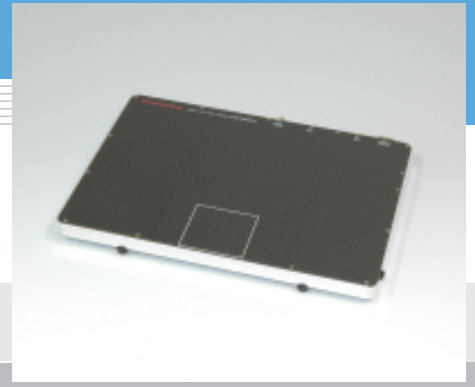




IMAGE SENSOR

# Flat panel sensor C9728DK-10

Cassette type X-ray sensor with USB 2.0 interface



### Features

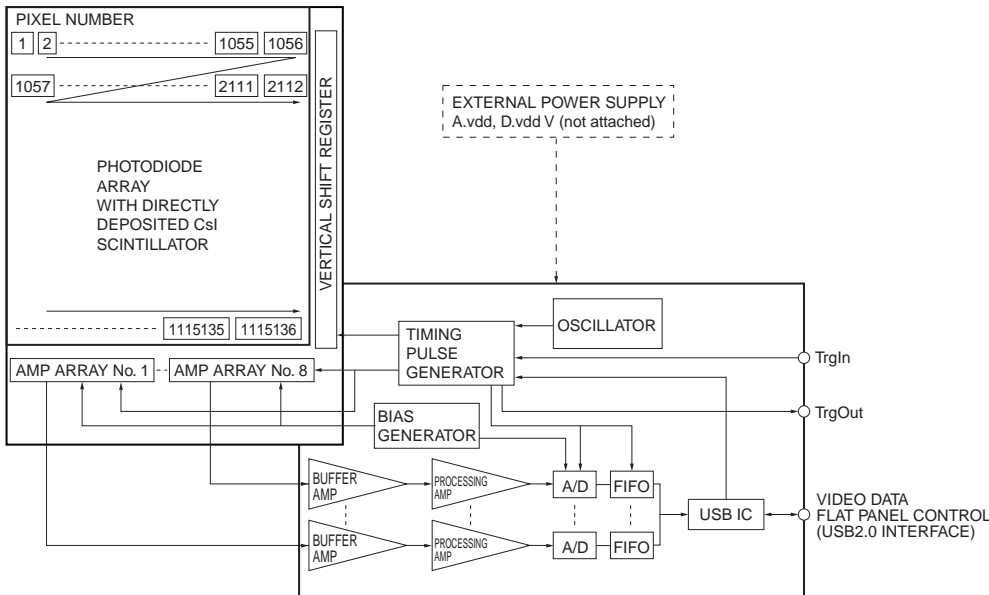
- Low noise: 80 electrons
- High quality image: 1032 x 1032 pixels
- Pixel size: 50 x 50 μm
- Digital output: 14-bit USB 2.0 interface
- High-speed imaging: 3 frames/s
- Supports HAMAMATSU API (DCAM-API).

### Applications

- Diffraction
- Radiography

### Block diagram

C9728DK-10 is a lightweight and compact flat panel sensor consisting of a sensor board and a control board. The sensor board also has 8 charge-sensitive amplifier arrays each having 132 channel amplifiers with a horizontal shift register. Analog video signals are amplified as the charge on each video line by 1056 ch charge amplifiers with CDS (Correlated Double Sampling) circuits added, and are output each of 8 amplifier arrays.



Note: Signals are read out in order of pixel number.

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■ General ratings

Parameter	Specification	Unit
Pixel size	50 × 50	μm
Photodiode area	52.8 × 52.8	mm
Number of pixels	1056 × 1056	pixels
Number of active pixels	1032 × 1032	pixels
Readout	Charge amplifier array	-
Video output	USB 2.0 14-bit	-
TrgIn, TrgOut	TTL	-
Scintillator	CsI	-

■ Absolute maximum ratings (Ta= 25 °C)

Parameter	Symbol	Value	Unit
Supply voltage for digital circuitry (+5 V)	D.vdd	+6.0	V
Supply voltage for analog circuitry (+5 V)	A.vdd	+6.0	V
Input voltage	Vin	0 to 6.0	V
Operating temperature *1	Topr	0 to +35	°C
Storage temperature *1	Tstg	0 to +50	°C

\*1: No condensation

■ Specification (Ta=25 °C, A.vdd=5.0 V, D.vdd=5.0 V)

Parameter	Symbol	Min.	Typ.	Max.	Unit
Frame rate (single operation)	Sf (int)	2.85	3	-	frame/s
Frame rate external (single operation)	Sf (ext)	-	Sf (int) to 0.1	-	frame/s
Noise (rms) *2	N (rms)	-	80	-	electrons
Sensitivity *3	S	360	450	-	LSB/mR
Saturation charge	Csat	-	0.45	-	M electrons
Resolution *4	Reso	9	10	-	line pairs/mm
Dynamic range	-	-	5600	-	-
Defect line *5	-	-	-	10	lines
Output offset *6	-	-	260	800	LSB

\*2: Internall trigger mode, single operation

\*3: 25 kVp (Mo target X-ray source), without filter

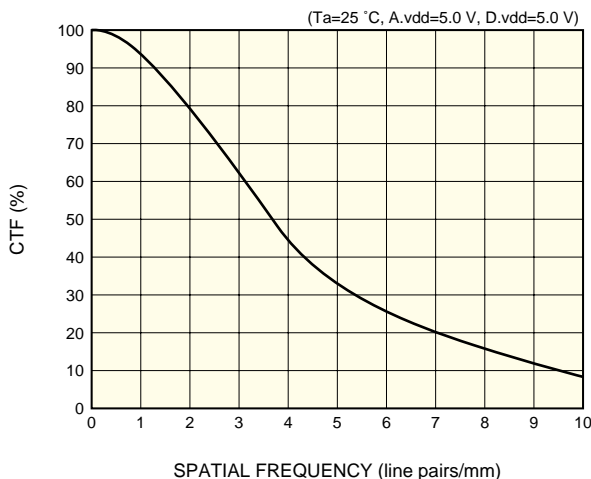
\*4: Spatial frequency at CTF=5 %

\*5: A defect line is a horizontal or vertical line containing 4 or more pixels that produce less than 1/8 of the average output from surrounding pixels and are formed continuously from the opposite side of a horizontal shift register or a vertical shift register.

\*6: Average of all active pixels in single operation at Sf (int)

Note: X-ray energy range is less than 18 keV.

■ Resolution



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## ■ System requirements

To operate C9728DK-10 at full performance, the following system and peripherals are required.

- PC: IBM full compatible PC with USB 2.0 running on Windows XP. The south bridge of on-board Intel chip set should be ICH4 or later.
- Power source: A.vdd = +5.0 ± 0.1 V (600 mA), D.vdd = +5.0 ± 0.1 V (900 mA)

Please use a low noise series power supply. (Avoid using a switching power supply.) A pigtail power cable (terminated with a JST J-C9-2C plug at one end and open at the other end; 2 m; see Table 1.), an trigger cable (terminated with an FGG.0B. 304. CLAD56 plug at one end and open at the other end; 5 m; see table 2.) and an earth cable (AWG 18; 4 m) come supplied with C9728DK-10.

The voltages described above are specified at the flat panel sensor side. The impedance of the power cable attached with the flat panel sensor is low enough but it causes 0.1 V approx. drop. Therefore the voltage at the power source side should be set 0.1 V higher than the voltage specified above. Install a noise filter on the AC power input line to prevent surges on the AC line.

DCAM-API (Digital Camera Application Programming Interface) produced by HAMAMATSU supports C9728DK-10. The driver software and DLL are included in DCAM-API. The latest version of the DCAM-API can be downloaded from <http://www.dcamapi.com/>. DCAM-SDK which includes function manual and sample software can be provided only for OEM customer.

The USB receptacle is mini-B type. The mini-B USB cable is not attached.

The earth terminal must be connected to a stable earth point to eliminate noise from surroundings.

Table 1: Pin assignment and cable color for 9-pin power receptacle

Pin No.	Color	Signal
1	Yellow	Digital GND
2	Blue	Digital GND
3	Gray	Analog GND
4	Black	Analog GND
5	Red	Analog GND
6	Green	Digital +5 V
7	Purple	Digital +5 V
8	White	Analog +5 V
9	Brown	Analog +5 V

9-pin receptacle: DE-9PF-N made by JAE (Japan Aviation Electronics Industry, Limited)

Mating plug: JST J-C9-2C made by J.S.T. Mfg. Co., Ltd.

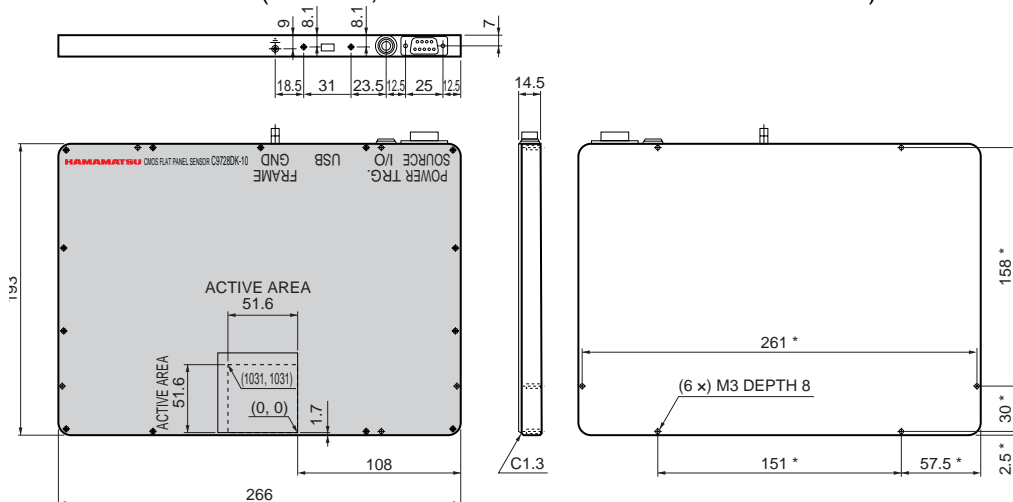
Table 2: Pin assignment and color cable for 4-pin trigger cable

Pin No.	Color	Signal	
1	Blue	Twist pair	TrgIn
2	Orange		Digital GND
3	Green	Twist pair	TrgOut
4	Brown		Digital GND

4-pin receptacle: ECG. 0B. 304. CLL made by LEMO S. A.

Mating plug: FGG. 0B. 304. CLAD56 made by LEMO S. A.

## ■ Dimensional outline (unit: mm, tolerance: ±1 mm unless otherwise noted)



Top cover material including window is carbon fiber (1.0 mm thickness).  
Weight: 1.3 kg

\* ±0.5

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**■ Notice**

- Do not subject the Flat Panel Sensors to strong vibration or shock. (Strong shock such as drop impacts may cause permanent damage to these sensors.)
  - Users must take responsibility for implementing X-ray shielding safety measures to avoid the risk of X-ray exposure.
  - The specification listed in this datasheet is defined at the time of shipment. Characteristics may vary somewhat due to exposure to X-rays so take proper countermeasures such as making periodic image correction.
  - This product is warranted for a period of 12 months after the date of the shipment.
- The warranty is limited to replacement or repair of any defective product due to defects in workmanship or materials used in manufacture. The warranty does not cover loss or damage caused by natural disaster, misuse (including modifications and any use not complying with the environment, application, usage and storage conditions described in this datasheet), or total radiation dose over 45000 Roentgen (less than 18 keV) even within the warranty period.

**HAMAMATSU**

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