

# Low-Temperature Polycrystalline Silicon System-on-Glass TFT LCD Display for Cellular Phones

## ACX333AKM

Sony has now developed the ACX333AKM 6 cm (2.4-type) QVGA LCD module that achieves high color purity with a color NTSC ratio of 60% and a high brightness of 300 nit, the top level in the cellular phone LCD market.

The ACX333AKM is a system display in which the whole LCD drive system is integrated on the glass substrate.

The ACX333AKM features single 2.9 V power supply operation and a reduced number of connections, making it a highly reliable module. It is truly the optimal LCD display module for cellular phones.

- 6 cm (2.4-type) QVGA transmissive panel
- High brightness and high color purity
- Single 2.9 V power supply operation system display
- 18-bit RGB digital interface circuit
- Digital VCOM adjustment function
- CPU interface IC included

### ■ Newly-Developed System Display

Sony has developed a high-level system display technology (system-on-glass technology) that forms, as a single integrated unit, all the LCD drive circuits on the LCD panel itself. This technology was developed using Sony's low-temperature polycrystalline silicon TFT technology, which achieves both high functionality and high reliability due to Sony's unique process and device technologies. The ACX333AKM integrates on the glass substrate all of the RGB interface and drive

circuits, including a supply voltage generator circuit (DC/DC converter) that can operate from a single 2.9 V power supply, an 18-bit RGB digital interface circuit, a reference driver, timing generator, a VCOM adjustment circuit, and other power supply system circuits. (See figure 1.) This system-on-glass technology can create extremely high reliability modules, since it significantly reduces the parts count and reduces the number of connections required. Furthermore, a CPU interface function can be implemented easily by using an interface IC mounted on the module FPC.

### ■ Increased Brightness

By making the oxide film in the transistor circuit thinner in a newly-developed process technology, Sony achieved a significant reduction in the surface area of the pixel internal Cs (supplementary capacitor) block. This allowed Sony to achieve an extreme high aperture ratio in the ACX333AKM, despite the fact that it has the extremely fine feature sizes of a 6 cm (2.4-type) QVGA display. By combining this display with a high-intensity backlight, Sony achieved a brightness level increased to 300 nit.

### V O I C E

System on glass displays are the new face for cellular phones. These devices are designed with an emphasis on the picture quality desired in the future for the growing range of functions in future cellular phones, such as digital still cameras, web browsing, and TV reception. Due to the energy of the project members, we were able to include many newly-developed technologies, and we created a product that is at the leading edge in terms of both picture quality and module form factor. I strongly recommend that you take advantage of Sony's LCDs, which provide bright clear images with natural colors.

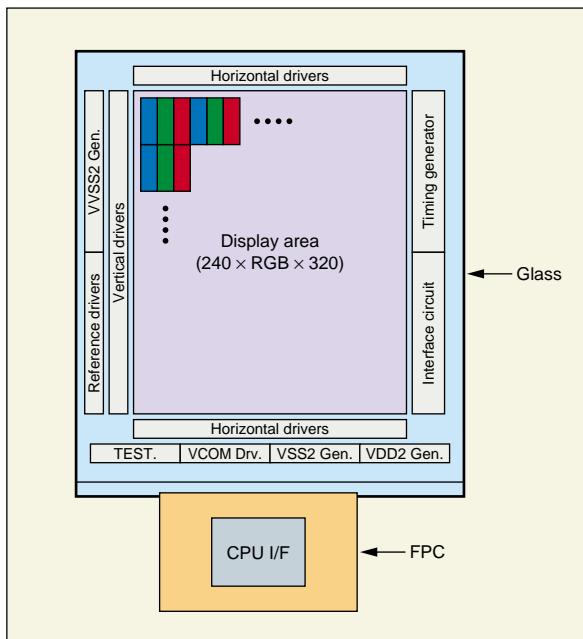
### ■ Digital VCOM Adjustment Function

The ACX333AKM is capable of adjusting the opposing electrode potentials (VCOM) digitally by using the D/A converter on the glass substrate and the CPU interface on the FPC\*. This allows a compact trimmer-free LCD module to be implemented.

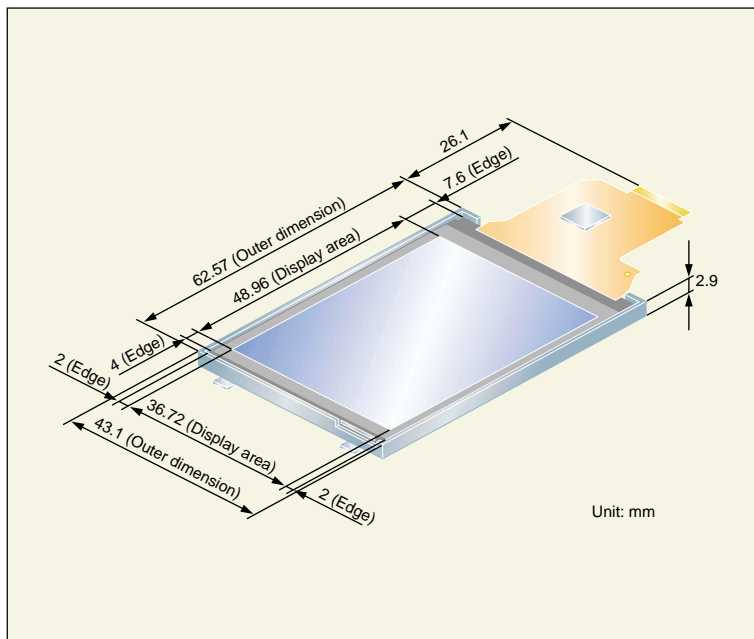
\*: ROM for the VCOM value settings is required in the external system. Note that analog adjustment using trimmers (variable resistors) is also possible without using this function.

### ■ High Color Purity

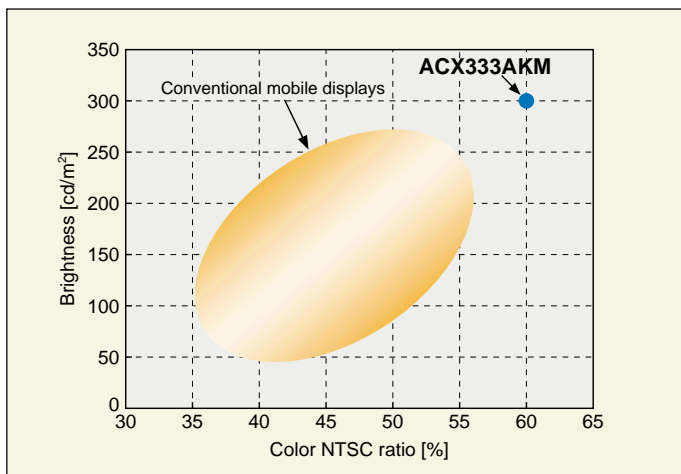
Sony developed new color filters optimized for the spectral characteristics of white LED backlights for the ACX333AKM, achieving both higher transmittance and higher color purity. As shown in figure 3, the ACX333AKM achieves an extremely wide color reproduction with a color NTSC ratio of 60%, a level that is unavailable in conventional mobile displays.



■ Figure 1 ACX333AKM Drive Circuit Block Diagram



■ Figure 2 ACX333AKM Module Drawing



■ Figure 3 Comparison of ACX333AKM and Conventional Mobile Display Optical Characteristics



■ Photograph 1 ACX333AKM Display Example

■ Table 1 ACX333AKM Main Characteristics

Number of pixels	240 × 320
Diagonal size	6 cm (2.4-type)
Pixel pitch	153 μm
Display mode	Transmissive TN mode
Interface	RGB, 18 bits
Number of colors	262,144
Supply voltage	2.9 V
Interface voltage	2.9 V
Power consumption (Still picture, full-screen display, 262K colors)	25 mW
Brightness	300 nit
NTSC ratio	60 %