DALSA CL-F2 TDI Cameras

The CL-F2 offers the senstivity and flexibility of bidirectional TDI line scanning with a single output for ease of interface.

Features

- Time Delay and Integration architecture for high sensitivity
- 512, 1024 or 2048 horizontal resolution
- 96 TDI stages
- 13µm square pixels
- Bidirectional scanning
- 8 bit RS422 Digital data output

Description

The CL-F2 series cameras use TDI (Time Delay and Integration) technology for high sensitivity line scan applications. The CL-F2 provides bi-directional capability. The camera series supports resolutions of 512, 1024 and 2048 pixels elements, with 96 stages in the TDI scan direction. The CL-F2 cameras offer sensitivity many times greater than comparable single line scan cameras, making these cameras ideally suited to applications with low ambient light levels.

The CL-F2 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 an A/D board processes the video and digitizes it for output. Contact DALSA for further information.

Applications

The CL-F2 cameras are ideally suited for use in:

- Document scanning
- Machine vision inspection
- Web inspection
- Low light scanning

Sensor

The CL-F2 cameras use DALSA's IL-F2 image sensor for high sensitivity and high resolution performance. The sensor uses a single output in each of the forward and reverse directions. The pixel size is 13µm x 13µm with a 100% fill factor (all of the image area is photosensitive) to achieve maximum quantum efficiency within the pixel. Figure 1 shows the block diagram of the IL-F2 sensor. Due to the bidirectional capabilities of the IL-F2 sensor, the CL-F2 camera can be operated so that the TDI scan is either Forward or Reverse. This permits multipass scanning in both directions, eliminating the need for time consuming mechanical return to start-of-scan.

Table 1. CL-F2 Camera Configurations

Specification	0512	1024	2048
Pixel Pitch	13µm x 13µm		
Aperture	6.7mm x 1.25mm	13.3mm x 1.25mm	26.6mm x 1.25mm
Lens Mount	C-mount	C-mount	F-mount
Max. Line Rate	23kHz	13kHz	6.9kHz

Specification	A Model
Data Bits, all resolutions	8
Data Rate, all resolutions	15MHz
Data Format, all resolutions	RS422
Data Channels, all resolutions	1

Example Configuration: CL-F2-1024A

Resolution ____ model

Operation

Power Supplies

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

Voltage	Current Draw	Notes
+15V	500mA	Specified at 25°C ambient.
+5V	1500mA	Tolerance for all supplies:
-5V	500mA	■ ± 50mV
-15V	100mA	■ <5mV ripple.

Optical Interface

The CL-F2 provides an adapter for a C-mount lens or a Nikon F type bayonet lens mount, depending on resolution. This mount threads into an opening in the camera's front plate, and 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 camera's connectors are on its rear plate. The CL-F2 "A" model uses a DB25 connector, two 20-pin IDC connectors, and a BNC video connector. The power and control signals are input to and output from the DB25 connector. Digital data and data clocking signals are provided on the 20-pin IDC connectors using the RS422 standard for data transmission. The BNC connector provides an analog video reference.

Input Control Signals

The standard cameras require only one input signal to operate. The line transfer clock EXSYNC is required once each line to trigger line readout. Note that for optimum performance, the cameras use an internal oscillator to control all internal timing, including pixel rate. **The camera does not normally use an external MCLK signal.** Contact DALSA if you want to supply MCLK.

The CL-F2 cameras require an additional signal to control the TDI scan direction. When the direction signal FORWARD is high, the camera integrates in the forward scan direction. When FOR/REV is low, the camera can scan in the reverse direction.

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

EXSYNC

EXSYNC is a required user-supplied RS422 input signal. 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 should not be clocked faster than the specified line rate. Minimum EXSYNC frequency is 300Hz.

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

FORWARD

FORWARD is a user-supplied RS422 input signal located on the DB25 connector. It controls the direction of scan on the CL-F2 cameras.

FORWARD State	Camera Mode
Low	scan in reverse direction
High	scan in forward direction

USR_EN

USR_EN is an optional input signal located on the DB25 connector (W model only). It can be used in special operating modes to select from among 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 data from the CL-F2 to be clocked into the acquisition system:

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

Digital Data D0-D7 (Digital output models only)

The A model outputs digital data in RS422 format using 20-pin IDC connectors. See Figure 3.

Figure 1. IL-F2 Sensor Block Diagram

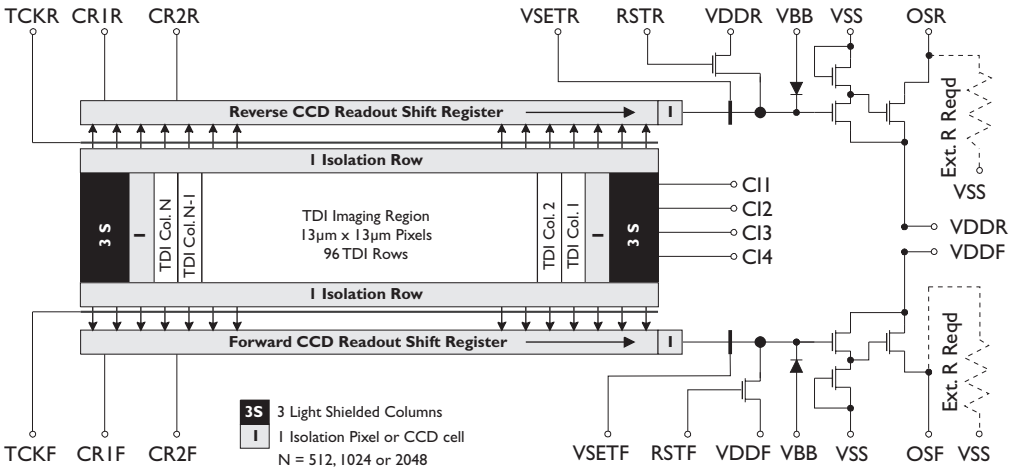


Figure 2. CL-F2 Camera Interface

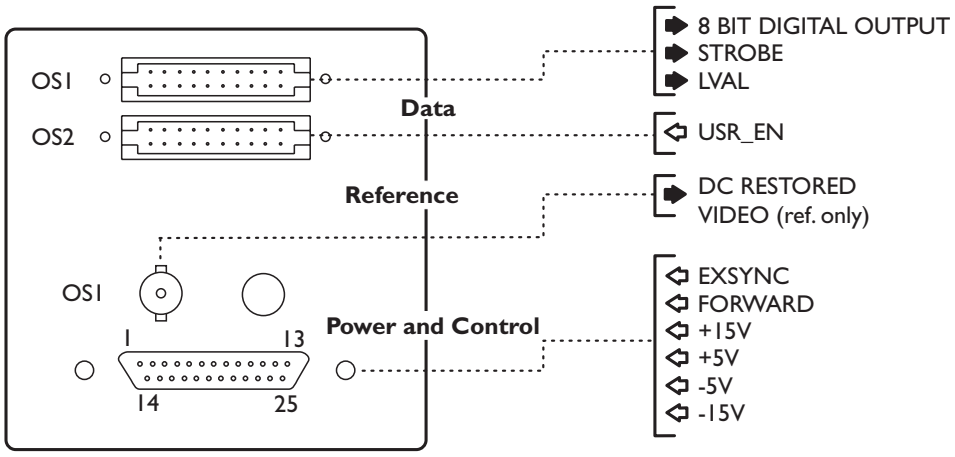
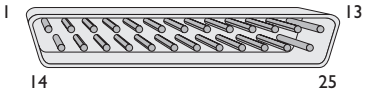


Figure 3. Pinouts

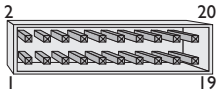
DB25—Power and Control



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	Future use	14	Future use
2	Future use	15	Future use
3	Future use	16	Future use
4	EXSYNCB	17	EXSYNC
5	FORWARDB	18	FORWARD
6	MCLK	19	MCLKB
7	Digital GND	20	Digital GND
8	+5 V Analog	21	+15 V Analog
9	+15 V Analog	22	-5 V Analog
10	Future use	23	Future use
11	Analog GND	24	Analog GND
12	-5 V Digital	25	-15 V Analog
13	+5 V Digital		

OS1 - Data and Clocking



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

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—A Model

1-17	No connect	2-18	No connect
19	USR_EN	20	USR_ENB

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

Figure 4. Mechanical Dimensions

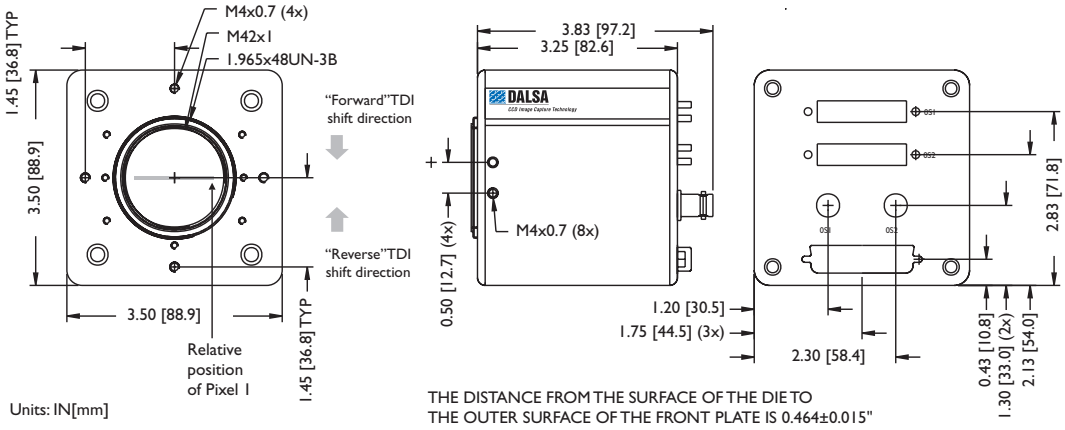
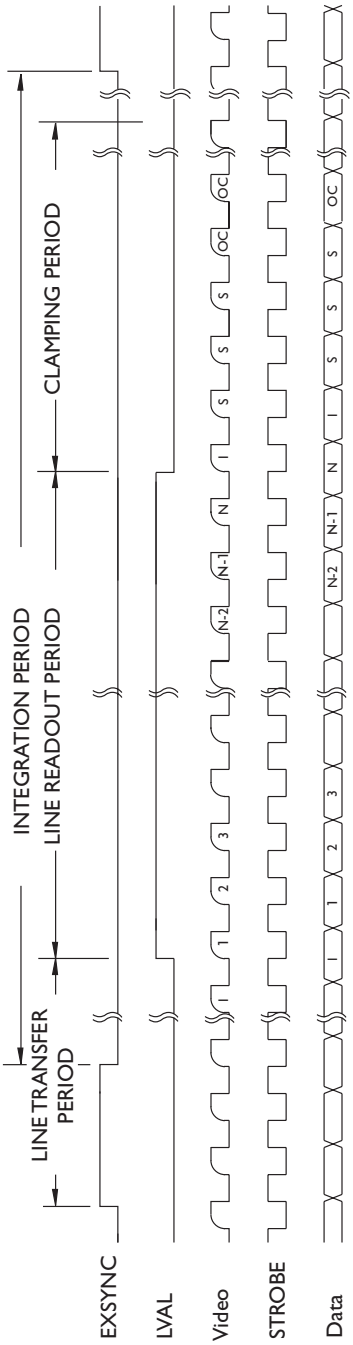


Figure 5. Camera Timing Overview



Notes:
Line Transfer period = time required to transfer signal charge from pixel to CCD readout register
I = Isolation pixel
OC = Overclock pixel
S = Light-Shielded pixel
N = 512, 1024, or 2048

Table 2. CL-F2 Performance Specifications

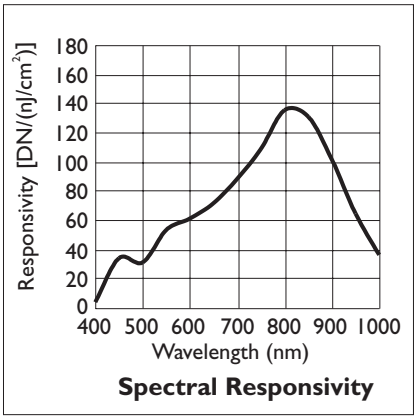
Specification		Units	A Model
Per Output Data Rate, max.		MHz	15
Line Rate, max.,	0512	kHz	23
	1024	kHz	13
	2048	kHz	6.9
Saturation Output Amplitude		DN	255
Photoresponse Non Uniformity (PRNU), max.		DN	25
Fixed Pattern Noise, dark (FPN), max.		DN	5
DC Offset, max.		DN	5
Random Noise, max.,	peak to peak	DN	3
	rms	DN	0.6
Noise Equivalent Exposure (NEE)		pJ/cm²	7.5
Saturation Equivalent Exposure (SEE)		nJ/cm²	3.1
Responsivity, typ.		DN/(nJ/cm²)	80
Dynamic Range, typ.		ratio	415:1
Operating Temperature, max. ambient		°C	35

Note:

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

Test Conditions:

- Tungsten halogen light source, black body color temperature 3200K, filtered with 750nm IR cutoff filter.



Spectral Responsivity

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.