FEATURING

Wider Aperture Ratio Technologies for Data Projector LCD Panels

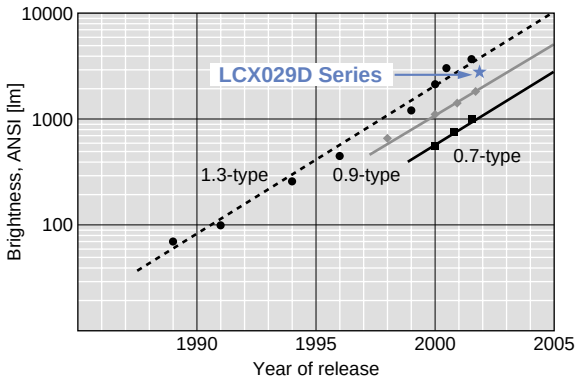
High-Temperature Polycrystalline Silicon TFT LCD Panel Achieves an Aperture Ratio of 66.1%, the Industry's Highest Level.

- **An aperture ratio of 66.1%, the industry's highest level**
- **High light resistance: 2700 ANSI lm**
- **Heat dissipating metal frame adopted**
- **Full line of optimal signal processing and drive system ICs available**

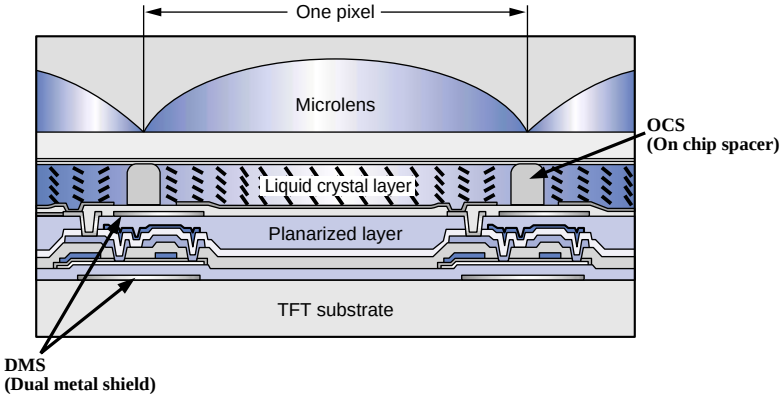
LCD data projectors are now widely used in meetings and conferences as a presentation tool, due to the widespread use of PCs. LCD data projectors feature great flexibility and support a wide range of high-level presentation techniques. However, until just a few years ago, the projected images were quite dim and they required the room lights to be lowered. However recent advances in LCD panel and optical technologies have made it possible to create much brighter projectors, although they are still quite large. (See figure 1.)

The LCX029D Series LCD panels presented in this article achieve an aperture ratio of 66.1%, the industry's highest level in a 0.9-type panel, and a light resistance of 2700 ANSI lm*, which is 1.8 times higher than previous Sony products. The LCX029D Series make it possible to create miniature light-weight high-resolution data projector products that can be used for presentations in brightly-lit conference rooms.

* : The light resistance also depends on the projector's optical system.



■ **Figure 1 Trends in Data Projector Brightness**



■ **Figure 2 Pixel Cross Section**

LCD Panel Technology

Figure 2 shows a model of the cross section of the LCX029D Series pixel. Sony achieved an improved aperture ratio and improved light resistance by adopting fine fabrication and a pixel transistor with a new structure.

■ Improved Aperture Ratio

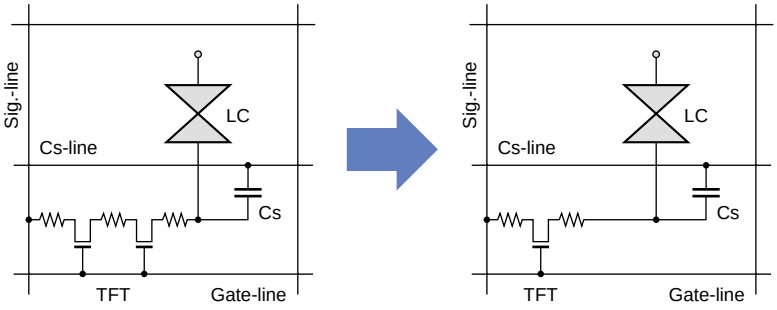
The three elements that limit the aperture ratio are the pixel transistors, the wiring required to drive those transistors, and the storage capacitors (Cs) used to hold the pixel potential. Since these must be blocked from light, they reduce the aperture area. In developing this product, Sony replaced the two series transistors used for each pixel with a single transistor. (See figure 3.) At the same time, Sony also introduced an even more advanced fine fabrication technology and a multilayer wiring structure to make it possible to increase the aperture ratio while maintaining transistor performance. This made it possible to increase the aperture ratio from 54.1% to 66.1% in a 0.9-type XGA panel.

■ Improved Light Resistance

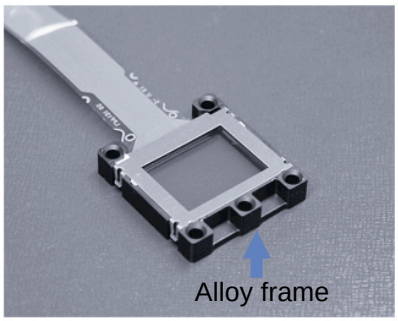
When an LCD panel is illuminated by an extremely bright light, the incident light causes leakage current to occur in the pixel transistors and degrades the picture quality. Until now, Sony has suppressed this leakage current by using a structure (DMS structure) in which a light blocking layer is provided in the layer under the pixel transistors. However, due to the increasing intensities used in recent projectors, light leakage due to dispersion and other phenomenon has now reached levels that cannot be ignored. In this product, Sony has made further optimizations in the light blocking layer pattern and has adopted a pixel transistor with a new structure that suppresses this leakage current and has succeeded in increasing the light resistance. As a result of these improvements, it is now possible to achieve excellent picture quality at high intensities of 2700 ANSI lumens and above even in a 0.9-type XGA panel with internal microlenses.

■ Heat Dissipating Structure

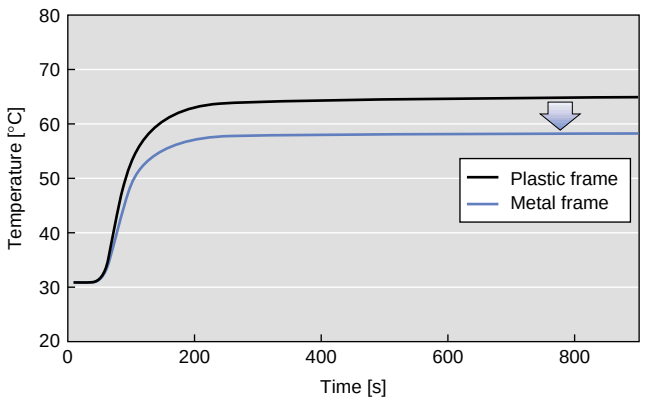
As the projector brightness increases, heating in the LCD panel becomes a problem. As a result, improved heat dissipation efficiency is now strongly desired in the panel itself. Sony has improved the efficiency of the frame at removing heat from the panel to the outside environment by using an aluminum alloy frame instead of the conventional plastic resin frame used previously. (See figure 4.) As compared to the plastic resin frame, this aluminum alloy frame provides a heat dissipation effect that is approximately 8°C better. (See figure 5.)



■ **Figure 3 Pixel Equivalent Circuit**



■ **Figure 4 LCX029 External View**



■ **Figure 5 LCD Panel Temperature Profiles in Actual Products**

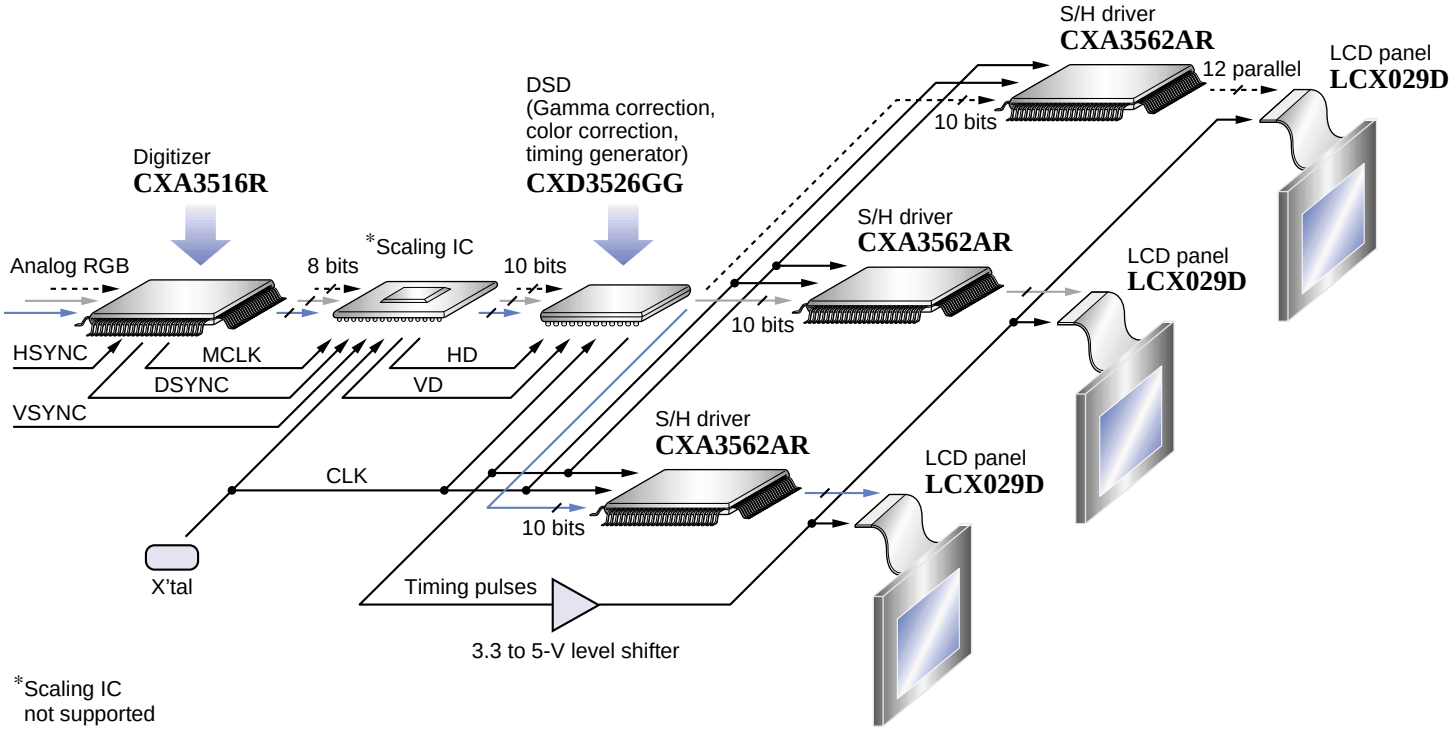
Signal-Processing and Drive System ICs

■ System Structure That Can Support a Wide Range of Applications

Figure 6 shows the system structure for driving the LCX029D Series panels. Sony's extensive LCD panel lineup covers display formats from SVGA to UXGA. Users can select a DSD (Digital Signal Driver) that performs high-resolution digital signal processing and an S/H (Sample-and-Hold Driver) that match the system structure to form an optimal drive system. (See table 1.)

■ Fine-Grained Picture Quality Adjustment

The DSD supports a wide range of functions including a high-resolution lookup table (LUT) gamma correction function, color shading correction functions for each area in the color depth range, a white balance adjustment function that in addition to main contrast and brightness adjustments also allows user adjustments, and an on-screen display (OSD) function. The CXD3511AQ operates with system clocks up to 200 MHz, and the CXD3526GG operates up to 100 MHz. Both include on-chip multi-timing generator circuits and can provide all the output pulses required by the LCD panel and the S/H driver IC. Since the S/H driver IC includes an on-chip 10-bit D/A converter, it can be directly connected digitally to the DSD ICs described above. Furthermore, the CXA3562AR can directly drive an LCD panel with 12 parallel outputs, while the CXA7000R provides 6 parallel outputs. These ICs integrate all functions required for picture quality adjustment, including precharge waveform generation and common voltage adjustment, and, in conjunction with the DSD IC, provide extremely fine-grained picture quality adjustment.



■ **Figure 6 XGA System Structure Example**

■ Approaches to PWB Design Rationalization

Sony system ICs adopt a structure that allows the same PWB design to be used even if the display format differs. For example, while SVGA and XGA have different requirements in both the number and type of S/H drivers, the same PWB can be used if the CXA3562AR is used for XGA or if the CXA7000R is used. This 2-type design can also be effective in reducing the time required for evaluation. (See figure 7.)

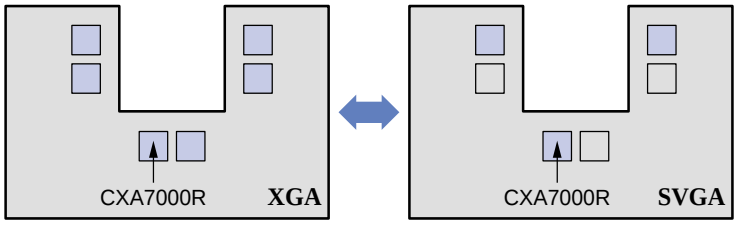
Future Developments

At the same time as introducing new types matching the current lineup based on the new fabrication process used in the LCX029D Series, Sony will also be expanding its lineup not only to respond to needs for even brighter panels, but also to support new markets, such as the home projector market, which is expected to become an area of great interest. Sony is committed to responding to our customers' various desires and the market needs in this area.

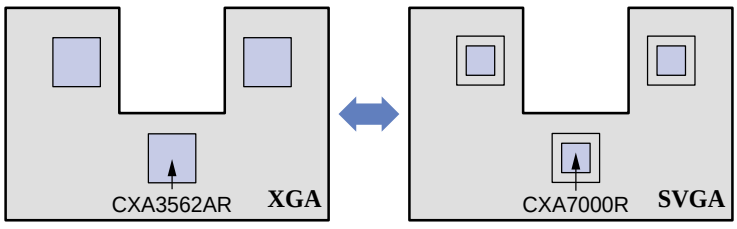
■ **Table 1 Sony System IC Products**

	DSD*1	S/H driver*2
SVGA	CXD3526GG × 1	CXA7000R × 3 (One each for RGB)
XGA		CXA7000R × 6 (Two each for RGB) or CXA3562AR × 3 (One each for RGB)
WXGA	CXD3511AQ × 1	
SXGA		
UXGA		CXA3562AR × 6 (Two each for RGB)

∗1 DSD: digital signal driver
∗2 S/H driver: sample-and-hold driver



<Structure when only the CXA7000R is used>



<Structure when the CXA7000R and CXA3562AR are used>

■ **Figure 7 Examples of Creating Shared PWBs - XGA and SVGA -**