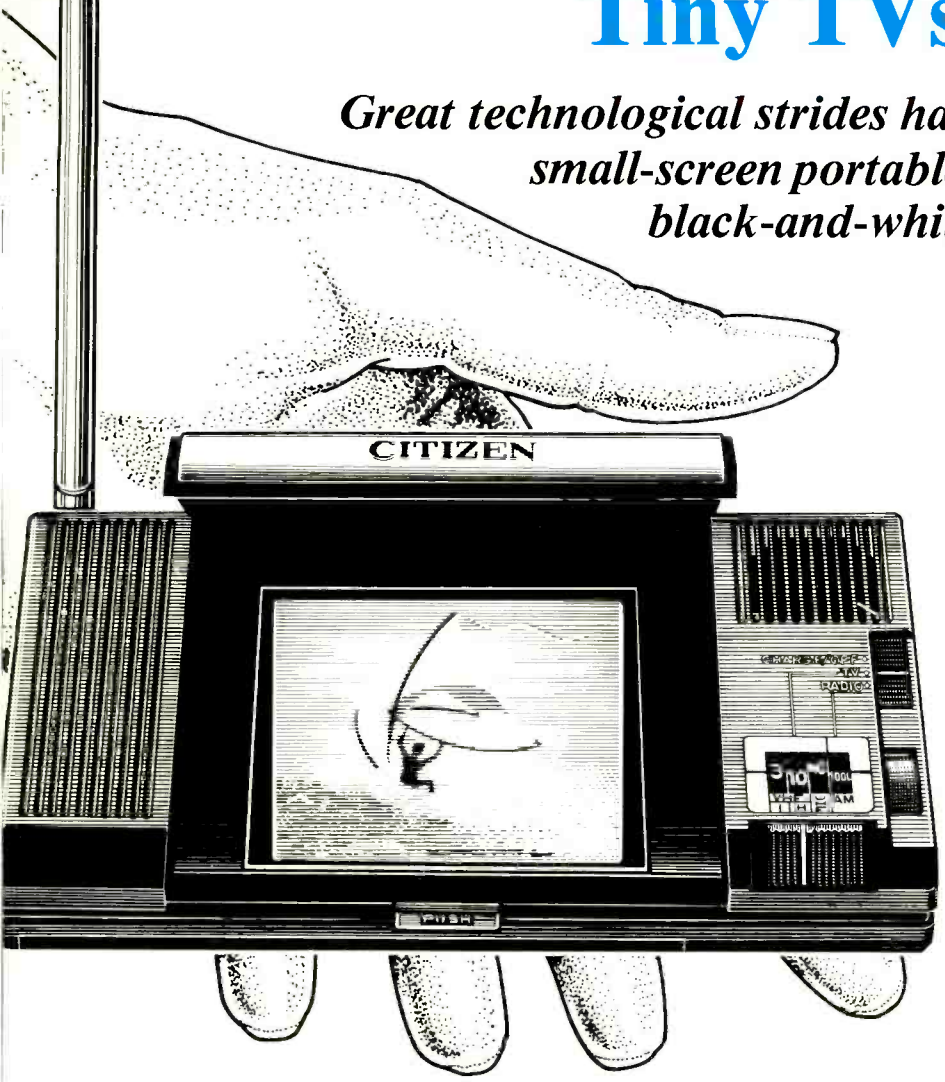
Tiny TVs

Great technological strides have been made in small-screen portable TV sets, both black-and-white and color



By Fred Blechman

Portable, tiny-screen TV receivers are increasingly popular. To underscore this, a bevy of manufacturers now market these Lilliputian TVs, sometimes called pocket TVs. Achieving diminutive size, low battery-power drain, and good-quality performance are technological hurdles that are still challenges.

For some background on these wonder products, Sony, which carved out its initial mark in the U.S. with small transistor radios, entered the micro TV market about three years ago with its 2″-screen Watchman. This originally sold for about $300, but now the earlier models sometimes are available at sell-out for about $100. Current models, with better battery life (about 4 hours) sell for $180-$240.

Sinclair Research, however, beat them to the punch by many years when it launched its Microvision 2″-screen TV in January 1977. It was larger than pocket-size, unless you had exceptionally large pockets, and also sold for $300. It was eventually discontinued, perhaps to make way for its flat-screen pocket TV that was being developed, but was a long time coming. Like most portables, Microvision battery life was limited to about two hours before recharging or replacement was necessary.

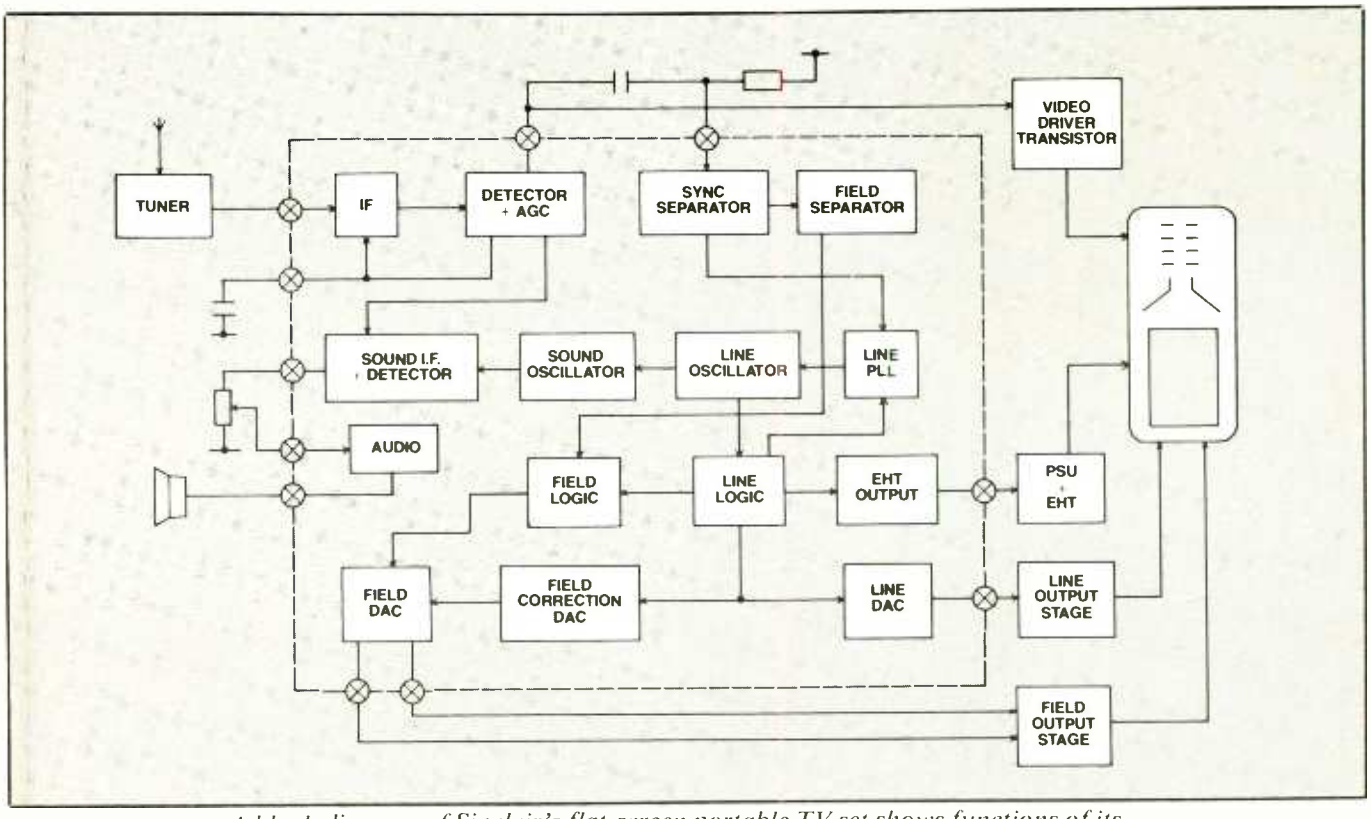
Sinclair's 2″ Flat-Screen Pocket Television, introduced September 1983 in England, has finally hit the American shores. It's the result of a six-year, $6-million development program, and is the first TV set ever to incorporate almost all its circuitry on a single chip. We'll examine this product more closely later in this article with a hands-on report.

Sinclair's 2" TV

Panasonic currently has four micro TVs with 1.5″ screens, selling for $200 and up. They are much too large to be called "pocket-size," their screens need magnifiers for effective viewing, and they gobble up batteries. The $470 CT-101 was the first color TV with this small size.

Up to this point, these micro-sized TVs offered CRT (cathode ray tube) screens only, and only in black and white (except for Panasonic CT-101). The conventional CRT offers a sharp picture but uses a lot of energy.

Now, Casio, Citizen, Epson, Radio Shack, Seiko and Zenith pocket TVs have appeared in the marketplace with LCD (liquid crystal display) screens in the 2″ range, both in color and black and white. The Radio Shack units appear to be private-label versions by Casio and Citizen. While LCD technology offers significant energy saving, the display has inherently low resolution and poor contrast compared to a CRT. (Table 1 gives addresses of the various manufacturers cited.)



A block diagram of Sinclair's flat-screen portable TV set shows functions of its single-chip circuit (dotted lines) and associated components.

Sinclair's American version of its 2" black-and-white flat-screen TV set is designated the FTV2A. It is currently selling for $100 in the U.S., but only to American Express Card holders at this time. Sinclair hopes to widen its marketing thrust, but since Sinclair Research Limited, UK, is presently in financial difficulty, the future of its flat-screen TV, is cloudy right now. The technology behind it and its performance is important nonetheless.

The FTV2A is housed in a black plastic case and measures just 5½" × 3¼" × 1¼". It weighs only about 10 ounces, including the battery. The 2" diagonal screen is recessed behind a magnifying Fresnel lens, and can be viewed easily from about 30-degrees left or right of center. A protective vinyl carrying case is included with the $100 unit.

A swing-out panel on the back of the TV case acts as an easel to provide comfortable desk-top viewing from one or two feet away. The TV's telescoping antenna is stored along the top of the FTV2A, but can be extended to 16½" and swung around for the best signal reception. Surprisingly, there is no external antenna input, and no direct video-input jack.

The Sinclair TV is very simple to operate since there are only three controls: an on-off/volume knob, a tuning knob and a TV band switch.

The band switch selects either low-band VHF (Channels 2-6), hi-band VHF (Channels 7-13) or UHF (Channels 14-83). A slide-indicator dial has markings in red (white would have been much easier to read!), giving only the upper and lower limits of each band.

One of the key design elements in the new TV model is Sinclair's revolutionary flat-screen CRT, which provides high brightness with little power consumption, and eliminates most of the depth exhibited by a conventional CRT. The screen is recessed to enhance brightness and contrast. (See Sidebar for details.)

Another key design element is the single integrated circuit designed by Sinclair Research and Ferranti Limited. This IC uses innovative digital techniques that automatically monitor video and audio inputs and adjust the receiver circuitry for local broadcast standards. Special features of the IC include sound selectivity, video innovations to eliminate image problems in UHF channels, and an advanced synthesized scan generator to control the complex waveforms needed to scan the flat CRT. It runs a check 50 times per second to ensure picture "hold." Because of these features, the common user-adjusted controls for horizontal hold, vertical hold, brightness and contrast are not included. (See another Sidebar for more IC details.)

Sinclair's flat-screen portable TV.

Sinclair has also designed an especially sensitive tuner. Moreover, it's unusually small, measuring just 31 × 23 × 11 mm. It uses advanced surface-mounting technology for its microminiature components.

A very small speaker is built into the case, but much better sound is available from a standard miniature monophonic earphone jack on the right side. A small 8-ohm earphone is supplied with the unit for private listening. I found no problem in using one of the popular miniature-plug stereo headsets with the FTV2A, although only one "side" was active.

Volume is controlled by the knob of the on/off switch. You roll the knob down to increase the volume, up to decrease it. This seems backwards to me, since most equipment uses "up" for "more."

Power

The FTC2A provides surprisingly high-quality video reception with very low power consumption. The average current drawn is only 80 milliamperes at 6 volts, or about ½ watt! A special Polaroid P500 Lithium Power Pack flat battery provides 15 hours of viewing, far more than its nearest competitor. The 3½" × 3" battery is 3/16" thick, and simply slides into a slot at the rear of the TV.

An alternate battery made by Polaroid is the P100, available at some hobby shops, for anywhere from $3.50 to $5 each. This is a zinc-manganese-dioxide battery with far less capacity than the P500, and will run the FTV2A for only about 2 hours. Therefore, the P500 is a much better choice, for which Sinclair charges $9.95 for three. Polaroid's retail price is $5, in contrast.

Better yet, I discovered a "free" battery source if you use Polariod 600 film. If you don't throw away the film packs after exposing the film, you can remove the battery from the film pack and get a powerful 6-volt, slightly-smaller version of the Polaroid P100 battery. Although the contacts are not in exactly the same place, I had no trouble at all in sliding this "used" battery into position, finding that it would run the FTV2A for more than an hour!

For nonportable desktop use, the FTV2A has a power-input jack on the side. Although the instructions that come with the set identify this jack, there is no information about polarity or voltage requirements. Furthermore, the jack is a rare coaxial-pin type, much smaller than the ones commonly used on cassette recorders. This is the U.S. model?

Obviously, 6 volts is required, since that's the voltage marked on the battery. Finding the mating plug and polarity was another story. I made my own coaxial plug from some brass and plastic tubing, and discovered that the plug tip required negative polarity. Using this home-brew plug and a nonregulated 6-volt ac-to-dc adapter, I had to add a 33-ohm resistor in series to control the voltage.

After all this trouble, I thought to contact Sinclair about the availability of an adapter from them. They don't offer one in the U.S. (the English adapter uses 220 volts input), but they suggested to me a Radio Shack #273-1650 "Universal ac-to-dc adapter" ($11.95). This adapter is switch-settable to supply various voltages and includes six different plugs. The design allows for plug polarity to be either tip-positive or tip-negative. One of the six plugs mates with the FTV2A power socket. I set the switch to 6 volts, installed the mating plug with tip-negative, and it worked like a charm!

Hands-On Testing

The real test of the FTV2A, of course, is how well it works. I'm located in a semi-fringe TV area of Southern California, with hills between me and the transmitters on Mount Wilson. Using an outside above-roof antenna, I can receive all the local channels reasonably well, but portable TVs on rabbit ears don't perform satisfactorily. I don't pay much attention to this since, I have cable TV and get a great picture on all

the cable-connected sets. Some of my non-cable neighbors have put up 30-ft.-high antennas, however, to capture better signals.

Therefore, it was amazing to see the FTV2A bring in *all* the local channels! On the VHF 2-6 band, it was sometimes necessary to move the set a few feet to another location or to reorient the whip antenna to improve the picture from poor to excellent. But this would be expected even in better reception areas than I have.

Tuning involves setting the range switch and rolling the tuning knob with your thumb—up to increase, down to decrease—just as it should be. The limit markings on the slide-indicator dial were the only guide, and they were not accurate. No problem, however, since the tuning range was broad enough to capture all the channels. Once captured, the signal is locked in, and you only need to fine-tune for the best sound.

I was particularly pleased with the picture quality on a good signal. One of the local UHF channels broadcasts stockmarket quotes on three crawling lines at the bottom of the screen. Even though this was on a UHF channel (usually weaker than VHF at this location), I was able to read all the stock quotes on the FTV2A screen! Also, all but the smallest text in commercials was easily readable.

As a matter of fact, it appears that UHF sensitivity of this set is better than its VHF sensitivity. The American version has had VHF tuning capability added. In the English unit, only UHF channels 21-69 are used since those are the frequency limits of most European TV transmissions.

The contrast and brightness in normal or subdued lighting was excellent. Of course, the picture washed out in direct sunlight, as with any CRT. But outdoor viewing in a shaded area was acceptable.

Video Monitor/Computer Use

I was curious about whether or not the FTV2A could be used as a video or computer monitor. Since there is no video input connector, this meant that an r-f modulator was required to feed the signal to the FTV2A antenna. For some strange reason, the FTV2A doesn't operate properly with the typical Channel 2/3/4 r-f modulators used in most American microcomputers. It did not provide anything approaching a clear signal from either a Timex Sinclair 1000 or a Timex Sinclair 2068 operating on either Channel 2 or 3. Possibly, this

Single-Chip Television

The first TV to use a single chip for most of its circuitry requirements, the new Sinclair flat-screen TV contains a single LSI integrated circuit (IC) to perform the majority of signal-processing.

Designed by Sinclair Research and produced by Ferranti Limited (using its FAB2 CD1 process), it is a complex linear/digital circuit with a number of original advanced features that are subjects of patent application.

The chip's principal function is to take the i-f output from the tuner, recover the video and sound signals, and feed them to the cathode-ray tube (CRT) and speaker, respectively. Additionally, information is extracted from the video signal to synchronize a multi-standard line- and field-scan system, which generates signals that enable correct picture display on the CRT. The system synthesizes scan waveforms digitally and accounts for the majority of the IC's logic.

Among the IC's principal innovations are:

1. Multi-standard capability: The Sinclair system caters to all 625-line systems (with an FM intercarrier frequency of 6.0 or 5.5 MHz) and the 525-line system.

A digital countdown circuit is employed that uses a high-frequency VCO locked to a multiple of received line sync pulses. Slaved from the line oscillaor, an identical VCO provides a local oscillator for the sound channel.

Timing components are contained on the IC, and VCO center frequency is derived from a single external resistor. The VCO is counted down to field rate, and on-chip logic determines reception of a 625- or 525-line signal, adjusting count number and VCO center frequency accordingly. Additional logic improves the noise immunity of line and field lock.

2. Synthesized scan generator: To display an orthogonal picture on the flat CRT, the field scan must be modulated by a correction wafeform at line rate. Both correction signal and field sweeps are generated digitally using digital-to-analog converters (DAC). Inputs are derived from the countdown system.

The use of DACs eliminated the need for set-up components and adjustments in generating the complex waveform. A further DAC generates a control signal for the line-scan output stage.

3. Video: The vision i-f signal emerges from the tuner at the unusually high frequency of 230 MHz—chosen to eliminate image problems in the UHF band.

After amplification in a 4-state agc-controlled amplifier, the signal is fed to a novel low-level envelope detector, with the recovered video going to a dc restorer for synce separation and an external amplifier to drive the CRT.

4. Sound Channel: An intercarrier sound signal, retrieved from the detector, is fed via a high-pass filter and converted to a 250-kHz i-f. Subsequently, it is passed through an ac-coupled limiting amplifier to a product detector for sound recovery.

All coupling, decoupling and phase-shift network components are integrated on the chip, providing integrated sound selectivity. The sound local-oscillator frequency is set to 5.75 MHz for 625 lines and 4.75 MHz for 525 lines, allowing demodulation of 4.5-MHz, 5.5 MHz and 6.0-MHz intercarrier sound without external switching. The audio signal is fed via the volume control to an on-chip audio amplifier.

was due to r-f interference from the computers themselves. I was, however, able to get a fine picture from the Channel 3 r-f outputs of a video recorder and a video camera.

I then switched to a UHF modulator that generates a signal on Channel 14. I connected the video output of the Timex Sinclair 2068 to the video input of the UHF modulator. The result was a nearly perfect, readable picture on the FTV2A tuned to Channel 14. Similarly, the video output of my Sanyo MBC555 was fed to the UHF modulator and produced a fine picture on the FTV2A, although 80-column text—as you would expect—was unreadable. Forty-column text was fine, though.

From the foregoing, then, the FTV2A can be used as a VCR or video camera monitor if a VHF or UHF modulator is used, and computer signals seem to work only through a UHF modulator, though with the latter it performs splendidly.

Comparisons

To compare the Sinclair Pocket TV with another tiny TV set, I bought a Citizen LC-TV Model 03TA-OA LCD Pocket Television/AM Receiver at a local store that was selling it for $99 instead of the regular $200 price. Apparently a new model is now available in the marketplace.

The snazzy-looking black-and-silver Citizen 03TA has a lot going for it. It is smaller than the Sinclair (3″ × 5¼″, but only 1⁵⁄₁₆″ thick!), it has a built-in AM radio, video input jack, and external-antenna jack. It uses standard batteries (4 AAA alkaline for 10 hours use), and a rechargeable battery pack is available. It comes with an earphone, external antenna wire, and external power supply. Coincidentally, the power supply has the same power plug, voltage and polarity as the Sinclair, which operates the Sinclair FTV2A perfectly!

The display technology of the Citizen, however, is LCD, which results in comparatively low image resolution. Unlike a black-and-white CRT, which has a continuous phosphor coating, and therefore resolution that's limited mainly by the electronics, an LCD screen has a defined number of "pixels" (picture elements). In the case of the Citizen 03TA, the pixel count is 148 across by 122 high. For comparison, a Timex Sinclair 1000 (and many other medium-resolution microcomputers) produce a picture with a resolution of 256 pixels across by 192 high.

Another severe disadvantage of the LCD display is that it requires external light since no light is generated (and that's why it uses so little power). This is great in sunlight, but not very good in poorer lighting conditions. A special backlight is required for dim-light viewing.

The Citizen 03TA is no slouch, though. Tuning is easy. Set a three-position band switch and move the power switch to TV (or Radio). The panel markings are much clearer and more accurate than the Sinclair unit's, and the built-in speaker

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The Sinclair Flat-Screen CRT

The Sinclair flat-screen CRT tube measures 4¼″ × 1¾″ × ¾″. It is three times brighter than a conventional CRT with the same-size screen, yet requires only one-quarter to one-tenth the power and occupies half the space.

Developed by Sinclair Research and implemented by its subcontractor, Timex in Dundee (Scotland), this CRT is designed for automatic, low-cost, high volume manufacture. A major technical breakthrough has been the perfection of a new method of vacuum forming of glassware.

The tube itself is assembled from just two sheets of glass: a flat front plate and a vacuum-formed backing plate. The phosphor screen is coated on the interior of the backing plate and is viewed through the front face from the same side that the electrons strike. As a result, the brightness is up to three times that of a conventional CRT with the same beam energy.

The electron gun is set to one side of the screen, with its axis parallel to the screen. Two sets of electrostatic deflection plates in the gun assembly provide horizontal and vertical scanning, and a third set between the phosphor screen and front face bends the electron beam toward the screen.

Without this additional focusing field, the angle of beam incidence would vary across the screen, spreading the beam spot into an ellipse. The focusing electrode is formed on the front face by a transparent tin-oxide coating.

If uncorrected, folding the electron optics would distort the raster scan, producing a keystone-shaped frame in which the vertical edges are curved and the horizontal edges form the side of a trapezium. Both electronic and optical techniques are used to correct for this distortion.

First, the screen height is reduced by two-thirds, but the width is kept constant. This narrows the angle subtended by the electron beam onto the screen, reducing both the distortion and the deflection power. The picture height is restored optically by means of a Fresnel lens, which can be inexpensively formed in a flat plastic faceplate. Trapezium distortion is eliminated by applying correcting modulation to the vertical plates.

The tube assembly lends itself to low-cost mass production and has significantly fewer components than a conventional CRT. Connections to the electron gun and deflection assembly are screen-printed onto the faceplate, and the assembly is attached in a single operation by a conductive frit.

The cooling problems to prevent phosphor damage are severe in a conventional tube, but since with the Sinclair CRT the image is viewed from the side of the phosphor that the electrons strike, the other side of the screen can be connected to a heat sink.

sounds much better than the FTV2A's. A slide-control on the side sets the volume.

The picture reflects from the actual flip-up screen to a mirror for comfortable desktop viewing. A brightness control on the side helps to maintain adequate contrast for different lighting conditions.

When you look at the picture on the Citizen by itself, it's not too bad. The pixels make the display resemble a newspaper photo. Instead of a continuous image, it resembles a photo that has been "half-toned" with a screen of about 70 lines per inch, which is rather coarse. The contrast ratio is poor, but the picture is undeniably there. Only large screen text is readable. All in all, if you didn't compare it with the Sinclair, however, you'd be favorably impressed.

Place the Sinclair FTV2A and the Citizen 03TA side-by-side with the same picture on their screen, however, and the difference heavily favors the Sinclair. There's nothing like a CRT at this time.

I was able to easily input video signals to the Citizen from a VCR, video camera and computers since it has a video input jack. The VCR and camera yielded an adequate picture for monitoring, but computer text was totally unreadable. The low screen resolution won't allows even 32-character lines. I was able to display a large graphic logo, but normal text is out for this type of display.

I suppose, in the final analysis, the picture is what counts, and the Sinclair FTV2A is the hands-down winner there. But the convenience of the Citizen's video and antenna inputs, the better speaker, the smaller size, the included power supply, and the availability of rechargeable batteries are definite "pluses."

It would be nice if Sinclair and Citizen got together and designed a unit with the best of both. But the LCD display world is too far away in quality at this time. Both CRT and LCD displays are making great strides, though. Sanyo, for example, has a prototype 1.7" CRT that generates a 3"-diagonal screen. And gas-electron-phosphor displays promise an alternative to both the CRT and LCD for flat-screen pictures. Meanwhile, "flat" is apparently the wave of the future. **ME**

Table 1—Pocket TV Sources

Casio
15 Gardner Road
Fairfield, NJ 07006
(201) 575-7400

Epson
2780 Lomita Blvd.
Torrance, CA 90505
(800) 421-0184
(213) 539-9140

Radio Shack
1700 One Tandy Center
Forth Worth, TX 76101
(817) 390-3011

Sinclair Research
50 Staniford St.
Boston, MA 02114
(617) 742-4826

Citizen
1200 Watt St. W
Lyndhurst, NJ 07071
(800) 526-6257
(201) 438-8150

Panasonic
One Panasonic Way
Secaucus, NJ 07094
(201) 348-7000

Seiko
1330 W. Walnut Parkway
Compton, CA 90220
(213) 603-9550

Sony
Sony Drive
Park Ridge, NJ 07656
(201) 930-1000

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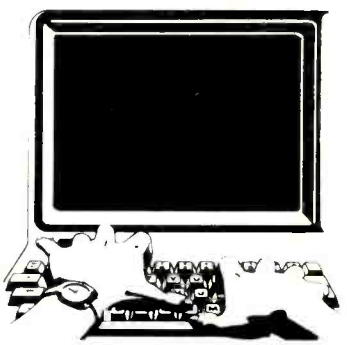

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