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GreenPAK Universal Development Board
User Guide

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Contents

1. Introduction

Thank you for choosing Silego Technology products. GreenPAK Universal Development Board allows you to develop your custom design using GreenPAK3 mixed signal IC. You can design your own projects starting from a blank project or by altering the sample projects provided at Silego website. GreenPAK3 chip is a mixed signal micro FPGA IC that combines configurable standard logic, timing, analog comparators, ADC and other macro modules in tiny 12-pin 2x3mm package when still running on very low power.

1.1. Kit contents

The GreenPAK Universal Development Board contains:

- GreenPAK Universal Development Board with socket board;
- USB A to mini B cable;
- GreenPAK3 samples;
- Quick start guide.

Inspect the contents of the kit; if you find any part missing, contact Silego for help.

1.2. GreenPAK3 Designer

GreenPAK3 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 a direct access to all GreenPAK3 device features and complete control over the routing and configuration options.

GreenPAK3 Designer has simple and intuitive software interface to GreenPAK3 Universal Board that gives you a quick and easy way to develop your entire GreenPAK3 project with just one tool.

With GreenPAK3 Designer, you can:

- Design the configuration which corresponds to your project needs;
- Verify the project using software interface to GreenPAK3 Universal Board hardware;
- With a 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 GreenPAK3 Designer please do the following steps:

- Download and install GreenPAK3 Designer software;
- Configure modules that you will need for your project;
- Interconnect and configure modules;
- Specify the pinout;
- Test your design with the GreenPAK3 Universal Board

1.3. Support

Free support for GreenPAK3 Universal Board is available online at http://www.silego.com.

At skype: silegousa
silegochinese
silegoeurope
silegojapan

At facebook: Silego-Technology

GreenPAK3 Designer will update itself when a new software version is detected and available. For manual updates please go to Software & Docs page at Silego Technology website
You can also find all these resources in the **Help** menu of GreenPAK3 Designer.

2. Getting Started

2.1. Introduction

This chapter describes how to install and configure the GreenPAK3 Universal Board. Chapter 3 provides the details of hardware operation.
Chapter 4 provides instructions on how to create a simple project example.
The Appendix section provides the schematics and BOM associated with the GreenPAK3 Universal Board.

2.2. Install Hardware

No hardware installation is required for this kit.

2.3. Install Software

GreenPAK3 Designer software is available free of charge from the Silego website at Software & Docs page.

2.4. 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

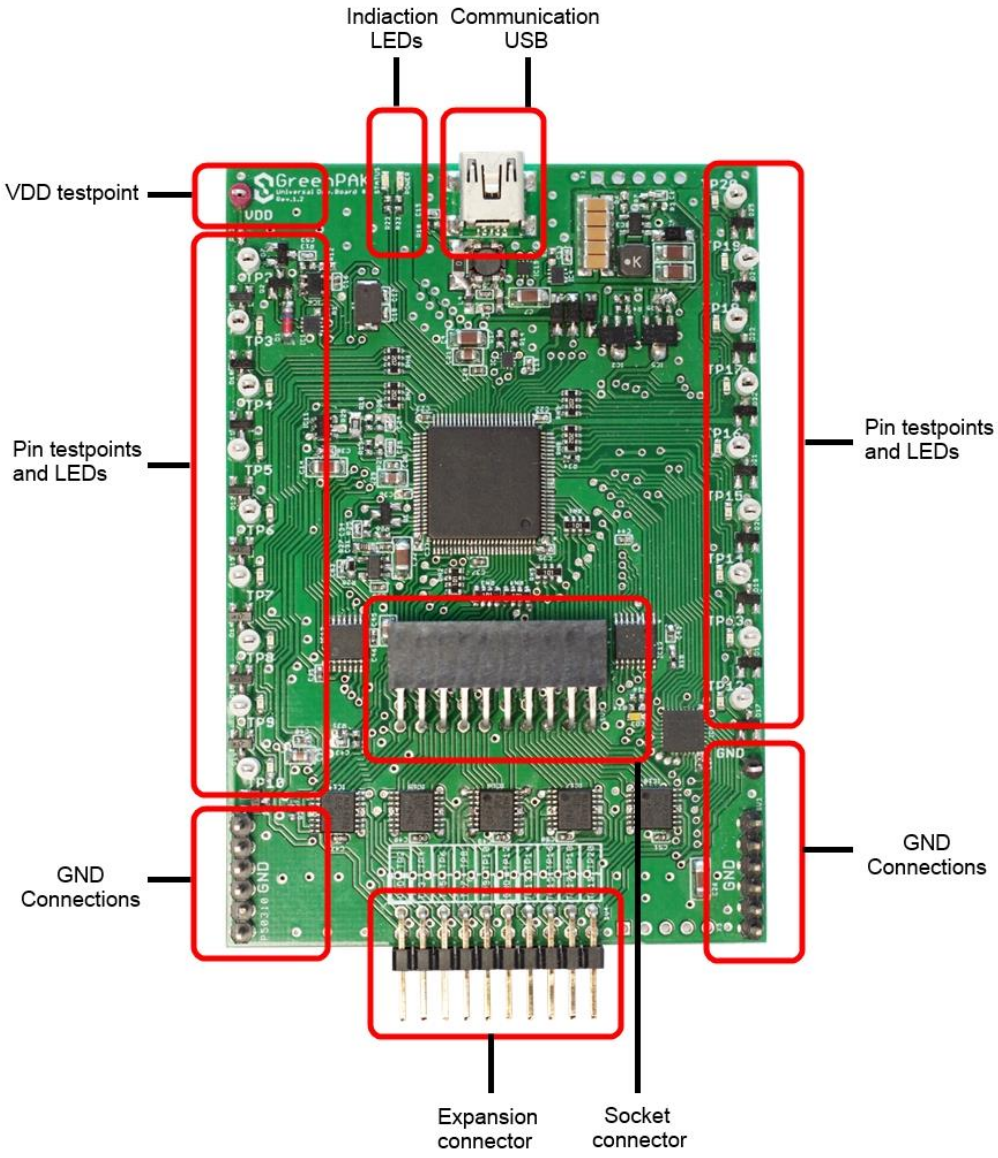


Figure 3-1. GreenPAK3 Universal Board, top view

Notification: All test points were designed only for observation of signals on the pins. Please do not try to connect external power/signal source to test points, this will affect GreenPAK3 Universal Board functionality and may even damage it.

3.2. Functional Description

3.2.1. Power Supply

Main power source of GreenPAK3 Universal Board is USB power lines. GreenPAK3 chip power supply range is 1.8-5.5 volts. The development board can provide power from 0 to 5.5V. To provide this power range the development board is enabled with a boost converter. A Signal generator with a buffered output controls GreenPAK3 chip power rail. For more information about GreenPAK3 electrical specification, please refer to the part datasheet.

3.2.2. USB Communication

The board has a USB communications interface that uses the USB mini-B connector, as shown in Figure 3-2. This interface provides communication with software control tool and supplies power to the board, as discussed in Power Supply chapter.

Figure 3-2. USB Interface

3.2.3. GND connections

There are 6 GND pins on the left side, 6 pins and 1 header on the right side. These can be used for test equipment (oscilloscope, multimeter etc.) ground reference connection or to connect external test circuitry ground.

3.2.4. Pin test points

Each GreenPAK3 chip pin including VDD has its own observation test point. These test points were designed only for observation, if you need to connect an external signal source, use a software-controlled expansion connector.

3.2.5. LEDs

All the pins except Pin2 can be connected to buffered LEDs. This option allows you to visualize digital levels on chip pins. There are 2 selection modes:

- Buffered LED (with high impedance input);

- Inverted Buffered LED (with high impedance input);

This option can be enabled in GreenPAK3 Designer.

3.2.6. Socket connector

The GreenPAK3 Universal Board is supplied with a detachable socket board (Figure 3-3). Its main purpose is to connect GreenPAK3 chip to the Development Board. It can be used to have an easy way to use programmed chip in external circuits, or measure current consumption of your project.

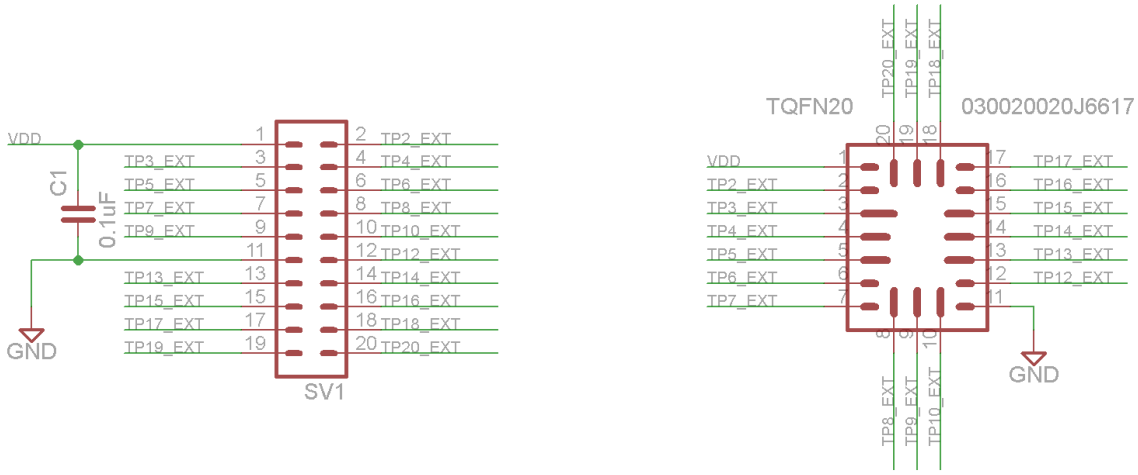


Figure 3-3.GreenPAK3 Socket Board and schematic

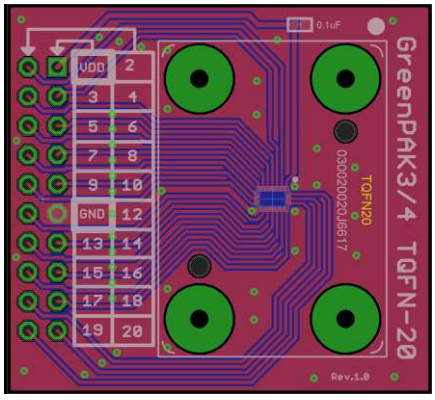


Figure 3-4.GreenPAK3 Socket PCB

3.2.7. Expansion connector

This port was designed to connect GreenPAK3 Universal Board to external circuits and apply external power, signal sources and loads. It can be used to apply GreenPAK3 chip into your custom design with minimum additional tools. Schematic is available on Figure 3-5.

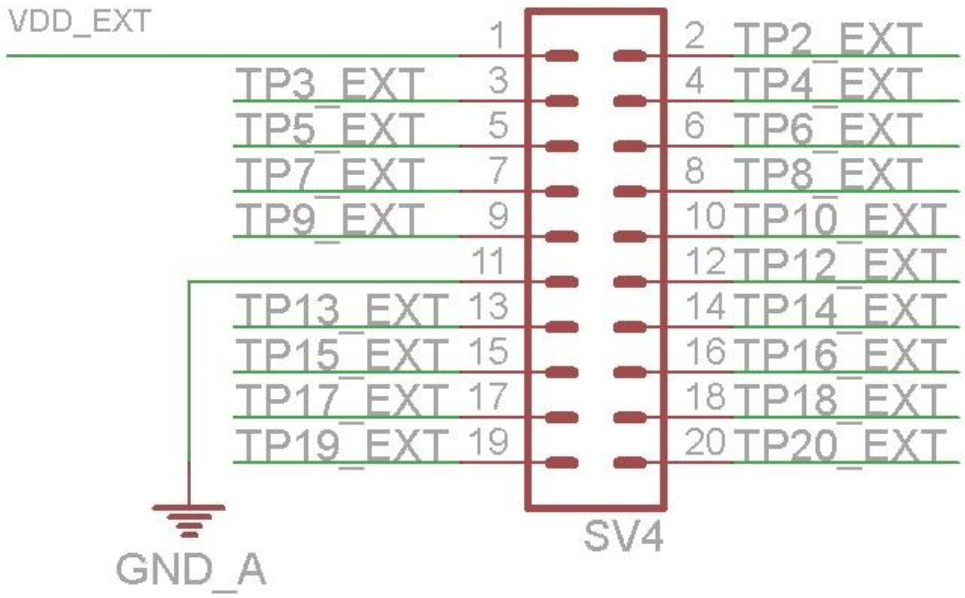


Figure 3-5. GreenPAK3 expansion connector schematic

Each pin except PIN11 (GND) is controlled through individual analog switch. Expansion connector is a standard 0.1” double row connector. GreenPAK3 Designer allows you to easily open or close external pins, as it is shown on figure below. Main purpose of Expansion connector is to connect external signal/power source safety for GreenPAK3 Universal Board.

Figure 3-6. Expansion connector control in GreenPAK3 Designer

Figure 3-7 demonstrates schematic of the expansion connector control.

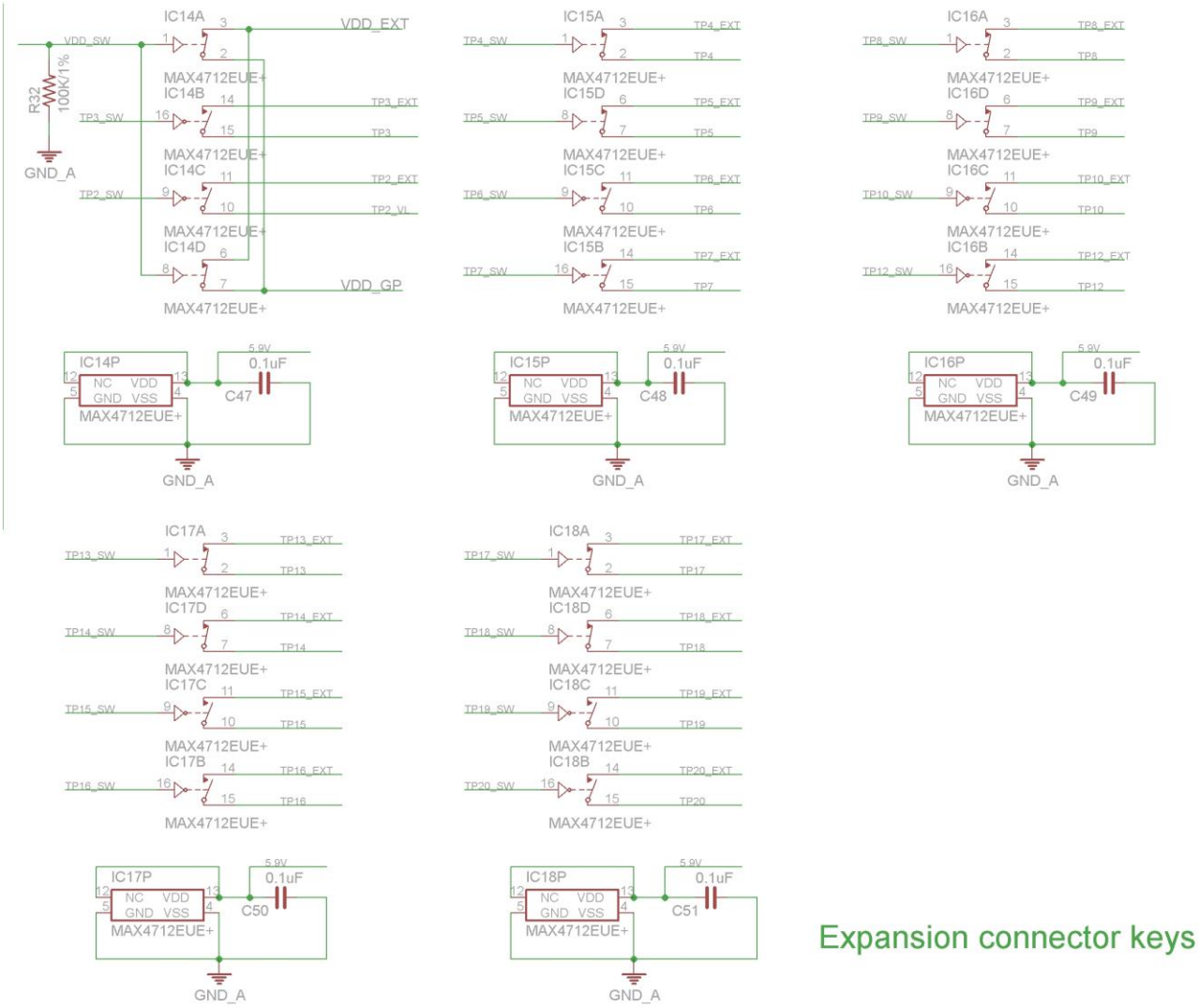


Figure 3-7. Socket and expansion connector schematic

Expansion connector is enabled only in Emulation mode or Test mode. To enter any of this two modes GreenPAK3 chip is required inside the socket. When the Test mode button is pressed the software will first read the chip to verify that it was inserted and then configure the GreenPAK3 Universal Board as it was set in Emulation Tool window. When the Test mode button is grey then the Dev. Board is in Default state and all expansion port switches are open (disconnected). After Emulation button is pressed, the software will automatically perform the following steps:

- check chip presence;
- open all expansion port switches (external signals/loads can be leaved connected to expansion port);
- use internal power and load configuration to the chip
- only for case #3: adjust internal power source to external power level -> close external power switch -> open internal power switch;
- configure board as it was set in Emulation Tool window;

Also the parasitic effects should be considered while using GreenPAK3 Universal Board in-circuit with analog signals. The entire board circuitry along with the wiring have significant amount of mutual capacitance and inductance. The detachable socket can also be used for the in-circuit development with programmed chips (the board and socket connectors have same pinout).

The GreenPAK Universal Board provides three possible ways of using expansion connector:

1) The internal power is used to run chip, no external power output is needed, external signal sources and loads can be connected between pins and GND.

The configuration steps:
- close internal and open external power switch;
- close all used expansion port switches in the software;
- hit Emulation/Test mode button;

This is common way of using Expansion connector.

Figure 3-8. Internal power source

2) The internal power is used to run chip and external circuit (internal power source/sink current is limited to 50mA).

The configuration steps:
- close internal power switch;
- close external power switch;
- close all used expansion port switches in the software;
- hit Emulation/Test mode button;

Figure 3-9. Internal power source for GreenPAK3 chip and external board

3) The external power is used to run chip and external circuit (internal source output is in Hi-Z state).

The configuration steps:

- open internal power switch;
- close external power switch;
- close all used expansion port switches in the software;
- hit Emulation/Test mode button (External power should be applied before this step);

Mention that GreenPAK3 chip is OTP part and "Emulation mode" allows to load the project into GreenPAK3 chip many times, but after power loss all internal data will be lose. Also when the GreenPAK chip is already programmed - user can use Emulation mode to load some other 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" is enough.

Expansion connector can be divided on 3 types of connections.

1. VDD;
2. GND;
3. Data connections.

VDD connection allows you to connect/disconnect external and internal power source. This connection meets next requirements:

- External power in range 1.8 - 5.5 volt.
- High ohm voltage dividers are not recommended.

GND connection is connected directly to Development board, and cannot be controlled with GreenPAK3 Designer.

Data connections are easiest way to connect external lines to GreenPAK3 chip. They are software controlled switches. Every line is connected with 100Ohm resistor.

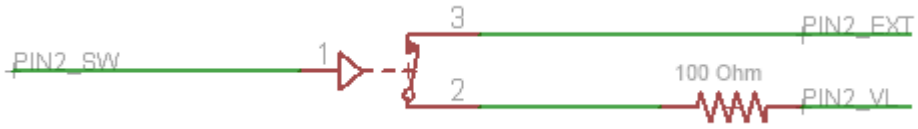


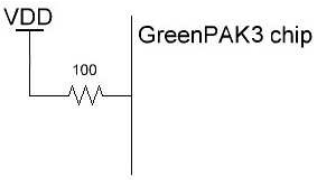
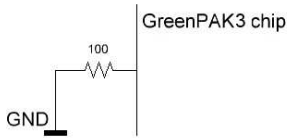
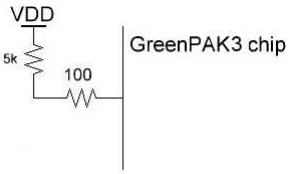
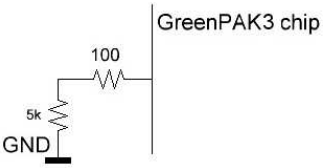
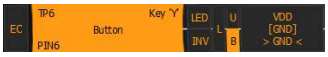
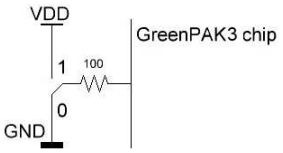
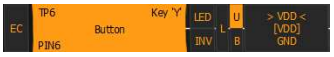
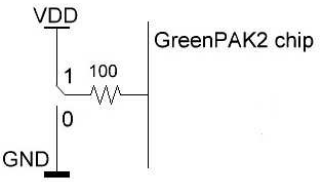
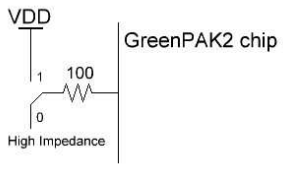
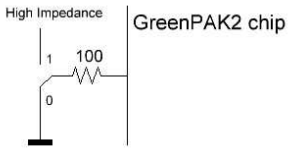
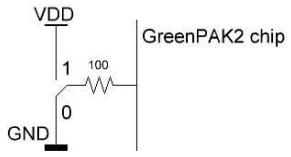
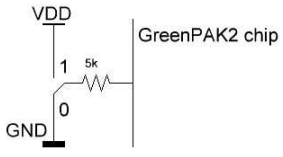
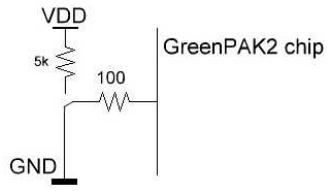
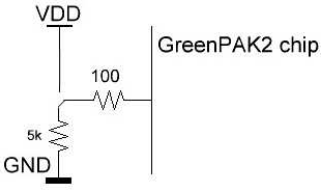
Figure 3-10. Expansion connector. Pin with protection resistor.

3.2.8. Pins connectivity

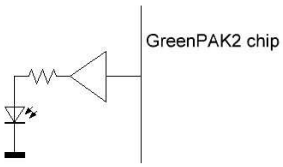
GreenPAK3 Universal Board allows connecting eight types of loads and signal sources. Each source has its own special purpose.
List of available connections for each pin is presented in the table below.

Pin	Set to VDD	Set to GND	Pull up	Pull down	Set configurable button	LED	Signal generator	Logic generator
#	1	2	3	4	5	6	7	8
VDD	-	-	-	-	-	-	+	-
Pin2	+	+	+	+	+	-	-	+
Pin3	+	+	+	+	+	+	-	+
Pin4	+	+	+	+	+	+	-	+
Pin5	+	+	+	+	+	+	-	+
Pin6	+	+	+	+	+	+	+	+
Pin7	+	+	+	+	+	+	+	+
Pin8	+	+	+	+	+	+	+	+
Pin9	+	+	+	+	+	+	-	+
Pin10	+	+	+	+	+	+	+	+
Pin12	+	+	+	+	+	+	+	+
Pin13	+	+	+	+	+	+	+	+
Pin14	+	+	+	+	+	+	+	+
Pin15	+	+	+	+	+	+	-	+
Pin16	+	+	+	+	+	+	-	+
Pin17	+	+	+	+	+	+	-	+
Pin18	+	+	+	+	+	+	-	+
Pin19	+	+	+	+	+	+	-	+
Pin20	+	+	+	+	+	+	-	+

Pin signal sources/loading schematics:

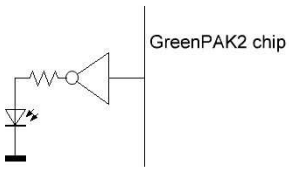
 Set to VDD	 Set to VDD	 Set to GND	 Set to GND
 Pull up	 Pull up	 Pull down	 Pull down
 Button pressed	 Button pressed	 Button released	 Button released
 Button with different configurations	 Button VDD – HI-Z	 Button HI-Z - GND	 Button VDD - GND
	 Button Pull up - Pull down	 Button Pull up - GND	 Button VDD – Pull down

LED



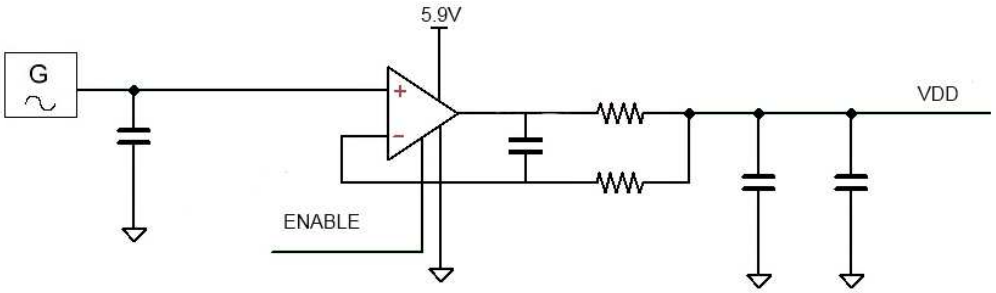
Buffered LED

LED



Inverted buffered LED

VDD Signal generator*



VDD Signal generator

*- VDD Signal generator works similar to other Signal generators but has wider output voltage range. It can provide maximum supply level of 5.5 V.

4. Example projects

4.1. Project: Counter with clock enable

The first example project - Counter with clock enable is very simple. For this project we will need:

- 2 digital inputs;
- 1 digital output;
- 1 Look-Up table with two inputs;
- 1 Counter.

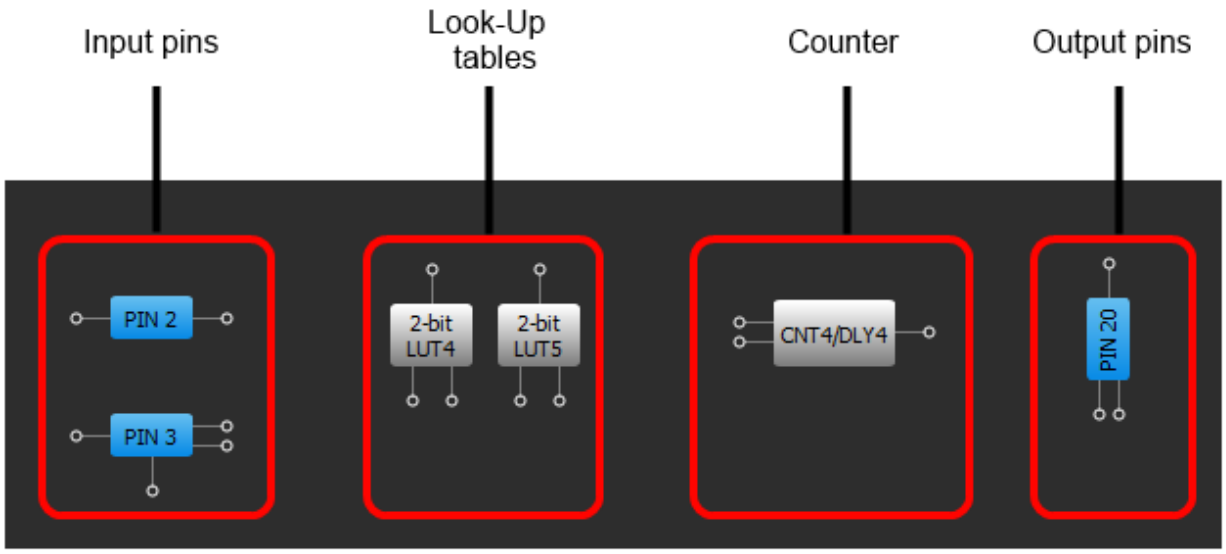


Figure 4-1. GreenPAK3 Designer

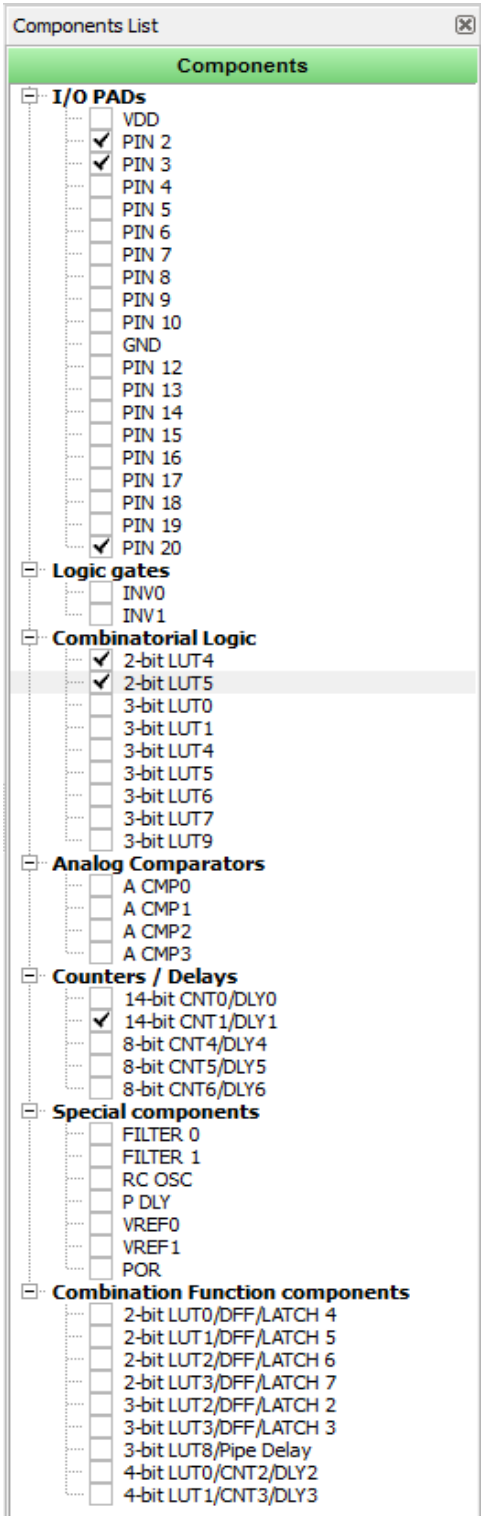


Figure 4-2. GreenPAK3 Components list

All these components can be found in components list. If there are no components on a work area - make sure this component is enabled.

Pin Configuration

Pin #	Pin Name	Type	Pin Description
1	VDD	PWR	Supply Voltage
2	Clock	Digital input	Digital Input
3	Enable	Digital input	Digital Input
11	GND	GND	Ground
20	Counter Output	Push pull output	Digital Output

On Figure 4-1 there are shown all the components used in project; next step is to configure selected blocks. Double click on PIN20 to open “Properties” panel. Select “1x push pull” from the drop-down menu in Pin20 properties and hit “Apply” button

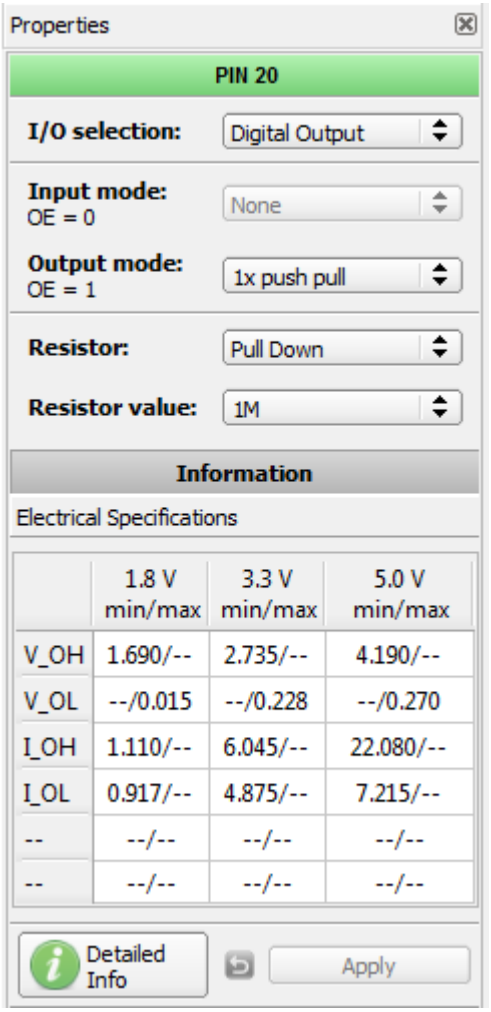


Figure 4-3. Pin 20 mode

Next component in this design is Look-Up table. First Look-Up (LUT4) table 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 (LUT5) configured as NOR gate. It is used to generate reset signal for counter on PIN3 falling edge.

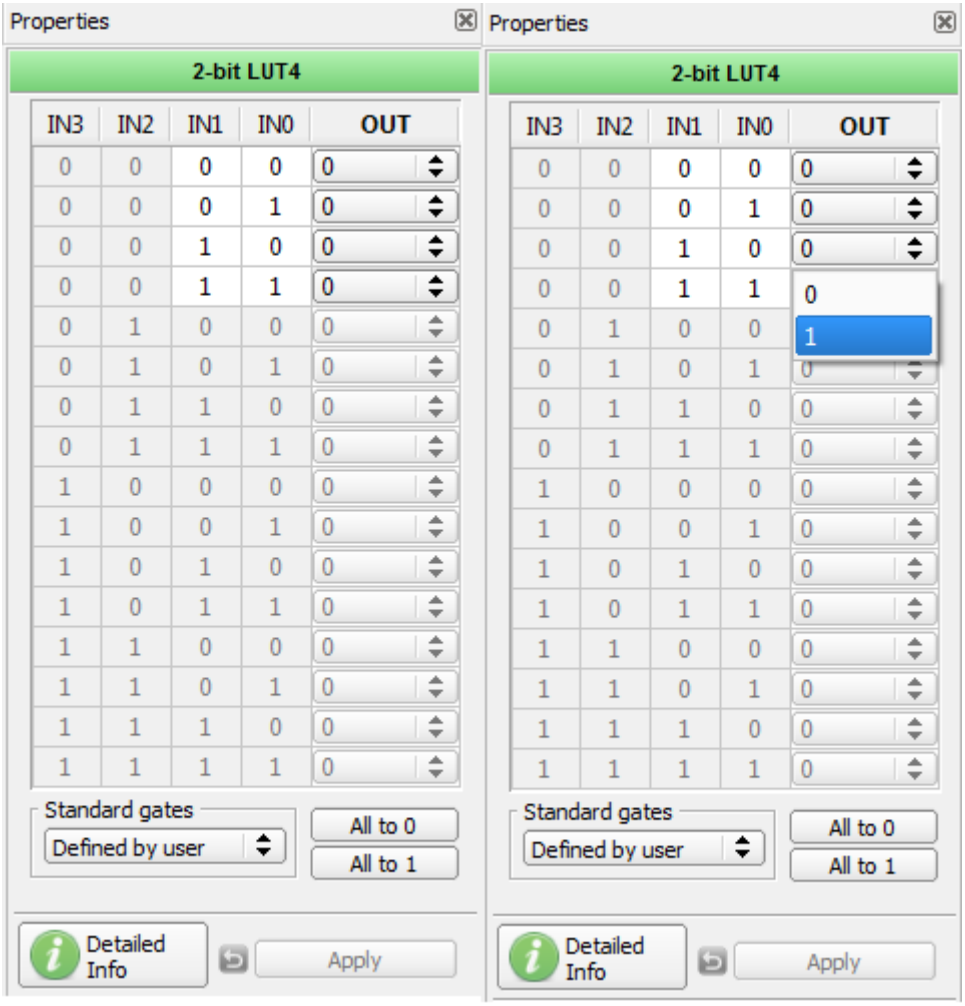


Figure 4-4. Look-Up table properties configured as AND gate

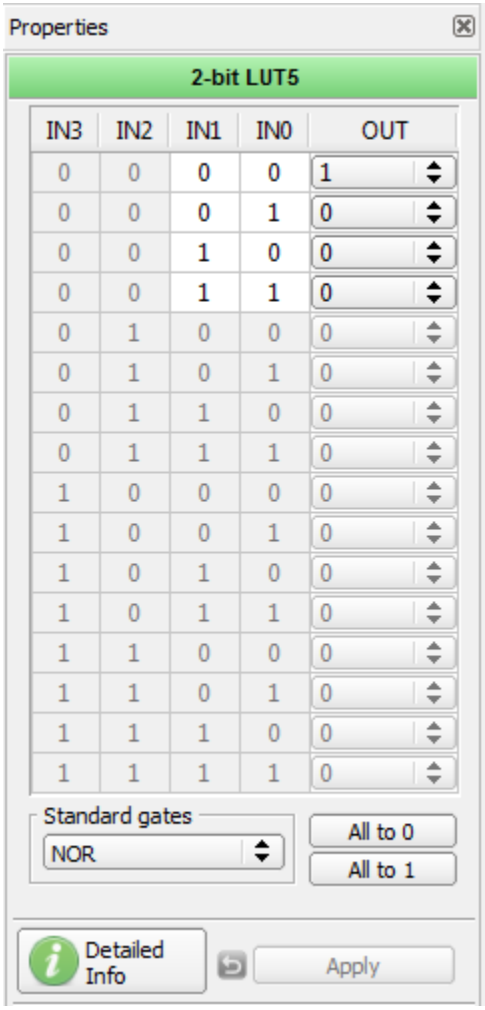


Figure 4-5. Look-Up table properties configured as AND gate

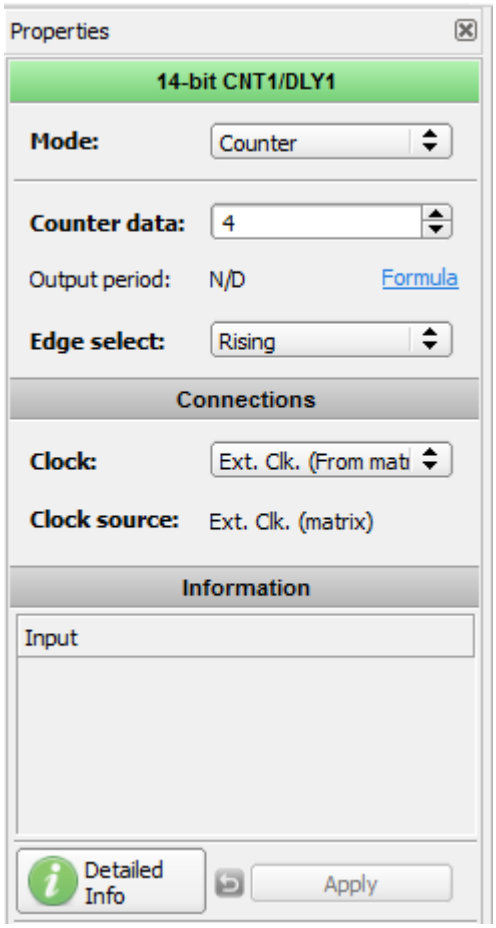


Figure 4-4. Counter properties

Final step is to connect used components. Use Wire tool to perform this action. To connect two pins select “Set Wire” 

and then click on the first and the second pin of the module or modules that you want to connect. The trace will be automatically routed.

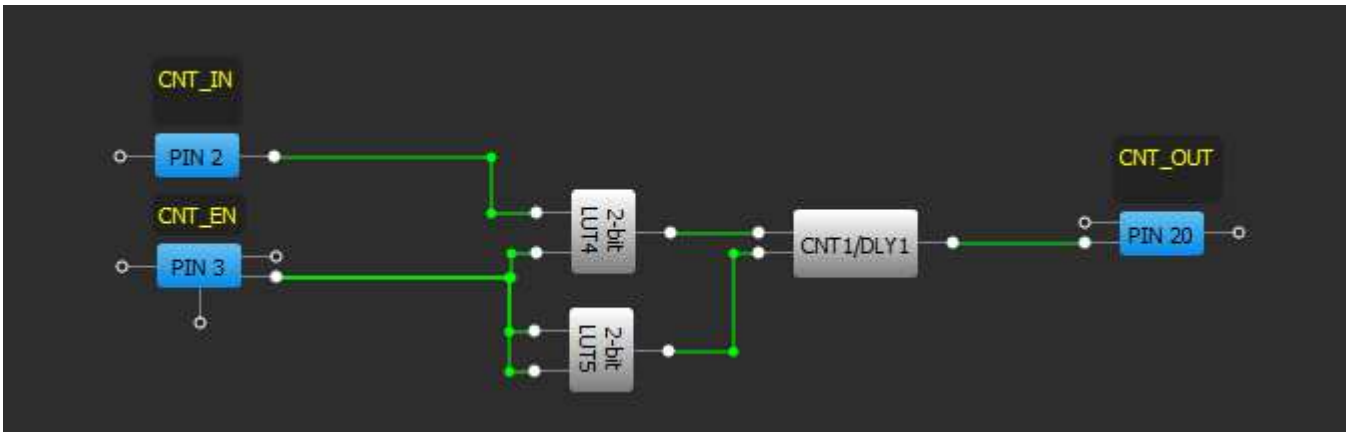


Figure 4-5. GreenPAK3 Designer

Figure 4-5 displays ready project, with configured blocks and wire connections.

Use the GreenPAK Universal Board to test this project. Connect GreenPAK Universal Board to PC and press “Emulation” button. This will load code of your project to the chip and will enable Test Board functionality of your Dev. Board.