

The Industry's First 1.3-Inch XGA Data Projector LCD to Adopt the DMS Structure

1.3-Inch 786K-dot XGA LCD

- **DMS*1 structure**
Light resistance: At least 1500 ANSI lumens
- **High optical transmittance**
Increased by 30% or more by the on-chip microlenses
- **Supports XGA display**
Supports high refresh rates up to at least $f_v = 75$ Hz
- **Sealed antidust glass structures**
Highly efficient panel cooling and dust-free operation
- **SXGA images are also viewable**
- **New cross talk-free and ghost-free structure**
- **Up/down and/or right/left inversion functions**
- **On-chip input level shifter circuits**

*1: Dual Metal Shield

Sony LCDs began with EVF products, and since then Sony has led the industry in introducing high quality, high-resolution, high transmittance LCD panels, including HMD, projectors, and data projectors.

The LCX023CM of this release is the first product in the industry to adopt the dual metal shield (DMS) structure. Furthermore, by adopting a newly developed microlens, this product achieves both increased brightness, which is highly desired in data projectors, and a significant increase in picture quality at the same time.

While data projectors were previously large units, great progress has been made in miniaturizing and reducing the weight of these products, and truly portable data projectors have been produced. At the same time, brightness has been increasing rapidly as well in response to strong desires from users, and thus the ability to withstand light and high temperatures is also strongly desired. The LCX023CM high-intensity LCD panel is truly a device that meet all of these needs.

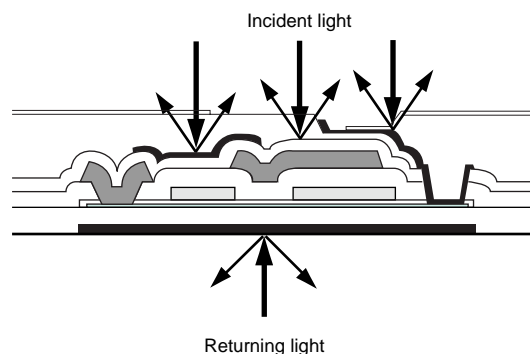
The temperature increases and optical leakage in transistors that occur under intense illumination have been suppressed by a newly-developed unique Sony technology, the DMS structure, that is used in the LCX023CM. This allows the LCX023CM to provide excellent picture quality even when used at light resistance in excess of 1500 ANSI lumens.

DMS Structure

The ability of the LCD to withstand light has been significantly increased in the LCX023CM by the adoption for the first time in the industry of a dual metal shield (DMS) structure and further improvements to Sony's unique polysilicon TFT technology.

In a projector, the returning light that enters the back side of the LCD panel (about 5% of the transmitted light*2) causes leakage currents to occur in the transistors when the panel is under intense illumination. This leakage current can reduce the picture quality provided by the projector. To resolve this problem, the LCX023CM uses the newly developed DMS structure and provides the ability to withstand returning light entering from the back side of the screen more than 12 times higher than earlier Sony products. In combination with the advanced on-chip black (AOCB) structure, which blocks light from the front surface and was introduced in earlier products, the DMS structure fully blocks the transistors from light and allows this LCD to provide excellent picture quality even under the light resistance of 1500 ANSI lumens or higher. (See figure 1.)

*2: This figure depends on the optical system actually used.



Contrast: increased by at least 2.5 times.
Flicker : reduced to less than 1/2.5 of previous levels.
(As compared to earlier Sony products)

■ Figure 1 DMS Structure

Microlenses for High Optical Transmittance

At the same time as providing 786K dots in a 1.3-inch device, the LCX023CM provides a high aperture ratio of 84% by the on-chip newly developed highly efficient microlenses in conjunction with the use of Sony's unique process technology and liquid crystal orientation technology. The microlenses collect light that was previously blocked out and unused and deliver it to the effective pixel regions of the device and thus achieve an optical transmittance of 30%. It is exactly this sort of high optical transmittance LCD panel that is required to display high resolution XGA images clearly. (See figure 2.)

Ghost-Free Structure

In earlier LCD panels at XGA and higher resolutions, the increased wiring loads associated with the larger numbers of pixels resulted in degrada-

tion of the picture quality. To resolve this problem, the LCX023CM adopts a newly developed wiring, the "ghost-free structure", that reduces the resistance of the wiring. In combination with Sony's earlier optical ghost and cross talk-free circuits, this technology achieves display that is free of ghosts and cross talk due to signals.

Sealed Antidust Glass Structure Adopted

High temperatures due to the extremely intense light used are a serious problem in LCD panels. As a result, a structure in which polarizers, which function as heat absorbers, are installed separately must be adopted. The adoption of sealed antidust glass structure reduces the temperature increases in the device itself by 10 to 20°C as compared to earlier Sony products.

This sealed antidust glass structure has the following advantages:

- At the same time as increasing the optical transmittance by suppressing front surface reflections at the

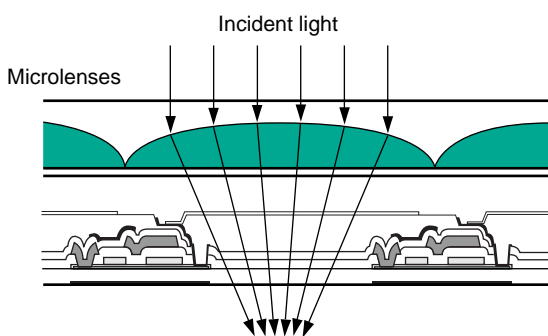
surface of the LCD panel itself, sealing the LCD panel in glass with an anti-reflective coating can reduce the increase in temperature in the LCD panel itself.

- Attaching cover glass prevents defocusing due to dust adhering to the LCD panel surface, and thus prevents picture quality degradation due to dust.

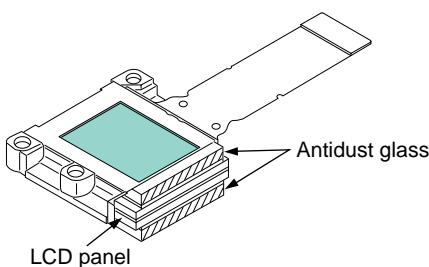
Thus the adoption of this unique Sony mounting type allows even brighter images to be provided. (See figure 3.)

Built-in Multi-Format Display Functions

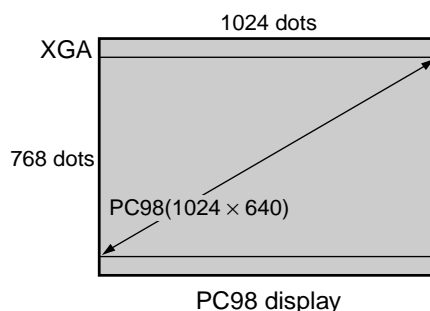
Since the LCX023CM provides a black-frame display circuit that can change the aspect ratio of the screen built into the panel itself, the aspect ratio can be changed easily without providing any special signal processing circuits externally. This black-frame display circuit provides two aspect ratios, 5:4 (960 × 768) and 8:5 (1024 × 640), and can support SXGA display when used in combination with the specially designed CXD2453Q timing generator IC. The SXGA display technique provided by the CXD2453Q decimates each frame and changes the position to provide smooth SXGA display.



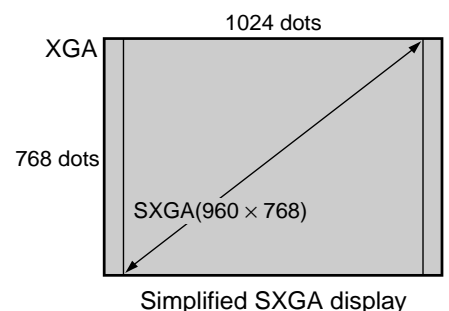
■ Figure 2 Microlens LCD



■ Figure 3 Antidust Glass Structure



■ Figure 4 Display Formats



Ease of Use

At the same time as providing up/down and/or right/left inversion functions to support a wide range of applications, Sony projector LCDs also include on-chip level shifters in the timing system to allow 5-V drive, reduce the number of external components, and suppress undesired radiation.

Either the newly developed CXD2467Q, which supports gamma correction, or the conventional CXA2111R can be used as the system IC, depending on the needs of the application, and both allow the implementation of high picture quality systems with a minimal number of adjustment points. In particular, the newly developed CXD2467Q digital signal processing IC integrates both timing generator and RGB driver functions on the same chip. Since this chip can operate with system clock rates up to 135 MHz, it can perform the operation processing required by the SXGA bandwidth. Furthermore, as opposed to the single gain and brightness adjustment function provided by earlier ICs, this IC provides three systems; user adjustments, white balance adjustments, and V-T curve variation corrections. Thus this IC provides even finer grained picture quality adjustments. (See table 1.)

Offset adjustment is made unnecessary by using the CXA2112R high voltage drive sample-and-hold IC, which provides an extremely small inter-channel offset voltage (5 mV, typical). This creates a structure that allows circuit board wiring patterns to be created easily. (See figure 5, 6, and 7.)

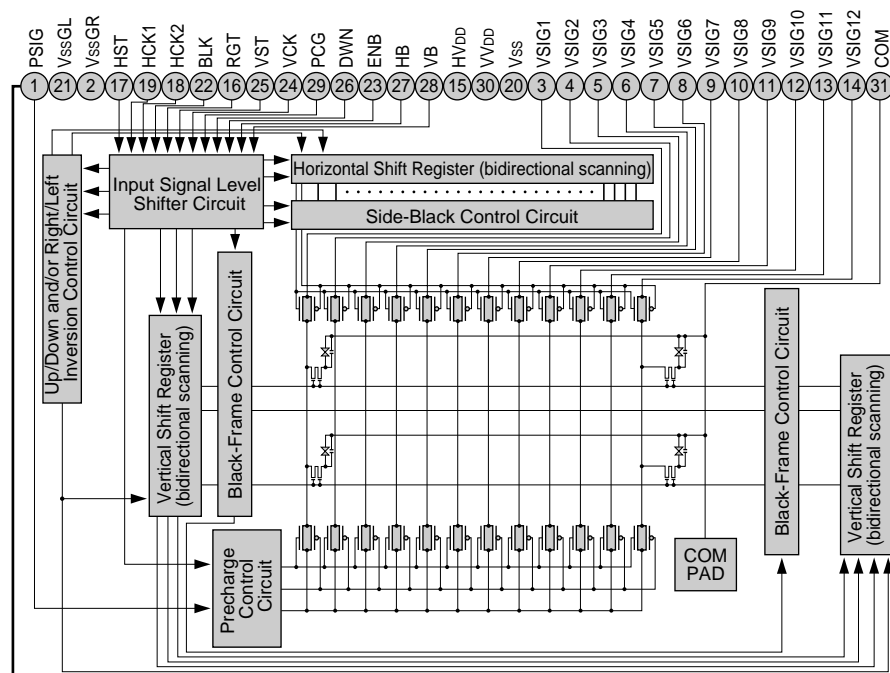
Future Developments

Miniaturization and lighter weights in data projectors has progressed and the portability of these products has improved greatly. The main desired improvement at this point is increased brightness so that clear picture quality can be provided even in relatively brightly lit rooms. Sony LCD panels now provide increased brightness by adopting the DMS structure, sealed ant dust glass structure, and on-chip microlenses. Sony will continue to look to the future and strive to develop LCD panels that can answer our customers'

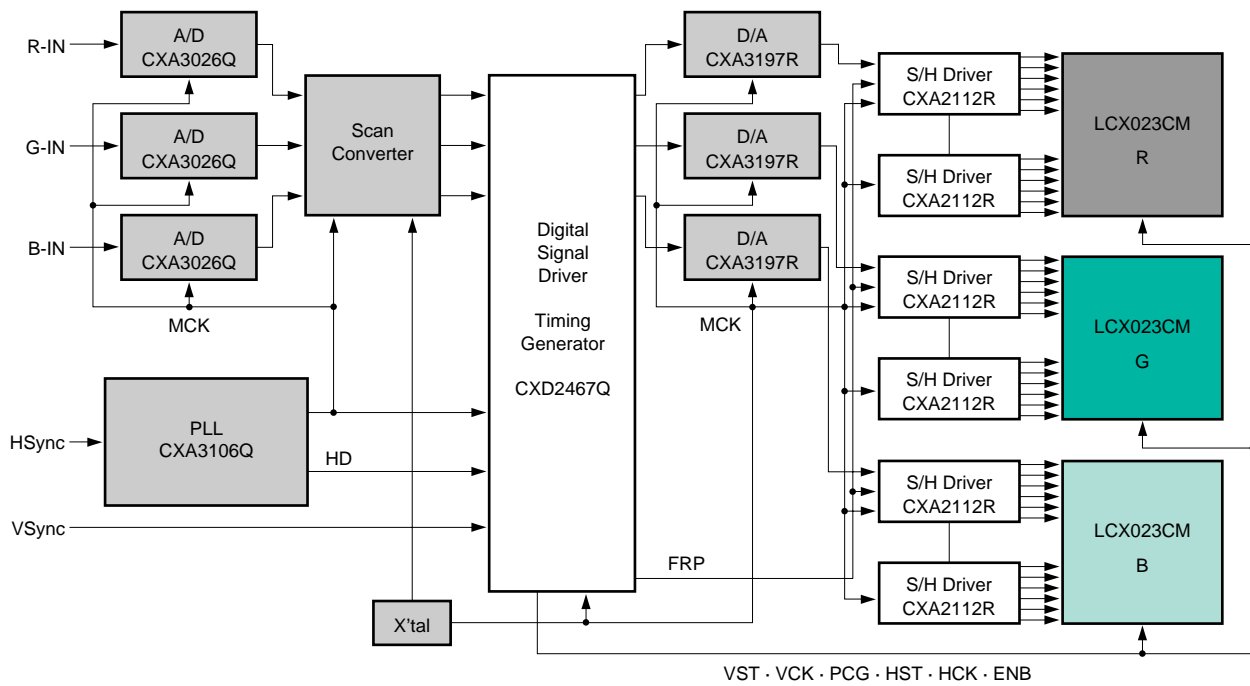
needs. You can be sure that Sony will continue to provide the most advanced LCD panel products.

■ **Table 1 Comparison of Picture Quality Adjustment Functions in the CXA2111R, CXD2449Q, and CXD2467Q**

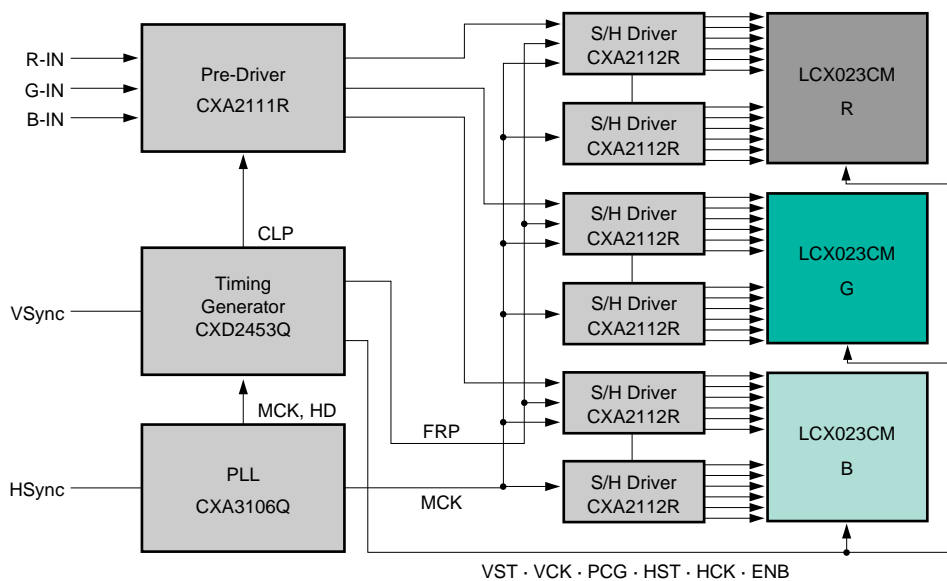
	CXD2467Q (Newly developed digital IC)	CXD2449Q (Earlier digital IC)	CXA2111R (Earlier analog IC)
User gain	Adjusted by setting register values	No adjustment function	No adjustment function
User brightness	Adjusted by setting register values	No adjustment function	Adjusted with external components
Sub-gain	Adjusted by setting register values	Adjusted by setting register values	Adjusted with external components and by setting register values
Sub-brightness	Adjusted by setting register values	Adjusted by setting register values	Adjusted with external components and by setting register values
Gamma correction	LUT method	LUT method	• Adjusted with external components and by setting register values
Gamma gain	Adjusted by setting register values	No adjustment function	• There are two black and one white inflection points
Gamma brightness	Adjusted by setting register values	No adjustment function	
Limiter	Adjusted by setting register values	Adjusted by setting register values	Only the black end of the range can be adjusted with external components.
Black frame processing	Adjusted by setting register values	Adjusted by setting register values	No adjustment function
Muting	Adjusted by setting register values	No adjustment function	No adjustment function
OSD	Adjusted by OSD input and by setting register values	No adjustment function	No adjustment function
Negative/positive inversion	Adjusted by setting register values	No adjustment function	No adjustment function



■ **Figure 5 Block Diagram**



■ Figure 6 Digital System



■ Figure 7 Analog System