DALSA CT-E4-2048 Camera

The CT-E4 offers the latest TDI technology in a 4-output configuration to combine high line rates and simplicity of interface.

Features

- Time Delay and Integration architecture for high sensitivity
- >100x Antiblooming
- Proprietary technology for enhanced blue responsivity
- 2048 horizontal resolution, 13µm square pixels
- Selectable 24, 32, 48, 64, or 96 TDI stages
- 4 output taps, up to 44kHz line rate
- 8-bit EIA-644 (LVDS) digital data @ 20 or 25MHz per tap
- CE-compliant
- Separate rugged D-Sub connectors for power, control, and data

Description

The DALSA CT-E4-2048W uses TDI (Time Delay and Integration) technology for high sensitivity line scan applications. The CT-E4 can be operated with a selectable number of TDI stages to give user control over sensitivity. The camera's four outputs provide extremely high line rates.

The CT-E4-2048W camera uses 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 CT-E4 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 CT-E4 is ideally suited for applications requiring very high resolution and very high speed in low light, such as:

- High performance document scanning-image lift
- Industrial inspection
- Low light scanning

Table 1. Camera Configurations

Specification	20MHz	25MHz
Pixel Pitch	[13µm]	
Aperture	[26.6mm x 1.3mm]	
Lens Mount	[F-mount]	
Max. Line Rate	36kHz	44kHz
Data Format	[8 bits, EIA-644]	
Data Channels	[4]	

Example Configuration: CT-E4-2048W

resolution ——— model

Sensor

The CT-E4-2048W camera uses DALSA's IT-E4 multi-tapped image sensor. The IT-E4 has a horizontal resolution of 2048 pixels (13µm square) and 96 TDI stages. The multiple exposures of TDI technology plus the enhanced blue response of the IT-E4 give the CT-E4-2048W orders of magnitude more sensitivity than single-line sensors.

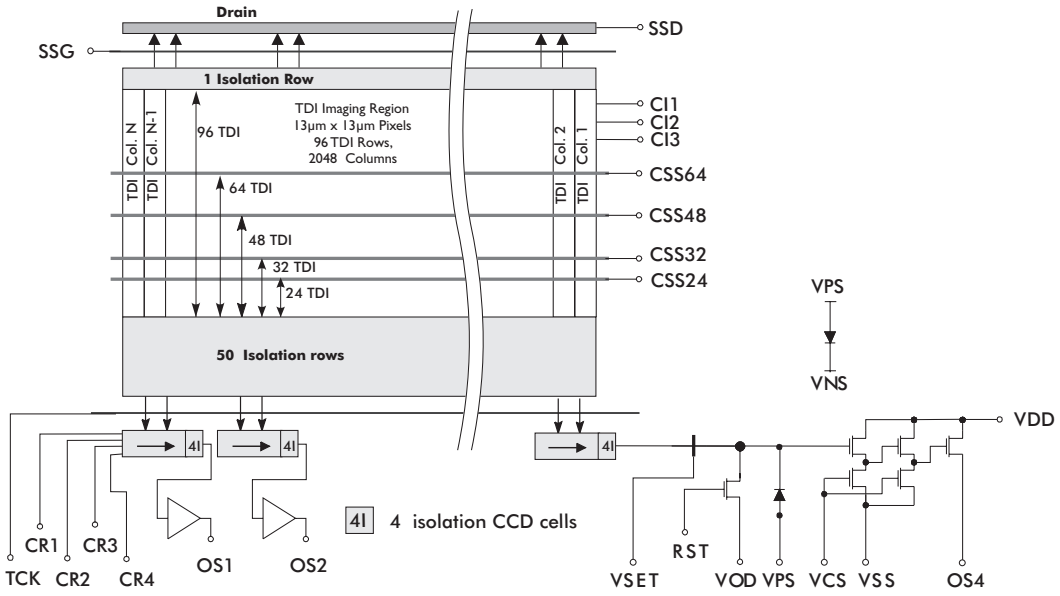
Operation

Power Supplies

The table below shows the requirements for the camera's three DC voltages. The power supply requirements indicated below are adequately overrated to accommodate all models and operating conditions.

Voltage	Current Draw	Notes
+15V	300mA	Specified at 25°C ambient. Tolerance for all supplies: ■ ± 50mV ■ <5mV ripple.
+5V	1500mA	
-5V	230mA	

Figure 1. IT-E4 Sensor Block Diagram



Optical Interface

The CT-E4 front plate provides an adapter for F-mount (35mm Nikon-compatable) lenses. The mount threads into a Z-axis alignment ring in the camera's front plate, which is optically aligned to provide the proper back focal distance between lens and sensor. The threaded hole can also be used to provide custom optical mounts.

Electrical Interface

All of the cameras connectors are on its rear plate. The camera uses a DB15M connector for power, a DB15F for control signals, and two DB37F connector for digital data. Digital data, data clocking, and control signals use the EIA-644 (LVDS) standard for data transmission.

Input Control Signals

The standard CT-E4 requires only one input signal to operate. The line transfer clock EXSYNC is required once each line to shift the integrating image one stage in the same direction as the incident image's motion. The CT-E4 cameras are optimized to use an internal oscillator to generate all master timing and clocking and **do not normally accept an external MCLK**. Contact DALSA if you want to supply an external MCLK.

The input signals are differential, requiring a complement (denoted by a B suffix—e.g. EXSYNC, EXSYNCB).

Signal	Controls
EXSYNC	Starts line transfer for synchronization to moving object
STGSEL	Selects number of TDI stages
BIN	Vertical Binning

EXSYNC

EXSYNC is a required user-supplied EIA-644 input signal located on the DB15F connector. On every rising edge of EXSYNC, the integrating image is shifted one line towards the CCD readout register. The frequency of EXSYNC **must** be synchronized with the motion of the incident image.

EXSYNC State	
Rising edge	Starts line transfer
Falling edge	min. 100ns after rising edge

STGSEL

STGSEL is used in combination with the stage selection rotary switches to select the number of TDI stages. Each switch position has two stage settings associated with it; the logic level of STGSEL determines which setting the camera uses.

BIN

BIN is an optional user-supplied input signal that controls pixel binning. When BIN is logic HIGH, the camera performs 2:1 vertical binning, which combines the charge collected in two pixels and changes the aspect ratio to 2:1.

Charge in 2 adjacent pixels | Charge binned: 1 pixel output | Normal image | Binned image

By using 2:1 binning mode it is possible to inspect a web moving faster than the camera's normal maximum line rate while still acquiring a crisp image and maintaining web synchronization with full web coverage. This is accomplished by matching the 2:1 pixel area ratio with the same web area ratio. See the camera user's manual for more details.

When nothing is connected to these inputs, the camera defaults into normal, non-binning mode.

BIN State	Camera Mode
High	2x1 vertical binning
Low	No binning

If not using BIN, connect it to logic LOW and BINB to logic HIGH or leave BIN and BINB unconnected.

Output Signals

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

Clocking Signal	Indicates
LVAL (high)	Valid line data
STROBE (rising edge)	Valid pixel data

Digital Data D0-D7

The cameras output 8-bit digital data in EIA644 format using DB37F connectors. See Figure 3.

IMPORTANT: This camera's data is valid on the **rising** edge of STROBE, unlike previous DALSA cameras which used the falling edge.

Multi-Camera Synchronization

Multi-camera synchronization allows you to synchronize the output of multiple cameras for a multi-camera inspection system. This feature is not normally available on the CT-E4-2048, but can be implemented with minor customization. Contact DALSA if your application requires this feature.

For more details on camera operation, see the camera user's manual.

Figure 2. Camera Interface

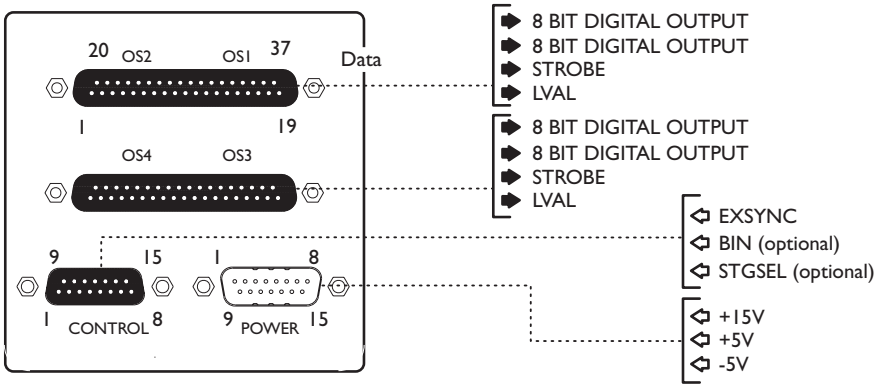
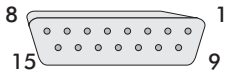


Figure 3. Connector Pinouts

DB15F—Control



Mating Parts: Amphenol hood 17-1657-15
AMP plug 205206-3, AMP pin 745254-7,
Belden cable 9807 28AWG (or equivalents)

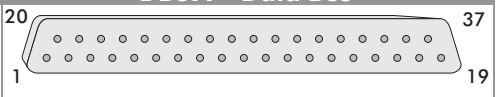
Pin	Signal	Pin	Signal
1	BIN	9	BINB
2	Future use	10	Future use
3	Future use	11	Future use
4	EXSYNCB	12	EXSYNC
5	STGSEL	13	STGSELB
6	Factory use	14	Factory use
7	No connection	15	No connection
8	No connection		

DB15M—Power

Mating Parts: Amphenol hood 17-1657-15
AMP receptacle 205205-2, AMP socket 745253-7,
Belden cable 9946 22AWG (or equivalents)

Pin	Signal	Pin	Signal
1	DGND	9	+5V Digital
2	+5V Digital	10	DGND
3	Future use	11	Future use
4	-5V Digital	12	Future use
5	Not used	13	-5V Analog
6	+15V Analog	14	AGND
7	+15V Analog	15	+5V Analog
8	AGND		

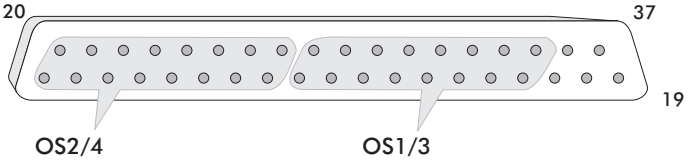
DB37F—Data Bus



Mating Parts: Amphenol hood 17-1657-37
AMP plug 205210-3, AMP pin 745254-7
Belden cable 9819 28AWG (or equivalents)

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

Note: Each DB37 connector has two channels of data (e.g. OS1+OS2, OS3+OS4, etc.)



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

Table 2. CT-E4-2048W Performance Specifications

Test Specification	Units	20MHz Model	25MHz Model
Per Output Data Rate, max.	MHz	20	25
Line Rate min. [1]	kHz	10	10
max.	kHz	36	44
Saturation Output Amplitude	DN	255	255
Output Gain Mismatch, max.	DN	11	11
Photoresponse Non Uniformity. Max., global	DN	15	15
PRNU, max., within tap	DN	15	15
PRNU, max., pixel-to-pixel [2]	DN	10	10
Fixed Pattern Noise, dark (FPN), max., global	DN	10	10
FPN, max., within tap	DN	6	6
Random Noise, peak to peak, max.	DN	4	4
RN (RMS)	DN	0.8	0.8
DC Offset, typ.	DN	3	3
DC Offset Mismatch, max.	DN	1	1
Noise Equiv. Exposure (NEE), typ.	pJ/cm²	2.6	2.6
Saturation Equiv. Exposure (SEE), typ.	nJ/cm²	1.3	1.3
Responsivity, typ.	DN/(nJ/cm²)	191	191
Dynamic Range, typ.	ratio	490:1	490:1
Operating Temperature, max., ambient	°C	40	40
First Pixel Mismatch, max. [3]	DN	15	15

Notes:

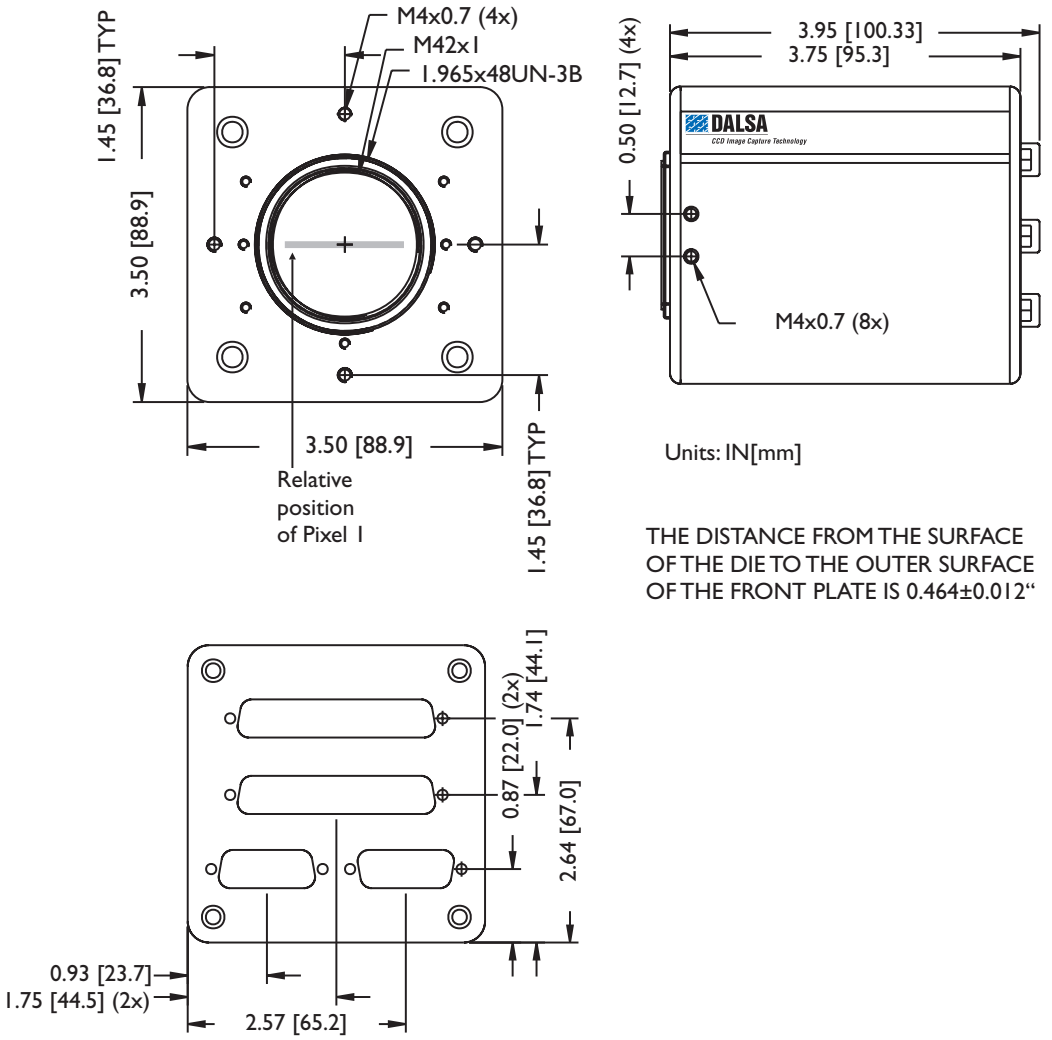
- DN = Digital Numbers (0-255 for 8-bit system).
- See Camera Measurement Definitions (doc# 03-36-00056) for specification definitions.

1. Camera will operate below this line rate with degraded performance.
2. A delta window of 8 pixels is examined and shifted by half its window. First and last pixels of each tap excluded.
3. Measured on each tap relative to next 10 pixels. Measured at V_{SAT}.

Test Conditions:

- Tungsten halogen light source, black body color temperature 3200K, filtered with 750nm IR cutoff filter.
- All measurements exclude last pixel of OS1 and first pixel of OS4.
- All measurements at 25°C ambient.

Figure 5. CT-E4 Mechanical Interface



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

Life Support Applications
These products are not designed for use in life support appliances, devices, or systems where malfunction of these products can reasonably be expected to result in personal injury. DALSA customers using or selling these products for use in such applications do so at their own risk and agree to fully indemnify DALSA for any damages resulting from such improper use or sale.