INSTALLATION GUIDE

BLACKFLY®S



USB3 VISION™

Version 26.1

Revised 11/1/2022

Copyright © 2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

TELEDYNE FLIR
Everywhereyoulook™

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 3 years. 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?

Copyright © 2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

TELEDYNE FLIR
Everywhereyoulook™

Table of Contents

1 Blackfly S Installation Guide **1**

2 Handling Precautions and Camera Care **2**

3 Blackfly S Installation **3**

3.1 Preparing for Installation 3

3.2 Installing Your Interface Card and Software 4

3.3 Installing Your Blackfly S—Cased Models 5

3.4 Installing Your Blackfly S—Board-level Models 7

3.5 Powering Your Blackfly S 8

4 Tools to Control your Blackfly S **9**

4.1 Using the Spinnaker® SDK 9

4.1.1 SpinView Camera Evaluation Application 9

4.1.2 Custom Applications Built with the Spinnaker API 9

4.2 Using GenICam Applications 10

5 Configuring Blackfly S Setup **11**

5.1 Configuring Camera Drivers 11

5.2 Configuring the IP Address—GigE 11

5.3 Allocating Bandwidth—GigE 12

5.3.1 Determining Bandwidth Requirements 12

5.4 Configuring Other Ethernet Settings—GigE 13

5.4.1 Stream Channel Destination Address 13

5.4.2 Heartbeat 13

5.5 Camera Firmware 15

5.5.1 Determining Firmware Version 15

5.5.2 Upgrading Camera Firmware 15

6 Blackfly S Physical Interface **17**

6.1 Blackfly S Cased Physical Description 17

6.2 Blackfly S Board-Level Physical Description 18

6.3 Blackfly S Dimensions 19

6.3.1 Keepout Layer—Board-level Models 23

6.4 Interface Connector 24

11/1/2022

©2015-2022 FLIR Integrated Imaging Solutions Inc.

All rights reserved.

6.4.1 Ethernet Connector 24
6.4.2 USB 3.1 Connector 24
6.5 Interface Cables 26
6.6 Interface Card 27
6.7 General Purpose Input/Output (GPIO) 27
6.8 Mounting Your Blackfly S 27
6.9 Camera Temperature and Heat Dissipation 28
6.10 Lens Mounting 30
6.10.1 Back Flange Distance—Cased Models 31
6.11 Non-Volatile Flash Memory 31
6.12 Dust Protection—Cased Models 31
6.13 Infrared Cut-Off Filters—Cased Models 32
6.14 Readout Method 33
6.14.1 Global Shutter 33
6.14.2 Rolling Shutter with Global Reset 33
7 Input/Output Control 35
7.1 General Purpose Input/Output (GPIO) 35
7.2 GPIO Electrical Characteristics 38
7.3 Input Timing Characteristics 42
7.4 Output Timing Characteristics 44
8 Troubleshooting 46
8.1 Support 46
8.2 Status Indicator LED 47
Contacting Us 48
Revision History 48

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

1 Blackfly S Installation Guide

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

- **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#.
- **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.

These resources as well as knowledge base articles and application notes can be found on the Support page for the product.

Blackfly S USB3 Support Articles
Blackfly S GigE Support Articles
Blackfly S Board-level Support Articles

Blackfly S USB3 Resources
Blackfly S GigE Resources
Blackfly S Board-level Resources

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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 Teledyne 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

Cleaning the imaging surface of your camera

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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 or Linux (32- or 64-bit)	Intel i5 or greater	4 GB	USB3 host controller or GigE network adapter	Microsoft Visual Studio 2010, Visual Studio 2013, or Visual Studio 2015

Note: Refer to Recommended USB 3.1 System Components for information on building a USB3 system.

Do you have all the parts you need?

To install your camera you need the following components:

- For GigE cameras—Ethernet cable (see Interface Cables)
- For GigE cameras— 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
- GPIO cable (see General Purpose Input/Output (GPIO))
- For board-level models—Lens mount and lens (see Lens Mounting)
- For cased models—Lens (see Lens Mounting) (type of lens mount is model dependent)
- Tripod adapter (optional) (see Mounting Your Blackfly S)
- Interface card (see Interface Card)

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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

Have you visited the Teledyne FLIR website?

The Teledyne FLIR machine vision products page has many resources to help you operate your camera effectively, including:

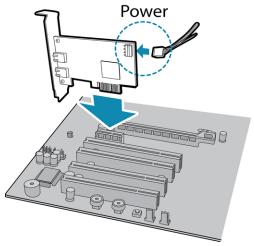
- Spinnaker® SDK software, including drivers (required for installation)
- Firmware updates and release notes
- Dimensional drawings and CAD models
- Documentation

To access these resources:

1. Go to Teledyne FLIR machine vision.
2. Click on your product family.
3. Click on **Go to Support Page**.
   - **Overview** tab - links to software, knowledge base articles, and application notes.
   - **Downloads** tab - links to camera references, technical references, getting started manuals, imaging performance results, drawings, PCNs, firmware, and software.

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. Ethernet cards appear under **Network Adapters**. 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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

a. Go to the Spinnaker SDK page.

b. Click the Download button.

c. Select your operating system.

d. Select your version. You can also read release notes here.
   - Python
   - Full SDK - downloads all components
   - Web Installer - downloads only the installer and then retrieves components based on your selection during install. This version requires an internet connection for the installation.

e. Select your version. On the preview page, click Download.

f. After download is complete, open the file to start the Spinnaker setup wizard.

g. Follow the steps in each setup dialog.

3. Enable jumbo frames on the Ethernet card

a. In **Start->All Programs-> Spinnaker SDK->SpinView**, right click on the Network Adapter and select Adapter Configuration, then select IP Configuration.

b. Click Open Network Connections.

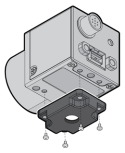
c. Click Change Settings.

d. Click on the Advanced tab and from the Settings list select Jumbo Packet.

e. Set the Value to 9014 Bytes and click OK.

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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

3. Connect the interface Card and Cable to the Camera

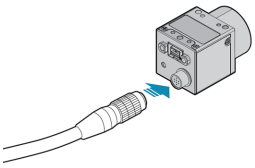


Plug the interface cable into the host controller card and the camera. The cable jack screws can be used for a secure connection.

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-> Spinnaker->SpinView**
The SpinView application can be used to test the camera's image acquisition capabilities.

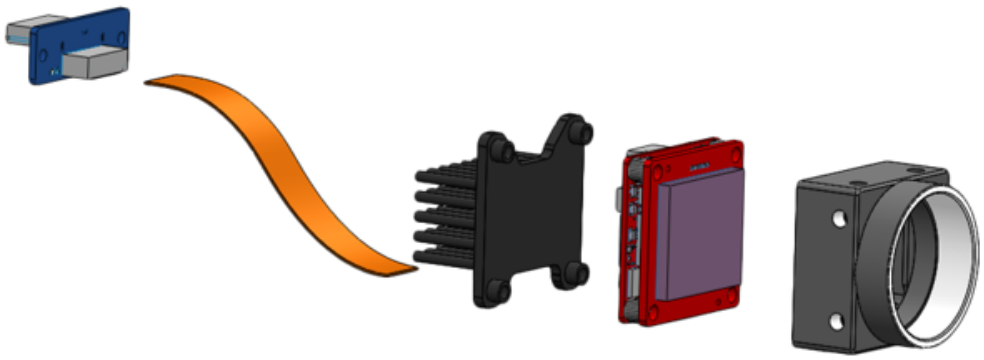
6. Configure IP Settings if necessary

For GigE cameras by default, a dynamic IP address is assigned to the camera according to the DHCP protocol. If DHCP addressing fails, a link-local address is assigned. If necessary, in SpinView change the IP address of the camera to be on the same subnet as the NIC.

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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

3.4 Installing Your Blackfly S—Board-level Models

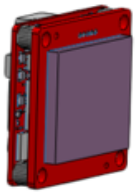


1. Prepare the lens mount.



The board-level models can use C-mounts, CS-mounts, or S-mounts.
For C- and CS-mounts, install the retainer, flip over and place IR filter in it then install the gasket.

2. Remove sticker and install lens mount.



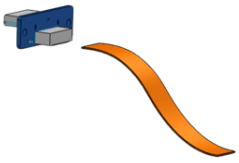
The sensor is covered with a protective sticker. Remove the sticker. If any residue is present, clean the sensor surface with a non-abrasive cotton swab and isopropyl alcohol cleaning solution. Immediately install the image board over the prepared lens mount.

3. Install a heat sink.



A heatsink (ACC-01-7000) is recommended but depends on your design and usage.

4. 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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

5. Attach a Lens

6. Plug in the GPIO connector if required

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

7. 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->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 cased 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 board-level GigE cameras—PoE can be used with board-level models with the RJ45 PoE bulkhead accessory (ACC-02-7002). Power can also be provided externally through the GPIO interface: 5 V nominal (4 - 5.5 V).

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 cameras—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 USB3 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

How can I power my USB3 camera?

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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® SDK

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.

The Spinnaker SDK is available for download from the Spinnaker page.

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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

4.2 Using GenICam Applications

GigE Vision is an interface standard that allows for fast image transfer over Ethernet networks. All cameras supporting GigE Vision interact the same way with software also supporting GigE Vision.

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
Getting Started with OpenCV
Getting Started with MATLAB
Getting Started with MVTec HALCON
Getting Started with Cognex VisionPro
Getting Started with Adaptive Vision
Getting Started with Matrox Imaging Library
Getting Started with Matrox Design Assistant
Getting Started with NI-MAX and LabVIEW
Getting Started with NI Vision Builder for Automatic Inspection

USB3 Vision and Third-Party Applications Resources

Title
Using USB3 Vision cameras with National Instruments' Acquisition Software
Using USB3 Vision cameras with A&B Software's ActiveUSB
Using USB3 Vision cameras with Matrox Imaging Library
Using USB3 Vision cameras with MVTec's Halcon software
Using USB3/USB2 cameras with Cognex VisionPro

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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 IP Address or 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-->FLIR Systems 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 Configuring the IP Address—GigE

When a new GigE camera is first powered and initialized, a dynamic IP address is assigned to the camera according to the DHCP protocol. If DHCP addressing fails, a link-local address is assigned. You can configure the IP address using the GenICam Features Transport Layer Control.

Alternatively, SpinView is a tool included with the Spinnaker SDK that allows you to set the internet protocol (IP) configuration for any GigE interface cards or Teledyne FLIR GigE Vision cameras connected to your system. Using SpinView, you can:

- Set the IP address for the current connection.
- Program a persistent IP address for the camera.
- Configure the default IP addressing behavior of the camera on startup using a persistent IP, DHCP or LLA.
- Enable Jumbo Frames on the GigE NIC.

Both your camera and host adapter must have an IP address on the same subnet. This can be assigned in three ways:

- **Persistent**—The camera has a fixed IP address that does not change. Generally the address is within a closed network range of 192.168.X.X.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

- **Dynamic (DHCP)**—The camera is set to automatically obtain an IP address. This means that the IP address may change (within a range) every time the camera or computer is restarted. It may take up to one minute for the IP address to resolve and the camera to enumerate.
- **Default (LLA)**—The camera uses an IP address from the link-local address block 169.254.x.x.

The camera assigns its current IP address in the following sequence:

1. **Persistent**—Uses the defined IP address. If not available, then;
2. **DHCP**—Attempts to find a dynamic IP address. If not available, then;
3. **LLA**—Uses an LLA IP address.

SpinView can automatically force an IP address refresh. This detects the IP address of the Network Interface card and automatically sets the camera's IP address relative to the card.

To open SpinView:

Start Menu > ***All Programs*** > ***Spinnaker SDK*** > ***SpinView***

5.3 Allocating Bandwidth—GigE

The User Datagram Protocol (UDP) used by the GigE Vision standard provides no guaranteed transmission or fixed timing mechanism. Therefore, bandwidth must be managed by the Device Throughput Limit, based on desired resolution and frame rate.

5.3.1 Determining Bandwidth Requirements

The maximum bandwidth available is 125 MB/s. This includes image data, control data and image resends, which occur when frames are being dropped. Each image and each packet has a certain amount of overhead that will use some bandwidth. Therefore, when calculating your bandwidth requirements, you should not attempt to use the full maximum of 125 MB/s.

To calculate your bandwidth requirements:

Determine your required resolution, frame rate, and pixel format (bytes per pixel)

(Height x Width x Frame Rate x Bytes per Pixel)/1000000 = Bandwidth in MB/s

For example, for an image that is VGA, 82 FPS, Mono8:

640 (H) x 480 (W) x 82 (FPS) x 1 (BPP) = ~25 MB/s

Once you have calculated your required bandwidth, you can allocate an amount to each camera by adjusting the Device Throughput Limit. Allocating a specific amount to each camera helps to avoid dropped packets due to a data burst. You would do this in a set up with multiple cameras, or in a situation where the system bandwidth might be limited or shared due to hardware architecture.

Bandwidth Requirements for Multiple Cameras

Multiple cameras can be set up in two ways: 1) Each camera is connected directly to a single Ethernet port; or, 2) multiple cameras are connected to a single port through an Ethernet switch.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

If using the first method, each camera has the full bandwidth allocation available to it. If using the second method, the combination of all cameras on a switch cannot exceed the available bandwidth.

Related Knowledge Base Articles

Setting Up Multiple GigE Cameras

5.4 Configuring Other Ethernet Settings—GigE

5.4.1 Stream Channel Destination Address

The stream channel destination address (SCDA) register is used to specify the streaming destination IP address. The default SCDA is the IP address of the network or computer to which the camera is connected. It can be set within a range so that the camera sends data as a multicast. As long as switches in the path between the sender and receivers support and are configured for multicasting, multiple receivers can listen to the data stream from the camera.

Multicast addresses are between 224.0.0.0 and 239.255.255.255.

> **Note:** For more information on multicast address assignments, see http://tools.ietf.org/html/rfc3171

To control SCDA use:

- GenICam—GevSCDA in the Transport Layer Control

5.4.2 Heartbeat

The heartbeat is a mandatory GigE Vision feature to monitor the connection between an application and the camera. The application must continually reset the heartbeat timer, or the camera assumes an error has occurred and shuts down the connection.

In general, the Spinnaker API manages the heartbeat at a low level; however the following two features are controllable: Heartbeat Timeout and Heartbeat Disable.

Heartbeat Timeout

Heartbeat timeout is the time, in milliseconds, that the camera waits before closing the connection. Heartbeat timeout can be set between 500 ms and 10 seconds. The default setting is 3000 ms (3 seconds). If there is no communication between the camera and the application for longer than the timeout value, the connection is shut down.

To control Heartbeat Timeout use:

- GenICam—Under Transport Layer Control, GevHeartbeatTimeout.
- Spinnaker API—The Spinnaker SDK supports configuring heartbeat timeout.

Heartbeat Disable

The heartbeat is enabled by default.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

To disable Heartbeat use:

- GenICam—Under Transport Layer Control GevGVCPHeartbeatDisable.
- Spinnaker API—The Spinnaker SDK supports disabling heartbeat.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

5.5 Camera Firmware

Firmware is programming that is inserted into the programmable read-only memory (programmable ROM) of most Teledyne 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.

5.5.1 Determining Firmware Version

To determine the firmware version number of your camera:

- Query the GenICam Device Control feature DeviceFirmwareVersion.

5.5.2 Upgrading Camera Firmware

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

Before upgrading firmware:

- Install the **Spinnaker SDK**, available from the Spinnaker page.
- Download the latest **model package** zip file for the product, available from the camera's resources page:

BFS-PGE Camera Resources	BFS-U3 Camera Resources	BFS-Board-level Camera Resources

To upgrade the firmware:

1. ***Start Menu-->All Programs--> 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

FLIR machine vision software and firmware version numbering systems

Determining my camera's firmware version

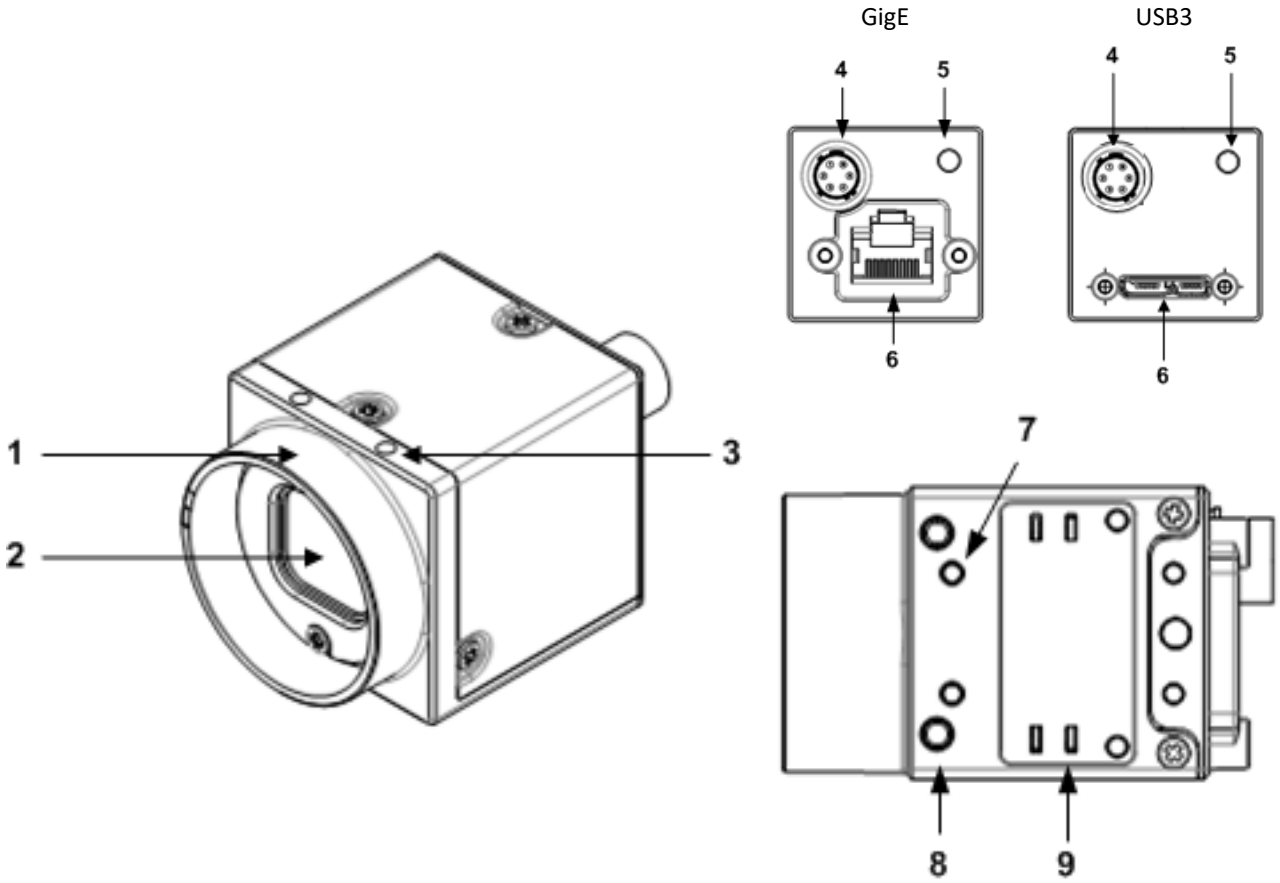
©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

Should I upgrade my camera firmware or software?

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6 Blackfly S Physical Interface

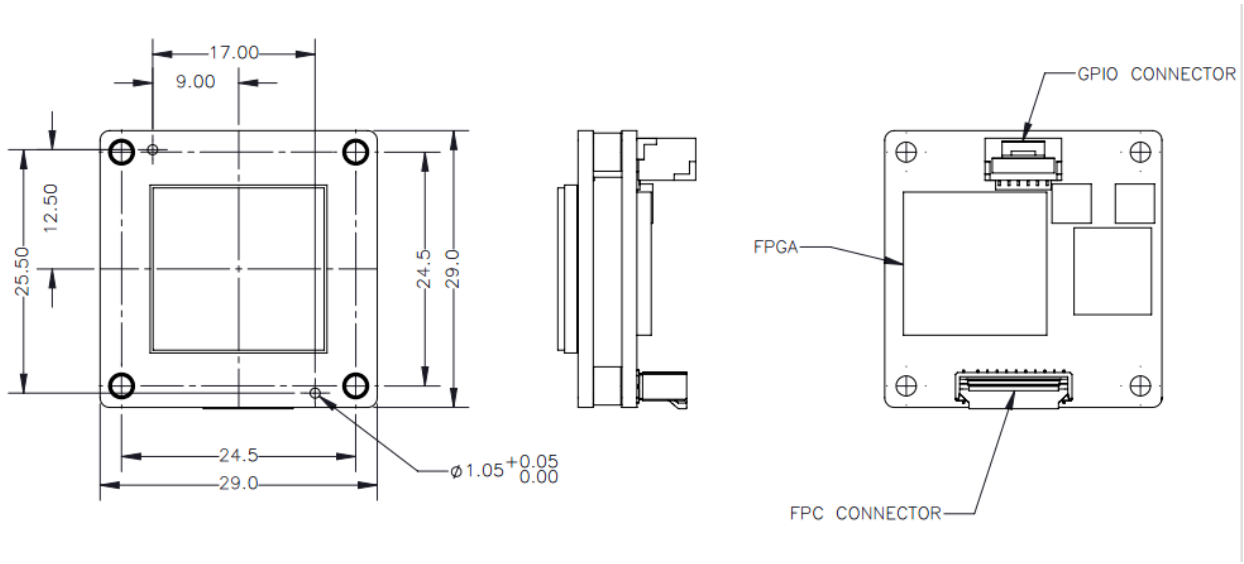
6.1 Blackfly S Cased Physical Description



1. **Lens holder**
   See Lens Mounting
2. **Glass/IR filter system**
   See Dust Protection—Cased ModelsInfrared Cut-Off Filters—Cased Models
3. **M2x2.5 mounting holes**
   See Mounting Your Blackfly S
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 Your Blackfly S
9. **Camera label**
   Contains camera information such as model name, serial number and required compliance.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6.2 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

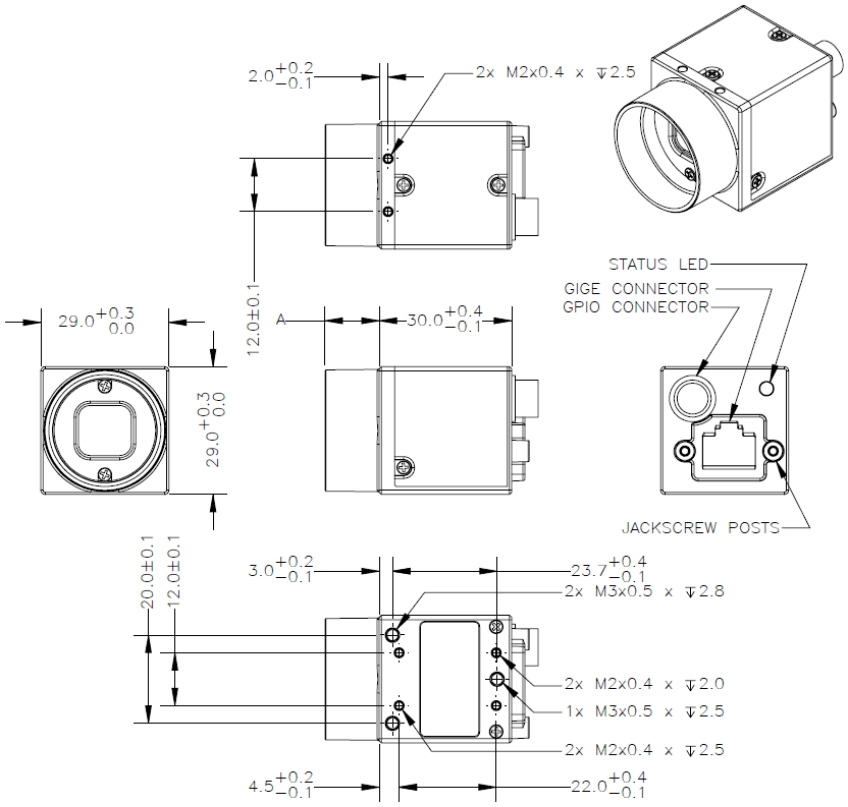
See Mounting Your Blackfly S

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6.3 Blackfly S Dimensions

Download 3D CAD Models / Drawings:

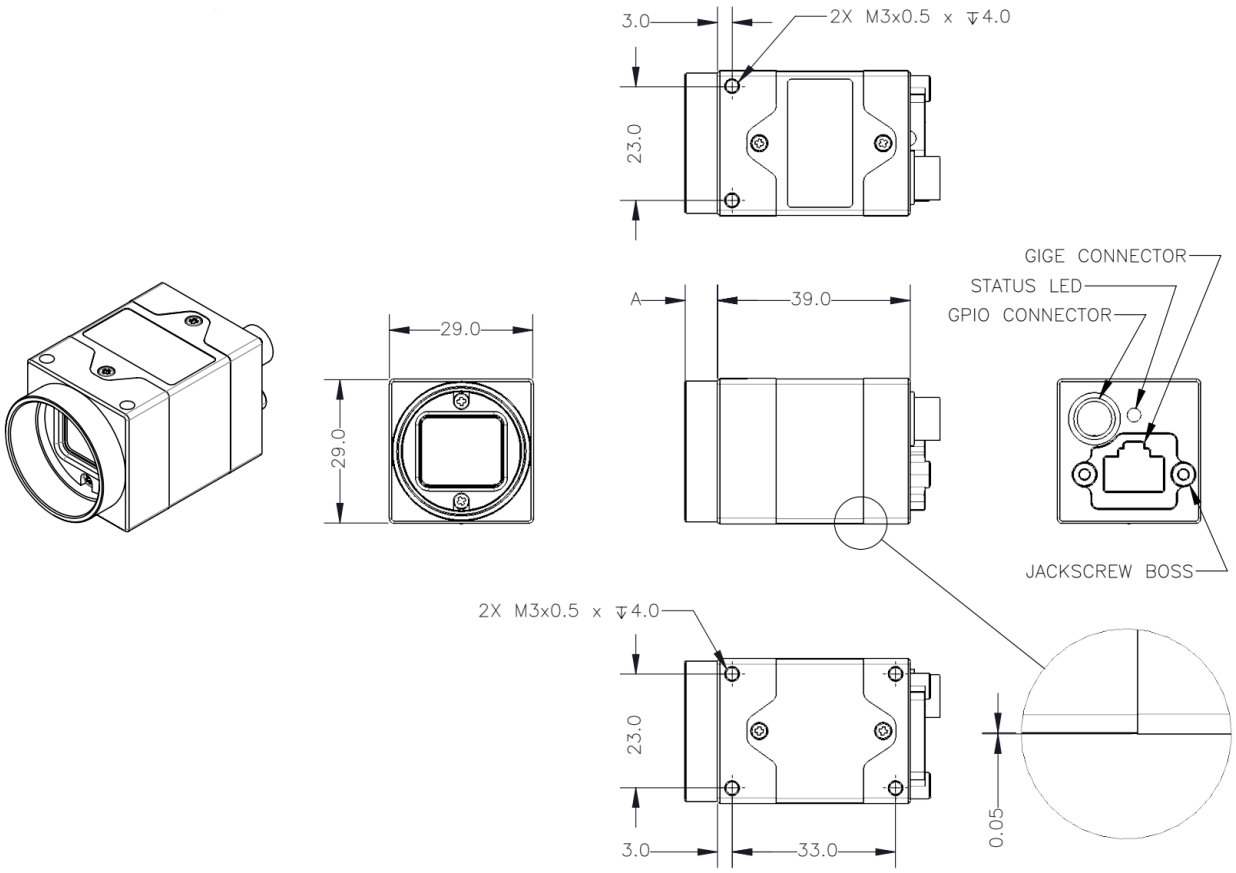
BFS-PGE CAD Models	BFS-U3 CAD Models	BFS Board-level CAD Models BFS Board-level Accessories CAD Models



Model	Barrel Length "A"	Model	Barrel Length "A"
BFS-PGE-04S2	6.8	BFS-PGE-63S4	11.7
BFS-PGE-13Y3 / BFS-PGE-14Y3	12.1	BFS-PGE-88S6	11.8
BFS-PGE-16S2	6.8	BFS-PGE-120S4	6.7
BFS-PGE-23S3	11.8 (C-mount) / 6.8 (CS-mount)	BFS-PGE-122S6	11.8
BFS-PGE-31S4	11.8	BFS-PGE-123S6	11.8
BFS-PGE-51S5	11.8	BFS-PGE-200S6	11.8
BFS-PGE-50S5	11.8		

Blackfly S GigE Dimensional Drawing—Standard Format

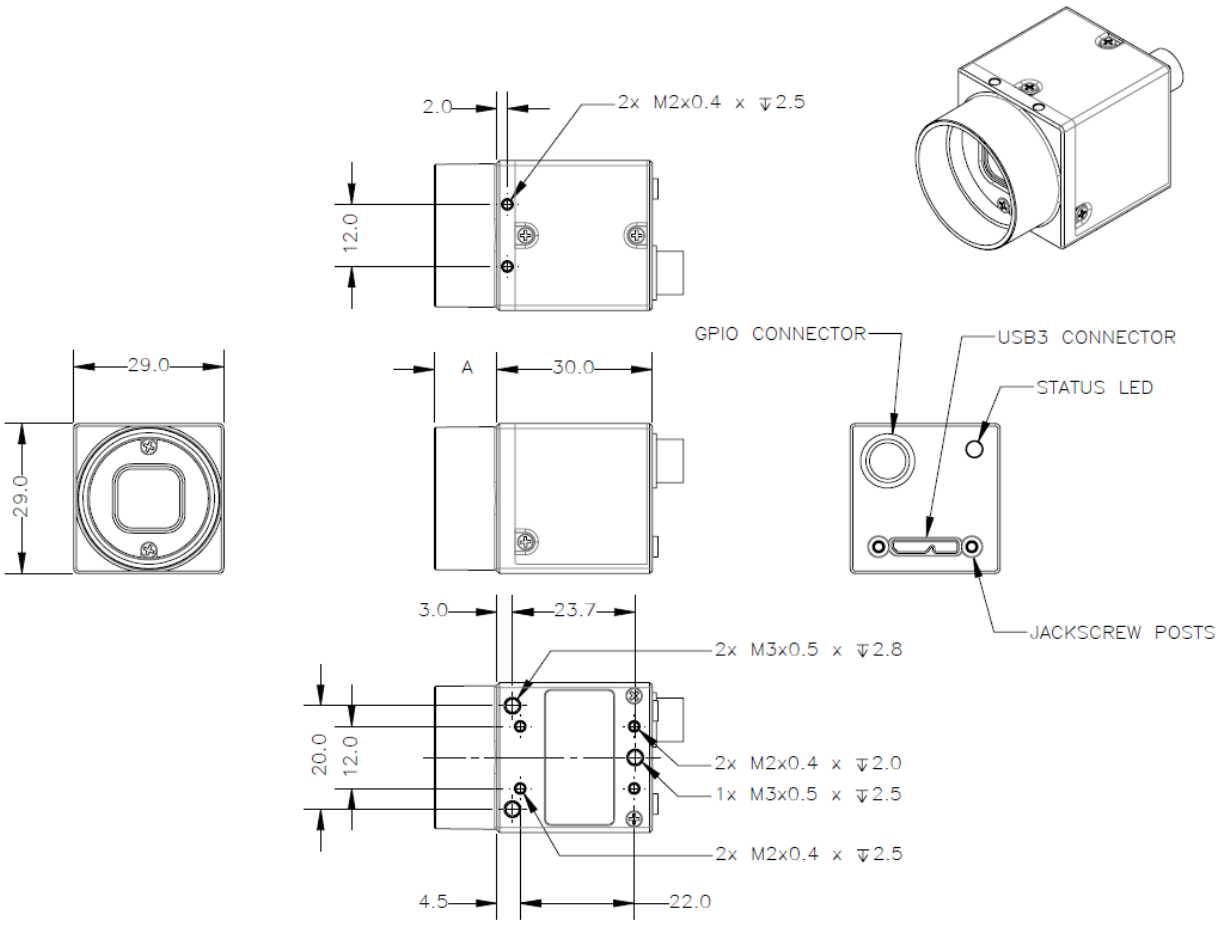
©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.



Model	Barrel Length "A"
BFS-PGE-16S7	6.5
BFS-PGE-19S4	6.5
BFS-PGE-27S5	6.5
BFS-PGE-50S4	6.5
BFS-PGE-70S7	6.5
BFS-PGE-80S5	6.5
BFS-PGE-120S6	6.5
BFS-PGE-161S7	6.5
BFS-PGE-200S7	6.5
BFS-PGE-244S8	6.5

Blackfly S GigE Dimensional Drawing—Large Format

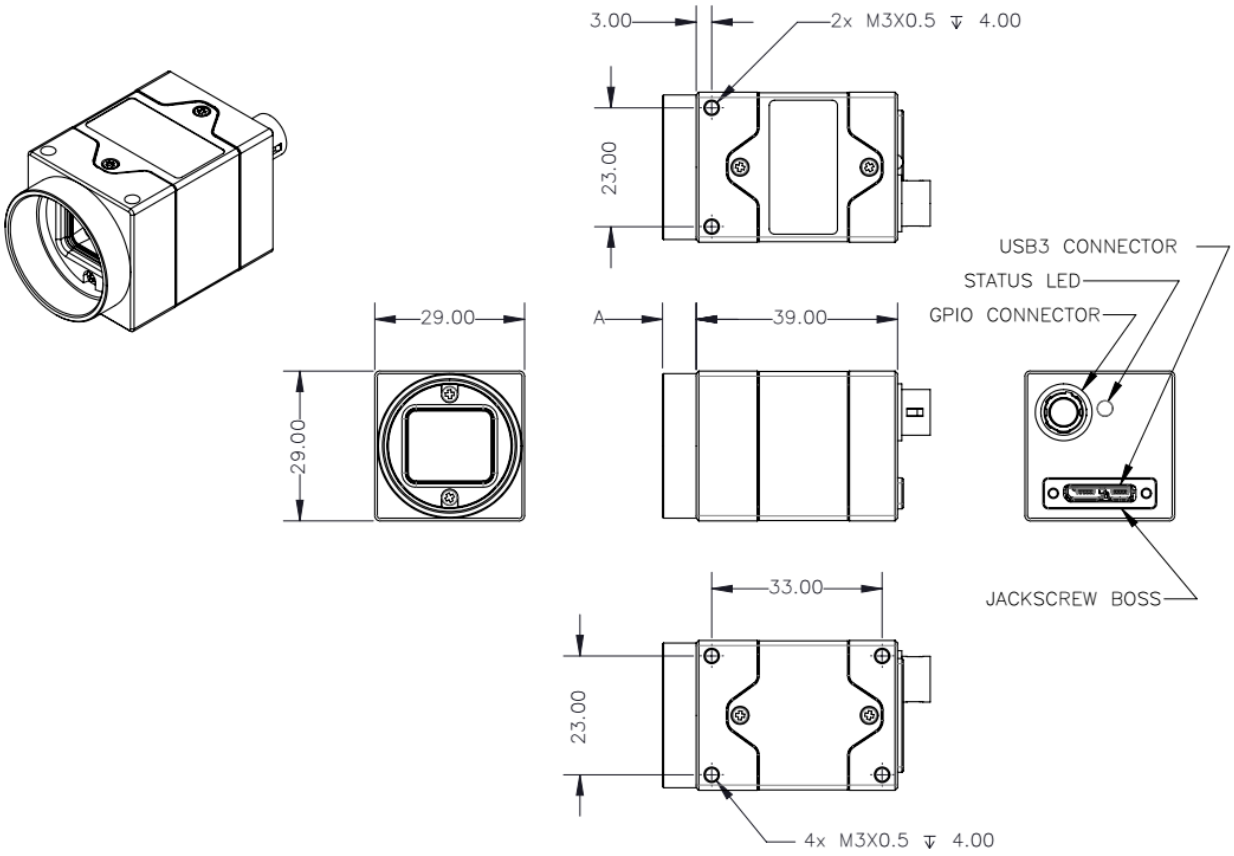
©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.



Model	Barrel Length "A"	Model	Barrel Length "A"
BFS-U3-04S2	11.8 (C-mount) / 6.8 (CS-mount)	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	11.7 (C-mount) / 6.7 (CS-mount)
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

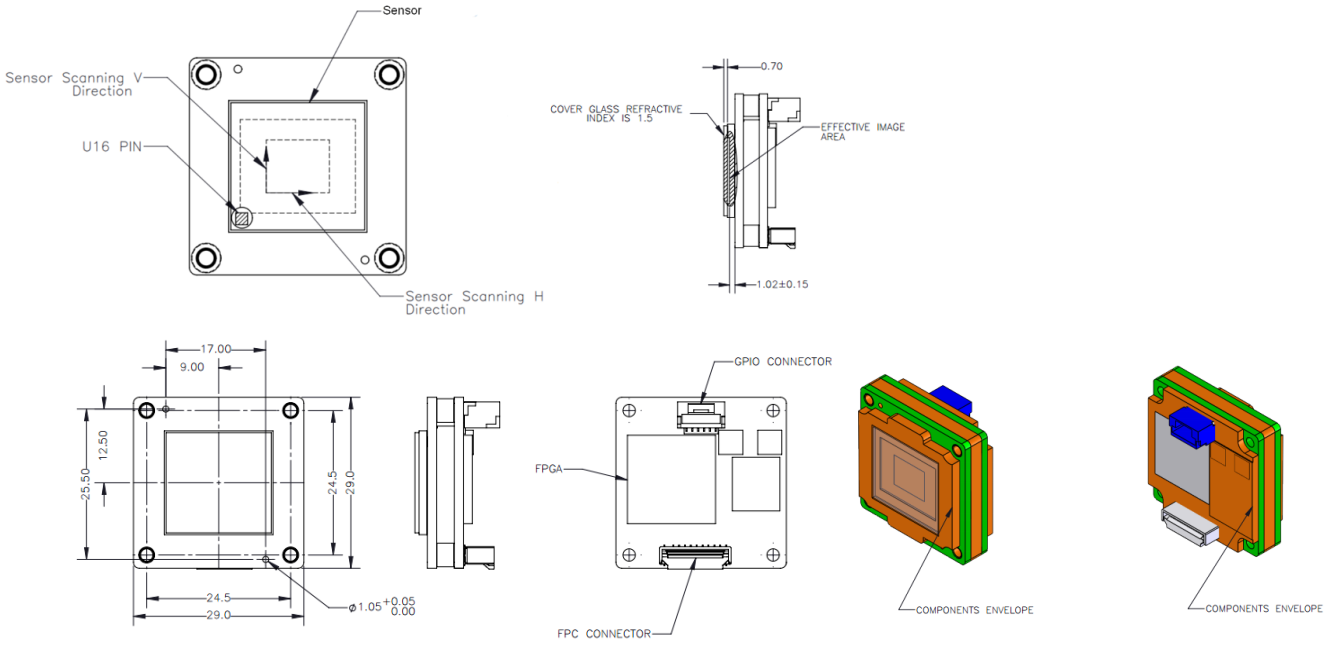
©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.



Model	Barrel Length "A"
BFS-U3-16S7	6.5
BFS-U3-17S7	6.5
BFS-U3-19S4	6.5
BFS-U3-20S4	6.5
BFS-U3-27S5	6.5
BFS-U3-28S5	6.5
BFS-U3-50S4	6.5
BFS-U3-70S7	6.5
BFS-U3-161S7	6.5
BFS-U3-244S8	6.5

Blackfly S USB3 Dimensional Drawing—Large Format

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.



Blackfly S Board-level Dimensional Drawing

6.3.1 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.

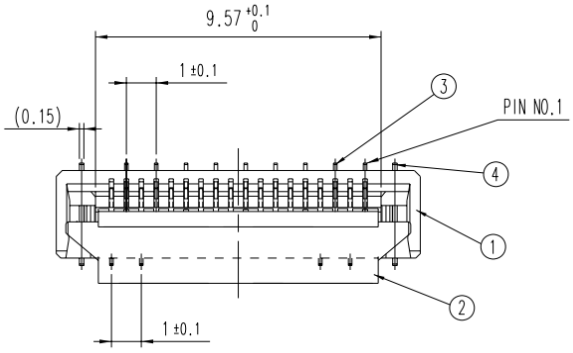
©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6.4 Interface Connector

6.4.1 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)

Board-level GigE 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.

6.4.2 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

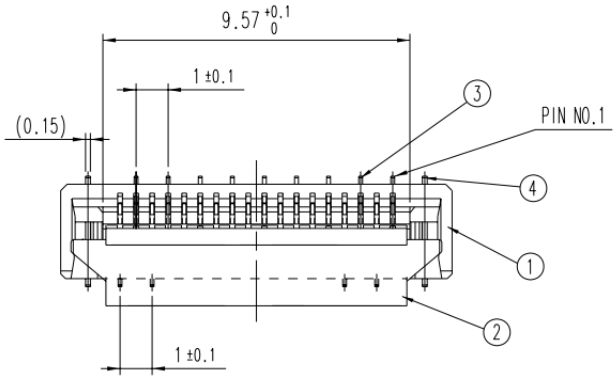
Pin	Signal Name	Description
1	VBUS	Power

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

Related Knowledge Base Articles

USB 3.1 Frequently Asked Questions

6.5 Interface Cables

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

Teledyne FLIR sells a number of recommended cables and FPC connectors for Blackfly S board-level cameras including:

- 15 cm FPC Cable—PN: ACC-01-2400
- 30 cm FPC Cable—PN: ACC-01-2401
- FPC Cable Bulkhead Connectors Micro-B bulkhead BD—PN: ACC-02-7000
- FPC Cable Bulkhead Connectors Standard A bulkhead BD—PN: ACC-02-7001
- FPC Cable Bulkhead Connectors RJ45 POE bulkhead BD—PN: ACC-02-7002

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. Teledyne FLIR sells a 5-meter Category 5e cable for this purpose.

> **Note:** For optimal ESD protection, we recommend using a shielded Ethernet cable or connecting the camera housing to chassis ground (earth).

For USB3 cameras—The USB3 standard does not specify a maximum cable length. FLIR sells a number of cable options. Visit the Product Accessories page for more information.

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

Related Knowledge Base Articles

Extending the Working Distance of USB3 Cameras

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6.6 Interface Card

To purchase a compatible card from Teledyne 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.

6.7 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.

See Input/Output Control for details on pin assignments and electrical characteristics.

6.8 Mounting Your Blackfly S

Using the Case—Cased Models

The case is equipped with the following mounting holes:

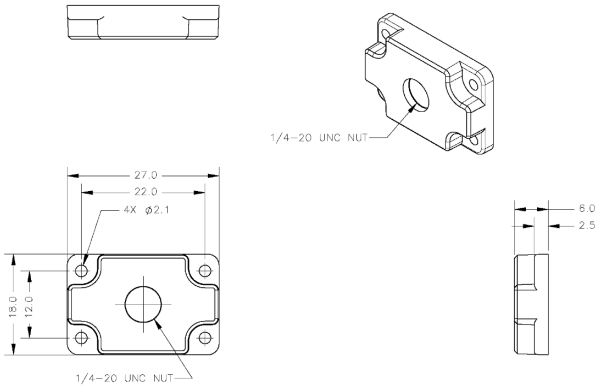
- Two (2) M2 x 2 mm mounting holes on the top of the case
- Three (3) M3 x 2.5 mm mounting holes on the bottom of the case
- Four (4) M2 x 2 mm mounting holes on the bottom of the case that can be used to attach the camera directly to a custom mount or to the tripod mounting bracket

Using the Mounting Bracket—Cased Models

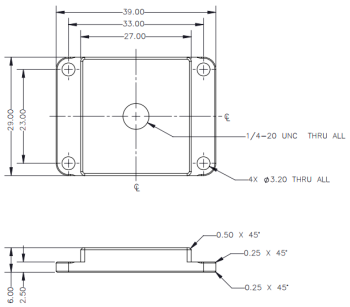
The tripod mounting bracket is equipped with four (4) M2 mounting holes.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

Tripod Adapter Dimensions—Cased Models



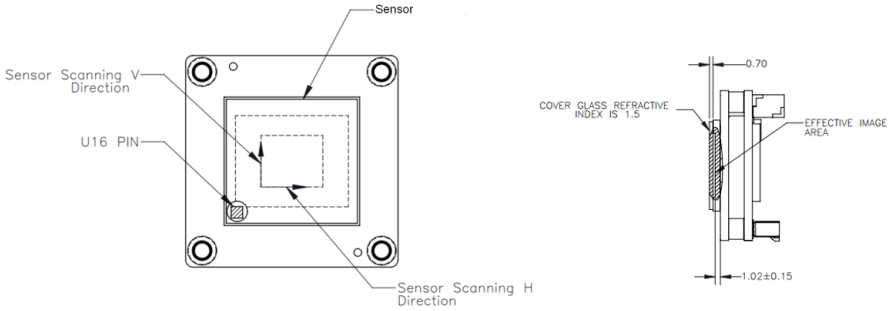
Tripod Adapter Dimensional Diagram
Standard Case (ACC-01-0003)



Tripod Adapter Dimensional Diagram
Large Case (ACC-01-0016)

Using the Mounting Holes—Board-level Models

Four mounting points are provided using M2 through holes. For precise alignment, index off the image sensor (U16 Pin in the drawing below). When designing a mounting bracket, respect the Keepout Layer—Board-level Models.



Board-level Diagram

6.9 Camera 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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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. Teledyne FLIR offers a recommended heat sink (PN: ACC-01-7000).
- 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.

For cased models—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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6.10 Lens Mounting

Lenses are not included with cameras. Teledyne FLIR sells a number of lenses compatible with our cameras from our website. There is also a Lens Calculator to help choose an appropriate lens.

In addition, lens mounts are not included with the board-level model cameras. Teledyne 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.

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-PGE-14Y3 / BFS-U3-13Y3	BFS-PGE-04S2 / BFS-U3-04S2
BFS-PGE-16S7 / BFS-U3-16S7 / BFS-U3-17S7	BFS-PGE-16S2 / BFS-U3-16S2
BFS-PGE-19S4 / BFS-U3-19S4	BFS-PGE-23S3-CS
BFS-U3-20S4	BFS-PGE-120S4 / BFS-U3-120S4
BFS-PGE-23S3-C / BFS-U3-23S3	
BFS-PGE-27S5 / BFS-U3-27S5	
BFS-U3-28S5	
BFS-PGE-31S4 / BFS-U3-31S4 / BFS-U3-32S4	
BFS-PGE-50S4 / BFS-U3-50S4	
BFS-PGE-50S5 / BFS-U3-50S5	
BFS-PGE-51S5 / BFS-U3-51S5	
BFS-PGE-63S4 / BFS-U3-63S4	
BFS-PGE-70S7 / BFS-U3-70S7	
BFS-PGE-80S5	
BFS-PGE-88S6 / BFS-U3-88S6 / BFS-U3-89S6	
BFS-PGE-120S4	
BFS-PGE-120S6	
BFS-PGE-122S6 / BFS-U3-122S6	
BFS-PGE-123S6P / BFS-U3-123S6	
BFS-PGE-161S7 / BFS-U3-161S7	
BFS-PGE-200S6 / BFS-U3-200S6 / BFS-PGE-200S7	
BFS-PGE-244S8 / BFS-U3-244S8	

Related Knowledge Base Articles

Selecting a lens for your camera

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6.10.1 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 (color models only) 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.

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

6.11 Non-Volatile Flash Memory

The Blackfly S has 6 MB of non-volatile flash memory for users to store data.

Related Knowledge Base Articles

Storing data in on-camera flash memory

6.12 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

Removing the IR filter from a color camera

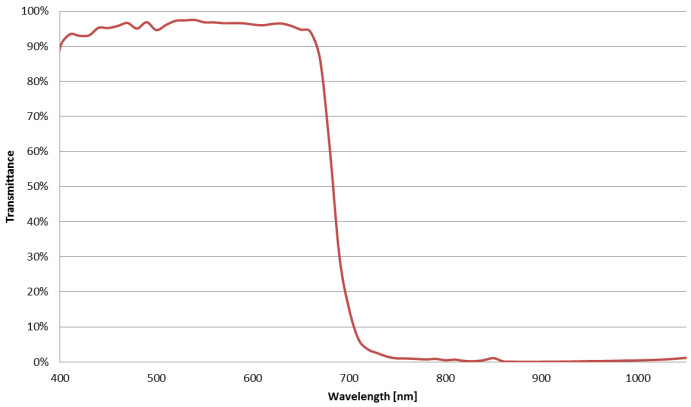
Selecting a lens for your camera

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

6.13 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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

For more information, see Dust Protection—Cased Models.

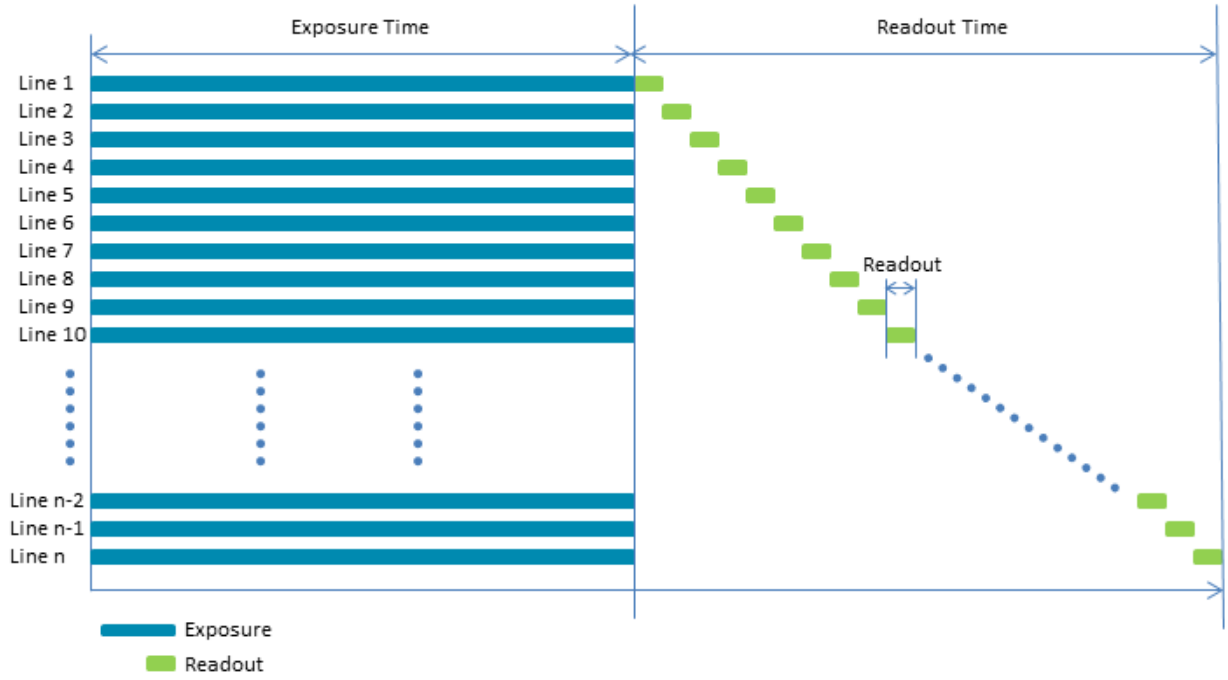
Related Knowledge Base Articles

Removing the IR filter from a color camera

6.14 Readout Method

6.14.1 Global Shutter

For cameras with a global shutter sensor, for each frame all of the lines start and stop exposure at the same time. The exposure time for each line is the same. Following exposure, data readout begins. The readout time for each line is the same but the start and end times are staggered. Readout time for a line is equal to 1/Horizontal Line Frequency.

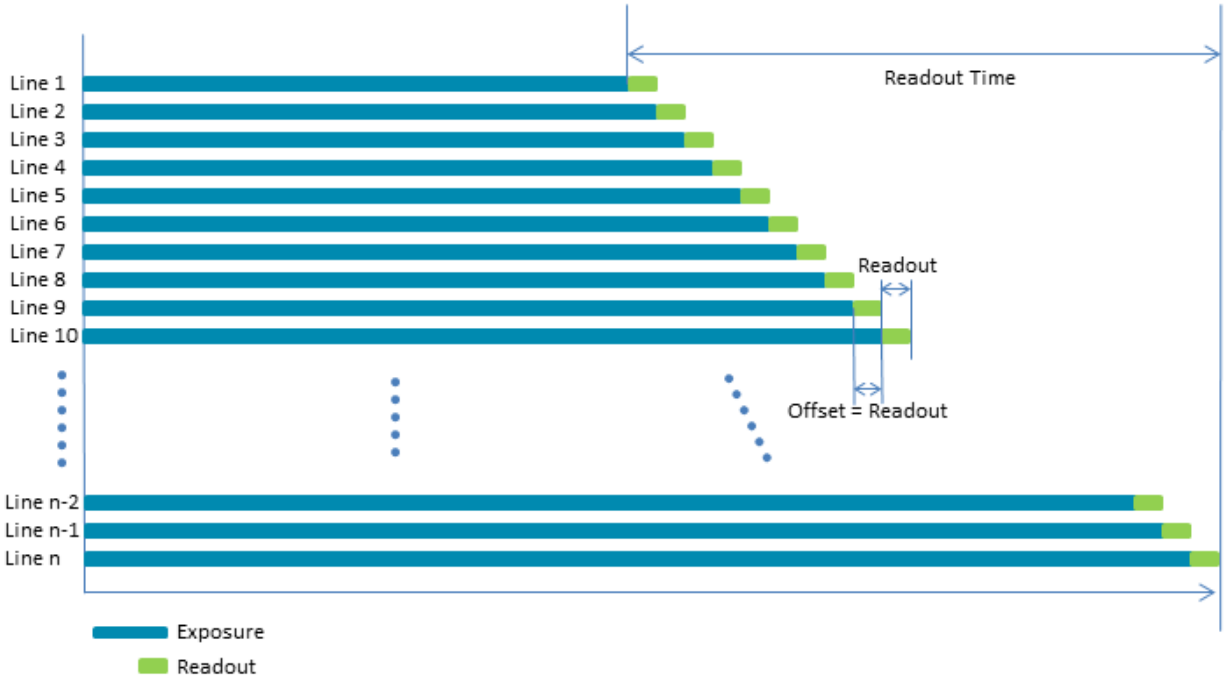


Some advantages of global shutter are more uniform brightness and minimal motion blur.

6.14.2 Rolling Shutter with Global Reset

For cameras with a rolling shutter with global reset sensor, for each frame all of the lines start exposure at the same time but the end of exposure is delayed by the offset of the previous line's readout. The exposure time for each line gradually lengthens. Data readout for each line begins immediately following the line's exposure. The readout time for each line is the same, but the start and end times are staggered. Readout time for a line is equal to 1/Horizontal Line Frequency.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.



An advantage of a rolling shutter with global reset is a reduction in image artifacts typical of rolling shutters such as skew and wobble. However, because exposure lengthens throughout the frame, there may be a gradual increase in brightness from top to bottom of an image. This gradient can be diminished or even eliminated by using a strobe flash.

If the camera supports a rolling shutter with a global reset, the strobe can be set to active from the start of exposure of the first line to the end of exposure on the last line (Any pixel) or from the start of exposure on the last line to the end of exposure on the first line (All pixels).

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

7 Input/Output Control

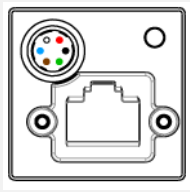
7.1 General Purpose Input/Output (GPIO)

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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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/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	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				

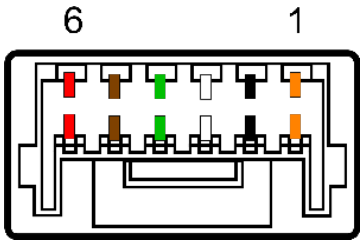
Measurement conditions: Opto-Isolated I/O VCC=5V, Rext=1KOhm, Non-Isolated Output: VCC=5V, Rext=330 Ohm, Non-Isolated Input: VCC=3.3V. Measured over operating temperature range (-20℃ to +50℃ ambient temperature), unless otherwise noted.

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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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

Blackfly S Board-level Models



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
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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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

7.2 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 is 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 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.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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

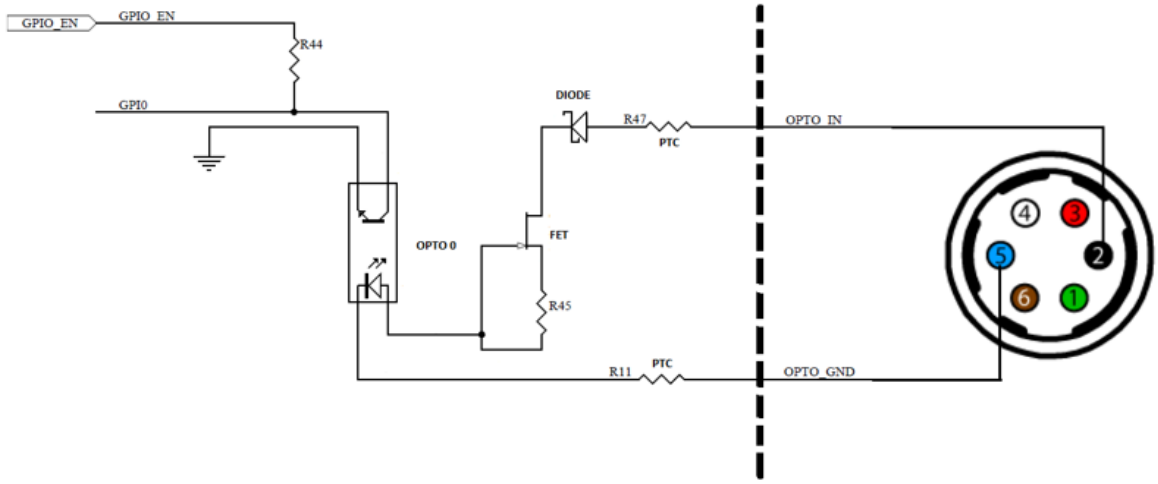
Description	Minimum	Maximum
Opto-isolated Input Voltage	0 V	30 V
Opto-isolated Output Voltage	0 V	24 V
Opto-isolated Output Current		25 mA
3.3 V Output Current		120 mA

Opto-isolated External Voltage Resistor Combinations

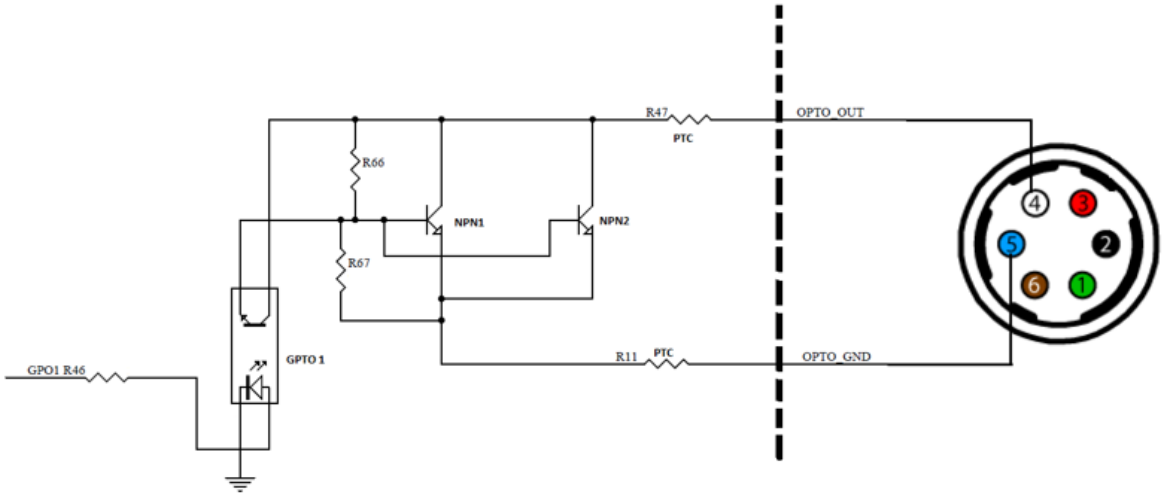
External Voltage	External Resistor	OPTO_OUT Low Voltage		OPTO_OUT High Voltage		Output Current	Output Current Low	Output Current High
		No Load	Load	No Load	Load	No Load	Load	Load
3.3 V	200 Ω	1.47 V	1.44 V	3.25 V	2.64 V	8.4 mA	2.52 mA	8.52 mA
5 V	1.0 kΩ	0.92 V	0.86 V	5 V	2.29 V	3.9 mA	2.68 mA	4.04 mA
12 V	2.4 kΩ	1.08 V	1.02 V	12.08 V	3.78 V	4.54 mA	3.44 mA	4.56 mA
24 V	4.7 kΩ	1.3 V	1.08 V	24 V	6.36 V	4.78 mA	3.7 mA	4.82 mA
30 V	4.7 kΩ	1.4 V	1.32 V	30 V	11.08 V	5.96 mA	3.02 mA	5.08 mA

Values are for reference only

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.



Opto-isolated input circuit—Cased



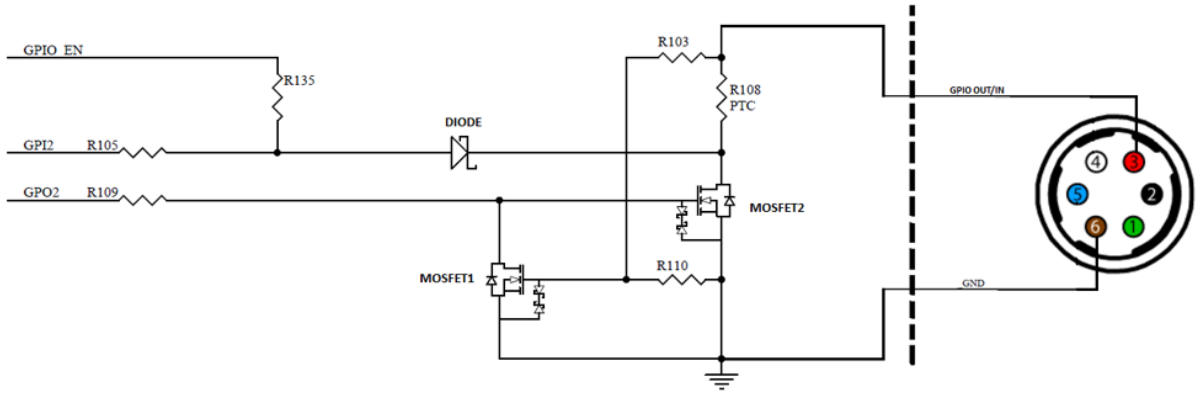
Opto-isolated output circuit—Cased

Non-isolated External Voltage Resistor Combinations

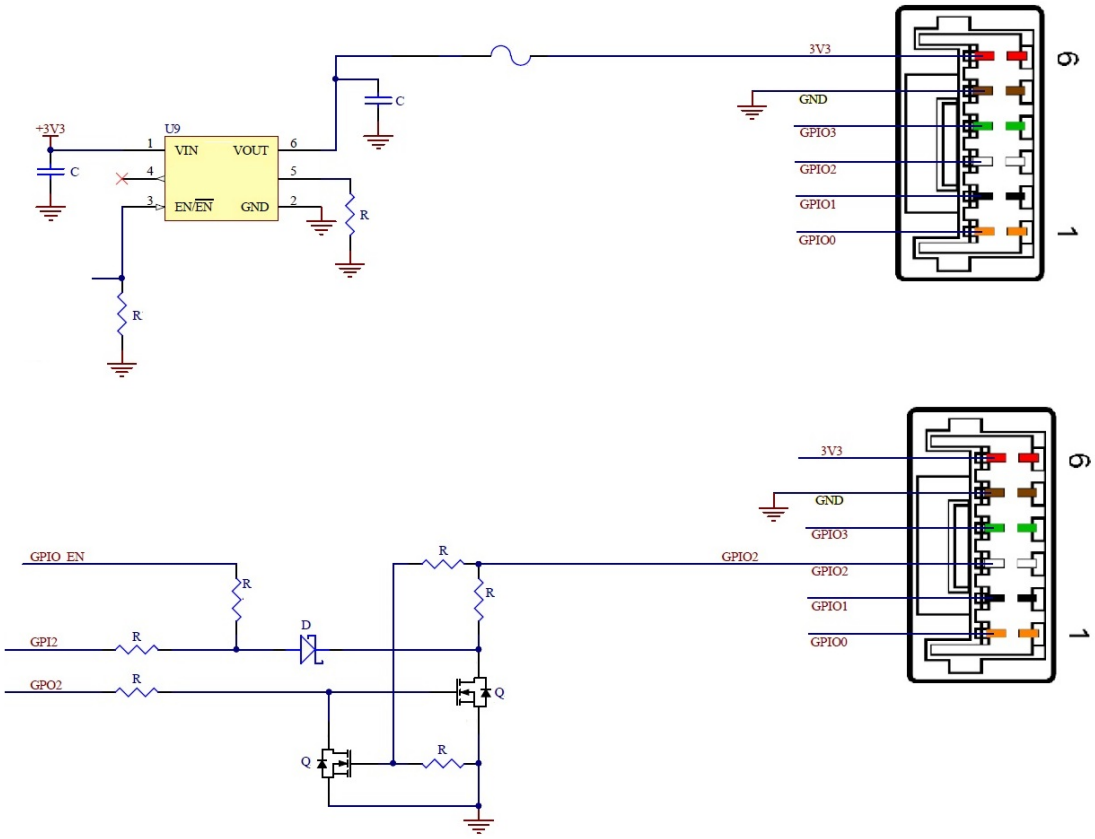
External Voltage	External Resistor	Current
3.3 V	1.0 kΩ	3.1 mA
5 V	1.0 kΩ	4.8 mA
12 V	2.0 kΩ	6 mA
12 V	2.4 kΩ	5 mA
24 V	4.7 kΩ	5.2 mA
30 V	4.7 kΩ	6.5 mA

Values are for reference only

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.



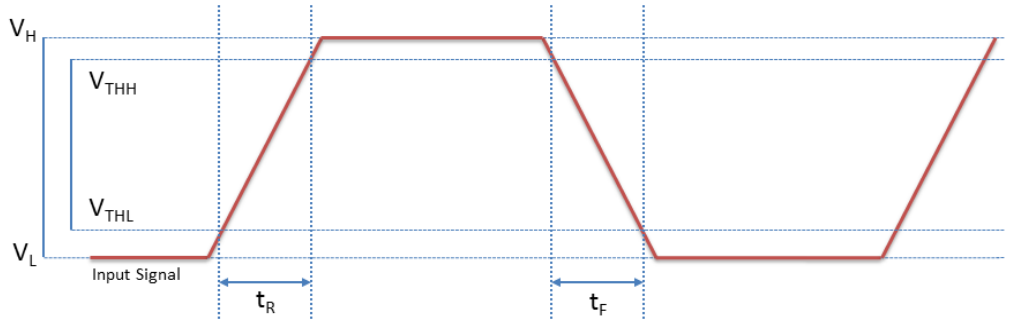
Non-isolated input and output circuit—Cased



Non-isolated input and output circuit—Board-level

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

7.3 Input Timing Characteristics

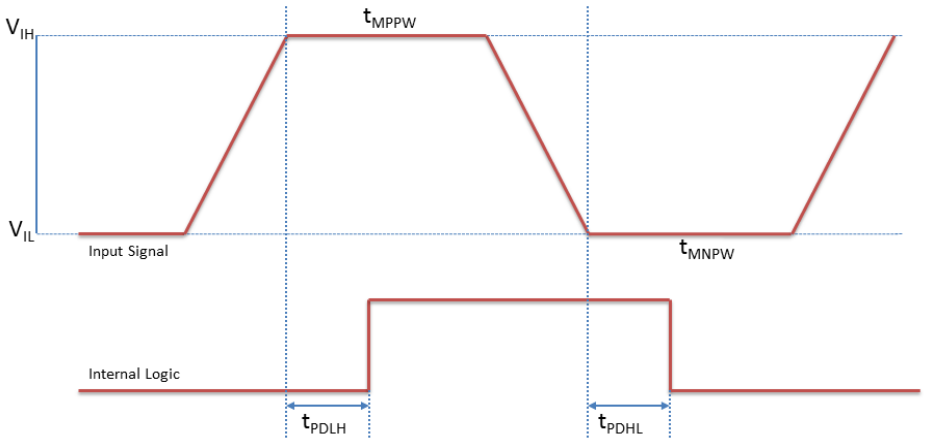


Input Timing Characteristics

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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

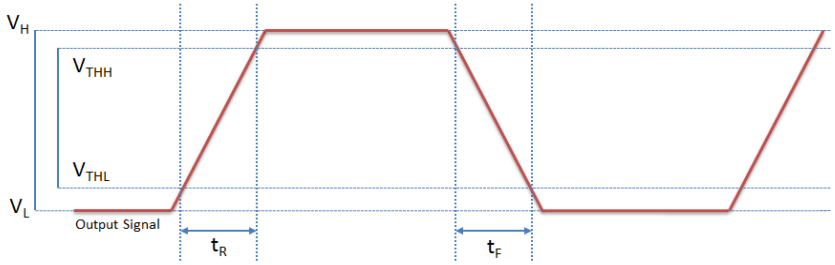


Opto-isolated Input Performance (Vcc = varying pk-pk)

Parameter	Symbol	Opto-isolated 5 V, 1 kΩ	Opto-isolated 3 V, 200 Ω
Input Low Voltage	V_{IL}	≤ 1.96 V	≤ 2 V
Input High Voltage	V_{IH}	≥ 2 V	≥ 2.05 V
Propagation Delay Low to High	t_{PDLH}	20.9 µs	19.7 µs
Propagation Delay High to Low	t_{PDHL}	5.6 µs	16.7 µs
Typical Positive Pulse Width	t_{MPPW}	12 µs	12 µs
Typical Negative Pulse Width	t_{MNPW}	6 µs	6 µs

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

7.4 Output Timing Characteristics



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	1.44 V	1.47 V
Output High Voltage	V_H	2.64 V	3.25 V
Output Threshold High Voltage	V_{THH}	2.52 V	3.07 V
Output Threshold Low Voltage	V_{THL}	1.56 V	1.65 V
Cycle Rise Time	t_R	5.2 µs	24 µs
Cycle Fall Time	t_F	28 µs	4.6 µs
Opto Current		3.08 mA	8.4 mA
Opto Isolator Delay (High to Low)		5.3 µs	5.5 µs
Opto Isolator Delay (Low to High)		12.7 µs	15.2 µs

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

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

		Opto-isolated	
Parameter	**Symbol**	**Load**	**No Load**
Output Low Voltage	V_L	0.86 V	0.92 V
Output High Voltage	V_H	2.29 V	5 V
Output Threshold High Voltage	V_{THH}	2.15 V	4.59 V
Output Threshold Low Voltage	V_{THL}	1.00 V	1.33 V
Cycle Rise Time	t_R	12 µs	10.3 µs
Cycle Fall Time	t_F	19.6 µs	17.2 µs
Opto Current		2.68 mA	3.9 mA
Opto Isolator Delay (High to Low)		3.9 µs	4.1 µs
Opto Isolator Delay (Low to High)		26.8 µs	25.1 µs

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

8 Troubleshooting

8.1 Support

Teledyne FLIR endeavors to provide the highest level of technical support possible to you. Most support resources can be accessed through your product's Support page. From the machine vision page, click on your product family and then click the **Go to Support Page** link.

The **Overview** tab contains links to:



Spinnaker SDK download



Application notes



Knowledge base articles



White papers



Warranty information

The **Resources** tab contains links to:

- EMVA Imaging Performance specification PDFs
- Camera References (HTML)
- Datasheets
- Drawings
- Firmware
- Getting Started manual PDFs
- Product Change Notifications (PCN)
- Technical Reference manual PDFs

The **Media** tab contains links to videos about sensor technology and camera use.

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

Contacting Technical Support

Before contacting Technical Support, have you:

1. Read the product documentation?
2. Searched the Product Support page?
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.

8.2 Status Indicator LED

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

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

Contacting Us

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

Email	General questions
Support Ticket	Technical support
Website	Find specifications, support articles, downloads on the product page at FLIR machine vision

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
15.0	February 19, 2019	Support for BFS-PGE-63S4 and BFS-U3-28S5
16.0	March 6, 2019	Support for BFS-PGE-27S5

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.

Version	Date	Description
		Added GigE large format case dimensional diagram
17.0	June 7, 2019	Support for BFS-PGE-16S7, BFS-U3-16S7, BFS-U3-17S7, BFS-PGE-19S4, BFS-U3-20S4
17.1	August 29, 2019	Added tripod adapter dimensional diagram for large case
18.0	November 1, 2019	Support for BFS-U3-19S4 and BFS-U3-27S5
19.0	March 6, 2020	Support for BFS-PGE-23S3 (CS-mount)
19.1	April 9, 2020	Updated link to contact support Updated GPIO electrical and input /output timing
20.0	June 5, 2020	Support for BFS-U3-244S8
21.0	February 11, 2021	Support for BFS-PGE-14Y3 and BFS-PGE-161S7
22.0	June 11, 2021	Support for BFS-PGE-50S4, BFS-U3-50S4, and BFS-PGE-244S8
23.0	September 9, 2021	Support for BFS-PGE-123S6P
24.0	December 10, 2021	Support for BFS-PGE-120S6 and BFS-PGE-200S7 Rebranded to Teledyne FLIR
25.0	February 28, 2022	Support for BFS-PGE-80S5 Added part numbers for board-level accessories
26.0	September 15, 2022	Support for BFS-U3-161S7
26.1	November 1, 2022	Added C-mount variant BFS-PGE-120S4

©2015-2022 FLIR Integrated Imaging Solutions Inc.
All rights reserved.