
Main Features

- High Sensitivity Full Frame CCD Sensor
- 2048 x 2048 Resolution with 14 μm Square Pixels
- Bayer Color Mosaic
- 12-bit Dynamic Range
- Very Low Noise: 66 dB SNR
- Binning Modes
- LVDS Data Format
- High Data Rate: 20 Mpixels/s
- Flexible and Easy to Operate via RS-232 Control
 - Trigger Mode: Free Run or External Trigger Modes
 - Binning 2 x 2 and 4 x 4
 - Exposure Time
 - Gain: x1 to x8
- Single Power Supply: 24VDC
- High Reliability – CE Compliant
- F (Nikon) Mount Adapter (Lens Not Supplied)

Product Description

This camera is designed to meet high performance and quality requirements while providing ease of use.

- ATMEL manages the whole process, from the sensor to the camera. The result is a camera that works in 12-bit, with dedicated electronics that provides an excellent signal to noise ratio.
- The programmable settings let the user work at different integration times and gains. The external trigger allows synchronization of the camera on an external event while the hardware white balance adjustment avoids subsequent software processing.

Applications

Performance and reliability of this camera make it well suited for the most demanding applications as film and document scanning, semiconductor and PCB inspection, DNA analysis, metrology, X-ray imaging.



CAMELIACOL 4M

**Full Frame Digital
Camera**



Rev. 5302B-IMAGE-04/03



Camelia Package Contents

Depending on the configuration selected, a Camelia package may include:

- Camelia Color camera
- FGT Color frame grabber board
- Power supply Cable and RS-232 cable
- Data and Sync cable
- COMMCAM software
- FGT software
- Documentation

System Requirements

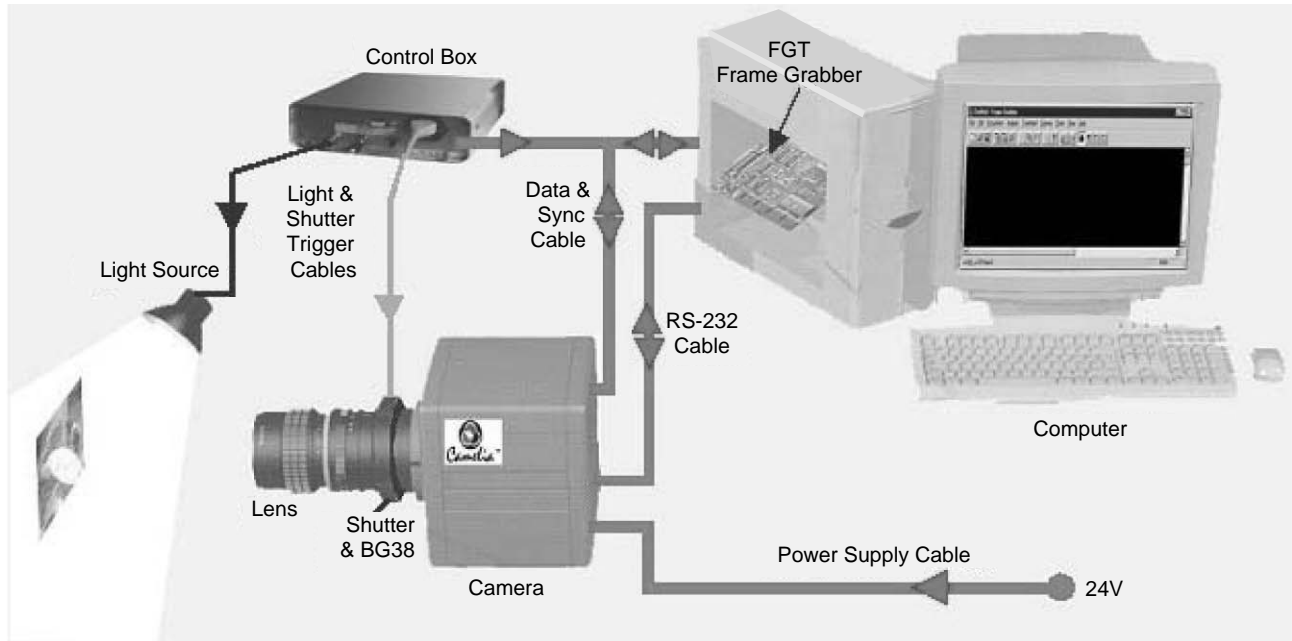
- 24V (0.6A) power supply
- Computer:
 - Minimal configuration:
 - PENTIUM II 350 MHz
 - RAM: 128 Mb
 - Cache memory: 256 Kb
 - 1 Free PCI slot
 - Operating System:
 - Windows[®] NT 4.0
 - Windows[®] 95b, 98
- NIKON lens
- Lighting control
 - Shutter/chopper or pulsed lighting
 - IR cut-off filter: a 2 mm BG38 is recommended to filter light from 700 to 1100 nm

Getting Started

1. Connect the camera to one of the computer serial ports (COM1 or COM2) by using the RS-232 cable.
2. Power on the camera.
3. Install "COMMCAM" software in your computer (refer to the "COMMCAM User Guide").
4. Install FGT COLOR frame grabber board and FGT software in your computer (refer to the "FGT Frame Grabber User Guide").
5. Run the system.

Imaging System Description

Figure 1. Imaging System



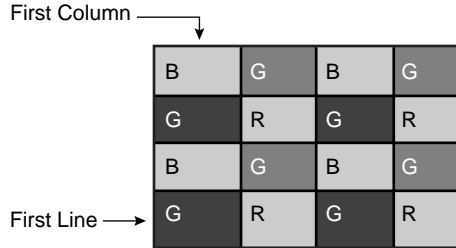
The Camelia 4M is powered by a 24V power supply and is configured through the serial port of the computer. The camera sends digital video to the FGT frame grabber.

As Camelia's CCD is a full frame sensor, either pulsed lighting or a chopper/shutter must be used in front of the camera during integration time in order to have incident lighting on the CCD. The user must design an electro-optical interface to drive the camera, shutter/chopper or lighting by using the SHUTTER signal delivered by the camera. If required, the system can send an external trigger or external ITC (integration time control) signal to the camera.

Camelia Color 4M Camera

CCD Description

- Image format: 28.7 mm (V) x 28.7 mm (H)
- 2048 mm (V) x 2048 mm (H) active pixels
- Pixel Geometry: 14 μm (V) x 14 μm (H)
- Filter Mosaic (Bayer Pattern):



Note: First active pixel of first active line is blue.

- Antiblooming by clocking.

Timing

- 2 x 2 and 4 x 4 pixel binning can be used to enable previewing modes.
- When binning is used, the camera delivers black and white video.
- Data rate is (pixel clock): 20 MHz.

Table 1. Frame Readout Time

Mode	Frame Readout Time
No binning	235 ms
2 x 2 pixel binning	125 ms
4 x 4 pixel binning	70 ms

Three timing modes are available:

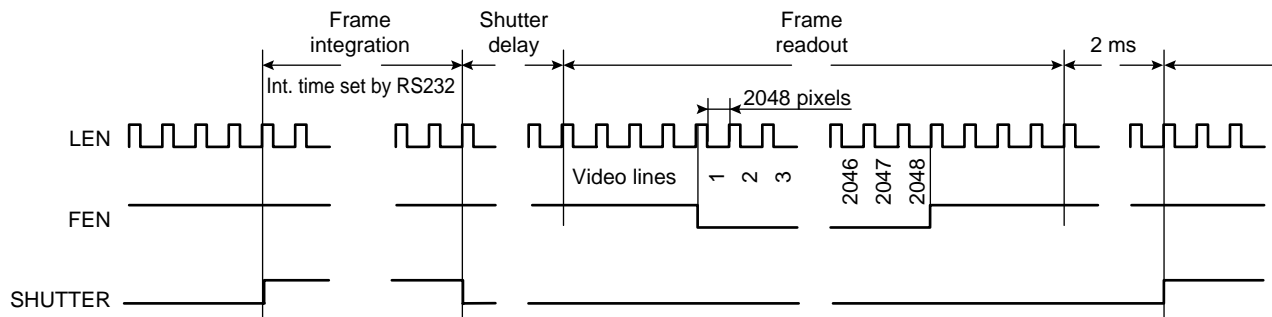
- Continuous
- External triggered
- Integration time controlled (ITC)

Continuous Timing Mode

The camera delivers frames continuously:

- Frame N+1 integration starts as soon as frame N readout is completed (Figure 2).
- Integration time is set by RS-232.

Figure 2. Continuous Timing Diagram

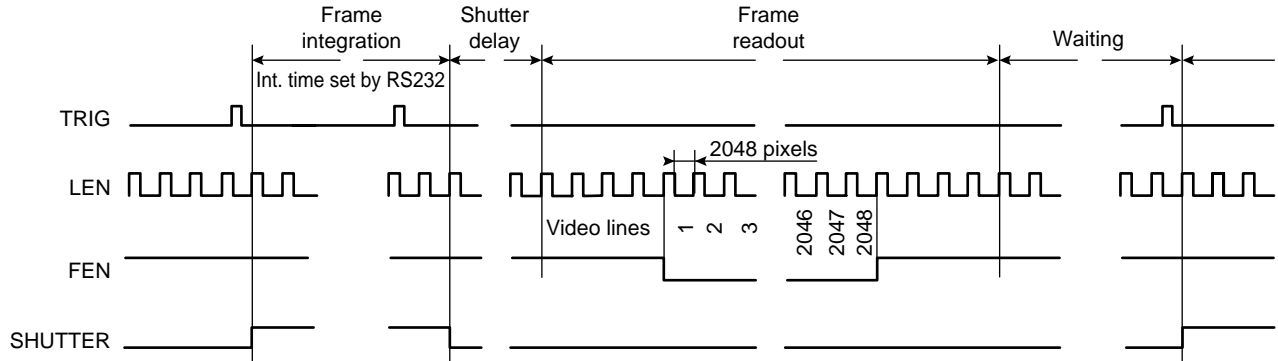


CAMELIACOL 4M Color Digital Camera

External Trigger Timing Mode The external TRIG signal allows the user to control the start of frame integration:

- The rising edge of TRIG activates the start of frame integration. This rising edge is synchronized by the camera with a precision of 112 μ s.
- Integration time is set by RS-232.
- Note that the TRIG signal period must be greater than the sum of the integration time and the frame readout time.

Figure 3. External Trigger Timing Diagram

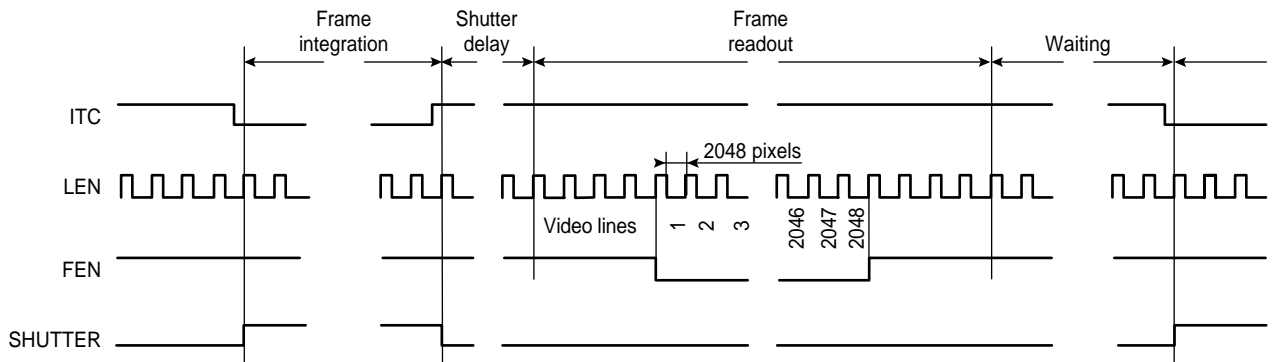


Integration Time Control (ITC) Timing Mode The external ITC signal allows the user to fully control frame integration:

Timing Mode

- The falling edge of ITC activates the start of frame integration. This falling edge is synchronized by the camera with a precision of 112 μ s.
- The rising edge of ITC activates the stop of frame integration. This rising edge is synchronized by the camera with a precision of 112 μ s.
- Note that the ITC signal period must be greater than the sum of the integration time (defined by ITC low) and the frame readout time.

Figure 4. Integration Time Control Timing Diagram



Antiblooming by Clocking

Antiblooming can be activated or inhibited (see "RS-232 Interface" on page 7):

- Antiblooming OFF: antiblooming inhibited. Recommended if antiblooming is not required for the application.
- Antiblooming ON: antiblooming activated.

Electrical Interfaces

Power Supply

Table 2. Power Supply Specifications

Parameter	Nominal Value	Min Value	Max Value
Voltage	24V	20V	28V
Current	0.60A	N/A	N/A

Digital I/O

Table 3. Digital I/O Specifications

Symbol	I/O	Definition	Level
TRIG_ITC	I	Timing control: - TRIG_ITC is either an external trigger or ITC (integration time control) depending on the timing mode configured via RS-232. Operation with external trigger: - TRIG_ITC = TRIG Operation with ITC: - TRIG_ITC = ITC - TRIG_ITC is synchronized by the camera line clock (jitter: 112 μ s)	LVDS ⁽¹⁾
S(11..0)	O	Digital video output: 12 bits	LVDS
FEN	O	Frame enable: - FEN = 0: frame data valid: active lines - FEN = 1: frame data not valid	LVDS
LEN	O	Line enable: - LEN = 0: line data valid: active pixels - LEN = 1: line data not valid	LVDS
PCK	O	Pixel clock	LVDS
SHUTTER	O	Shutter open/close: - during integration: SHUTTER = 1 - during readout: SHUTTER = 0 Delay between the falling edge of SHUTTER and the start of readout: - 4 positions: 1, 5, 10 or 20 ms (set via RS-232).	LVDS

Note: 1. LVDS (Low Voltage Differential Signal) is an EIA 644 standard.

LVDS Drivers/Receivers:

- LVDS: All digital I/Os are differential: (signal+, signal-). Specifications are given for signal +.
- Manufacturer NS.
- Driver: DS90C031TM (SO16 package)
- Receiver: DS90C032TM (SO16 package).

CAMELIACOL 4M Color Digital Camera

RS-232 Interface

Camera configuration is set by RS-232 interface. Table 4 lists the available features:

Table 4. RS-232 Specifications

Function	RS-232 Configuration	Comment
Timing mode	3 modes: - continuous (free running) - external trigger - external ITC	
Binning	3 modes: - no binning - 2 x 2 pixel binning - 4 x 4 pixel binning	Image size: 2048 (H) x 2048 (V) Image size: 1024 (H) x 1024 (V) Image size: 512 (H) x 512 (V)
CDS gain ⁽¹⁾	2 positions: - G = 1 - G = 4	G = 4 is recommended for applications requiring high sensitivity
Camera gain ⁽¹⁾	Camera gain value from 1.00x to 2.00x in 16 steps	
Shutter control	2 modes: - active - inactive (always open)	
Shutter delay	4 positions: - 1 ms - 5 ms - 10 ms - 20 ms	
Antiblooming control	2 modes: - active - inactive	
Integration time	Value must be in milliseconds Range: 1 to 2000 ms	Must be an integer (e.g. 120 for 120 ms, 120.4 is not permitted)

Note: 1. The video signal processing gain of the camera can be adjusted by setting either the CDS or camera gain.

CDS gain: a 1x or 4x gain is available at the input of the video signal processing. Use of the 4x gain is recommended for low level applications as it results in lower noise.

Camera gain: a range of 1x to 2x is available in 16 steps.

Electro-optical Performance

Conditions:

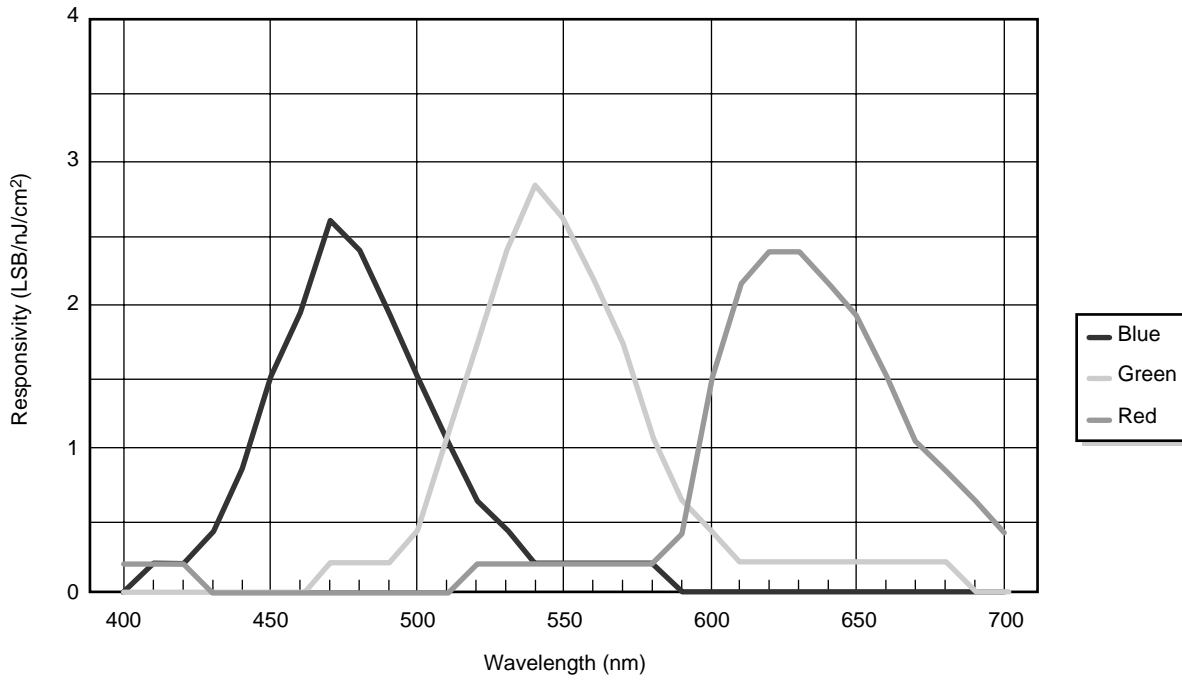
- Frame integration time: 40 ms
- Camera operating ambient temperature: 25°C

Table 5. Electro-optical Performance

Parameter	Symbol	Typical Value	Unit
Full scale value ⁽²⁾	VPE	4095	LSB ⁽¹⁾
Temporal noise ⁽³⁾	VN	2	LSB
Dark signal non-uniformity ⁽⁴⁾	DSNU	5	LSB
Dynamic range ⁽⁵⁾	DY	2048	–
Responsivity ⁽⁶⁾	Rb	0.76	LSB/(nJ/cm ²)
	Rg	1.39	
	Rr	1.79	
Responsivity ⁽⁶⁾	Rb	220	LSB/(lux.s)
	Rg	390	
	Rr	510	
Resolution ⁽⁷⁾			
Horizontal Resolution	TBD	–	–
Vertical Resolution	TBD	–	–

- Notes:
1. LSB (Least Significant Bit): 12-bit = 4095 LSB or gray levels
 2. Full scale value VPE: maximum digital video signal
 3. Temporal noise VN: r.m.s value in darkness; measured by subtracting 2 images pixel to pixel
 4. Dark signal non-uniformity: r.m.s value; excludes blemishes
 5. Dynamic range $DY = VPE/VN$
 6. Responsivity conditions: 3200K, BG38 2 mm, camera gain = 1x, light source powered between 400 and 700 nm, measured on the sensor.
 7. Resolution conditions: light source 3200K, BG38 2 mm, measured at VIDEO = 2000 LSB, CDS gain = 1x.

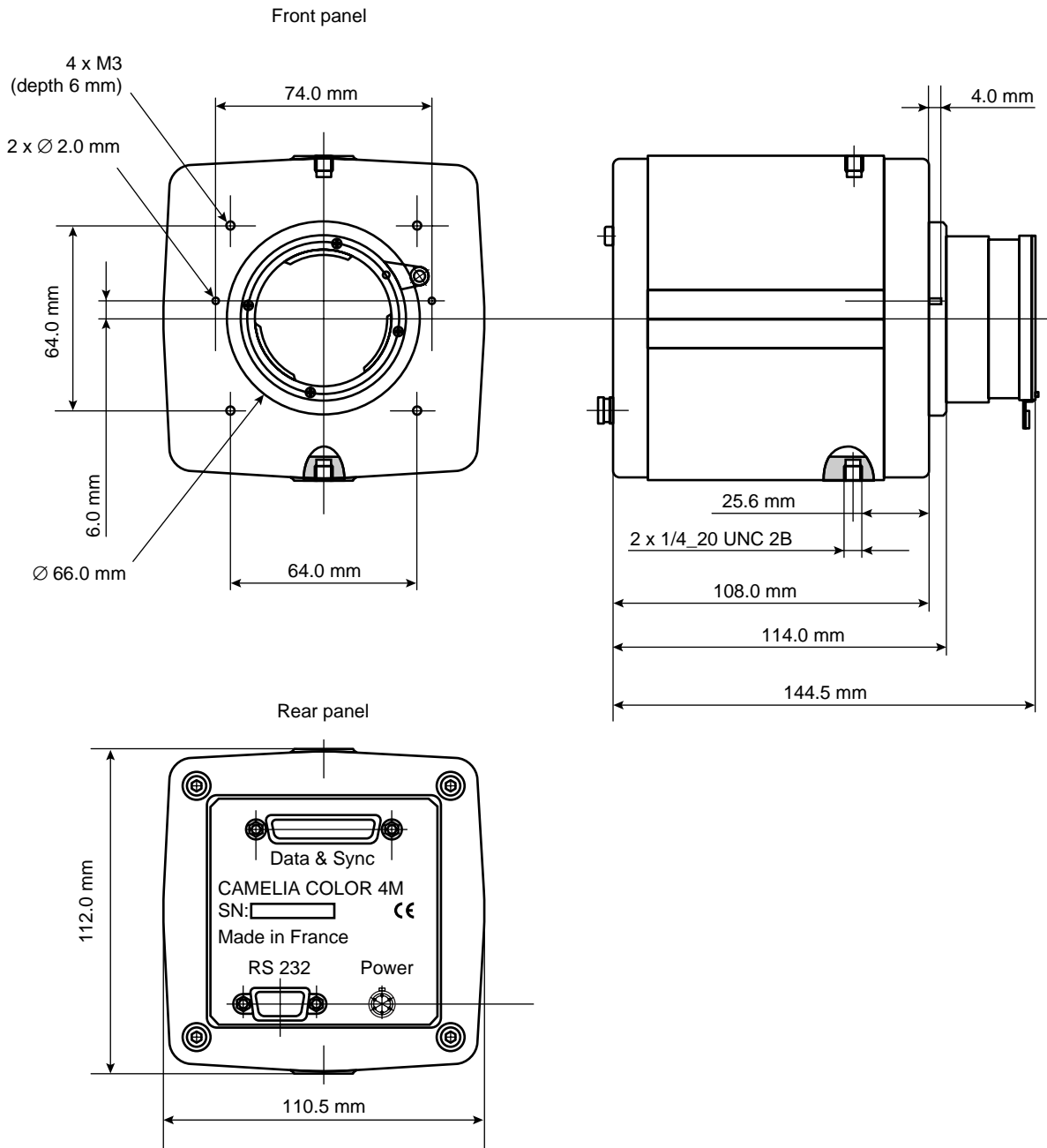
Figure 5. Camelia Color 4M Spectral Responsivity



Note: nJ/cm² measured on the CCD chip.
Including BG38 2 mm.

Geometrical Specifications

Figure 6. Camelia Color 4M Geometrical Specifications



Weight: 1.4 kg

Environmental Requirements

- Operating temperature: 0 to 50°C
- Storage temperature: -20 to 70°C
- Operating humidity: < 80% at 35°C
- Vibration: 2g sinusoidal, from 10 to 55 Hz

Connectors and Cables

Data and Sync Connector

50 points 3M connector.

- Connector reference: HIROSE DX10A-50S
- Mating connector on cable side: HIROSE DX40-50P; shell: HIROSE DX50-CV1

Table 6. Data and Sync⁽³⁾ Pinout

Pin Number	Signal	Pin Number	Signal
1	PCK+	26	LEN+
2	PCK-	27	LEN-
3	FEN+	28	COLOUR_O1+ ⁽¹⁾
4	FEN-	29	COLOUR_O1- ⁽¹⁾
5	COLOUR_O2+ ⁽¹⁾	30	GROUND
6	COLOUR_O2- ⁽¹⁾	31	GROUND
7	PDATA0+	32	PDATA1+
8	PDATA0-	33	PDATA1-
9	PDATA2+	34	PDATA3+
10	PDATA2-	35	PDATA3-
11	PDATA4+	36	PDATA5+
12	PDATA4-	37	PDATA5-
13	PDATA6+	38	PDATA7+
14	PDATA6-	39	PDATA7-
15	PDATA8+	40	PDATA9+
16	PDATA8-	41	PDATA9-
17	PDATA10+	42	PDATA11+
18	PDATA10-	43	PDATA11-
19	GROUND	44	NC ⁽²⁾
20	GROUND	45	NC ⁽²⁾
21	SHUTTER+	46	TRIG_ITC+
22	SHUTTER-	47	TRIG_ITC-
23	COLOUR_I1+ ⁽¹⁾	48	COLOUR_I2+ ⁽¹⁾
24	COLOUR_I1- ⁽¹⁾	49	COLOUR_I2- ⁽¹⁾
25	NC	50	NC

- Notes:
1. Not used for Camelia Color: must be left unconnected.
 2. NC: not connected.
 3. A Data and Sync cable is provided with the FGT frame grabber. It includes a part that connects to the electro-optical interface, and to the FGT frame grabber. Refer to the "FGT Frame Grabber User Manual".

Power Supply Cable

Connector on supply side: SUBD9 male

Table 7. Pinout

Pin Number	Signal
1	24V
2	24V
3	NC
4	NC
5	NC
6	GROUND
7	GROUND
8	NC
9	NC

Note: NC: not connected.

RS-232 Cable

Connector on computer side:

- DSUB9 female,
- Pinout compatible with a computer serial port.

Pinout is the same on camera side and on computer side.



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