

# Development of a New Series Television Ready for Digital Broadcasting

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*OVERVIEW: Digital broadcasting is becoming widespread around the world these days, so the market for household electronic appliances is expected to grow considerably. High-resolution large-screen digital television is at the forefront of this expectation. Hitachi, Ltd. long ago recognized the large-screen television as a long-term strategic product and, consequently, released a new television called "ULTRAVISION" in 1989 in the United States, the biggest "home theater" market in the world. "ULTRAVISION" was developed according to the concept of an extremely high-resolution TV image. Since then, Hitachi has attained the top position in the high-quality home-theater market in the U.S. by utilizing its unique engineering systems and high-resolution-display technology. Broadcast satellite (BS) digital broadcasting will start in Japan, following Europe and the United States, in the year 2000. Hitachi will use its developed technologies in progressive scanning (the standard for next-generation television) and liquid-crystal panels (the next-generation display device) to take the initiative in developing next-generation television products. As part of this initiative, the "GA!Z" series, which represents this next-generation television for Japanese digital broadcasting, has been developed and is described in this paper.*

## INTRODUCTION

DIGITIZATION of video and broadcasting is very close at hand with the availability of satellite-delivered digital broadcasting scheduled for availability in the year 2000. In Japan, applying compression processing technology to video signals, satellite digital broadcasting companies plan to deliver digital High Definition (HD) broadcasts (1080i) over multiple channels (seven channels), as well as progressive 480P

(480 scan lines) and interlaced 480i (NTSC compliant) format signals.

Hitachi has greatly strengthened its television lineup with the all new Provision GA!Z (pronounce "gazette") series, that provides extraordinary image quality and contrast while supporting satellite-delivered digital broadcasting (Fig. 1). This series will be the company's flagship line of television products going into the year 2000. This article will provide a



Fig. 1—Images of the "GA!Z" Series Television for Digital Broadcasting.

The name "GA!Z" is a combination of GA for "gate" and the letter Z, used in medieval Rome to mean the number 2,000. Thus it signifies "a gateway to the year 2000." It also combines the Japanese word "ga" (picture) and the letter Z used to mean "ultimate," signifying our aim to achieve the ultimate in picture quality.

comprehensive overview of Hitachi’s satellite digital broadcast-ready television lineup in Japan, the Provision GA!Z series.

**FEATURES OF THE GA!Z SERIES (28-, 32-, and 36-in. models)**

Television now stands at a major turning point with users looking for five basic things in next-generation sets: (1) digital high image quality, (2) digital-ready, (3) digital high sound quality, (4) simple operation, and (5) compact space savings.

Focusing on a design concept that can achieve both digital-ready high image quality and fits snugly into the corner of a room, we have been guided by two catch phrases: “bring on digital broadcasting” and “a large screen in the corner.” Now let us consider in more detail how we achieved these two goals.

**Digital High Image Quality and Digital-ready: “Bring on Digital Broadcasting”**

Guided by the concept “sharp image today and sharp image tomorrow,” our primary aim was to develop a television that delivers excellent image quality across the full spectrum of broadcast media available today and in the coming years. This encompasses current terrestrial broadcast of course but also includes HD digital, soon-to-be-available satellite digital, and terrestrial digital broadcasts. The following new technologies had to be developed to make this possible. Let us next consider the technologies that had to be developed to accommodate these diverse

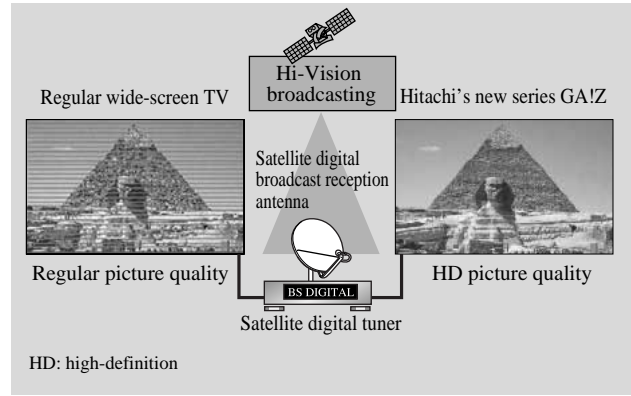


Fig. 2— Wide-Screen TV Versus GA!Z Series Image Quality. When satellite-delivered digital broadcasts become by connecting a satellite digital tuner, viewers can not enjoy Hi-Vision image quality on a regular wide-screen TV. The new series GA!Z TVs will display the full image quality of Hi-Vision (HD).

digital media formats.

**An HD-ready monitor**

The video display format of satellite-delivered digital broadcasting will primarily be HD 1080i, but video signals will be broadcast in progressive 480P and interlaced 480i formats as well.

The GA!Z series televisions feature a deflection circuit with a horizontal deflection frequency of 33.75 kHz that, when connected to a future digital broadcast satellite tuner, will enable the set to display original HD quality images. Furthermore, as indicated in Fig. 2, real video 480P input can be displayed by converting to a progressive-scan 31.5-kHz deflection circuit, and

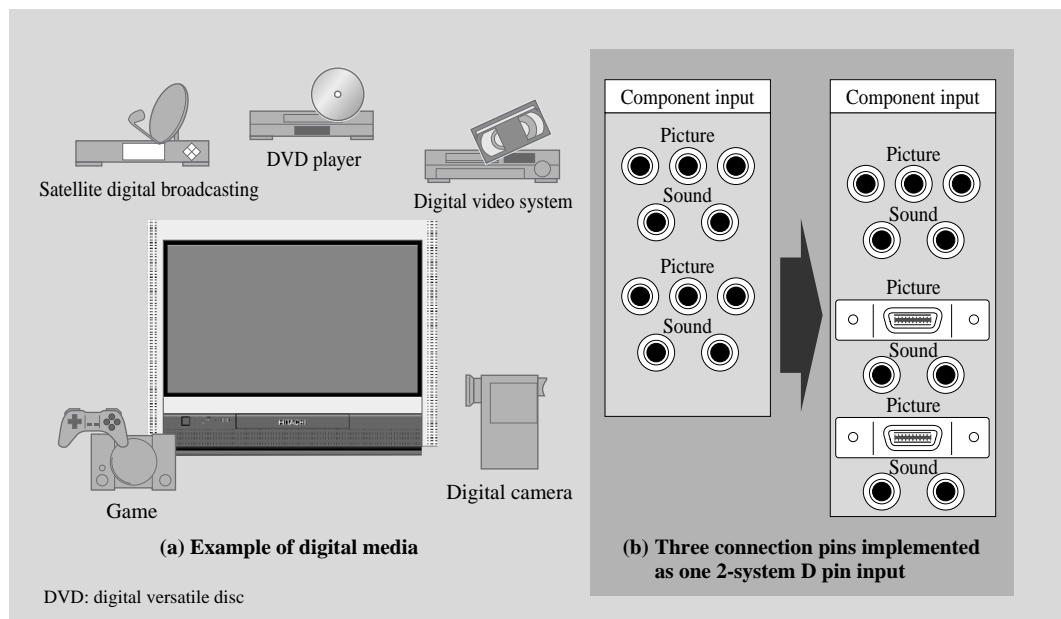


Fig. 3— Various Digital Media and the Component Input Interface. Various formats are supported through video signals that can be input on the D pin (D1: 480i; D2: 480i, 480P; D3: 480i, 480P, 1080i).  
DVD: digital versatile disc

current interlaced 480i can be displayed with excellent picture quality by converting to progressive-scan format.

In the digital media age, moreover, the video interface is a component (that is, chroma difference signals Y, Pb, Pr) high image quality interface. In GA!Z series televisions is equipped with a dual select system that supports conventional component inputs (Y, Pb, and Pr three-pin inputs) as well as an industry standard D3-connector enabling viewers to enjoy high-quality digital broadcast images. While certainly future satellite digital tuners are supported, one can see in Fig. 3 that viewers can watch high-quality images by connecting to a terrestrial digital tuner or a digital peripheral device such as digital versatile disc (DVD) player.

**New-century progressive**

The current NTSC analog terrestrial broadcast TV standard defines an interlaced scanning scheme (two fields are interlaced in each frame) in which pictures are produced by 525-line 60 interlaced fields per second. In GA!Z series televisions, a new progressive-

scan approach is adopted in which pictures are drawn by a single 525-scan line field in each frame. This approach dramatically reduces course scan lines and line flicker that have been so noticeable and annoying in the past. New-Century Progressive is the third-generation version of Hitachi's unique proprietary progressive-scan technology. As illustrated in Fig. 4,

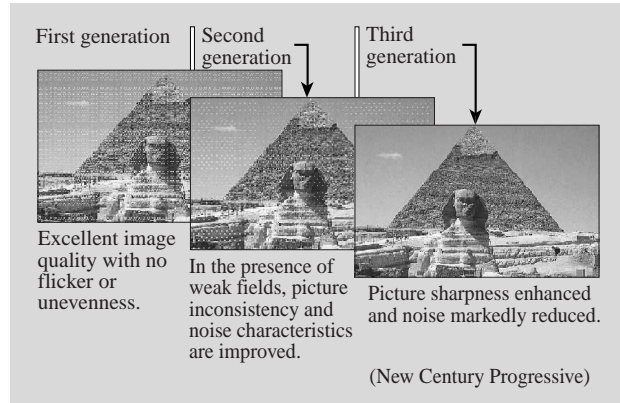


Fig. 4— Evolution of New Century Progressive. New Century Progressive is the third generation. It achieves significantly improved video image quality while reducing noise to a new level.

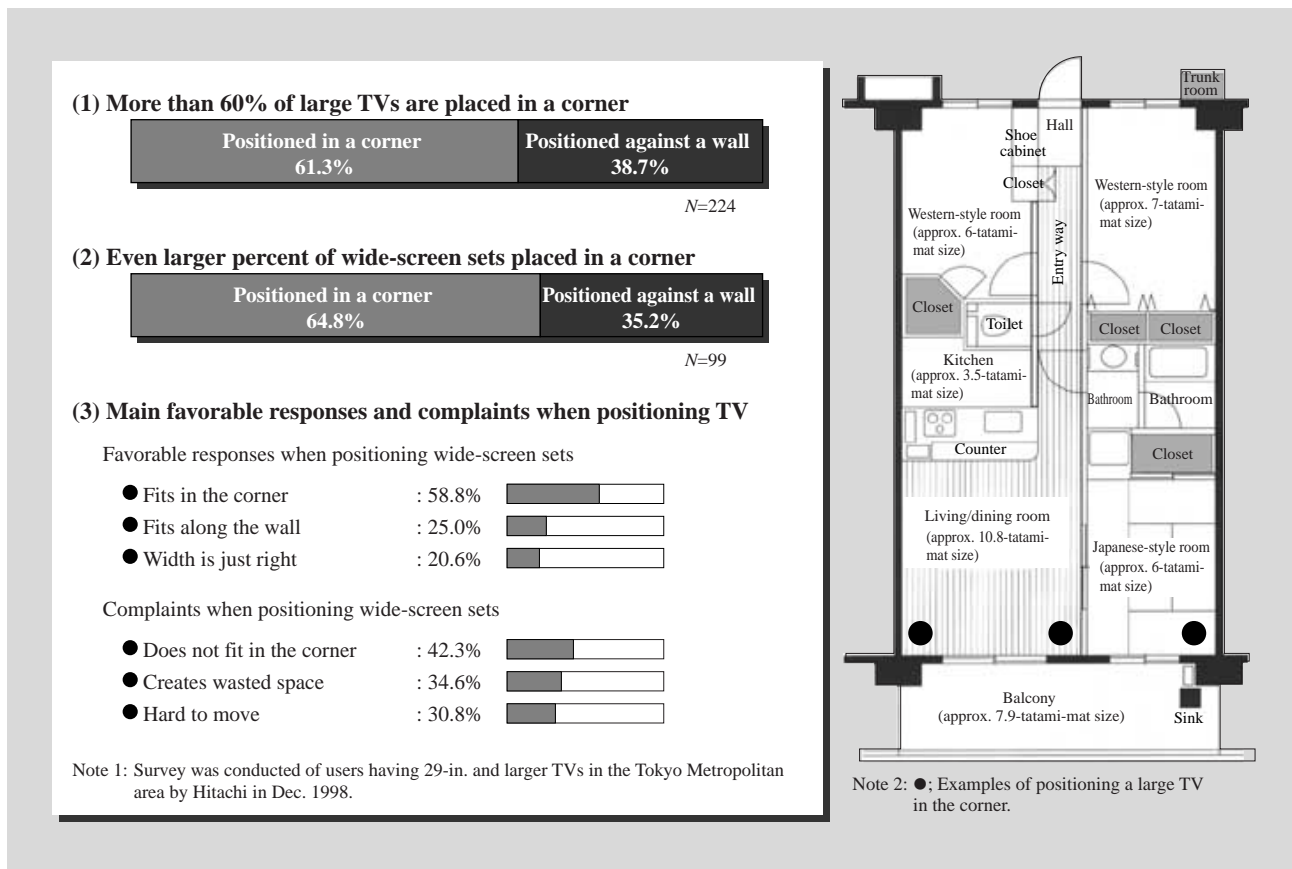


Fig. 5— Survey of TV Placement in the Home. Consensus is that TVs are generally located in the corner of a room.

this latest version achieves markedly better picture quality by implementing a number of new capabilities: sense of dizziness associated with on-screen motion has been reduced and a new function automatically detects the amount of noise on each channel and cancels the noise appropriately.

### Compact Space Savings: “a Large Screen in the Corner”

Television sets are increasing in size, but the space available in the average Japanese home is limited. This led us to conduct a survey to discover the views of consumers regarding the placement of large-screen TVs.

The survey revealed that about 60 percent of the owners of 29-inch and larger TVs and about 65 percent of the owners of wide-screen TVs consider the corner of a room to be the best location for larger sets. The survey also asked the respondents to rank what factors were most pleasing and most annoying about their placement of the TV in a corner.

The floor plan of typical condominium is shown in Fig. 5. One can see in the same figure that the majority of respondents identified the corner of a room as the best location for a large TV. The main factors considered were to provide a large enough space that the whole family could watch TV together, arrangement of the other furniture and paths of movement through the rooms, what to do with the antenna wiring, light reflections from outside, and so on.

One of primary objectives in developing the GA!Z series of televisions was to increase consumer satisfaction by developing a TV set that takes up less space than a conventional set when it is placed in the corner of a room. With this product line, we succeeded in developing a 32-inch wide-screen TV that actually takes up less corner space than a conventional 29-inch set. We did this by better integrating the digital circuitry, by optimizing the configuration of the chassis, and by beveling the back of the set to give it a triangular shape that fits snugly into a corner. In consideration of the environment and recyclability, Fig. 6 shows that we also employed a halogen-free material for the outer box that produces very little waste at the end of the set’s useful life.

### Additional Features

#### Superior sound quality

Let us next consider what owners are looking for in the sound quality of large-screen TVs. Here again,

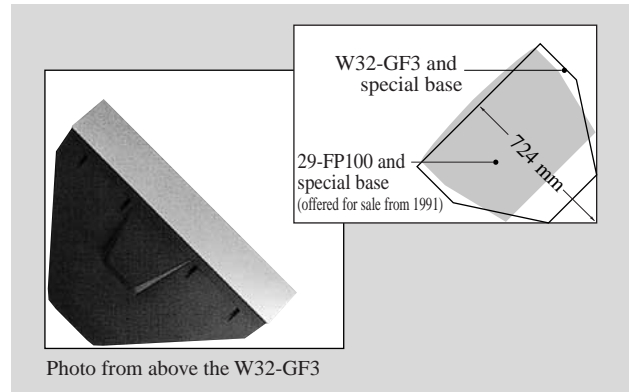


Fig. 6— Back and Positioning of the 32-inch GA!Z Set. Featuring a new compact design optimized for corner installation, a 32-inch GA!Z set takes up no more space than a conventional 29-inch set.

we went back to the basics and polled owners of large sets. Regarding sound quality, the primary consideration of most respondents in determining their next purchase of a large TV was “clear sound.” The respondents were not only concerned with clear sound including people’s voices, but they also identified the quality of low sounds and surround sound as important for conveying a more vivid, realistic sense of presence.

This led us in the GA!Z line to incorporate a new sound technology called FOCUS\*. As shown in Fig. 7, FOCUS not only achieves a crisp sound quality that enables the viewer to pick up on-screen voices, it also realized a superior digital sound quality through the sound elevation effect. A heightened sense of presence is achieved through movement of a sound image to the full height of the screen.

\* FOCUS is a registered trademark of SRS Labs, Inc.

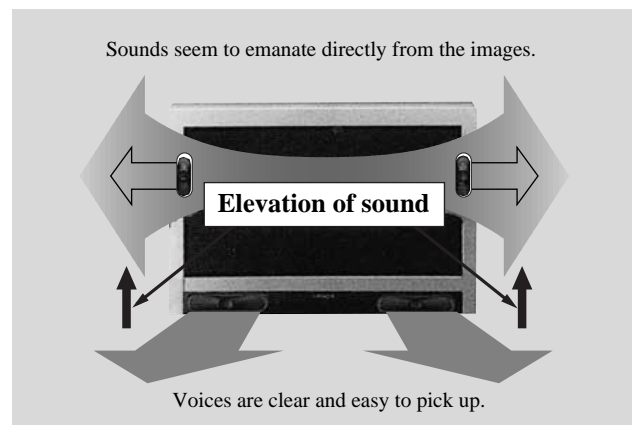


Fig. 7— New Sound Technology “FOCUS.” Speech on news and other shows is crisp and distinct; images and music convey a powerful sense of presence.

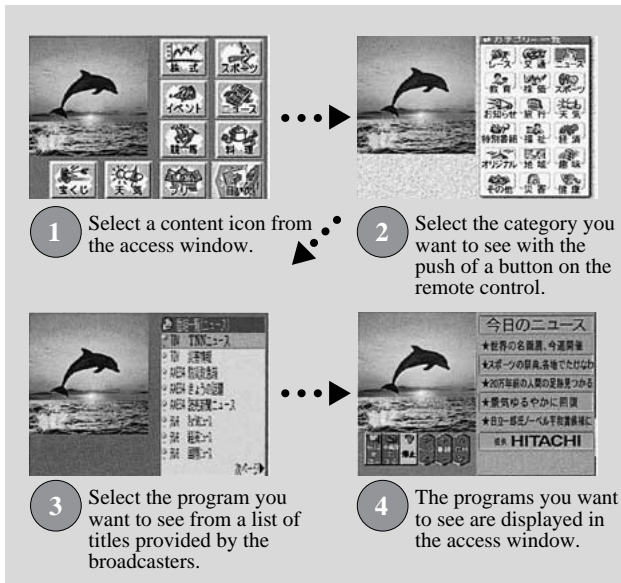


Fig. 8— Access Window.

Everything a viewer wants to know is readily accessible from the nationwide weather forecast to the last news events.

In the sound production system, large-capacity base reflex speakers are mounted in the speaker unit at the very front of the set to produce a clear, distinct sound quality. In addition, by incorporating tweeters in the two-way four-speaker system mounted on either side of the screen, a powerful sound-production system is achieved.

#### Simple operation

To simplify the operation of the GA!Z sets, we completely overhauled the access window and developed an icon-driven interface that is extremely easy to visualize and even easier to understand. The viewer can readily access programming information provided by the broadcasters that corresponds to the standardized Mojinet (broadcast teletext service) information contents. As illustrated in Fig. 8, ease of use has been markedly enhanced by attractive, more visual graphic screens.

#### Design

While loaded with numerous advanced new capabilities, the GA!Z series has also undergone a complete design makeover that befits the advanced style and tone of this new era of high-quality digital images. As apparent from Fig. 9, simple styling with no extraneous ornamentation has been adopted for its compatibility with a diverse range of different life styles. As mentioned earlier, the recyclability of the GA!Z products has been significantly improved by widely adopting halogen-free material for the body.

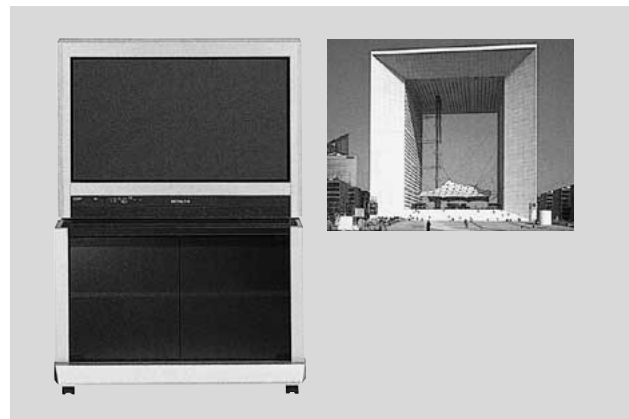


Fig. 9— New Design.

Adopting a new triumphal arch as a motif, the new set projects a sleek new image as a gateway to the new century. Adopting grayish-blue for the panel color projecting a hint of things to come, a sleek sophisticated design has been achieved that goes as well in Western style rooms as it does in Japanese style rooms.

These materials produce very little environmental waste when they are recycled.

#### FEATURES OF BIG SLIM 52: A LIQUID-CRYSTAL PROJECTION TELEVISION

Anticipating a growing market for home theater style systems as the era of digital video continues to unfold, this product was developed for use in homes to provide a large-screen visual experience while taking up the least amount of space.

Conventional projection TVs employ three 7-in. picture tubes, and the images from the three picture tubes are assembled to create a single image.

The BIG SLIM 52 uses a liquid-crystal flat panel

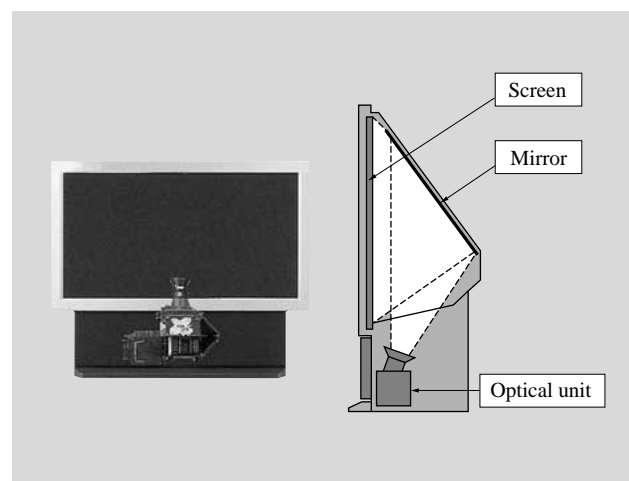


Fig. 10— BIG SLIM 52 Optical System.

A high-resolution picture is projected from the back.

digital display device, and adopts a rear-projection scheme. A 1.6-inch liquid crystal panel is used instead of picture tubes. As illustrated in Fig. 10, light from a very high-intensity lamp is separated into three colors, and used to produce images composed of high-density pixels that are enlarged and projected on the screen. Let us now take a closer look at the features of the high-performance optical unit that produces the high-luminosity, high-contrast images.

**Industry's First Liquid-cooled Direct-coupled Projection System**

In a liquid-crystal projection type display that uses a lamp for a light source, the liquid-crystal panels function as light shutters in displaying images. The light that is shielded as a result of the shutter effect turns into heat; the liquid panel itself thus becomes quite hot, so some means of cooling the panel must be implemented. Cooling the panels with fans has been the mainstream approach up to now, however an altogether different approach was adopted in BIG SLIM52. In this product, a liquid cooling scheme is adopted in which a liquid coolant with a refractive index close to that of glass (ethylene glycol) is directly coupled between the lens and the liquid-crystal panel. Fig. 11 reveals that, since the boundary between the air layer and liquid-crystal panel disappears as a result of the difference in refractive index due to the cooling, unnecessary reflections are suppressed, thus enabling very high-contrast images. Furthermore, since the liquid-crystal panel and polarizing place are so efficiently cooled, a heat-radiating panel has been added. In this system, Hitachi has successfully reconciled excellent image quality with high reliability through a combination of state-of-the-art production technologies: a coolant injection technology that was refined for the picture tubes and assembly processing

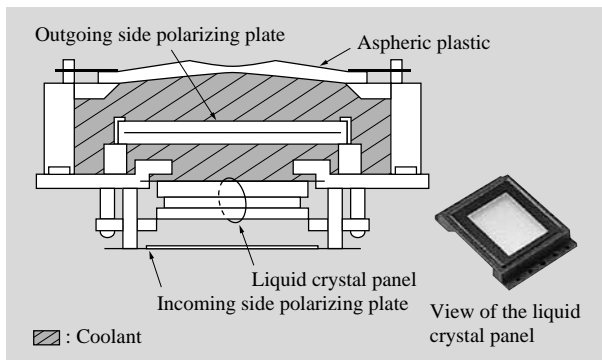


Fig. 11— Liquid-cooling Direct-coupled Projection System. Industry's first implementation of a liquid-cooling scheme.

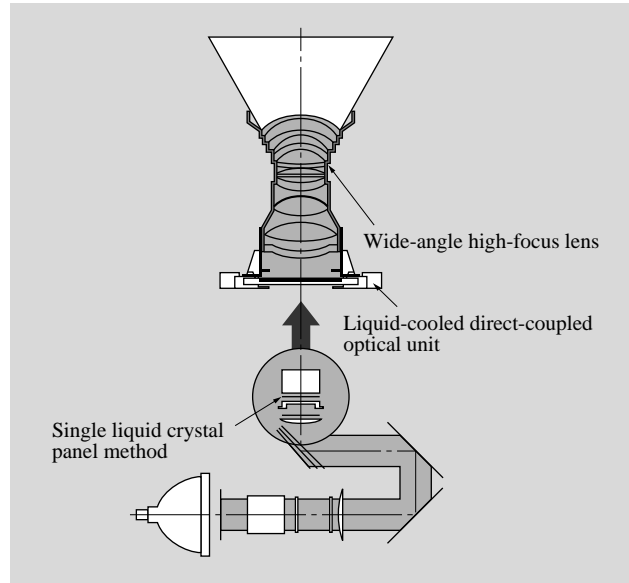


Fig. 12— Schematic of the Optical Unit. The focal distance has been brought closer by employing a unique wide-angle high-focus lens.

with a high clean rating that prevents dust and other contaminants from spoiling the various components.

**High-focus Short Focal Point Projection System**

Fig. 12 shows a novel wide-angle high focus lens developed by Hitachi. The focal distance was reduced using a new configuration in which aspherical plastic lens are alternated with glass lens in an 11-layer configuration. This has enabled us to realize a large-screen 52-inch television that is only 51 cm deep. By sharply beveling the back of the set to give it a triangular shape as shown in Fig. 13, the large-screen television takes up no more space than a conventional

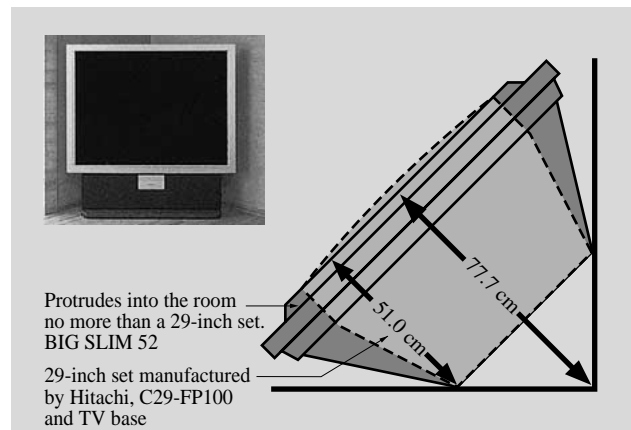


Fig. 13— Positioning of BIG SLIM 52. Implemented with a slim compact body, the BIG SLIM 52 fits snugly in the corner of a room.

29-inch set when positioned in the corner of a room.

### 1.6-in. Single Panel Polysilicon TFT (Thin-film Transistor) Active-matrix Liquid Crystal

A 1.6-inch high-resolution liquid-crystal panel [(800 × 600) × 3 colors] with 1.44 million dots was employed for the display device. By using a single panel that does not require color integration, uneven coloration and color mismatch is minimized in projected images. What is more, color distortion due to the adverse effects of electromagnetic fields is practically nonexistent.

### New High-contrast Screen

Very high-contrast images are obtained by implementing a wavelength-selective filter at the outermost surface layer of the screen and by integrating this with a lenticular lens that is implemented by the fine-pitch (0.16 mm) black stripe method which effectively suppresses external reflected light. This has also made it possible to achieve a wider viewing angle than that of the conventional C39-WE40 system, and the ease of using the system as a home theater TV has also been enhanced.

Careful consideration has also been given to the ecological impact of the product by adopting easy-to-recycle materials and an easy-to-disassemble design. In the plastic components and parts, every effort was made to minimize the proportion of materials contributing to environmental waste.

In addition, a component input dual system was implemented as the interface for future digital broadcasting and other digital image equipment; one of the systems is the industry standard D3-pin interface. This means that a full range of broadcast formats are supported including Hi-Vision 1080i, progressive 480P, and interlaced 480i. In the case of 1080i broadcasts, the images are played by interfield interpolation in conjunction with pixel count of the liquid-crystal panel. Finally, by employing an application-specific progressive-scan LSI, crisp clear images are produced that are devoid of flicker.

## CONCLUSIONS

This article discussed the features and basic technologies of Hitachi's GA!Z series televisions, a

lineup of innovative new products that support satellite-delivered digital broadcasting.

We can anticipate that as televisions for home viewers increase in size and become increasingly digitized in the years ahead, there will be a growing integration of optical technologies that have been developed for enlargement projection of images and cutting-edge digital video processing technologies such as represented by the unique progressive-scan LSI described in this paper. This will lead to the emergence of new worldwide television market based on core technologies that apply liquid crystal, plasma, and other new display devices.

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