



The World's **Sixth Sense**[®]

Configuring Synchronized Capture with Multiple Cameras

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Applicable products

- Blackfly[®]S
- Blackfly[®]
- Chameleon[®]3
- Flea[®]3
- Grasshopper[®]3
- Oryx[®]

Application note description

This application note describes how to set up multiple cameras for synchronized capture.

What is synchronized capture?

Synchronized capture is when two or more cameras are capturing images at the same time (within microseconds of each other). One method of doing this is when one "primary" camera is used to trigger one or more "secondary" cameras, using the primary camera's strobe. This ensures that the frame rates of the secondary cameras are the same as the that of the primary camera. Strobes occur when a camera begins to capture images. With the GPIO connection on a FLIR machine vision camera, it's possible to use the strobe output as an input for other cameras.

Note: An alternative method of synchronized capture is to have all cameras triggered by an external hardware trigger (for example, a function generator). Any hardware trigger that provides a 3.3 V or 5 V square wave TTL signal can trigger the cameras. This application note does not cover the configuration of an external hardware trigger.

Configuring synchronized capture

There are two steps to configuring synchronized capture:


1. Create a physical connection between the cameras by linking their GPIO pins.
2. Configure inputs and outputs for each camera either with the SDK demo application or with code.

Step 1—Connect the cameras

The first step is to create a physical link between the cameras. The methods vary depending on the camera used.

Blackfly S (BFS)

BFS cameras have a 6-pin GPIO. The BFS GPIO has both a non-isolated output and an opto-isolated output. If using the opto-isolated output as in our example below, the primary camera requires a pull-up resistor to strengthen its strobe signal.

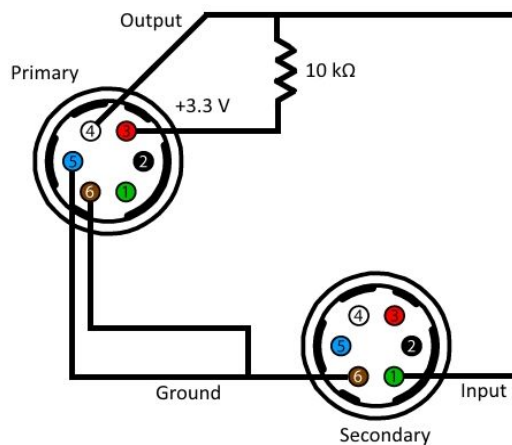
| Diagram | Color | Pin | Line | Function | Description |
|---|-------|-----|------|---------------------|------------------------------|
|  | Green | 1 | 3 | V_{AUX} | Auxiliary Input Voltage (DC) |
| | | | | GPI | Non-isolated Input |
| | Black | 2 | 0 | OPTOIN | Opto-isolated Input |
| | Red | 3 | 2 | VOUT | Camera Power Output |
| | | | | GPIO | Non-isolated Input/Output |
| | White | 4 | 1 | OPTOOUT | Opto-isolated Output |
| | Blue | 5 | N/A | Opto GND | Opto-isolated Ground |
| Brown | 6 | N/A | GND | Camera Power Ground | |

To configure primary and secondary BFS cameras:

1. Connect the primary camera's pin 4 (white wire, opto-isolated output) to each secondary camera's pin 1 (green wire, non-isolated input).
2. Connect the primary camera's pin 5 (blue wire, opto-isolated ground) to each secondary camera's pin 6 (brown wire, ground).


To configure the pull-up resistor needed to strengthen the signal:

1. Connect one end of a 10 k Ω resistor to the primary camera's pin 3 (red wire, 3.3 V output).
2. Connect the other end of the resistor to the primary camera's pin 4 (white wire) and to each secondary camera's pin 1 (green wire).
3. Connect the primary camera's pin 6 (brown wire) to each secondary camera's pin 6 (brown wire). Note: the secondary camera's pin 6 is already connected to the primary camera's pin 5.



Blackfly (BFLY)

BFLY cameras use a 6-pin GPIO connector. The BFLY GPIO has only opto-isolated output pins, so the primary camera requires a pull-up resistor to strengthen its strobe signal.

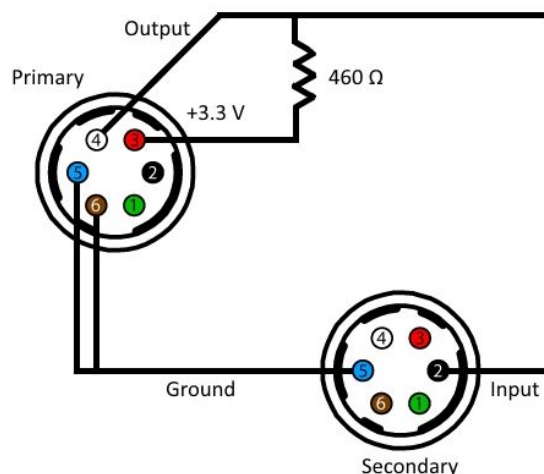
| Diagram | Color | Pin | Function | Description |
|---|-------|-----|------------------|--|
|  | Green | 1 | V _{EXT} | +12 V DC Camera Power |
| | Black | 2 | I0 | Opto-isolated input (GPIO 0) |
| | Red | 3 | NC / +3.3 V | +3.3 V output. Current 120 mA (nominal). Firmware enabled (OUTPUT_VOLTAGE_ENABLE: 19D0h) |
| | White | 4 | O1 | Opto-isolated output (GPIO 1) |
| | Blue | 5 | OPTO_GND | Ground for opto-isolated I/O, not connected to camera ground |
| | Brown | 6 | GND | DC camera power ground |

To configure primary and secondary BFLY cameras:

1. Connect the primary camera's pin 4 (white wire, opto-isolated output) to each secondary camera's pin 2 (black wire, opto-isolated input).
2. Connect the primary camera's pin 5 (blue wire, opto-ground) to each secondary camera's pin 5 (blue wire, opto-ground).

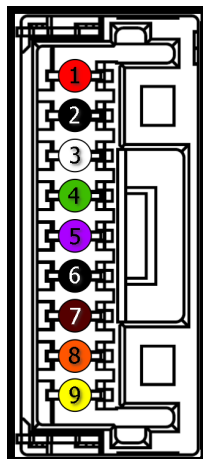
To configure the pull-up resistor needed to strengthen the signal:

1. Connect one end of a 460 Ω resistor to the primary camera's pin 3 (red wire, 3.3 V output).
2. Connect the other end of the resistor to the primary camera's pin 4 (white wire) and to each secondary camera's pin 2 (black wire).
3. Connect the primary camera's pin 6 (brown wire) to each camera's pin 5 (blue wire). Note: the secondary camera's pin 5 is already connected to the primary camera's pin 5.



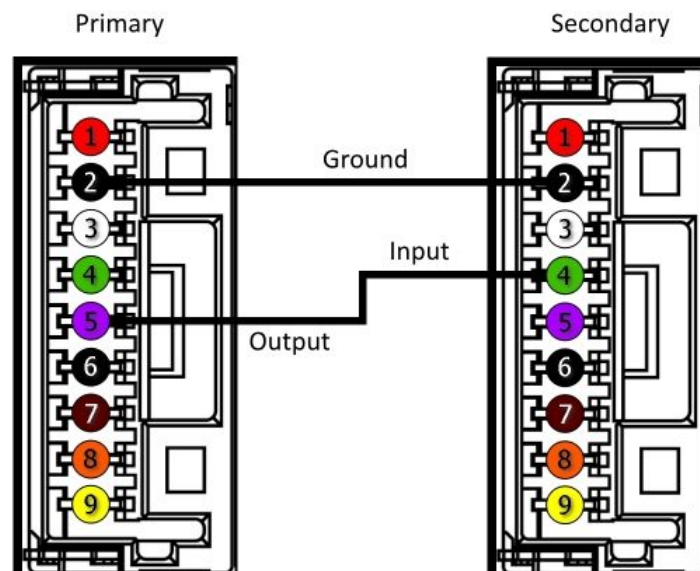
Chameleon 3 (CM3)

CM3 uses a 9-pin GPIO. It has two non-opto input/output pins that can be used as either input or output. Non-opto pins do not need a pull-up resistor combination to strength the strobe signal. This example uses the non-opto pins.

| Diagram | Color | Pin | Function | Description |
|---|--------|-----|------------------|---|
|  | Red | 1 | V_{EXT} | Allows the camera to be powered externally 5 - 24 VDC |
| | Black | 2 | GND | Ground for Input/Output, V_{EXT} , +3.3 V pins |
| | White | 3 | +3.3 V | Power external circuitry fused at 150 mA maximum |
| | Green | 4 | GPIO3 / Line3 | Input/Output |
| | Purple | 5 | GPIO2 / Line2 | Input/Output |
| | Black | 6 | GND | Ground for Input/Output, V_{EXT} , +3.3 V pins |
| | Brown | 7 | OPTO_GND | Ground for opto-isolated IO pins |
| | Orange | 8 | OPTO_OUT / Line1 | Opto-isolated output |
| | Yellow | 9 | OPTO_IN / Line0 | Opto-isolated input |


To configure primary and secondary CM3 cameras:

1. Connect the primary camera's pin 5 (purple wire, output) to each secondary camera's pin 4 (green wire, input).
2. Connect the primary camera's pin 6 (black wire, ground) to each secondary camera's pin 6 (black wire, ground).



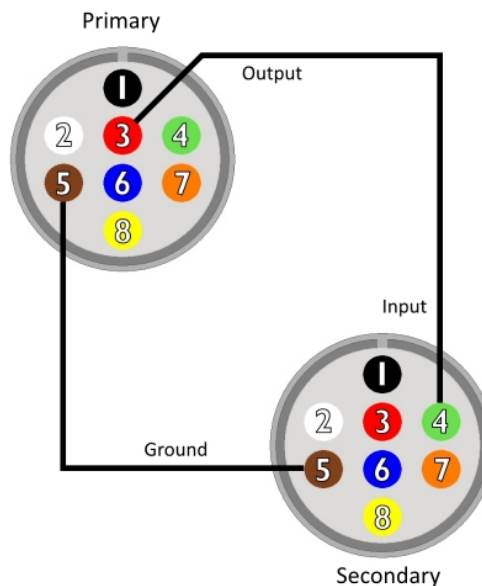
Flea3 (FL3) and Grasshopper3 (GS3)

FL3 and GS3 each use an 8-pin GPIO. They have two non-opto input/output pins that can be used as either input or output. Non-opto pins do not need a pull-up resistor combination to strength the strobe signal. This example uses the non-opto pins.

| Diagram | Color | Pin | Function | Description |
|---|--------|-----|-----------|---|
|  | Black | 1 | I0 | Opto-isolated input (default Trigger in) |
| | White | 2 | O1 | Opto-isolated output |
| | Red | 3 | IO2 | Input/Output/serial transmit (TX) |
| | Green | 4 | IO3 | Input/Output/serial receive (RX) |
| | Brown | 5 | GND | Ground for bi-directional IO, V_{EXT} , +3.3 V pins |
| | Blue | 6 | OPTO_GND | Ground for opto-isolated IO pins |
| | Orange | 7 | V_{EXT} | Allows the camera to be powered externally |
| | Yellow | 8 | +3.3 V | Power external circuitry up to 150 mA |

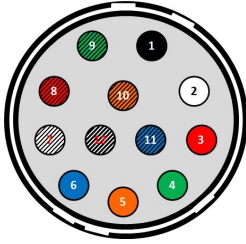
To configure primary and secondary FL3 or GS3 cameras:

1. Connect the primary camera's pin 3 (red wire, output) to each secondary camera's pin 4 (green wire, input).
2. Connect the primary camera's pin 5 (brown wire, ground) to each secondary camera's pin 5 (brown wire, ground).



Oryx (ORX)

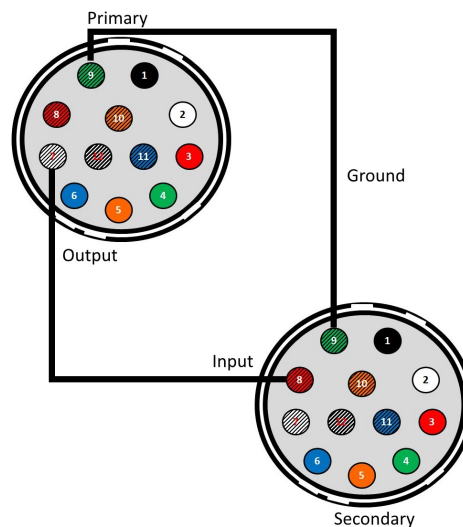
ORX cameras have a 12-pin GPIO. It has two non-opto input/output pins that can be used as either input or output. Non-opto pins do not need a pull-up resistor combination to strength the strobe signal. This example uses the non-opto pins.

| | Color | Pin | Line | Function | Description |
|---|----------------------|-----|--------|---------------|--|
|  | Black | 1 | N/A | GND | DC camera power ground |
| | White | 2 | N/A | POWER | DC camera power |
| | Red | 3 | Line 1 | GPIO_OPT_OUT1 | Opto-isolated output (GPO1) |
| | Green | 4 | Line 4 | GPIO_OPT_OUT2 | Opto-isolated output (GPO2) |
| | Orange | 5 | Line 0 | GPIO_OPT_IN1 | Opto-isolated input (GPI1) |
| | Blue | 6 | Line 3 | GPIO_OPT_IN2 | Opto-isolated input (GPI2) |
| | White/black stripes | 7 | Line 2 | GPIO_TTL_IO3 | TTL input/output 3* |
| | Red/black stripes | 8 | Line 5 | GPIO_TTL_IO4 | TTL input/output 4* |
| | Green/black stripes | 9 | N/A | GND | DC camera power ground |
| | Orange/black stripes | 10 | N/A | POWER | DC camera power |
| | Blue/black stripes | 11 | Line 6 | 3.3 V OUTPUT | +3.3 V output, current 120 mA (nominal) - firmware enabled |
| | Black/white stripes | 12 | N/A | OPTO_GND | Ground for opto-isolated I/O, not connected to camera ground |

*When configured as output line format is open drain, not TTL. Users should attach their own external pull-up resistor.

To configure primary and secondary ORX cameras:

1. Connect the primary camera's pin 7 (white with black stripes wire, output) to each secondary camera's pin 8 (red with black stripes wire, input).
2. Connect the primary camera's pin 9 (green with black stripes wire, ground) to each secondary camera's pin 9 (green with black stripes wire, ground).



Step 2—Configure the cameras

After the cameras have been physically connected, use either the SDK's demo program or write code to configure the GPIO lines.

Using SpinView

SpinView is the demo program available with the Spinnaker[®] SDK.

For the primary camera:

1. Open SpinView and select the camera.
2. On the Features tab, click Digital IO Control.
3. For BFS cameras, enable the 3.3 V line:
 - a. From the line selection drop-down select Line 2.
 - b. Check the checkbox for 3.3V Enable.
4. For BFLY cameras, select 3.3V Enable to enable the 3.3 V line.
5. For CM3, FL3, GS3, and ORX cameras, set Line 2 to output:
 - a. From the line selection drop-down select Line 2.
 - b. Set Line Mode to Output.
6. Save the settings in a user set:
 - a. Click User Set Control.
 - b. From the User Set Selector drop-down, select User Set 0 or User Set 1.
 - c. Click User Set Save.
 - d. From the User Set Default drop-down, select the user set just saved.

For each secondary camera:

1. Open SpinView and select the camera.
2. Select the GPIO tab.
 - For BFS, CM3, FL3, GS3 cameras, from the Trigger Source drop-down, select Line 3.
 - For ORX cameras, from the Trigger Source drop-down, select Line 5.
3. From the Trigger Overlap drop-down, select Read Out.
4. From the Trigger Mode drop-down, select On.
5. Save the settings in a user set:
 - a. Click User Set Control.
 - b. From the User Set Selector drop-down, select User Set 0 or User Set 1.

- c. Click User Set Save.
- d. From the User Set Default drop-down, select the user set just saved.

Note: Saving the settings to a user set ensures the camera starts up with these settings even after a power cycle.

Using FlyCap2 (BFLY, CM3, FL3, GS3)

FlyCap2 is the demo program available with the FlyCapture[®]2 SDK.

For the primary camera:

1. Open FlyCap2, select the camera and click Configure Selected.
2. For BFLY camera only, enable the 3.3 V line (red):
 - a. In the Camera Control dialog, select the Camera Registers tab.
 - b. Enter Register 19D0h (OUTPUT_VOLTAGE_ENABLE) and click Read Register.
 - c. Set bit 31 to 1.
 - d. Click Write Register.
3. For all cameras, enable the strobe:
 - a. Select the Trigger/Strobe tab.
 - b. For BFLY only, enable the strobe for GPIO1.
For all other cameras, enable the strobe for GPIO2.
4. Save the settings:
 - a. Select the Advanced Camera Settings tab.
 - b. Select a Memory Channel (either 1 or 2).
 - c. Click Save.

For each secondary camera:

1. Open FlyCap2, select the camera and click Configure Selected.
2. In the Camera Control dialog, select the Trigger/Strobe tab.
3. For BFLY camera only, set the Source to 0.
For all other cameras, set the Source to 3.
4. Set the Mode to 0 or 14. (Not all models support trigger mode 14.)
5. Select Enable/disable trigger.

6. Save the settings:
 - a. Select the Advanced Camera Settings tab.
 - b. Select a Memory Channel (either 1 or 2).
 - c. Click Save.

Note: Saving the settings to a memory channel ensures the camera starts up with these settings even after a power cycle.

Start saving images at the same time

Once you have configured the primary and secondary cameras you can start saving synchronized images.

Note: If saving images at high bandwidth, we recommend using a console application instead SpinView or FlyCap2. For details, see [Saving Images at High Bandwidth](#).

For both SpinView and FlyCap2:

1. Ensure the primary camera's trigger mode is turned on.
2. In the streaming window for the primary camera, click on the recording button.
3. Modify the recording settings as necessary.
4. Click the Start Recording button.
5. Keep the recording window open.
6. Repeat steps 1 through 5 for the secondary camera.
7. Turn off trigger mode for the primary camera. This starts capture for both cameras.

Using custom code

Both the Spinnaker SDK and the FlyCapture2 SDK come with example code. Elements of these two code examples can be combined to configure multiple cameras.

| SDK | Examples | Location |
|------------------------|--------------------------------------|--|
| Spinnaker SDK | AcquisitionMultipleCamera Trigger | \src\ of the SDK directory Example: C:\Program Files\Point Grey Research\Spinnaker\src |
| FlyCapture2 SDK | MultipleCameraEx AsyncTriggerEx | \src\ of the SDK directory Example: C:\Program Files\Point Grey Research\FlyCapture2\src |

In the example configurations above, FL3, GS3, and CM3 use switchable input/output GPIO pins for their strobe outputs. The strobe must be turned on when using these cameras for synchronized capture. To turn on the strobe, create an instance of the StrobeControl struct using the following code:

```
StrobeControl strobe;  
strobe.source = 2;  
error = cam.GetStrobe(&strobe);  
strobe.onOff = true;  
error = cam.SetStrobe(&strobe);
```

Troubleshooting

Secondary camera captures images at half the frame rate of the primary camera

Cause: The secondary camera isn't using overlapping triggering

Solution: On the secondary camera, switch to using Trigger Overlap as described [above](#). Not all camera models support Trigger Overlap (Trigger Mode 14). To determine if it is supported, consult the Technical Reference for your camera, available from our [downloads page](#).

For more information on trigger modes and differences between overlapped and non-overlapped triggering, see the following knowledge base articles:

- [Maximum frame rate possible in asynchronous \(external trigger\) mode](#)
- [What external trigger modes are supported by my camera?](#)

Secondary camera captures images at a very slow frame rate

Cause: The camera's exposure (shutter) value is too large.

Solution: Exposure (shutter) time can be adjusted.

- In SpinView—On the Settings tab
- In FlyCap2—On the Camera Settings tab of the Camera Control dialog.

I can't properly trigger more than one secondary camera

Cause: the physical setups shown above have been tested with only one secondary camera; we do not guarantee they will work for multiple secondary cameras.

Solution: Use your own pull up resistor setup.

Downloads and support

FLIR endeavors to provide the highest level of technical support possible to our customers. Most support resources can be accessed through the [Support](#) section of our website.

The first step in accessing our technical support resources is to obtain a customer login account. This requires a valid name and email address. To apply for a customer login account go to our [downloads](#) page.

Customers with a customer login account can access the latest **software** and **firmware** for their cameras from our website. We encourage our customers to keep their software and firmware up-to-date by downloading and installing the latest versions.

Finding information

Spinnaker SDK—The Spinnaker SDK provides API examples and the SpinView camera evaluation application. Available from our [Downloads](#) page.

API Documentation—The installation of the Spinnaker SDK comes with API references for C++, C#, and C code. A Programmer's Guide is included in each of the references. Available from:

- Start Menu→All Programs→Point Grey Spinnaker SDK→Documentation
- The SpinView application Help menu

Getting Started with SpinView—A quick guide to using the SpinView camera evaluation application provided in the Spinnaker SDK. Available from:

- Start Menu→All Programs→Point Grey Spinnaker SDK→Documentation
- The SpinView application Help menu
- Camera Reference zip package

Camera Reference—A zip package containing PDF and HTML copies of the camera's references, including: Installation Guide, Technical Reference, and Getting Started. Available from our [downloads](#) page.

Knowledge Base—A database of articles and application notes with answers to common questions as well as articles and tutorials about hardware and software systems. Available from our [knowledge base](#).

Learning Center—Our [Learning Center](#) contains links to many resources including videos, case studies, popular topics, other application notes, and information on sensor technology.

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.



Additional resources

GenICam—A programming interface for cameras and devices. More information available on the EMVA.org website.

USB3 Vision—A vision standard for the USB 3.1 interface that uses GenICam. More information available on the AIA Vision Online website.