INSTALLATION GUIDE

FLIR BLACKFLY®S

USB3 VISION™

GiGE VISION

POE ENABLED

Version 15.0

Revised 2/19/2019

FLIR® | The World's Sixth Sense®

FCC Compliance

This device complies with Part 15 of the FCC rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesirable operation.

Korean EMC Certification

The KCC symbol indicates that this product complies with Korea's Electrical Communication Basic Law regarding EMC testing for electromagnetic interference (EMI) and susceptibility (EMS). This equipment has received a conformity assessment for use in a business environment, and it may cause radio frequency interference if it is used in a home environment.

Hardware Warranty

The warranty for the Blackfly S camera is . For detailed information on how to repair or replace your camera, please see the terms and conditions on our website.

Export Control

The ECCN for this product is EAR099.

WEEE

The symbol indicates that this product may not be treated as household waste. Please ensure this product is properly disposed as inappropriate waste handling of this product may cause potential hazards to the environment and human health. For more detailed information about recycling of this product, please contact us.

Trademarks

Names and marks appearing on the products herein are either registered trademarks or trademarks of FLIR Systems, Inc. and/or its subsidiaries.

Licensing

To view the licenses of open source packages used in this product please see What open source packages does firmware use?

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1 Blackfly S Installation Guide

Welcome to the Blackfly S camera. We offer a number of resources to assist you with the Blackfly S.

- **Release Notes**—information about the current firmware release including feature additions or changes, bug fixes, and known issues.
- **Specifications**—information about the camera model as it performs with the current firmware.
- **Getting Started**—quick start guide for installing the camera and software.
- **Installation Guide**—information about installing the camera and SDK, the physical interface and mechanical properties, troubleshooting and how to get help. This document is available as a PDF for download or as a webpage included in the firmware release package.
- **Technical Reference**—information about the features supported by the camera model with the current firmware, including: image format control, acquisition control, sequencing, binning/decimation, and others. This document is available as a PDF for download or as a webpage included in the firmware release package.
- **Firmware**—programming inserted into the programmable ROM of the camera that can be updated in-field. New firmware packages are available for download and include both the firmware file and documentation.
- **Spinnaker SDK**—software development kit that provides GenICam-compliant controls to create applications for the camera. Spinnaker is available for download. Each installation includes API documentation for C, C++, and C#.

Our website provides additional information in our Knowledge Base and Technical Application Note library. As well, the Downloads site is the portal to access documentation and firmware updates.

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2 Handling Precautions and Camera Care

Warning! Do not open the camera housing. Doing so voids the Hardware Warranty described in the Terms and Conditions on our website.

Your FLIR machine vision camera is a precisely manufactured device and should be handled with care. Here are some tips on how to care for the device.

- Avoid electrostatic charging.
- If you have purchased a board-level camera you should take the following additional protective measures:
  - Either handle bare handed or use non-chargeable gloves, clothes or material. Also, use conductive shoes.
  - Install a conductive mat on the floor or working table to prevent the generation of static electricity.
- When handling the camera unit, avoid touching the lenses. Fingerprints will affect the quality of the image produced by the device.
- To clean the lenses, use a standard camera lens cleaning kit or a clean dry cotton cloth. Do not apply excessive force.
- Extended exposure to bright sunlight, rain, dusty environments, etc. may cause problems with the electronics and the optics of the system.
- Avoid excessive shaking, dropping or any kind of mishandling of the device.

Related Knowledge Base Articles

Title	Article
Cleaning the imaging surface of your camera	Knowledge Base Article 10243

3 Blackfly S Installation

3.1 Preparing for Installation

What system configuration is recommended?

	Operating System	CPU	RAM	Ports	Software to run and compile example code
Recommended System Configuration	Windows 7, Windows 8, or Windows 10 (32- or 64-bit)	Intel i5	4 GB	Intel USB3 host controller	Microsoft Visual Studio 2010, Visual Studio 2013, or Visual Studio 2015

Note: Refer to Technical Application Note 10359 for important information on recommended USB 3.0 system components.

Do you have all the parts you need?

To install your camera you will need the following components:

- For GigE cameras—Ethernet cable (see Interface Cables) and Powered Ethernet switch or Ethernet power injector (if using PoE)
- For USB3 cameras—USB3 cable (see Interface Cables)
- For board-level models—TF38 to FPC USB3 or RJ45 PoE panel mount adapter
- For board-level models—Heatsink (recommended)
- For board-level models—FPC cable
- 6-pin GPIO cable (see General Purpose Input/Output (GPIO))
- For board-level models—Lens mount and lens (see Lens Mounting)
- Model dependent—CS-mount (or C-mount with adaptor) Lens (see Lens Mounting)
- Model dependent—C-mount Lens (see Lens Mounting)
- Tripod adapter (optional) (see Mounting)
- Interface card (see Interface Card)

FLIR sells a number of the additional parts required for installation. To purchase, visit the Accessories page.

Do you have a downloads account?

The downloads page has many resources to help you operate your camera effectively, including:

- Spinnaker® SDK software, including drivers (required for installation)
- Firmware updates and release notes
- Dimensional drawings and CAD models
- Documentation

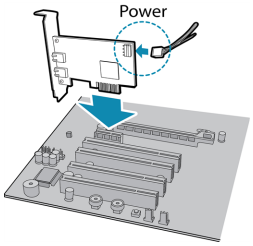
To access the software and firmware downloads you must have a downloads account.

1. Go to our website: www.flir.com/mv.
2. In the upper right corner, click **Register**.
3. Complete the form, then click **Register**.

After you submit your registration, you will receive an email with instructions on how to activate your account.

3.2 Installing Your Interface Card and Software

1. Install your Interface Card



Ensure the card is installed per the manufacturer's instructions.

Connect the internal IDE or SATA power connector on the card to the computer power supply.

Alternatively, use your PC's built-in host controller, if equipped.

Open the Windows Device Manager. Ensure the card is properly installed. USB3 cards appear under **Universal Serial Bus Controllers**. An exclamation point (!) next to the card indicates the driver has not yet been installed.

2. Install the Spinnaker® Software

> **Note:** For existing users who already have Spinnaker installed, we recommend ensuring you have the latest version for optimal performance of your camera. If you do not need to install Spinnaker, use SpinView to install and enable drivers for your card.

a. Login to the Downloads page.

b. Select your **Product Family**, **Camera Model** and **Operating System** from the drop-down lists.

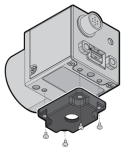
c. Click on the **Software** search results to expand the list.

d. Click the appropriate link to begin the download and installation.

After the download is complete, the Spinnaker setup wizard begins. If the wizard does not start automatically, double-click the .exe file to open it. Follow the steps in each setup dialog.

3.3 Installing Your Blackfly S—Cased Models

1. Install the Tripod Mounting Bracket (optional)



The ASA and ISO-compliant tripod mounting bracket attaches to the camera using the included screws.

2. Attach a Lens

Unscrew the dust cap from the lens holder to install a lens. Note: the camera can be used with a removable 5 mm C-mount adapter.

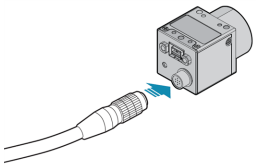
3. Connect the interface Card and Cable to the Camera

Plug the interface cable into the host controller card and the camera. The cable jack screws can be used for a secure connection.

When the camera is first connected, the operating system automatically installs the camera driver. Camera drivers are available with the Spinnaker SDK installation.

a. If using PoE, connect a powered Ethernet switch or Ethernet power injector in between the card and the camera.

4. Plug in the GPIO connector if required



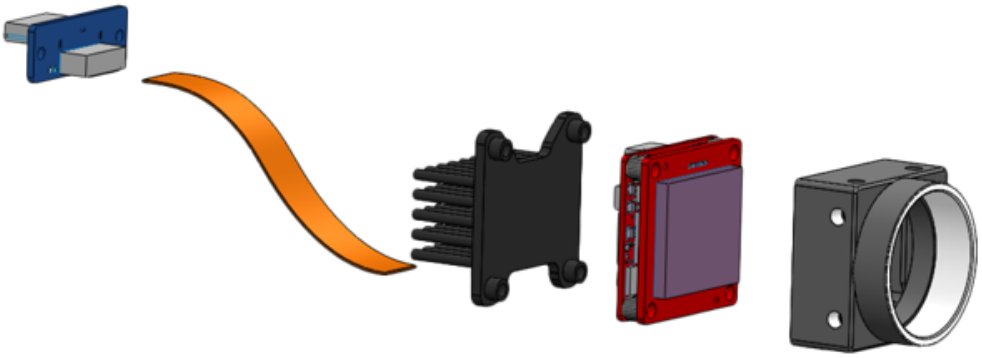
GPIO can be used for power, trigger, and strobe.

5. Confirm Successful Installation

Run the SpinView application: **Start->All Programs-> Point Grey Spinnaker->SpinView**
The SpinView application can be used to test the camera's image acquisition capabilities.

Changes to your camera's installation configuration can be made using the SpinView application.

3.4 Installing Your Blackfly S—Board-level Models



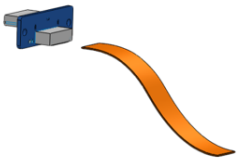
1. Install the lens mount.

The board-level models can use C-mounts, CS-mounts, or S-mounts.

2. Install a heat sink.

A heatsink is recommended but depends on your design and usage.

3. Connect the FPC cable to the panel mount adapter then connect the adapter to the interface card.



A TF38 to FPC USB3 panel mount adapter allows a USB3 cable connection to a PC.
A TF38 to FPC RJ45 PoE panel mount adapter allows a GigE cable connection to a PC.

4. Attach a Lens

5. Plug in the GPIO connector if required

GPIO can be used for power, trigger, serial input output, and strobe.

6. Confirm Successful Installation

When the camera is first connected, the operating system automatically installs the camera driver. Camera drivers are available with the Spinnaker SDK installation.

Run the SpinView application: **Start->All Programs-> Point Grey Spinnaker->SpinView**
The SpinView application can be used to test the camera's image acquisition capabilities.

Changes to your camera's installation configuration can be made using the SpinView application.

3.5 Powering Your Blackfly S

For GigE cameras—Power can be provided over the Ethernet interface (PoE). To use PoE, you must also have a powered Ethernet card, a powered Ethernet switch, or an Ethernet power injector.

For USB3 cameras—The USB3 connector provides a power connection between the camera and the host computer. The ideal input voltage is nominal 5 V DC. For the USB3 connector to provide power, the host controller must be connected to the computer's power supply.

For Cased Models—Power can also be provided externally through the GPIO interface: 12 V nominal (8 - 24 V). Power consumption is 3 W maximum.

If both power sources are connected the camera always uses external power over the GPIO connector.

> **Note:** Some systems, especially those with laptop computers or longer cable lengths, may not provide adequate power through the USB 3.0 cable which could result in intermittent operation. The use of external power through the GPIO is required for these systems.

The camera does not transmit images for the first 100 ms after power-up. The auto-exposure and auto-white balance algorithms do not run while the camera is powered down. It may therefore take several images to get a satisfactory image.

When the camera is power cycled (power disengaged then re-engaged), the camera reverts to its default factory settings, or if applicable, a saved user set.

Related Knowledge Base Articles

Title	Article
How can I power my USB 3.0 camera?	Knowledge Base Article 10240

4 Tools to Control your Blackfly S

The Blackfly S's features can be accessed using various controls, including:

- Spinnaker SDK including API examples
- SpinView camera evaluation application, included in the Spinnaker SDK installation
- Third-party GenICam applications

4.1 Using the Spinnaker® Software Development Kit

You can monitor or control features of the camera through Spinnaker API examples provided in the Spinnaker SDK, or through the SpinView camera evaluation application. A *Programmer's Guide and API Reference* is included in the installation.

4.1.1 SpinView Camera Evaluation Application

The SpinView application is a generic, easy-to-use streaming image viewer included with the Spinnaker SDK that can be used to test many of the capabilities of your camera. It allows you to view a live video stream from the camera, save individual images, adjust the various attributes, frame rates, features and settings of the camera. It includes tools for updating firmware, managing drivers, IP addressing, and activity logging.

4.1.2 Custom Applications Built with the Spinnaker API

The Spinnaker SDK includes a full Application Programming Interface that allows you to create custom applications to control your camera. Included with the SDK are a number of source code examples to help you get started.

Spinnaker API examples are provided for C, C++, C#, and VB.NET languages. These examples are precompiled for your convenience.

4.2 Using GenICam Applications

USB3 Vision is a communication interface for vision applications based on the USB 3.0 technology. All cameras supporting USB3 Vision interact the same way with software also supporting USB3 Vision.

For more information on the standard, visit visiononline.org.

The standard defines required elements for camera identification, control, and output. It uses GenICam, a programming interface for camera attribute control. GenICam allows camera vendors to define features and attributes in an XML file stored inside the camera. The file is parsed by the host application when the camera is initially discovered. One of the key benefits of GenICam is the ability for camera vendors to introduce new camera-specific features without needing to update the host application.

Each camera attribute, such as exposure time, is controlled by a specific GenICam feature. The camera includes an XML device description file for interfacing with third-party GenICam-compliant APIs.

For more information on GenICam, visit emva.org.

Getting Started with Third-Party Applications Resources

Title	Article
Getting Started with OpenCV	Technical Application Note 10861
Getting Started with MATLAB	Technical Application Note 10898
Getting Started with MVTec HALCON	Technical Application Note 10793
Getting Started with Cognex VisionPro	Technical Application Note 10794
Getting Started with Adaptive Vision	Technical Application Note 10865
Getting Started with Matrox Imaging Library	Technical Application Note 10790
Getting Started with Matrox Design Assistant	Technical Application Note 10862
Getting Started with NI-MAX and LabVIEW	Technical Application Note 10791
Getting Started with NI Vision Builder for Automatic Inspection	Technical Application Note 10875

USB3 Vision and Third-Party Applications Resources

Title	Article
Using USB3 Vision cameras with National Instruments' Acquisition Software	Technical Application Note 10337
Using USB3 Vision cameras with A&B Software's ActiveUSB	Technical Application Note 10335
Using USB3 Vision cameras with Matrox Imaging Library	Technical Application Note 10701
Using USB3 Vision cameras with MVTec's Halcon software	Technical Application Note 10774
Using USB3/USB2 cameras with Cognex VisionPro	Technical Application Note 10788

5 Configuring Blackfly S Setup

After successful installation of your camera and interface card, you can make changes to the setup. Use the tools described below to change the driver for your interface card.

For information on updating your camera's firmware post installation, see Camera Firmware.

5.1 Configuring Camera Drivers

Camera drivers are provided as part of the Spinnaker SDK. The first time the camera is connected to the computer, the operating system installs the driver.

To manage and update drivers use the SpinView application:

1. Start SpinView:
   Start Menu-->All Programs-->Point Grey Spinnaker SDK-->SpinView
2. From the Devices list, select the camera and click the Switch Driver button.

3. Select the driver from the drop-down list.
4. Click Install Driver.

5.2 Camera Firmware

Firmware is programming that is inserted into the programmable read-only memory (programmable ROM) of most FLIR cameras. Firmware is created and tested like software. When ready, it can be distributed like other software and installed in the programmable read-only memory by the user.

The latest firmware versions often include significant bug fixes and feature enhancements. To determine the changes made in a specific firmware version, consult the Release Notes.

Firmware is identified by a version number, a build date, and a description.

5.2.1 Determining Firmware Version

To determine the firmware version number of your camera:

- Query the GenICam Device Control feature DeviceFirmwareVersion.

5.2.2 Upgrading Camera Firmware

Camera firmware can be upgraded or downgraded to later or earlier versions using SpinView, part of the Spinnaker SDK available from the Downloads page.

Before upgrading firmware:

- Install the Spinnaker SDK, available from the Downloads page.
- Download the firmware file from the Downloads page.

To upgrade the firmware:

1. ***Start Menu-->All Programs-->Point Grey Spinnaker SDK-->SpinView***
2. From the Device list, right click the camera and select Update Device Firmware.
   If you get a Device is Active warning, close the Display pane or click the Disconnect button and right click the camera again.
3. Browse to select the firmware file and click Open.
4. Click Yes to continue.

Warning! Do not disconnect the camera during the firmware update process.

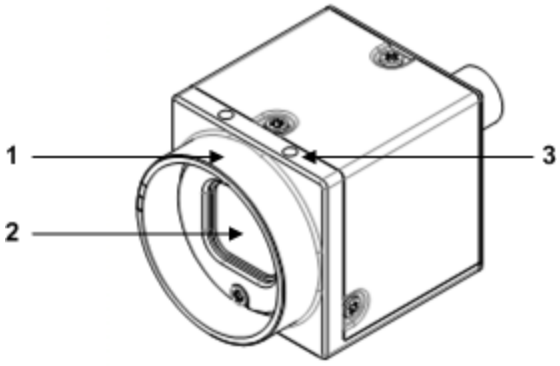
Related Knowledge Base Articles

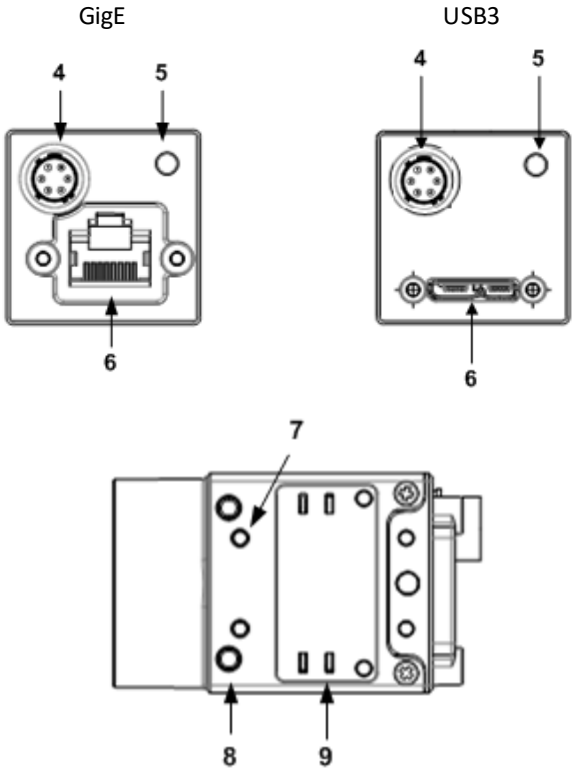
Title	Article
FLIR software and firmware version numbering scheme/standards	Knowledge Base Article 10310
Determining the firmware version used by my camera	Knowledge Base Article 10312

Title	Article
Should I upgrade my camera firmware or software?	Knowledge Base Article 10216

5 Blackfly S Physical Interface

5.1 Blackfly S Cased Physical Description





1. **Lens holder**

   See Lens Mounting

2. **Glass/IR filter system**

   See Dust Protection— Cased Models Infrared Cut- Off Filters— Cased Models

3. **M2x2.5 mounting holes**

   See Mounting

4. **General purpose I/O connector**

   See General Purpose Input/Output (GPIO)

5. **Status LED**

   See Status Indicator LED

6. **Interface connector**

   See Interface Connector

7. **M2x2.5 mounting holes**

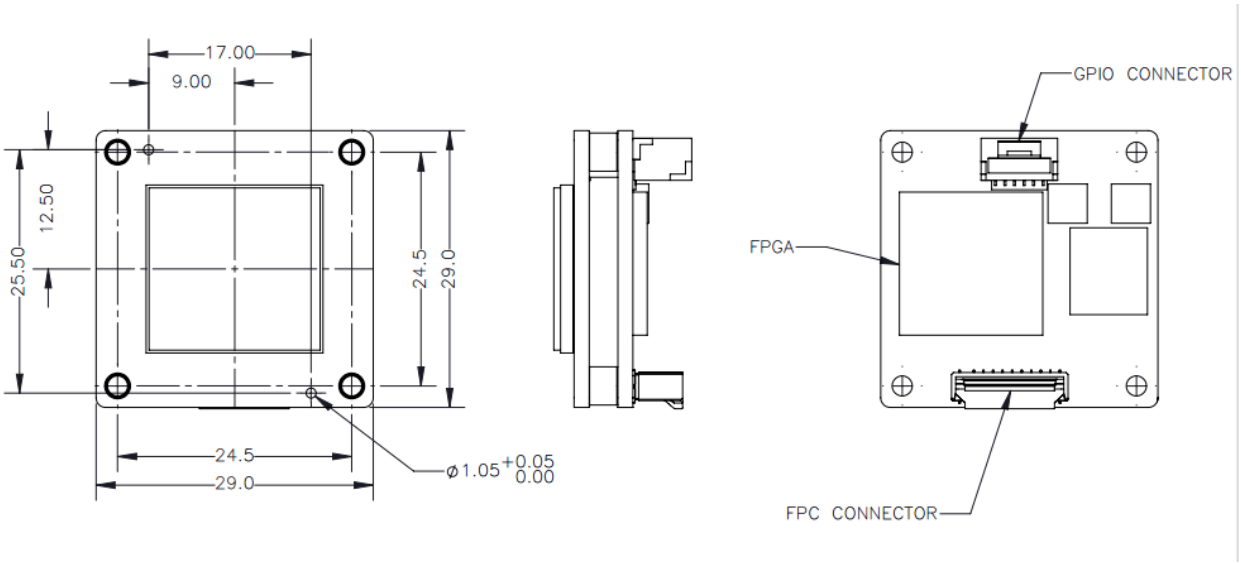
8. **M3x2.5 mounting holes**

   See Mounting

9. **Camera label**

   Contains camera information such as model name, serial number and required compliance.

5.2 Blackfly S Board-Level Physical Description



GPIO connector

See General Purpose Input/Output (GPIO)

Status LED (to right of FPC connector)

See Status Indicator LED

FPC connector

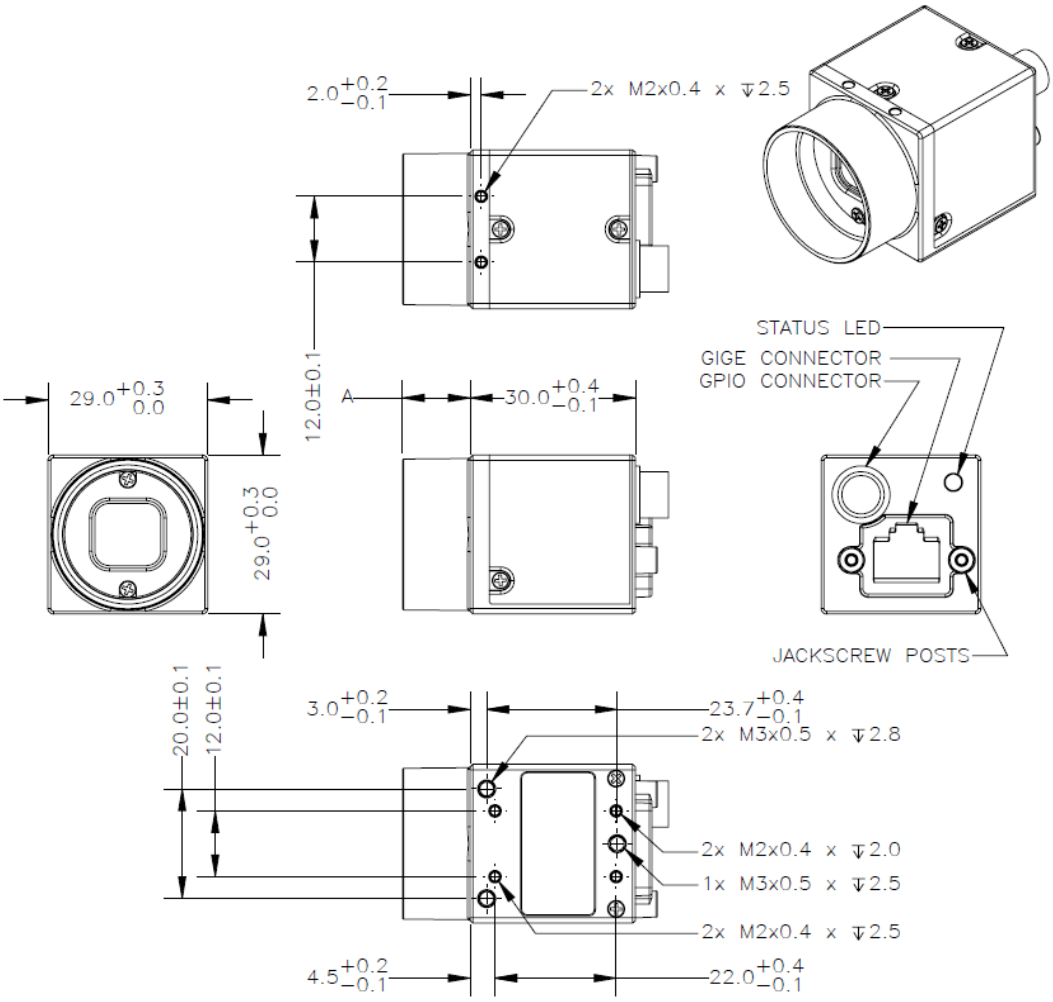
See Interface Connector

Mounting holes

See Mounting

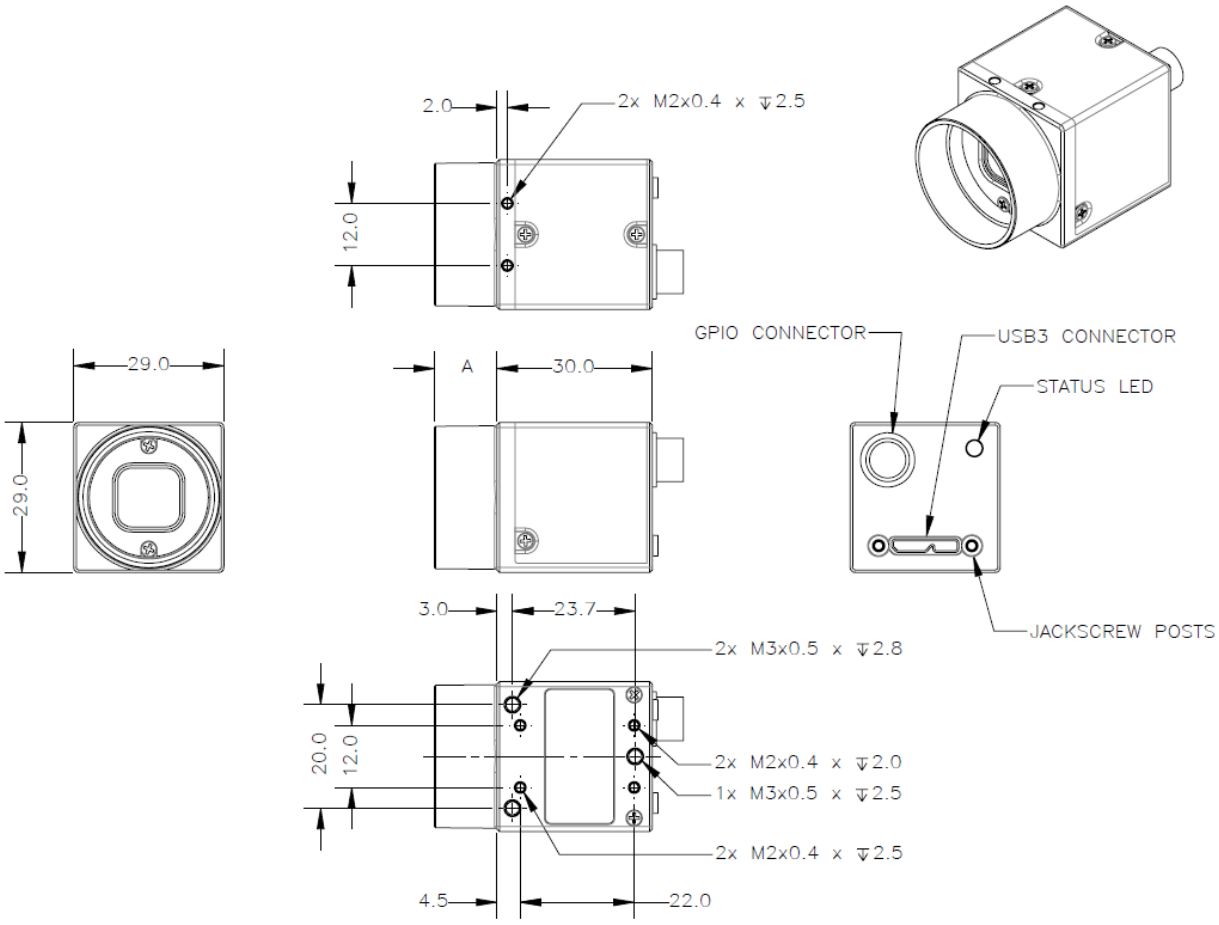
5.3 Blackfly S Dimensions

Note: To obtain 3D models, go to Downloads or contact Support.



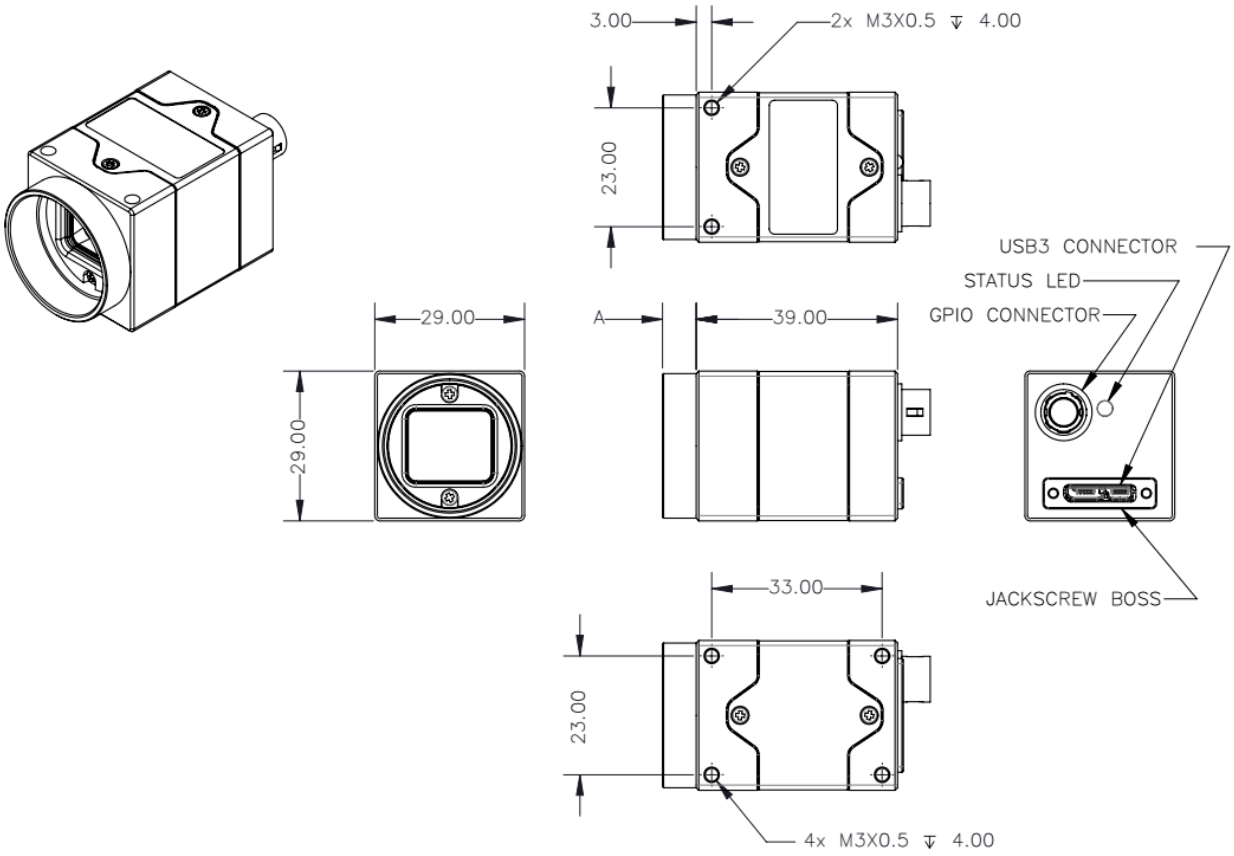
Model	Barrel Length "A"	Model	Barrel Length "A"
BFS-PGE-04S2	6.8	BFS-PGE-50S5	11.8
BFS-PGE-13Y3	12.1	BFS-PGE-63S4	11.7
BFS-PGE-16S2	6.8	BFS-PGE-88S6	11.8
BFS-PGE-23S3	11.8	BFS-PGE-120S4	6.7
BFS-PGE-31S4	11.8	BFS-PGE-122S6	11.8
BFS-PGE-51S5	11.8	BFS-PGE-200S6	11.8

Blackfly S GigE Dimensional Drawing



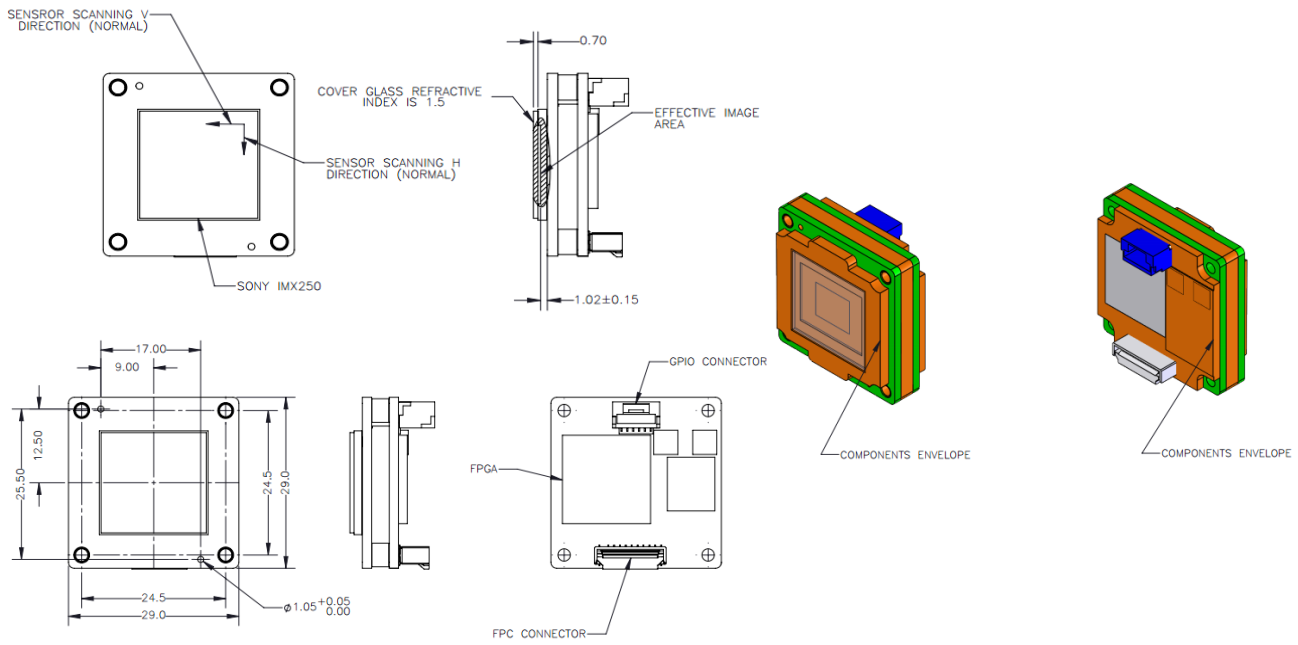
Model	Barrel Length "A"	Model	Barrel Length "A"
BFS-U3-04S2	6.8	BFS-U3-63S4	11.7
BFS-U3-13Y3	12.1	BFS-U3-88S6	11.8
BFS-U3-16S2	6.8	BFS-U3-89S6	11.8
BFS-U3-23S3	11.8	BFS-U3-120S4	6.7
BFS-U3-31S4	11.8	BFS-U3-122S6	11.8
BFS-U3-32S4	11.8	BFS-U3-123S6	11.8
BFS-U3-50S5	11.8	BFS-U3-200S6	11.8
BFS-U3-51S5	11.8		

Blackfly S USB3 Dimensional Drawing—Standard Format



Model	Barrel Length "A"
BFS-U3-28S5	6.5
BFS-U3-70S7	6.5

Blackfly S USB3 Dimensional Drawing—Large Format



Blackfly S Board-level Dimensional Drawing

5.3.1 Keepout Layer—Board-level Models

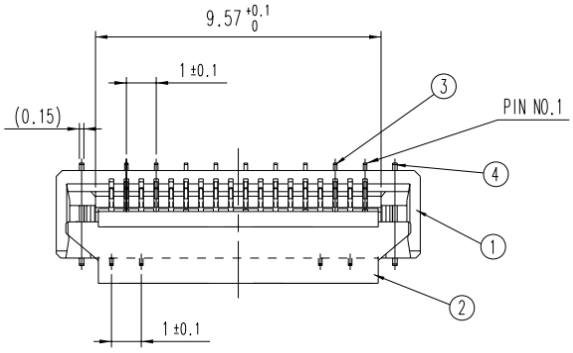
Board-level hardware can change without notice. The component envelope is shown above to assist in hardware integration design. Areas marked in orange (front, back, and middle) are locations where components can change or move, potentially affecting hardware integration as board revisions occur.

5.4 Interface Connector

5.4.1 Ethernet Connector

Cased models—The 8-pin RJ-45 Ethernet jack is equipped with two (2) M2 screwholes for secure connection. Pin assignments conform to the Ethernet standard.

Board-level models—The camera is equipped with a GigE TF38 connector that is used for data transmission, camera control, and power.



Hirose TF38 high-speed FPC connector

GigE TF38 Pin Assignments

Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	VPOE	VPOE	TRXN3	GND	TRXP3	GND	TRSN2	GND	TRXP2	GND	TRXN1	GND	TRXP1	GND	TRXN0	GND	TRXP0	GND

Power over Ethernet (PoE)

Boad-level cameras can support PoE. You can purchase a separate add-on adapter or design your own.

To use PoE, an Ethernet power injector or a powered Ethernet switch must be connected to the camera. The PoE conforms to the IEEE 802.3af-2003 standard.

5.4.2 USB 3.1 Connector

Cased models—The camera is equipped with a USB 3.1 Micro-B connector that is used for data transmission, camera control and power. For more detailed information, consult the USB 3.1 specification available from http://www.usb.org/developers/docs/.

USB 3.1 Micro B Connector

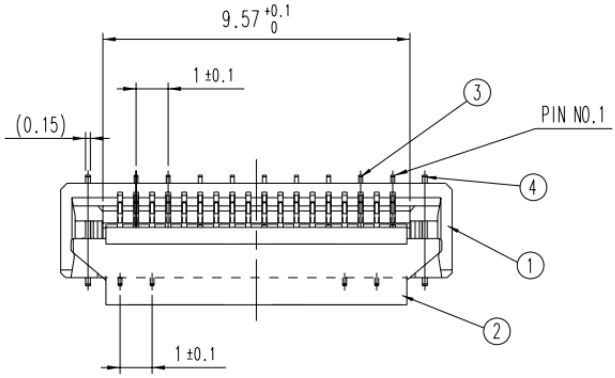
USB 3.1 Micro-B Connector Pin Assignments

Pin	Signal Name	Description
1	VBUS	Power

Pin	Signal Name	Description
2	D-	USB 2.0 differential pair
3	D+	
4	ID	OTG identification
5	GND	Ground for power return
6	MicB_SSTX-	SuperSpeed transmitter differential pair
7	MicB_SSTX+	
8	GND_DRAIN	Ground for SuperSpeed signal return
9	MicB_SSRX-	SuperSpeed receiver differential pair
10	MicB_SSRX+	

The USB 3.1 Micro-B receptacle accepts a USB 2.0 Micro-B plug and, therefore, the camera is backward compatible with the USB 2.0 interface.

Board-level models— The camera is equipped with a USB3.1 TF38 connector that is used for high speed data transmission, camera control, and power.



Hirose TF38 high speed FPC connector

USB3 TF38 Pin Assignments

Pin	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
	Vbus	Vbus	GND	GND	USB2D_N	GND	USB2D_P	GND	USB2_ID	GND	SSTX_N	GND	SSTX_P	GND	SSRX_N	GND	SSRX_P	GND

The camera is backwards compatible to USB2.0, therefore, only connecting Pins 1-10 to a USB2.0 interface is sufficient for USB2.0 communication with the camera.

Note: When the camera is connected to a USB 2.0 interface, it runs at USB 2.0 speed, and maximum frame rates are adjusted accordingly based on current imaging parameters.

Related Knowledge Base Articles

Title	Article
USB 3.1 Frequently Asked Questions	Knowledge Base Article 10019

5.5 Interface Cables

To purchase a recommended cable from FLIR, visit the Products Accessories page.

For GigE cameras—Category 5e or 6 cables up to 100 meters in length should be used for connecting the camera to the network interface card on the host system. FLIR sells a 5-meter Category 5e cable for this purpose.

For USB3 cameras—The USB3 standard does not specify a maximum cable length.

- 3-meter USB3 cable (Part Number ACC-01-2300)
- 5-meter USB3 cable (Part Number ACC-01-2301)
- 5-meter USB3 cable high performance (Part Number ACC-01-2302)

Note: A 5-meter USB3 cable (or longer) is not recommended for laptops or on board controllers.

Related Knowledge Base Articles

Title	Article
Extending the Working Distance of USB3 Cameras	Technical Application Note 10341

5.6 Interface Card

To purchase a compatible card from FLIR, visit the Products Accessories page.

The camera must connect to an interface card. This is sometimes called a host adapter, a bus controller, or a network interface card (NIC).

For GigE cameras—A 1000 BASE-T NIC is recommended for streaming images on the Ethernet network between the camera and host system.

> **Note:** For optimal video streaming and camera control performance, we recommend an Intel Pro chipset on a PCIe interface.

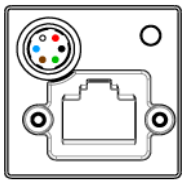
For USB3 cameras—In order to achieve the maximum benefits of USB3, the camera must connect to a USB3 PCIe 2.0 card. The card must be connected to the PC power supply in order to power the camera through the USB3 interface.

5.7 General Purpose Input/Output (GPIO)

Cased models—The camera is equipped with a 6-pin GPIO connector on the back of the case. The connector is a Hirose HR10A-7R-6PB, the mating connector is a Hirose HR10A-7P-6S(73).

Board-level models—The camera is equipped with a 6-pin GPIO connector. The connector is a JST BM06B-NSHSS-TBT (LF)(SN), the mating connector is a JST NSHR-06V-S.

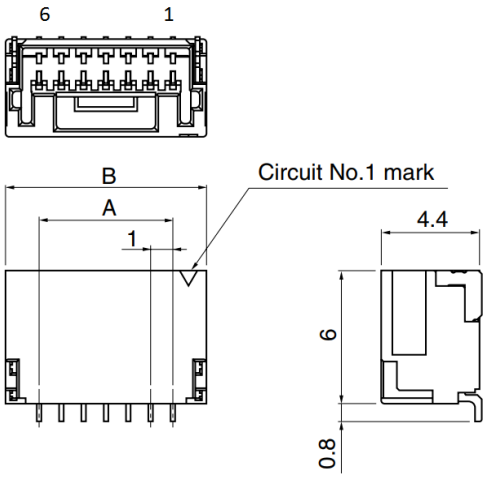
Blackfly S Cased Models

Diagram	Color[1]	Pin	Line	Function	Description	Parameter	Min	Max	Unit
	Green	1[2]	3	V_{AUX}	Auxiliary Input Voltage (DC)	Input Voltage Range	8	24	V
				GPI	Non-isolated Input	Input Low Level	0	1.4	V
						Input High Level	2.6	3.6	V
						Propagation Delay		1	µs
	Black	2	0	OPTOIN	Opto-isolated Input	Input Low Level	0	1.4	V
						Input High Level	2.6	30	V
						Input Current	3.5	7	mA
						Propagation Delay Low to High		18	µs
						Propagation Delay High to Low		9	µs
	Red	3[2]	2	VOUT	Camera Power Output	Output Voltage	3.05	3.35	V
						Output Current		120	mA
				GPIO[3]	Non-isolated Input/Ouput	Input Low Level	0	1.4	V
						Input High Level	2.6	24	V
						Propagation Delay		1	µs
						Output Low Current		25	mA
						Output High Level	0	24	V
	White	4	1	OPTOOUT[3]	Opto-isolated Output	Output Low Current[4]		25	mA
						Output High Level	0	24	V
						Propagation Delay Low to High		36	µs
						Propagation Delay High to Low		18	µs
	Blue	5	N/A	Opto GND	Opto-isolated Ground				
	Brown	6	N/A	GND	Camera Power Ground				

Measurement conditions: Opto-Isolated I/O VCC=5V, Rext=1KOhm, Non-Isolated Output: VCC=5V, Rext=330 Ohm, Non-Isolated Input: VCC=3.3V. Measured over operating temperature range (-20℃ to +50℃ ambient temperature), unless otherwise noted.

1—GPIO cable assembly wire colors
2—Dual function pin
3—Open drain output, requires pullup resistor
4—Output low level depends on the output voltage / pullup resistor combination

Blackfly S Board-level Models



Note: Diagram is for reference only.
Actual number of pins is 6.

Board-level USB3

Color	Pin	Line	Function	Description	Parameters	Min	Max	Unit
Orange	1	0	GPIO0	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Black	2	1	GPIO1	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
White	3	2	GPIO2	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V

Color	Pin	Line	Function	Description	Parameters	Min	Max	Unit
Green	4	3	GPIO3	Non-isolated Input/Output (USB3)	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Brown	5	N/A	GND	Camera Power Ground				
Red	6	N/A	Vout	Camera Power Output	Output Voltage	3.05	3.35	V
					Output Current		120	mA

Board-level GigE

Color	Pin	Line	Function	Description	Parameters	Min	Max	Unit
Orange	1	0	GPIO0	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Black	2	1	GPIO1	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
White	3	2	GPIO2	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Green	4	N/A	VExt	Camera Input Power (GigE)		4.0	5.5	V
Brown	5	N/A	GND	Camera Power Ground				
Red	6	N/A	Vout	Camera Power Output	Output Voltage	3.05	3.35	V
					Output Current		120	mA

5.8 Mounting

Using the Case—Cased Models

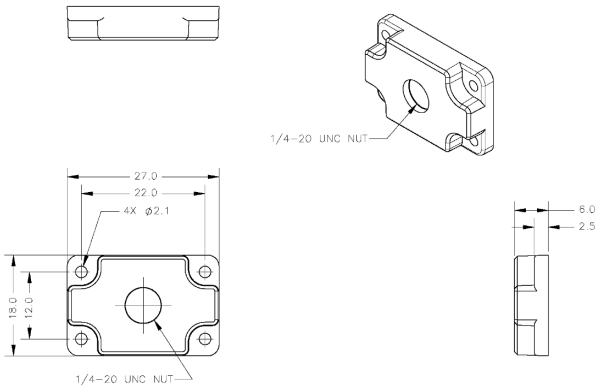
The case is equipped with the following mounting holes:

- Two (2) M2 x 2 mm mounting holes on the top of the case
- Three (3) M3 x 2.5 mm mounting holes on the bottom of the case
- Four (4) M2 x 2 mm mounting holes on the bottom of the case that can be used to attach the camera directly to a custom mount or to the tripod mounting bracket

Using the Mounting Bracket—Cased Models

The tripod mounting bracket is equipped with four (4) M2 mounting holes.

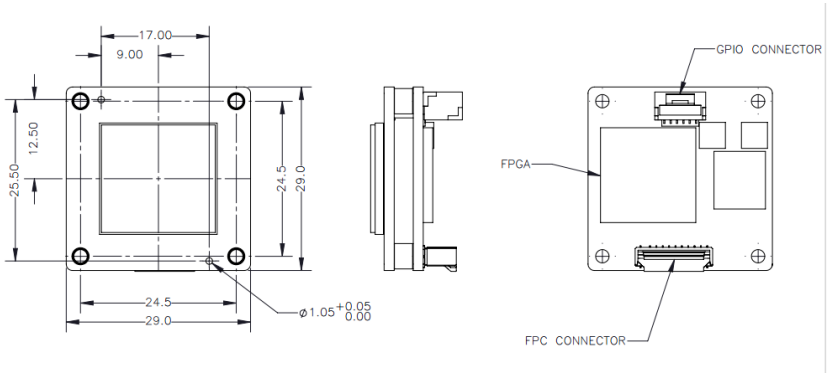
Tripod Adapter Dimensions—Cased Models



Tripod Adapter Dimensional Diagram

Using the Mounting Holes—Board-level Models

Four mounting points are provided using M2 through holes. Additionally, an indexing key is available on the imager board. When designing a mounting bracket, respect the Keepout Layer—Board-level Models.



Board-level Diagram

5.9 Case Temperature and Heat Dissipation

You must provide sufficient heat dissipation to control the internal operating temperature of the camera.

The camera is equipped with an on-board temperature sensor.

- For cased models—It allows you to obtain the temperature of the camera board-level components. The sensor measures the ambient temperature within the case.
- For board-level models—It allows you to obtain the temperature of the camera FPGA junction temperature. The temperature must be kept under 100°C. Some models may not require heat sinking depending on the mode of operation.

As a result of packing the camera electronics into a small space, the camera can become hot to the touch when running. For cased models, this is expected behavior and will not damage the camera electronics. For board-level models, the temperature must be kept under 100°C and therefore may require a heat sink to avoid damage.

To reduce heat, use a cooling fan to set up a positive air flow around the camera, taking into consideration the following precautions:

- Mount the camera on a heat sink, such as a camera mounting bracket, made out of a heat-conductive material like aluminum. When designing a heat sink for a board-level model, respect the Keepout Layer—Board-level Models.
- Make sure the flow of heat from the camera to the bracket is not blocked by a non-conductive material like plastic.
- Make sure the camera has enough open space around it to facilitate the free flow of air.

To access temperature information:

- Query the GenICam Device Control feature DeviceTemperature.

For board-level models—Device temperature can be monitored in SpinView as follows:

- Select Device_Temperature_Selector Enum Node
- Set Device_Temperature_Selector Enum Node Value to Mainboard
- Read Device_Temperature Node

5.10 Lens Mounting

Lenses are not included with the cased model cameras.

Lenses and lens mounts are not included with the board-level model cameras. FLIR offers compatible lens mounts for board-level products on our machine vision accessories page. When designing a lens mount, respect the Keepout Layer—Board-level Models.

Related Knowledge Base Articles

Title	Article
Selecting a lens for your camera	Knowledge Base Article 10694

Correct focus cannot be achieved using a CS-mount lens on a C-mount camera.

C-mount models	CS-mount models
BFS-PGE-13Y3 / BFS-U3-13Y3	BFS-PGE-04S2 / BFS-U3-04S2
BFS-PGE-31S4 / BFS-U3-31S4	BFS-PGE-16S2 / BFS-U3-16S2
BFS-PGE-23S3 / BFS-U3-23S3	BFS-PGE-120S4 / BFS-U3-120S4
BFS-U3-28S5	
BFS-U3-32S4	
BFS-PGE-50S5 / BFS-U3-50S5	
BFS-PGE-51S5 / BFS-U3-51S5	
BFS-PGE-63S4 / BFS-U3-63S4	
BFS-U3-70S7	
BFS-PGE-88S6 / BFS-U3-88S6	
BFS-U3-89S6	
BFS-PGE-122S6 / BFS-U3-122S6	
BFS-U3-123S6	
BFS-PGE-200S6 / BFS-U3-200S6	

5.10.1 Back Flange Distance—Cased Models

The Back Flange Distance (BFD) is offset due to the presence of both a 1 mm infrared cutoff (IRC) filter and a 0.5 mm sensor package window. These two pieces of glass fit between the lens and the sensor image plane. The IRC filter is installed on color cameras. In monochrome cameras, it is a transparent piece of glass. The sensor package window is installed by the sensor manufacturer. Both components cause refraction, which requires some offset in flange back distance to correct.

The resulting C-mount BFD is 17.99 mm.

The resulting CS-mount BFD is 12.52 mm.

For more information about the IRC filter, see Infrared Cut-Off Filters—Cased Models.

5.11 Non-Volatile Flash Memory

The camera has 6 MB flash memory for users to store data.

Related Knowledge Base Articles

Title	Article
Storing data in on-camera flash memory	Knowledge Base Article 10370

5.12 Dust Protection—Cased Models

The camera housing is designed to prevent dust from falling directly onto the sensor's protective glass surface. This is achieved by placing a piece of clear glass (monochrome camera models) or an IR cut-off filter (color models) that sits above the surface of the sensor's glass. A removable plastic retainer keeps this glass/filter system in place. By increasing the distance between the imaging surface and the location of the potential dust particles, the likelihood of interference from the dust (assuming non-collimated light) and the possibility of damage to the sensor during cleaning is reduced.

Warning! Cameras are sealed when they are shipped. To avoid contamination, seals should not be broken until cameras are ready for assembly on site.

Warning! Use caution when removing the protective glass or filter. Damage to any component of the optical path voids the Hardware Warranty. Removing the protective glass or filter alters the optical path of the camera, and may result in problems obtaining proper focus with your lens.

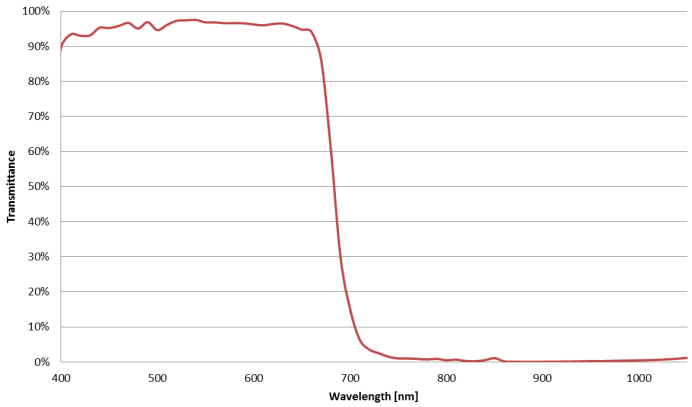
Related Knowledge Base Articles

Title	Article
Removing the IR filter from a color camera	Knowledge Base Article 10080
Selecting a lens for your camera	Technical Application Note 10694

5.13 Infrared Cut-Off Filters—Cased Models

Note: Board-level color models do not have infrared cut-off filters.

Color camera cased models are equipped with an additional infrared (IR) cut-off filter. This filter can reduce sensitivity in the near infrared spectrum and help prevent smearing. The properties of this filter are illustrated in the results below.



IR filter transmittance graph

Transmission	Wavelength
T=50%	680 nm ±10 nm
T>80%	400 nm - 420 nm
T>85%	420 nm - 650 nm
T average 1%	750 nm - 1100 nm
T<3%	750 nm - 1100 nm

In monochrome cased models, the IR filter is replaced with a transparent piece of glass.

The following are the properties of the IR filter/protective glass:

	1" and 1/1.2" Sensors	All Other Sensors
Type	Anti-reflective	Anti-reflective
Material	Schott B270	Schott B270
Dimensions	15.5 ±0.08 x 18 ±0.08 mm	14 ±0.08 x 14 ±0.08 mm
Thickness	1 ±0.07 mm	1 ±0.07 mm

For more information, see Dust Protection—Cased Models.

Related Knowledge Base Articles

Title	Article
Removing the IR filter from a color camera	Knowledge Base Article 10080

6 Input/Output Control

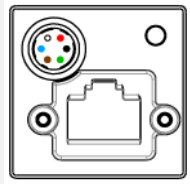
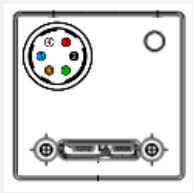
6.1 General Purpose Input/Output (GPIO)

Cased models—The camera is equipped with a 6-pin GPIO connector on the back of the case. The connector is a Hirose HR10A-7R-6PB, the mating connector is a Hirose HR10A-7P-6S(73).

Board-level models—The camera is equipped with a 6-pin GPIO connector. The connector is a JST BM06B-NSHSS-TBT (LF)(SN), the mating connector is a JST NSHR-06V-S.

GPIO pin assignments (as shown looking at rear of camera)

Blackfly S Cased Models

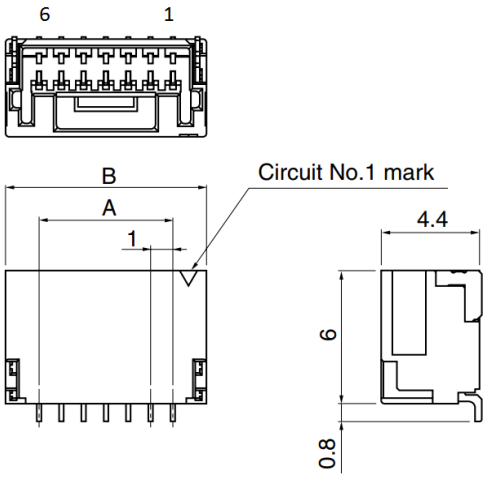
Diagram	Color[1]	Pin	Line	Function	Description	Parameter	Min	Max	Unit
  	Green	1[2]	3	V_{AUX}	Auxiliary Input Voltage (DC)	Input Voltage Range	8	24	V
				GPI	Non-isolated Input	Input Low Level	0	1.4	V
						Input High Level	2.6	3.6	V
						Propagation Delay		1	µs
	Black	2	0	OPTOIN	Opto-isolated Input	Input Low Level	0	1.4	V
						Input High Level	2.6	30	V
						Input Current	3.5	7	mA
						Propagation Delay Low to High		18	µs
						Propagation Delay High to Low		9	µs
	Red	3[2]	2	VOUT	Camera Power Output	Output Voltage	3.05	3.35	V
						Output Current		120	mA
				GPIO[3]	Non-isolated Input/Ouput	Input Low Level	0	1.4	V
						Input High Level	2.6	24	V
						Propagation Delay		1	µs
						Output Low Current		25	mA
						Output High Level	0	24	V
	White	4	1	OPTOOUT[3]	Opto-isolated Output	Output Low Current[4]		25	mA
						Output High Level	0	24	V
						Propagation Delay Low to High		36	µs
						Propagation Delay High to Low		18	µs
	Blue	5	N/A	Opto GND	Opto-isolated Ground				
	Brown	6	N/A	GND	Camera Power Ground				

Measurement conditions: Opto-Isolated I/O VCC=5V, Rext=1KOhm, Non-Isolated Output: VCC=5V, Rext=330 Ohm, Non-Isolated Input: VCC=3.3V. Measured over operating temperature range (-20℃ to +50℃ ambient temperature), unless otherwise noted.

1—GPIO cable assembly wire colors
2—Dual function pin

3—Open drain output, requires pullup resistor
4—Output low level depends on the output voltage / pullup resistor combination

Blackfly S Board-level Models



Note: Diagram is for reference only.
Actual number of pins is 6.

Board-level USB3

Color	Pin	Line	Function	Description	Parameters	Min	Max	Unit
Orange	1	0	GPIO0	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Black	2	1	GPIO1	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
White	3	2	GPIO2	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V

Color	Pin	Line	Function	Description	Parameters	Min	Max	Unit
Green	4	3	GPIO3	Non-isolated Input/Output (USB3)	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Brown	5	N/A	GND	Camera Power Ground				
Red	6	N/A	Vout	Camera Power Output	Output Voltage	3.05	3.35	V
					Output Current		120	mA

Board-level GigE

Color	Pin	Line	Function	Description	Parameters	Min	Max	Unit
Orange	1	0	GPIO0	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Black	2	1	GPIO1	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
White	3	2	GPIO2	Non-isolated Input/Output	Input Low Level	0	1.4	V
					Input High Level	2.6	24	V
					Propagation Delay		1	µs
					Output Low Current		25	mA
					Output High Level	0	24	V
Green	4	N/A	VExt	Camera Input Power (GigE)		4.0	5.5	V
Brown	5	N/A	GND	Camera Power Ground				
Red	6	N/A	Vout	Camera Power Output	Output Voltage	3.05	3.35	V
					Output Current		120	mA

For Cased Models—Power can also be provided externally through the GPIO interface: 12 V nominal (8 - 24 V). Power consumption is 3 W maximum.

If both power sources are connected the camera always uses external power over the GPIO connector.

> **Note:** Some systems, especially those with laptop computers or longer cable lengths, may not provide adequate power through the USB 3.0 cable which could result in intermittent operation. The use of external power through the GPIO is required for these systems.

The camera does not transmit images for the first 100 ms after power-up. The auto-exposure and auto-white balance algorithms do not run while the camera is powered down. It may therefore take several images to get a satisfactory image.

When the camera is power cycled (power disengaged then re-engaged), the camera reverts to its default factory settings, or if applicable, a saved user set.

Related Knowledge Base Articles

Title	Article
How can I power my USB 3.0 camera?	Knowledge Base Article 10240

6.2 GPIO Electrical Characteristics

Both the opto-isolated input and output have over current protection.

The output is open collector and thus requires a pull-up resistor to operate. The rise time and bias current will be determined by the resistor value chosen. If the camera is generating an output signal that approaches the rise time plus the fall time of the opto-isolated circuit, care must be taken to optimize the pull-up resistor chosen to minimize the rise time while still remaining within the current limits of the output circuit.

The opto-isolated specifications listed below are applicable when power to the camera is provided through the interface and not through the GPIO.

> **Warning!** To avoid damage, connect the OPTO_GND pin first before applying voltage to the GPIO line.

> **Warning!** Prolonged use of the camera outside of the Operating Range described below may lead to unexpected behavior and should be avoided.

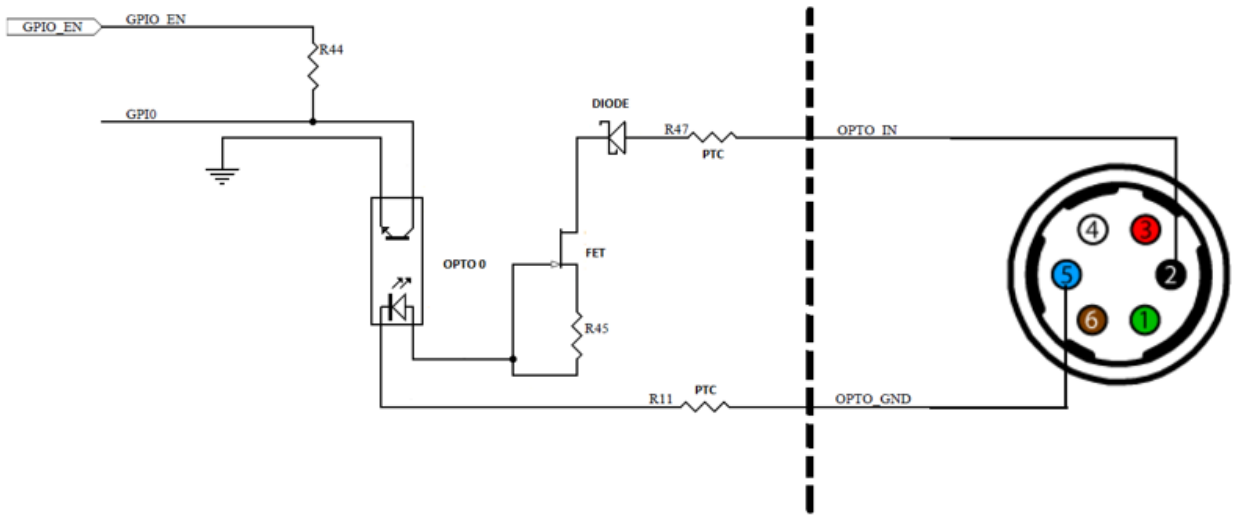
Operating Range

Description	Minimum	Maximum
Opto-isolated Input Voltage	0 V	30 V
Opto-isolated Output Voltage	0 V	24 V
Opto-isolated Output Current		25 mA
3.3 V Output Current		120 mA

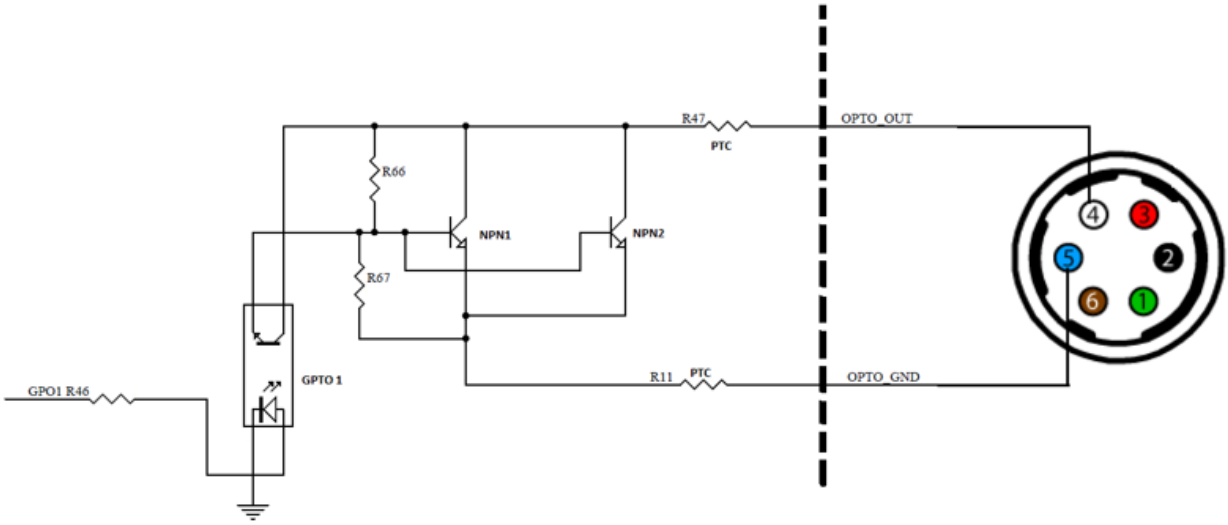
Opto-isolated External Voltage Resistor Combinations

External Voltage	External Resistor	OPTO_OUT Low Voltage	OPTO_OUT High Voltage	Output Current No Load	Output Current With Load
3.3 V	200 Ω	1.41 V	3.225 V	7.96 mA	2.094 mA
5 V	1.0 kΩ	0.86 V	5.06 V	4.06 mA	2 mA
12 V	2.4 kΩ	0.96 V	12.08 V	4.64 mA	2.46 mA
24 V	4.7 kΩ	0.9 V	24 V	5.08 mA	2.64 mA
30 V	4.7 kΩ	1.1 V	30 V	7.08 mA	2.86 mA

Values are for reference only



Opto-isolated input circuit

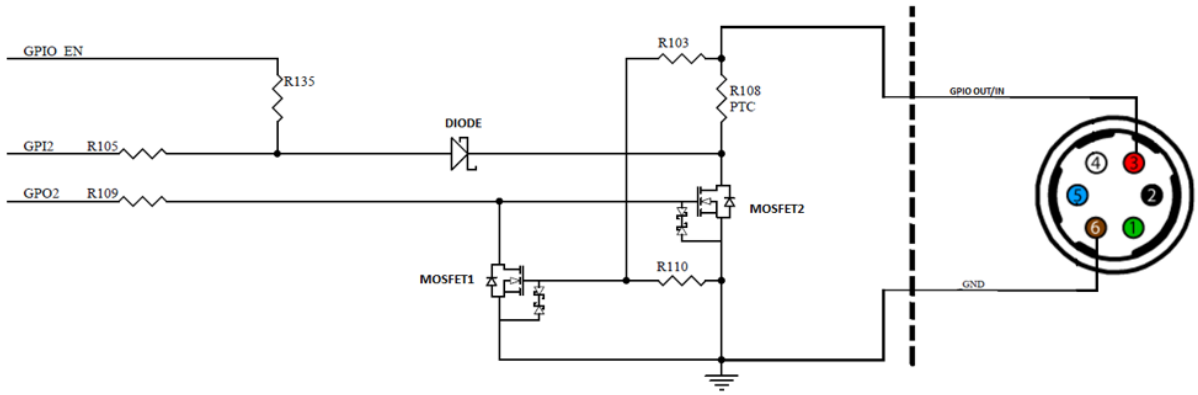


Opto-isolated output circuit

Non-isolated External Voltage Resistor Combinations

External Voltage	External Resistor	Current
3.3 V	1.0 kΩ	3.1 mA
5 V	1.0 kΩ	4.8 mA
12 V	2.0 kΩ	6 mA
12 V	2.4 kΩ	5 mA
24 V	4.7 kΩ	5.2 mA
30 V	4.7 kΩ	6.5 mA

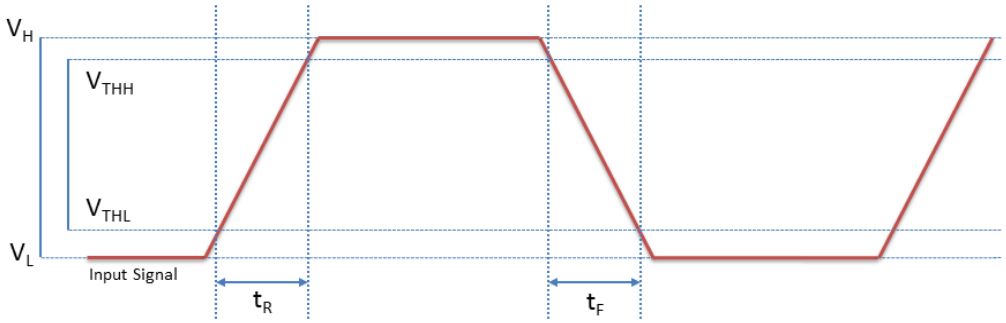
Values are for reference only



Non-isolated input and output circuit

6.3 Input Timing Characteristics

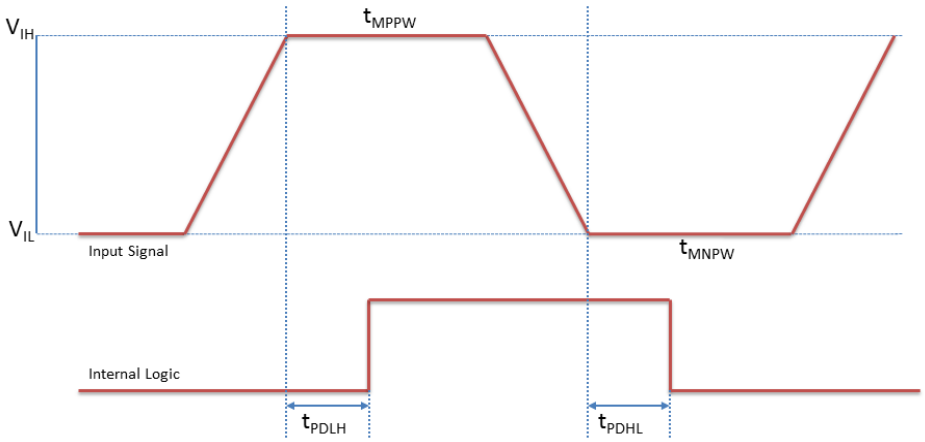
Note: Timing specifications are preliminary and subject to change.



Input Timing Characteristics

Non-isolated Input Performance (measured at Vcc = 5 V, Rext = 1 kΩ)

Parameter	Symbol	Non-isolated
Input Low Voltage	V_L	0.85 V
Input High Voltage	V_H	4.94 V
Input Threshold High Voltage	V_{THH}	4.54 V
Input Threshold Low Voltage	V_{THL}	1.26 V
Cycle Rise Time	t_R	10.8 µs
Cycle Fall Time	t_F	2 µs
Current		4.1 mA

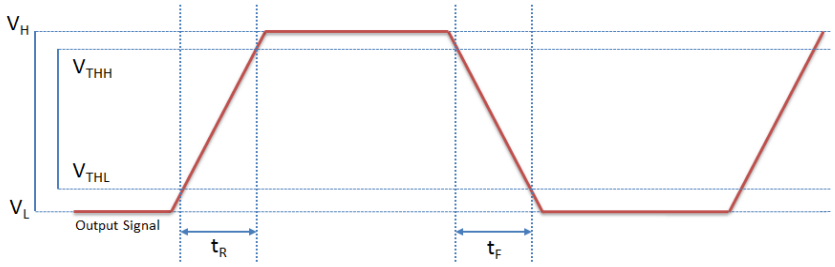


Opto-isolated Input Performance (Vcc = varying pk-pk)

Parameter	Symbol	Opto-isolated with Load
Input Low Voltage	V_{IL}	≤ 2 V
Input High Voltage	V_{IH}	≥ 2.05 V
Propagation Delay Low to High	t_{PDLH}	19.74 µs
Propagation Delay High to Low	t_{PDHL}	16.692 µs
Typical Positive Pulse Width	t_{MPPW}	12 µs
Typical Negative Pulse Width	t_{MNPW}	6 µs

6.4 Output Timing Characteristics

Note: Timing specifications are preliminary and subject to change.



Output Timing Characteristics

Non-isolated Output Performance (measured at Vcc = 5 V, Rext = 1 kΩ)

Parameter	Symbol	Non-isolated
Output Low Voltage	V_L	0.23 V
Output High Voltage	V_H	4.95 V
Output Threshold High Voltage	V_{THH}	4.48 V
Output Threshold Low Voltage	V_{THL}	0.7 V
Cycle Rise Time	t_R	2.6 µs
Cycle Fall Time	t_F	0.23 µs
Opto Current		4.8 mA

Opto-isolated Output Performance (measured at Vcc = 3.3 V, Rext = 200 Ω)

		Opto-isolated	
Parameter	Symbol	Load	No Load
Output Low Voltage	V_L	1.3875 V	1.41 V
Output High Voltage	V_H	2.80625 V	3.26 V
Output Threshold High Voltage	V_{THH}	2.66 V	3.08 V
Output Threshold Low Voltage	V_{THL}	1.53 V	1.60 V
Cycle Rise Time	t_R	5.04 µs	6 µs
Cycle Fall Time	t_F	3.18 µs	3.66 µs
Opto Current		2.094 mA	7.96 mA

		Opto-isolated	
Parameter	**Symbol**	**Load**	**No Load**
Opto Isolator Delay (High to Low)		5.34 µs	5.5 µs
Opto Isolator Delay (Low to High)		12.7 µs	15.24 µs

Opto-isolated Output Performance (measured at Vcc = 5 V, Rext = 1 kΩ)

		Opto-isolated	
Parameter	**Symbol**	**Load**	**No Load**
Output Low Voltage	V_L	0.85 V	0.86 V
Output High Voltage	V_H	2.9 V	5.06 V
Output Threshold High Voltage	V_{THH}	2.695 V	4.64 V
Output Threshold Low Voltage	V_{THL}	1.063 V	1.28 V
Cycle Rise Time	t_R	11.4 µs	8.92 µs
Cycle Fall Time	t_F	1.84 µs	1.98 µs
Opto Current		2 mA	4.06 mA
Opto Isolator Delay (High to Low)		3.8776 µs	4.117 µs
Opto Isolator Delay (Low to High)		26.754 µs	25.124 µs

7 Troubleshooting

7.1 Support

FLIR endeavors to provide the highest level of technical support possible to you. Most support resources can be accessed through our Product Support page.

Creating a Customer Login Account

The first step in accessing our technical support resources is to obtain a Customer Login Account. This requires a valid name and e-mail address. To apply for a Customer Login Account go to our website, and from the upper right corner, click **Register**. Complete the form and then click **Register**. After you submit your registration, you will receive an email with instructions on how to activate your account.

Knowledge Base

Our Knowledge Base contains answers to some of the most common support questions. It is constantly updated, expanded, and refined to ensure that our customers have access to the latest information.

Learning Center

Our Learning Center contains links to many resources including videos, case studies, popular topics, application notes, and information on sensor technology.

Product Downloads

With a Customer Login Account you can access the latest software and firmware for their cameras from our Product Downloads page. We encourage you to keep your software and firmware up-to-date by downloading and installing the latest versions.

Contacting Technical Support

Before contacting Technical Support, have you:

1. Read the product documentation?
2. Searched the Knowledge Base?
3. Downloaded and installed the latest version of software and/or firmware?

If you have done all the above and still can't find an answer to your question, contact our Technical Support team.

7.2 Status Indicator LED

LED	USB
No Light	No power or LED is in inactive state or LED is in error status state with no error
Blinking Green (1 blink)	USB1
Blinking Green (2 blinks)	USB2
Blinking Green (3 blinks)	USB3
Solid Green	Acquisition Started
Rapid Flashing Green	Firmware update in progress
Flashing Green and Red	General Error

Contacting Us

For any questions, concerns or comments please contact us via the following methods:

Email	General questions Technical support (existing customers only)
Knowledge Base	Find answers to commonly asked questions in our Knowledge Base
Downloads	Download the latest documents and software
Contact Information	Contact Us on our website

Revision History

Version	Date	Description
1.0	June 23, 2016	Support for BFS-U3-13Y3 and BFS-U3-51S5
2.0	September 14, 2016	Support for BFS-U3-32S4 and BFS-PGE-50S5 Clarification of measurement conditions for GPIO
3.0	January 12, 2017	New layout Corrected Lens Mount in Physical Description
4.0	May 4, 2017	Support for BFS-PGE-13Y3 and BFS-PGE-31S4
4.1	June 9, 2017	Updated GPIO Electrical section
5.0	August 25, 2017	Support for BFS-U3-200S6
6.0	November 1, 2017	Support for BFS-PGE-16S2 and BFS-U3-16S2
7.0	November 15, 2017	Support for BFS-PGE-04S2 and BFS-U3-04S2
8.0	January 4, 2018	Support for BFS-U3-89S6 and BFS-U3-123S6
9.0	February 8, 2018	Support for BFS-PGE-200S6 and BFS-U3-120S4
10.0	March 14, 2018	Support for BFS-PGE-88S6, BFS-U3-88S6, BFS-PGE-122S6, and BFS-U3-122S6
11.0	May 8, 2018	Support for BFS-U3-31S4, BFS-U3-50S5, and BFS-U3-63S4
12.0	June 22, 2018	Support for BFS-U3-51S5-BD2
13.0	August 17, 2018	Support for BFS-PGE-51S5 Support for BFS-PGE-16S2-BD2 Updated GPIO electrical input/output timing tables
14.0	November 20, 2018	Support for BFS-GE-16S2-BD2, BFS-PGE-23S3, BFS-U3-23S3, BFS-U3-51S5-BD2, BFS-U3-70S7, and BFS-PGE-120S4

Version	Date	Description
15.0	February 19, 2019	Support for BFS-PGE-63S4 and BFS-U3-28S5