High Image Quality Super HAD CCD Optimal for Digital Recording
1/4-Inch 360,000 and 420,000-Pixel Color CCD Image Sensors

Super HAD CCD* Products
ICX088AK(NTSC) ICX089AK (PAL)

Digital video cameras have recently appeared in the consumer camcorder market, and not only is this market expected to expand, there are even hopes that the digital video camera can become a common consumer item. To respond to these hopes, Sony has developed the ICX088AK and ICX089AK as CCDs optimal for miniature digital video cameras.
The ICX088AK and ICX089AK are optimal CCDs for digital recording with the 1/4-inch optical system that has become the mainstream in the camcorder area. By adopting the "*Super* HAD CCD*" technology and by reducing the drive voltage, these CCDs can provide the high image quality and low power consumption required in digital video cameras.

- **1/4-inch optical system**
- **Supports the DV technique (13.5-MHz drive)**
- **High sensitivity (+4.5 dB higher than the Sony ICX068AK and ICX069AK)**
- **Wide dynamic range (+2.5 dB wider than the Sony ICX068AK and ICX069AK)**
- **Low voltage and low power consumption**
  Supply voltage: 12 V
  Horizontal register reset gate drive amplitude: 2.7 to 3.6 V

Now that digital video cameras from many manufacturers are enjoying brisk sales, Sony has developed two new CCDs, the ICX088AK and the ICX089AK, which are optimal for use in miniature digital video cameras. These products incorporate the latest 1/4-inch CCD technology and were developed for systems that insist on the high image quality promised by digital recording. As low power devices and as devices that support electronic zoom and electronic vibration stabilizer, these devices are optimal standard CCDs for digital recording.

V O I C E

The ICX088AK and ICX089AK are CCDs that are optimal for digital recording. They incorporate Sony's latest CCD technology, including the Super HAD CCD technology, and achieve imaging characteristics that can take full advantage of the high image quality recording that digital recording is capable of. These are 1/4-inch CCDs that are appropriate for a digital age.

Support for the DV Technique

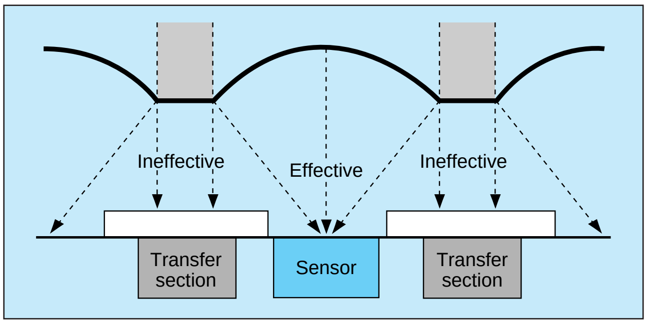
The ICX088AK and ICX089AK are interline transfer CCDs that support the DV technique. The effective number of pixels provided by the NTSC ICX088AK is 724(H) · 494(V) (360,000 pixels) and by the PAL ICX089AK is 724(H) · 582(V) (420,000 pixels). Both products use a horizontal drive frequency of 13.5 MHz, which is also the sampling rate in the DV technique. (See table 1.) This means that these CCDs are not only optimal for miniature digital video cameras, but also that they can contribute to signal-processing system simplification, since rate conversion is not required. They are also appropriate for a wide range of image capture device applications, such as digital still cameras.

High Image Quality

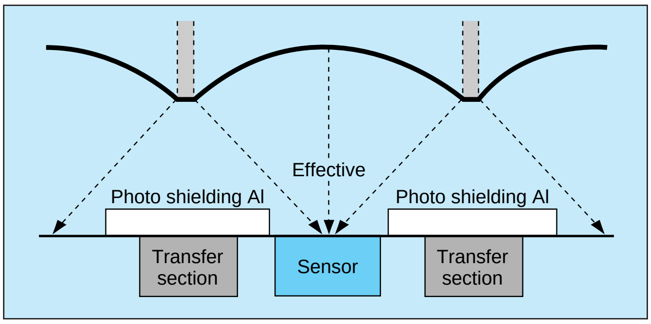
In designing the ICX088AK and ICX089AK, Sony explicitly addressed the issue of improving the sensor characteristics, since that is the area required to provide improved image quality. First, we adopted the Super HAD CCD technology, which increases the effective optical efficiency by minimizing the ineffective areas on the CCD with a microlens over each pixel. This provides a sensitivity increased by +4.5 dB over the Sony ICX068AK and ICX069AK CCDs. (See figures 1 and 2.) These CCDs also provide a saturation signal level improved by +2.5 dB over the Sony ICX068AK and ICX069AK by increasing the amount of charge handled per unit area in the vertical registers. (See table 2.)

Low Power Consumption

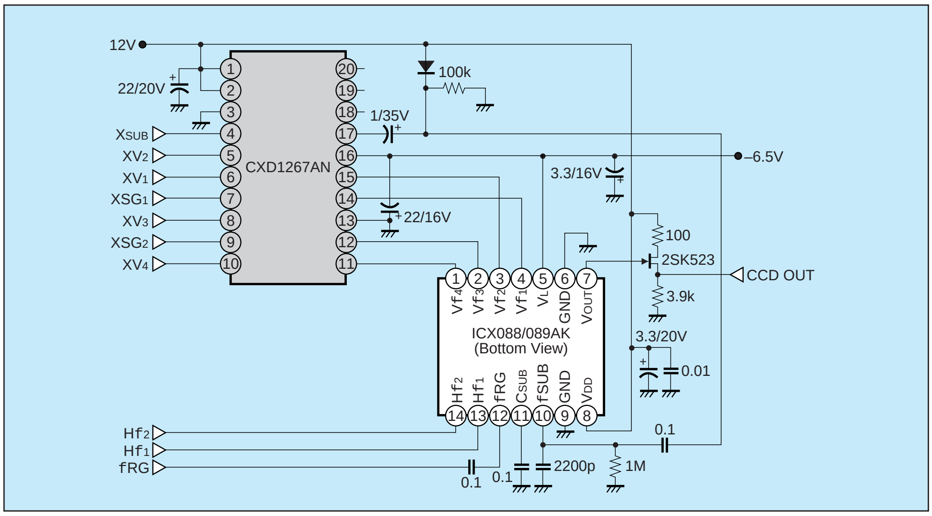
By optimizing the sensor structure, we were able to lower the voltage used to read out images to the vertical register and thus achieve operation from a 12-V power supply. The vertical register drive amplitude was also reduced to the low voltage of 6.5 V. Furthermore, by adopting a nonvolatile analog memory circuit, we were able to make the substrate voltage and the reset gate bias free from external adjustment, and we achieved a minimum 2.7-V drive in both the reset gate and the horizontal register drive amplitudes. (See table 3.)



n **Figure 1 Previous CCD Sensor Structure**



n **Figure 2 Super HAD CCD Sensor Structure**



n **Figure 3 Drive Circuit Example**

n **Table 1 ICX088AK and ICX089AK Device Structures**

Item	ICX088AK	ICX089AK
Optical size	1/4-inch format	
TV format	NTSC	PAL
Transfer technique	Interline transfer technique	
Total number of pixels	766 (H) · 508 (V) Approx. 390,000 pixels	766 (H) · 596 (V) Approx. 460,000 pixels
Number of effective pixels	724 (H) · 494 (V) Approx. 360,000 pixels	724 (H) · 582 (V) Approx. 420,000 pixels
Number of pixels used	711 (H) · 485 (V) Approx. 340,000 pixels	702 (H) · 575 (V) Approx. 400,000 pixels
Chip size	4.60mm (H) · 3.97mm (V)	
Unit cell size	5.05µm (H) · 5.55µm (V)	5.15µm (H) · 4.70µm (V)
Optical black	Horizontal (H) direction: front 2 pixels, rear 40 pixels Vertical (V) direction: front 12 pixels, rear 2 pixels	
Number of dummy bits	Horizontal: 20 Vertical: 1 (Even fields only)	
Horizontal drive frequency	13.5MHz	
Package	14-pin DIP (Plastic)	

n **Table 2 ICX088AK and ICX089AK Imaging Characteristics**

Item	ICX088AK/089AK	ICX068AK/069AK	Notes
Sensitivity (F 5.6)	480mV/470mV	290mV/280mV	3200K, 706cd/m^2
Saturation signal level	800mV/720mV	600mV/540mV	
Smear (F 5.6)	–86dB		Using the V/10 technique

n **Table 3 ICX088AK and ICX089AK Voltage Specifications**

Item	Voltage specification
Supply voltage (typ.)	12V
Vertical register drive amplitude (typ.)	6.5V
Horizontal register drive amplitude (min.)	2.7V
Reset gate drive amplitude (min.)	2.7V