

BUMBLEBEE[®] X

GigE Vision Stereo Cameras

Preparing for Installation

Will your system support the camera?

Recommended desktop configuration:

- **OS**—Ubuntu Linux 22.04 (64-bit) / Windows 10 64-bit
- **CPU**—Intel® i7 10th gen or greater
- **RAM**—16 GB dual channel
- **Software**—ROS 2 Humble (Ubuntu Linux 22.04)

Tested **ARM** configuration:

- NVIDIA Jetson AGX Orin 64 GB Developer Kit

Do you have all the parts you need?

To install your camera you need the following components:

- Ethernet power injector
- IP-rated M12 Ethernet cable (from camera to power injector)
- Standard RJ45 Ethernet cable (from power injector to host adapter)
- Ethernet host adapter with 1G or 5G (preferred) Full Duplex support
- IP-rated GPIO cable with Hirose 12-pin connector
- Pattern projector (optional)

Teledyne FLIR sells a number of the additional parts required for installation. To purchase, visit the [Accessories page](#).

Have you visited our website?

A downloads account is required to download software and firmware.

1. Go to teledynevisionsolutions.com.
2. Enter your email address and click Continue.
3. Complete the Create an account form and click Continue.
4. You will receive an email with a link to activate your account.
5. Once activated, you can login using your credentials.

The [Bumblebee X product page](#) has many resources, including:

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

Bumblebee X Camera Care

Warning! Do not open the camera housing. Doing so voids the Hardware Warranty.

Avoid electrostatic charging.



The outer case of the camera can become hot to the touch when running. This is expected behavior.

Installing your Software—Linux Users

1. Install the Spinnaker® SDK Software

Note: Linux users of the Bumblebee X camera require Spinnaker version 4.1.0.338 or later.

- a. Go to the [Spinnaker download](#) page. If you are not already logged in, you are prompted to login.
- b. Select Spinnaker version 4.1.0.338 (or later) for Ubuntu 22.04.
- c. Install the Ubuntu dependencies:

```
$ sudo apt-get install libavcodec58 libavformat58 \
libswscale5 libswresample3 libavutil56 libusb-1.0-0 \
libpcre2-16-0 libdouble-conversion3 libxcb-xinput0 \
libxcb-xinerama0 qtbase5-dev qtchooser qt5-qmake \
qtbase5-dev-tools
```

- d. Install Spinnaker deb files:

```
$ sudo sh install_spinnaker.sh
```

2. Restart your computer.

See the Spinnaker README file for additional information.

Installing your Software—ARM Users

1. Install the Spinnaker® SDK Software

Note: ARM users of the Bumblebee X camera require Spinnaker version 4.2.0.21 or later for ARM64.

- a. Go to the [Spinnaker download](#) page. If you are not already logged in, you are prompted to login.
- b. Select Spinnaker version 4.2.0.21 (or later) for Ubuntu 22.04.
- c. Install the Ubuntu dependencies:

```
$ sudo apt-get install libusb-1.0-0 qtbase5-dev \
qtchooser qt5-qmake qtbase5-dev-tools
```

- d. Install Spinnaker deb files:

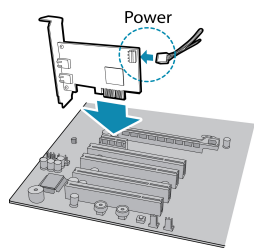
```
$ sudo sh install_spinnaker_arm.sh
```

2. Restart your computer.

See the Spinnaker README_ARM file for additional information.

Installing your Host Adapter—Linux and ARM Users

1. Install your Host Adapter



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

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

2. Maximize Network Settings

To maximize the successful usage of the camera it is important to optimize some network settings.

Note: Administrator privileges are required.

A network tuning script provided with the Spinnaker SDK optimizes certain network settings using the standard tool: ethtool. Note that depending on your network interface and architecture, not all parameters set by the script are supported. The `gev_netweek` tuning script is located in: `/opt/spinnaker/bin/`

- a. Install ethtool:

```
$ sudo apt install ethtool
```

- b. To show name of your host adapter:

```
$ ip addr show
```

- c. Adjust `<your host adapter>` using the network tuning script:

```
$ sudo ./gev_netweek <your host adapter>
```

The `gev_netweek` script adjusts the following parameters:

Parameter	Function
MTU	Maximizes the Maximal Transmission Unit (MTU) size on the host adapter. This is the maximum packet size for image data.
net.ipv4.udp_rmem_min	Adjusts the receive memory allocation size in the network stack.
net.core.netdev_max_backlog	Adjusts the network packet backlog queue size.
net.unix.max_dgram_qlen	Adjusts the network queue length and computes the amount of memory for UDP packets.
net.core.rmem_default net.core.rmem_max	Adjusts the default and maximum memory for receiving network packets.
rx_jumbo	Adjusts the setting of the network device drivers to optimize the <code>rx_ring</code> and the <code>rx jumbo</code> packet queue for maximum throughput and to disable the <code>rx pause</code> operation. This improves reception of image data packets from the cameras.

Note: Optimizations made by the tuning script are temporary settings that revert to default when the computer is rebooted. To make the changes permanent, adjust the parameters independently from the script.

3. Disable Reverse Path Filtering (RPF)

To ensure the camera enumerates properly, RPF needs to be disabled.

To disable RPF:

- a. Run the following:

```
$ sudo gedit /etc/sysctl.d/10-network-security.conf
```

- b. In the file, comment out the lines:

```
# Turn on Source Address Verification in all  
# interfaces to  
# in order to prevent some spoofing attacks.  
## net.ipv4.conf.default.rp_filter=1  
## net.ipv4.conf.all.rp_filter=1
```

- c. Restart the computer.

4. Set 5GigE Link Speed

To use the full potential of 5GigE, we recommend setting the auto-negotiation speed and duplex of your host adapter to 5GBASE-T.

- a. Verify your supported link modes:

```
$ sudo ethtool <your host adapter>
```

- b. If supported, **temporarily** set the auto-negotiation speed and duplex to 5GBASE-T and full duplex:

```
$ sudo ethtool -s <your host adapter>  
advertise 0x1000000000000
```

Or,

- c. To **permanently** set it, navigate to `/etc/rc.local` and edit that file with a text editor to copy in:

```
sudo ethtool -s <your host adapter>  
advertise 0x1000000000000
```

Installing your Software—Windows Users

1. Install the Spinnaker® SDK Software

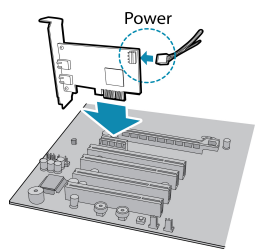
Note: The Bumblebee X camera requires Spinnaker version 4.2.0.27 or later.

- a. Go to the [Spinnaker SDK Download](#) page. If you are not already logged in, you are prompted to login.
- b. Select Spinnaker version 4.2.0.27 or later for Windows.
- c. Run the install file and follow the installation instructions.

See the Spinnaker README file for additional information.

Installing your Host Adapter—Windows Users

1. Install your Host Adapter



Ensure the card is installed per the manufacturer's instructions.
Alternatively, use your PC's built-in host adapter, if equipped.

2. Maximize Network Settings

To maximize the successful usage of the camera it is important to optimize some network settings.

Note: Administrator privileges are required.

In **Start→Teledyne Spinnaker SDK→SpinView**, right click on the Network Adapter and select Adapter Configuration. The Adapter Config Utility lists your network adapters and allows you to access the following:

- Adapter IP address
- Subnet mask
- Default gateway
- Receive buffers
- Transmit buffers
- Jumbo packets
- RSS
- Media optimization
- CPU affinity

Note: See [How to Optimize GigE Network Adapter Settings](#) for more information on configuring for best performance.

3. Set 5GigE Link Speed

To use the full potential of 5GigE, we recommend setting the auto-negotiation speed and duplex of your host adapter to 5GBASE-T.

- a. If necessary, update the driver to the latest to access the 5G Full Duplex option.
- b. In Windows go to Control Panel\Network and Internet\Network Connections, right-click on your network adapter and select Properties.
- c. Click Configure.
- d. On the Advanced tab, from the Property box select Speed & Duplex and from the Value drop-down select 5Gbps Full Duplex.
- e. Click OK.

Installing your Bumblebee X Camera

1. Mount the Camera

- a. Calculate the distance required for your model's stereo field of view.
- b. If using a pattern projector, mount the projector to the camera.
- c. Mount the camera using the mounting holes on the top, bottom, or back of the case.

2. Connect the Camera

- a. Connect the host adapter to the Ethernet power injector using an RJ45 Ethernet cable.
- b. Connect the camera to the injector using an M12 Ethernet cable.

3. Connect the GPIO

- a. Connect the IP-rated GPIO cable, or;
- b. Ensure the plug is secure in the GPIO connector on the back of the camera.

4. Confirm Successful Installation

- a. Launch SpinView to connect to the camera for streaming.
- b. Refer to the [ROS Wrapper README file](#) for using the camera in ROS and SDK examples.
- c. Test and adjust the mounting position as necessary.

Status Indicator LED

LED	1GigE / 5GigE
Blinking Green (1 blink)	Link-Local Address (LLA)
Blinking Green (2 blinks)	DHCP IP Address
Blinking Green (3 blinks)	Persistent IP Address
Solid Green	Acquisition Started
Solid Red	Link is down
Rapidly Flashing Green	Firmware updating
Flashing Green and Red	General Error

Camera Interface

Ethernet Connector

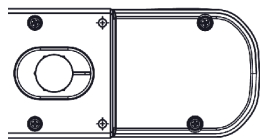
The Bumblebee X camera is equipped with a M12 X-code 8-pin Ethernet connector which can be connected to the RJ45 Ethernet jack on the Ethernet power injector using an IP- rated cable. Pin assignments conform to the Ethernet standard.



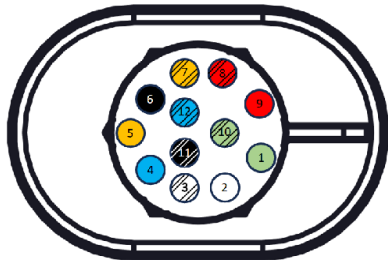
Note: To retain the IP rating of the camera, an IP-rated cable must be securely attached to the camera's connector.

General Purpose I/O Connector

The Bumblebee X camera is equipped with a 12-pin GPIO connector on the back of the case. The connector is a Hirose LF10WBRB, the mating connector is a Hirose LF10WBP-12P.



Connector orientation on back of case



Connector with pins

Note: To retain the IP rating of the camera, an IP-rated GPIO cable must be securely attached to the camera's connector. If not using GPIO, the sealing plug must be in place.

Color	Pin	Line	Function	Description
Green	1	N/A	Opto GND	Ground for opto-isolated IO
White	2	Line0	IO	Opto-isolated input (default trigger in)
White/Black	3	Line1	O1	Opto-isolated output
Blue	4	Line2	IO2	Input/Output
Orange	5	N/A	Aux Vout	a. Adjustable output V (10 mA)
				b. 3.3 V (400 mA)
				c. 5 V (400 mA)
Black	6	N/A	GND	Ground for Vext, Aux Vout, and Non-isolated GPIO
Orange/Black	7	Line4	IO4	Input/Output
Red/Black	8	N/A	Vext	External power input to the camera
Red	9			
Green/Black	10	Line5	IO5	Input/Output
Black/White	11	Line3	IO3	Input/Output
Blue/Black	12	N/A	GND	Ground for Vext, Aux Vout, and Non-isolated GPIO

Contacting Us

For any questions, concerns or comments please contact us:

Email	General sales questions
Support Ticket	Technical Support
Support Forum	Teledyne FLIR Community
Website	Bumblebee X page for articles, documents, firmware, CAD models