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DALSA CA-D4/D7 Cameras

Designed for the most demanding imaging challenges, the DALSA CA-D4 and CA-D7 cameras offer superior performance. 1024x1024 progressive scan, 40 frames per second, outstanding sensitivity and extremely low dark current make the CA-D4 and CA-D7 the choice of OEMs and professionals around the world.



Features

- 1024x1024 resolution, 12µm square pixels
- 100% fill factor
- Frame transfer architecture and pixel reset/exposure control—no shutter required
- One or two outputs
- 25MHz (8-bit) or 10MHz (12-bit) per output data rate
- Vertical and horizontal binning options
- "Snapshot" operation
- CE-compliant version of A model available

Description

The CA-D4/D7 cameras offer 1024 x1024 resolution with switch-selectable single or dual 8-bit outputs (A model) or a single 12-bit output (T model).

Data for the 8-bit models is provided at 25MHz per output. This results in frame rates up to 21 frames/sec with a single output or 40 frames/sec with dual outputs. Data for the 12-bit model is provided at 10MHz. This results in frame rates up to 8 frames/sec.

The CA-D4/7 cameras use DALSA's patented modular architecture. This system of connecting circuit modules through standardized busses allows DALSA to build a high performance modular camera using the reliability, flexibility, and cost-effectiveness of high-volume interchangeable parts. Within the camera, a driver board provides bias voltages and clocks to the CCD image sensor, a timing board generates all internal timing, and A/D boards process the video and digitize it for output. Contact DALSA for further information.

Applications

The CA-D4 /D7 are ideally suited for use in:

- Wafer and Electronic Inspection
- Medical Imaging
- Microscopy

Table 1. Camera Configurations

Specification	A Model	T Model
Pixel Pitch	12µm	12µm
Aperture	12.3 x 12.3mm	12.3 x 12.3mm
Lens Mount	F-mount	F-mount
Data Bits	8 per channel	12
Data Rate	1 or 2 x 25MHz	1 x 10MHz
Max. Frame Rate	40fps	8fps
Data Format	RS422	RS422
CE model available	Yes (code A-ECE)	No
Data Channels	1 or 2	1

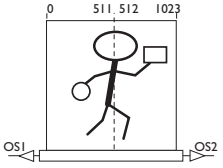
Example Configuration: CA-D4-1024A

resolution — model

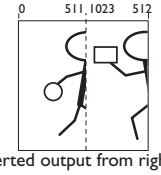
Sensor

The CA-D4/D7 cameras use the IA-D4 area scan image sensor for high speed, high resolution performance. The sensor uses a frame transfer architecture. The pixel size is 12µm x 12µm with a 100% fill factor (all of the image area is photosensitive) to achieve maximum sensitivity within the pixel. Figure 6 shows the block diagram of the sensor. The sensor uses one output in the CA-D7-1024T camera and one or two outputs in the CA-D4-1024A. When reading out pixels to a single output, the sensor starts at pixel column 1 and proceeds to column 1024; but when using two outputs, the sensor simultaneously reads out columns 1 to 512 to OS1 and columns 1024 to 513 to OS2. This output effectively mirrors the right half of an image as shown below.

Image on IA-D4 sensor



CA-D4-1024A Output (two channels)



inverted output from right tap

Operation

Power Supplies

Cameras provide optimum performance using well-regulated linear supplies. The power supply requirements indicated here are adequately overrated to accommodate all models and operating conditions.

Voltage	Current Draw	Notes
+28V	250mA	Specified at 40°C ambient.
+5V	1500mA	Tolerance for all supplies:
-5V	225mA	■ ± 50mV
-15V	50mA	■ <5mV ripple.

Optical Interface

The CA-D4/D7 cameras provide an adapter for an F-mount (35mm Nikon-compatible) lens. This mount threads into an opening in the camera's front plate, and is optically aligned to provide the proper back focal distance between F-type lens and sensor. The threaded hole can also be used to provide custom optical mounts. The image sensor's frame transfer architecture and its pixel reset feature mean the camera does not require a shutter for most applications.

Electrical Interface

All of the CA-D4/D7 connectors are on the rear plate. The power and control signals are input and output from a DB25 connector. For 8-bit models, digital data and clocking signals are provided on two 20-pin IDC connectors. CE-compliant models use DB25 data connectors. The CA-D7 T model uses a single 40 pin IDC connector. See Figures 1-3.

All control, digital data and clocking signals use the RS422 (differential) standard for data transmission.

CE Compliance

The CA-D4-1024A-ECE camera meets the following EMC standards:

- EN 50082-1
- IEC 1000-4-2;1995
- IEC 1000-4-3;1995
- IEC 1000-4-4;1995
- CISPR-22

Input Control Signals

The CA-D4/D7 cameras require only one input signal. The transfer clock EXSYNC is required to trigger frame readout. Note that for optimum performance, the cameras use an internal oscillator to control all internal timing, including pixel rate. **These cameras do not accept an external MCLK signal.**

Control signals are differential, requiring complements denoted with a "B" suffix (e.g. EXSYNC, EXSYNCB).

Signal	Controls
EXSYNC	Start of frame readout, Frame rate, Integration/Exposure time
PRIN	Pixel Reset, Effective exposure time
BIN	Pixel Binning

EXSYNC

EXSYNC is a required user-supplied input signal used to trigger frame readout, thereby controlling the camera frame rate and integration time. The camera integrates from falling edge of EXSYNC to the next falling edge of EXSYNC.

EXSYNC State	Camera Mode
High	Integration
Falling Edge	Frame readout begins
Held low	Maximum frame rate

PRIN (Exposure Control)

PRIN is an optional user-supplied input signal that can be used to control exposure by altering exposure time independently of EXSYNC.

PRIN State	Camera Mode
Low	Pixel reset (no exposure)
Rising Edge	Exposure begins
High	Exposure
Unconnected	Exposure

BIN

BIN is an optional user-supplied input signal. BIN high causes the camera to bin its pixels 2x2 vertically and horizontally to provide 512x512 resolution, increasing sensitivity while reducing resolution. **If you do not use BIN, tie BIN low and BINB high.**

USR_EN

USR_EN is an optional input signal located on the OS2 connector (A model only). It can be used in special operating modes to select a camera from multiple cameras multiplexed onto a common data bus.

USR_EN State	Camera Mode
Low	Camera outputs tri-stated
High	Camera outputs active
Unconnected	Camera outputs active

Output Signals

These signals indicate when data is valid, allowing you to clock camera data into your acquisition system:

Clocking Signal	Indicates
FVAL (high)	Valid frame
LVAL (high)	Valid line
STROBE (falling edge)	Valid pixel

Digital Data

The CA-D4-1024A outputs one or two channels of 8-bit RS422 data at 25MHz. The CA-D7-1024T models output 12-bit RS422 data. See Figures 2-4 for pinouts.

Snapshot Operation

By using a combination of EXSYNC and PRIN inputs, the camera can operate in "snapshot" mode, in which image capture is triggered by an external event with up to one minute between image captures. Note that the EXSYNC and PRIN signals must be triggered by another part of your acquisition system. For an application note on this topic, contact DALSA and request doc# 03-32-00220.

Figure 1. Camera Interface, A Model

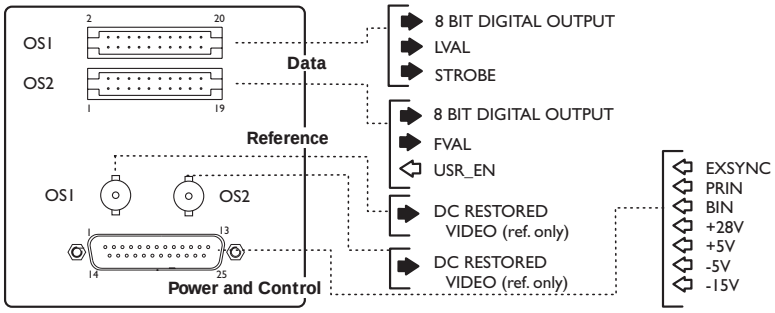


Figure 2. Camera Interface, T Model

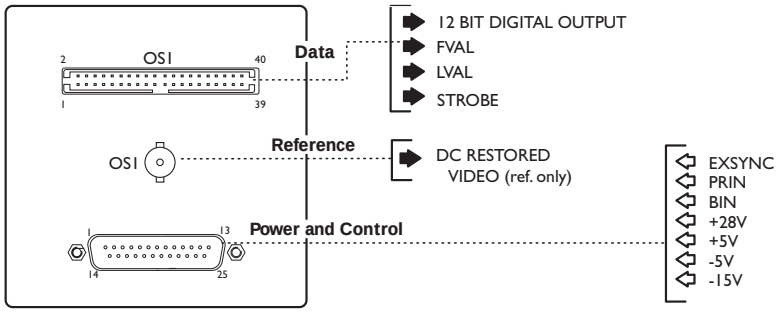
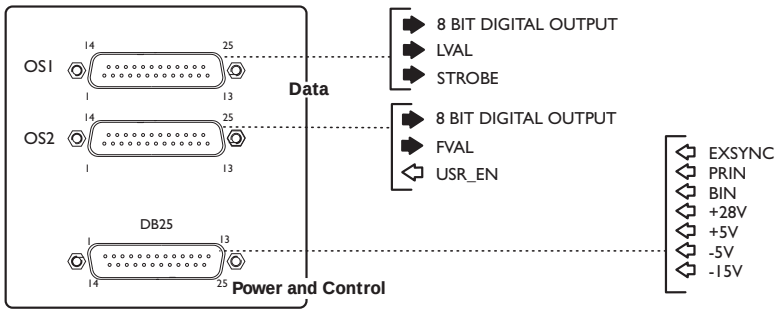


Figure 3. Camera Interface, CE-Compliant A Model

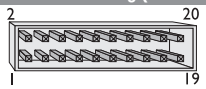


ISO 9001 DALSA maintains a registered quality system meeting the ISO 9001 standard.

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Figure 4. Data Connector Pinouts

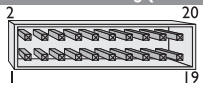
OS1 — Data & Clocking (A models)



Mating Part: 3M 3421-6000 (or equiv.)
Cable: 26 AWG

Pin	Signal	Pin	Signal
1	D7 (MSB)	2	D7B
3	D6	4	D6B
5	D5	6	D5B
7	D4	8	D4B
9	D3	10	D3B
11	D2	12	D2B
13	D1	14	D1B
15	D0 (LSB)	16	D0B
17	STROBE	18	STROBEB
19	LVAL	20	LVALB

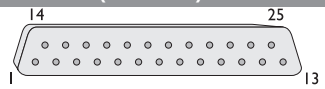
OS2[1] — Data & Clocking (A models)



Mating Part: 3M 3421-6000 (or equiv.)
Cable: 26 AWG

Pin	Signal	Pin	Signal
1	D7 (MSB)[1]	2	D7B[1]
3	D6[1]	4	D6B[1]
5	D5[1]	6	D5B[1]
7	D4[1]	8	D4B[1]
9	D3[1]	10	D3B[1]
11	D2[1]	12	D2B[1]
13	D1[1]	14	D1B[1]
15	D0 (LSB)[1]	16	D0B[1]
17	FVAL	18	FVALB
19	USR_EN	20	USR_ENB

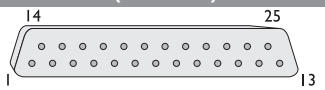
OS1 (ECE model)



Mating Parts: Amphenol hood 17-1657-25
AMP plug 207464-2, AMP pin 745254-7,
Belden cable 9819 28AWG (or equivalents)

Pin	Signal	Pin	Signal
1	D7 (MSB)	14	D7B
2	D6	15	D6B
3	D5	16	D5B
4	D4	17	D4B
5	D3	18	D3B
6	D2	19	D2B
7	D1	20	D1B
8	D0 (LSB)	21	D0B
9	STROBE	22	STROBEB
10	LVAL	23	LVALB
11	No connect	24	No connect
12	No connect	25	No connect
13	No connect		

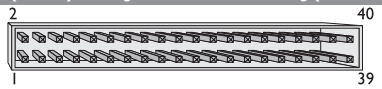
OS2[1] (ECE model)



Mating Parts: Amphenol hood 17-1657-25
AMP plug 207464-2, AMP pin 745254-7,
Belden cable 9819 28AWG (or equivalents)

Pin	Signal	Pin	Signal
1	D7 (MSB)[1]	14	D7B[1]
2	D6[1]	15	D6B[1]
3	D5[1]	16	D5B[1]
4	D4[1]	17	D4B[1]
5	D3[1]	18	D3B[1]
6	D2[1]	19	D2B[1]
7	D1[1]	20	D1B[1]
8	D0 (LSB)[1]	21	D0B[1]
9	FVAL	22	FVALB
10	USR_EN	23	USR_ENB
11	No connect	24	No connect
12	No connect	25	No connect
13	No connect		

OS1 (40-Pin) — Digital Data and Clocking (T model)



Mating Part: 3M 3417-6000 (or equivalent)
Cable: 26 AWG 100 Ω shielded twisted pair

Pin	Signal	Pin	Signal	Pin	Signal	Pin	Signal
1	No connect	2	No connect	21	D7	22	D7B
3	No connect	4	No connect	23	D6	24	D6B
5	No connect	6	No connect	25	D5	26	D5B
7	No connect	8	No connect	27	D4	28	D4B
9	D11 (MSB)	10	D11B (MSB)	29	D3	30	D3B
11	D10	12	D10B	31	D2	32	D2B
13	D9	14	D9B	33	D1	34	D1B
15	D8	16	D8B	35	D0 (LSB)	36	D0B (LSB)
17	FVAL	18	FVALB	37	STROBE	38	STROBEB
19	No connect	20	No connect	39	LVAL	40	LVALB

Note: Do not connect to "Factory use," "Future use," or "No connect" pins.

Notes

1. In single-output mode, CA-D4 models do not output data on OS2.

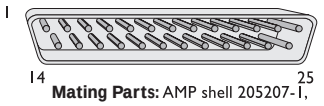
Cabling Guidelines

Maximum cable lengths are determined by the RS422 standard.

Power cables should be 22 AWG minimum.

Figure 5. Control and Power Connector Pinout

DB25—User Bus & Power



Mating Parts: AMP shell 205207-1, Amphenol hood 17-1657-25, AMP socket 745253-6
Control cable: Belden 9819 28AWG (or equivalents)
Power Cable: 22AWG

Pin	Signal	Pin	Signal
1	BINB (optional)	14	BIN (optional)
2	Factory use	15	Factory use
3	Factory use	16	Factory use
4	EXSYNCB	17	EXSYNC
5	PRIN	18	PRINB
6	Future use	19	Future use
7	Digital ground	20	Digital ground
8	+5 V Analog	21	+28 V Analog
9	+28 V Analog	22	-5 V Analog
10	Factory use	23	Factory use
11	Analog ground	24	Analog ground
12	-5 V Digital	25	-15V
13	+5 V Digital		

Note: Do not connect to "Factory use," "Future use," or "No connect" pins.

Figure 6. Sensor Block Diagram

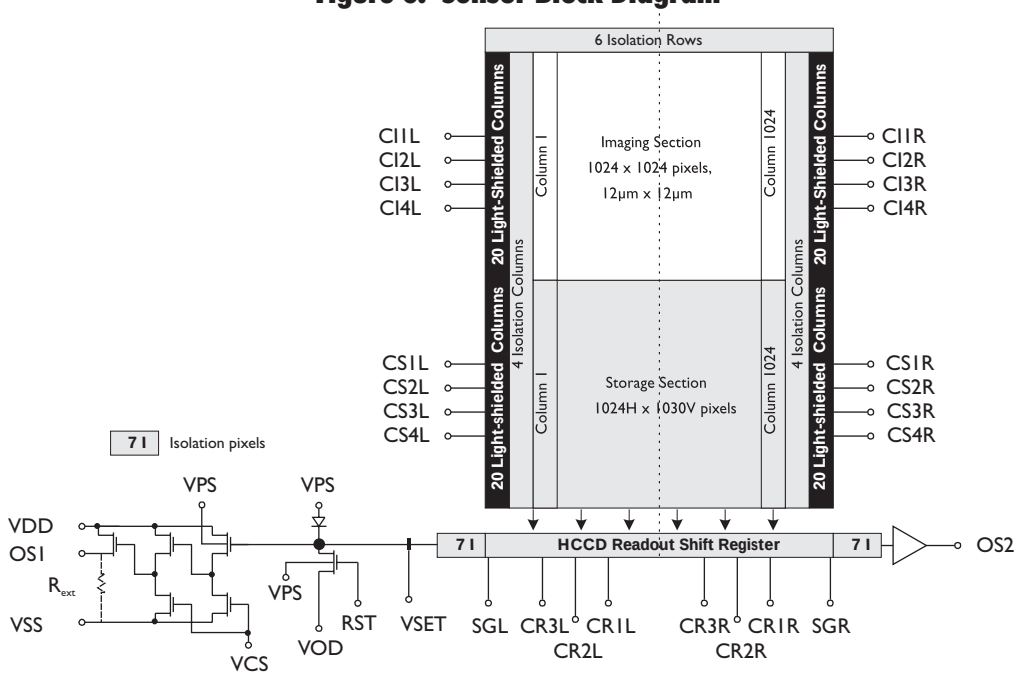
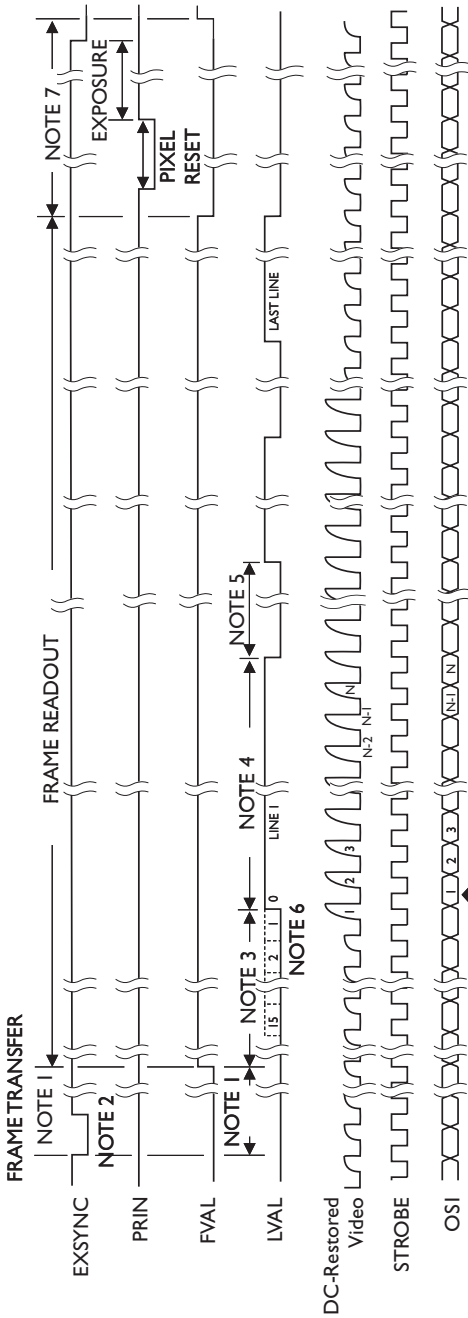


Figure 7. CA-D4 A Camera Timing, One Output

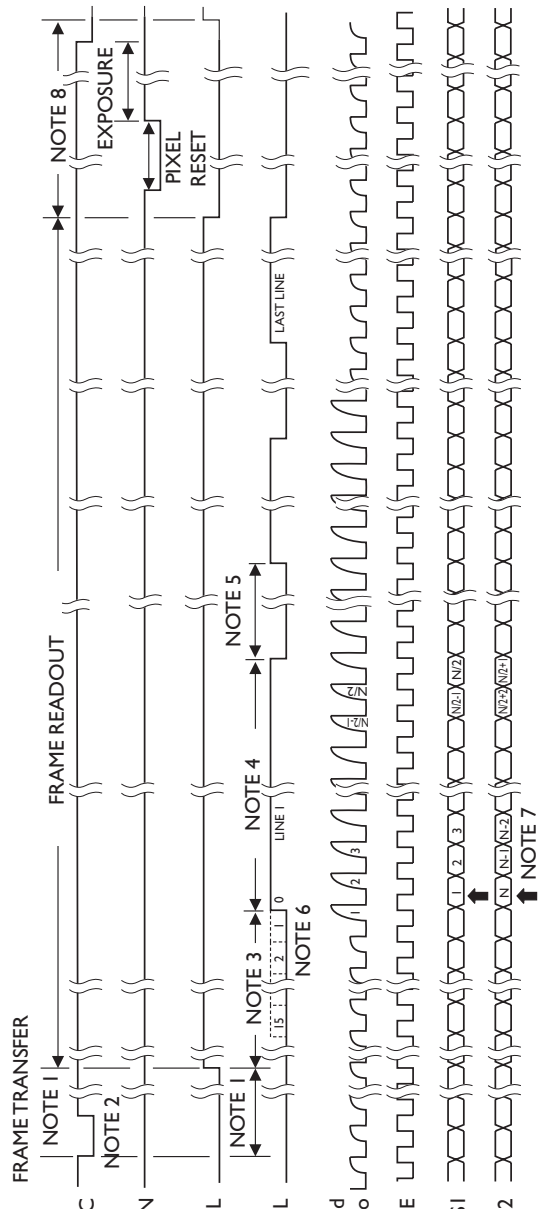


NOTES: N = 1024 (2x2 Binning mode: N = 512)

1. EXSYNC to FVAL rising edge A model = 1.012 ms at 25 MHz.
   EXSYNC to first valid pixel A model = 25337 ± 25 STROBEs. 2x2 Binning mode: 12680 ± 12 STROBEs.
2. EXSYNC minimum pulse width = 100 ns.
3. FVAL to LVAL = 31-(pretrigger) STROBEs. 2x2 Binning mode: 15-(pretrigger) STROBEs.
4. Line readout: LVAL stays logic HIGH for 1024 STROBEs. 2x2 Binning mode: 512 STROBES.
5. Between lines: LVAL stays logic LOW for 101-(pretrigger) STROBEs. 2x2 Binning mode: 62-(pretrigger) STROBEs.
6. Dashed lines indicate LVAL position with pretrigger. Pretrigger is user-selectable in 1-pixel increments from 0-15.
7. Minimum time between frames: 32500±25 STROBEs. 2x2 binning mode: 13750±10 STROBEs.

⬆ Position of first valid pixel.

Figure 8. CA-D4 A Camera Timing, Two Outputs

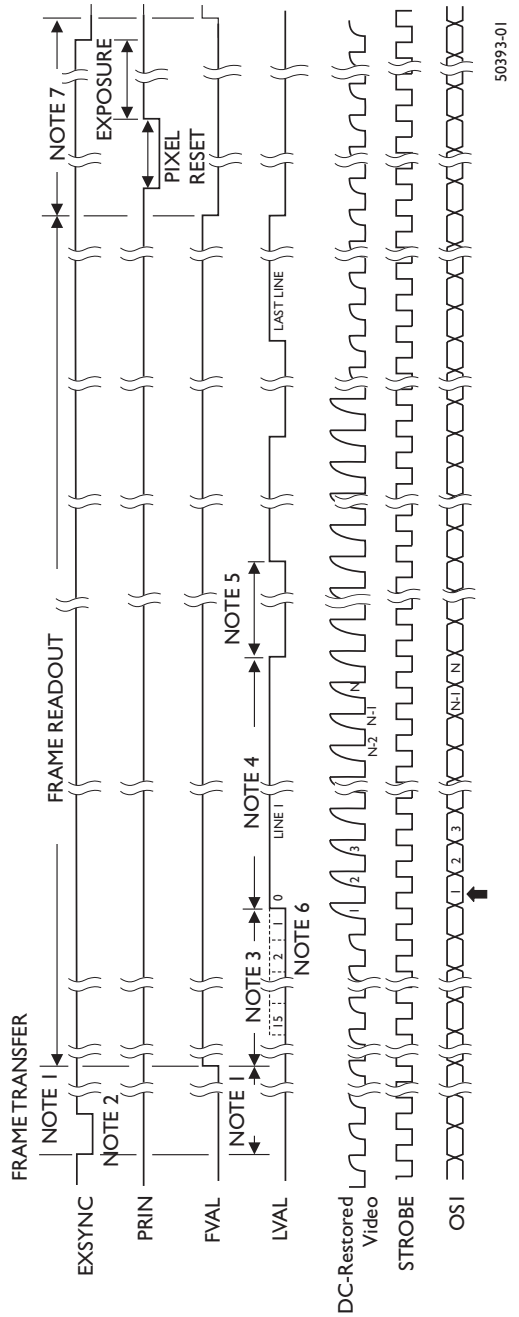


NOTES: N = 512 (2x2 Binning mode: N = 256)

1. EXSYNC to FVAL rising edge A model: 1.012 ms at 25 MHz.
   EXSYNC to first valid pixel A model: 25337 ± 25 STROBEs. 2x2 Binning mode: 12680 ± 12 STROBEs.
2. EXSYNC minimum pulse width = 100 ns.
3. FVAL to LVAL = 31-(pretrigger) STROBEs. 2x2 Binning mode: 15-(pretrigger) STROBEs.
4. Line readout: LVAL stays logic HIGH for 512 STROBEs. 2x2 Binning mode: 256 STROBES.
5. Between lines: LVAL stays logic LOW for 70-(pretrigger) STROBEs. 2x2 Binning mode: 47-(pretrigger) STROBEs.
6. Dashed lines indicate LVAL position with pretrigger. Pretrigger is user-selectable in 1-pixel increments from 0-15 (1-15 for B model).
7. On OS2,A models output pixels from 1024 to 513 (2x2 Binning mode: 512 to 257); B models output 513-1024 (2x2 Binning mode: 257 to 512).
8. Minimum time between frames: 27500±25 STROBEs. 2x2 binning mode: 12500±10 STROBEs.

⬆ Position of first valid pixel.

Figure 9. CA-D7 T Camera Timing



NOTES: N = 1024 (2x2 Binning mode: N = 512)

1. EXSYNC to FVAL rising edge T model = 2.531 ms at 10 MHz.
   EXSYNC to first valid pixel T model = 25337 ± 25 STROBEs. 2x2 Binning mode: 12680 ± 12 STROBEs. .
2. EXSYNC minimum pulse width = 100 ns.
3. FVAL to LVAL = 31-(pretrigger) STROBEs. 2x2 Binning mode: 15-(pretrigger) STROBEs.
4. Line readout: LVAL stays logic HIGH for 1024 STROBEs. 2x2 Binning mode: 512 STROBES.
5. Between lines: LVAL stays logic LOW for 101-(pretrigger) STROBEs. 2x2 Binning mode: 62-(pretrigger) STROBEs.
6. Dashed lines indicate LVAL position with pretrigger. Pretrigger is user-selectable in 1-pixel increments from 0-15.
7. Minimum time between frames: 32500±25 STROBEs. 2x2 binning mode: 13750±10 STROBEs.

⬆ Position of first valid pixel.

Table 2. CA-D4/D7 Performance Specifications

Specification		Units	A Models (incl. ECE)	T Model
Per Output Data Rate, max.		MHz	25	10
Frame Rate, max.		Hz	40	8.4
Saturation Output Amplitude		DN	255	4095
Light Intensity at Saturation,	single output	$\mu W/cm^2$	1.80	1.05
	dual output	$\mu W/cm^2$	3.41	-
Output Gain Mismatch, max.		%	3.0	1.0
DC Offset, binning disabled, max.		DN	8.0	60
DC Offset, binning enabled, max.		DN	8.0	120
Photoresponse Non Uniformity (PRNU) rms, max. [1,3]		%	3.0	3.0
PRNU rms, max. [2,3]		%	4.0	4.0
Fixed Pattern Noise (FPN) rms, binning disabled, max.		DN	2.0	9.0
FPN rms, binning enabled, max.		DN	2.0	18.0
Random Noise	Peak to peak, max.	DN	5	15
	rms, max	DN	0.9	3.0
Noise Equiv. Exposure (NEE), typ.		pJ/cm^2	170	48
Saturation Equiv. Exposure (SEE), typ.		nJ/cm^2	86	127
Responsivity, typ.		$DN/(nJ/cm^2)$	2.9	31
Dynamic Range, min.		ratio	280:1	1325:1
Dynamic Range, typ.		ratio	500:1	2650:1
Operating Temperature, max. ambient		°C	40	40

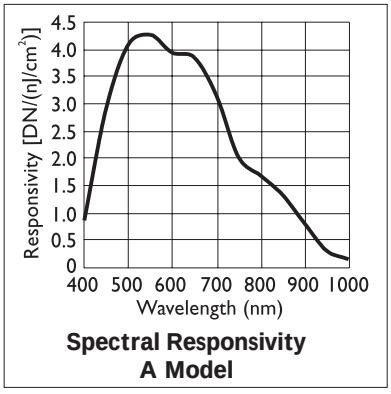
Notes:

- DN = Digital Numbers (0-255 for 8-bit system).
- See Camera Measurement Definitions (doc# 03-36-00056) for specification definitions.

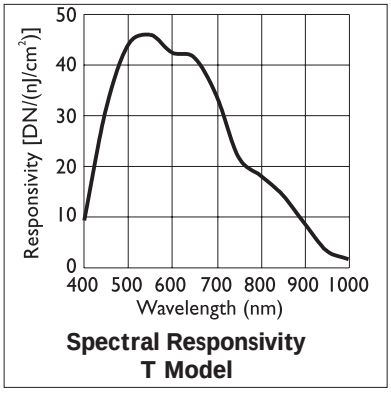
1. With exposure control disabled.
2. With exposure control enabled.
3. Includes cosmetic defects.

Test Conditions

- All measurements exclude perimeter 16 rows and columns.
- All measurements exclude column defects.
- Tungsten halogen light source, black body color temperature 3200K, filtered with 750nm IR cutoff filter.



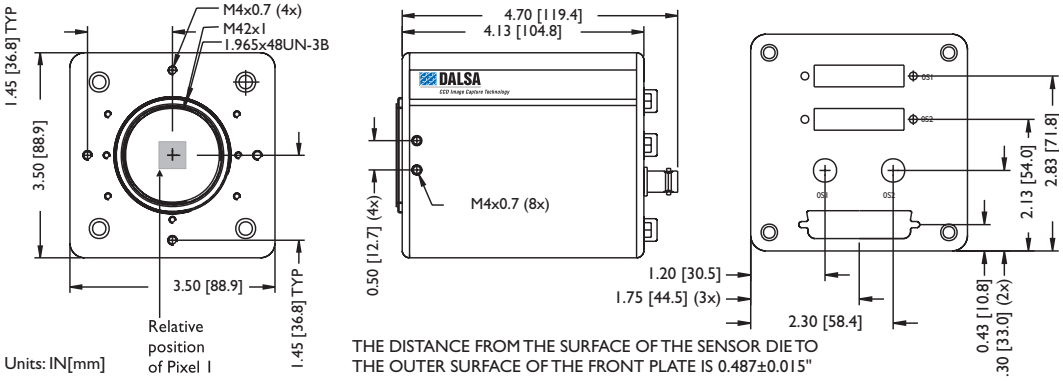
Spectral Responsivity A Model



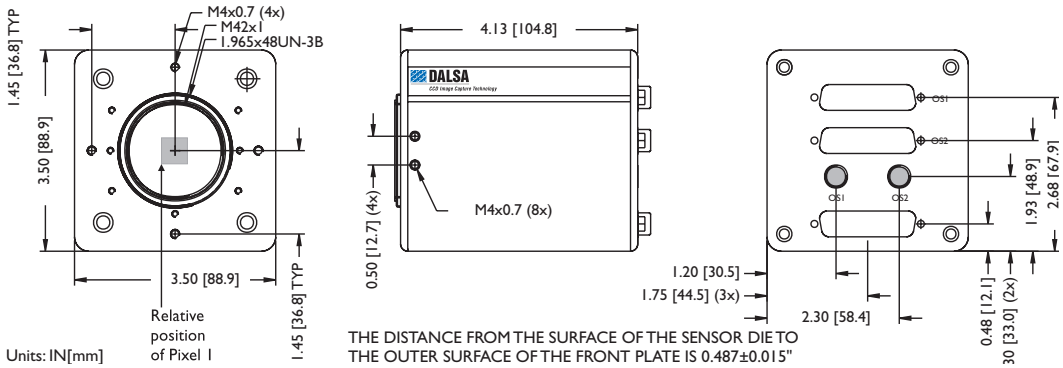
Spectral Responsivity T Model

Figure 10. Mechanical Dimensions

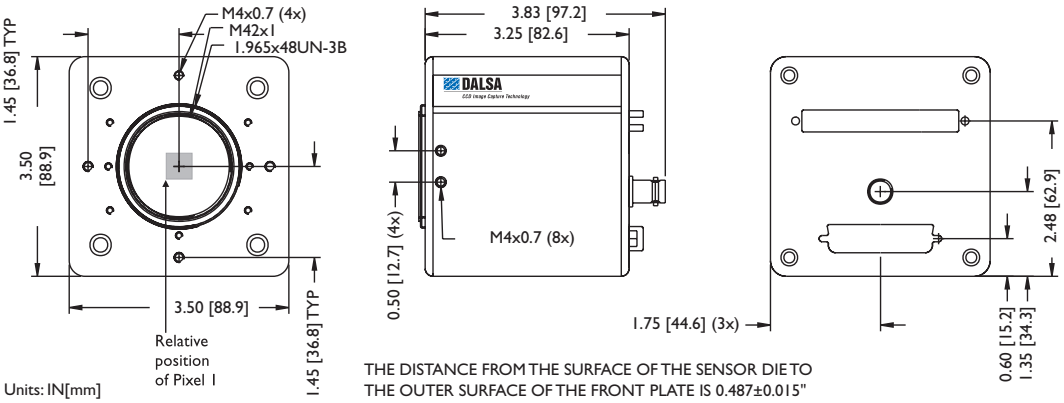
A Model



CE-Compliant A Model



T Model



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