Plasma Displays

—The Leading Medium in Visual Presentations at Exhibitions and Shows—

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OVERVIEW: The leading medium in visual presentations at exhibitions and shows is fast becoming plasma displays. These displays feature full-color, 40-inch and larger screens having a thickness of only 10 centimeters or so, plus a wide viewing angle. They are unaffected by terrestrial magnetism and can be easily attached to walls or hung from ceilings. As a result of these features, plasma displays are beginning to be used at airport counters for displaying travel information, at stock exchanges for displaying share prices, in restaurants and hospitals for displaying information, notices, and scenic views, etc. In addition, despite the fact that they are still relatively expensive, plasma displays have begun to appear in the shop windows of home-electronics stores as the "dream wall TV" and have spread to a small number of households. At present, color plasma displays in actual use employ the alternating-current drive system, which was invented more than 30 years ago in 1964. Hitachi has also been studying plasma displays from early on and has made significant progress in fundamental research. In Japan, NHK Science and Technical Research Laboratories and many other research institutions have been engaged in the research and development of wall-hanging televisions for over 20 years. It was in 1993, however, that Fujitsu Limited marketed the first 21-inch VGA plasma display triggering the practical use of these devices. Rapid progress is now being made in achieving plasma displays having high brightness and high resolution, long life, large size, and high efficiency. The goal of current development work, moreover, is to achieve plasma displays that can perform full progressive display of high-definition signals and that can be implemented in large sizes up to 60 inches.

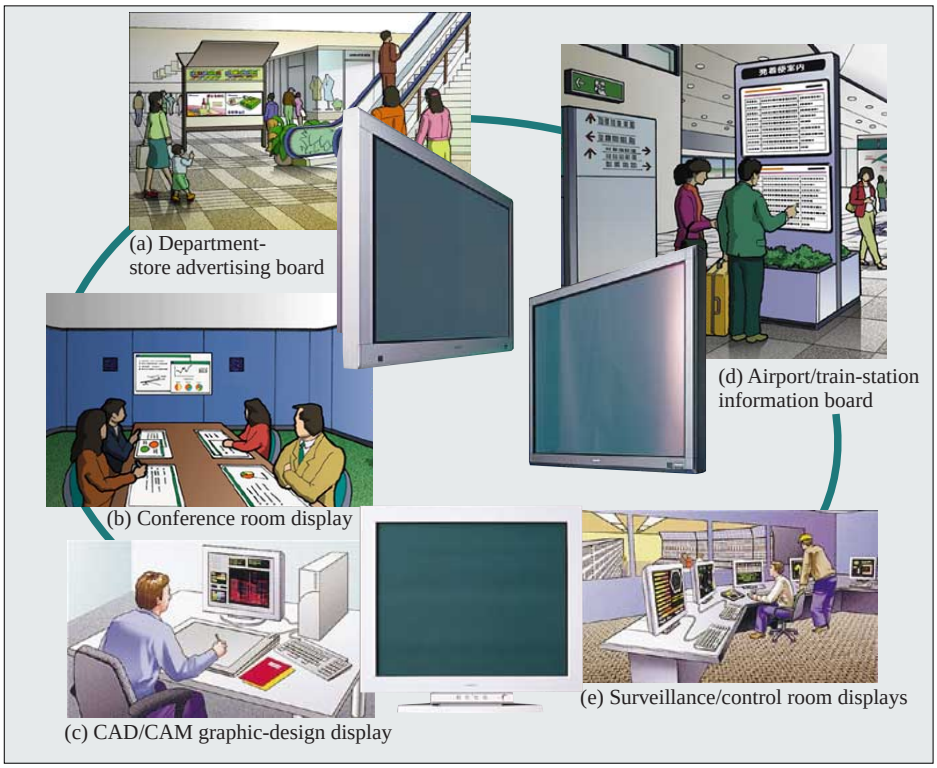

Fig. 1—Applications of Plasma Displays.
The application of plasma displays is expanding, from use as a presentation tool and surveillance monitor, to the electronic display of information in airports, train stations, department stores, and shopping centers.

HDTV : high definition television
MUSE : multiple sub-nyquist sampling
XGA* : extended graphics array
SXGA : super extended graphics array
VGA* : video graphics array
SVGA : super video graphics array
NTSC : national television system committee
LCD : liquid crystal display
PDP : plasma display panel
W-VGA : wide VGA

* XGA and VGA are registered trademarks of International Business Machines Corp. in the U.S.

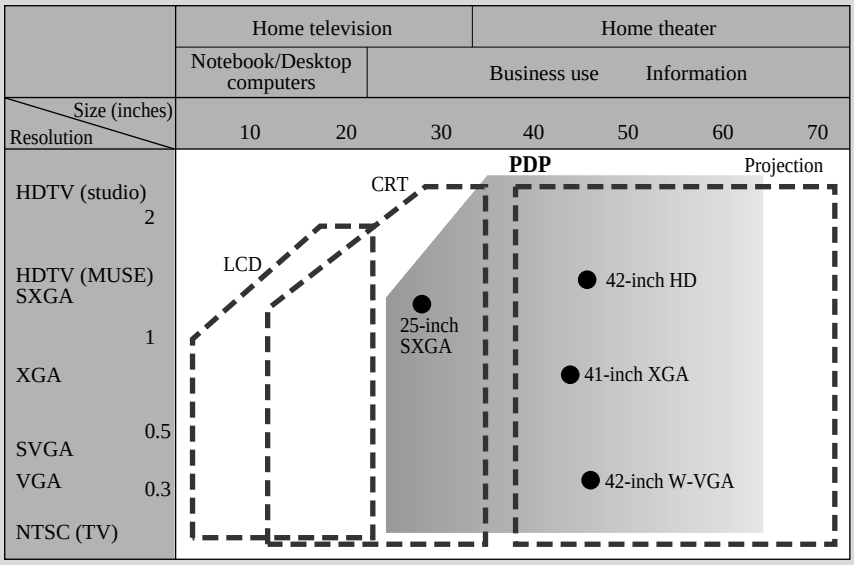

Fig. 2— Plasma Display Panels (PDPs) in Comparison with Other Display Devices.

INTRODUCTION

IN April, 1999, Hitachi jointed with Fujitsu Limited a joint venture, Fujitsu Hitachi Plasma Display Limited (FHP) for strengthening and expanding the PDP business, which is for developing, manufacturing and selling plasma display panels. In June of the year, Hitachi announced the development of a 42-inch high-definition monitor having 1,024 × 1,024 pixels (aspect ratio 16:9); a 41-inch XGA display having 1,024 × 768 pixels; and a 25-inch SXGA display having 1,280 × 1,024 pixels. Domestic sales of these products began in a step-by-step manner in July and their export to the United States began in September.

The main features of plasma displays can be summarized as follows.

(1) 40-inch and larger flat screens with thin profiles of 10 cm or less making for space-saving installation

(2) Self-luminescence system providing a wide viewing angle of at least 160 degrees from top to bottom and left to right

(3) Operation unaffected by terrestrial magnetism, facilitating installation

(4) Digital driver (fixed-pixel display) eliminating distortion from screen center to periphery and providing high picture quality uniformly over the screen.

Current plasma displays on the market range in size from 21 inches (VGA) to 50 inches (W-XGA). Functions have improved significantly in recent years, and the market for plasma displays has been expanding. From this point on, achieving low-cost plasma displays will be an issue in addition to further enhancement of functions.

Plasma displays are compared with other display devices in Fig. 2.

For flat displays, from the viewpoint of size, plasma displays begin where LCDs leave off at 25 inches, and extend as far as the 60-inch class considering restrictions in glass size. Larger screens are turned over to projection displays.

Plasma displays are actually digital display devices, and they therefore exhibit good affinity with personal computers (PCs). They are also expected to find widespread use as large-screen multimedia displays in conjunction with the future digitalization of broadcasting and packaged media. Picture processing technology and interface technology should therefore become major factors in this development.

Keeping in mind, moreover, that the most outstanding feature of plasma displays is their thin profile, taking full advantage of this space factor and developing 30-inch-class plasma displays for practical use may eventually make it possible to replace conventional cathode ray tubes (CRTs).

MARKET TRENDS

With the appearance of 42-inch-wide VGA model in 1996, the use of plasma displays has spread rapidly as information boards at stock exchanges, airports, exhibition and event halls, etc., and the number of production units has increased dramatically. Sales in Europe and the United States have been especially strong and the majority of plasma displays produced in Japan have been exported to these markets.

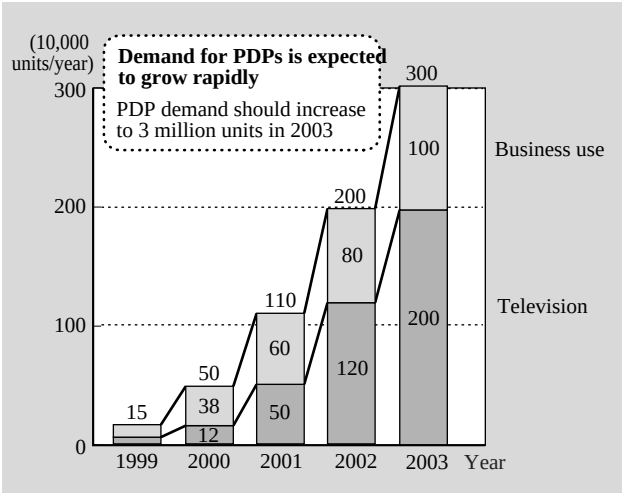

Fig. 3—Predicted World Demand for Plasma Display Panels.

The spread of plasma displays as a new form of display device in business applications has therefore begun. On the other hand, sales of high-end televisions (or home theaters) that combine a television tuner and audio system with a core 42-inch-wide VGA model began in the European and Japanese television markets in 1997.

In Japan, moreover, the market is predicted to take off with the start of digital broadcasting at the end of 2000.

To achieve widespread use of plasma televisions, it is, of course, important that potential customers look favorably on the hardware features of plasma displays, namely, flat, large screens and a thin profile that can save on space. Equally important, however, is ample provision of video software such as high-definition broadcasting. At the same time, it goes without saying that lowering the price of plasma televisions will be an important factor in their penetration of the market. In this regard, a surge in demand is predicted to take place in 2001 and 2002 when the price of plasma displays is expected to be about 10,000 yen or less per inch of display (Fig. 3).

HITACHI'S PRODUCT LINEUP

Hitachi divides the market for plasma displays into three major categories.

The first category is the PC monitor market in which Hitachi marketed a 25-inch SXGA (Table 1) prior to the development of large-screen LCDs. This model represents the largest size for personal use, and its thin configuration and space-saving feature are being highly promoted in the engineering workstation (EWS) market for computer aided design (CAD), computer aided manufacturing (CAM), and other applications.

The second category is the information systems market. In this regard, Hitachi has already established itself as a leader in the monitoring and control field with its rear-projection high-resolution displays, and Hitachi display devices for making presentations are being used in conferencing and education systems. We have therefore developed and marketed a 41-inch XGA model for this market that we have been especially strong in (Table 2).

At software creation sites, the need is expected to grow for single plasma displays that can perform accurate display and not distort production screens in

TABLE 1. CMP205SX Specifications

Item	Specification
Effective screen dimensions	499 (horizontal) × 399 (vertical) mm
No. of pixels	1,280 (horizontal) × 1,024 (vertical)
Pixel pitch	0.39 (horizontal) × 0.39 (vertical) mm
Brightness	90 cd/m² (criterion: at white peak)
Contrast ratio	50 : 1 (criterion: in darkroom)
No. of colors (gradations)	260,000 (64)
External dimensions	590 (W) × 550 (H) × 122 (D) mm
Weight	20.5 kg

TABLE 2. CMP401X Specifications

Item	Specification
Effective screen dimensions	892 (horizontal) × 622 (vertical) mm
No. of pixels	1,024 (horizontal) × 768 (vertical)
Pixel pitch	0.81 (horizontal) × 0.81 (vertical) mm
Brightness	120 cd/m² (criterion: at white peak)
Contrast ratio	150 : 1 (criterion: in darkroom)
No. of colors (gradations)	260,000 (64)
External dimensions	940 (W) × 742 (H) × 97 (D) mm
Weight	33.5 kg (excluding stand)

TABLE 3. CMP402HD Specifications

Item	Specification
Effective screen dimensions	922 (horizontal) × 522 (vertical) mm
No. of pixels	1,024 (horizontal) × 1,024 (vertical)
Pixel pitch	0.90 (horizontal) × 0.51 (vertical) mm
Brightness	250 cd/m2 (criterion: at white peak)
Contrast ratio	350 : 1 (criterion: in darkroom)
No. of colors (gradations)	16,700,000 (256)
External dimensions	1,041 (W) × 648 (H) × 89 (D) mm
Weight	34.0 kg (excluding stand)

widely used XGA. These displays will be capable of playing back video signals by incorporating two PC input ports as well as two video input ports. Future development work will focus on making these displays larger and wider.

The third category is the digital broadcasting market. With the launch of digital broadcasting in the near future, the demand for high-resolution, large-screen televisions is predicted to rise in the Japanese market. Against this background, Hitachi has marketed a 42-inch high-definition monitor (Table 3) initially for business applications using plasma display panels (PDPs) based on the "alternate lighting of surfaces (ALIS)" method. In the fall of this year, moreover, a version of this monitor for public use will be added to our lineup to promote sales in the television market.

An important feature here is 1024 pixels in both the horizontal and vertical directions that enables the product to be used in a wide variety of applications in addition to use as a genuine high-definition plasma display monitor. For example, as a multimedia display, this monitor supports all television signals as well as most others from VGA to SXGA plus PC input. The monitor is equipped with two video input ports and two PC input ports.

Hitachi plans to enhance the quality of its monitors for digital broadcasting in parallel with similar efforts for its monitors in the information display field.

CORE TECHNOLOGIES IN PLASMA DISPLAY PRODUCTS

XGA Support

41-inch high-resolution color plasma display

Hitachi's 41-inch high-resolution plasma display is a large-screen, high-brightness, and high-contrast unit based on previously developed XGA-compatible 25-inch high-resolution plasma-display technology. Basic panel structure is shown in Fig. 4. Here, to incorporate $1{,}024 \times 768$ pixels for XGA use in a 41-inch screen size, panel design adopts a pixel pitch of 0.81 (0.27×3) mm.

Similar to the 25-inch model, the panel-drive system features a 16.7-ms field divided into eight sub-fields, each of which consists of a reset period, addressing period, and display-sustain period for generating luminescence. The single-scan system is used for 768-line scanning in the addressing period.

To stabilize this 41-inch panel that features about twice as much discharge current as the 25-inch one, a new 500 mA-output insulated-gate bipolar-transistor (IGBT) scan driver was developed and a high-voltage-breakdown and large-current-capacity MOS-FET was adopted for the sustain circuit.

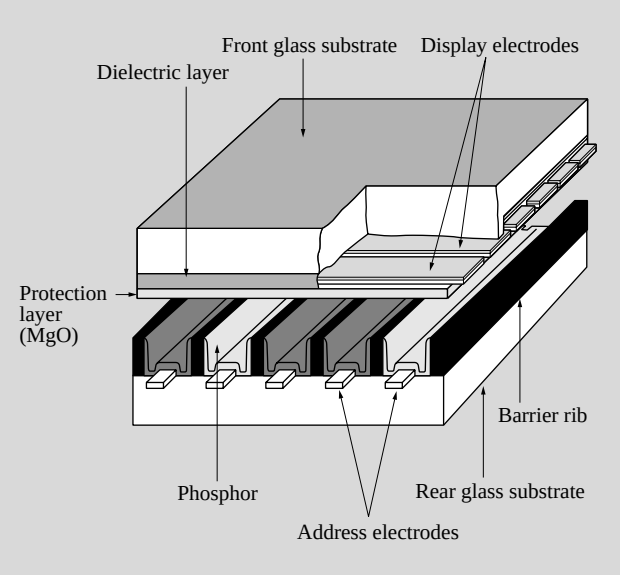

Fig. 4— Basic Structure of Color Plasma Display Panel.

As for brightness, high-speed addressing at a pulse width of 1.7 μs was achieved by improving panel discharge delay and drive waveform, and a peak brightness of at least 250 cd/m^2 per panel was achieved by shortening the addressing period and lengthening the display-sustain period by an equivalent amount.

Furthermore, to minimize rear luminescence caused by total-screen-reset discharge, a darkroom contrast value of at least 150:1 was achieved by a high-contrast drive system that excludes total-screen reset for the 2nd and subsequent sub-fields, as shown in Fig. 5.

Finally, by forming a black stripe in segments that do not directly contribute to panel display luminescence, bright-room contrast has been improved and a high-quality display achieved.

High-Definition Support

42-inch high-resolution color plasma display

To achieve high brightness at 1,000 or more scan lines as required for high-definition broadcasting, the previously mentioned ALIS method* has been adopted.

As shown in Fig. 6, the ALIS method obtains twice the number of display lines as the conventional display-discharge method by also using the space between

* The ALIS method is a PDP drive system developed by Fujitsu Limited.

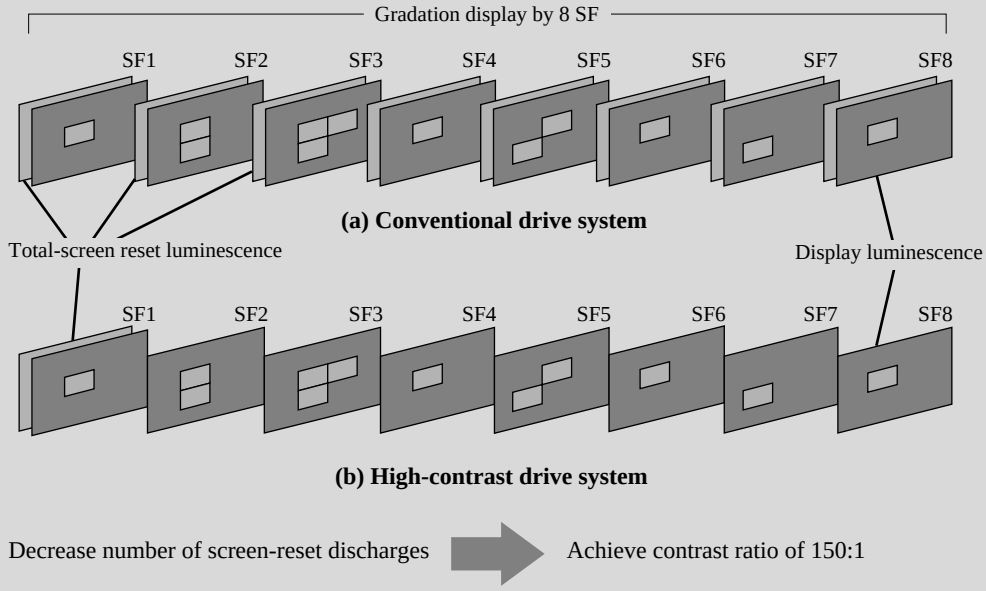

Fig. 5— High-contrast Drive System.

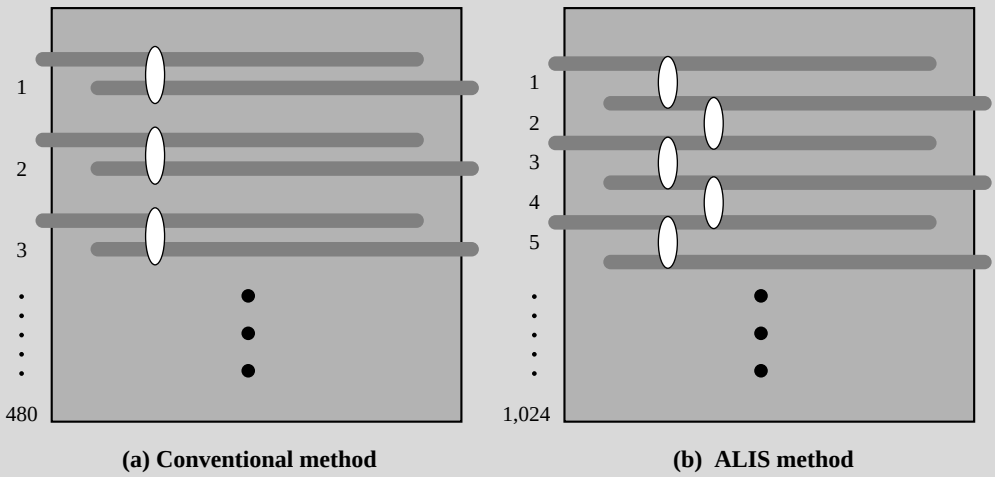

Fig. 6— Comparison of Display Discharge Methods.

adjacent cells that is not employed by the conventional method. High brightness is also made possible by broadening the discharge area.

This panel is driven by an interlaced system in which one TV frame is divided into an odd-numbered field and an even-numbered field, with the former field consisting of odd-numbered display lines and the latter field of even-numbered display lines. This system provides optimal display depending on the application, providing not only high-resolution interlaced display but also progressive display at conventional resolution levels.

APPLICATION PRODUCTS AND MARKET CONSIDERATIONS

By promoting the high-picture-quality and thin-profile features of plasma displays, the market for them as information-display equipment at airports, stock exchanges, and the like is now being established. Their application is expected to expand even further in coming years to electronic information boards and electronic advertisements at train stations, department stores, and shopping malls. Consideration is also being given to the use of plasma displays as stylish display equipment when creating courtesy lounges and other

Fig. 7—Digital Picture System "Kaleid Art" Using the 41-inch XGA Plasma Display.

places for relaxation.

Hitachi Information Network Limited has developed a digital picture system called "KaleidArt" in cooperation with Image Mall Japan Co., Ltd., and is producing this system for the Japanese market (Fig. 7). The plasma display shown within the picture frame in the photo is the 41-inch XGA model. This system can create a feeling of seeing actual objects when presenting, for example, famous works of art from France and Italy and computer-generated art that has recently become popular. KaleidArt is expected to satisfy the needs of hotels, banks, and other public facilities, art galleries, art enthusiasts, etc.

CONCLUSIONS

Since exhibiting a prototype 25-inch XGA model for the first time at the Electronics Show in 1966, Hitachi has adopted a trial-and-error approach in its efforts to market plasma display products. These efforts have consequently borne fruit with the simultaneous announcement of three types of plasma display monitors in June of this year. In relation to these products, the development of plasma display panels, which have always been key devices, will be transferred from July to Fujitsu Hitachi Plasma Display Limited, a joint venture established by Hitachi and Fujitsu Limited. The major issues to be addressed in future development work will be lowering power consumption, raising picture quality, and lowering cost. Our goal is to respond to the needs of the market through joint efforts based on the panel technology of Fujitsu Hitachi Plasma Display Limited and the manufacturing technologies of Hitachi.

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