

Technical Note

Tips for configuring GPIO

Background and purpose of this document

JAI cameras support a GPIO (General Purpose Input/Output) function. It is a useful function to generate/format/figure out the signals which will be used for camera triggers. The signals can be used internally and can be output through a TTL/OPT out pin in order to be used for another camera's trigger.

While the idea is straightforward, configuring the GPIO can be a bit difficult to understand. Therefore, this document will explain the concept of GPIO and will provide some examples.

Concept

The GPIO function includes the following items:

1) Input

- i. Software trigger
- ii. Input through TTL/Opto In/Camera Link/LVDS In
- iii. Output from a variety of signals/functions in the camera, such as LVAL, FVAL, Frame Active, etc.
- iv. Output from logic gates (see item 2 below)
- v. Output from pulse generators (see item 3 below)
- vi. Output from an output signal (see item 4 below)

2) Logic gates

- i. Inverters
- ii. NAND gates

3) Pulse Generators (explained in a separate white paper)

4) Output signals

- i. Camera internal trigger
- ii. Output through TTL/Opto Out

By combining the items from 1-4 above, a user can construct his own logic gates within the camera. The actual wire connection is established by selecting sources from 2-4 above.

A block diagram of GPIO

The block diagram on the following page is taken from the GO-5000-USB and will be used to explain concept of GPIO. Details may vary from camera to camera. Users should refer to each camera's manual for the applicable diagram.



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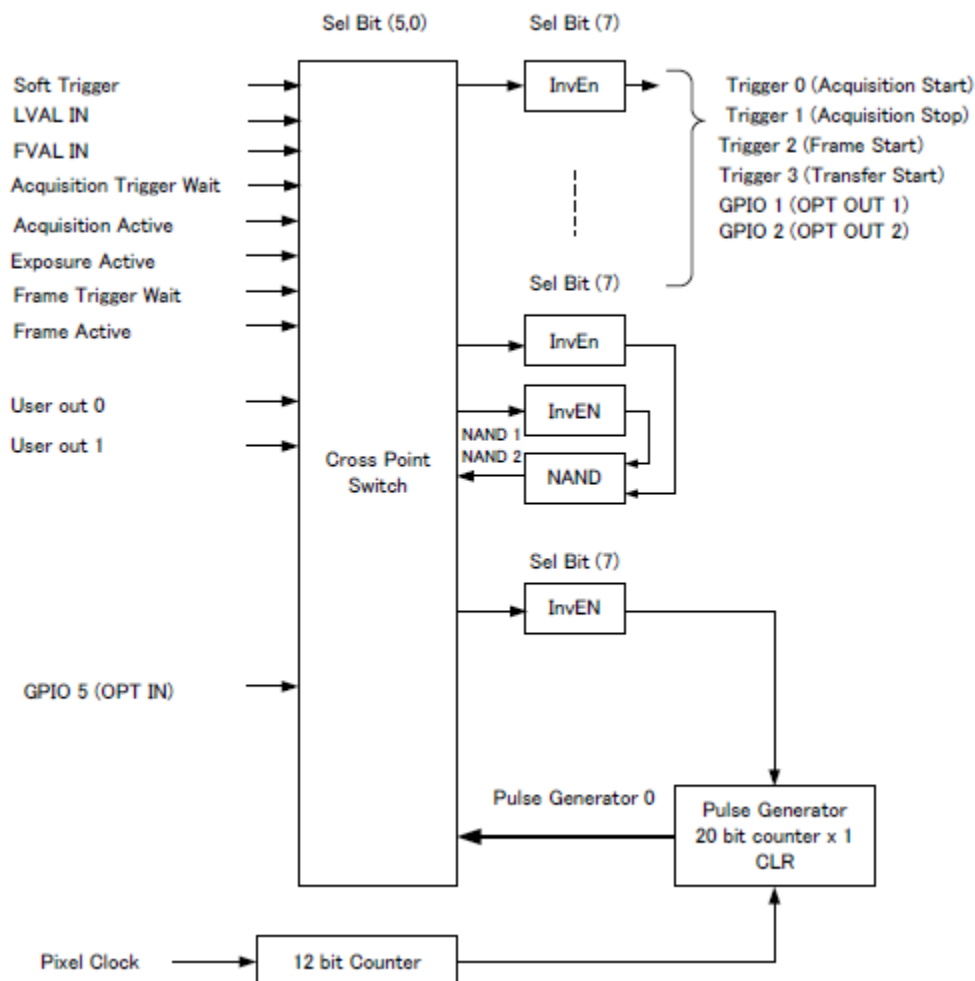


Figure 1 - GPIO Block Diagram (GO-5000-USB)

Examples:

Example 1 - Output FVAL to monitor it

This is one of the simplest examples to explain GPIO. To monitor the FVAL signal from outside of camera, set FVAL out to “Line 2 - Opt Out 1.”

Here is how the example looks using the GPIO from the GO-5000C-USB.

Refer to Figure 2 on the following page.

1. Select “Line2 - Opt Out1” in “Line Selector.” By this selection, settings for lines shown under the “Line Selector” field are applied for “Line2 - Opt Out1”.
2. Select “FVAL” in “Line Source.”



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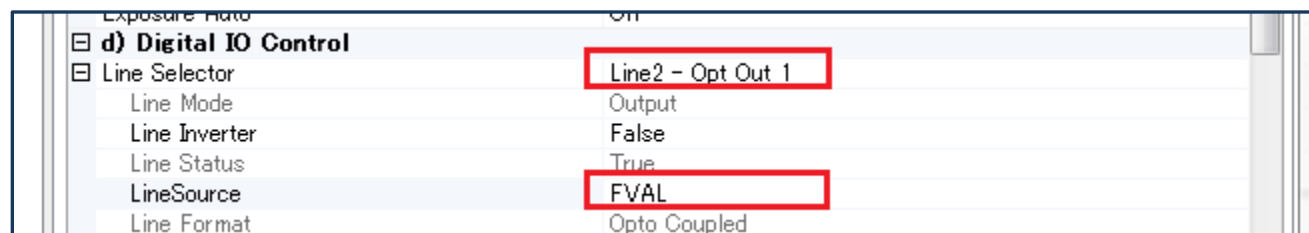


Figure 2 - Line Selector

Note: be careful about the order of setting these parameters. There are several selectors in the camera and each selector has its own “Line Source” and “Line Inverter.” All selectors work at the same time. If you set Line Source before setting Line Selector, you may change the parameters for a selector other than the intended one.

By making the selections above, the logic gates are established as shown in Figure 3.

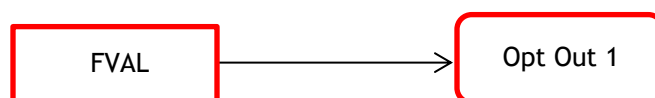


Figure 3 - GPIO Logic for FVAL Output

With this configured, the user can now track the FVAL signal simply by monitoring Pin 4 (Line 2, Opt out 1) on the Hirose 6-pin connector on the back of the camera.

Example 2 - Self-trigger by using Pulse Generator 0

In this example, images can be captured by setting up pulse generator timing and using the pulses as Frame Start trigger signals.

The details of the pulse generator function are explained in another white paper. Here is an example of the signal coming from pulse generator 0: two pulses at 50 ms and 100 ms intervals (see Figure 4).

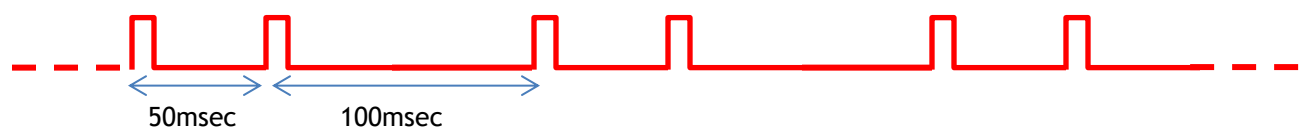


Figure 4 - Pulse Generator signal

We can now configure the trigger settings in the GO-5000-USB in order to utilize this GPIO signal as a Frame Start trigger.



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1. Select “Trigger Selector” and set it to “Frame Start.” By making this selection, other trigger settings shown under the “Trigger Selector” field are applied for “Frame Start” triggering.
2. Set “Trigger Mode” to “On.”
3. Select “Pulse Generator 0” as “Trigger Source.”

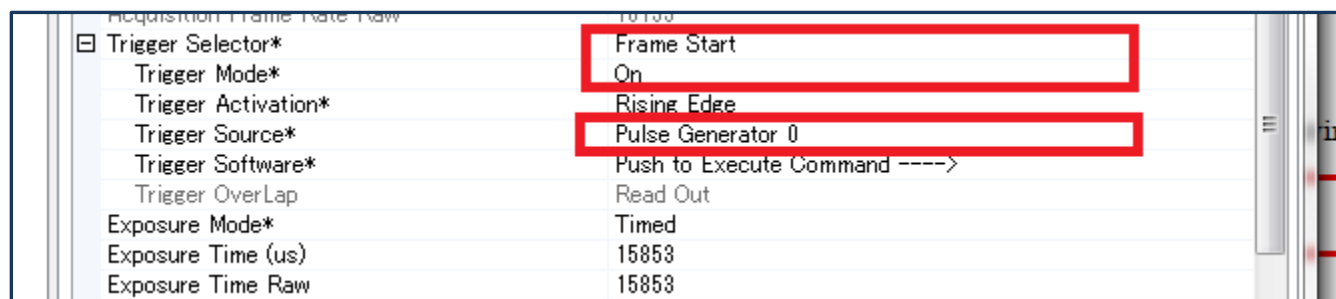


Figure 5 - Trigger Settings

Based on the settings above, the following logic gates are established:



Figure 6 - Self-trigger logic

When image acquisition is started, the image capture sequence will be as follows;

Image 1, 50 ms interval, image 2, 100 ms interval, image 3, 50 ms interval, image 4, 100 ms interval, and so on.

Example 3 - Re-configuration of trigger signal

Here is a more complicated example.

In cases where a trigger signal coming into the camera is noisy or dull, the camera may not be able to recognize the trigger correctly. Sometimes the camera may receive too many triggers in a short period. In this case, the camera may decide that the signals are noise and ignore them.

To improve this, here is an example to mask the input signal for a certain period of time after recognizing the first trigger.

By configuring these GPIO settings, the camera can recognize the trigger signal correctly.



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This example uses the feature set from the BB-500GE.

1. Settings for GPIO:

To configure the settings for this, we will use a script file shown in the Appendix of this white paper. You can cut and paste this script into a plain text document and save it as a .txt or .xml file. The script file can then be uploaded and executed on the camera using the script tab in the JAI SDK Control Tool as shown in Figure 7.

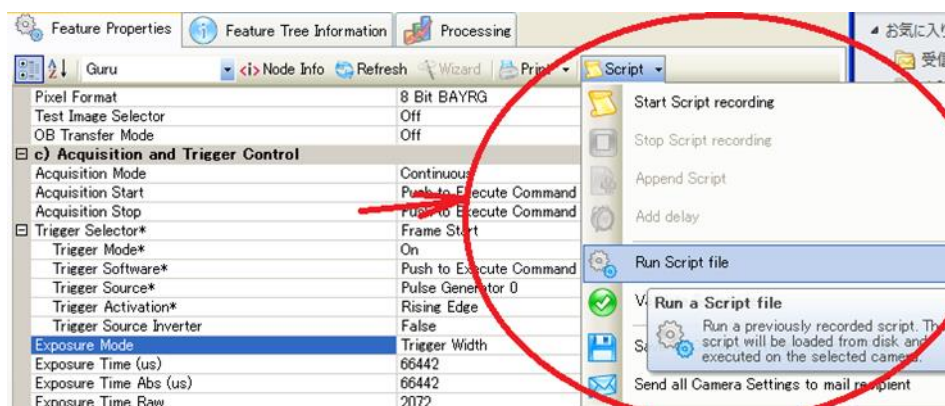


Figure 7 - running a script file in the JAI Control Tool

By uploading the script, the logic shown on the following page is established (Figure 8).

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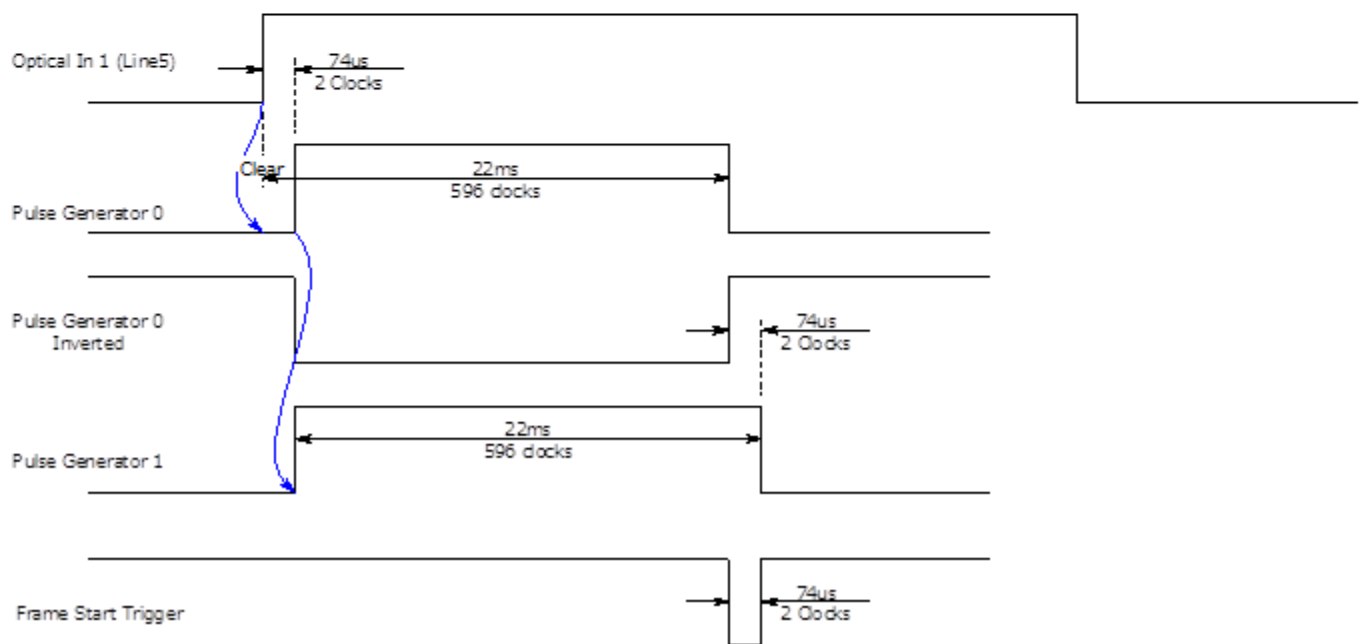
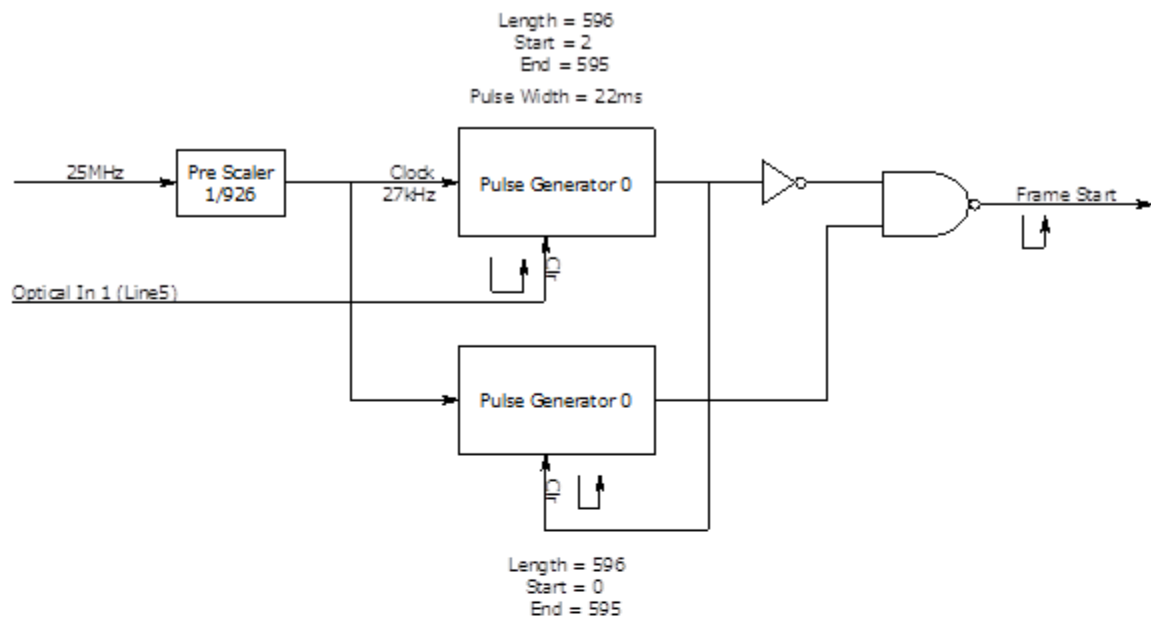


Figure 8 - Trigger logic created by script file

In this example, the signal coming to Opt In 1 is noisy and dull. Once the BB-500GE camera recognizes the signal, the GPIO configuration causes it to ignore Opt In 1 for 22 ms. After this period, a trigger pulse for



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Frame Start is generated by two of the camera's pulse generators. Thus, Frame Start is correctly triggered by the pulse initially received on the Opt In 1 line.

Although Example 3 is a complicated one, this GPIO approach can be modified and applied to many other cases, such as noise reduction of input signals, timing synchronization/shift among multiple cameras, and so on.

-----End-----

Appendix - Script file for Example 3, re-configuration of trigger signal

Cut all the text below and on the following two pages and paste it into a text editor for saving in plain text format with a .txt or .xml extension. See Example 3 for how to load the script into the camera using the JAI Control Tool.

```
<?xml version="1.0" encoding="utf-8"?>
<Script xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance"
xmlns:xsd="http://www.w3.org/2001/XMLSchema">
  <CommandList>
    <Command>
      <FeatureName>TriggerSelector</FeatureName>
      <FeatureValue>FrameStart</FeatureValue>
    </Command>
    <Command>
      <FeatureName>TriggerMode</FeatureName>
      <FeatureValue>On</FeatureValue>
    </Command>
    <Command>
      <FeatureName>TriggerSource</FeatureName>
      <FeatureValue>NAND 1 Output</FeatureValue>
    </Command>
    <Command>
      <FeatureName>TriggerActivation</FeatureName>
      <FeatureValue>Rising Edge</FeatureValue>
    </Command>
    <Command>
      <FeatureName>TriggerSourceInverter</FeatureName>
      <FeatureValue>False</FeatureValue>
    </Command>
    <Command>
      <FeatureName>LineSelector</FeatureName>
      <FeatureValue>NAND_1_In_1</FeatureValue>
    </Command>
    <Command>
      <FeatureName>LineSource</FeatureName>
      <FeatureValue>Pulse Generator 0</FeatureValue>
    </Command>
    <Command>
```



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```

    <FeatureName>LineInverter</FeatureName>
    <FeatureValue>True</FeatureValue>
</Command>
<Command>
    <FeatureName>LineSelector</FeatureName>
    <FeatureValue>NAND_1_In_2</FeatureValue>
</Command>
<Command>
    <FeatureName>LineSource</FeatureName>
    <FeatureValue>Pulse Generator 1</FeatureValue>
</Command>
<Command>
    <FeatureName>LineInverter</FeatureName>
    <FeatureValue>True</FeatureValue>
</Command>
<Command>
    <FeatureName>LineInverter</FeatureName>
    <FeatureValue>False</FeatureValue>
</Command>
<Command>
    <FeatureName>ClockSource</FeatureName>
    <FeatureValue>25 MHz</FeatureValue>
</Command>
<Command>
    <FeatureName>ClockPreScaler</FeatureName>
    <FeatureValue>926</FeatureValue>
</Command>
<Command>
    <FeatureName>PulseGeneratorSelector</FeatureName>
    <FeatureValue>PulseGenerator0</FeatureValue>
</Command>
<Command>
    <FeatureName>PulseGeneratorLength</FeatureName>
    <FeatureValue>596</FeatureValue>
</Command>
<Command>
    <FeatureName>PulseGeneratorStartPoint</FeatureName>
    <FeatureValue>2</FeatureValue>
</Command>
<Command>
    <FeatureName>PulseGeneratorEndPoint</FeatureName>
    <FeatureValue>595</FeatureValue>
</Command>
<Command>
    <FeatureName>PulseGeneratorRepeatCount</FeatureName>
    <FeatureValue>1</FeatureValue>
</Command>
<Command>
    <FeatureName>PulseGeneratorClearActivation</FeatureName>
    <FeatureValue>Rising Edge</FeatureValue>
</Command>

```



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```

<Command>
  <FeatureName>PulseGeneratorClearSource</FeatureName>
  <FeatureValue>Line5 - Optical In 1</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorClearInverter</FeatureName>
  <FeatureValue>False</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorSelector</FeatureName>
  <FeatureValue>PulseGenerator1</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorLength</FeatureName>
  <FeatureValue>596</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorStartPoint</FeatureName>
  <FeatureValue>0</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorEndPoint</FeatureName>
  <FeatureValue>595</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorRepeatCount</FeatureName>
  <FeatureValue>1</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorClearActivation</FeatureName>
  <FeatureValue>Rising Edge</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorClearSource</FeatureName>
  <FeatureValue>Pulse Generator 0</FeatureValue>
</Command>
<Command>
  <FeatureName>PulseGeneratorClearInverter</FeatureName>
  <FeatureValue>False</FeatureValue>
</Command>
</CommandList>
</Script>

```

