Color TV tube needs no shadow mask

by Charles Cohen, Tokyo bureau manager

Index signals from faceplate direct single gun to fire three 'colors' of video signal at matching phosphor stripes

An experimental color television tube of the beam-index kind, which uses only a single electron beam and has no need of a color selection mask, requires much less power than the usual shadow-mask type and could also cost less. And the image is improved, being slightly brighter and without any misconvergence, even in the corners.

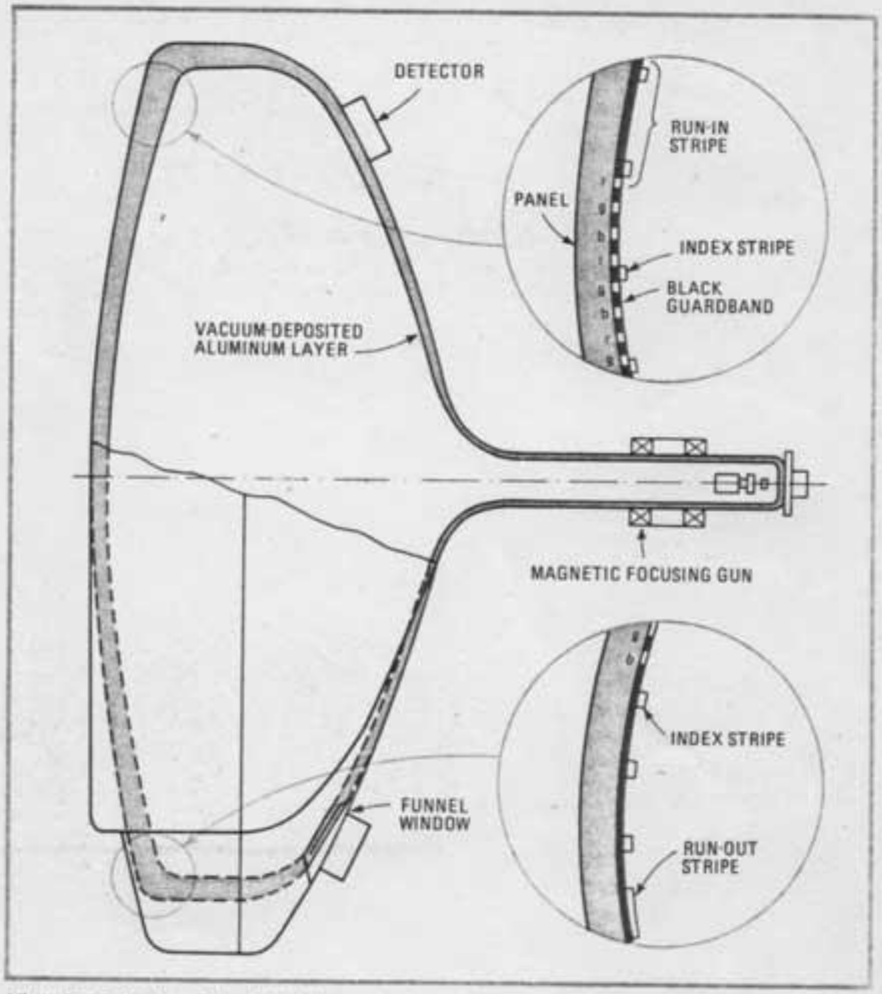
The 30-inch tube is made by Japan's Sony Corp. It employs a bulb with the same 32-in. outer diagonal as the firm's largest shadow-mask–type Trinitron tubes.

Akio Ohkoshi, general manager of the Electronic Devices Development division, says that the firm selected the largest tube size because it promises the greatest cost reduction. The number of circuits and other artifacts a tube requires is independent of its size, whereas the cost of the shadow mask increases with size.

Inside. The tube has a repeating pattern of vertical red, green, and blue phosphor stripes separated by black stripes of the same width. As the electron beam sweeps horizontally across the face of the tube, electronic switching circuits feed the electron gun's grid with a sequence of primary-color video signals matched to the sequence of colored stripes. As in other beam-index tubes proposed from the early 1950s on, periodic index stripes on the inside of the faceplate respond to the electron beam as it passes over them with a signal. This signal is used to synchronize the switching circuits with the motion of the beam.

To generate the index signal, Sony uses a short-persistence green phosphor on top of the aluminum screen backing of every fourth black stripe. To detect the signal, a p-i-n photodiode is used. Photodetectors consisting of a hybrid circuit with the sensitive p-i-n photodiode and a 30-megahertz monolithic preamplifier are attached at four windows on the picture-tube funnel to pick up the index signal from the four quadrants of the faceplate (see figure).

Two factors contribute to the tube's low power. Because its single-beam electron gun is smaller in



View from the top. This TV tube's vertical red, blue, and green phosphor stripes are swept horizontally by matching primary-color video signals from the single electron gun.

diameter, its neck can also shrink to 30.6 millimeters from the 36.5 mm normal for this size of tube—so that the deflection coil is smaller and deflection therefore uses 20% less power. Moreover, beam current is decreased by about two thirds because there is no shadow mask to intercept electrons. The total power consumption of a prototype TV set is 160 watts, 45 W less than that of a comparable commercial 30-in. TV.

Several innovations are used to make a reliable beam-index TV. A constant dark current of less than 1 microampere ensures an index signal even in dark portions of the screen. This current gives a screen brightness of only 0.3 footlambert. Since the maximum screen brightness exceeds 120 ft-L, the contrast ratio is more than 52 decibels. Signals from a run-in region of six index stripes at the left-hand side of the screen serve to ensure synchronization on each scan. Together with signals from a run-out region at the right-hand side (see figure, p. 73), they are also used to stabilize picture width despite changes in brightness. This is extremely important because switching frequency is directly proportional to scan width.

The tube also improves its performance by correcting the linearity of the scan as it travels across the screen. The picture tube screen is sliced horizontally by 34 lines and vertically by 14 lines. The points where these lines cross are used for the acquisition of linearity data, which is stored as 6-bit samples in a 4-K random-access memory. Each time the channel is changed, the screen is driven momentarily to full white brightness for best pickup of index information and then data for linearizing the scan is stored.

Unmuddied hues. For the best color purity, the electron gun shoots a vertically oriented rectangular beam. This rectangle is tilted when the beam is deflected to the corners of the screen, but dynamic correction is provided by a magnetic quadripole on the tube neck. Color purity is thus maintained even at the corners.

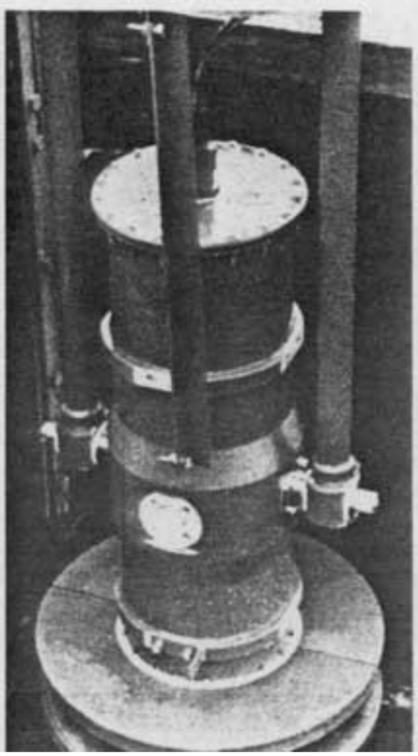
Sony will not say when it will produce the new tube. Some capital investment is required, in particular for the automated line that would fabricate the new single-beam electron gun. On the other hand, set manufacturing costs could probably be cut by about 5%.

Three years ago, Matsushita Electric Industrial Co. built a prototype portable color TV around a 7-in. beam-index tube fabricated by subsidiary Matsushita Electronics Corp. [*Electronics*, Sept. 28, 1978, p. 67]. The aim was not lower cost or a better picture but power consumption low enough for the set to run on dry cells. That project is now in limbo, though, because the demand for and price of this type of set are both low. Sanyo Electric Co. also built a small beam-index tube similar to Matsushita's as a vehicle with which to start a picture tube division, but failed to follow through.

Great Britain

Solid-state sonar builds on new sensor

A plastic with far greater piezoelectric sensitivity than conventional inorganic materials is bringing sonar technology into the solid-state era. Soon electronically scanned sonar arrays with no moving parts will be displacing more conventional mechanically scanned sonar heads in the lethal hide-and-seek game of submarine warfare.



But while research interest in these sonar arrays, printed on thin films of polyvinylidene fluoride (PVDF), a highly piezoelectric organic compound, is strong and though systems using the technology may already be afloat, little of this work has been made public. One exception is Britain's Marconi Space & Defence Systems Ltd., whose Naval and Ocean Engineering division in Camberley, Surrey, recently launched two PVDF-based systems: a fixed installation sonar for protecting harbors, oil rigs, and other strategic installations, plus a towed small-boat sonar system. Both were developed privately.

Electronic scanning with these arrays is more reliable and cheaper and occupies less space than conventional scanned systems, making it practical for the first time to equip boats as short as 12 meters with sonars, according to Clive A. Bridges, manager of the division. But perhaps more importantly, the sensing material, PVDF, is 30 times more sensitive to underwater sound than conventional piezoceramics.

Untrimmed. Moreover, says R. H. Wisbey, who heads the materials applications group at Marconi's research laboratories, where the new 100-element omnidirectional sonar array was developed, "PVDF has a number of other advantages by virtue of its being plastic. Because its acoustic impedance is reasonably close to water's, it naturally has a broadband capability and need not be trimmed to resonance."

Operationally, this last factor is extremely important, explains Bridges, because lower frequencies give long-range penetration through the water and higher frequencies can be used to obtain high resolution close in. For instance, the Marconi

Ultrasensitive. This solid-state sonar head located near a harbor entrance picks up movements of underwater objects as close as 25 meters or as far as 1.2 kilometers

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