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</table>
Delivery Contents

If you ordered the trigger extension board **Opto Trigger 5**, the following items are contained in your delivery package:

- Trigger extension board **Opto Trigger 5** (article no. 155010)
- 34-pin flat cable for connecting to the frame grabber board

**Additional Equipment**

- Additional equipment (such as a custom-tailored 34-pin flat cable for a multi-board installation) you can order directly from Silicon Software.

Delivery content: Opto Trigger 5 and off-the-shelf 34-pin flat cable
1 Introduction

**OPTO Trigger 5** is a trigger extension board that can be used together with all frame grabbers of the microEnable IV, microEnable 5 marathon and microEnable 5 ironman series.¹

**OPTO Trigger 5** offers 16 opto-coupled (galvanically isolated) trigger signals for controlling cameras and peripheral devices. Its signals can be adapted to the industrial signal level (typically 5 V - 24 V).

**OPTO Trigger 5** also allows to synchronize multiple frame grabbers.

**OPTO Trigger 5** is configurable and can replace any of the 6 flavors of its predecessor *Silicon Software OPTO trigger board IV*.

It is connected to the frame grabber via a 34-pin flat cable:

---

¹The only Silicon Software standard frame grabbers that cannot be connected to Opto Trigger 5 are the stand-alone devices of the LightBridge series.
Ports and LEDs on the trigger extension board *Opto Trigger 5*:
The GPIs and GPOs are mapped to two ports, port A and port B:

![Port A and Port B diagram]

**Opto Trigger 5** offers 8 inputs and 8 outputs on its two female SUB-D 15 sockets:

- **Port A:**
  - 4 inputs
  - 4 outputs

- **Port B:**
  - 4 inputs
  - 4 outputs

You can configure various parameters that allow you to use Opto Trigger 5 in different operation modes:

- You can configure the IN pins of port A to receive single-ended or differential incoming signals.
- You can configure the IN pins of port B to receive single-ended or differential incoming signals.
- You can configure if you want to use the IN pins of both ports in pull-up or pull-down mode.
- You can configure if the outgoing signals are inverted or not.

For details on configuring Opto Trigger 5, refer to section *Configuration Options*.

For information which signals are received by the microEnable frame grabber board via the flat cable, see section *Flat Cable Pinout*.
Example: Frame grabber with attached Opto Trigger 5 within a sample production line

Trigger System Documentation
For more information on how you can use your Opto Trigger 5 for various tasks within a trigger system, refer to the Trigger System documentation.

Applet-Specific Trigger Settings
How the individual inputs and outputs of the trigger extension board are employed you can configure via the applet you are using. Please refer to the documentation of your specific applet.
2 Installing a Trigger Extension Board

Set DIP switches before installing Opto Trigger 5

Before installation, check if the DIP switches on the microEnable frame grabber board are easily available after installation. If not, we recommend you first set the DIP switches before installing Opto Trigger 5 into the host PC.

For information on how you use the DIP switches for configuration, see section Configuration Options.

Caution

Make sure you use an adequate ventilation system within your computer. This is of special importance if

- there is little space between boards in a multi board installation,
- an installation is close to a graphics card.

We also recommend leaving enough free space between boards.

You need the following components:

- One microEnable frame grabber board
- One trigger extension board
- One 34-pin flat cable you received from Silicon Software
To install your trigger extension board:

1. Shut down the host PC.
2. Unplug the host PC from the power outlet.
3. Plug the trigger board into an empty slot on the slot bracket of the host PC.

microEnable frame grabber board and empty slots in host PC
4. Fasten the trigger board to the PC chassis by screws.

5. Connect the trigger board with the GPIO socket of your microEnable frame grabber board, using the 34-pin flat cable.
6. Reboot your host PC.

Now, the trigger board is ready for use.

**Using Multiple Boards**

For information how you can use multiple microEnable frame grabber boards with one trigger board or vice versa, see section *Using Multiple Boards*.
All GPIs and GPOs available on OptoTrigger 5 are mapped to the two SUB D15 sockets (Port A and Port B). They have the following indices:

- **4 IN port A (indices 0-3)**
- **4 OUT port A (indices 0-3)**
- **4 IN port B (indices 4-7)**
- **4 OUT port B (indices 4-7)**

### Pin Layout

#### Port A

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Signal Name</th>
<th>Signal Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Trigger Output 0 Port A</td>
<td>Trigger Output 4 Port B</td>
</tr>
<tr>
<td>2</td>
<td>Trigger Output 1 Port A</td>
<td>Trigger Output 5 Port B</td>
</tr>
<tr>
<td>3</td>
<td>Trigger Output 2 Port A</td>
<td>Trigger Output 6 Port B</td>
</tr>
<tr>
<td>4</td>
<td>Trigger Output 3 Port A</td>
<td>Trigger Output 7 Port B</td>
</tr>
<tr>
<td>5</td>
<td>V_IN (VCC Input Port A)</td>
<td>V_IN (VCC Input Port B)</td>
</tr>
<tr>
<td>6</td>
<td>GND Port A</td>
<td>GND Port B</td>
</tr>
<tr>
<td>7</td>
<td>nc</td>
<td>nc</td>
</tr>
<tr>
<td>8</td>
<td>nc</td>
<td>nc</td>
</tr>
<tr>
<td>9</td>
<td>nc</td>
<td>nc</td>
</tr>
<tr>
<td>10</td>
<td>V_IN (VCC Input Port A)</td>
<td>V_IN (VCC Input Port B)</td>
</tr>
<tr>
<td>11</td>
<td>Trigger Input 0 Port A (+ if used for diff. signal)</td>
<td>Trigger Input 4 Port B (+ if used for diff. signal)</td>
</tr>
<tr>
<td>12</td>
<td>Trigger Input 1 Port A (- if used for diff. signal)</td>
<td>Trigger Input 5 Port B (- if used for diff. signal)</td>
</tr>
<tr>
<td>13</td>
<td>Trigger Input 2 Port A (+ if used for diff. signal)</td>
<td>Trigger Input 6 Port B (+ if used for diff. signal)</td>
</tr>
<tr>
<td>14</td>
<td>Trigger Input 3 Port A (- if used for diff. signal)</td>
<td>Trigger Input 7 Port B (- if used for diff. signal)</td>
</tr>
<tr>
<td>15</td>
<td>GND Port A</td>
<td>GND Port B</td>
</tr>
</tbody>
</table>
Powering Opto Trigger 5

The power must be delivered by an external power source.

IN Signals on Opto Trigger 5

The input signals are not directly passed to the opto couplers but send to differential comparators. The advantage is that the input accepts low current, voltage driven signals between 5 and 25V. (Input signals can have pull up or a pull down resistor of 10k Ohm).

The polarity of the input signals is NOT inverted.

OUT Signals on Opto Trigger 5

On Opto Trigger 5, the opto-couplers do not directly connect to the output, but are buffered by MOSFET transistors. These transistors build an easy-to-use open collector driver with a 20 mA static current diode as pull-up.
Special Case: Pin Layout when using microEnable IV Camera Link Frame Grabbers with Standard Acquisition Applets

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Signal Name</th>
<th>Signal Name</th>
</tr>
</thead>
</table>
| 1     | Trigger Output 0 Port A  
Flash Signal                                | Trigger Output 4 Port B  
Flash Signal                                |
| 2     | Trigger Output 1 Port A  
For Area Cameras: Image Trigger (Ex Sync)  
For Line Cameras: Line Trigger (ExSync2) | Trigger Output 5 Port B  
For Area Cameras: Image Trigger (Ex Sync)  
For Line Cameras: Line Trigger (ExSync2) |
| 3     | Trigger Output 2 Port A  
For Area Cameras: HD Sync  
For Line Cameras: Line Trigger Line(Ex Sync) | Trigger Output 6 Port B  
For Area Cameras: HD Sync  
For Line Cameras: Line Trigger Line(Ex Sync) |
| 4     | Trigger Output 3 Port A  
User Output (DigitalOut Bit#0) | Trigger Output 7 Port B  
User Output (DigitalOut Bit#1) |
| 5     | V_IN (VCC Input Port A)  | V_IN (VCC Input Port B) |
| 6     | GND Port A  | GND Port B |
| 7     | nc  | nc |
| 8     | nc  | nc |
| 9     | nc  | nc |
| 10    | V_IN (VCC Input Port A)  | V_IN (VCC Input Port B) |
| 11    | Trigger Input 0 Port A (+ if used for diff. signal)  | Trigger Input 4 Port B (+ if used for diff. signal) |
| 12    | Trigger Input 1 Port A (- if used for diff. signal)  | Trigger Input 5 Port B (- if used for diff. signal) |
| 13    | Trigger Input 2 Port A (+ if used for diff. signal)  | Trigger Input 6 Port B (+ if used for diff. signal) |
| 14    | Trigger Input 3 Port A (- if used for diff. signal)  | Trigger Input 7 Port B (- if used for diff. signal) |
| 15    | GND Port A  | GND Port B |

Inputs: ● ● ● ●, Outputs: ● ● ● ●
All GPIs and GPOs available on **OptoTrigger 5** are mapped to the two SUB D15 sockets (Port A and Port B). They have the following indices:

- 4 IN port A (indices 0-3)
- 4 OUT port A (indices 0-3)
- 4 IN port B (indices 4-7)
- 4 OUT port B (indices 4-7)

---

**Powering Opto Trigger 5**

The power must be delivered by an external power source.

---

**IN Signals on Opto Trigger 5**

The input signals are not directly passed to the opto couplers but send to differential comparators. The advantage is that the input accepts low current, voltage driven signals between 5 an 25V. (Input signals can have pull up or a pull down resistor of 10k Ohm).

The polarity of the input signals is NOT inverted.

---

**OUT Signals on Opto Trigger 5**

On Opto trigger 5, the opto-couplers do not directly connect to the output, but are buffered by MOSFET transistors. These transistors build an easy-to-use open collector driver with a 20 mA static current diode as pull-up.
## Special Case: Pin Layout when using microEnable IV GigE Vision Frame Grabbers with Standard Acquisition Applets

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Signal Name</th>
<th>Connected Camera Ports (Processes)</th>
<th>Signal Name</th>
<th>Connected Camera Ports (Processes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Trigger Output 0 Port A</td>
<td>Cam Port A (Process 0)</td>
<td>Trigger Output 4 Port B</td>
<td>Cam Port C (Process 2)</td>
</tr>
<tr>
<td>2</td>
<td>Trigger Output 1 Port A</td>
<td>Cam Port A (Process 0)</td>
<td>Trigger Output 5 Port B</td>
<td>Cam Port C (Process 2)</td>
</tr>
<tr>
<td>3</td>
<td>Trigger Output 2 Port A</td>
<td>Cam Port B (Process 1)</td>
<td>Trigger Output 6 Port B</td>
<td>Cam Port D (Process 3)</td>
</tr>
<tr>
<td>4</td>
<td>Trigger Output 3 Port A</td>
<td>Cam Port B (Process 1)</td>
<td>Trigger Output 7 Port B</td>
<td>Cam Port D (Process 3)</td>
</tr>
<tr>
<td>5</td>
<td>V_IN (VCC Input Port A)</td>
<td>V_IN (VCC Input Port B)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>GND Port A</td>
<td>GND Port B</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>nc</td>
<td>nc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8</td>
<td>nc</td>
<td>nc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9</td>
<td>nc</td>
<td>nc</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td>V_IN (VCC Input Port A)</td>
<td>V_IN (VCC Input Port B)</td>
<td>_IN (VCC Input Port B)</td>
<td></td>
</tr>
<tr>
<td>11</td>
<td>Trigger Input 0 Port A (+ if used for diff. signal)</td>
<td>Cam Port A (Process 0)</td>
<td>Trigger Input 4 Port B (+ if used for diff. signal)</td>
<td>Cam Port C (Process 2)</td>
</tr>
<tr>
<td>12</td>
<td>Trigger Input 1 Port A (- if used for diff. signal)</td>
<td>Cam Port A (Process 0)</td>
<td>Trigger Input 5 Port B (- if used for diff. signal)</td>
<td>Cam Port C (Process 2)</td>
</tr>
<tr>
<td>13</td>
<td>Trigger Input 2 Port A (+ if used for diff. signal)</td>
<td>Cam Port B (Process 1)</td>
<td>Trigger Input 6 Port B (+ if used for diff. signal)</td>
<td>Cam Port D (Process 3)</td>
</tr>
<tr>
<td>14</td>
<td>Trigger Input 3 Port A (- if used for diff. signal)</td>
<td>Cam Port B (Process 1)</td>
<td>Trigger Input 7 Port B (- if used for diff. signal)</td>
<td>Cam Port D (Process 3)</td>
</tr>
<tr>
<td>15</td>
<td>GND Port A</td>
<td>Process 0</td>
<td>GND Port B</td>
<td></td>
</tr>
</tbody>
</table>

**Inputs:** 🟢 , **Outputs:** 🟠
All GPIs and GPOs available on **OptoTrigger 5** are mapped to the two SUB D15 sockets (Port A and Port B). They have the following indices:

- **4 IN port A** (indices 0-3)
- **4 OUT port A** (indices 0-3)
- **4 IN port B** (indices 4-7)
- **4 OUT port B** (indices 4-7)

**Powering Opto Trigger 5**

The power must be delivered by an external power source.

**IN Signals on Opto Trigger 5**

The input signals are not directly passed to the opto couplers but send to differential comparators. The advantage is that the input accepts low current, voltage driven signals between 5 and 25V. (Input signals can have pull up or a pull down resistor of 10k Ohm).

The polarity of the input signals is NOT inverted.

**OUT Signals on Opto Trigger 5**

On Opto Trigger 5, the opto-couplers do not directly connect to the output, but are buffered by MOSFET transistors. These transistors build an easy-to-use open collector driver with a 20 mA static current diode as pull-up.
4 Configuring the Physical Interface

Configuration Options

You can configure various parameters that allow you to use Opto Trigger 5 in different operation modes:

- You can configure the IN pins of port A to receive single-ended or differential incoming signals.
- You can configure the IN pins of port B to receive single-ended or differential incoming signals.
- You can configure if you want to use the IN pins of both ports in pull-up or pull-down mode.
- You can configure if the outgoing signals are inverted or not.

You set the individual parameters via the DIP switches located directly on the trigger board.

---

**Configuration via Software**

When connected to microEnable 5 marathon Frame Grabbers, the configuration can be programmed by software, using the command line tool gpiotool.exe (see section **Configuration via Software**). Programming by software overrides the DIP switch setting.

The LEDs on the board inform you which settings are active.
Configuration via Software

When connected to microEnable 5 marathon Frame Grabbers, the configuration can be read by using the tool gpiotool.exe (see section Configuration via Software). Programming by software overrides the DIP switch setting.
Default Settings

On delivery, the default settings are active. All DIP switches on Opto Trigger 5 are OFF. All LEDs are OFF.

The default settings for the OPTO trigger board are the following ones:

- Port A receives 4 single-ended incoming signals.
- Port B receives 4 single-ended incoming signals.
- The trigger board is in pull-up mode.
- The outgoing signals are not inverted.

In default setting, the four LEDs are set to OFF:
Single-Ended / Differential Signals

You can configure the IN pins of Opto Trigger 5 in one of the four following ways:

- all IN pins of port A and B receive single ended inputs (= 8 single-ended IN signals):

This is the default setting. The DIP switches for Port A (switch 1) and B (switch 2) are in OFF position. The LEDs for port A (A DS) and port B (B DS) are OFF:
all IN pins of port A and B receive differential inputs (= 4 differential IN signals, i.e., 4 pairs):

The DIP switches for port A (switch 1) and B (switch 2) are in ON position. The LEDs for port A (A DS) and B (B DS) are ON:

Port A receives 2 differential incoming signals.
Port B receives 2 differential incoming signals.
- all IN pins of port A receive single-ended inputs, all IN pins of port B receive differential inputs (= four single-ended IN signals on A + two differential signals on B):

![Diagram of Port A and Port B connections]

The DIP switch for port A (switch 1) is in OFF position. The LED for port A (A DS) is OFF. The DIP switch for port B (switch 2) is in ON position. The LED for port B (B DS) is ON:

- Port A receives 4 single-ended incoming signals.
- Port B receives 2 differential incoming signals.
all IN pins of port A receive differential inputs, all IN pins of port B receive single-ended inputs (= two differential signals on A + four single-ended IN signals on B):

The DIP switch for port A (switch 1) is in ON position. The LED for port A (A DS) is ON. The DIP switch for port B (switch 2) is in OFF position. The LED for port B (B DS) is OFF:

Port A receives 2 differential incoming signals.

Port B receives 4 single-ended incoming signals.
Pull-up / Pull Down

You can configure Opto Trigger 5 according to the electrical source of the incoming signal:

- Use pull-up (10 kΩ) to receive signals from NPN transistors (open collector, open drain).
- Use pull-down (10 kΩ) to receive signals from PNP transistors (open emitter, open source).

In most application scenarios, you will need to configure OPTO trigger 5 to pull-up.

Pull-up variant:

Pull-up is the default setting. The DIP switch for transistor mode (switch 3) is in OFF position. The LED P DN is OFF:

```
P DN 3 | Trigger board is in pull-up mode.
```

Pull-down variant:

The DIP switch for transistor mode (switch 3) is ON position. The LED P DN is ON:

```
P DN 3 | Trigger board is in pull-down mode.
```

Outgoing Signals Inverted / Not Inverted

You can configure the OUT pins of the trigger board to send the outgoing trigger signals in inverted mode.
Not inverted:

Not inverted is the default setting. The DIP switch for the inversion mode (switch 4) is in OFF position. The LED **O INV** is OFF:

![O INV OFF](image)

The outgoing signals are not inverted.

Inverted:

The DIP switch for the inversion mode (switch 4) is in ON position. The LED **O INV** is ON:

![O INV ON](image)

The outgoing signals are inverted.
Configuration via Software

If you use Opto Trigger 5 together with microEnable 5 marathon, you can - as an alternative to the DIP switches - use software to configure the physical interface of Opto Trigger 5. This is especially helpful if you want to test Opto Trigger 5 under laboratory conditions.

As soon as you configure Opto trigger 5 via software, the position of the DIP switches does not provide any information about the actual configuration.

However, the LEDs on Opto Trigger 5 always inform you which setting is active*. In addition, you can use the software to get information about the current settings.

Software Configuration Overrides DIP Switch Position

If you configure the physical interface of the trigger board via Software, the DIP switch position has no effect on the actual physical interface of the trigger board.

How to reset the trigger board to read the DIP position for configuration of its physical interface, see section Re-Enabling DIP Switch Configuration.

* Known issue: In some cases, LED O INV shines less brightly than the other LEDs when Opto Trigger 5 has been configured via software. This doesn't indicate any difference in function.
Configuration via Command Line

For configuring the physical interface of Opto Trigger 5 via command line, you work with the `gpioTool` which comes as part of the Silicon Software runtime environment.

---

**Software Configuration Overrides DIP Switch Position**

If you configure the physical interface of the trigger board via Software, the DIP switch position has no effect on the actual physical interface of the trigger board.

How to reset the trigger board to read the DIP position for configuration of its physical interface, see section Re-Enabling DIP Switch Configuration.

---

Configuring GPIO Banks on a Frame Grabber

To configure a GPIO unit via command line:

1. Open the command line window:

2. In the command line tool, go to the bin directory of your runtime installation:

   ```
   cd /D %SISODIR5%\bin
   ```

3. Now, enter your commands and values as described in the following.
You have the following commands and parameters available:

```
gpioTool -b <board_index>
-g
-s <bank>:<settings>
-h
-v
```

**Commands**

With command `gpioTool -b` you specify which frame grabber board in your system you want to address. Specifying the addressed board is mandatory.

Via command `gpioTool -b <board_index> -g` you get the current GPIO bank settings of the specified frame grabber board displayed directly in the command line window.

Via command `gpioTool -b <board_index> -s <bank>:<settings>` you configure a specific GPIO bank on the specified frame grabber board.

Via command `gpioTool -h` you get help instructions displayed directly in the command line window.

Via command `gpioTool -b <board_index> -v` you get verbose output displayed directly in the command line window.

**Value ranges:**

 `<board_index>`: Index of the frame grabber board you want to configure. The value range depends on the number of frame grabbers you have installed in your system. When you are configuring a trigger extension board, you need to specify the frame grabber the trigger extension board is connected to.
<bank>: The bank defines which GPIO bank on the frame grabber board/trigger extension board you want to address. You have the following values available:

<table>
<thead>
<tr>
<th>Value</th>
<th>Addressed GPIO Bank</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Front GPIO</td>
</tr>
<tr>
<td>1</td>
<td>GPIO on LightBridge / Port A on external trigger extension board</td>
</tr>
<tr>
<td>2</td>
<td>Port B on external trigger extension board</td>
</tr>
<tr>
<td>all</td>
<td>Addresses all GPIO banks of the selected frame grabber. When working with LightBridge, all addresses the Front GPIO and the GPIO. With marathon, all addresses the front GPIO and both ports of the trigger extension board.</td>
</tr>
</tbody>
</table>

<settings>: You set here the values for three parameters, separated by comma. <settings> is in the form <signal>,<pull-up-down>,<inversion>

- <signal> is either "ds" or "se" (GPIOs receive differential or single-ended signals)
- <pull-up-down> is either "pu" or "pd" (pupull-up or pull-down)
- <inversion> is either "in" or "ni" (inverted or not-inverted)

Alternatively, "default" can be used for <settings> to set the default values for the bank, or "clear|dip-switch" can be used to control the settings on the GPIO extension board via the dip-switch (bank settings via software will be erased).
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Effect of specific value</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;signal&gt;</td>
<td>se</td>
<td>You set all addressed GPs to receive single-ended signals.</td>
</tr>
<tr>
<td>&lt;signal&gt;</td>
<td>ds</td>
<td>You set all addressed GPs to receive differential signals.</td>
</tr>
<tr>
<td>&lt;pull-up-down&gt;</td>
<td>pu</td>
<td>You set to pull-up mode.</td>
</tr>
<tr>
<td>&lt;pull-up-down&gt;</td>
<td>pd</td>
<td>You set to pull-down mode.</td>
</tr>
<tr>
<td>&lt;inversion&gt;</td>
<td>ni</td>
<td>GPOs are not inverted.</td>
</tr>
<tr>
<td>&lt;inversion&gt;</td>
<td>in</td>
<td>GPOs are inverted.</td>
</tr>
</tbody>
</table>

**Example:**

```
C:\Users\nameofuser> cd /D %SISODIR5\bin
C:\SiliconSoftware\Runtime5.4.1\bin> gpioTool -b 0 -s 0:ds,pu,ni
```

**Explanation:**

a. In the first line of the example, you go into the bin directory of your Silicon Software runtime installation.

In the second line:

b. You call the GPIO configuration tool via `gpioTool`.

c. You specify which frame grabber board in your system you want to configure. When you are configuring a trigger extension board, specify the frame grabber the trigger extension board is connected to. You first enter `-b` to say that the next input will be the board index of the frame grabber board. Then you enter the index number of the frame grabber you want to configure `{0, 1, 2 ...}`. If
you have only one frame grabber board in your system, the board index is 0. In our example, you want to configure GPIOs on frame grabber 0. Specifying the frame grabber index is mandatory.

d. With `-s` you announce that you are now starting the actual configuration.

e. With the value that follows `{0,1,2,all}` you specify which GPIO bank on the selected frame grabber/trigger extension board you are going to configure. In the example, you selected the Front GPIO (0).

f. With double dot `:` you separate the specification of the addressed GPIO bank and the actual configuration values.

g. After the double dot you specify the values for the three parameters. In the example, the Front GPIO is configured to receive two differential IN signals (ds), to work in pull-up mode (pu), and to send the outgoing signals not inverted (ni).

**Re-Enabling DIP Switch Configuration**

⚠️ **SW configuration no longer active**

If you re-set the GPIO banks on a frame grabber board to be configured per DIP switch position on the microEnable frame grabber board, the configuration you entered via Software will no longer be effective.

To re-enable the configuration via DIP switches:

1. Open the command line window:

   ![cmd](image)

2. In the command line tool, go to the bin directory of your runtime installation:

   ```
   cd /D %SISODIR5%\bin
   ```
Now, enter the following string:

```
installdir\bin>gpioTool -b <board_index> -s <bank>:dip-switch
```

### Re-Setting Default Values

To re-set a bank to the default values:

1. Open the command line window:

   ![command line window](image)

2. In the command line tool, go to the bin directory of your runtime installation:

   ```
cd /D %SISODIR5%\bin
```

Now, enter the following string:

```
installdir\bin>gpioTool -b <board_index> -s <bank>:default
```

### LED Behaviour

<table>
<thead>
<tr>
<th>LED Label</th>
<th>LED not active</th>
<th>LED active</th>
</tr>
</thead>
<tbody>
<tr>
<td>A DS</td>
<td>Port A receives 4 single-ended incoming signals.</td>
<td>Port A receives 2 differential incoming signals.</td>
</tr>
<tr>
<td>B DS</td>
<td>Port B receives 4 single-ended incoming signals.</td>
<td>Port B receives 2 differential incoming signals.</td>
</tr>
<tr>
<td>P DN</td>
<td>Trigger board is in pull-up mode.</td>
<td>Trigger board is in pull-down mode.</td>
</tr>
</tbody>
</table>
LED Label | LED not active | LED active
--- | --- | ---
O INV | The outgoing signals are not inverted. | The outgoing signals are inverted.

Examples:

a) **Default setting**: The four LEDs on the OPTO trigger board are not active:

| A DS | Port A receives 4 single-ended incoming signals. |
| B DS | Port B receives 4 single-ended incoming signals. |
| P DN | Trigger board is in pull-up mode. |
| O INV | The outgoing signals are not inverted. |

b) All LEDs on the OPTO trigger board are active:

| A DS | Port A receives 2 differential incoming signals. |
| B DS | Port B receives 2 differential incoming signals. |
| P DN | Trigger board is in pull-down mode. |
| O INV | The outgoing signals are inverted. |

Of course you can configure any combination of parameter settings, so that altogether you can use your OPTO trigger board with 16 different physical interfaces.
c) Another one out of the sixteen possible combinations (example):

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>DS</td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>DS</td>
<td></td>
</tr>
<tr>
<td>P</td>
<td>DN</td>
<td></td>
</tr>
<tr>
<td>O</td>
<td>INV</td>
<td></td>
</tr>
</tbody>
</table>

Port A receives 2 differential incoming signals.

Port B receives 4 single-ended incoming signals.

Trigger board is in pull-up mode.

The outgoing signals are inverted.

**LEDs Independent of Configuration Mode**

The LEDs always show the actual setting of the parameter, no matter if the parameter has been set via DIP switch or via software.
5 Electrical Characteristics

There are three different power/ground systems on Opto Trigger 5. One supplies the signals of the port A connector, another one the signals of the port B connector, and the third one the signals of the flat cable connector. There is no electrical connection between these three power/ground systems.

Each of the three power/ground systems may have a different supply voltage. The voltage range lies between 5 and 25.0 Volt. The signal voltage is defined by the supply voltage for both, input and outputs. See below for details on the electrical characteristics.

The following data apply to the physical input and output ports of both ports, port A and port B.

Inputs

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage</td>
<td>4.5 V</td>
<td></td>
<td>28 V</td>
<td>V</td>
</tr>
<tr>
<td>Input threshold</td>
<td></td>
<td>20% Supply Voltage</td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Differential Input</td>
<td></td>
<td>10 mV</td>
<td></td>
<td>mV</td>
</tr>
<tr>
<td>Offset Voltage</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Current</td>
<td></td>
<td></td>
<td>4</td>
<td>mA (per channel)</td>
</tr>
</tbody>
</table>
IN Signals on Opto Trigger 5

The input signals are not directly passed to the opto couplers but send to differential comparators. The advantage is that the input accepts low current, voltage driven signals between 5 and 25 V. (Input signals can have pull up or a pull down resistor of 10k Ohm).

The polarity of the input signals is NOT inverted.

Surge Protection

OPTO Trigger 5 has been designed with a varistor which opens at an input voltage of 30V to let the onboard surge protector get active to protect the board. At a total supply voltage of 36V, the electronic chips will become defective.

Outputs

<table>
<thead>
<tr>
<th></th>
<th>Min</th>
<th>Typical</th>
<th>Max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Supply Voltage (max. supply current per port)</td>
<td>4.5</td>
<td></td>
<td>28</td>
<td>V</td>
</tr>
<tr>
<td>Output Signal Voltage High</td>
<td>-0.3 V Supply Voltage</td>
<td></td>
<td></td>
<td>V</td>
</tr>
<tr>
<td>Output Signal Voltage Low</td>
<td></td>
<td></td>
<td>0.3</td>
<td>V</td>
</tr>
<tr>
<td>Output Current</td>
<td></td>
<td>20</td>
<td></td>
<td>mA (per channel)</td>
</tr>
</tbody>
</table>
The supply current required for each port of Opto Trigger 5 depends on the number of used inputs and outputs, the signal and the voltage level. Typical supply current required per port: < 200 mA/port

**OUT Signals on Opto Trigger 5**

On Opto Trigger 5, the opto-couplers do not directly connect to the output, but are buffered by MOSFET transistors. These transistors build an easy-to-use open collector driver with a 20 mA static current diode as pull-up. Note that the power must be delivered by the external power source.

**Surge Protection**

Opto trigger 5 has been designed with a varistor which opens at an input voltage of 30V to let the onboard surge protector get active to protect the board. At a total supply voltage of 36V, the electronic chips will become defective.
# 6 Timing Characteristics

## Inputs

<table>
<thead>
<tr>
<th></th>
<th>min</th>
<th>typical</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propagation delay</td>
<td>200</td>
<td>230</td>
<td>260</td>
<td>ns</td>
</tr>
<tr>
<td>min. Puls Width</td>
<td></td>
<td>200</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>max. Frequency (50% duty cycle)</td>
<td></td>
<td>2.5</td>
<td></td>
<td>MHz</td>
</tr>
</tbody>
</table>
Outputs

<table>
<thead>
<tr>
<th></th>
<th>min</th>
<th>typical</th>
<th>max</th>
<th>Unit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propagation delay</td>
<td>40</td>
<td>60</td>
<td>80</td>
<td>ns</td>
</tr>
<tr>
<td>min. Pulse Width</td>
<td></td>
<td>200</td>
<td></td>
<td>ns</td>
</tr>
<tr>
<td>max. Frequency (50% duty cycle)</td>
<td></td>
<td>2,5</td>
<td></td>
<td>MHz</td>
</tr>
</tbody>
</table>

Due to the use of a static current diode as pull-up of the output signal, there is a static rise time that leads to different low-high transition delays for different voltages and loads. The delay time is measured without load from/to 50% of the signal level.
7 Use Cases

Using Multiple Boards

You can also combine multiple boards, i.e.,

- use multiple OPTO Trigger 5 boards with one frame grabber board, or
- use one OPTO Trigger 5 board with multiple frame grabber boards.

You connect the frame grabber(s) to the OPTO Trigger 5 board(s) by a specific 34-pin flat cable (see below). The signals of this cable use open collector drivers.

Using one OPTO Trigger 5 for several frame grabbers makes synchronizing the frame grabbers most easy. By sharing the trigger input lines of OPTO trigger 5, all frame grabbers in the PC are accurately synchronized. All frame grabbers connected to one OPTO trigger 5 must be seated in the same PC.

In most use cases, one OPTO Trigger 5 synchronizes all frame grabbers seated in one host PC. This is useful if the acquisition is controlled by an external generator.

Only Connect Devices residing in ONE Host PC

Do NOT connect frame grabbers residing in different host PCs.
Special 34-pin Flat Cable

To connect the devices in the host PC (one or several Opto trigger 5 boards and one or several frame grabbers), use a custom-tailored 34-pin flat cable which provides all required connectors in the desired order. Please contact Silicon Software sales department for ordering information.

Pins that must not be connected

Don’t connect the following pins between two frame grabbers:

- pin 2
- pin 4
- pin 32
- pin 34

If you use the special 34-pin flat cable available from Silicon Software, these lines are already disconnected directly on the cable.

Synchronization without External Trigger Inputs

There are applications where no external source is available or desired. In these cases, synchronization of multiple frame grabbers is not possible via OPTO trigger 5. Instead, a master frame grabber needs to synchronize all its slave frame grabbers.

Special Cases with some microEnable IV Products

microEnable IV AD4-CL, microEnable IV AD4-LVDS, and the microEnable IV VD4-CL with implemented I/O option "3.3V TTL (LVTTL) compatible (push/pull)" DO NOT allow the connection of two or more microEnable IV frame grabbers via the flat cable.
Connecting a Shaft Encoder (Example)

Pins

You connect the two differential signals (A and B) of the Shaft encoder to one of the trigger board ports as follows:

The Shaft Encoder sends differential signals, i.e., signal A+, signal A-, signal B+, and signal B-. Therefore, you have to use four pins (11 - 14) for receiving two signals (signal A and signal B).

Explanation

If you are using a Shaft Encoder, you receive either one signal or two signals (signal A and signal B).

Using one signal, you are receiving pulses when the transportation belt is moving.

The combination of both signals indicates in addition if the transportation belt moves forward or backward. If you are receiving both signals (A and B), you can suppress and compensate backward movements.
Figure: One signal, indicating the movement of the transportation belt

Figure: Two signals, indicating movement and direction of the transportation belt

Figure: Using both signals for suppressing and compensating backward movement of the transportation belt
## 8 Appendix

### Flat Cable Pinout

<table>
<thead>
<tr>
<th>Odd Pin Numbers</th>
<th>Even Pin Numbers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pin Number</td>
<td>I/O Name</td>
</tr>
<tr>
<td>1</td>
<td>Trigger Output 0</td>
</tr>
<tr>
<td>3</td>
<td>Trigger Output 1</td>
</tr>
<tr>
<td>5</td>
<td>Trigger Output 2</td>
</tr>
<tr>
<td>7</td>
<td>Trigger Output 3</td>
</tr>
<tr>
<td>9</td>
<td>Trigger Input 0</td>
</tr>
<tr>
<td>11</td>
<td>Trigger Input 1</td>
</tr>
<tr>
<td>13</td>
<td>Trigger Input 2</td>
</tr>
<tr>
<td>15</td>
<td>Trigger Input 3</td>
</tr>
<tr>
<td>17</td>
<td>Trigger Output 4</td>
</tr>
<tr>
<td>19</td>
<td>Trigger Output 5</td>
</tr>
<tr>
<td>21</td>
<td>Trigger Output 6</td>
</tr>
<tr>
<td>23</td>
<td>Trigger Output 7</td>
</tr>
<tr>
<td>25</td>
<td>Trigger Input 4</td>
</tr>
<tr>
<td>27</td>
<td>Trigger Input 5</td>
</tr>
<tr>
<td>29</td>
<td>Trigger Input 6</td>
</tr>
<tr>
<td>Odd Pin Numbers</td>
<td>Even Pin Numbers</td>
</tr>
<tr>
<td>-----------------</td>
<td>-----------------</td>
</tr>
<tr>
<td>31</td>
<td>Trigger Input 7</td>
</tr>
<tr>
<td>33</td>
<td>Presence Detect</td>
</tr>
</tbody>
</table>
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