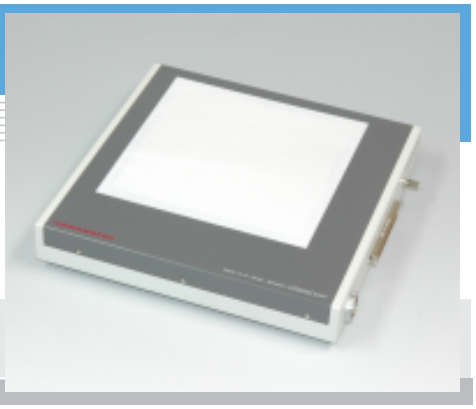
Flat panel sensor
C9250DP

High sensitivity, high-speed frame rate, high resolution



Flat panel sensor C9250DP is a digital X-ray image sensor newly developed as key devices for real-time imaging applications requiring high resolution X-ray images.

Features

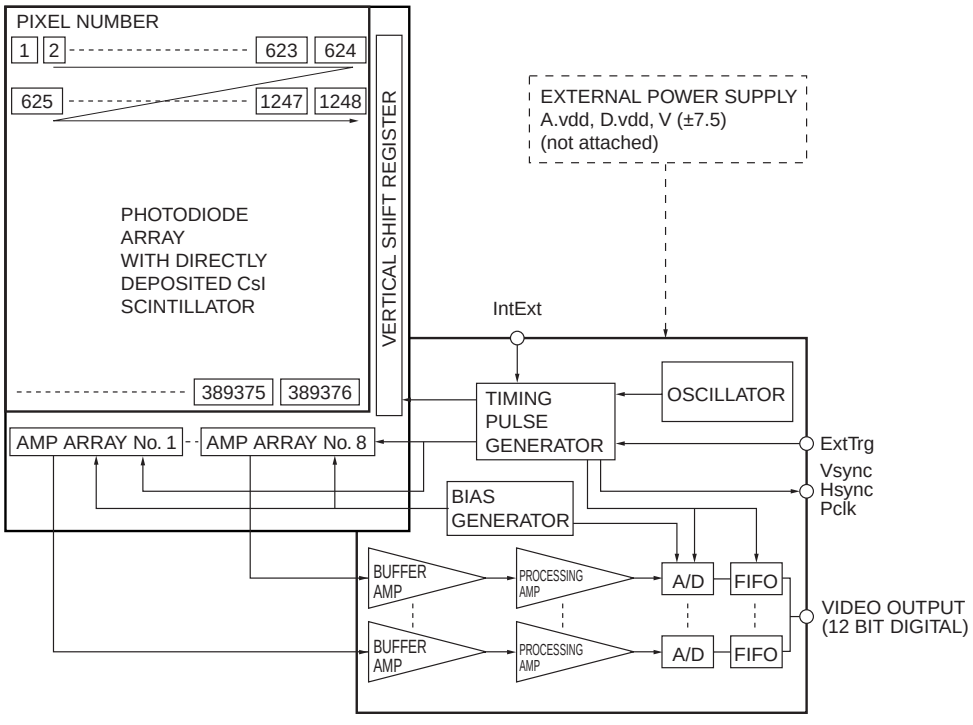
- High sensitivity
- High-speed frame rate: 30 frames/s
- 624 × 624 pixels
- Flat panel structure wituout image distortion
- 12-bit digital output

Applications

- Digital radiography
- Real time CT, etc.

■ Block diagram

C9250DP 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 78 ch amplifiers with a horizontal shift register. Analog video signals are amplified as the charge on each video line by 624 ch charge amplifiers with CDS (Correlated Double Sampling) circuits added, and are output each of 8 amplifier arrays. The control board converts the analog video signal into a 12-bit digital signal and outputs it to an external frame grabber through the 12-bit parallel port.



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

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■ General ratings

Parameter	Specification	Unit
Pixel size	200 × 200	µm
Photodiode area	124.8 × 124.8	mm
Number of pixels	624 × 624	pixels
Number of active pixels	608 × 616	pixels
Readout	Charge amplifier array	-
Video output (Data1 - 12)	LVDS (differential) 12 bit	-
Output data rate	15.15	MHz
Synchronous signal (Vsync, Hsync, Pclk)	LVDS (differential)	-
ExtTrg, IntExt	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
Supply voltage for analog circuitry (±7.5 V)	V(±7.5)	±12	V
Input voltage (ExtTrg, IntExt)	Vin	0 to 6.0	V
Operating temperature *1	Topr	0 to +35	°C
Storage temperature *1	Tstg	0 to +50	°C

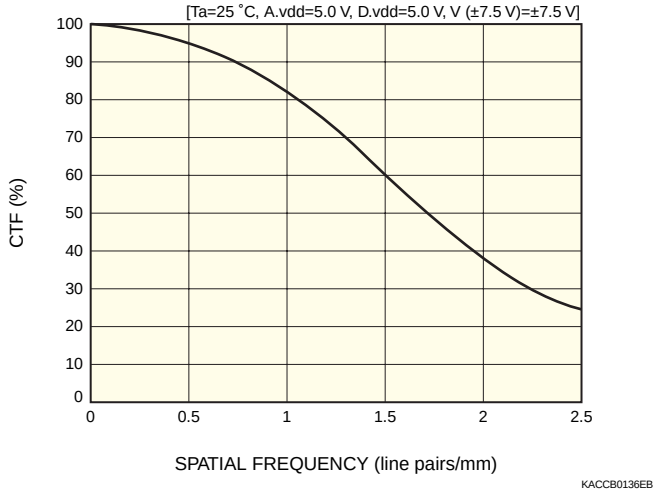
*1: No condensation.

■ Specification [Ta=25 °C, A.vdd= 5.0 V, D.vdd= 5.0 V, V (±7.5)= ±7.5 V]

Parameter	Symbol	Min.	Typ.	Max.	Unit
Frame rate (single operation)	Sf (int)	28.5	30	-	frames/s
Frame rate external	Sf (ext)	-	Sf (int) to 0.1	-	frames/s
Noise (rms) *2	N (rms)	-	2500	-	electrons
Saturation charge	Csat	-	10	-	M electrons
Sensitivity *3	S	1920	2400	-	LSB/mR
Resolution *4	Reso	2	2.5	-	line pairs/mm
Dynamic range	-	-	4000	-	-
Defect line *5	-	-	-	10	lines
Output offset *6	-	-	65	200	LSB

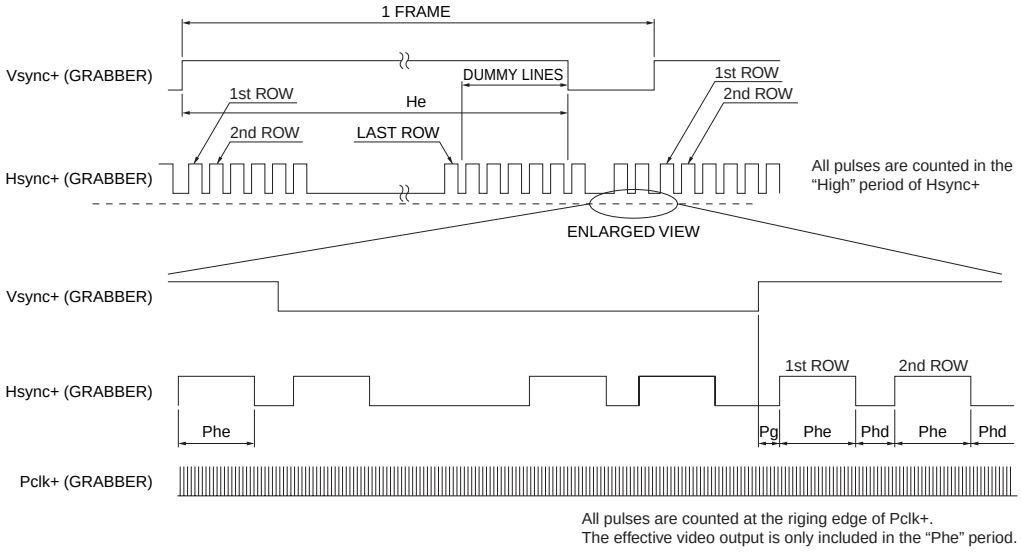
*2: Internal trigger mode, single operation
*3: 80 kVp, acrylic filter 170 mm
*4: Spatial frequency at CTF=5 %
*5: A defect line is a horizontal or vertical line containing 4 or more pixels that produce less than 5/8 of the average output from surrounding pixels and are formed continuously from the opposite side of an amplifier array or a vertical shift register. Without a couple of adjacent defect line.
*6: Average of all effective pixels in single operation at Sf (int)
Note: X-ray energy range is 20 k to 80 kVp.

■ Resolution



■ Timing chart

To acquire images through an image grabber board, write parameters in the software program or parameter file by referring to the following timing chart and description.



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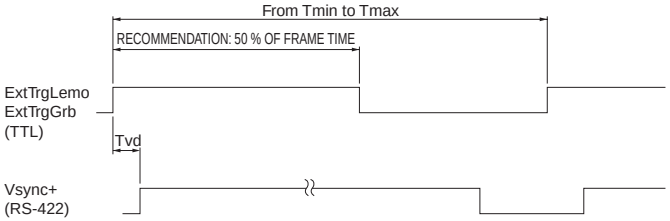
Parameter		Count
He	Effective line	616
	Dummy line	8
Phe	Effective pixel	608
	Dummy pixel	17
Phd		157
Pg		19

Note: "He" is the Hsync count. Phe, Phd and Pg are the Pclk count.

■ External trigger mode

To acquire images in external trigger mode, input an external trigger pulse as shown below. When the time Tvd has passed after the rising edge of the external trigger pulse, synchronous signals and video signals are output.



Hsync+, Pclk+ and Data 1-12 are the same as internal trigger mode.
· Tmin is defined as 1/Sf (int).
· Tmax is defined as the reciprocal of the minimum value of Sf (ext).
· Tvd=100 µs

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■ System requirements

To operate C9250DP at full performance, the following system and peripherals are required.

· PC: IBM compatible PC running on Windows XP or later operating system

· Digital frame grabber card: Monochrome 16 bits or more, pixel clock 15.15 MHz or more, LVDS interface synchronous signal (See the frame grabber manual.)
The National Instruments IMAQ PCI-1424 (NI parts No. 777662-02) frame grabber has been verified to successfully acquire 12-bit digital images from C9250DP. The IMAQ PCI-1422 (NI parts No. 777959-02) also acquires satisfactory images from C9250DP. You can utilize the demonstration software that comes with the frame grabber as a simple viewer, to acquire and save an image. To do so, refer to the frame grabber user's guide for how to use the camera information file for the demonstration software.

· Power source: A.vdd = +5.0 ± 0.1 V (700 mA), D.vdd = +5.0 ± 0.1 V (400 mA), V (±7.5) = ±7.5 ± 0.5 V (±100 mA)
Please use a low noise series power supply. (Avoid using a switching power supply.) A optional power cable (terminated with an FGG.2B.307.CLAD92Z plug at one end and open at the other end; 2 m; see Table 2.) and an earth cable (AWG 18; 4 m) comes supplied with C9250DP. An optional frame grabber cable for interface with the 80-pin receptacle (see Table 1) on C9250DP is also available for synchronous signal, video output and external control.
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. The earth terminal must be connected to a stable earth point to eliminate noise from surroundings.

Table 1: Pin assignment of 80-pin receptacle

Pin No.	Signal	Pin No.	Signal
1	Data1+	41	Reserved
2	Data1-	42	Reserved
3	Data2+	43	Reserved
4	Data2-	44	Reserved
5	Data3+	45	Reserved
6	Data3-	46	Reserved
7	Data4+	47	Reserved
8	Data4-	48	Reserved
9	Data5+	49	Reserved
10	Data5-	50	Reserved
11	Data6+	51	Reserved
12	Data6-	52	Reserved
13	Data7+	53	Reserved
14	Data7-	54	Reserved
15	Data8+	55	Reserved
16	Data8-	56	Reserved
17	Data9+	57	Reserved
18	Data9-	58	Reserved
19	Data10+	59	Reserved
20	Data10-	60	Reserved
21	Data11+	61	Reserved
22	Data11-	62	Reserved
23	Data12+ (MSB)	63	Reserved
24	Data12- (MSB)	64	Reserved
25	Reserved	65	Reserved
26	Reserved	66	Reserved
27	Reserved	67	Reserved
28	Reserved	68	Reserved
29	Reserved	69	Reserved
30	Reserved	70	Reserved
31	Reserved	71	Reserved
32	Reserved	72	Reserved
33	IntExt (TTL)	73	ExtTrg (TTL)
34	Reserved	74	Reserved
35	Vsync+	75	Reserved
36	Vsync-	76	Reserved
37	Hsync+	77	Reserved
38	Hsync-	78	Reserved
39	Pclk+	79	GND
40	Pclk-	80	GND

Unless otherwise noted, signal level is LVDS.
80-pin receptacle: PCS-E80LMO made by Honda Tsushin Kogyo Co., Ltd.
Mating plug: PCS-E80FA made by Honda Tsushin Kogyo Co., Ltd.
Pins described "Reserved" are prepared for an extention of the future. Do not connect any signal or power or GND to this plug.

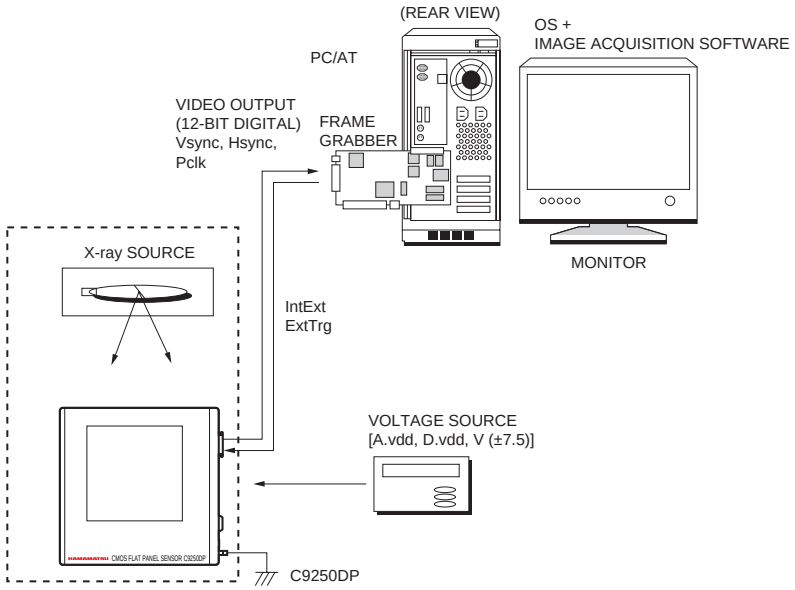
Table 2: Power pin assignment and cable color

Pin No.	Color	Signal
1	Brown	+7.5 V
2	Red	Analog GND
3	Orange	-7.5 V
4	Yellow	Analog GND
5	Green	Analog +5 V
6	Blue	Digital GND
7	Purple	Digital +5 V
Shield	-	Analog GND

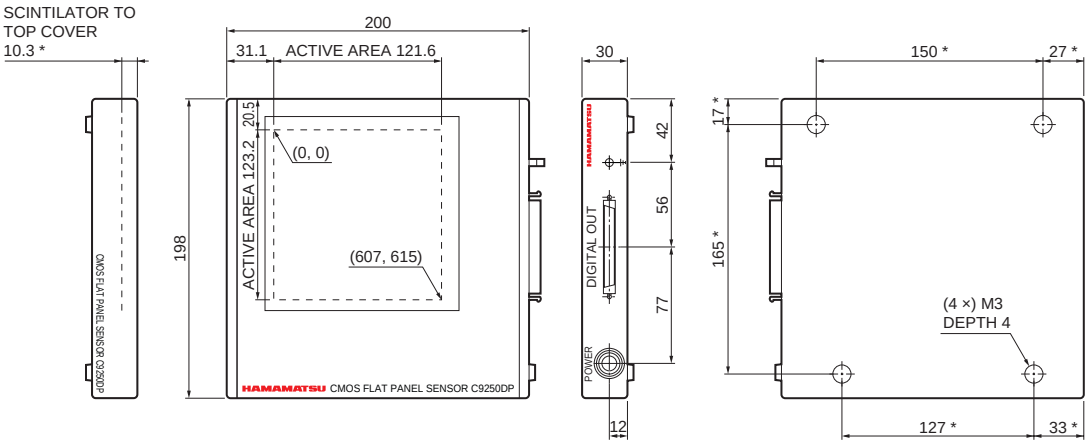
7-pin power plug: FGG.2B.307.CLAD92Z made by LEMO S. A.
7-pin power receptacle: ECG.2B.307.CLV made by LEMO S. A.

■ Connection

Install the digital frame grabber board into the PC by the manufacture's instructions. When a general-purpose frame grabber board is used, trigger operation for IntExt and ExtTrg can be controlled with its digital I/O control.



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



Window material is polycarbonate 1.0 mm thickness
Weight: 2.5 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.
- Data listed in this datasheet was measured 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 1 million Roentgen (80 kV) even within the warranty period.

■ Optical frame grabber cable

Frame grabber	Cable type No.	Cable length	Cable end	Cable end
General-purpose	A8406-41	5 m	PCS-E80FA *8	open
	A8406-46	7 m		
	A8406-47	10 m		
	A8406-48	12 m		
IMAQ PCI-1424 *7	A8406-42	5 m		PCS-XE100MA+ *8
	A8406-43	7 m		
	A8406-44	10 m		
	A8406-45	12 m		

*7: Made by NI (National Instruments Corporation)
*8: Made by Honda Tsushin Kogyo Co. Ltd.
Note: The detailed information for these optional cables is shown in the datasheet of A8406 series.

HAMAMATSU PHOTONICS K.K., Solid State Division
1126-1 Ichino-cho, Higashi-ku, Hamamatsu City, 435-8558 Japan, Telephone: (81) 53-434-3311, Fax: (81) 53-434-5184, www.hamamatsu.com
U.S.A.: Hamamatsu Corporation: 360 Foothill Road, P.O.Box 6910, Bridgewater, N.J. 08807-0910, U.S.A., Telephone: (1) 908-231-0960, Fax: (1) 908-231-1218
Germany: Hamamatsu Photonics Deutschland GmbH: Arzbergerstr. 10, D-82211 Herrsching am Ammersee, Germany, Telephone: (49) 08152-3750, Fax: (49) 08152-2658
France: Hamamatsu Photonics France S.A.R.L.: 19, Rue du Saule Trapu, Parc du Moulin de Massy, 91882 Massy Cedex, France, Telephone: 33-(1) 69 53 71 00, Fax: 33-(1) 69 53 71 10
United Kingdom: Hamamatsu Photonics UK Limited: 2 Howard Court, 10 Tewin Road, Welwyn Garden City, Hertfordshire AL7 1BW, United Kingdom, Telephone: (44) 1707-294888, Fax: (44) 1707-325777
North Europe: Hamamatsu Photonics Norden AB: Smidesvägen 12, SE-171 41 Solna, Sweden, Telephone: (46) 8-509-031-00, Fax: (46) 8-509-031-01
Italy: Hamamatsu Photonics Italia S.R.L.: Strada della Moia, 1/E, 20020 Arese, (Milano), Italy, Telephone: (39) 02-935-81-733, Fax: (39) 02-935-81-741

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