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1 Introduction

Thank you for choosing Silego Technology products. The GreenPAK Pro Development Platform allows you to develop your custom design using GreenPAK mixed signal ICs. You can design your own projects starting from a blank project, or by altering the sample projects provided at Silego website.

1.1 GreenPAK Designer

GreenPAK Designer is an easy-to-use full-featured integrated development environment (IDE) that allows you to specify exactly how you want the device to be configured. This provides you direct access to all GreenPAK device features and complete control over the routing and configuration of a PAK project with just one tool.

With GreenPAK Designer you can:
• design the configuration which corresponds to your project needs
• verify the project using software interface to GreenPAK Pro Development Platform hardware
• with simple-to-use and intuitive software and hardware tools you can reduce your project development time and get to market faster

To start working with GreenPAK Designer please take the following steps:
• download and install GreenPAK Designer software
• configure modules that you will need for your project
• interconnect and configure modules
• specify the pins out
• test your design with the GreenPAK Pro Development Board

1.2 Support

Free support for GreenPAK Pro Development Platform is available online at http://www.silego.com/.

At Facebook: Silego-Technology

GreenPAK Designer will automatically notify you when a new version of software is available. For manual updates please go to http://www.silego.com/softdoc/software.html.

These resources are also available under the Help menu of GreenPAK Designer.
2 Getting Started

2.1 Introduction

This chapter describes how to install and configure the GreenPAK Pro Development Platform. Chapter 3 provides the details of hardware operation. Chapter 4 provides instructions on how to create simple projects.

2.2 Install Software

GreenPAK Designer software is available free of charge from the Silego website at http://www.silego.com/softdoc/software.html page.

Drivers required for the operation of the board will be installed as part of the software installation.

2.3 Uninstall Software

The software can be uninstalled in the way typical for your operating system. Please refer to your operating system support documentation if you need the specific instructions or visit Support section of this document for additional support from Silego.
3 Hardware

3.1 Overview

The GreenPAK Pro Development Platform is a high-performance development platform. The Super Speed USB 3.0 interface on the Development Board supports high speed data transfer, and configuration flexibility. GreenPAK Pro Development Board provides a high data rate pattern generator with 30 digital channels, and time resolution down to 40 ns point time per channel. For chip power usage analysis, GreenPAK Pro Development Board includes a 2 channel power monitor for measuring voltage and current consumption parameters. These power monitors have two current measuring ranges: high current measurement that supports up to 60 mA, and low current measurement that supports up to 1 mA. The current resolution in low current mode is equal to 400 nA. The external power rails include voltage protection to 15 V, and UV/OV level control in chip emulation mode. The power rails voltage ranges are from 0.5 to 5.5 V.

The analog portion of this Development Board has a 32-channel arbitrary waveform generator with 8 us point time conversion and low latency data reconfiguration. Each test point channel has connection to a 400 kSps ADC for voltage measurement. Two channels are used for voltage control of the power rails. For support of high accuracy measurement, this Development Board includes an SoC with a 100 kSps 16 bit ADC. This SoC is connected to each test point pin and can provide chip programming. SoC functionality includes OV/UV sense and switch on/off. For GreenPAK memory programming high voltage power rail up to 9 V controlled by SoC MCU is used also. This program rail is named VPP and is connected to test point 2 exclusively. VPP voltage is controlled by an 8 bit DAC. It is possible to switch VPP on/off by high voltage analog switch.

This Development Board can be used for external chip signal characterization, design test and analysis. An external I2C port is available for controlling external expansion, such as an oscilloscope test point the Development Board, or LED indicator the Development Board.
Figure 1. GreenPAK Pro Development Board, Top View
3.2 Functional Description

3.2.1 Power Supply

The main power source of the GreenPAK Pro Development Board is an external power supply that is supplied with the Development Board. Use only power supply that comes with the Development Board. The Development Board will not operate correctly without the external power supply.

3.2.2 USB 3.0 Communication

The Development Board has the USB communications interface that uses the USB 3.0 micro-B connector, as shown on Figure 2. This interface provides communication with the software control tool.

3.2.3 Socket Connector

This 34-pin connector is in the left bottom portion of the Development Board. The Socket Connector is a standard 0.1” double row female connector. The GreenPAK Pro Development Board should be used with a detachable socket board. Its main purpose is to connect the target GreenPAK chip to the Development Board.

3.2.4 Expansion Connector

This 34-pin connector is in the right bottom portion of the Development Board. The Expansion Connector is a standard 0.1” double row female connector. This port was designed to connect the GreenPAK Pro Development Board to external circuits and apply external power, signal sources and loads. It can be used to connect GreenPAK chip into your custom design with a minimum of additional tools, while maintaining full control over the chip.
Each pin except GND and NC is controlled through an individual analog switch. GreenPAK Designer can enable or disable external pins, as it is shown on Figure 5. The main purpose of the Expansion connector is to connect an external signal/power source safely to the GreenPAK Pro Development Board. In addition, each Expansion Connector line has ESD protection.

The Expansion Connector is enabled only in Emulation mode or Test mode. To enter either of these two modes, the target GreenPAK device must be inside the socket. When the Test mode button is pressed, the software will first read the chip to verify if it was inserted correctly, and then configure the GreenPAK Pro Development Board as it was set in Emulation mode. After the Emulation button is pressed, the software will automatically perform the following steps:

- check chip presence
- open all expansion port switches (allowing external signals/loads to be left connected to Expansion Connector)
- load target configuration into the target GreenPAK device using internal power
- configure Development Board as it was selected in Emulation Tool window

Note that the GreenPAK device has internal OTP memory which is normally loaded into RAM registers at initialization time. "Emulation mode" will bypass this load, and write the updated version of the project directly into the RAM register inside the GreenPAK chip many times, but after power loss all internal data will be lost. Also, when the GreenPAK chip is already programmed - user can use Emulation mode to load another project and test it on the emulation tool during the Emulation mode, in that case emulation data will be cleared. The "Emulation" mode is not necessary for checking programmed parts: in this case the "Test mode" will supply power to the device, which will perform the standard load of configuration data from OTP to RAM. The difference between the "Emulation" and the "Test mode" is that in the "Test mode", the process of loading configuration memory is skipped, and after the chip power, the OTP memory loads into RAM registers.

The Expansion Connector has the following type of connections:

1. VDD
2. GND
3. Data connections
The VDD connection allows the user to both use internal power supply to power the external circuit, and use external power source as the on-board chip power. This selection to use either internal or external power is made in the Emulator Controls window.

The GND connection is connected directly to the GreenPAK Pro Development Board ground, and cannot be controlled or switched.

Data connections are the easiest way to connect external signals to the GreenPAK chip. They are software controlled switches that are controlled in the Emulator Controls window.

### 3.2.5 Pins Connectivity

The Socket connector has the following type of connections:

1. VDD
2. GND
3. Data connections

The GreenPAK Pro Development Board supports connecting eight types of loads and signal sources. Each source has its own special purpose.

For VDD pins is only available a signal generator connection.

For the Data pins the following connections are available: VDD, GND, Pull Up, Pull Down, Configurable Virtual Button, Signal Generator, Logic Generator.
Data pin connections schematics:

<table>
<thead>
<tr>
<th>Connect PIN to VDDA or VDDB* via level shifter through 33 Ω resistor</th>
<th>Connect PIN to GND through 33 Ω resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image1" alt="Schematic" /></td>
<td><img src="image2" alt="Schematic" /></td>
</tr>
<tr>
<td>Set to VDD</td>
<td>Set to GND</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Connect PIN to VDDA through MCU 5 kΩ Pull Up resistor + 33 Ω resistor</th>
<th>Connect PIN to GND through MCU 5 kΩ Pull Down resistor + 33 Ω Resistor</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image3" alt="Schematic" /></td>
<td><img src="image4" alt="Schematic" /></td>
</tr>
<tr>
<td>Pull up</td>
<td>Pull down</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>When button released, it connects to bottom connection</th>
<th>When button pressed, it connects to upper connection</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image5" alt="Schematic" /></td>
<td><img src="image6" alt="Schematic" /></td>
</tr>
<tr>
<td>Button released</td>
<td>Button pressed</td>
</tr>
<tr>
<td>Upper connection to VDDA or VDDB* via level shifter through 33 Ω resistor; bottom connection to high impedance MCU input</td>
<td>VDDA/VDDB</td>
</tr>
<tr>
<td>---</td>
<td>---</td>
</tr>
<tr>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Upper connection to VDDA or VDDB* via level shifter through 33 Ω resistor; bottom connection to GND through 33 Ω resistor</th>
<th>VDDA/VDDB</th>
<th>GreenPAK chip</th>
<th>Upper connection to VDDA through MCU 5 kΩ Pull Up resistor + 33 Ω resistor; bottom connection to GND through MCU 5 kΩ Pull Down resistor + 33 Ω resistor</th>
<th>GreenPAK chip</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>33 Ohm</td>
<td></td>
<td>Button VDD – GND</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Button Pull up – Pull down</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Upper connection to VDDA or VDDB* through MCU 5 kΩ Pull Up resistor + 33 Ω resistor; bottom connection to GND through 33 Ω resistor</th>
<th>VDDA</th>
<th>GreenPAK chip</th>
<th>Upper connection to VDDA or VDDB* via level shifter through 33 Ω resistor; bottom connection to GND through MCU 5 kΩ Pull Down resistor + 33 Ω resistor</th>
<th>GreenPAK chip</th>
</tr>
</thead>
<tbody>
<tr>
<td>5k</td>
<td>1</td>
<td>33 Ohm</td>
<td></td>
<td>Button Pull up – GND</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Button VDD – Pull down</td>
</tr>
</tbody>
</table>

*Note*: Connection to VDDA or VDDB depends on which logical voltage level pin belongs to. For this information see chip datasheet.

*Figure 6* shows the schematic connection of the GP VDD pins.
Figure 7 shows the schematic connection of the GP data pins.
Figure 7. Schematic Connection of the Data Pin
3.2.6 Preparing GreenPAK Pro Development Board

To start working with GreenPAK Pro Development Board it is necessary to:

- connect external Power Supply
- connect Development Board to PC via USB cable
- connect socket adapter to the Socket connector (if you would like to work with chip: emulate, program, test)
- connect test point expansion Development Board to the Expansion connector (if necessary)
- place chip into the socket.

3.2.7 Chip PIN versus Development Board Test Point (TP)

Before you start working with a chip, you need to understand the difference between such concepts as PIN (chip pin) and TP (the Development Board test point). Figure 9 shows where PINs and TPs are.
PINs refer to the physical pins that are on the chip package (their marking can be seen in the datasheet). TPs refer to the Socket and Expansion connector pins. TP and PIN numbers may not match since different PINs on the chip have different functions (see Figure 10).

Figure 9. PINs and TPs location
In GreenPAK designer you can switch between PInS and TPs display mode. There is the button “TP Map” In Emulation Controls window, which will show this function (see Figure 25).

3.2.8 Using 20 Pins Socket Adapter with 32 Pins Socket Connector

For working with a chip in 20-pin socket, you need to connect it to the Development Board Pro Socket connector, as shown in Figure 11. Pin numbering starts from the lower right corner (entire connector pinpoint shown in the Figure 4).
Figure 11. 20 Pins Socket Adapter connected into 32 Pins Socket Connector
4 Example Projects using SLG46880

4.1 Project: Counter with Clock Enable

Blocks required:
- 2 digital inputs
- 1 digital output
- 2 Look-Up table with two inputs
- 1 Counter

All these components can be found in Components List. If there are no components on the work area - make sure this component is enabled by checking appropriate boxes.
Figure 13. GreenPAK Components List
GreenPAK Pin Configuration

<table>
<thead>
<tr>
<th>Pin #</th>
<th>Pin Name</th>
<th>Type</th>
<th>Pin Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>31</td>
<td>VDD1</td>
<td>PWR</td>
<td>Supply Voltage</td>
</tr>
<tr>
<td>15</td>
<td>VDD2</td>
<td>PWR</td>
<td>Supply Voltage</td>
</tr>
<tr>
<td>3</td>
<td>Clock</td>
<td>Digital Input</td>
<td>Digital Input</td>
</tr>
<tr>
<td>2</td>
<td>Enable</td>
<td>Digital Input</td>
<td>Digital Input</td>
</tr>
<tr>
<td>14, 30</td>
<td>GND</td>
<td>GND</td>
<td>Ground</td>
</tr>
<tr>
<td>1</td>
<td>Counter Output</td>
<td>Push Pull Output</td>
<td>Digital Output</td>
</tr>
</tbody>
</table>

All components used in this project are shown on Figure 12; next step is to configure selected blocks. Double click on PIN1 to open “Properties” panel. Select “Digital output” in I/O Selection field and then select “1x push pull” from the drop-down menu in Output mode field and hit “Apply” button.
Figure 14. Pin1 Mode
The next component in this design is Look-Up table. First Look-Up Table (LUT0) is used to generate logic “1” only when there are high logic levels on both inputs (AND gate). Select AND gate from “Standard gates” drop-down menu or set table manually. Second Look-Up Table (LUT1) is configured as NOR gate. It is used to generate reset signal for counter on PIN2 falling edge.

![Figure 15. Look-Up Table Properties Configured as an AND Gate](image-url)
Figure 16. Look-Up Table Properties Configured as a NOR Gate

Figure 17 shows counter properties.
The Final step is to connect each of the selected components. Use Wire tool to perform this action. To connect two pins select “Set Wire” and then click on the first and the second pins of the module or modules that you want to connect. The trace will be automatically routed.

Figure 17. Counter Properties
Figure 18 displays ready project with configured blocks and wire connections.

Use the GreenPAK Pro Development Board to test this project. Prepare the Development Board to work (see Chapter 3.2.6) and press "Emulator" button. Wait until the initialization process of GreenPAK Pro Development Board is in progress. In emulation mode you are able to add sources/loads to GreenPAK pins using additional emulation toolbar (see Figure 19).

Figure 19. Additional Emulation Toolbar in Emulation Mode

To test this project, we will use the following tools:

- Signal generator. Signal generator is applied to VDD pin to power GreenPAK chip
- Logic generator. Logic generator serves as clock source
- Button is a software simulation of the real button. It switches PIN between VDD and GND signal levels
The Signal generator is presented as power source for the GreenPAK chip (at VDD and VDD2 pins). The values for VDD and VDD2 will match the selections made in the Project Info window by default. To see signal generators settings, double-click on the generator icon near the pin VDD or VDD2.

Figure 20 shows signal generator settings window.

![Figure 20. Generator Settings Window](image)

It is necessary to connect logical generator to the PIN3, and to the PIN 2 button. To do so click on “Add” menu from Additional emulation toolbar and from the drop-down menu select needed tool (see Figure 21).
After this click on point near “EXT IN/OUT” pin output (see Figure 22) (after you selected needed item in “Add” menu, “EXT IN/OUT” pin will change color on light green).

After all settings have done, signal label near pin will change in accordance with the selected tool. When mouse move on signal label, it shows available tools in pop-up control panel (see Figure 23).
The purpose of the logic generator is to provide clock pulses for the Counter block. It is configured for 10 Hz clock source as shown on the Figure 24.
After all settings are done, click button “Emulation” from Emulation Controls window to start emulation process.

To start all logic and signal generators (expect VDD/VDD2 signal generators) press button “Start All” (see Figure 25).
Functionality Waveform
Channel 1 (yellow/top) – Logic generator
Channel 2 (light blue/2nd line) – Button, 1 - enable Counter; 0 - disable Counter
Channel 3 (magenta/3rd line) – Counter output

Figure 25. Emulator Controls Window

Figure 26. Waveform, Triggered on Button Pressed

Channel 1 (yellow/top) – Logic generator
Channel 2 (light blue/2nd line) – Button, 1 - enable Counter; 0 - disable Counter
Channel 3 (magenta/3rd line) – Counter output
Channel 1 (yellow/top) – Logic generator
Channel 2 (light blue/2nd line) – Button, 1 - enable Counter; 0 - disable Counter
Channel 3 (magenta/3rd line) – Counter output

As it is shown on Figure 27 and Figure 28 Counter works only when the button is pressed.
5 Support

If you have problems with GreenPAK Pro Development Platform feel free to contact us info@silego.com.
Conclusion

This GreenPAK Pro Development Platform is a truly versatile tool. It allows the designer to create a custom project within minutes, without using additional devices (except oscilloscope).

For more information please visit our website http://www.silego.com/.
## 6 Appendix A - Electrical Specification

<table>
<thead>
<tr>
<th>Mode</th>
<th>Parameter</th>
<th>Min.</th>
<th>Typ.</th>
<th>Max.</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General</strong></td>
<td>Test Point Capacitance</td>
<td>55</td>
<td>--</td>
<td>--</td>
<td>pF</td>
</tr>
<tr>
<td></td>
<td>Input Leakage Current</td>
<td>--</td>
<td>--</td>
<td>5</td>
<td>nA</td>
</tr>
<tr>
<td></td>
<td>Max. Current through Protection Diode to VDD</td>
<td>--</td>
<td>--</td>
<td>200</td>
<td>mA</td>
</tr>
<tr>
<td><strong>Power Supply (VDDA/VDDB)</strong></td>
<td>Voltage Range</td>
<td>0</td>
<td>--</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>VDD Max. Current</td>
<td>--</td>
<td>--</td>
<td>70</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>Voltage Output Total Error</td>
<td>--</td>
<td>--</td>
<td>±30</td>
<td>mV</td>
</tr>
<tr>
<td><strong>Logic generator</strong></td>
<td>Number of Channels</td>
<td>--</td>
<td>--</td>
<td>30</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Output Voltage High</td>
<td>--</td>
<td>VDDA</td>
<td>--</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Output Voltage Low</td>
<td>--</td>
<td>VDDA</td>
<td>0.8</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>Max. Current per TP</td>
<td>--</td>
<td>--</td>
<td>50</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>Rise Time</td>
<td>2.5</td>
<td>--</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>Fall Time</td>
<td>3</td>
<td>--</td>
<td>--</td>
<td>ns</td>
</tr>
<tr>
<td></td>
<td>Max. Output Frequency</td>
<td>0.152</td>
<td>--</td>
<td>12.5</td>
<td>MHz</td>
</tr>
<tr>
<td></td>
<td>Max. Number of Points</td>
<td>--</td>
<td>--</td>
<td>180</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Sample Rate</td>
<td>--</td>
<td>25000</td>
<td>--</td>
<td>kSPS</td>
</tr>
<tr>
<td><strong>Signal Generator</strong></td>
<td>Number of Channels</td>
<td>--</td>
<td>--</td>
<td>32</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Output Voltage Range</td>
<td>0</td>
<td>--</td>
<td>5.5</td>
<td>V</td>
</tr>
<tr>
<td></td>
<td>DC Output Impedance</td>
<td>--</td>
<td>0.2</td>
<td>--</td>
<td>Ω</td>
</tr>
<tr>
<td></td>
<td>Short-Circuit Current</td>
<td>--</td>
<td>--</td>
<td>25</td>
<td>mA</td>
</tr>
<tr>
<td></td>
<td>Min. Output Voltage</td>
<td>--</td>
<td>--</td>
<td>2</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>Output Total Error</td>
<td>--</td>
<td>--</td>
<td>±7</td>
<td>mV</td>
</tr>
<tr>
<td></td>
<td>Output Frequency (SINE)</td>
<td>0.01</td>
<td>--</td>
<td>5000</td>
<td>Hz</td>
</tr>
<tr>
<td></td>
<td>Max. Number of Points</td>
<td>--</td>
<td>--</td>
<td>512</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Sample Rate</td>
<td>--</td>
<td>100</td>
<td>--</td>
<td>kSPS</td>
</tr>
<tr>
<td><strong>Virtual Button, VDD/GND, Pull Up/Down Driver</strong></td>
<td>Output Level High</td>
<td>--</td>
<td>VDDA</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Output Level High (Pull Up)</td>
<td>--</td>
<td>VDDA</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Output Level Low</td>
<td>--</td>
<td>GND</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td></td>
<td>Strong Drive (VDD/GND) Resistance</td>
<td>--</td>
<td>33</td>
<td>--</td>
<td>Ω</td>
</tr>
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<td>Pull Up/Down Resistance</td>
<td>3.5</td>
<td>5.6</td>
<td>8.5</td>
<td>kΩ</td>
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<tr>
<td><strong>Expansion Connector Switch</strong></td>
<td>Max. Voltage</td>
<td>--</td>
<td>--</td>
<td>5.5</td>
<td>V</td>
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<tr>
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<td>Continuous Current through Any Terminal</td>
<td>--</td>
<td>--</td>
<td>±30</td>
<td>mA</td>
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<td>Switch On-Resistance</td>
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<td>5</td>
<td>Ω</td>
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<td>External VDD Switch On-Resistance</td>
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<td>mΩ</td>
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<td>On Leakage Current</td>
<td>-0.1</td>
<td>--</td>
<td>0.1</td>
<td>nA</td>
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<tr>
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<td>Off Leakage Current</td>
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<td>0.1</td>
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<tr>
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<td>Bandwidth</td>
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<td>150</td>
<td>--</td>
<td>MHz</td>
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