a comb filter, and a one-hour turn-off sleep timer. On-screen displays are provided for Hit, channel

Sony Model KV-2670R Laboratory Analysis

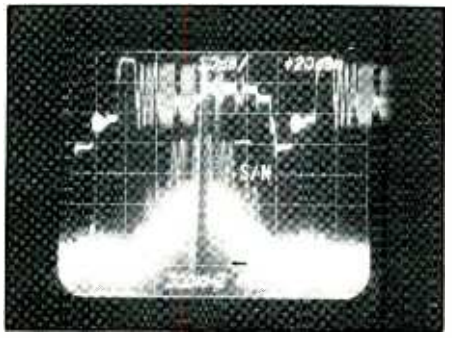
Ac power drain (100 to 130V ac; varies with video input)	102 watts			
Voltage regulation (with signal input)	source	100V	130V	%
	135V	119.5V	135.7V	88
	9.8V	8.5V	9.2V	92
	27.5kV	24.8kV	28.0kV	84
Tuner/system sensitivity				
vhf channel 3	−5 dBmV			
uhf channels 15 and 50	−4 and −2 dBmV			
Agc swing before picture change (−5 to +50 dB)	55 dB			
Luminance/chroma S/N (at CRT)	42/40 dB			
CRT temperature	9000° K			
Dc restoration	76%			
Horizontal overscan	15%			
Convergence	93%			
Maximum center CRT vertical resolution	448 lines			
Horizontal frequency response (at CRT)	≤4 MHz			
Audio response (out of speaker)	12 kHz at −10 dB			
MPX pure audio response	to 100 kHz at −8 dB			

Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Telequipment Models D66 and D67A oscilloscopes; B&K-Precision Models 1260 NTSC and 3020 function generators; Sencore Models VA48 video generator, PR57 Powerite power supply and CG169 color-bar generator; Data Precision Models 945, 1350 and 1750 multimeters; Sadelco Model FS-3D field-strength meter; Gossen Luna-Pro light meter.

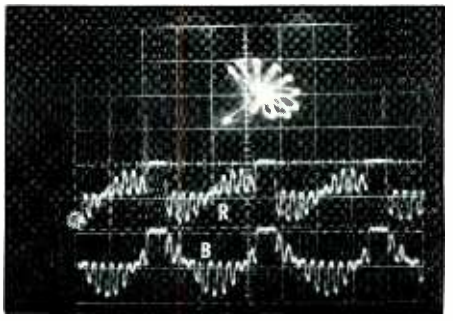
Sony



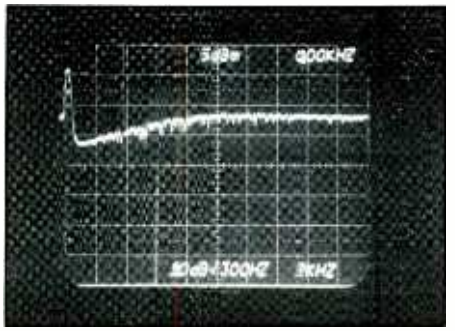
Multiburst showing bandwidths at video detector and CRT.



Best signal-to-noise ratio measured 42 dB in the laboratory.



Red and blue rainbow patterns from vector at quadrature.



Multiplex (MPX) output actually goes out to 100 kHz.

numbers, picture, and volume. The display begins as large numerals that gradually diminish and remain small until turned off by the remote-control transmitter.

The slim 6¾"L × 1⅜"W infrared remote-control transmitter has 21 buttons that control power, audio muting, the sleep function, direct channel address and enter display, picture, sound, and up/down channel scanning. With the adoption of phase-locked-loop (PLL) quartz accuracy and frequency-synthesis tuning, Sony has made channel programming both easy and convenient.

User Comment. You'll like the big 26" screen, relatively compact cabinet, and outstanding appearance of this TV receiver. Picture and sound quality are very adequate, operation of the remote-control system is flawless, S/N ratios are excellent, and tuner sensitivity is good. However, convergence could be improved, power supply regulation needs work, the 15% overscan needs attention, and the 76% dc restoration is said to result from a video-changing selective black level circuit. For service, we suggest the Sony factory center.

Zenith's Smart Set

In still the most popular screen size, Zenith's 19" Model SA1977PT receiver/monitor appears in a smartly styled, brushed-aluminum finish on pressed wood cabinet. It offers a pair of forward-tilted, side-mounted 6½" oval speakers, a picture tube with removable tinted glass front cover, and a 29-function dual TV/VCR infrared remote-control system.

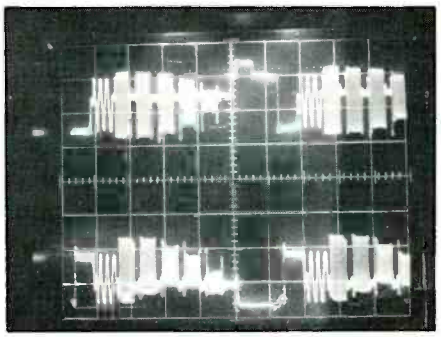
This Smart Set offers good colors, automatic CRT tracking, and exceptional electron beam focusing. With proper test equipment, 442 lines of vertical resolution is easily measured, and a high-resolution frequency check reveals that video response at baseband amounts to exactly 4.48 MHz, as seen with an 8-digit, 250-MHz frequency counter.

Zenith Model SA1977PT Laboratory Analysis

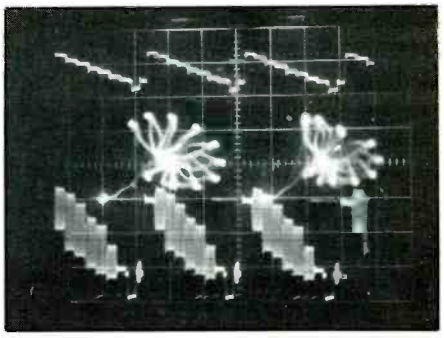
Ac power drain (100 to 130V ac; varies with video input)	116 watts average			
Voltage regulation (with signal input)	source	100V	130V	%
	12V	12.6V	12.7V	99.2
	58V	56V	58V	96.5
	26kV	25.8kV	26.6kV	96.9
Tuner/system sensitivity				
vhf channels 3 and 8	−1 and −6 dBmV			
uhf channels 15 and 50	0 and +4 dBmV			
Agc swing (−6 to +55 dB)	61 dB			
Luminance/chroma S/N (at CRT)	43 dB			
CRT temperature	8200° K			
Dc restoration	81%			
Horizontal overscan	12%			
Convergence	99.5%			
Maximum center CRT vertical resolution	432 lines			
Barrelling/pincushioning/flagwaving	slight pincushioning			
Horizontal resolution				
r-f input	4.2 MHz			
video input	4.48 MHz			
Audio response through speaker at baseband	11 kHz at −11 dB			
	10 kHz at −6 dB			

Test equipment: Tektronix Models 7L5 and 7L12 spectrum analyzers; Telequipment Model D66 (modified) and Hameg Model 605 oscilloscopes; B&K-Precision Model 1260 NTSC color-bar generator, Model 3020 function generator, and Model 1653 variac power supply; Data Precision Models 245, 1350 and 1750 multimeters and Model 585 frequency counter; Sencore Model VA48 (modified) video generator and Model CG169 color-bar generator; Sadelco Model FS-3D VU field-strength meter; Gossen Luna-Pro light meter.

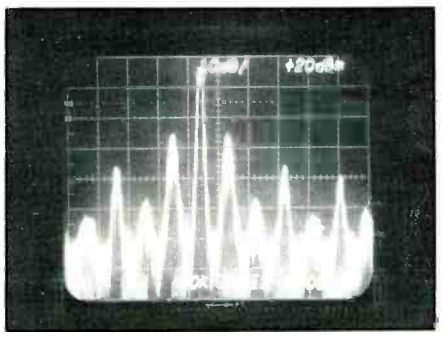
Zenith



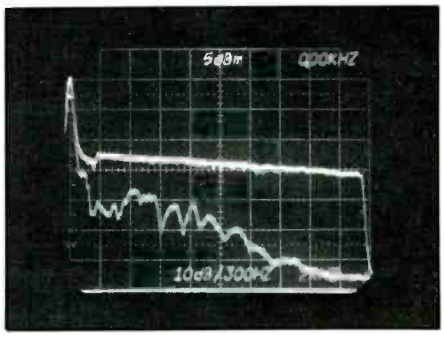
Excellent 4.2-MHz multiburst at the audio detector and CRT.



Passable staircase, good NTSC color bars, rather poor vectors.



S/N was good, measuring 43 dB, as shown in this analyzer photo.



Audio is out to 20 kHz at baseband (top), to 11 kHz at speakers.

Couple this set's good parameters, coupled with a 178-channel vhf/uhf/CATV tuner (with excellent PLL and quartz-accurate tuning, including broad cable capture afc), give you an idea of the potential of this receiver. Among its advanced features are a comb filter (PRP in Zenith parlance), 30-times-per-second advanced color sentry strobing, automatic monitoring of color and color threshold, chroma blending, tint stabilizer, and color saturation prevention.

A video filter reduces picture noise (snow), and picture control maintains color level and tint with manual brightness (black-level) adjustments. There are also the advantages of automatic fringe lock for weak signals and minimal aircraft flutter, a magic-touch smooth membrane (capacitive-action) keyboard on the receiver for local command entry, and an extremely responsive remote-control system designed for both VCRs and this particular group of TV receivers.

The receiver measures 20½"W × 17⅝"H × 14¾"D. It carries a suggested retail price of $649.95.

More Features. Designated by Zenith as the "A" line for the 1984-1985 model year, this set will also serve adequately as a monitor for video and audio inputs and outputs, as well as for powering a pair of external speakers. Even though it has a switchable video filter for games, computers and certain displays, unstable sync from these sources may sometimes cause jitter, which is by no means the fault of the receiver.

On the rear of the chassis are a rediplug and stereo adapter jacks for TV multichannel sound, teletext, selectable cable TV decoders, and an optional four-antenna switch for multiple inputs.

Up front, you'll find the usual normal, remote and CATV selector switches and color, tint, sharpness, black-level, color-sentry, video/auxiliary, and tone controls. These are normally hidden behind a panel. With this panel closed, only the remote-port amplifier and ambient light sensor are exposed, enclosed in a small rectangle of dark plastic.

On the remote-control transmitter are buttons for TV stereo, power, audio mute, TV/VCR select, parental channel lockout, instant recall of previously selected channel, volume and channel up/down scan keys, enter recall, antenna select, and the usual 10-key direct-entry keypad for random channel access. Additionally, for VCRs, there are play, record, rewind, fast-forward, stop, pause, and reverse/forward controls.

User Comment. Considering that this Smart Set retails for just $650, we'd call it a bargain for regular TV, cable and ordinary video and audio from sources like VCRs but not necessarily for the general run of computers. We are not happy with the way the color sentry automatic control fouls up the vector pattern. But the excellent 110° picture tube, good voltage regulation, fully modular chassis with five printed-circuit boards and pluggable ICs for serviceability, and worthwhile contrast, color (in the non-color sentry mode), and brightness merit a "well done!"

ME

programs tell ADAM to "think" of random locations for the colored squares and stripes painted on the screen. Here's a program that gives *you* some control over the pattern on Adam's screen:

```
10 GR
20 COLOR = INT(RND(1)*16)
30 x = PDL(1)/6.4
40 y = PDL(3)/6.4
50 HLIN 0,39 AT x
60 VLIN 0,39 AT y
70 GOTO 20
```

This program produces patterns resembling colorfully striped corners and intersections. At any instant, one vertical and one horizontal stripe switch to randomly selected colors (see line 20). Moving the handle of the game controller causes new stripes to be painted on the screen.

You can create visually striking patterns by moving the handle in various directions. To freeze the display, allow the controller's handle to return to its center (neutral) position.

How does "Paddle Plaid" work? Lines 30 and 40 permit the hand controller to control the position of what's painted on ADAM's screen. PDL(1) and PDL(3) tell ADAM to retrieve the status (a number from 0 to 255) of the leftmost controller. Since the low-resolution screen is divided into a grid of 40 × 40 units, it's necessary to divide 256 by 40 to get the paddle correction factor of 6.4.

Rainbow Scribbler. This program emulates the popular "Etch-A-Sketch" toy. It allows you to move a continuous stream of randomly colored boxes anywhere on ADAM's screen. Here's the listing.

```
20 COLOR = INT(RND(1)*16)
30 x = PDL(1)/6.4
40 y = PDL(3)/6.4
50 PLOT x, y
60 GOTO 20
```

As you can see, this program is a modification of "Paddle Plaid." Lines 50 and 60 of "Paddle Plaid" have been replaced by the single PLOT statement in Line 50. This causes ADAM to place randomly colored boxes (see line 20) at the x-y coordinates determined by the paddle's controller.

Turtles +

BASIC isn't the only computer language available for use with the ADAM computer. A neat version of Logo, called "SmartLOGO," is also in ADAM's software library. The $79 data pack comes with a professional-like 300-page manual that's packaged in a traditional three-ring documentation binder. Moreover, paper quality is tops, as is typography and colorful illustrations. More importantly, it is written with unusual clarity.

As many know, Logo was developed from the bowels of the artificial-intelligence language, LISP. It's an easier language to handle than the research-oriented LISP, though. Its "turtle graphics," which was originally a robot-like turtle device attached to a computer (by a cable) that could be preprogrammed to move about, proved to be an appealing learning tool.

SmartLOGO's data pack has an "Exploring SmartLOGO" tutorial that provides computer-assisted instruction on all SmartLOGO commands, as well as a series of graphics demonstrations. It guides the user through the use of 30 different Turtles of various shapes, sizes, and colors, and illustrates how to move them across the video screen.

The manual is divided into two sections: a primer ("Turtle Talk") and a more advanced part ("Logo Reference Manual"). The first section gently guides even the youngest user through the wonderful world of Turtle Graphics, describing in simple detail the one-word program commands demonstrated in the tutorial. Then the text shows one how to write single-word command procedures, small subroutines composed of primitive commands that can be accessed much like a "COM" or "CMD" file in the CP/M or MS-DOS operating systems.

Armed with the foregoing knowledge, the manual shows you how to generate sophisticated shapes under cursor control and graphics rivaling the best of "Etch-a-Sketch" devices. Circles, squares, spirals, multicolor bursts and Moire patterns fill the screen. Add color, setshape, and speed, and you can now animate the 30 different Turtle shapes in 16 different colors.

Going this far, the user is primed to travel through the Reference section of the manual, where virtually every page has a sample program. This includes procedures for creating and editing, sound generation, predefined Turtle character (shape) sets—stars, dogs, flowers, trucks, rockets, etc.—and how to create and control up to 30 of them at one time. Furthermore, there are also chapters on text generation and manipulation, mathematical operations, commands and conditional operations, and interfacing the Turtles to your game controllers and keyboard.

SmartLOGO doesn't take a backseat to other Logo versions written for more costly computers. In fact, surprise of surprises, it's a definite leader. Adam's Logo has more of everything, it seems. More colors, more turtles, more different shapes. Moreover, it can be set to perform at a constant speed, and operates very fast. Of course, using tape slows up work. Coleco will doubtlessly come up with a disk version for its new drive (which, parenthetically, works beautifully, with an excellent Disk Manager operating system disk that makes full use of the ADAM's function keys). Now if there was only an alternate dot-matrix printer with graphics that could take a screen dump of SmartLOGO's magnificent outpourings . . . .

Concluding, should a user tire of the "business" end of programming with SmartBASIC, SmartLOGO can be a welcome change. It's an especially appealing language whose great graphics and sound capabilities can make the creative juices flow. Simple enough for a child to learn, yet challenging for even an experienced programmer, SmartLOGO is a "must" buy for owners of an ADAM.

—Charles Rubenstein.

Rainbow Tunnels. This program tells ADAM to draw a changing pattern of lines across the screen using all 16 available colors. The visual impression is as if ADAM's screen is displaying what a television camera might see as its enters a multi-colored, square-sided tunnel.

```
10 REM Rainbow Tunnels
20 REM Eric Ryan Mims 1984
30 GR
40 t = 0
50 IF t = 8 THEN GOTO 150
60 FOR h = 15 TO 0 STEP -1
70 COLOR = h
80 HLIN 0, 39 AT h + 24
90 HLIN 0, 39 AT h + 5
100 VLIN 0, 39 AT h
110 VLIN 0, 39 AT 39 - h
120 NEXT h
130 t = t + 1
140 GOTO 50
145 REM Beep When Done
150 PRINT CHR$(7)
160 END
```

Readers who are experienced users of BASIC can have a lot of fun with this program. First, you can change the order the colors are drawn by changing line 60 to:

```
60 FOR h = 0 to 15
```

This causes the colors to appear in the opposite order then they did in the first program. Also, notice the "AT h . . ." in lines 80 through 110. By changing the numbers added to or subtracted from "h," you can make major changes to the moving patterns displayed on the screen. Finally, you can increase the time the patterns are displayed by increasing value of "t" in line 50.

As you can see, ADAM can produce some strikingly colorful effects with exceptionally simple programs.

ADAM's graphics can be even more spectacular when the computer is operated in its high-resolution mode. For example, the following full graphics screen program produces some interesting results:

```
10 REM Pinwheel
20 REM Eric Ryan Mims 1984
30 HGR2
40 COLOR = 3
50 FOR y = 0 to 191 step 2
60 HPLOT 128, 96 TO 255, y: NEXT
70 FOR x = 255 TO 0, STEP -2
80 HPLOT 128, 96 TO x, 191: NEXT
90 FOR a = 191 to 0 STEP -2
100 HPLOT 128, 96 TO 0, a: NEXT
110 FOR b = 0 TO 255 STEP 2
120 HPLOT 128, 96 TO b, 0: NEXT
130 END
```

Note that after this program is run, you will not be able to see any text on the screen. To return to text mode, you must first blind-type "TEXT." This will clear the screen and you will be able to enter text.

Again, for readers who are into programming, try changing the color in line 40 from "3" to another of the 15 colors available. Also, notice the "STEP" after the "FOR" commands. You might want to try changing the step value to some larger or smaller number. If the step number is positive, keep your changes positive. The same goes for negative numbers.

We conclude that ADAM graphics are splendid enough to encourage a user to let his or her creative juices run hog wild. **ME**

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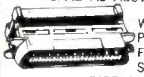

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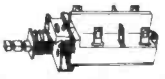

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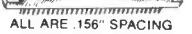

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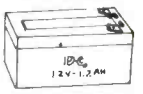

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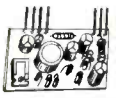

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Color From A Monochrome CRT

(from page 45)

light, a two-primary field sequential color display can be produced.

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A limitation is a somewhat restricted viewing angle, which makes it most suitable for use by just one or two viewers.

Another interesting technique similar to this is the liquid-crystal light valve. This is actually an optical projection system for the production of large, high-resolution color displays. These types of systems converge the output from several single-color projection displays and a light valve is used to provide sufficient brightness.

There's no doubt, therefore, that a lot of new action is taking place in developing color displays. **ME**

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(from page 61)

ing *IC1* and *IC2*. Capacitor *C2* can be mounted on either side of the board, depending on accessibility needs.

If you wish to make Timebase II into a test fixture, you'll want to use toggle switches for *S1* through *S4*. If you go this route, wire the inputs and outputs to banana jacks.

Test & Calibration

Before testing Timebase I, a program for RST, EN and DIV should be decided upon and the appropriate jumpers installed (or the appropriate switches set). This done, connect a 5-volt power supply to the +5 and GND and an input signal of known frequency to the CLK IN terminals on the board. The signal source can have any wave shape, though the circuit is designed primarily for the sinusoids prevalent in commercial ac power systems.

Observe the CLK OUT terminals with an oscilloscope or frequency counter to check for the proper frequency. Since the frequency output from this circuit is a direct function of the input frequency and the specific IC used, there are no adjustments to be made. Any discrepancy observed is the result of using the incorrect number RED IC, an error in programming the jumpers, or both.

With Timebase II, a similar division program should be selected and implemented prior to test and calibration. Once this is done, connect a 5-volt power supply to the +5 and GND terminals on the pc board. The output of Timebase II can be observed at four different points: At CKO1 is the fundamental frequency of the crystal. At BO1 is the buffered output after *IC1*. At CKO2 is the same frequency as at BO1, except that it is not buffered. Finally, the buffered output after both divide stages is available at BO2.

Because other outputs are a function of the frequency at CLO1, precise adjustment of *C2* is mandatory. For added stability, you might also consider using a standard crystal oven for *XTAL1*. **ME**

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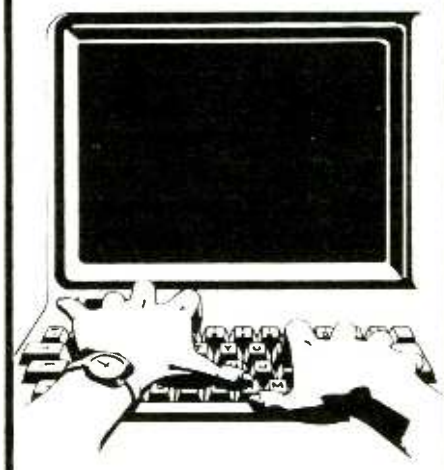

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