

We make optical measurements easy!

Our CCD line-scan cameras are suitable for all kind of optic measuring task, like object recognition, quality control tests, position and distance measurement, or for spectral and laser beam diagnostics. Picture recognition systems for simple measurement tasks up to complete systems for spectroscopy with cooled sensors (also UV and IR) are available.

The sensors of the cameras which can be delivered have 128, 256, 1024, 1728, 2048, 3456, 5000 or 7926 pixels (pixel = "picture elements"). The pixels are assembled in a line and build a high definition, one-dimensional optical multi channel detector (OMA). The sensors, which are used mainly in copiers and fax machines, are also well suited for all other kinds of measuring tasks.

The optic signal can be coupled directly or focused with a lens to the sensor. The sensor sensitivity extends over a spectral range of 400 to 1100 nm according to the detector area. An expanded measuring range from 200 nm is possible by a sensors without window or with quartz window.

Also available are special line sensors for spectroscopy, which are sensitive in the near infrared range from 0.9 μm to 1.7 μm . These sensors have to be cooled thermo electrically down to -20°C . We can deliver complete camera systems with stable cooling and a sealed case for avoiding condensation at the detectors window.

Also available are specially coated sensors, which are sensitive in the X-ray range of 10 to 100 keV.

For running the camera with a IBM-compatible computer, we suggest our comprehensive software package. This package contains the entire interface programming, including the operation of several cameras simultaneously, as well as a graphical online display of the data on the screen. The program is delivered with source code (Turbo- Pascal), so that you can make all necessary changes you need for your application.

For the IBM-PC a modified printer card is offered to operate the camera. Also a connection to any other computer is possible, in this case 8 data lines (input) and 2 handshake lines (output) are required.

In our cameras the complete electronics for clock and level control for the sensor is integrated, as well as an 8 bit parallel interface for data transmission. The interface at the camera series CCD 2000 is switchable between an IEC-bus interface or a simple parallel interface. At the series 2010 only the parallel interface is possible, however the data transmission speed is doubled.

Sensors with a 12 bit resolution are also available. This leads indeed to twice the data transmission time. Besides this, the noise of some sensors at room temperature is relatively high, so that an advantage of a full 12 bit solution can only be achieved with the available thermo electrical cooling.



The sensor reacts in a similar way to a chemical film: the light is integrated in the sensor cells, until the read out sequence is started. The exposure time is determined by the distance between two read out processes and as a result the sensitivity can be increased by raising that interval. The simplest way to use the camera is a continuous read of the line with a constant repetition rate.

Sensor Specifications - Series 2010

Standard sensors with glass window

TH 7803A(Z) with 1728 pixel (Th)	
active length	: 17,3 mm
max. exposure time	: 5 sec.*
pixel size	: 10 x 13 μm^2
dyn. range ptp	: 1200:1(6000:1rms)
responsivity	: 4,5 V/($\mu\text{J}/\text{cm}^2$)
optical responsivity	: ca. 0,4 - 1,1 μm
Pclk /linerate	: 2 MHz /1kHz

Anti-Blooming

The anti-blooming sensor can be overexposed in one pixel up to 100 times without flooding the hole sensor with electrons. An overexposed standard sensor shows maximum value over all pixels.

Anti-Blooming sensor IL-C6 2048C

with 2048 pixel (DALSA)	
active length	: 26,6 mm
max. exposure time	: 0.2 sec. *
pixel size	: 13 x 500 μm^2
dyn. range rms	: 6000:1
responsivity	: 360 V/($\mu\text{J}/\text{cm}^2$)
optical responsivity	: ca. 0,4 - 1,1 μm
Pclk/linerate	: 6 MHz / 3 kHz

* These values were measured when the noise reaches 40% of the saturation (100 at a full range of 0..255).

High speed sensors

Toshiba TCD1707 with 7450 pixel	
active length	: 35 mm
max. exposure time	: 1 sec.*
pixel size	: 4.7 x 4.7 μm^2
dyn. range ptp	: 1800:1
responsivity	: 15 V/lxs
optical responsivity	: ca. 0,4 - 1 μm
Pclk /linerate	: 33 MHz / 3.5kHz@ 8bit



UV sensitive sensor and anti blooming

TH 7813 / 14 with 1024 pixel (Th)	
active length	: 10,3 / 20,5 mm
max. exposure time	: 0,5 sec.*
pixel size	: 10 x 10 μm^2
dyn. range ptp	: 6600:1
responsivity	: 10 V/($\mu\text{J}/\text{cm}^2$)
optical responsivity	: ca. 0,2 - 1 μm
Pclk /linerate	: 33MHz/33/15kHz@ 8bit

Sensors for Spectroscopy

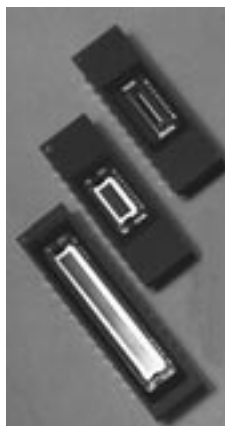
Special linescan sensors for spectrographs has taller pixel, excellent dynamic range and special noise reduction for low light level conditions. These detectors are also called OMA-Systems (optical multi channel analyzer).

Photo Diode Arrays (PDA's)

sensor	size	pitch	no. pixel
	[μm]	[μm]	
S3901	45 x 2500	50	128,256,512
S3902	45 x 500	50	128,256,512
S3903	20 x 500	25	256,512,1024
S3904	20 x 2500	25	512,1024,2048

Technical specifications:

manufacturer	: Hamamatsu
dyn. range(rms)	: 7000:1 .. 47000:1
ESat	: 2,2 10^{-10} J / line
max. exposure time	: 50 sec. *
optical responsivity	: ca. 0,2 - 1 μm with
QE max (600nm)	: 66%
Pclk	: 2 MHz
quartzwindow / optional with phosphor layer :	
10 keV - 100 keV	



The Photo Diode Arrays consists of a line of photo diodes with very tall pixels in comparison to others. They are connected with integrated switches to the output gate, one at a time. Additional control gates for anti blooming and reset function are implemented. The standard quartz window enables good UV-sensitivity.

CCD-Array (FFT's)

,Front illuminated FFT-CCD' 7010 and 7011

sensor	size	pitch	pixel
S701X-	[mm]	[μm]	h x v
906	12,29 x 1,44	24	512 x 60
907	12,29 x 2,98	24	512 x 124
908	12,29 x 6,05	24	512 x 252
1006	24,58 x 1,44	24	1024 x 60
1007	24,58 x 2,98	24	1024 x 124
1008	24,58 x 6,05	24	1024 x 252

maximal exposure time (64 lines) 4 sec.

,Back thinned FFT-CCD' 7030 without cooling, 7031 with cooling -20 °C and 7032 with cooling -40 °C

sensor	size	pitch	pixel
S703X-	[mm]	[μm]	h x v
906	12,29 x 1,39	24	512 x 58
907	12,29 x 2,93	24	512 x 122
908	12,29 x 6,00	24	512 x 250
1006	24,58 x 1,39	24	1024 x 58
1007	24,58 x 2,93	24	1024 x 122
1008	24,58 x 6,00	24	1024 x 250

,Back thinned FFT-CCD' 7033 double full-well capacity and 7034 additional with cooling -20 °C

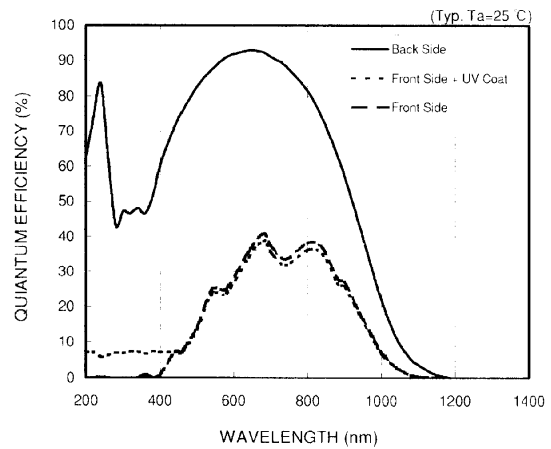
sensor	size	pitch	pixel
S703X-	[mm]	[μm]	h x v
907	12,29 x 2,93	24	512 x 122
1007	24,58 x 2,93	24	1024 x 122

technical specifications:

manufacturer	: Hamamatsu
pixel size	: 24 x 24 μm^2
dyn. range(rms)	: 75000:1
ESat	: 2,2 10^{-13} J / line
optical responsivity	: appr. 0,4 - 1,1 μm
back thinned	: appr. 0,12 - 1,1 μm
QE max (650nm)	: 85%
max. exposure time with full binning	
256 lines/ 25 °C	: appr. 0,4 sec .*
64 lines/ 25 °C	: appr 1 sec .*
256 lines/ 0 °C	: appr. 20 sec .*
128 lines/ -40 °C	: appr. 80 min.*
full well capacity	
Standard sensors	: 6 $\cdot 10^5$ e ⁻
sensor 7033/34	: 12 $\cdot 10^5$ e ⁻

* These values are measured at 25 °C when the noise reaches 40% of the saturation (100 at a full range of 0..255).

Figure 2: Spectral Response: QE vs. Wavelength (without Window) *9



The spectral sensitivity of the front illuminated and the back illuminated sensor is shown here for comparison.

(FFT = full frame transfer)

The FFT's are CCD-area sensors which were clocked in a special way, so that the vertical pixels are already added inside the chip (binning mode). This works like a linescan sensor where each cell consists of 64, 128 or 256 vertical pixels. The averaging of the vertical pixels reduces the noise. An additional reduction of the dark signal is achieved by using different clock levels (MPP mode = multi pinned phase).

The S7030 and S7031 are 'back thinned'. Which means that they are illuminated from the back side and therefore they are highly UV sensitive in opposite to the front illuminated.

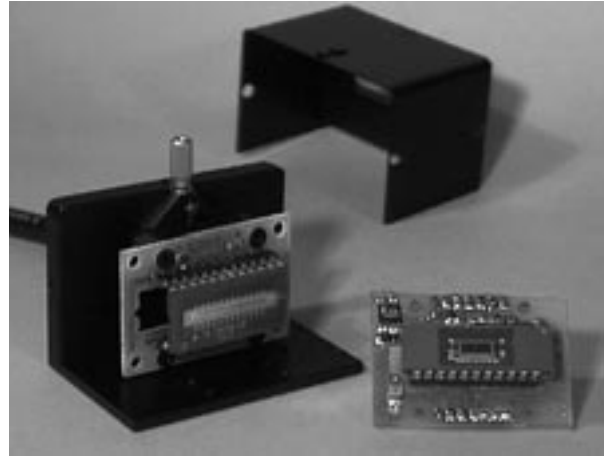


In comparison with the PDAs' the FFT sensors were 30 to 100 times more sensitive. But they have no anti-blooming and no reset function. Caused by the construction, those sensors needs a shutter. This is not necessary by pulsed signals

Accessory

Adaptor

A small board is available (44 x 30 mm), for mounting the sensor outside the camera case. This board is connected with a 0,5 m cable to the camera. Additionally we offer a shielded case with a stable micro positioner for adjusting the sensors horizontal position.



Distributor

With the digital distributor one computer interface board can manage up to 4 cameras, which can be exposed simultaneously.

With the analog distributor up to 4 adaptor boards can be managed simultaneously. The analog distributor has a complete camera electronic and a power supply inside.

The resolution of the distributor is switchable between 8 and 12 bit.



Thermoelectric Cooler

For very long exposure times (low light level conditions) it is necessary to cool the sensor, which lowers the dark current.

The control unit can stabilize the temperature of the sensor down to -20°C (7032 to -40°C). The sensor is mounted in a dense case with dried air for avoiding condensation at the front window.

Cooling the sensors to -20°C will decrease the dark noise up to 1000 times.



Control Unit

The CCD control unit also manage stand alone applications where saving of the data is not necessary. All clock signals are generated by the unit which replaces the computer.

