UG336: Si5396J Evaluation Board User's Guide

The Si5396J-A-EVB is used for evaluating the Si5396 Any-Frequency, Any-Ouput, Jitter-Attenuating Clock Multiplier. There is only one EVB for the 44-pin 4 output Si5396, which is an embedded reference device J-grade. There is no EVB for the external reference A grade version for the Si5396-EVB. The device grade and revision is distinguished by a white 1 inch x 0.187 inch label with the text “Si5396J-A-EB” installed in the lower left hand corner of the board. (For ordering purposes only, the terms “EB” and “EVB” refer to the board and the kit respectively. For the purpose of this document, the terms are synonymous in context.)

KEY FEATURES OR KEY POINTS

- Si5396J-A-EVB for evaluating internal reference versions Si5396J/K
- Powered from USB port or external power supply.
- ClockBuilder® Pro (CBPro) GUI programmable VDD supply allows device to operate from 3.3, 2.5, or 1.8 V.
- CBPro GUI allows control and measurement of voltage, current, and power of VDD and all 4 VDDO supplies.
- Status LEDs for power supplies and control/status signals of Si5396J.
- SMA connectors for input clocks and output clocks

Table of Contents

1. Si5396J-A-EVB Functional Block Diagram

Below is a functional block diagram of the Si5396J-A-EVB. This evaluation board can be connected to a PC via the main USB connector for programming, control, and monitoring. See section 3. Quick Startor section 9. Installing ClockBuilder Pro Desktop Softwarefor more information.

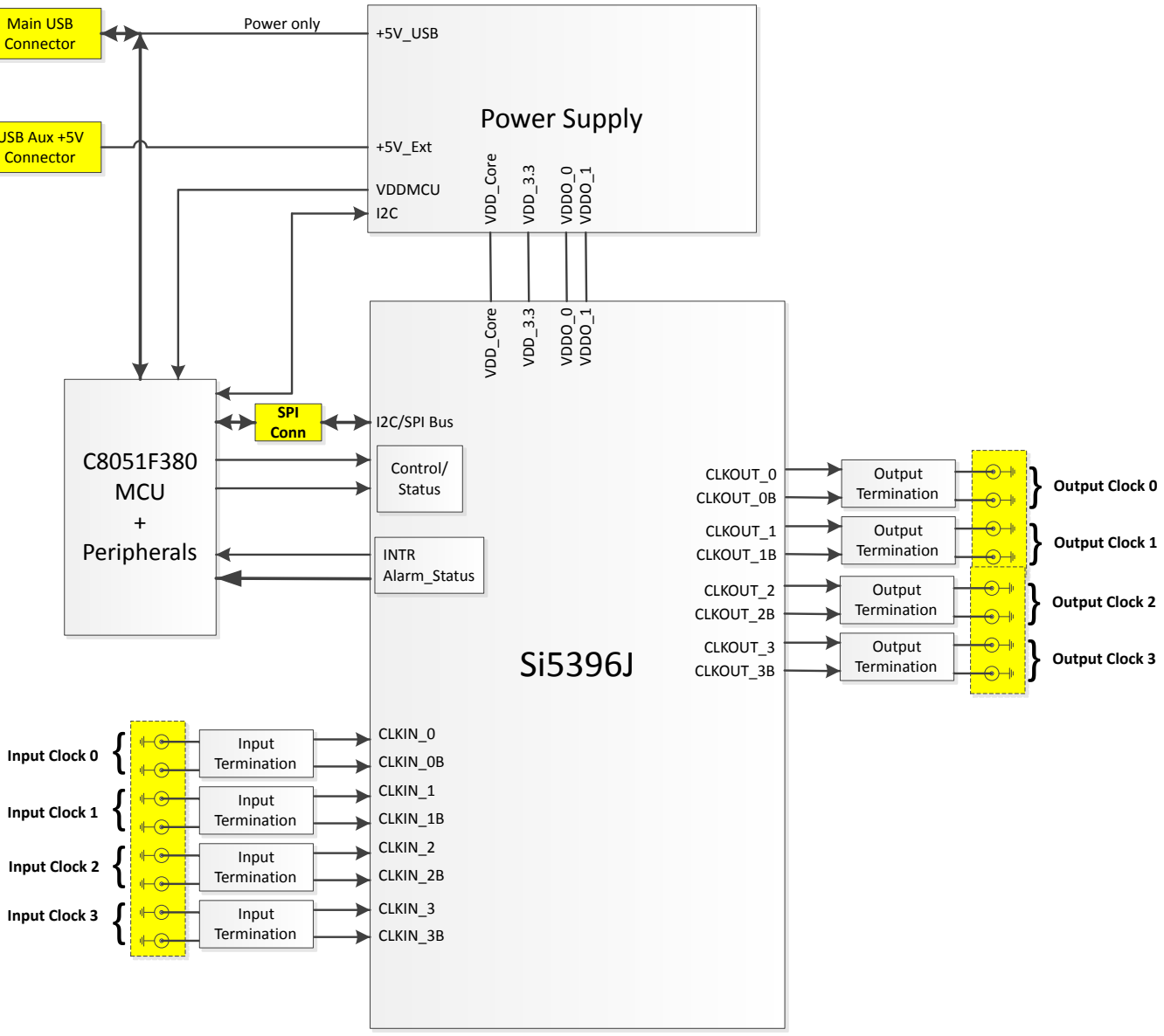

Figure 1.1. Si5396J-A-EVB Functional Block Diagram

2. Si5396J-A-EVB Support Documentation and ClockBuilder Pro Software

All Si5396J-A-EVB schematics, BOMs, User’s Guides, and software can be found online:

www.silabs.com/documents/public/schematic-files/si539x-design-files.zip

3. Quick Start

1. Install ClockBuilder Pro desktop software from https://www.silabs.com/products/development-tools/software/clock.
2. Connect a USB cable from Si5396J-A-EB to the PC where the software was installed.
3. Confirm jumpers are installed as shown in Table 4.1 Si5396J-A-EVB Jumper Defaults on page 6.
4. Launch the ClockBuilder Pro Software.
5. You can use ClockBuilder Pro to create, download, and run a frequency plan on the Si5396-A-EB.
6. Find the Si5396J data sheet: https://www.silabs.com/documents/public/data-sheets/si5397-96-a-datasheet.pdf

4. Jumper Defaults

Table 4.1. Si5396J-A-EVB Jumper Defaults

Location	Type	I = Installed 0 = Open	Location	Type	I = Installed 0 = Open
JP1	2 pin	I			
JP2	2 pin	I			
JP3	2 pin	O			
JP4	2 pin	I			
JP5	3 pin	1 to 2 (USB)			
			J17	5 x 2 Hdr	All 5 installed
Note: Refer to the Si5396J-A-EVB schematics for the functionality associated with each jumper.					

5. Status LEDs

Table 5.1. Si5396J-A- EVB Status LEDs

Location	Silkscreen	Color	Status Function Indication
D5	LOS_XAXBB	Blue	XA/XB Loss of Signal indicator
D6	INTRB	Blue	MCU INTR (Interrupt) active
D7	LOL_BB	Blue	DSPLL A Loss of Lock indicator
D8	LOL_AB	Blue	DSPLL B Loss of Lock indicator
D11	+5V MAIN	Green	Main USB +5V present
D12	READY	Green	MCU Ready
D13	BUSY	Green	MCU Busy

D5, D6, D7, and D8 are status LEDs indicating the device alarms currently asserted. D11 is illuminated when USB +5 V supply voltage is present. D12 and D13 are status LEDs showing on-board MCU activity.

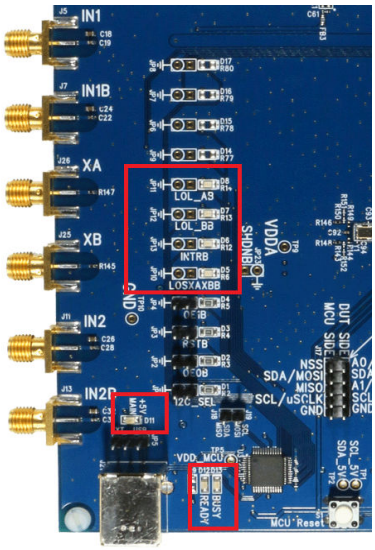

Figure 5.1. Status LEDs

6. Clock Input Circuits (INx/INxB)

The Si5396J-A-EVB has eight SMA connectors (IN0/IN0B–IN3/IN3B) for receiving external clock signals. All input clocks are terminated as shown in Figure 6.1 Input Clock Termination Circuit on page 8 below. Note input clocks are ac-coupled and 50 Ω terminated. This represents four differential input clock pairs. Single-ended clocks can be used by appropriately driving one side of the differential pair with a single-ended clock. For details on how to configure inputs as single-ended, please refer to the Si5396 data sheet. Typically a 0.1 µF dc block is sufficient, however, 10 µF may be needed for lower input frequencies. Note that the EVB is populated with both dc block capacitor values.

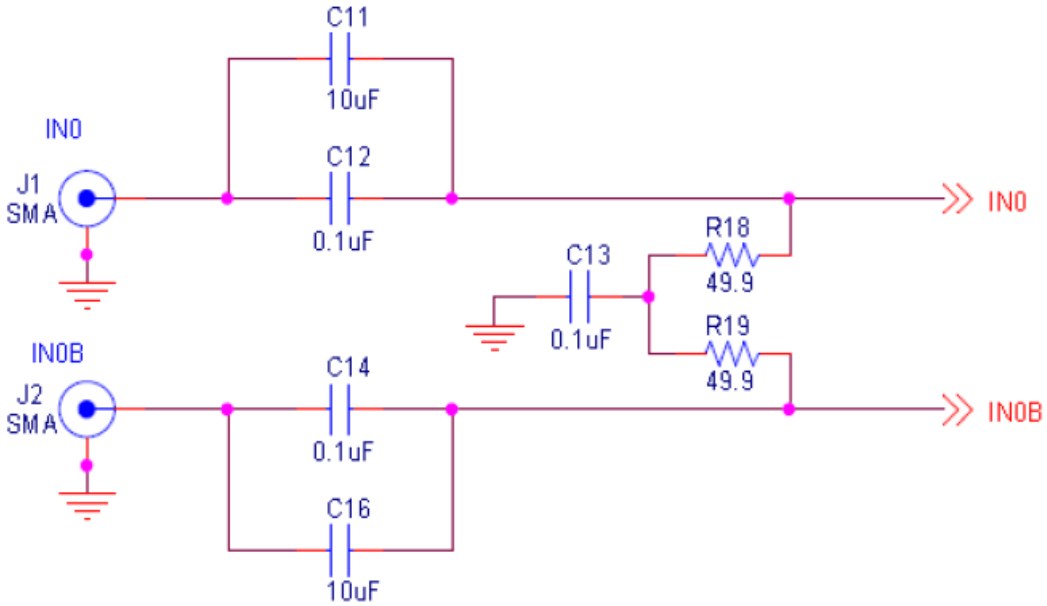

Figure 6.1. Input Clock Termination Circuit

7. Clock Output Circuits (OUTx/OUTxB)

Each of the eight output drivers (four differential pairs) is ac-coupled to its respective SMA connector. The output clock termination circuit is shown in Figure 7.1 Output Clock Termination Circuit on page 9 below. The output signal will have no dc bias. If dc coupling is required, the ac coupling capacitors can be replaced with a resistor of appropriate value. The Si5396J-A-EVB provides an L-network at OUT0/OUT0B output pins for optional output termination resistors. Note that components with schematic “NI” designation are not normally populated.

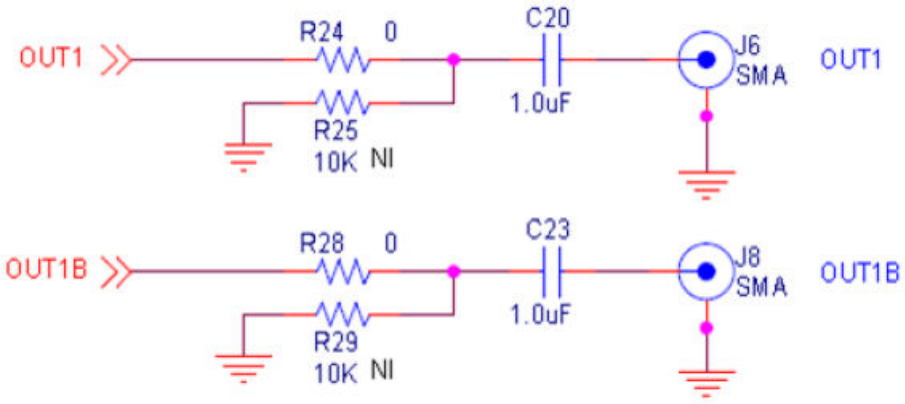

Figure 7.1. Output Clock Termination Circuit

8. External Reference Clock (XA/XB) Not Supported

The Si5396J-A-EVB does not support an external reference clock on XA/XB. The layout for the external XTAL is on the board, but the EVB for this part is an embedded XTAL version only and therefore this circuit should remain disconnected and unused.

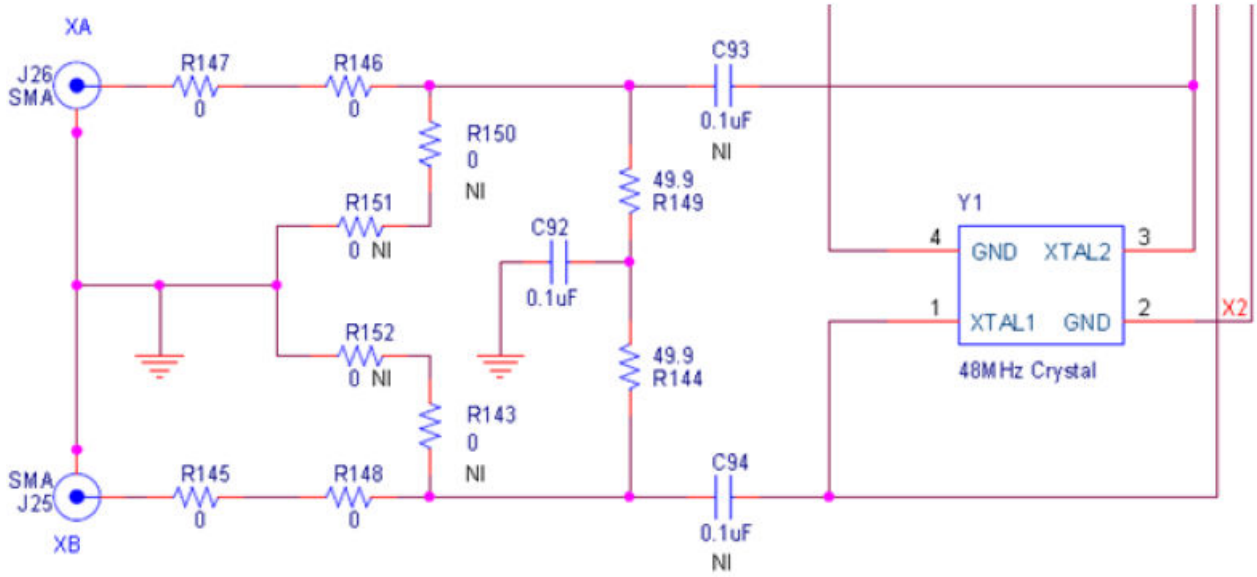

Figure 8.1. External Reference Clock Termination Circuit

9. Installing ClockBuilder Pro Desktop Software

To install the CBOPro software on any Windows 7 (or above) PC:

Go to http://www.silabs.com/CBPro and download ClockBuilder Pro software.

Installation instructions and User's Guide for ClockBuilder Pro can be found at the download link shown above. Please follow the instructions as indicated.

10. Using the Si5396J-A-EVB

10.1 Connecting the EVB to Your Host PC

Once ClockBuilder Pro software is installed, connect to the EVB with a USB cable as shown below.

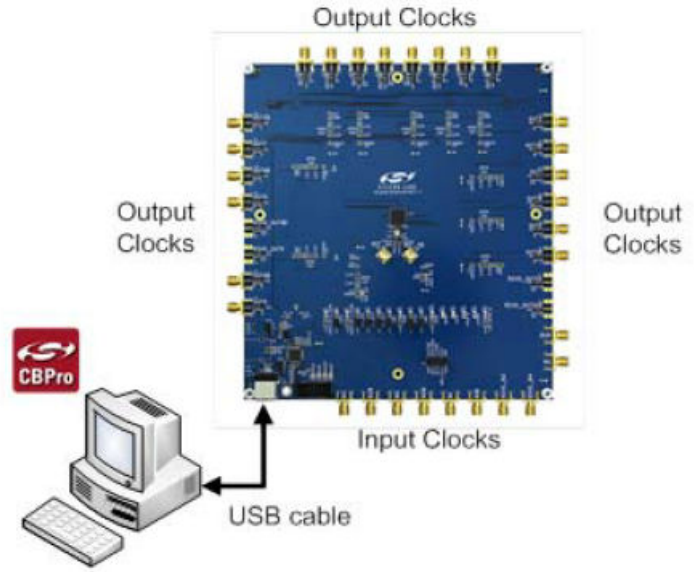

Figure 10.1. EVB Connection Diagram

10.2 Overview of ClockBuilder Pro Applications

The following instructions and screen captures may vary slightly depending on the version of ClockBuilder Pro. (The screen captures below were taken for a board labeled "SI5396J-A-EB".) The ClockBuilder Pro installer will install two main applications:

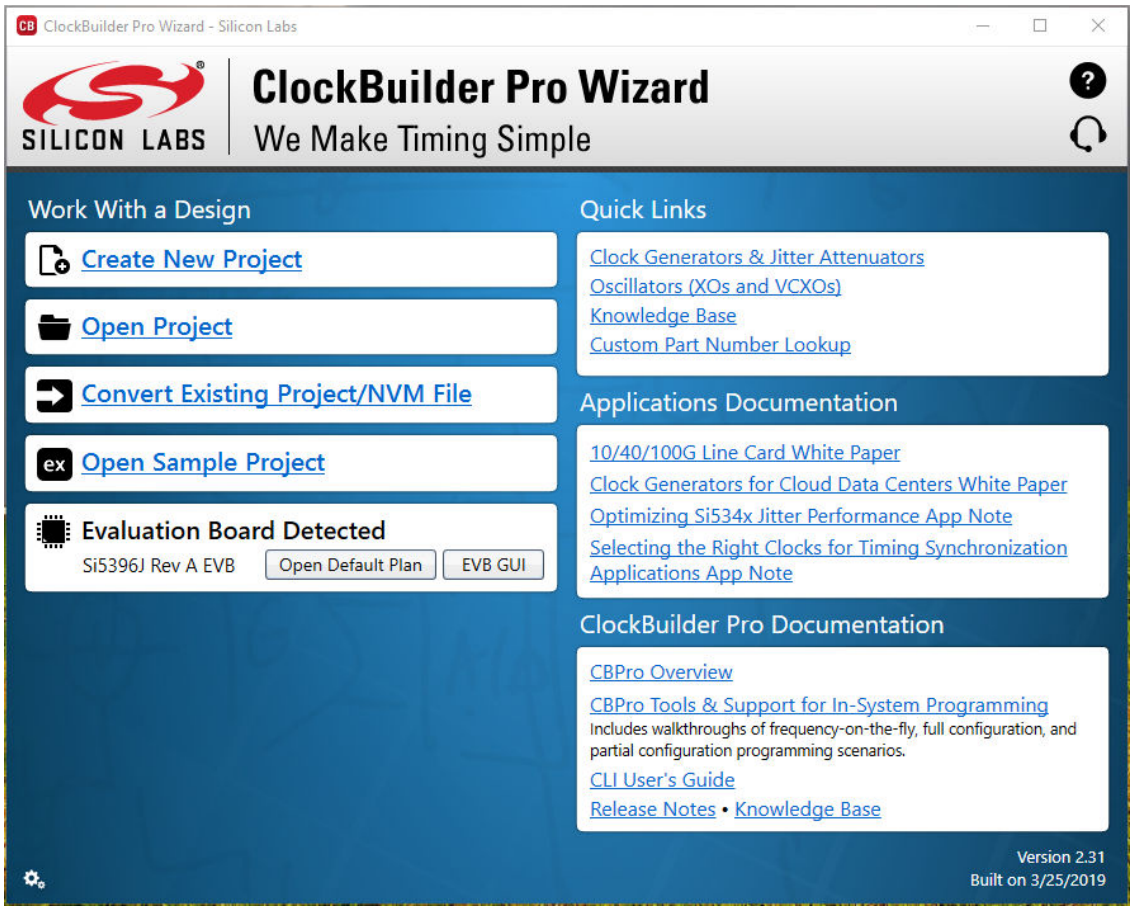

Figure 10.2. Application #1: ClockBuilder Pro Wizard

Use the CBPro Wizard to:

- Create a new design
- Review or edit an existing design
- Export: create in-system programming

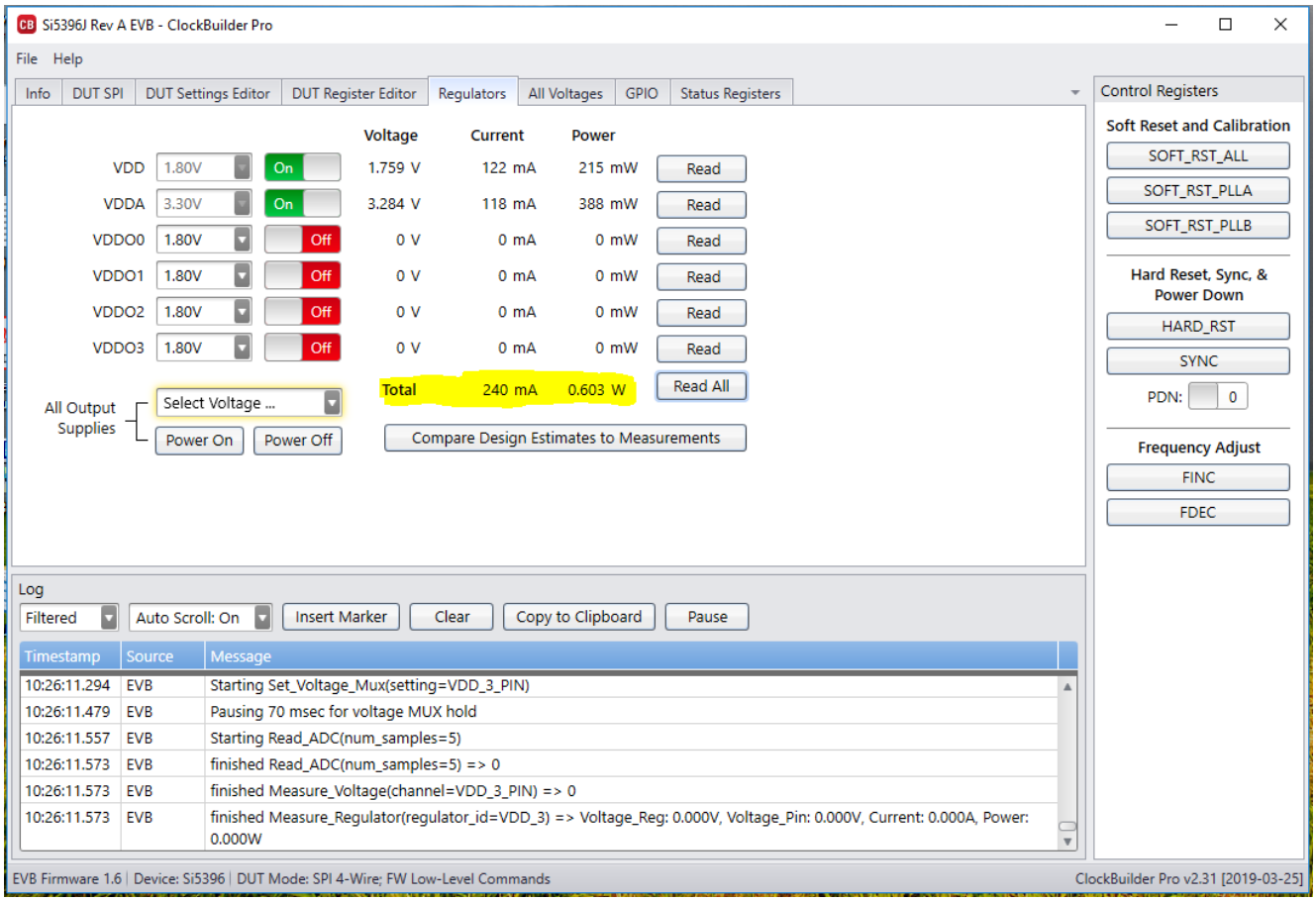

Figure 10.3. Application #2: EVB GUI

Use the EVB GUI to:

- Download configuration to EVB's DUT (Si5396)
- Control the EVB's regulators
- Monitor voltage, current, power on the EVB

10.3 Common ClockBuilder Pro Work Flow Scenarios

There are three common workflow scenarios when using CBPro and the Si5396J-A-EVB. These workflow scenarios are:

- Workflow Scenario #1: Testing a Silicon Labs-Created Default Configuration
- Workflow Scenario #2: Modifying the Default Silicon Labs-Created Device Configuration
- Workflow Scenario #3: Testing a User-Created Device Configuration

Each is described in more detail in the following sections.

10.4 Workflow Scenario #1: Testing a Silicon Labs-Created Default Configuration

The flow for using the EVB GUI to initialize and control a device on the EVB is as follows.

Once the PC and EVB are connected, launch ClockBuilder Pro by clicking on this icon on your PC's desktop.

Figure 10.4. ClockBuilder Pro Desktop Icon

If an EVB is detected, click on the "Open Default Plan" button on the Wizard's main menu. CBPro automatically detects the EVB and device type.

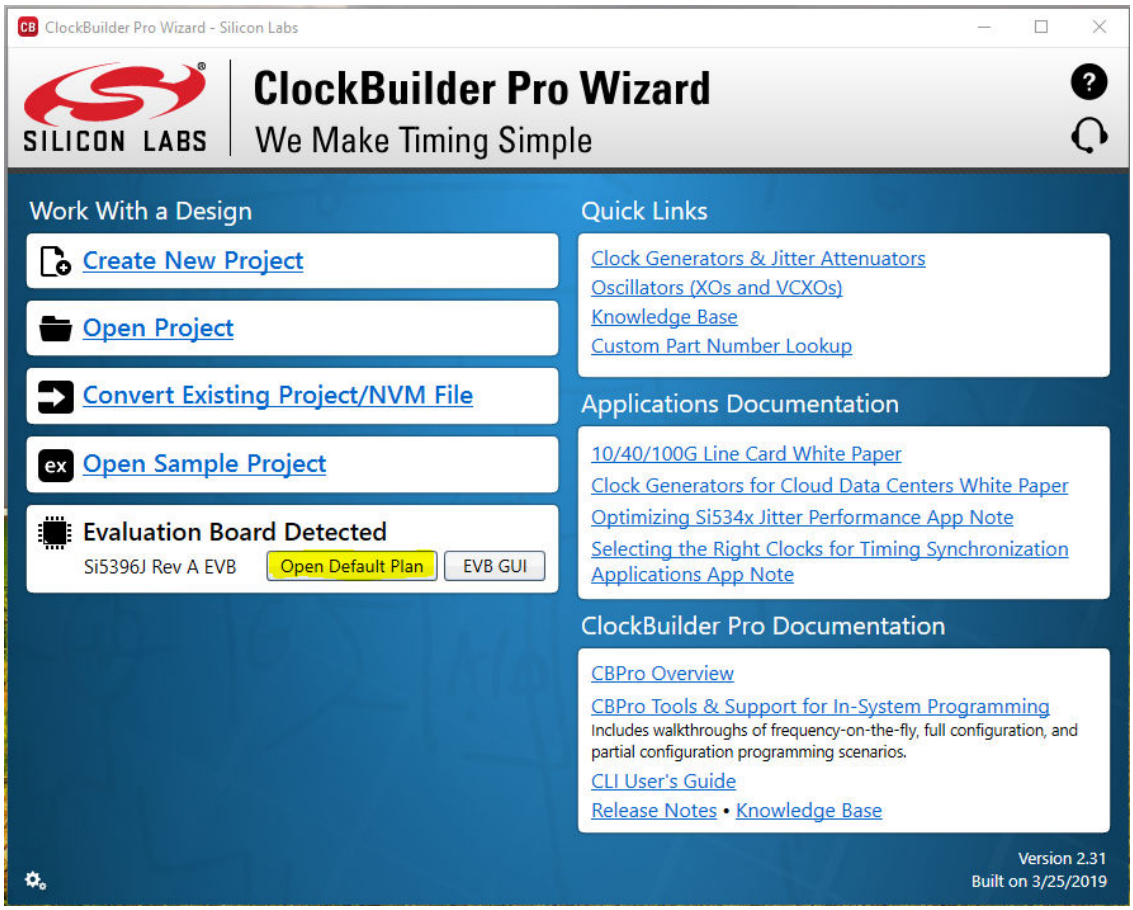

Figure 10.5. Open Default Plan

Once you open the default plan (based on your EVB model number), a popup will appear.

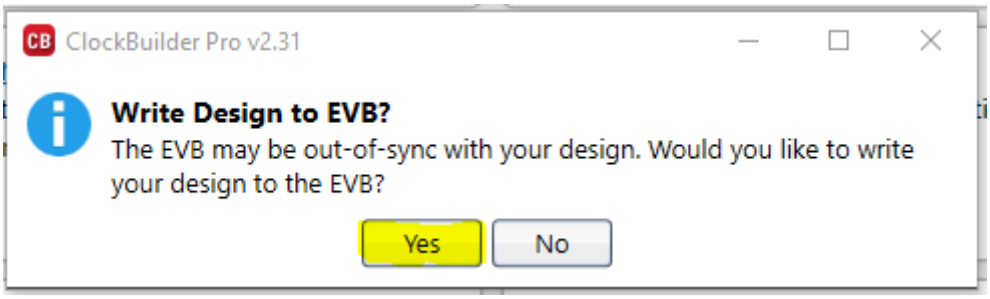

Figure 10.6. Write Design to EVB Dialog

Select “Yes” to write the default plan to the Si5396 device mounted on your EVB. This ensures the device is completely reconfigured per the Silicon Labs default plan for the DUT type mounted on the EVB.

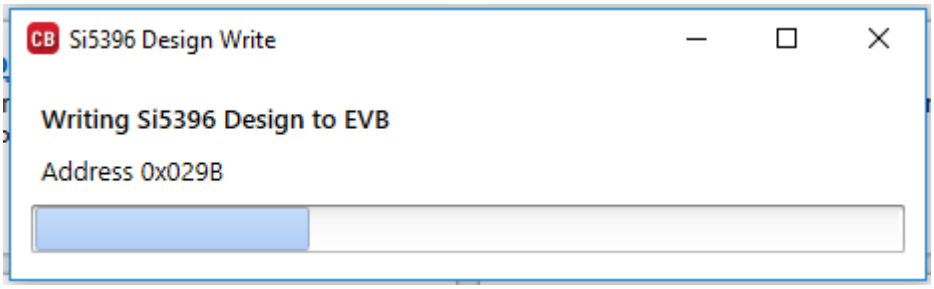

Figure 10.7. Writing Design Status

After CBPro writes the default plan to the EVB, click on “Open EVB GUI” as shown below.

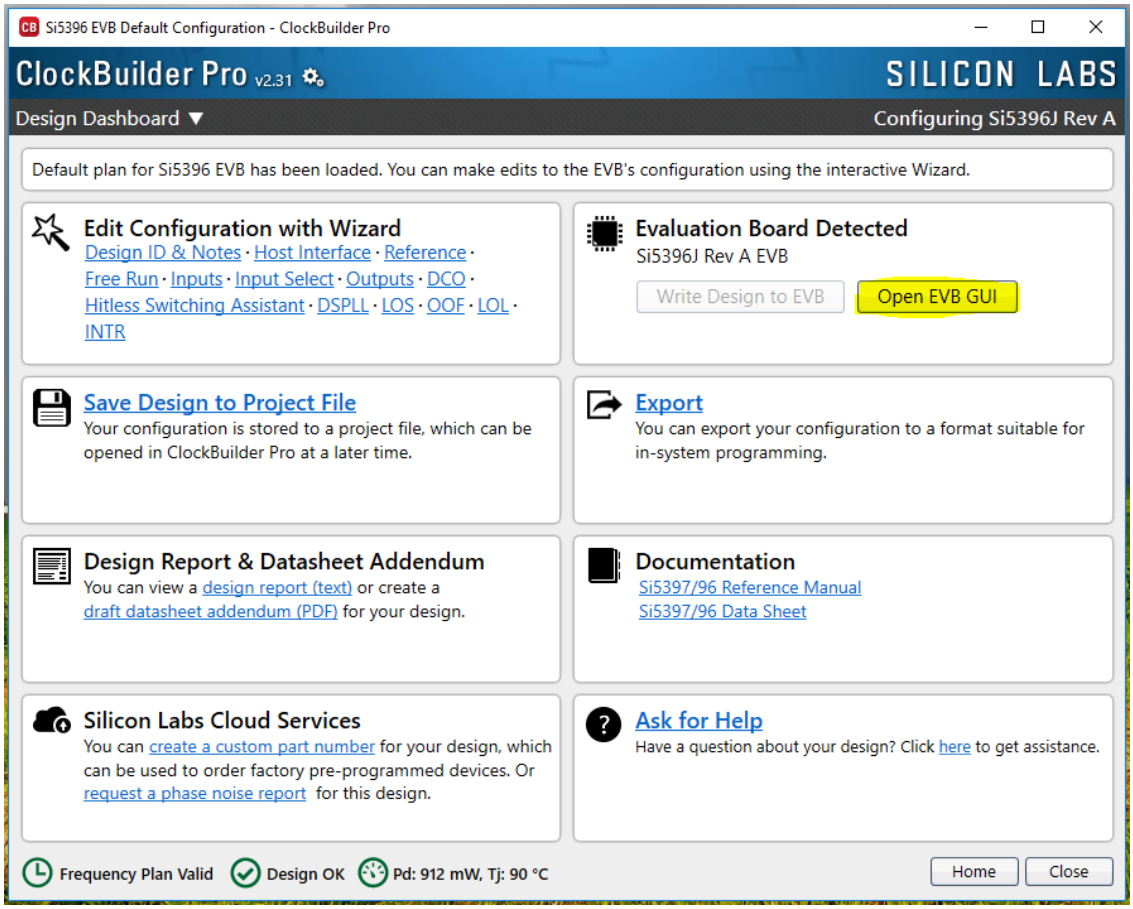

Figure 10.8. Open EVB GUI

The EVB GUI will appear. Note all power supplies will be set to the values defined in the device default CBPro project file created by Silicon Labs, as shown below.

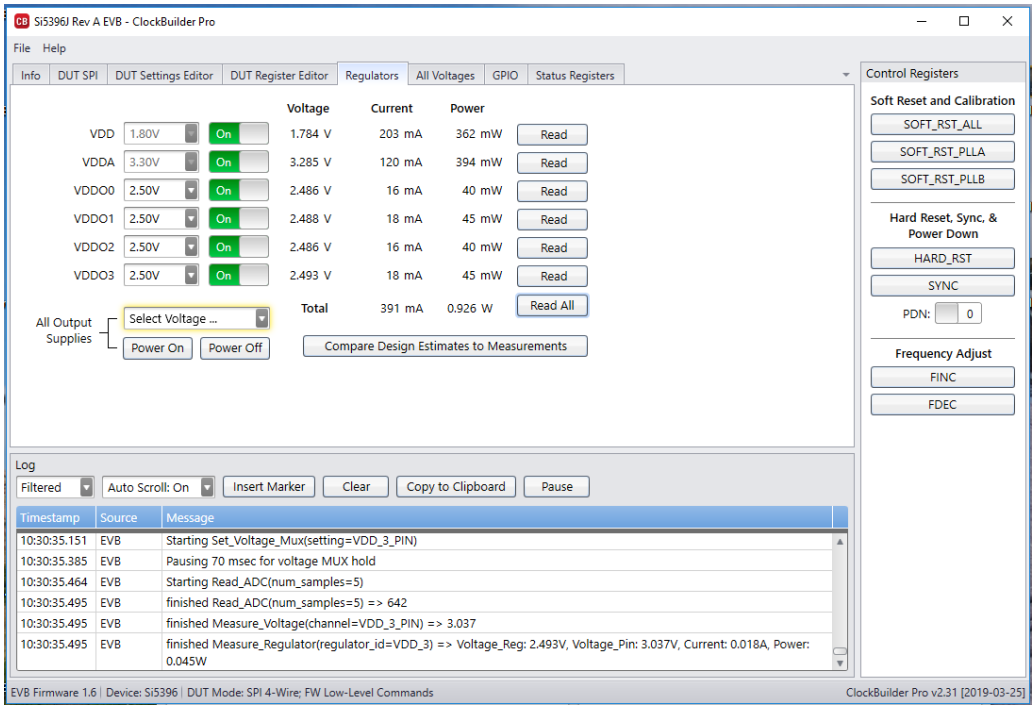

Figure 10.9. EVB GUI Window

10.4.1 Verify Free-Run Mode Operation

Assuming no external clocks have been connected to the INPUT CLOCK differential SMA connectors (labeled “INx/INxB”) located around the perimeter of the EVB, the DUT should now be operating in free-run mode, as the DUT will be locked to the crystal in this case.

You can run a quick check to determine if the device is powered up and generating output clocks (and consuming power) by clicking on the Read All button highlighted above and then reviewing the voltage, current and power readings for each VDDx supply.

Note: Shutting “Off” then “On” of the VDD and VDDA supplies will power-down and reset the DUT. Every time you do this, to reload the Silicon Labs-created default plan into the DUT’s register space, you must go back to the Wizard’s main menu and select “Write Design to EVB” as shown below.

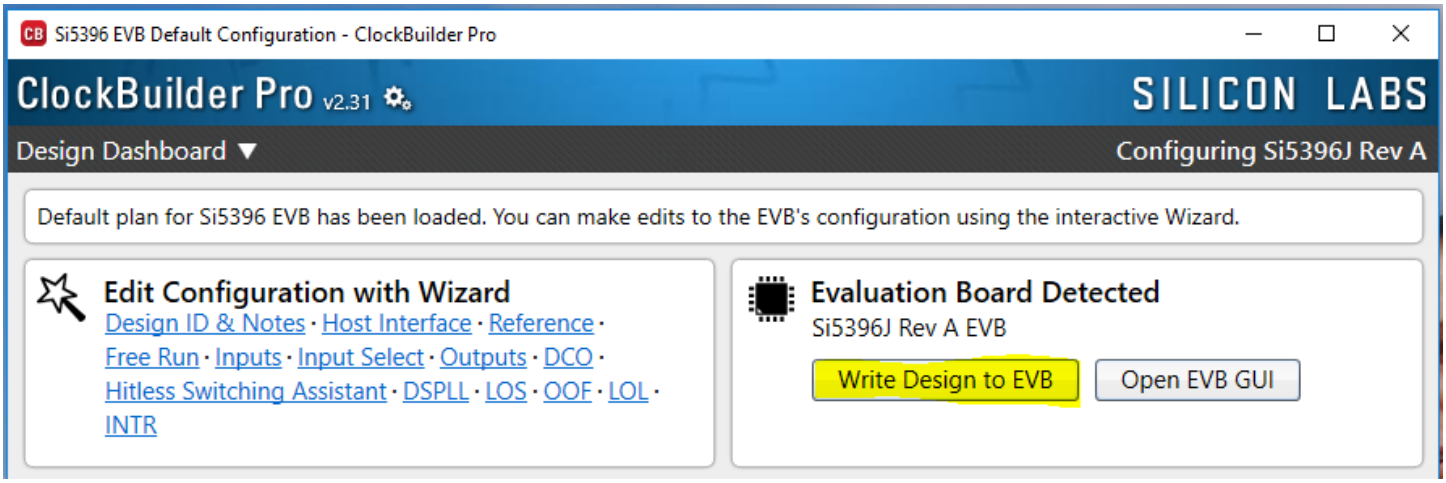

Figure 10.10. Write Design to EVB

Failure to do the step above will cause the device to read in a pre-programmed plan from its non-volatile memory (NVM). However, the plan loaded from the NVM may not be the latest plan recommended by Silicon Labs for evaluation.

At this point, you should verify the presence and frequencies of the output clocks (running to free-run mode from the crystal) using appropriate external instrumentation connected to the output clock SMA connectors. To verify the output clocks are toggling at the correct frequency and signal format, click on View Design Report as highlighted below.

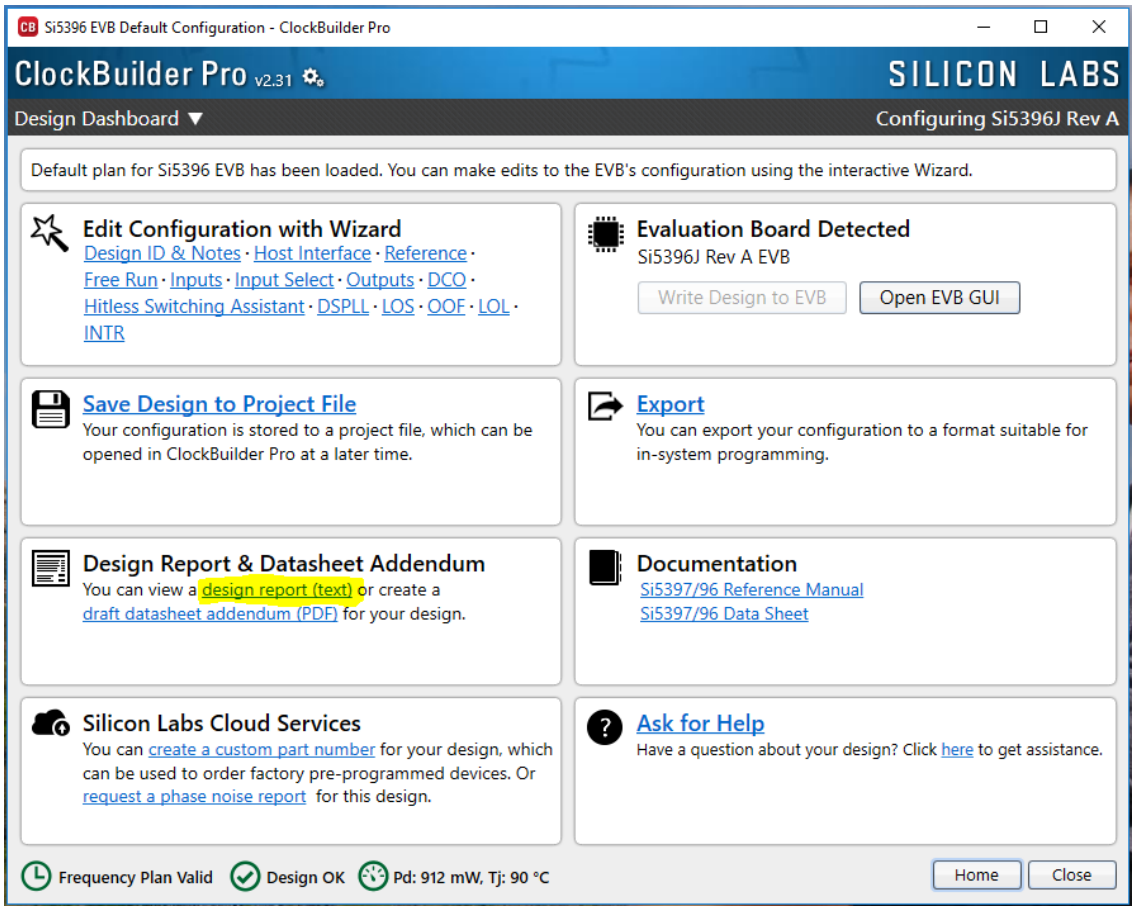

Figure 10.11. View Design Report

Your configuration's design report will appear in a new window, as shown below. Compare the observed output clocks to the frequencies and formats noted in your default project's Design Report.

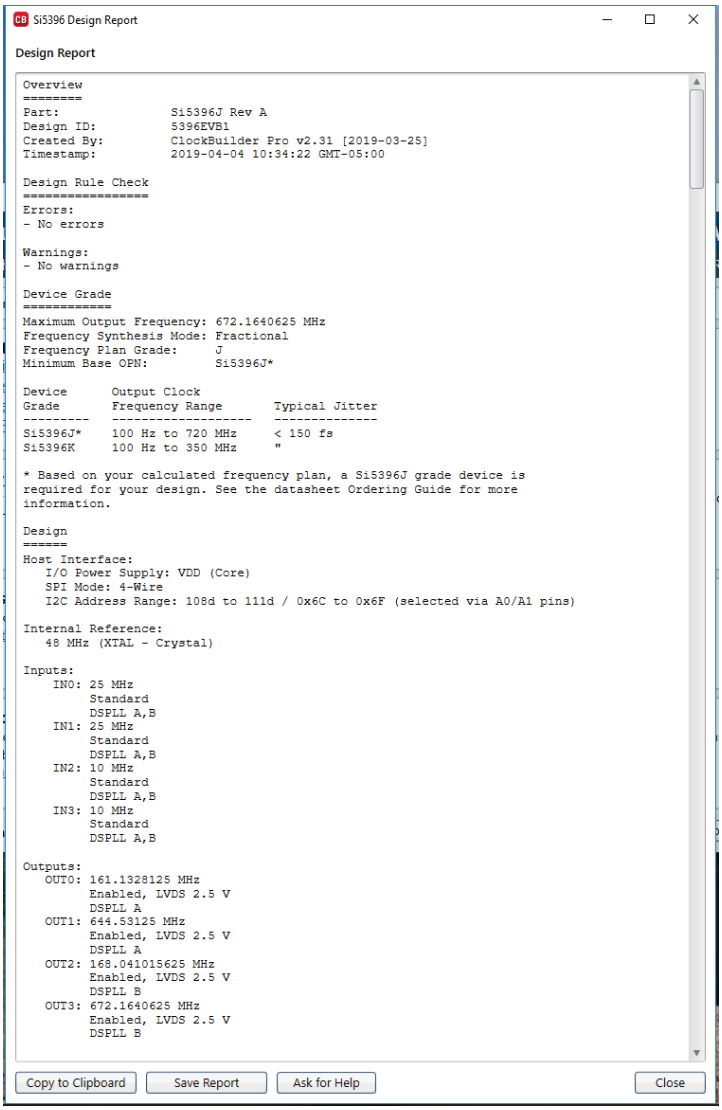

Figure 10.12. Design Report Window

10.4.2 Verify Locked Mode Operation

Assuming you connect the correct input clocks to the EVB (as noted in the Design Report shown above), the DUT on your EVB will be running in "locked" mode.

10.5 Workflow Scenario #2: Modifying the Default Silicon Labs-Created Device Configuration

To modify the “default” configuration using the CBPro Wizard, click on Edit Configuration with Wizard:

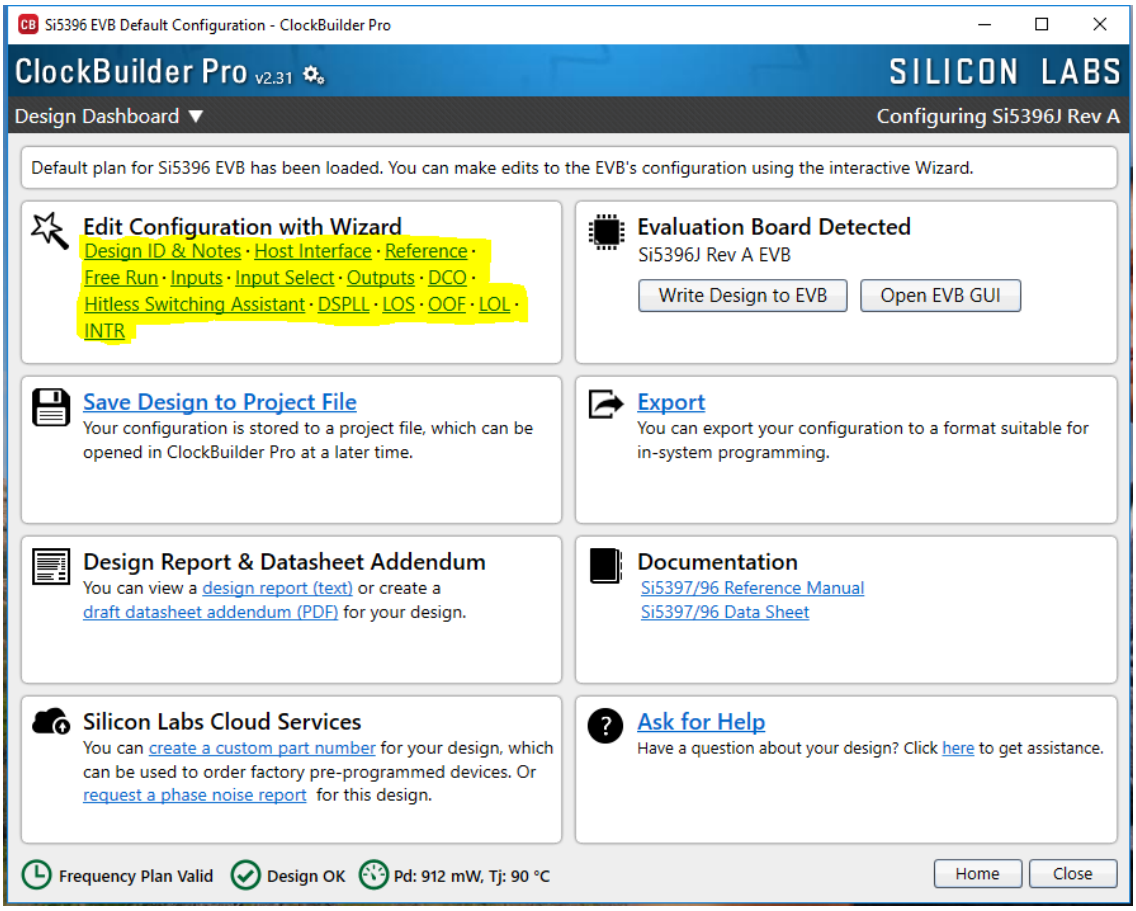

Figure 10.13. Edit Configuration with Wizard

You will now be taken to the Wizard’s step-by-step menus to allow you to change any of the default plan’s operating configurations.

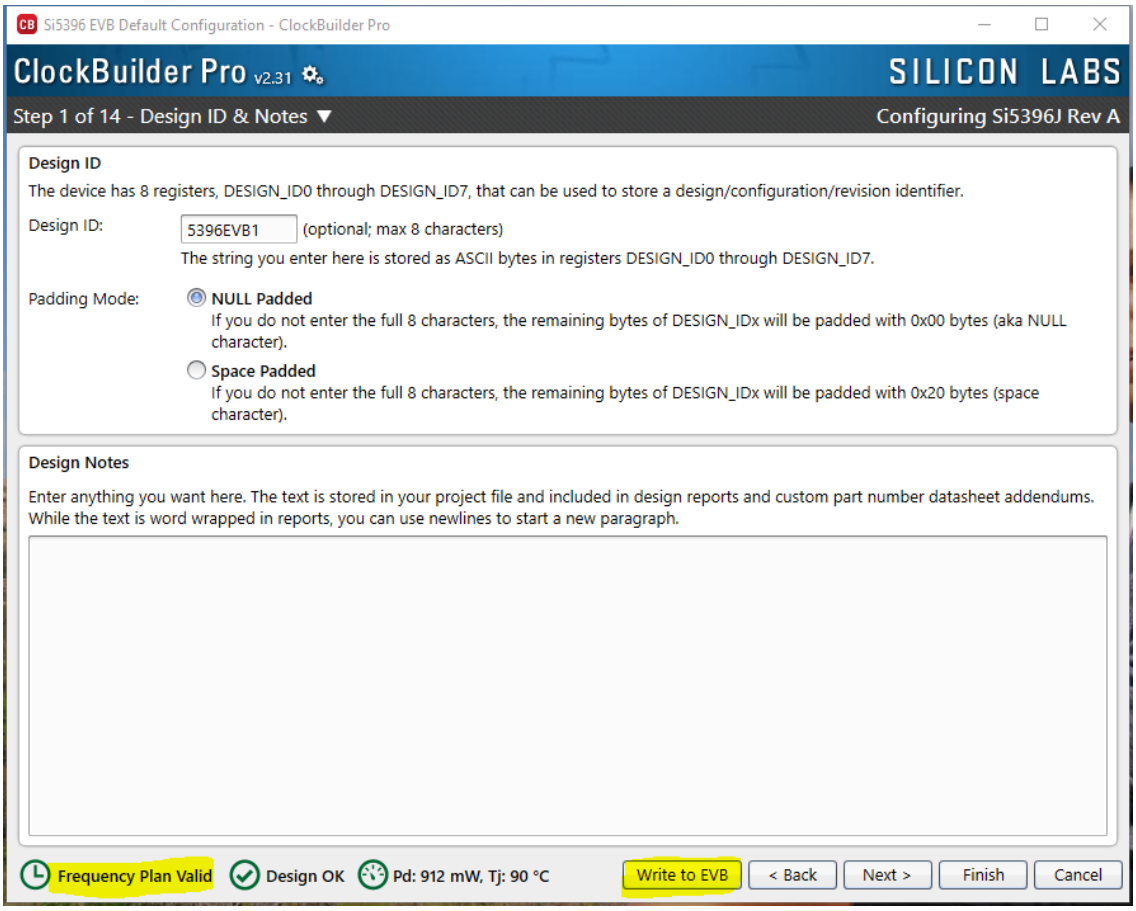

Figure 10.14. Design Wizard

Note you can click on the icon on the lower left hand corner of the menu to confirm if your frequency plan is valid. After making your desired changes, you can click on Write to EVB to update the DUT to reconfigure your device real-time. The Design Write status window will appear each time you make a change.

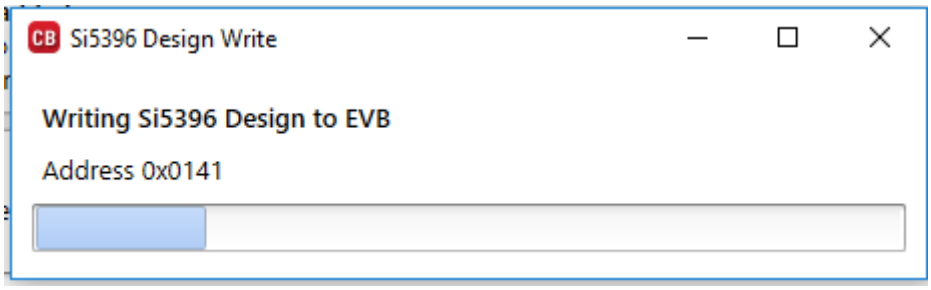

Figure 10.15. Writing Design Status

10.6 Workflow Scenario #3: Testing a User-Created Device Configuration

To test a previously created user configuration, open the CBPro Wizard by clicking on the icon on your desktop and then selecting Open Design Project File.

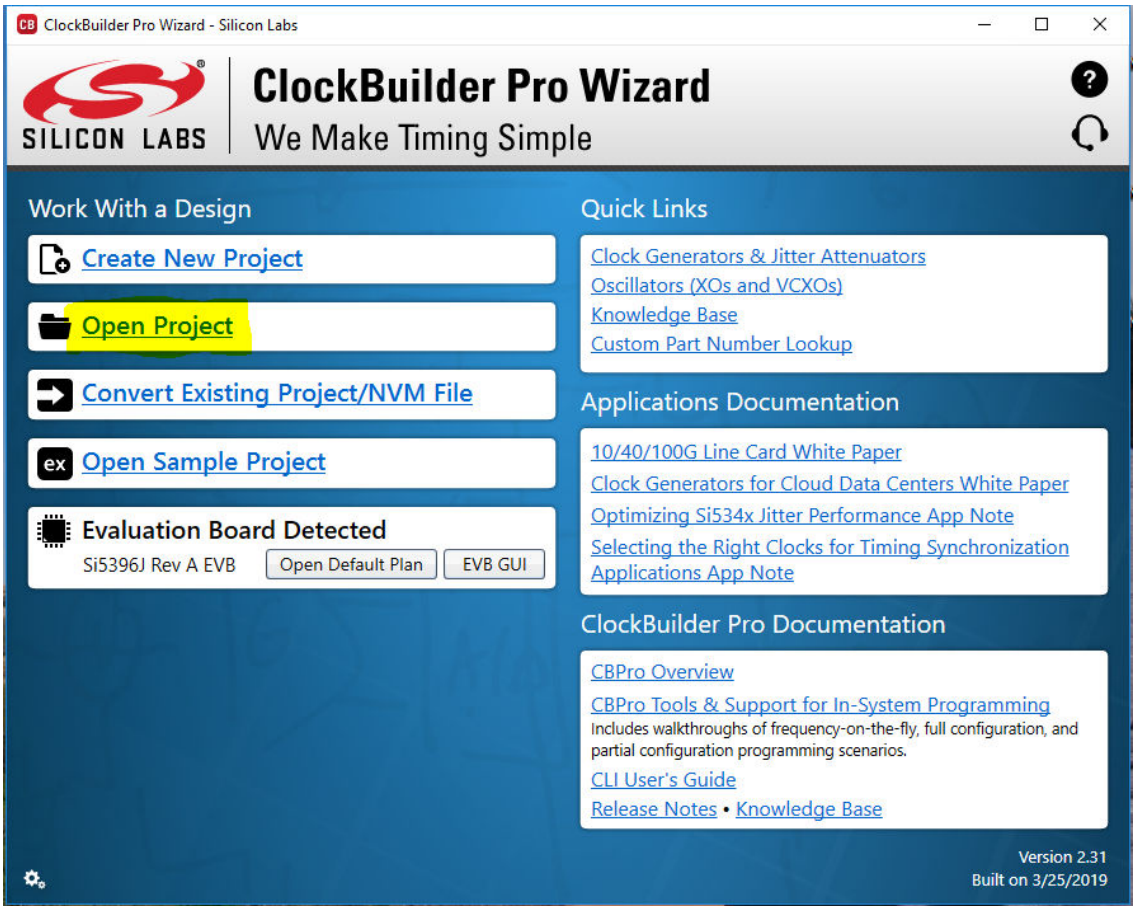

Figure 10.16. Open Design Project File

Locate your CBPro design file (*.slabtimeproj or *.sitproj file).design file in the Windows file browser.

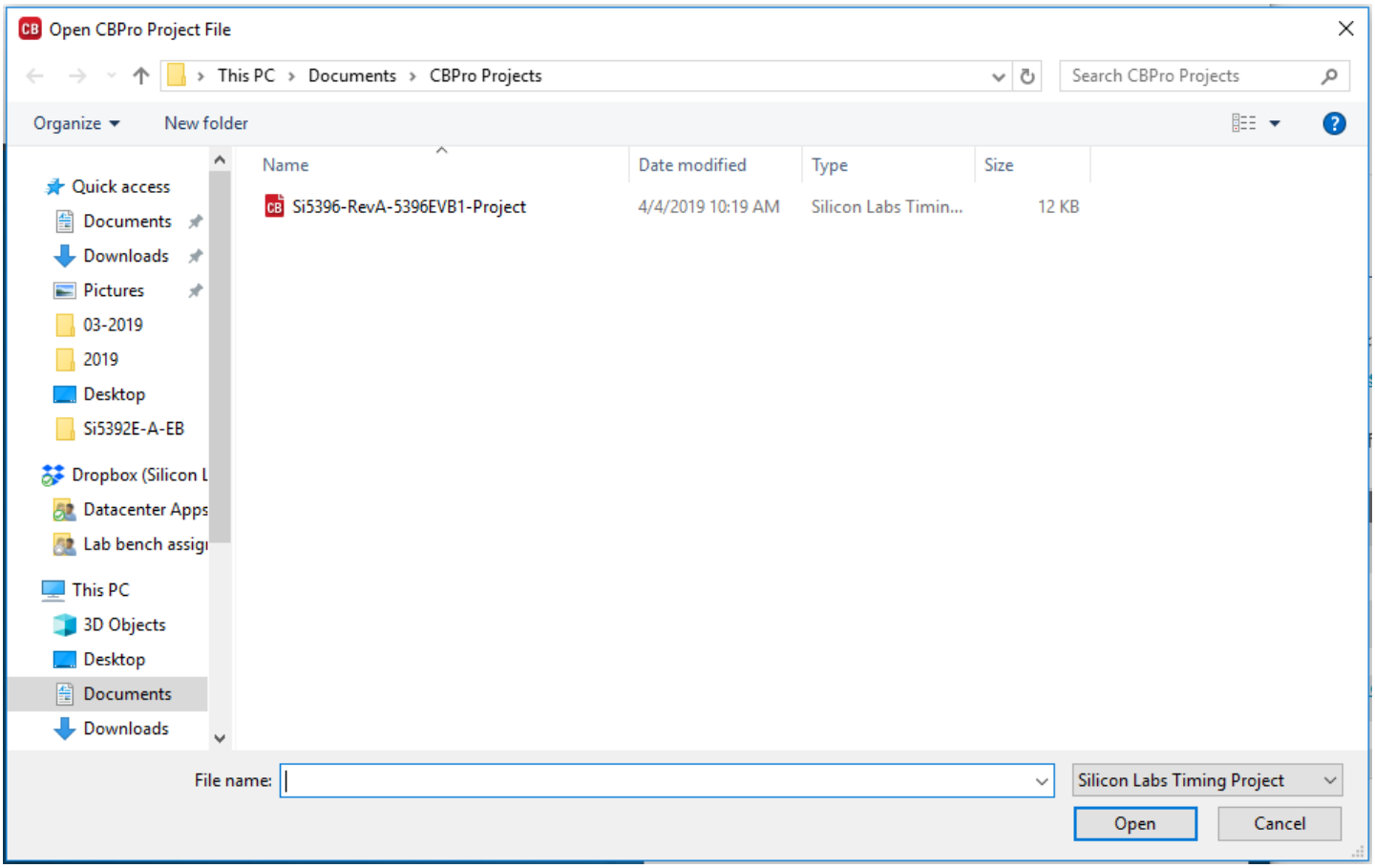

Figure 10.17. Browse to Project File

Select Yes when the WRITE DESIGN to EVB popup appears:

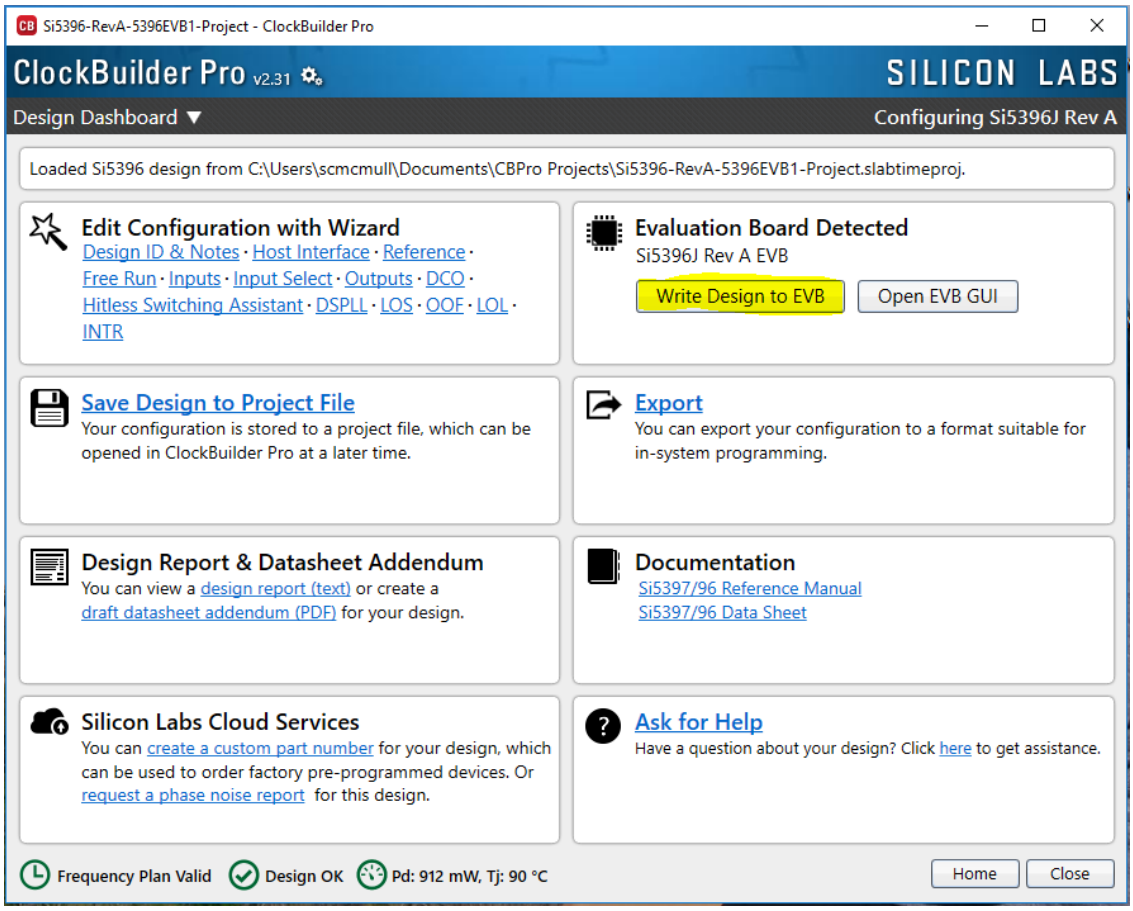

Figure 10.18. Write Design to EVB Dialog

The progress bar will be launched. Once the new design project file has been written to the device, verify the presence and frequencies of your output clocks and other operating configurations using external instrumentation.

10.7 Exporting the Register Map File for Device Programming by a Host Processor

You can also export your configuration to a file format suitable for in-system programming by selecting Export as shown below:

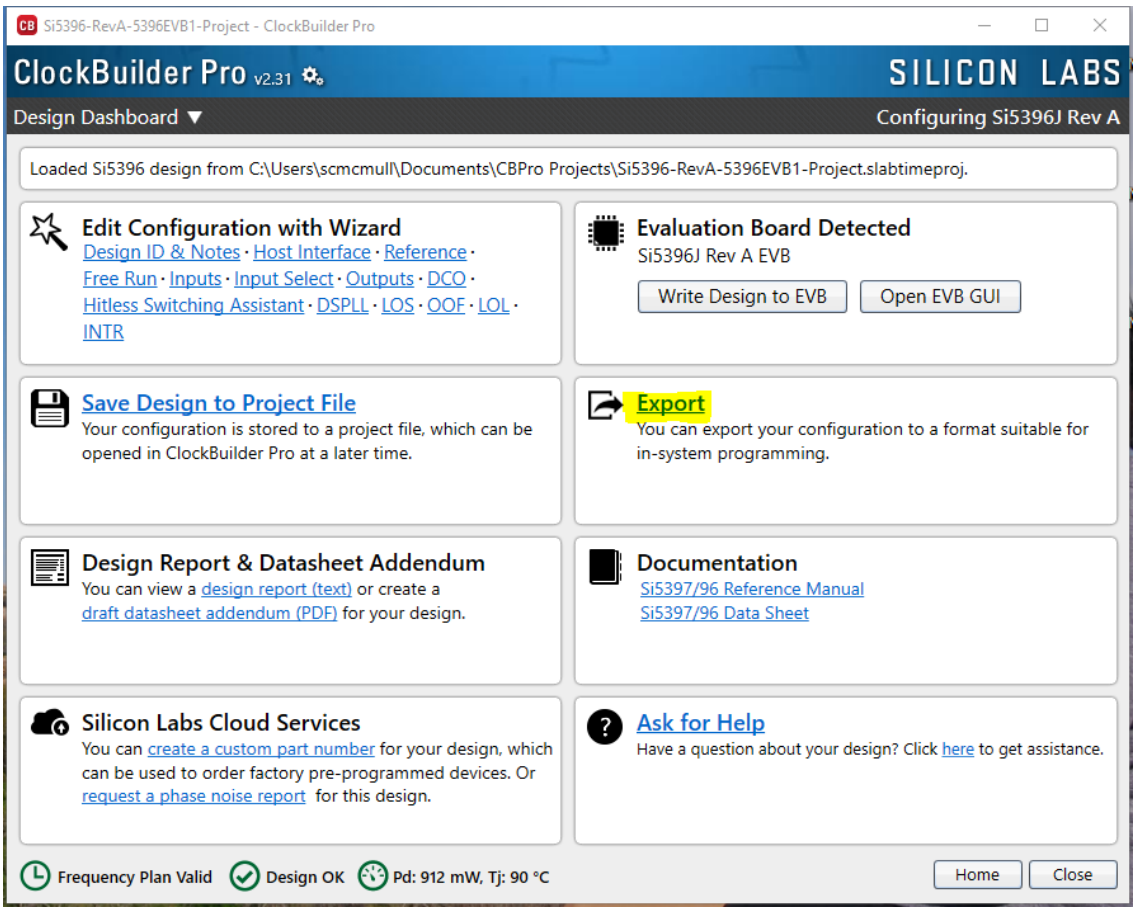

Figure 10.19. Export Register Map File

You can now write your device's complete configuration to file formats suitable for in-system programming.

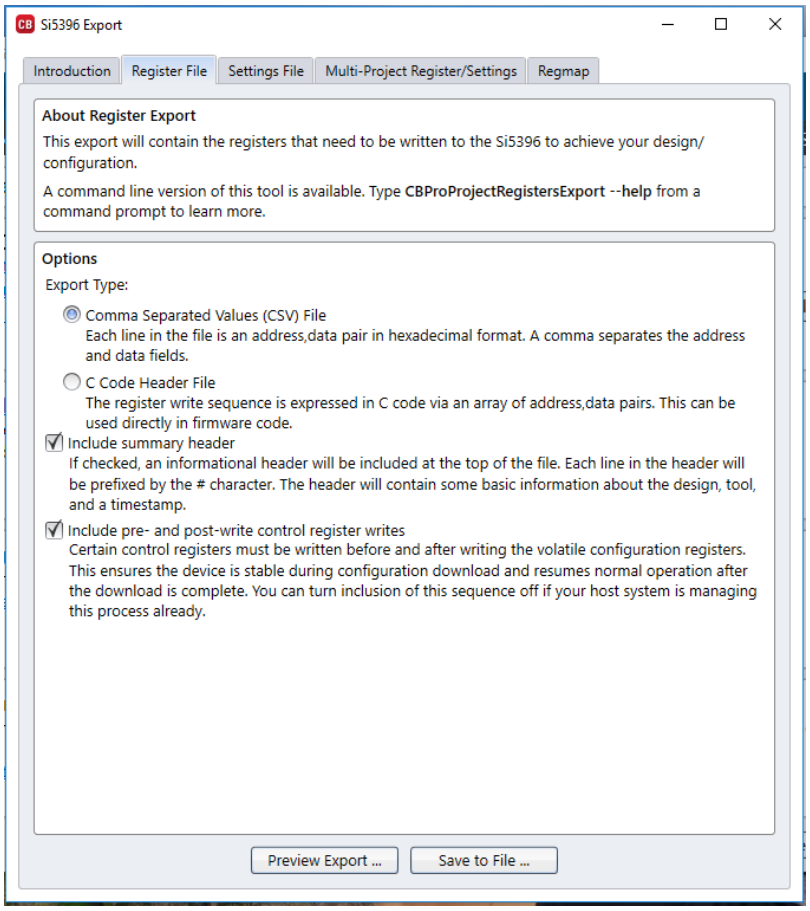

Figure 10.20. Export Settings

11. Writing a New Frequency Plan or Device Configuration to Non-Volatile Memory (OTP)

Note: Writing to the device non-volatile memory (OTP) is NOT the same as writing a configuration into the Si5396 using ClockBuilder Pro on the Si5396J-A-EVB. Writing a configuration into the EVB from ClockBuilder Pro is done using Si5396 RAM space and can be done virtually unlimited numbers of times. Writing to OTP is limited as described below.

Refer to the Si5397/96 Reference Manuals and device data sheets for information on how to write a configuration to the EVB DUT's non-volatile memory (OTP). The OTP can be programmed a maximum of two times only. Care must be taken to ensure the configuration desired is valid when choosing to write to OTP.

12. Serial Device Communications

12.1 Onboard SPI Support

The MCU onboard the Si5396J-A- EVB communicates with the Si5396 device through a 4-wire SPI (Serial Peripheral Interface) link. The MCU is the SPI master and the Si5396 device is the SPI slave. The Si5396 device can also support a 2-wire I^2C serial interface, although the Si5396 EVB does NOT support the I^2C mode of operation. SPI mode was chosen for the EVB because of the relatively higher speed transfers supported by SPI vs. I^2C.

12.2 External I^2C Support

I^2C can be supported if driven from an external I^2C controller. The serial interface signals between the MCU and Si5396 pass through shunts loaded on header J17. These jumper shunts must be installed in J17 for normal EVB operation using SPI with CBPro. If testing of I^2C operation via external controller is desired, the shunts in J17 can be removed thereby isolating the on-board MCU from the Si5396 device. The shunt at JP1 (I2C_SEL) must also be removed to select I^2C as Si5396 interface type. An external I^2C controller connected to the Si5396 side of J17 can then communicate to the Si5396 device. (For more information on I^2C signal protocol, please refer to the Si5396 data sheet.)

The figure below illustrates the J17 header schematic. J17 even numbered pins (2, 4, 6, etc.) connect to the Si5396 device and the odd numbered pins (1, 3, 5, etc.) connect to the MCU. Once the jumper shunts have been removed from J17 and JP1, I^2C operation should use J17 pin 4 (DUT_SDA_SDIO) as the I2C SDA and J17 pin 8 (DUT_SCLK) as the I^2C SCLK. Please note the external I^2C controller will need to supply its own I^2C signal pull-up resistors.

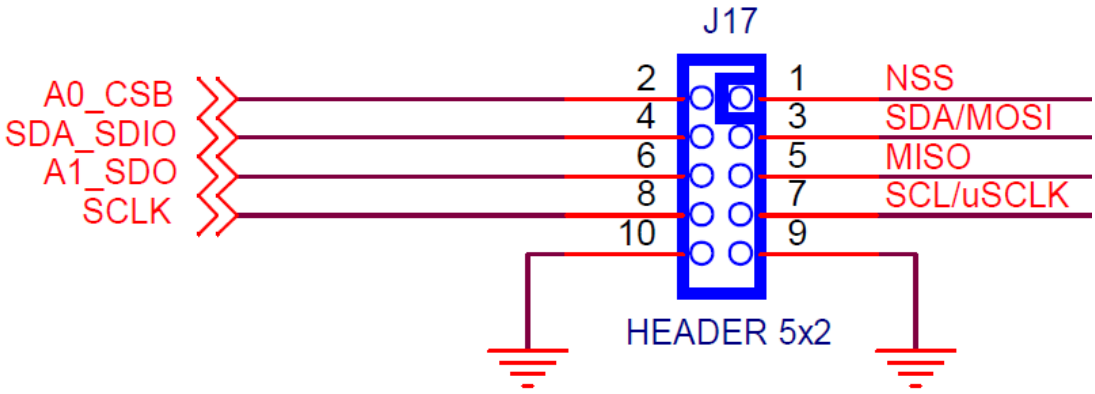

Figure 12.1. Serial Communications Header J17

13. Si5396J-A-EVB Schematic and Bill of Materials (BOM)

The Si5396J-A-EVB Schematic and Bill of Materials (BOM) can be found at www.silabs.com/documents/public/schematic-files/si539x-design-files.zip

Note: Please be aware that the Si5396J-A-EVB schematic is in OrCad Capture hierarchical format and not in a typical “flat” schematic format.

This document supports the evaluation board silkscreened Si5396J-A-EB for the following configurations as described in the table below. The data sheet documents the different Si5396 grades.

Table 13.1. Evaluation Board Configurations

Config #	Eval Board Label	Si5396		Notes
		Grade	Revision	
1	Si5396J-A-EB	J	A	No Crystal and related components installed.

Note:
1. The Si5396J-A-EB should be used to evaluate Si5396J/K/L/M plans.

14. Revision History

Revision 1.1

November, 2020

- Changed the front page description to specify 4 output 44-pin Si5396 device

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