

# OtO Photonics

## Ultra Micro Spectro-module Series Product sheet (UM Series)



### Description

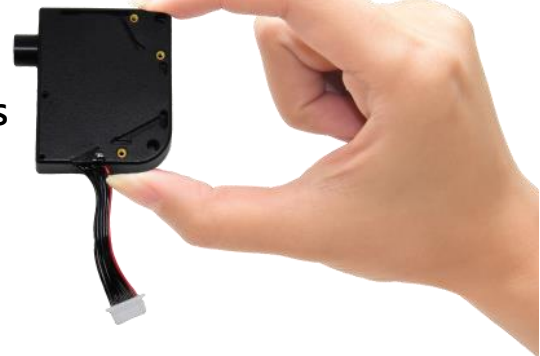
UM Series spectro-module is constructed by a new invented technology and can provide high optical resolution and fast spectral response. The optical engine is very simple and optimized for the spectrometer. The optical bench is very rigid and stable for measurement system. The compact size is very flexible for system integration

UMX3X0 spectro-module is a new OtO optical platform with 50% footprint down size compared to UMX2X0 series. Besides the smaller size, the SMA905 is designed as an optional features. Customers can design the optical detector head (like collimator or cosine-corrector) to attach to the UMX3X0 to save the SMA905 space. UMX390 is designed as the right-angled SMA905 type..

UM Series spectro-module is built in with the linear CCD type sensor and 8 pin external interface..

### Ultra Micro Spectro-module Series

UM1280/UM2280  
UM1380/UM2380  
UM1390/UM2390




We provide the related information and the detailed instructions of how to operate with UM Series in this guide. The optical detector used in the UM Series spectro-module is a high-sensitivity Sony ILX563A 3000-element CCD array sensor. The system integrator can control the CCD sensor directly through the 8-pins external cable.

- This Document is for business promotion use only.
- For customer's Specification Approval or IQC need, we will provide official Approval Sheet.

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### Attention

Picture	Description
	<p>To prevent over tightening and <u>damaging of the slit</u> in the spectrometer. Please Hand tightening the optical fiber only. <b>Do not</b> use any tool including wrench to tighten up the optical fiber and SMA905 connector.</p> <p>Apply adhesive to optical fiber connector after hand tightening is recommended if the fiber needs to be fixed robustly for a long time operation.</p>

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### Overview

#### 1.1 Lineup of UM Series

Model	Type	Spectral response range (nm)		Slit size (μm)	Resolution (nm)	CCD	SNR*1	A/D	Dark noise (Upper Limit)	Stray light	Parameter of Optical System
		V2	330								
UM series	UM1280	Standard	√	10	3.5	ILX563A	150	16	65	1%	f/4.5 NA: 0.11 R1-R2: 7-15
				25	5.5						
				40	10						
	UM2280	High Sensitivity	√	10	3.5	ILX563A + Cylindrical lens	200	16	103	1%	f/4.5 NA: 0.11 R1-R2: 7-15
				25	6						
				40	10						
	UM1380	Standard	√	10	3	TCD1254	200	16	103	1%	f/4.5 NA: 0.11 R1-R2: 7-15
				25	6						
				40	10						
	UM2380	High Sensitivity	√	10	3	TCD1254 + Cylindrical lens	200	16	103	1%	f/4.5 NA: 0.11 R1-R2: 7-15
				25	6						
				40	10						
	UM1390	SMA905 90 deg.	√	10	3	TCD1254	200	16	103	1%	f/4.5 NA: 0.11 R1-R2: 7-15
				25	6						
				40	10						
	UM2390	SMA905 90 deg. +High Sensitivity	√	10	3	TCD1254 + Cylindrical lens	200	16	103	1%	f/4.5 NA: 0.11 R1-R2: 7-15
				25	6						
				40	10						

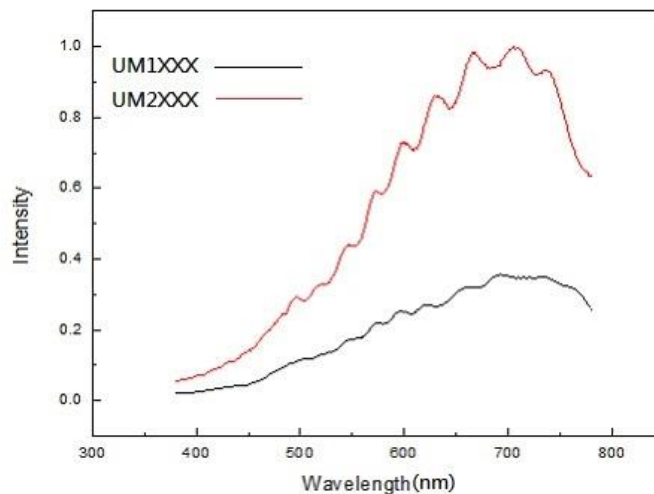
\*1 : Single acquisition

- UM1280 are the standard type spectrometer module.
- UM2280 with new optical design provide high sensitivity performance.
- UM1380, UM2380 are the volume 50% shrink standard type spectrometer module.
- UM1390, UM2390 are volume 50% shrink with right-angled SMA905.

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### ► 1.2 Output Comparison



- New Optical Design Spectrometer Shows 2.5 times efficiency toward Standard type Spectrometer

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### ■ Main Features

#### ▶ 2.1 Feature

#### ■ SONY ILX563A & TCD 1254 Detector

- High sensitivity detector
- Readout Rate: 2 MHz

#### ■ Optics

- Optical resolution: 3~10 nm (FWHM)
- slit width: 10, 25 or 40  $\mu\text{m}$
- SMA905:  $\Phi 3.20 \pm 0.01 \text{mm}$

#### ■ Electrical Performance

- Integration times: from 1 ms to the time user defined

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### Product sheet

#### ► 2.2 Specification

##### ■ Absolute Maximum Ratings

- CCD input power  $V_{CC}$ : + 5.25  $V_{DC}$

##### ■ Physical Specifications

- Physical dimensions:

UMX280 : 39.25 mm (W) x 43.54 mm (D) x 10.1 mm (H)

UMX380 : 23.2 mm (W) x 31 mm (D) x 10 mm (H)

UMX390 : 23.2 mm (W) x 31 mm (D) x 8.5 mm (H)

- Weight:

UMX280 : 8g

UMX3X0 : 13g

##### ■ Power

- Power requirement:

UMX2X0 : 12 mA at + 5  $V_{DC}$

UMX3X0 : 5 mA at +5 VDC

- Supply voltage: 4.5 – 5.5 V

##### ■ Spectro-module

- MEMS Optical Structure

- Input fiber connector: SMA 905

- Entrance slit: 10, 25 or 40  $\mu\text{m}$

- Detector:

UMX2X0 : Sony ILX563A CCD

UMX3X0 : Toshiba TCD1254 CCD

- Filters: 2nd & 3rd order rejection

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### ■ Spectroscopic

- Wavelength range: 330 ~ 850 nm
- Integration time: 1 ms ~ user defined
- Resolution (FWHM): 3~10 nm

### ■ Environmental Conditions

- Temperature: -30°C to +70°C Storage & 0°C to +50°C Operation
- Humidity: 0% - 90% non-condensing

### ■ Interfaces

- CCD direct control



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### ■ Structure

#### ▶ 3.1 Mechanical Diagram

#### ■ UMX280 Series

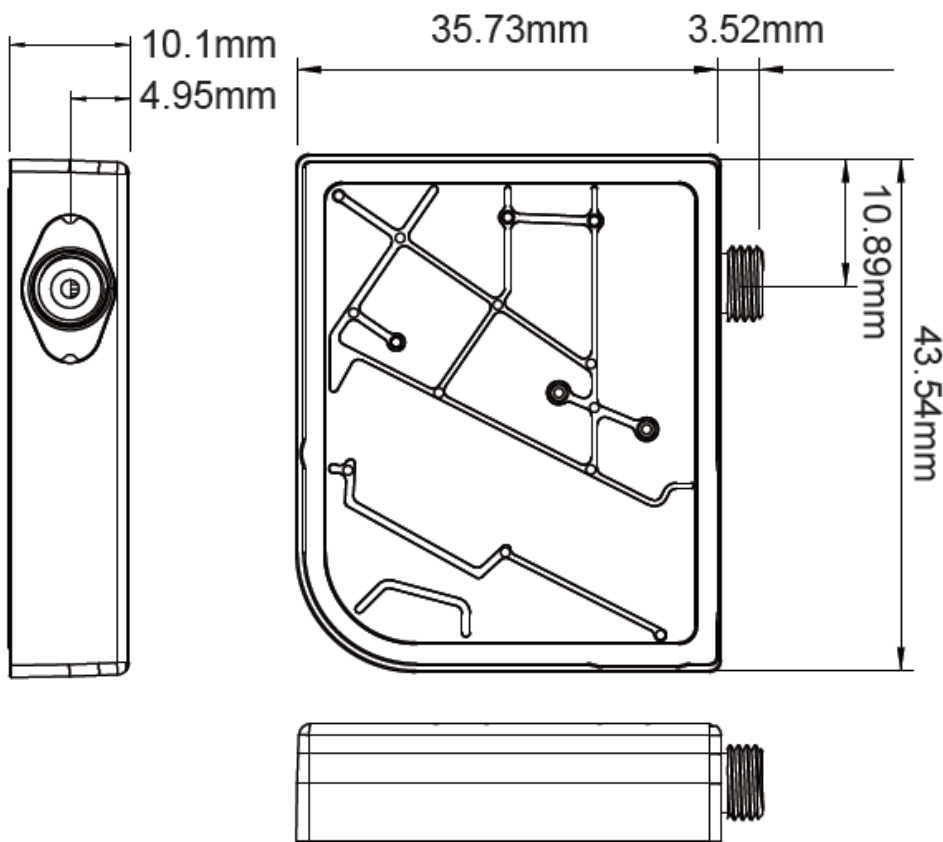
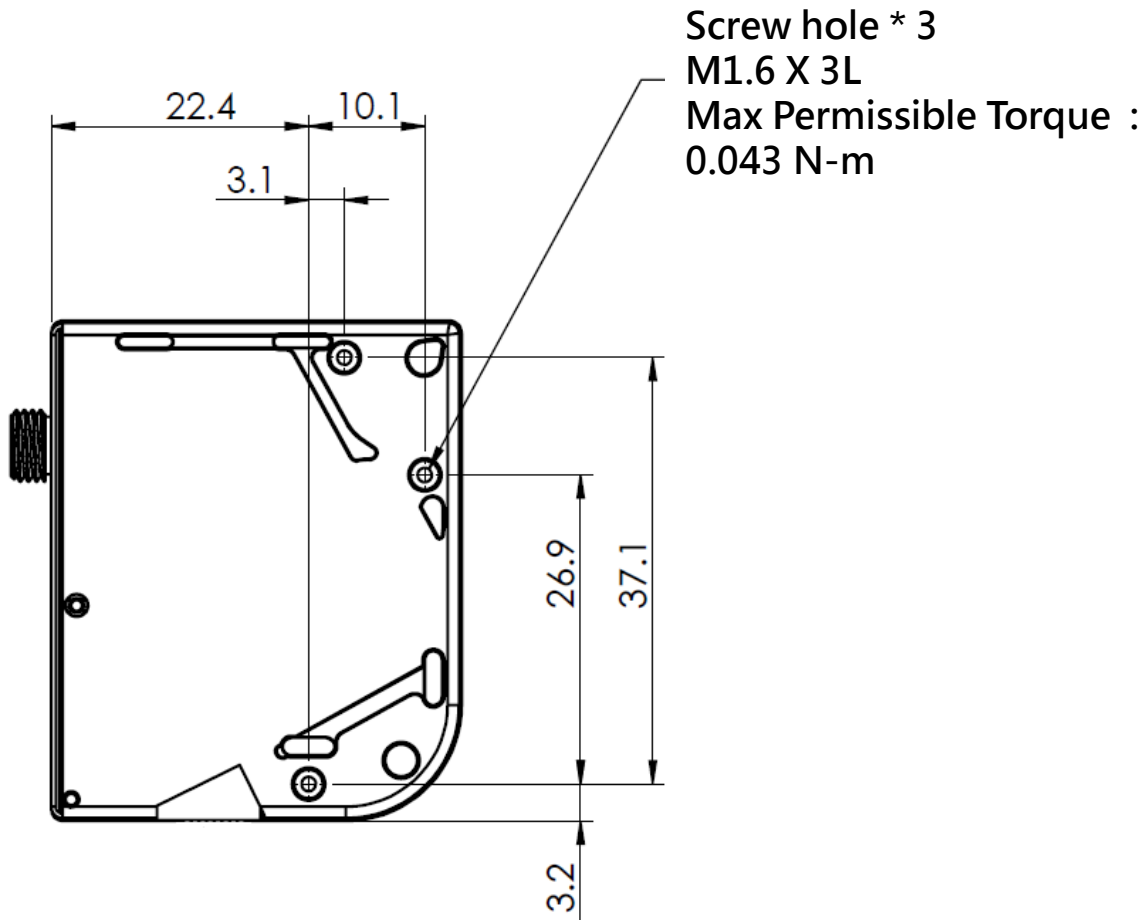


Fig. 1: UMX280 outer dimensions

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- UMX280 Screw hole for system integration



- Fig. 2: UMX280 Screw hole for system integration

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### ■ UMX380 Series

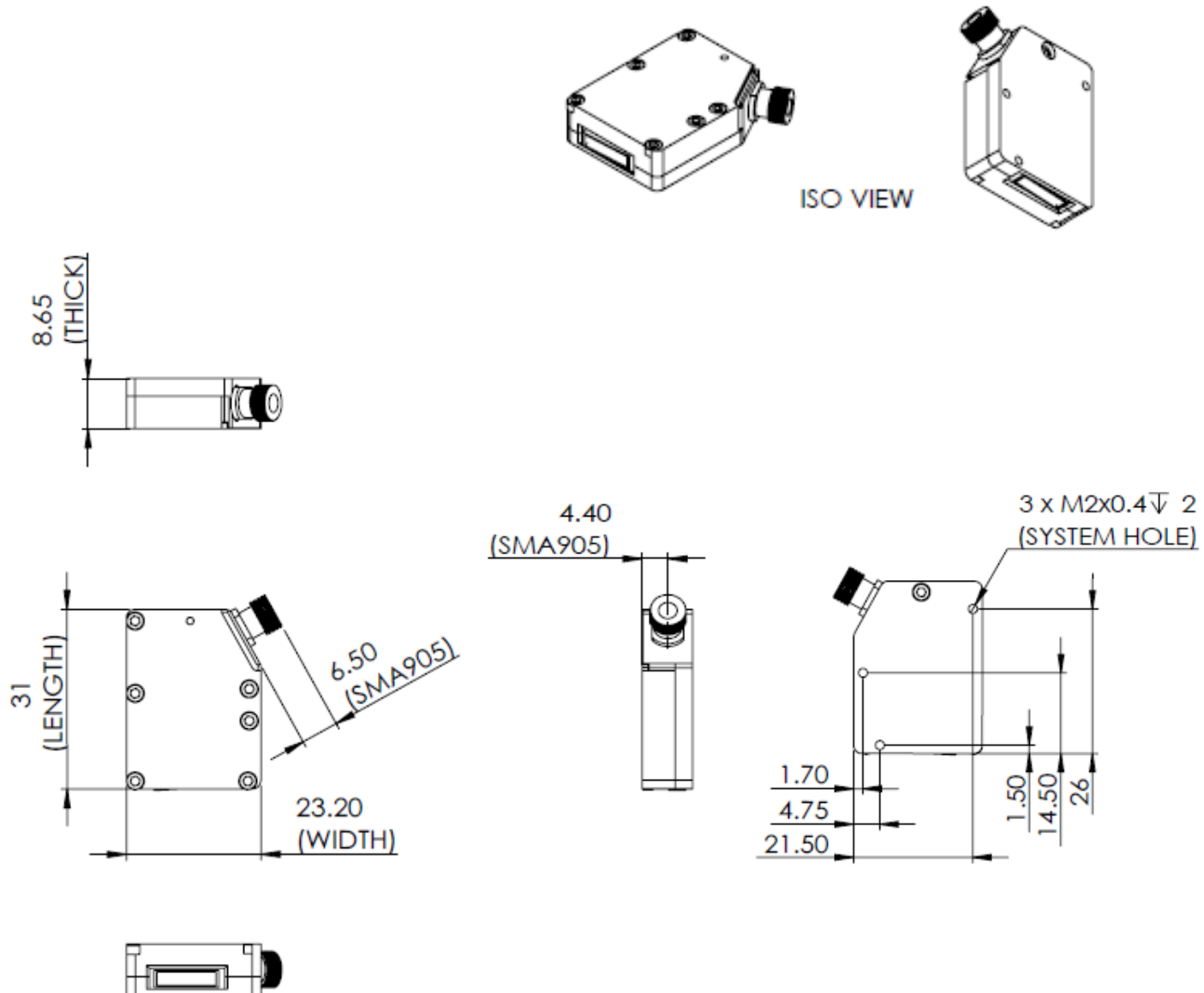
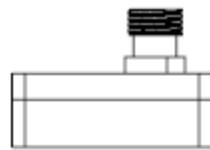
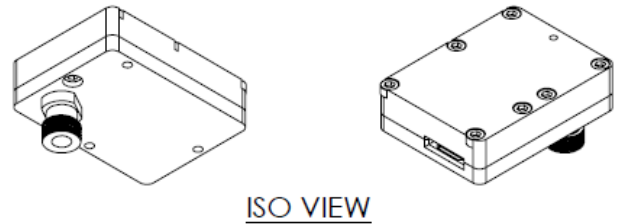


Fig. 3: UMX380 outer dimensions

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### ■ UMX390 Series



$23.200 \pm 0.100$   
(WIDTH)

$31 \pm 0.100$   
(LENGTH)

$8.500 \pm 0.100$   
(THICK)

$7.450 \pm 0.050$   
(SMA905)

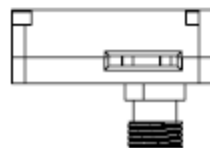


Fig. 4: UMX390 outer dimensions

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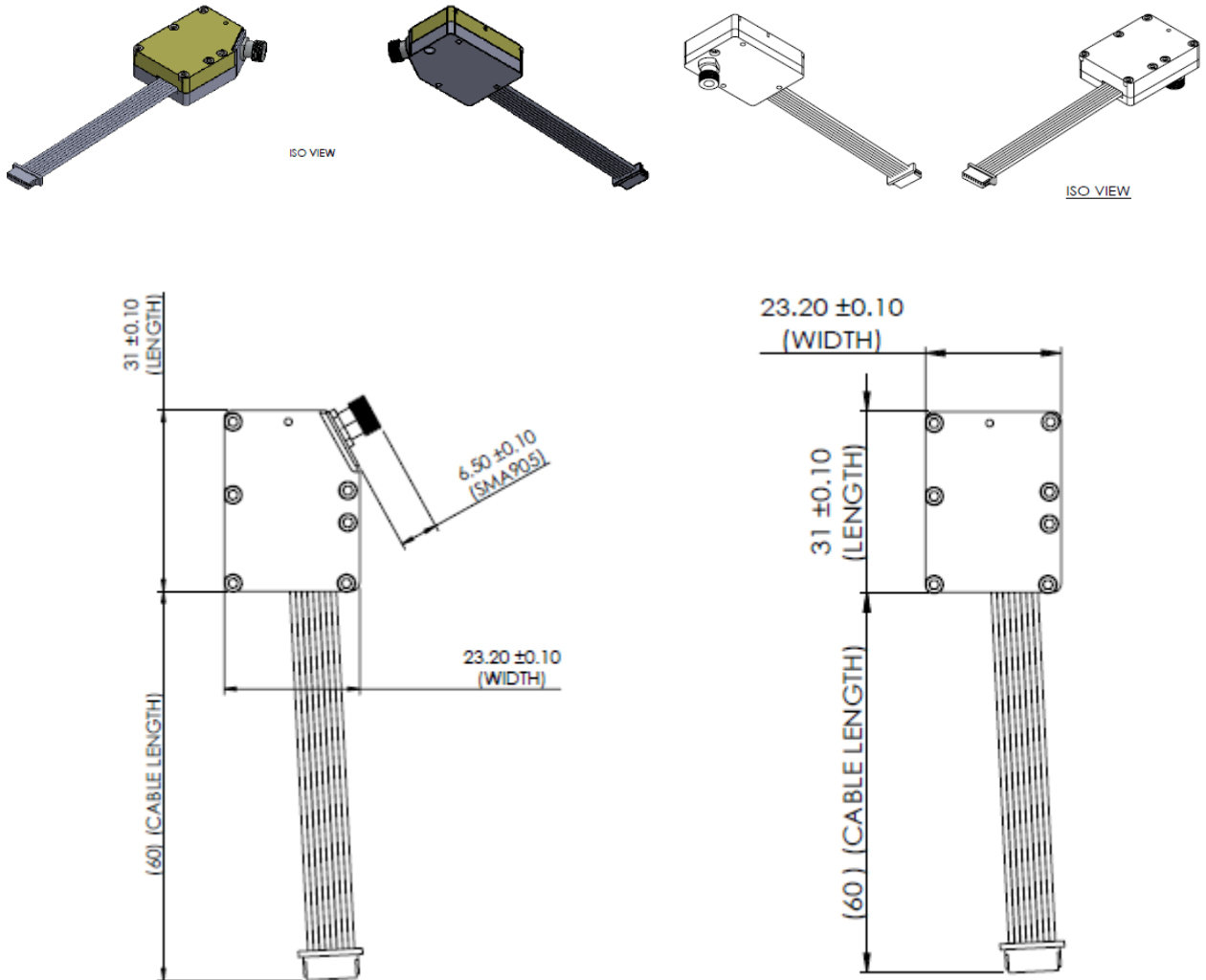


Fig. 5: UM1380/ UM2380/ UM1390/ UM2390 with Cable outer dimensions

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#### ► 3.2 Electrical Pinout

The following listed is the pin description for UM Series External Connector. As shown in fig.6, the UMXX80/UMXX90 module side is 8 pin interface. (pitch 1.0mm) The corresponding connector on board side is HTHR-08WR. Terminal P1 is assembled inside UMXX80/UMXX90. Terminal P2 is linked to the main board.

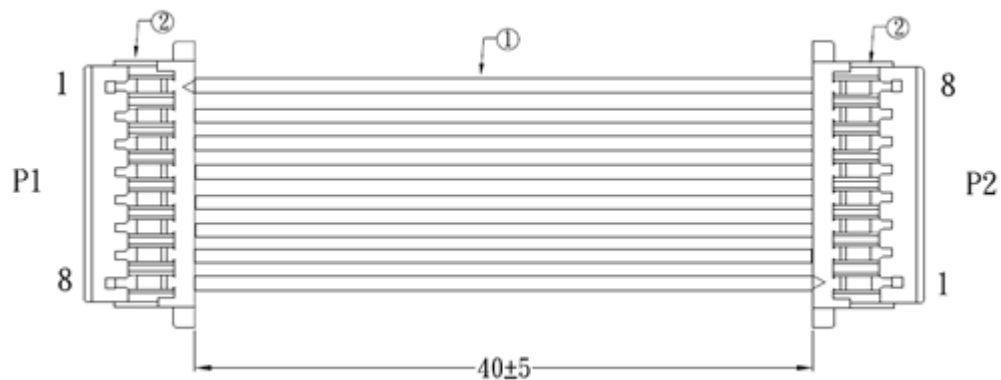


Fig. 6: 8 pin Cable Drawing

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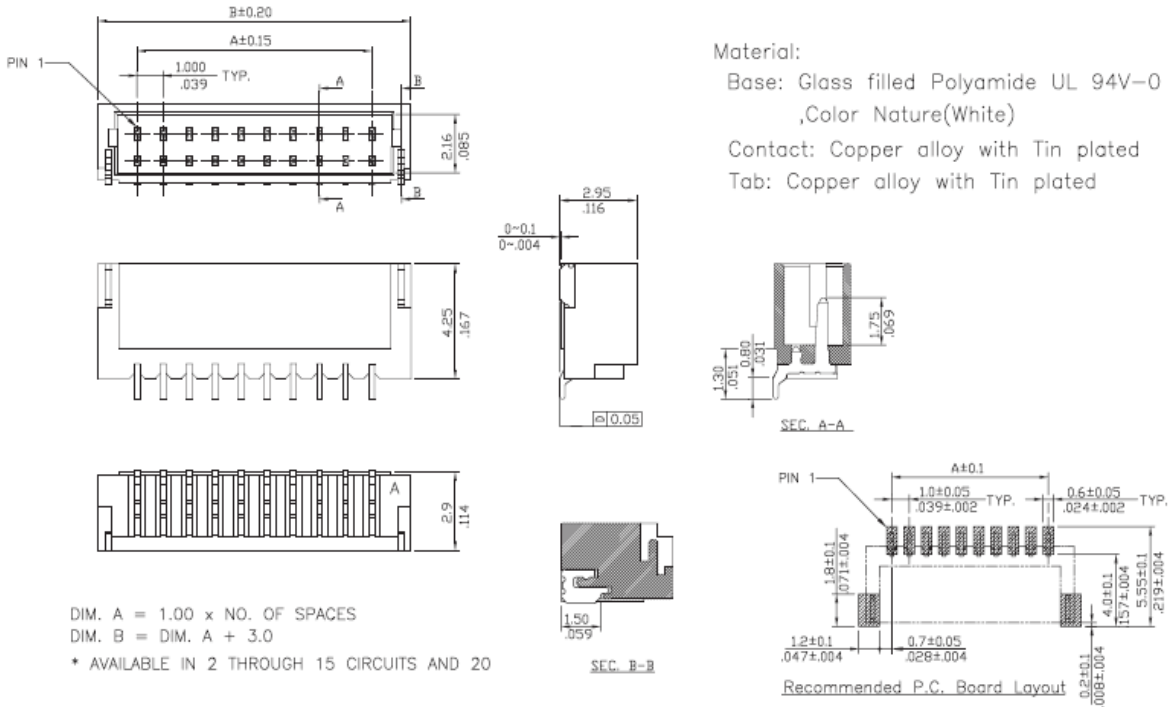


Fig. 7: HTHR-08W drawing

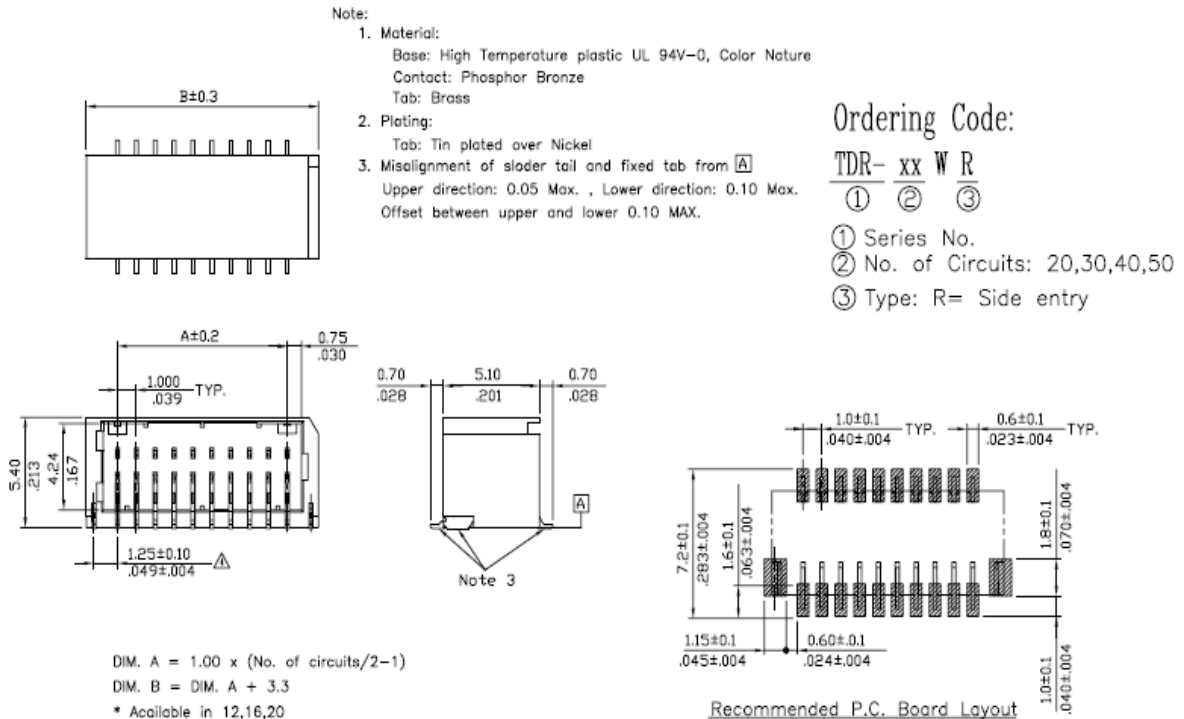


Fig. 8: TDR-16WR drawing

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### ● Pin# Description\_UMXX80/UMXX90

\*All I/Os are TTL-level input/output

Pin No.	Direction	Pin Name	Function
1	Input	SH	CCD SH Control
2	Input	GainSW	CCD Gain Control, the default is low gain (GainSW=0)
3	Analog Output	VOUT	CCD Video Output
4	GND	GND	GND
5	Input	ROG	CCD ROG Control
6	Input	CLK	CCD CLK Control
7	Power	+5V	CCD Power +5V
8	GND	GND	GND

### ● Pin orientation\_UMXX80/UMXX90

UM1280/UM2280/UM1380/UM2380/UM1390/UM2390 8 pin cable as shown in Fig.9, red line is the pin 1 of 8 pin connector. (for main board).

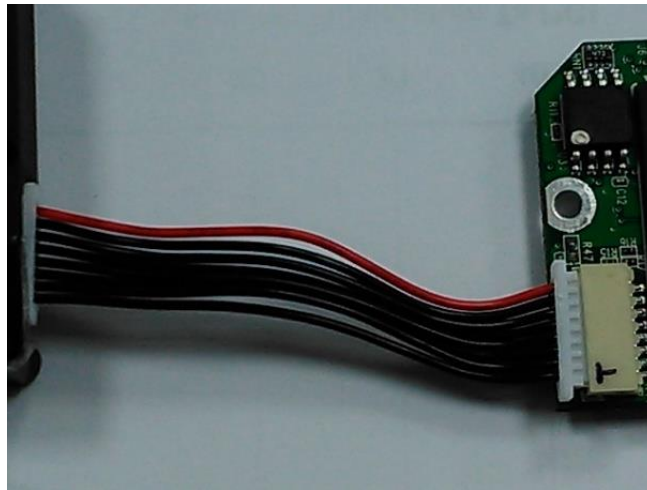


Fig. 9: UMXX80/UMXX90 CCD Board and Cable



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### ► 3.3 CCD Overview

#### ● CCD DETECTOR

The ILX563A & TCD1254 are rectangular reduction type CCD linear image sensor designed for optical measuring equipment use. A built-in timing generator and clock-drivers ensure single 5V power supply for easy use.

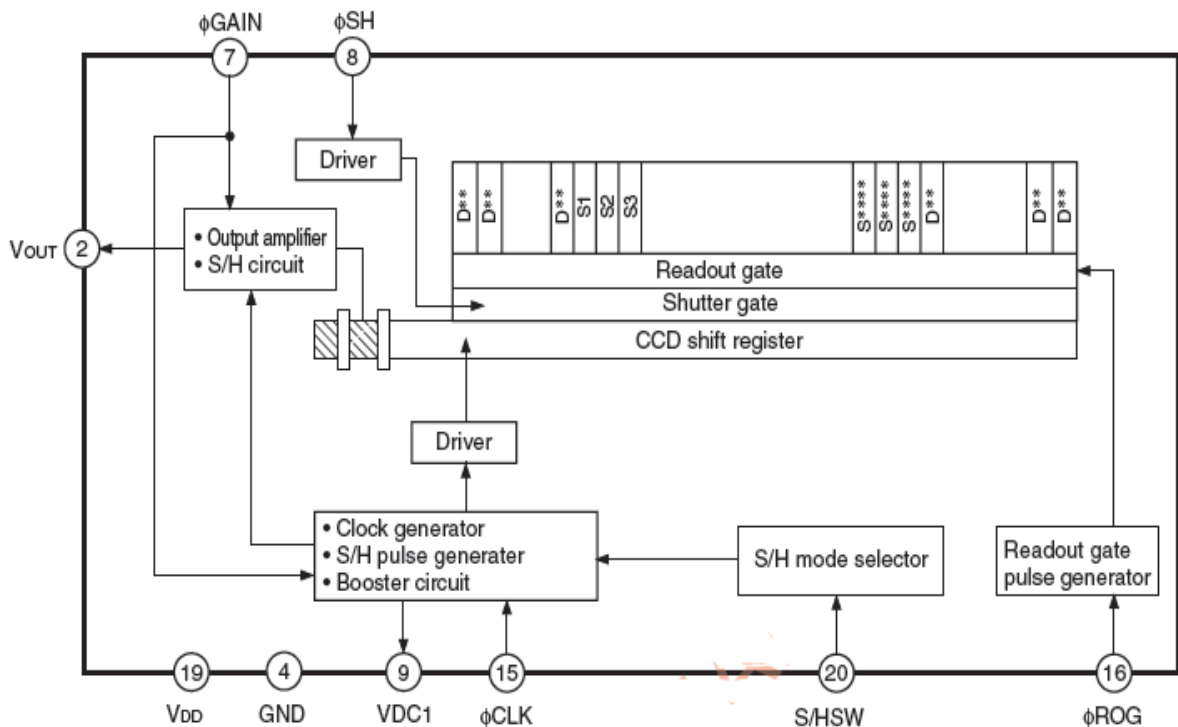
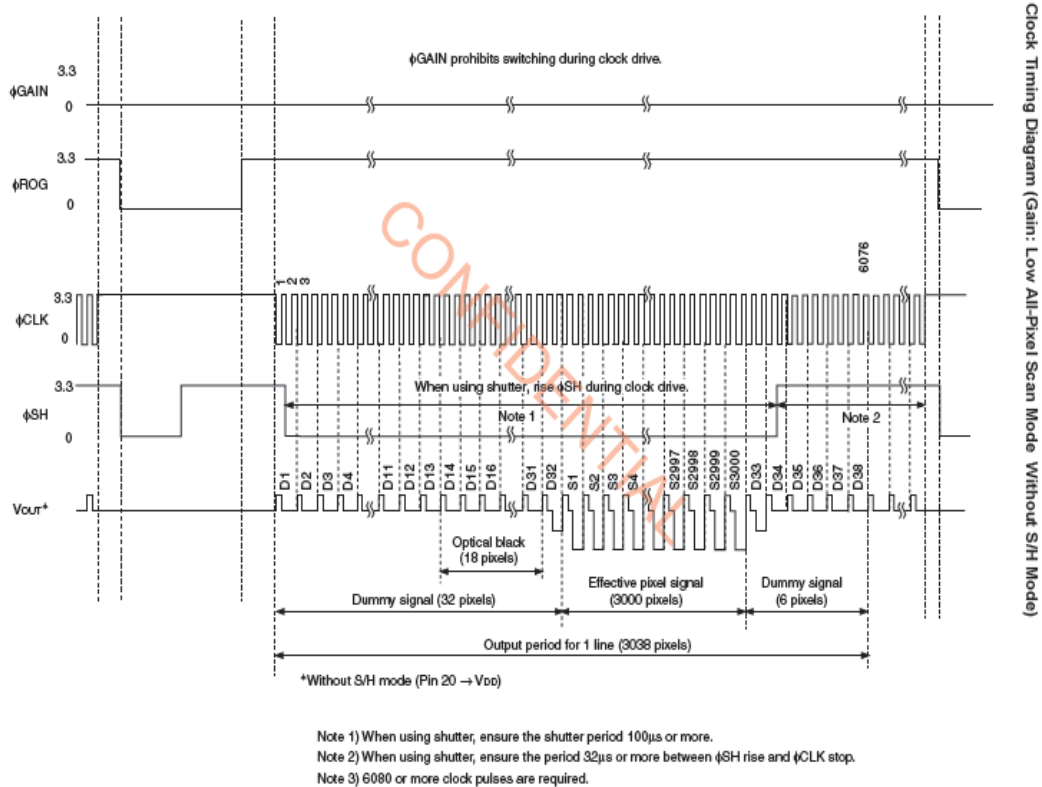


Fig. 10: Sony ILX563A CCD Block Diagram

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**Fig.11: CCD operation timing waveform**

There are two operation modes in this Sony CCD. One is sample & hold mode, the other is without the sample/hold mode. The above timing chart is running without the sample/hold mode. There is one reset level during two clock cycles. UM Series is operated under this mode. The corresponding AFE (Analog Front End) device needs to be run at CDS mode. (Correlated Double Sample)

The CCD operation sequence is exposed-transferred-readout. We need to perform the integration time first, then, read the Vout in the next cycle. The operation is like pipeline. The Vout signal shows in the top waveform actually is the exposed result in the previous cycle. The output signal is almost proportion to the integration time. When the light energy or integration time is long enough to fully charge the pixel, the CCD output will be saturated.

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### Block Diagram

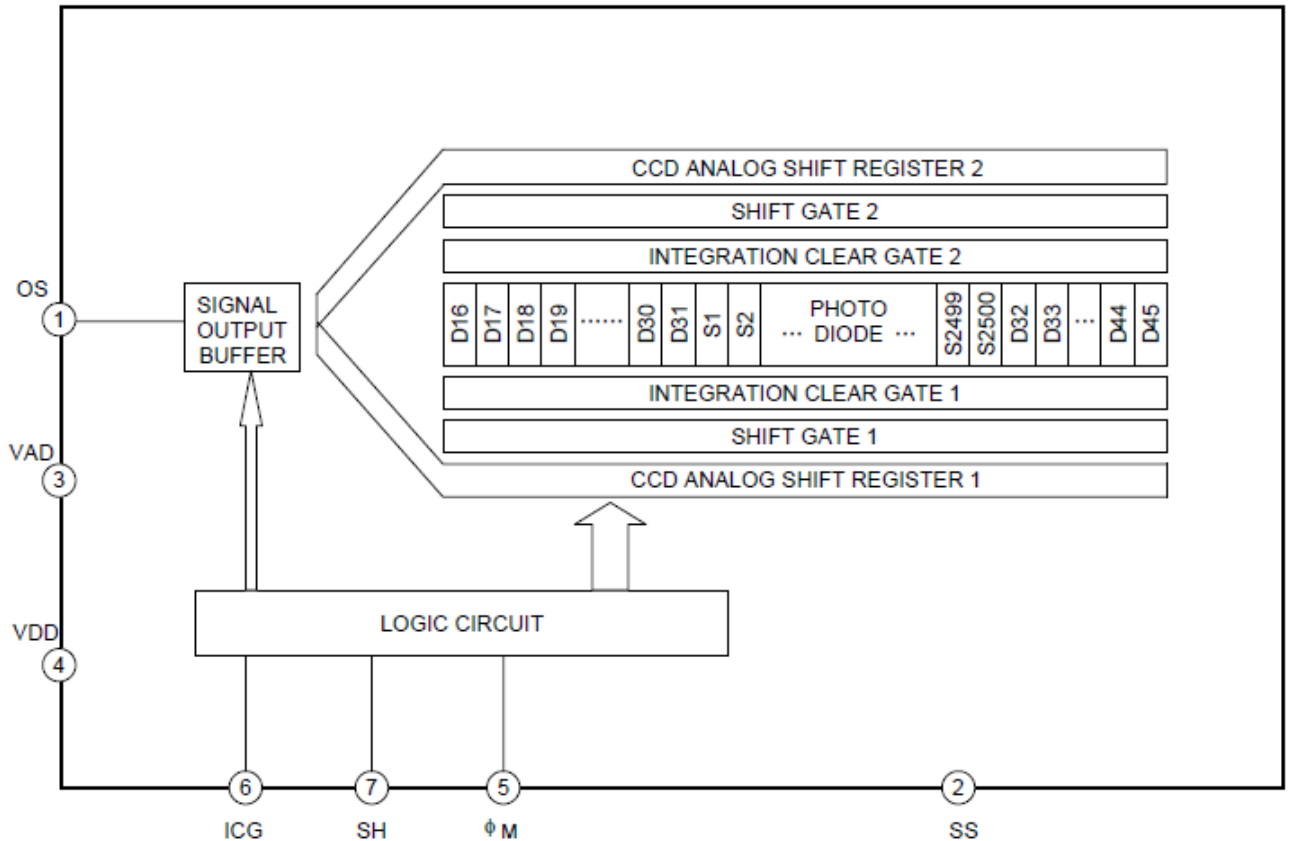


Fig. 12: TCD1254 CCD Block Diagram

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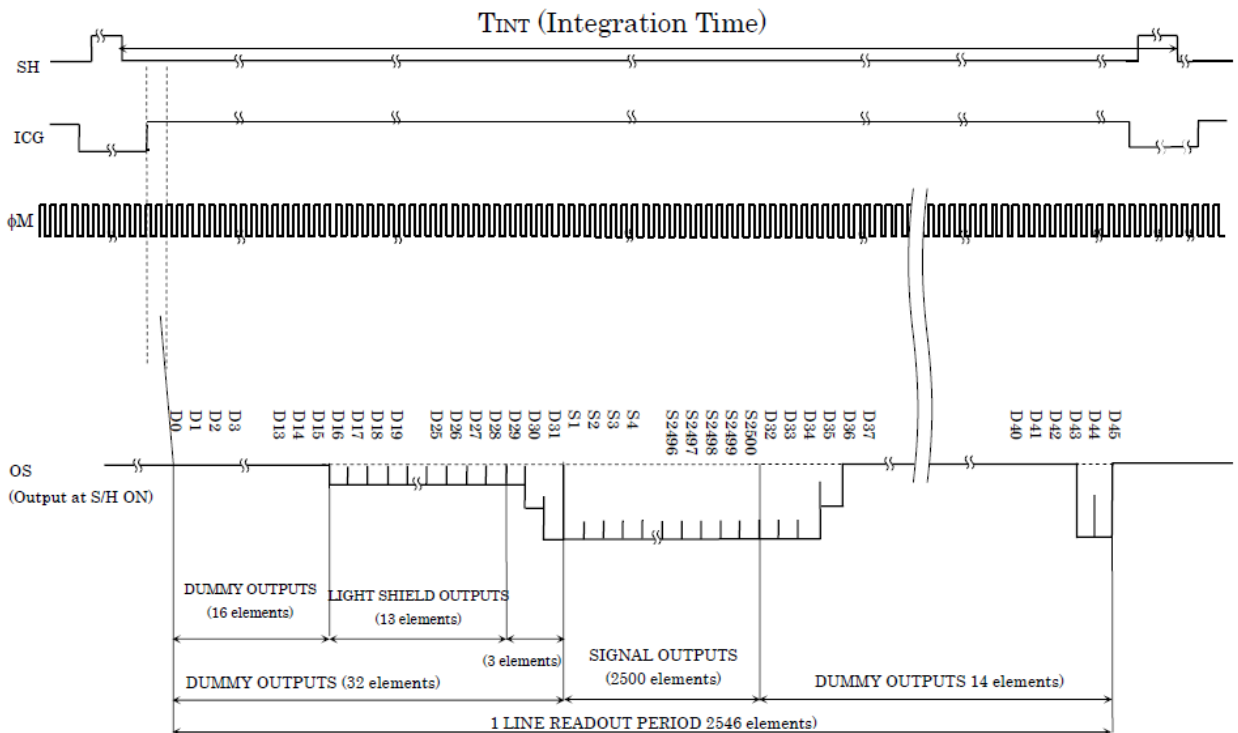


Fig.13 : CCD operation timing waveform

This Toshiba CCD only support sample & hold mode. The above timing chart is TCD1254 operation timing. UM1380/ UM2380/ UM1390/ UM2390 CCD board is built-in an inverse Op-AMP circuit to make the output voltage to be proportional to the incident light level.

The CCD operation sequence is exposed-transferred-readout. We need to perform the integration time first, then, read the  $V_{out}$  in the next cycle. The operation is like pipeline. The  $V_{out}$  signal shows in the top waveform actually is the exposed result in the previous cycle. The output signal is almost proportion to the integration time. When the light energy or integration time is long enough to fully charge the pixel, the CCD output will be saturated. When the incident light is strong and cause the serious over-saturation condition, the  $V_{out}$  signal may not work correctly and causes some wrong spectrum.

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### ● CCD/SYSTEM NOISE

There are three major sources impact the Vout signal reading. One is the light source stability, the second is the electronics noise, and the other is CCD detector noise. If we don't consider the light source impact, we can check the dark noise performance of this system. The dark noise we define here is the RMS of Vout signal under 1ms integration time in dark condition. So the dark noise will be only contributed by electronics readout noise and the CCD sensor.

The other major parameter to define the noise performance is the SNR. The SNR we define here is the ratio of the full signal (65535 counts) to the RMS value under the full signal condition. The higher SNR performance indicates the readout signal is more stable. It will be helpful for the low signal differentiation.

### ● SIGNAL AVERAGING

Generally, there are two options for the signal curve operations. The first one is the signal averaging. By the averaging method, we can reduce the noise impact on each pixel. Sure, more sampling points will bring the better averaging performance. But it will need more time to get one spectra. When we use the time-base type of signal averaging, the S:N increases by the square root of the number of samples. Thus, a S:N is readily 10x achieved by averaging 100 spectra.

The other curve smoothing is boxcar filter. It can average the adjacent points to show the smoother curve. But if the target signal is peak type, the boxcar may not be suitable for this. These two methods can be enabled at the same time if the measurement target is suitable for this operation.

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### ■ Internal Operation

#### ● Pixel Definition

If the system integrator uses the AFE device, you can use the command to manually adjust the baseline. (adjust the AFE OFFSET) The other baseline adjustment method is to enable the background removal. It depends on the user how to use the baseline. °

The following is a description of all of the pixels

Sony ILX563A Pixel Definition :

Pixel	Description
1-13	Dummy pixels
14-31	Optical black pixels
32	Dummy pixels
33-3032	Optical active pixels
3033-3038	Dummy pixels

Toshiba TCD1254 Pixel Definition :

Pixel	Description
1-16	Dummy pixels
17-29	Optical black pixels
30-32	Dummy pixels
33-2532	Optical active pixels
2533-2546	Dummy pixels