Synchronizing to an External Trigger Signal using DCAM 1.31 Trigger Mode0

Applicable Products

- Flea®

- Scorpion® (all models except SCOR-03NS) with firmware version 0.9.1.8 or higher.

- Dragonfly® Express

- Dragonfly®2

- Flea®2

- Bumblebee®2

- Firefly® MV

Consult Knowledge Base Article 10312 to determine camera firmware versions. The most recent firmware versions can be downloaded from our downloads page.

Application Note Description

The purpose of this Technical Application Note is to provide you with a set of basic instructions on how to configure one of the Applicable Products to acquire images synchronized to an external electrical signal using the DCAM 1.31 parallel input/output (PIO) functionality. This process is often known as "externally triggering" a camera. For a full explanation of the DCAM v1.31-specific input modes, please consult the "General Purpose Input/Output" section of the FLIR Machine Vision Camera Register Reference.

Preparing for Use

Before you use your camera, we recommend that you are aware of the following resources available from our downloads page:

- ***Getting Started Manual* for the camera**—provides information on installing components and software needed to run the camera.

- ***Technical Reference* for the camera**—provides information on the camera's specifications, features and operations, as well as imaging and acquisition controls.

- **Firmware updates**—ensure you are using the most up-to-date firmware for the camera to take advantage of improvements and fixes.

- **Tech Insights**—Subscribe to our monthly email updates containing information on new knowledge base articles, new firmware and software releases, and Product Change Notices (PCN).

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General Considerations

General Purpose Input/Output Pins

The cameras are equipped with a set of general purpose input/output (GPIO) pins that can be accessed via the connector on the back of the camera. Different products may use different connectors; consult your camera's Technical Reference or Getting Started manual for part numbers and specifications, GPIO connector pin layouts, and GPIO electrical characteristics.

Testing Tools

For basic testing and configuration, we recommend using the FlyCap demo program (included with all versions of the FlyCapture® SDK) in conjunction with the [FLIR Machine Vision Camera Register Reference](#). FlyCap allows easy access to camera trigger functionality and camera registers, and the Register Reference is a source of general information pertaining to all FLIR machine vision FireWire cameras.

Example Programs and Source Code

The AsyncTriggerEx sample program is included with the FlyCapture SDK. It demonstrates some of the basic asynchronous trigger capabilities of the cameras. This program only works with cameras that can be asynchronously triggered, either using an external hardware trigger or by using the camera's internal software trigger.

Configuring the Camera

Determine the Default External Trigger Pin

One of the camera GPIO pins is configured as the default trigger. To determine which pin is the default input/trigger pin:

- Get the value of the TRIGGER_MODE register 0x830. The Trigger_Source field (bits 8-10) is the current trigger source e.g. if the value represented by the Trigger_Source field is 0, the default trigger source is GPIO0.

For example:

```
0x830 = 0x80100000
```

8	0	1	0	0	0	0	0	Hex
1000	00**00**	**000**1	0000	0000	0000	0000	0000	Binary
0-7		8-15		16-23		24-31		Bits

This indicates that a Trigger Mode is available (bit 0 = 1) but not currently enabled (bit 6 = 0). It also indicates that GPIO0 is the default trigger pin (bits 8-10 = 0), and the default polarity of the pin is active low (bit 7 = 0), which means the camera trigger on the falling edge of a pulse.

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Configure a Different GPIO Pin to be an External Trigger

If you wish to use a different GPIO pin as the external trigger instead of the default trigger, you need to configure the specific pin to be an input trigger, then configure the camera to use this newly allocated trigger pin.

> **Note:** Only one GPIO pin can be configured as a trigger source using this method. To have multiple pins acting as a trigger sources, use the GPIO_MODE_2 method via the GPIO_CTRL_PIN_x registers (see the Register Reference for more information).

For example, to configure the camera to use GPIO2 as the external trigger pin:

1. Get the value of the PIO_DIRECTION register 0x11F8 to determine the current states of each GPIO pin. For example:

```
0x11F8 = 0x20000000
```

2	0	0	0	0	0	0	0	Hex
0010	0000	0000	0000	0000	0000	0000	0000	Binary
0-7		8-15		16-23		24-31		Bits

Each of the first four bits represents the current state of its associated GPIO pin: '0' indicates it is a input/trigger, and '1' indicates it is an output/strobe. In the example above, 0x2 = 0010 in binary, so GPIO0, GPIO1 and GPIO 3 are all configured as inputs and GPIO2 is an output.

2. To set GPIO2 in the example above to be an input/trigger, and all other GPIO pins as outputs:

```
0x11F8 = 0xD0000000
```

D	0	0	0	0	0	0	0	Hex
1101	0000	0000	0000	0000	0000	0000	0000	Binary
0-7		8-15		16-23		24-31		Bits

3. Configure the camera to use GPIO2 as the external trigger source by setting bits 8-10 of the TRIGGER_ MODE register (i.e. for GPIO pin "2", we set bits 8-10 to 010, which is 2 in binary):

```
0x830 = 0x8040000000 (assumes bits 11-31 are zero)
```

8	0	4	0	0	0	0	0	Hex
1000	0000	0100	0000	0000	0000	0000	0000	Binary
0-7		8-15		16-23		24-31		Bits

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Enable Trigger Mode

The camera must be put into Trigger Mode_0 to allow it to be externally triggered.

To do this in the FlyCap graphical user interface:

1. Open the Camera Control Dialog (F11).

2. Select the "Trigger" tab (or "Extended" tab in older versions).

3. Check the "Trigger Mode On/Off" checkbox.

To do this by directly accessing the camera's TRIGGER_MODE register:

1. Get register 0x830.

2. Turn trigger Mode_0 ON by setting bit 6 to one (1) and setting bits 12-15 to zero (0).

Ensure Trigger is Armed

It is possible for the camera to be in asynchronous trigger mode but not be ready to accept a trigger. The reason for this is that the camera may be currently exposing an image; the camera is only ready to be triggered again when this image finishes integrating and is completely read off of the sensor.

To ensure that the camera is ready to be triggered, poll the SOFTWARE_TRIGGER register 0x62C or SOFT_ASYNC_TRIGGER register 0x102C. The concept of polling to ensure the trigger is armed is demonstrated in the AsyncTriggerEx example program distributed with the FlyCapture SDK.

Once the the trigger is reporting that it is armed, there should be no delay between when the user can enable isochronous transmission and when they can trigger the camera. In fact, it is possible to trigger the camera before iso is enabled and receive the image that was triggered, provided iso is enabled at some point during exposure. For example, assuming a 10 ms shutter time, it is possible to trigger the camera, enable iso 5 ms after, and still receive the triggered image.

Externally Trigger the Camera

At this point, one of the camera's GPIO pins should be configured as the external trigger source, the camera should be in Trigger Mode_0, and the trigger is armed and ready to be fired. To acquire an image, connect the external 5 V or 3.3 V TTL synchronization signal to the GPIO pin. Once the trigger signal is received, an image is grabbed. For specific external trigger timing information, consult your camera's Technical Reference or Getting Started Manual.

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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

FlyCapture SDK—The FlyCapture SDK provides API examples and the FlyCap camera evaluation application. Available from our Downloads page.

API Documentation—The installation of the FlyCapture SDK comes with API references for C++, C#, and C code. Available from Start Menu→All Programs→Point Grey FlyCapture2 SDK→Documentation

Product Documentation—The camera's *Getting Started Manual* provides information on installing components and software needed to run the camera. The *Technical Reference* provides information on the camera's specifications, features and operations, as well as imaging and acquisition controls. They are available from the 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.

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