Si5347-D Evaluation Board User's Guide

Description

The Si5347-D-EVB is used for evaluating the Si5347 Any-Frequency, Any-Output, Jitter-Attenuating Clock Multiplier revision D. The device revision is distinguished by a white 1 inch x 0.187 inch label with the text "SI5347-D-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.)

EVB Features

- Powered from USB port or external +5 V power supply via screw terminals.
- Onboard 48 MHz XTAL allows standalone or holdover mode of operation on the Si5347.
- CBPro™ GUI programmable V_{DD} supply allows device supply voltages of 3.3, 2.5, or 1.8 V.
- CBPro GUI programmable V_{DDO} supplies allow each of the 8 outputs to have its own supply voltage selectable from 3.3, 2.5, or 1.8 V.
- CBPro GUI allows control and measurement of voltage, current, and power of V_{DD} and all 8 V_{DDO} supplies.
- Status LEDs for power supplies and control/status signals of Si5347.
- SMA connectors for input clocks, output clocks and optional external timing reference clock.



Figure 1. Si5347-D Evaluation Board

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1. Si5347-D-EVB Functional Block Diagram

Below is a functional block diagram of the Si5347-D-EB. This evaluation board can be connected to a PC via the main USB connector for programming, control, and monitoring. See section “3. Quick Start” for more information.

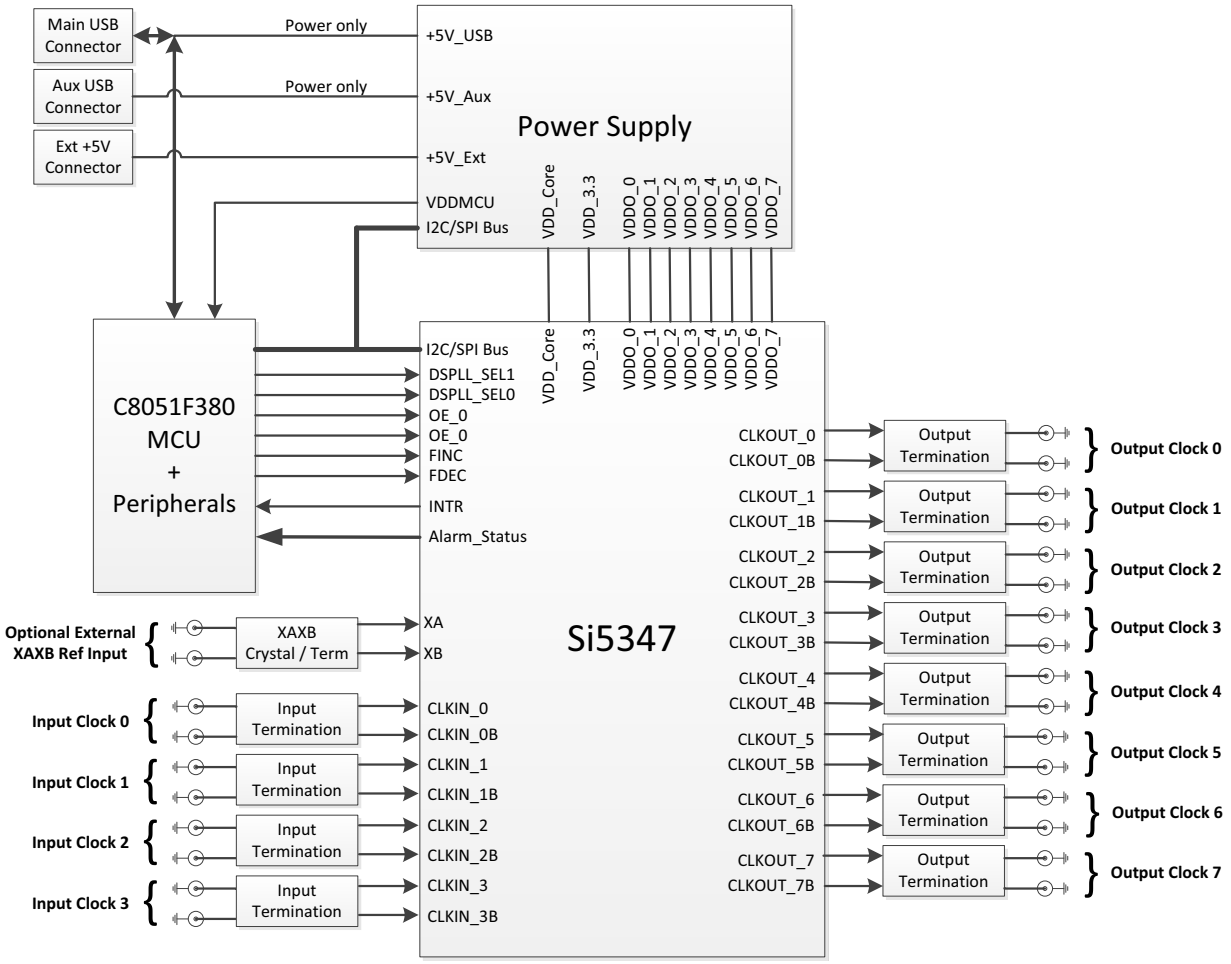


Figure 2. Si5347-D-EB Functional Block Diagram

2. Si5347-D-EVB Support Documentation and ClockBuilderPro™ Software

All Si5347-D-EVB schematics, BOMs, User's Guides, and software can be found online at the following link:
http:www.silabs.com/products/clocksoscillators/pages/si538x-4x-evb.aspx

3. Quick Start

1. Install ClockBuilderPro desktop software from EVB support web page given in Section 2.
2. Connect USB cable from Si5347-D-EB to PC with ClockBuilderPro software installed.
3. Leave the jumpers as installed from the factory, and launch the ClockBuilderPro software.
4. You can use ClockBuilderPro to create, download, and run a frequency plan on the Si5347-D-EB.
5. For the Si5347 data sheet, go to http://www.silabs.com/timing.

4. Jumper Defaults

Table 1. Si5347-D-EB Jumper Defaults

Location	Type	I = Installed 0 = Open		Location	Type	I = Installed 0 = Open
JP1	2 pin	I		JP23	2 pin	O
JP2	2 pin	O		JP24	2 pin	O
JP3	2 pin	I		JP25	2 pin	O
JP4	2 pin	I		JP26	2 pin	O
JP5	2 pin	O		JP27	2 pin	O
JP6	2 pin	O		JP28	2 pin	O
JP7	2 pin	I		JP29	2 pin	O
JP8	2 pin	O		JP30	2 pin	O
JP9	2 pin	O		JP31	2 pin	O
JP10	2 pin	I		JP32	2 pin	O
JP13	2 pin	O		JP33	2 pin	O
JP14	2 pin	I		JP34	2 pin	O
JP15	3 pin	all open		JP35	2 pin	O
JP16	3 pin	1 to 2		JP36	2 pin	O
JP17	2 pin	O		JP38	3 pin	All Open
JP18	2 pin	O		JP39	2 pin	O
JP19	2 pin	O		JP40	2 pin	I
JP20	2 pin	O		JP41	2 pin	I
JP21	2 pin	O		J36	5 x 2 Hdr	All 5 installed
JP22	2 pin	O				

***Note:** *Refer to the Si5347-D-EB schematics for the functionality associated with each jumper.*

5. Status LEDs

Table 2. Si5347-D-EB Status LEDs

Location	Silkscreen	Color	Status Function Indication
D27	5VUSBMAIN	Blue	Main USB +5 V present
D22	3P3V	Blue	DUT +3.3 V is present
D26	VDD DUT	Blue	DUT VDD Core voltage present
D25	INTR	Red	MCU INTR (Interrupt) active
D21	READY	Green	MCU Ready
D24	BUSY	Green	MCU Busy
D2	LOS_XAXB_B	Blue	Loss of Signal at XAXB input
D5	LOL_AB	Blue	Loss of Lock - DSPLL A
D6	LOL_BB	Blue	Loss of Lock - DSPLL B
D8	LOL_CB	Blue	Loss of Lock _ DSPLL C
D11	INTRB	Blue	Si5347 Interrupt Active
D12	LOL_DB	Blue	Loss of Lock _ DSPLL D

D27, D22, and D26 are illuminated when USB +5 V, Si5347 +3.3 V, and Si5347 Vcore supply voltages, respectively, are present. D25, D21, and D24 are status LEDs showing on-board MCU activity. D2 indicates loss of signal at XAXB input (either crystal osc or external reference). D5, D6, D8, D12 indicate loss of lock for one of 4 internal DSPLLs (A–D). D11 indicates Si5347 interrupt output is active (as configured by Si5347 register programming). LED locations are highlighted below with LED function name indicated on board silkscreen.

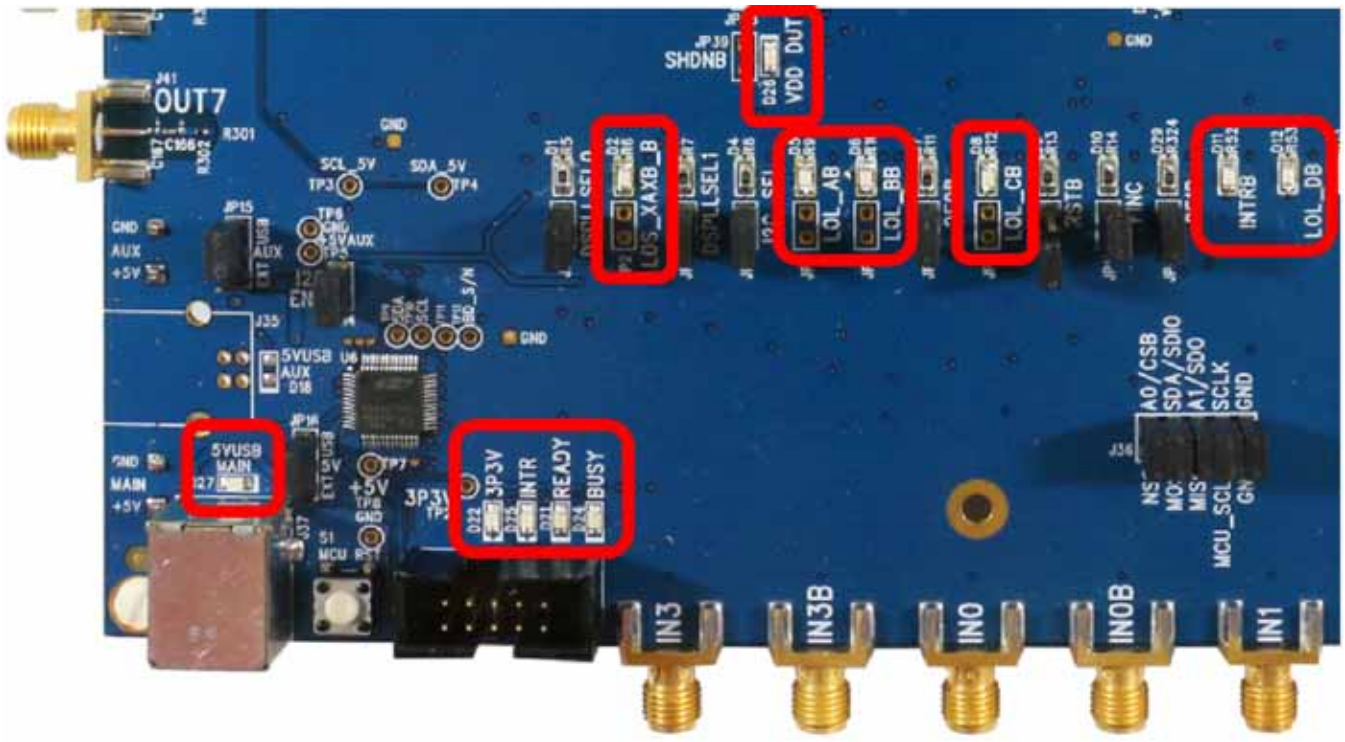


Figure 3. Si5347-D-EB LED Locations

6. External Reference Input (XA/XB)

An external timing reference (48 MHz XTAL) is used in combination with the internal oscillator to produce an ultra-low jitter reference clock for the DSPLL and for providing a stable reference for the free-run and holdover modes. The Si5347-D-EB can also accommodate an external reference clock instead of a crystal. To evaluate the device with an external REFCLK, C111 and C113 must be populated and XTAL Y1 removed (see Figure 4 below). The REFCLK can then be applied to SMA connectors J39 and J40.

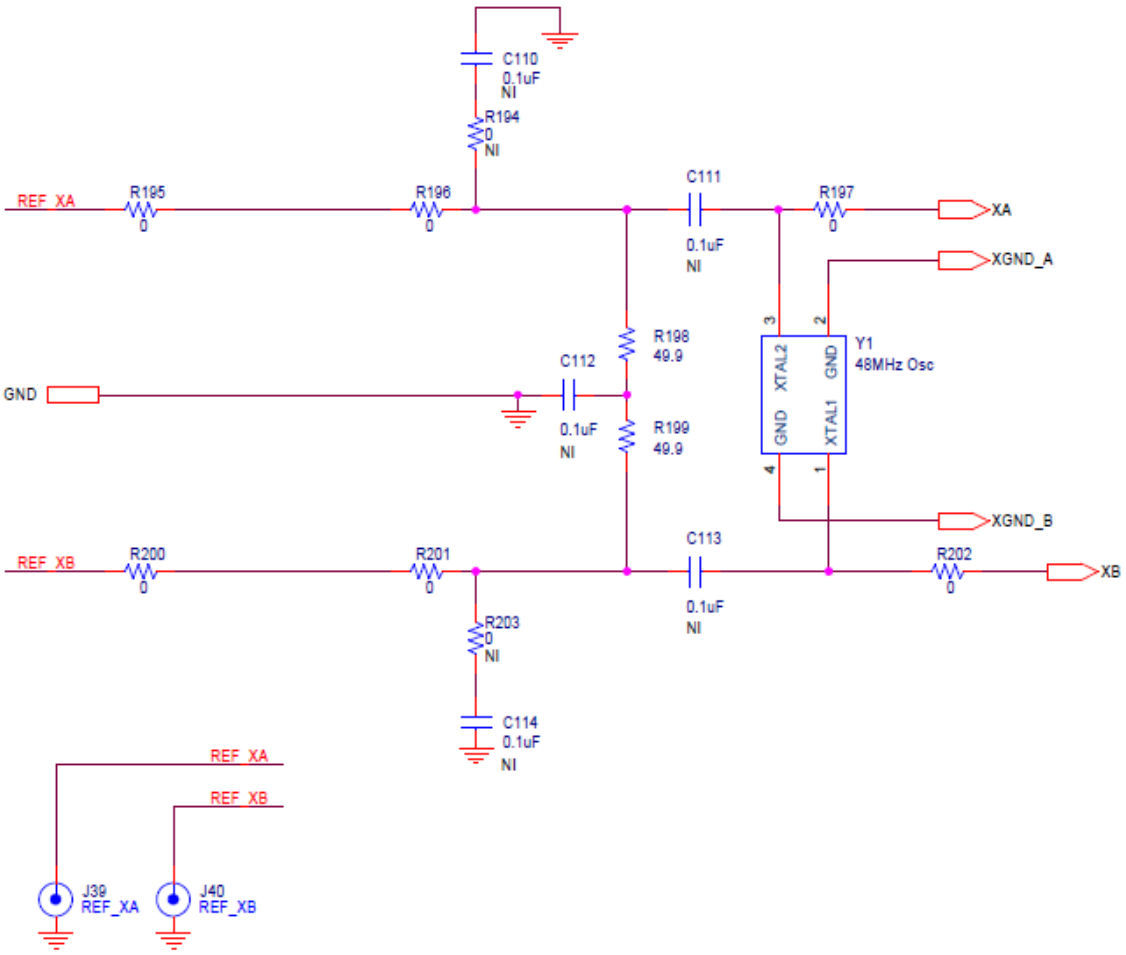


Figure 4. External Reference Input Circuit

7. Clock Input Circuits (INx/INxB)

The Si5347-D-EB has eight SMA connectors (IN0-IN0B—IN3./IN3B) for receiving external clock signals. All input clocks are terminated as show in Figure 5 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 Si5347 data sheet.

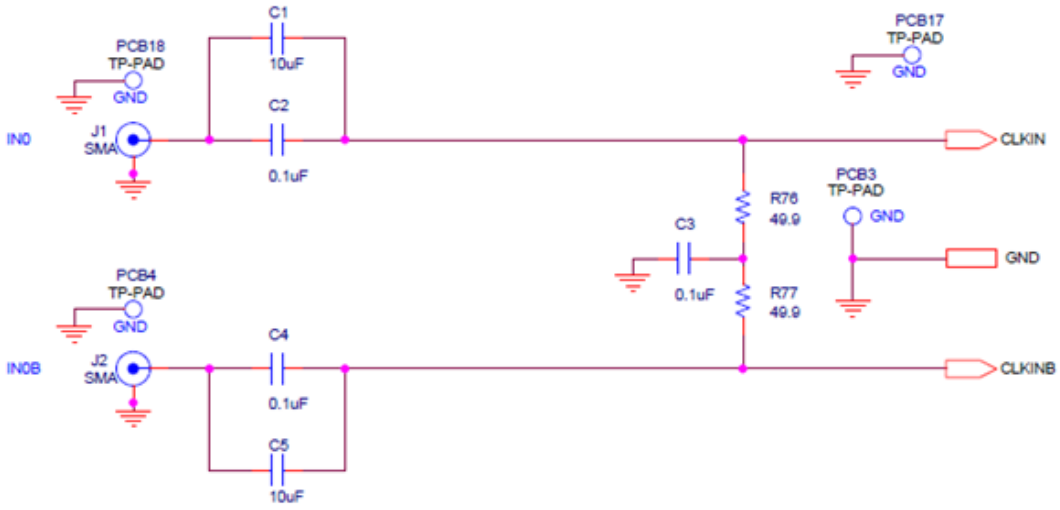


Figure 5. Input Clock Termination Circuit

8. Clock Output Circuits (OUTx/OUTxB)

Each of the sixteen output drivers (eight differential pairs, OUT0/OUT0B—OUT7/OUT7B) is ac-coupled to its respective SMA connector. The output clock termination circuit is shown in Figure 6 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 Si5347-D-EB provides pads for optional output termination resistors and/or low frequency capacitors. Note that components with schematic “NI” designation are not normally populated on the Si5347-D-EB and provide locations on the PCB for optional dc/ac terminations by the end user.

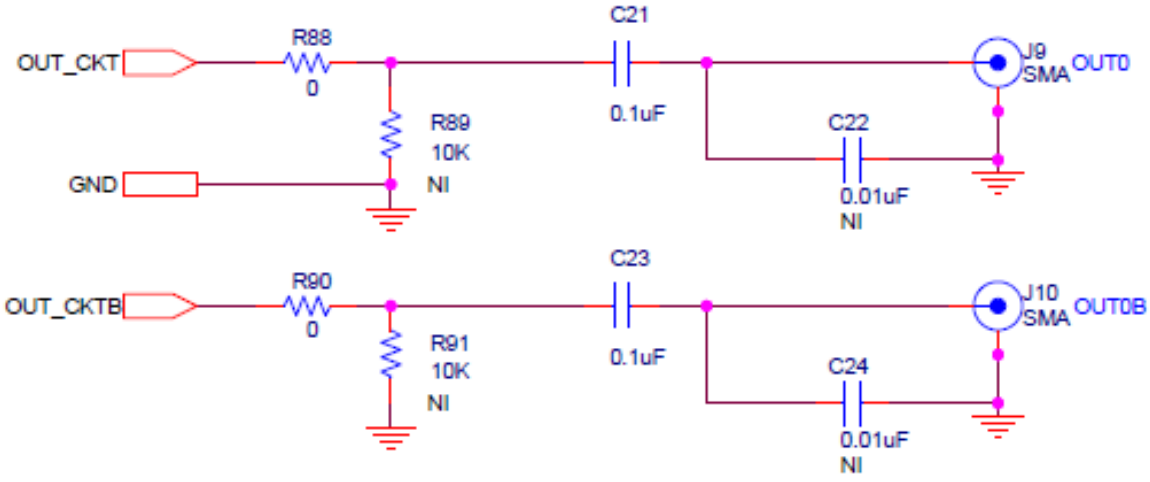


Figure 6. Output Clock Termination Circuit

9. Installing ClockBuilderPro (CBPro) Desktop Software

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

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

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

10. Using the Si5347-D-EVB

10.1. Connecting the EVB to Your Host PC

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

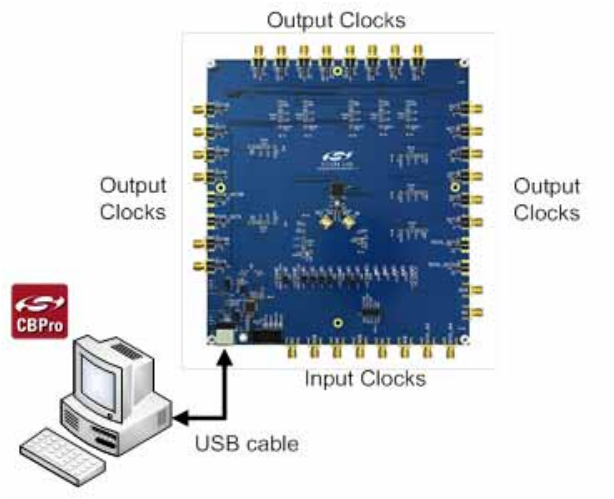


Figure 7. EVB Connection Diagram

10.2. Additional Power Supplies

The Si5347-D-EB comes pre-configured with jumpers installed at JP15 and JP16 (pins 1-2 in both cases) in order to select “USB”. These jumpers, together with the components installed, configure the evaluation board to obtain all +5 V power solely through the main USB connector at J37. This setup is the default configuration and should normally be sufficient.

Figure 8 shows the correct installation of the jumper shunts at JP15 and JP16 for default or standard operation.

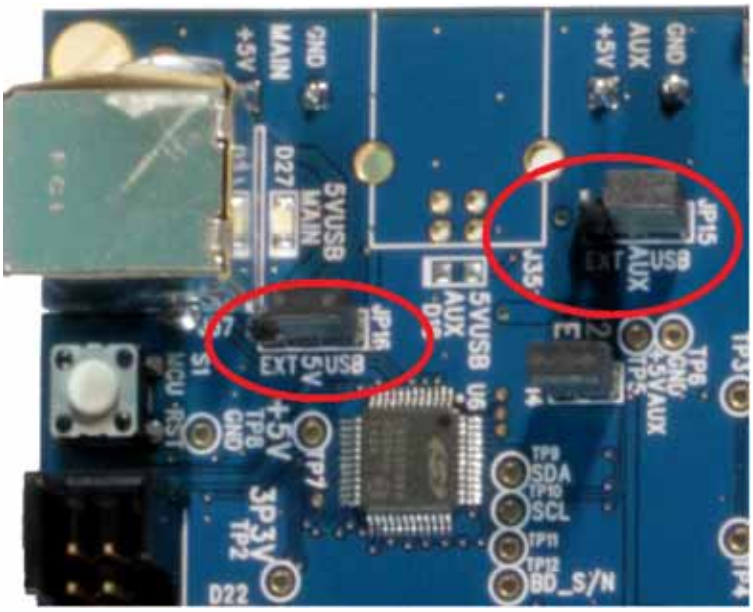


Figure 8. JP15-JP16 Standard Jumper Shunt Installation

Errata Note: Some early versions of the 64-pin Si534x-EBs may have the silkscreen text at JP15-JP16 reversed regarding EXT and USB, i.e., USB EXT instead of EXT USB. Regardless, the correct installation of the jumper shunts for default or standard operation is on the right hand side as read and viewed in Figure 8.

The general guidelines for single USB power supply operation are listed below:

- Use either a USB 3.0 or USB 2.0 port. These ports are specified to supply 900 mA and 500 mA respectively at +5 V.
- If you are working with a USB 2.0 port and you are current limited, turn off enough DUT output voltage regulators to drop the total DUT current ≤ 470 mA. (Note: USB 2.0 ports may supply > 500 mA. Provided the nominal +5 V drops gracefully by less than 10%, the EVB will still work.)
- If you are working with a USB 2.0 and you are current limited and need all output clock drivers enabled, re-configure the EVB to drive the DUT output voltage regulators from an external +5 V power supply as follows:
  - Connect external +5 V power supply to terminal block J33 on the back side of the PCB.
  - Move the jumper at JP15 from pins 1-2 USB to pins 2-3 EXT.

10.3. Overview of ClockBuilderPro Applications

Note: The following instructions and screen captures may vary slightly depending on your version of ClockBuilder Pro.

The ClockBuilderPro installer will install two main applications:



Figure 9. Application #1: ClockbuilderPro Wizard

Use the CBPro Wizard to:

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

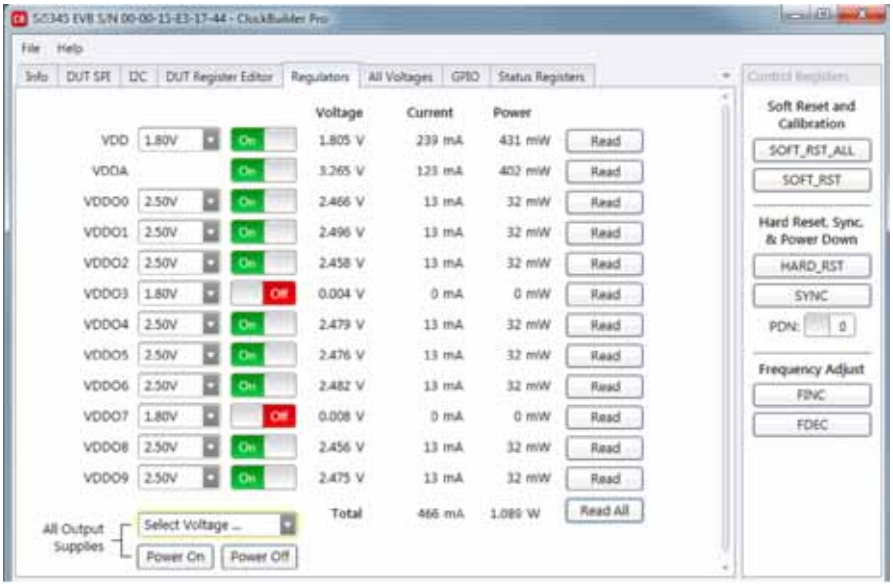


Figure 10. Application #2: EVB GUI

Use the EVB GUI to:

- Download configuration to EVB's DUT (Si5347)
- Control the EVB's regulators
- Monitor voltage, current, power on the EVB

10.4. Common ClockBuilderPro Work Flow Scenarios

There are three common workflow scenarios when using CBPro and the Si5347-D-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.

10.5. 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 11. ClockBuilderPro 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 12. Open Default Plan

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

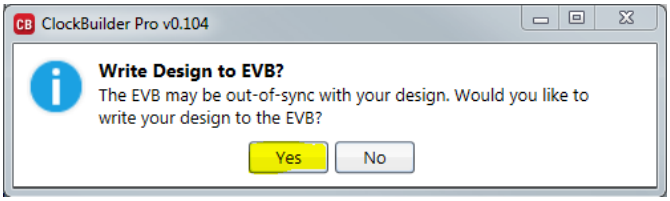


Figure 13. Write Design to EVB Dialog

Select "Yes" to write the default plan to the Si5347 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.

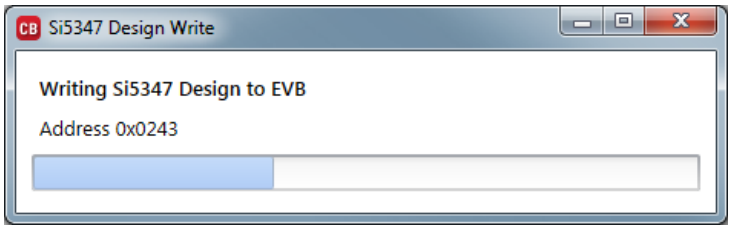


Figure 14. Writing Design Status

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

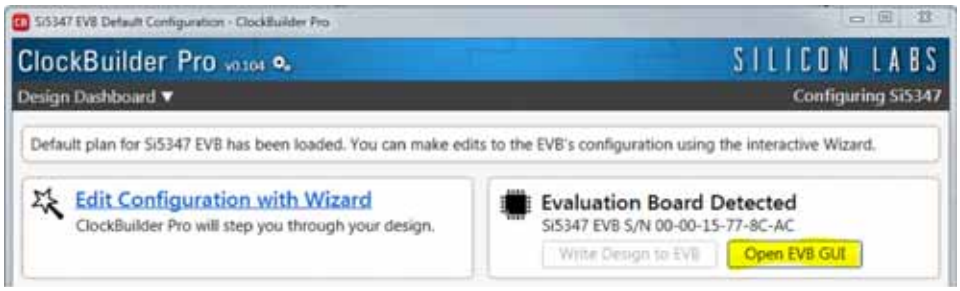


Figure 15. Open EVB GUI

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

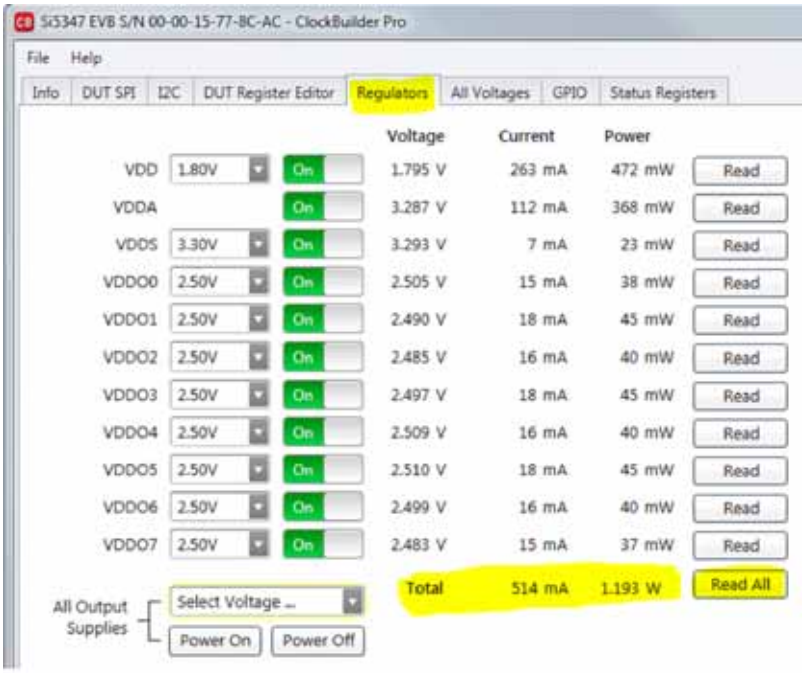


Figure 16. EVB GUI Window

10.5.1. 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”:

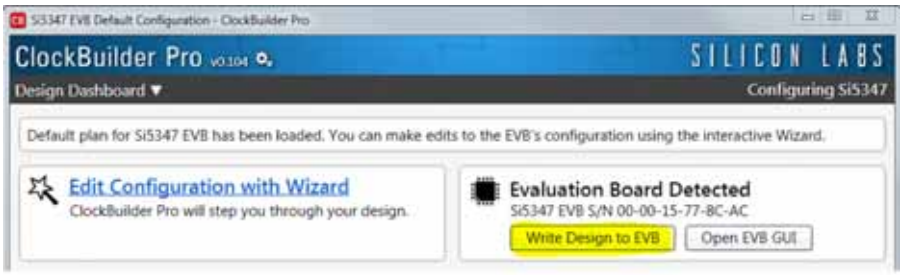


Figure 17. Write Design to EVB

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 18. 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.

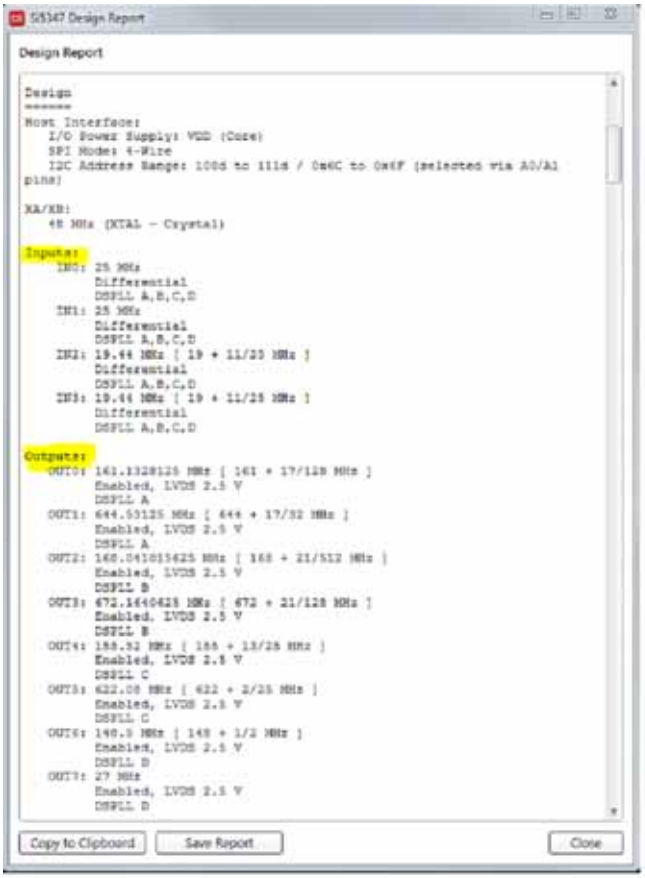


Figure 19. Design Report Window

10.5.2. 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.

10.6. 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 20. 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.

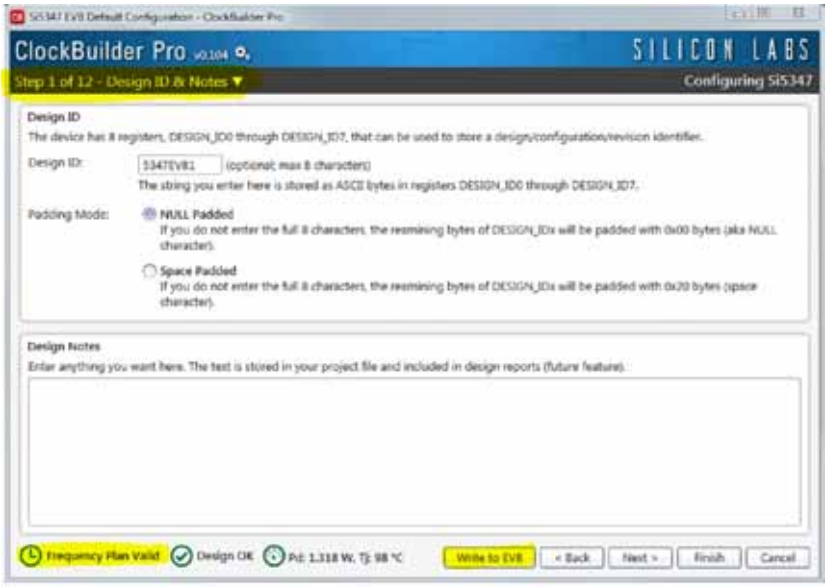


Figure 21. Design ID and Notes

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.

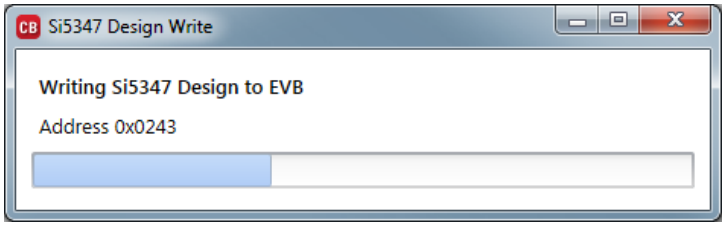


Figure 22. Writing Design Status

10.7. 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 23. Open Design Project File

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



Figure 24. Browse to Project File

Select Yes when the WRITE DESIGN to EVB popup appears:

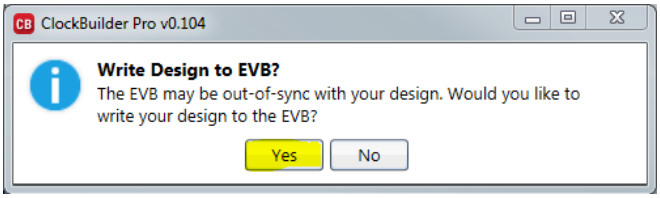


Figure 25. Write Design to EVB Dialog

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.

10.8. 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:

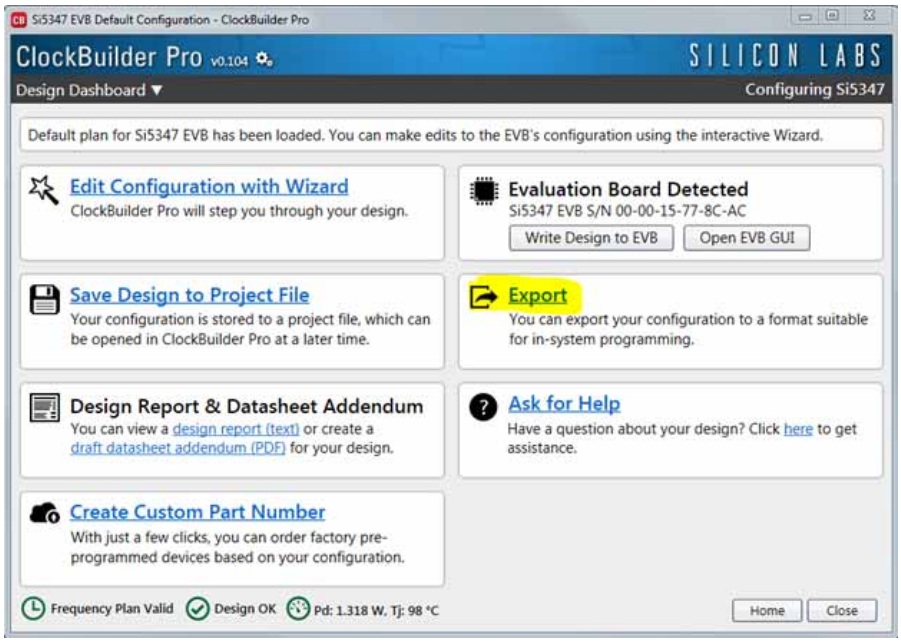


Figure 26. Export Register Map File

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

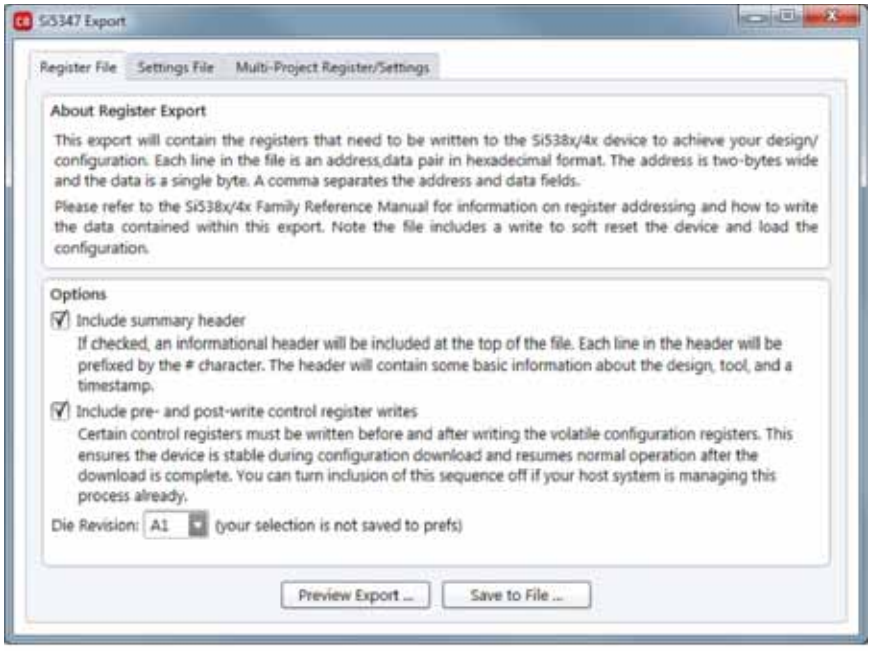


Figure 27. Export Settings

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 Si5347 using ClockBuilderPRo on the Si5347-D-EB. Writing a configuration into the EVB from ClockBuilderPro is done using Si5347 RAM space and can be done virtually unlimited numbers of times. Writing to OTP is limited as described below.

Refer to the Si534x/8x Family 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. On-Board SPI Support

The MCU on-board the Si5347-D-EB communicates with the Si5347 device through a 4-wire SPI (Serial Peripheral Interface) link. The MCU is the SPI master and the Si5347 device is the SPI slave. The Si5347 device can also support a 2-wire I2C serial interface, although the Si5347-D-EB does NOT support the I2C mode of operation. SPI mode was chosen for the EVB because of the relatively higher speed transfers supported by SPI vs. I2C.

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 Si5347 pass through shunts loaded on header J36. These jumper shunts must be installed in J36 for normal EVB operation using SPI with CBPro. If testing of I^2C operation via external controller is desired, the shunts in J36 can be removed thereby isolating the on-board MCU from the Si5347 device. The shunt at J4 (I2C_SEL) must also be removed to select I^2C as Si5347 interface type. An external I^2C controller connected to the Si5347 side of J36 can then communicate to the Si5347 device. For more information on I^2C signal protocol, refer to the Si5347 data sheet.

Figure 28 illustrates the J36 header schematic. J36 even numbered pins (2, 4, 6, etc.) connect to the Si5347 device, and the odd numbered pins (1, 3, 5, etc.) connect to the MCU. Once the jumper shunts have been removed from J36 and J4, I^2C operation should use J36 pin 4 (DUT_SDA_SDIO) as the I^2C SDA and J36 pin 8 (DUT_SCLK) as the I^2C SCLK. Note that the external I^2C controller will need to supply its own I^2C signal pull-up resistors.

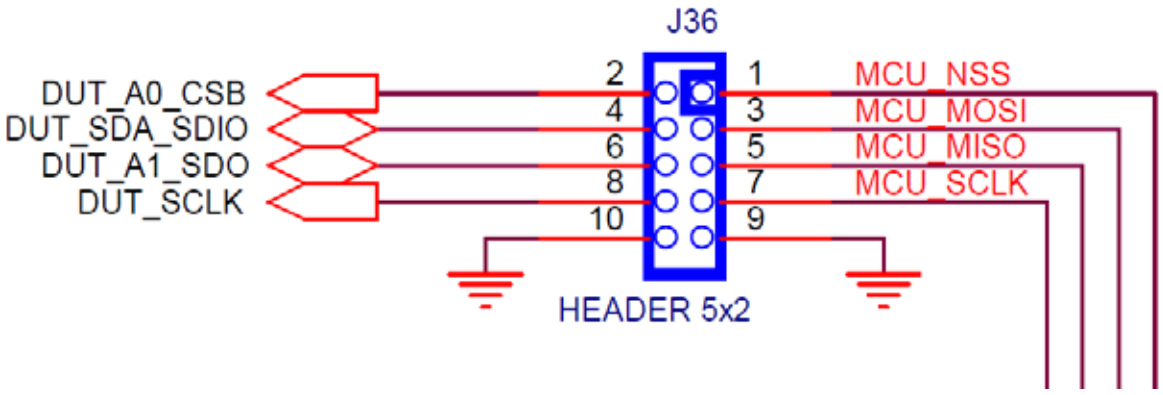


Figure 28. Serial Communications Header J36

13. Si5347-D-EB Schematic and Bill of Materials (BOM)

The Si5347-D-EB Schematic and Bill of Materials (BOM) can be found online at:

http://www.silabs.com/products/clocksoscillators/pages/si538x-4x-evb.aspx

Note: Please be aware that the Si5347-D-EB schematic is in **OrCad Capture** *hierarchical format* and not in a typical “flat” schematic format.



ClockBuilder Pro

One-click access to Timing tools, documentation, software, source code libraries & more. Available for Windows and iOS (CBGo only).

www.silabs.com/CBPro

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